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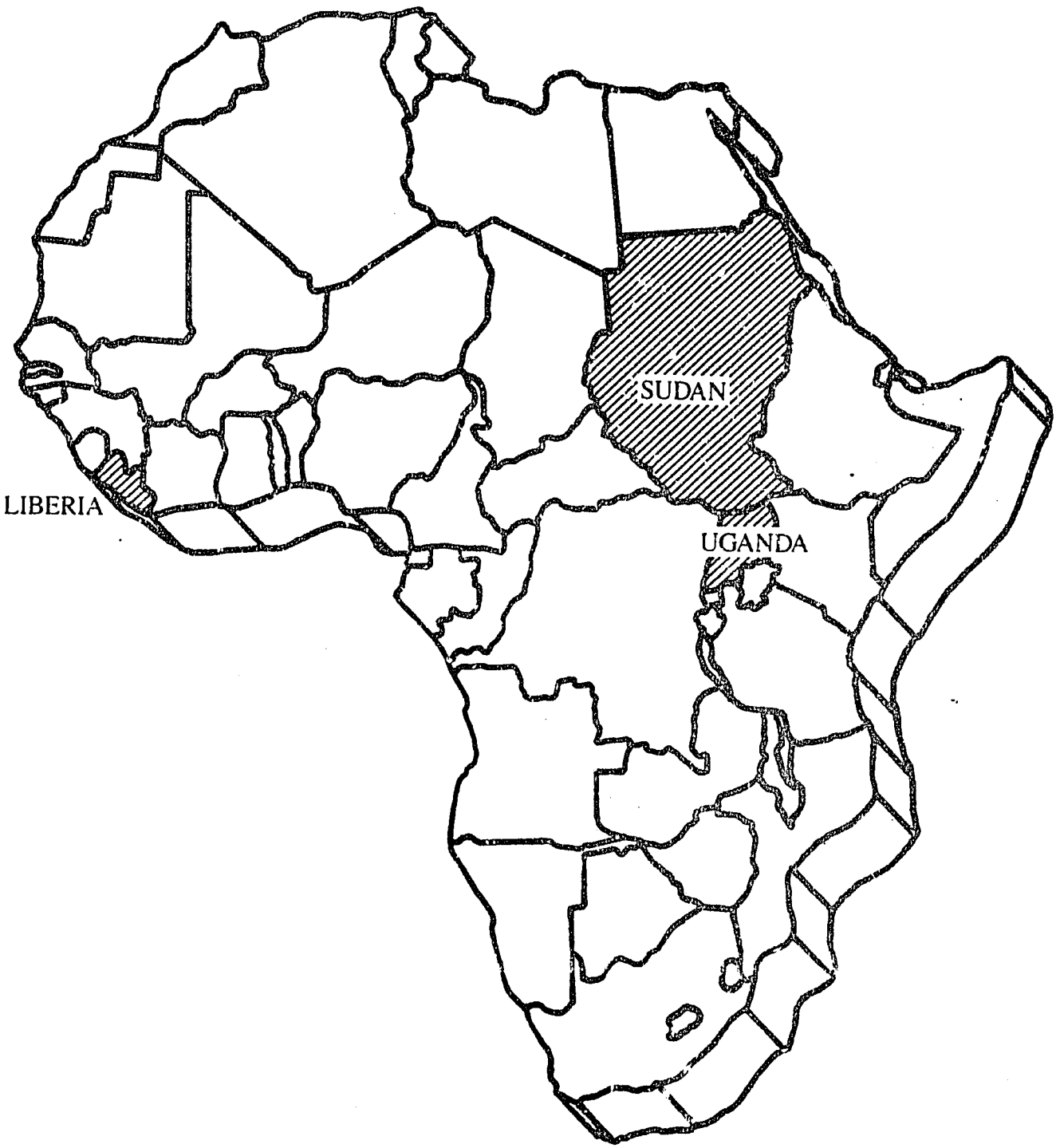
Improving Energy Data Collection and Analysis in Developing Countries: A Comparative Study in Uganda, Liberia and Sudan



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IMPROVING ENERGY DATA COLLECTION AND ANALYSIS IN DEVELOPING COUNTRIES: A COMPARATIVE STUDY IN UGANDA, LIBERIA AND SUDAN

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Division of Agriculture and Rural Development

Shirley A. Burchfield, Ph.D.

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ABSTRACT

IMPROVING ENERGY DATA COLLECTION AND ANALYSIS IN DEVELOPING COUNTRIES: A COMPARATIVE STUDY IN UGANDA, LIBERIA AND SUDAN

Shirley A. Burchfield

Following the fuel shortages of the 1970's, the vital role of energy in a country's economic development was widely recognized, particularly in many petroleum-importing countries, where a significant portion of foreign exchange earnings are used to pay for imported oil. The availability of accurate information about energy supply and use is a prerequisite for conducting effective energy planning,

In Africa, information on energy supply and demand is of very poor quality in some places and virtually non-existent in others. This study assesses the resources (funds, analytic equipment and trained personnel) available for collecting and analyzing data in energy planning agencies and organizations in three African countries: Uganda, Liberia and Sudan. It examines the quality of national energy assessments and energy supply/demand balance statements conducted in each of these countries.

The objectives of this study were (a) to make recommendations regarding specific training needs in the three countries included in the analysis; and (b) to make observations about planning activities and data collection and analysis problems in these countries that might have application in other countries which may be involved in energy data collection and analysis activities.

The methodology involved conducting structured interviews with host government personnel in ministries/ agencies who participate in energy planning activities in each country, as well as with United States Agency for International Development (USAID) staff members associated with energy planning projects in these countries. Data quality was analyzed using a standardized rating sheet, based on recommendations of the United Nations Statistical Commission.

The findings identified a number of analytic and institutional problems were common to all of the countries analyzed and delineated criteria which lead to the success or failure of planning activities.

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LIST OF ACRONYMS

AID	Agency for International Development (see also USAID)
AMOCO	American Motor Oil Company
BUCEN	United States Bureau of Census
CETP	Conventional Energy Training Program
CIDA	Canadian International Development Agency
CMEA	Council for Mutual Economic Assistance
DOE	Department of Energy
E/DI	Energy/Development International
ECE	Economic Commission for Europe
EEC	European Economic Community
EIA	Energy Initiatives for Africa
EPM	Energy Planning and Management
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agriculture Organization
FDA	Forestry Development Authority
GMRD	Geology and Mining Resources Directorate
GNP	Gross National Product
GOL	Government of Liberia
GOS	Government of Sudan
GOU	Government of Uganda
GPA	General Petroleum Administration
GPC	General Petroleum Corporation

GTZ	German Development Assistance Agency
GWh	Gigawatt hour
IEDP	Integrated Energy Development Program
IMF	International Monetary Fund
ISTI	International Science and Technology Institute
Kwh	Kilowatt hour
LDC	less developed country
LEC	Liberia Electricity Corporation
LPRC	Liberia Petroleum Refining Company
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mining
MLEM	Ministry of Lands, Energy and Mines
MLME	Ministry of Lands, Mines and Energy
MPEA	Ministry of Planning and Economic Affairs
MPED	Ministry of Planning and Economic Development
MPPT	Ministry of Power, Posts and Telecommunications
MW	Megawatt
NEC	National Energy Committee (Liberia)
NEC	National Electricity Corporation (Sudan)
NRC	National Research Council
ODA	Overseas Development Administration
OECD	Organization for Economic Cooperation
OPEC	Organization of Petroleum Exporting Countries
ORNL	Oak Ridge National Laboratory
SADCC	Southern African Development Coordination Conference

SEPAP	Sudan Energy Policy and Planning Project
SMC	Sudanese Mining Corporation
SOEC	Statistical Office of the European Communities
ST/EY	Bureau for Science and Technology, Energy Office
TOE	tons of oil equivalent
UEB	Uganda Electricity Board
UN	United Nations
UNDP	United Nations Development Program
UPC	Uganda People's Congress
USAID	United States Agency for International Development
USDOE	United States Department of Energy

CHAPTER 1

INTRODUCTION

The area defined as sub-Saharan Africa (excluding the Republic of South Africa) is comprised of 45 independent nations and has a population of approximately 350 million people (USAID, 1984). The United Nations (UN) estimated that sub-Saharan Africa is the only region in the world that experienced population growth rate increases during the period from 1960 to 1980--rising from 2.5 percent in the 1960's to 2.9 percent in the 1970's, with a projected increase to 3.0 percent over the 1980-1985 period. The poverty of Africa is widely recognized, and 25 of the sub-Saharan countries are on the UN's list of the world's 36 "least developed countries" (UN, 1980).

Africa's development-related problems are numerous, ranging from slow overall economic growth to declining agricultural productivity. These difficulties were exacerbated by petroleum price hikes which occurred in 1973 and the ensuing energy crisis of the 1970's. While the impact of increased energy costs was world-wide, developing countries were particularly affected. According to Kohler, Kariisa, et al., (1982), Africa suffered more from the inflationary effects of increased energy costs than other parts of the world. This was

due, in part, to the absence in African countries of fuel-saving infrastructure such as railroad networks and the heavy reliance on imported food and capital equipment, which increase in price in proportion to the energy costs embodied in them.

Most development specialists argue that increasing energy consumption is a necessary condition for sustained economic growth. Although the exact relationship of energy to development has not been completely defined, it is clear that limited energy supplies have had serious consequences for oil-importing developing countries.[1]

Palmedo and Nathans (1978) contend that energy use is highly correlated with development. Citing studies in Singapore, Brazil and Mexico, they point out that most development activities result in increased fuel consumption. For example, attempts to increase food production or develop local manufacturing capabilities often result in sharp increases in commercial fuel use and more sophisticated energy delivery systems, as well as increased dependence on petroleum products such as gasoline, diesel and fertilizer. Likewise, efforts to improve mobility in the rural areas require energy-intensive road building programs and lead to greater use of fuel for transportation. In addition, increasing the standard of living of rural and urban households (e.g., providing adequate cooking fuel; improved diets; better housing, health and sanitary conditions) means greater energy consumption.

Over three-fourths[2] of the commercial energy[3] used in African countries is imported oil. Although oil consumption is small in relation to total energy use, the cost of oil imports represents an increasingly significant part of limited foreign exchange earnings. In 1983, most African countries were spending between 20 and 40 percent of their export earnings on oil, and at least six countries in Africa spend over 40 percent.[4] Furthermore, for some of these countries, debt service, which is frequently related to oil imports, represented a substantial portion of remaining foreign exchange earnings (Dunkerley, Ramsay, et al., 1983).

The effect of these trends has been a sharp reduction in the availability of foreign exchange required to increase agricultural productivity and industrial development. Few, if any, African countries with abundant energy resources--oil, gas, coal, hydroelectric power, biomass, wind or solar energy--have so far been able to translate such resource availability into sustainable economic development. According to a recent analysis of oil import costs (Dunkerley, Ramsay, et al., 1983), high import bills and debt service have seriously inhibited development. At present these factors are co-opting the major part of available foreign exchange resources and holding back imports of other strategic development inputs, thus leading to low rates of growth in many countries, especially since 1979. Even countries touted as future growth centers with both energy resources and non-energy minerals, remain stagnant.

Koshel (1983) warns that even though world oil prices have declined somewhat and may continue to do so in the near future, there is little doubt that petroleum resources are limited and that energy costs will remain high enough to inhibit developing country growth prospects.

The effects of restricted petroleum supplies are even more severe when viewed in light of the increasing shortage of woodfuels which is pervasive throughout Africa. In 19 sub-Saharan countries, firewood makes up more than four-fifths of total energy use, including both commercial and non-commercial energy (Howe and Gulick, 1980). Arnold (1978) estimates that 1.5 billion people throughout the world depend on wood for fuel Openshaw (1978), contends that the world's woodfuel consumption[5] ranges from one to three billion cubic meters per year.[6] The World Bank (1983) estimated that over 2,250 million people in developing countries use traditional fuels (including firewood, charcoal, crop residues and animal dung) for cooking. World Bank analysts project that a fifteen-fold increase in current tree-planting levels in Africa is required to bring projected supply and demand into better balance by the year 2000.[7]

Donor Response to Energy Problems

As the role of energy in the overall development process became more widely recognized, many developing countries and development assistance agencies initiated programs designed to alleviate energy problems. During the latter part of the 1970's many donor agencies, private voluntary organizations and

private industries initiated a large number of energy projects and technologies in developing countries, most of which were in the experimental stage. Developing countries became the testing ground and the new marketplace for a plethora of renewable energy technologies considered to be the "hope for the future." As a result, many host governments became[8] inundated with projects which were, for the most part, conceived and implemented with very little prior analysis to determine whether they were suited to the cultural traditions, problems, and resources of the country or region in which they were implemented.

By 1983 expenditures on energy projects by foreign assistance agencies (U.S. Germany, France, Belgium, Italy, and Canada) amounted to well over a billion dollars (Canadian International Development Agency, 1984). The U.S. Agency for International Development (AID),[9] in 1977 initiated an agency-wide program to test sustainable energy sources and technologies, designed to assist developing countries in addressing problems in the energy area. During the four years from FY 1978 to FY 1982, AID funding for African energy activities (including fuelwood projects) rose from $6 million to $30 million, supporting as many as 24 renewable energy projects in 15 countries and 15 fuelwood and forestry projects in 12 countries. These renewable energy projects were aimed mainly at learning about the future potential of a wide range of

technologies, many of which were still in the prototype or development stages.

Most systems were designed for small-scale domestic and village applications, such as cooking, crop and fish drying, potable water pumping, irrigation, water heating, vaccine refrigeration, and lighting for schools and clinics. Unfortunately these projects were carried out in a relatively uncoordinated and haphazard way. USAID, like many other donors, to a large degree implemented energy projects without defining the nature and magnitude of host-country energy problems nor researching and determining potential solutions.

The Need for Better Information

The lack of accurate information has been a large factor in the inability of developing countries and foreign assistance agencies to effectively address energy-related problems. As previously noted, both donor and lesser developed country (LDC) resources are often allocated in an ad hoc fashion, with little data on which to base decisions and assign priorities. In most African countries there is very limited information on the energy/natural resource base or on the nature and magnitude of energy-related problems and prospects for addressing them. Many of the difficulties relating to the acquisition and use of energy information revolve around two principal factors: (a) the lack of quality energy supply/demand information; (b) the absence of LDC staff trained in statistical sampling and data collection and analysis techniques.

Lack of Quality Data

Information on energy supply and demand in Africa is of very poor quality in some places and virtually non-existent in others. Estimates of traditional fuels such as wood, agricultural residues and animal dung are particularly difficult to obtain, and a good portion of the data consist of rough estimates based on guesswork, rather than on sound methodology or statistical sampling procedures. Similarly, petroleum imports and consumption estimates, where they do exist, vary widely from source to source. For example, in Lesotho, estimates of total energy consumption during 1980 ranged from 67,000 tons of energy equivalent (TOE) to more than double that amount.[10]

The Food and Agriculture Organization (FAO) reports annually in its yearbook of forest products, estimated production of woodfuel and industrial wood consumption throughout the world. According to Openshaw (1978); Abdu (1984); and Arnold (1978), production figures are continually underestimated because of inaccuracies in recording and reporting woodfuel production. In addition, Arnold (1978), points out that available data are chiefly based on estimates which are extremely susceptible to error because most woodfuel production and use occurs outside commercial channels (i.e., it is cut and gathered locally for household use). Despite the flaws in the data, these figures represent the best estimates available and are widely utilized by the FAO and others

(Arnold, 1978; Arnold and Jonama, 1978; Ceceliski, Dunkerley, Bouhdilli, et al., 1979; the World Bank, 1980; and Dunkerley, Ramsay, et al., 1983) to estimate energy consumption.

The World Bank emphasized the need for better data collection and analysis in the 1983 World Development Report, which pleads the case for more systematic data collection procedures. Gibbs (1981) maintains that the absence of "a discrete body of baseline information concerning energy supply and demand" is likely to result in "misdirected policies, incorrect allocation of scarce resources, and inability to monitor and evaluate policies of national importance" (p. 1).

Similarly, Robinson (1980) purports that the "piece-meal, problem-by-problem" approach to policy formulation which typifies foreign assistance in developing countries leads to a proliferation of projects and programs and is responsible for many of the incoherent and ineffective LDC policies which have emerged. He emphasizes some of the inadequacies of conventional planning in developing countries, maintaining that traditional "five-year development plans" are usually the result of uninformed planning--representing simply an enumeration of goals, rather than "the outcome of inquiry which has examined the problems, quantified the resource constraints and identified the means that are required to attain the selected ends or objectives" (p. 34). He admonishes donors for proposing remedies without carefully diagnosing and designing solutions to problems that have been analyzed superficially.

He contends that only by accurately defining the nature and magnitude of problems can solutions be devised that are properly matched to the problems.

A necessary condition for this to occur in the energy area is the development of a sound energy supply and demand data base. Palmedo and Chatterjee, et. al., (1981), Hassell (1982) and Cirillo (1981) maintain that the assessment of energy supply and demand and an analysis of the balance between the two is a prerequisite for rational decision-making and effective policy and planning in the energy sector.

The Absence of LDC Data Gathering and Analysis Capabilities

Despite efforts of donors to improve the quality of data in developing countries, a number of development specialists (Robinson, 1980; Gibbs, 1981; Cirillo, 1980; Palmedo, 1982; Palmedo and Chatterjee, et. al., 1981) are convinced that significant improvements in LDC policy-making and planning are not likely to occur without better techniques for gathering and analyzing information.

A study of USAID data collection and analysis capability (Herman, 1983) supports the contention that both USAID and host government staffs have insufficient analytic capabilities to adequately address development problems. This study recommends that USAID devote more resources to data collection and analysis and that the agency's commitment to promoting self-sufficiency for data-related activities be strengthened..

Robinson (1984, 1985a, 1985b) asserts that foreign assistance agencies have not helped to establish a process of data collection and analysis that would provide the information needed to formulate sound policies. He warns against making the assumption that donor agencies can provide LDCs with the solutions to their problems. He is convinced that most learning takes place as part of the problem formulation and analysis process, and calls for a collaborative approach to planning--a process in which host country analysts are directly involved at each stage of data collection and analysis. With such an approach, outside advisors do not provide assistance to host countries with the idea that they are ready to offer immediate policy solutions, but rather their role is to facilitate a process of inquiry that is designed in accordance with the existing LDC capabilities in data collection, processing and analysis. Host country analysts become fully involved and their skills are systematically broadened through the technical assistance and training that is provided on-the-job.

There are two major advantages of the collaborative approach:

1. it provides analytic findings that are of immediate utility for the formulation of policies by host country personnel

2. it establishes a permanent LDC process of data collection, processing and analysis that continues to function after the foreign technicians have left (Robinson, 1983).

Pryor (1983), who is also a proponent of the collaborative approach, believes that these precepts are particularly relevant to the energy area. He maintains that little is known about the availability of skills within Africa countries to address energy problems. He goes on to suggests that institutional resources and training needs should be assessed so that institutions with expertise in providing training in energy-related areas can be identified and training programs can be designed to meet those needs.

Notes to Chapter 1

[1]There are a number of studies which have also demonstrated the relationship between income and energy use (Kohler, Kariisa, et al., 1982; Fernandez, 1980; Ceceliski and Dunkerley, 1980; Arnold, 1978; Hosier, 1981). Studies by Fernandez (1980) and Ceceliski and Dunkerley (1980) show that energy consumption increases as income rises. The Beijer Institute (1981) research findings reveal that increased incomes lead to a move away from traditional wood-based fuels toward heavier dependence on petroleum products.

[2]World Bank. 1984 World Bank Development Report, 1984.

[3]"The term 'commercial energy' generally refers to energy forms normally actively traded in developed country markets such as oil, gas, coal, and electricity" (Palmedo and Nathans, 1978, p. 115).

[4]These figures are based on 1981 estimates and include the following countries: Ethiopia, Burkina Faso, Tanzania, Ghana, Kenya and Senegal (World Bank, 1984 World Development Report, p. 232).

[5]Interpretation of wood consumption figures is complicated by the fact there are no universally accepted definitions relating to this area, and terms have been variously defined. Generally, the terms "firewood and fuelwood" are used interchangeably. The National Academy of Sciences (1980, p. 215) uses "firewood" to connote small-scale use (e.g. home cooking), while defining "fuelwood" to mean large-scale industrial use. Abdu (1984, p. 4) adopts these definitions and defines "woodfuel" to mean "both firewood and charcoal." Traditional fuels are also called "non-commercial" or "non-conventional." Palemedo and Nathans (1978, p. 115) assert that the use of the term "non-commercial" fuels is a misnomer, since there are monetary markets for these fuels.

[6]The accuracy of existing woodfuel consumption estimates is considered by most experts to be unreliable. Nevertheless, they represent the only available data and provide a rough indication of the extent of the fuelwood problem in developing countries.

[7]An estimated five-fold increase would be needed worldwide. (World Bank, 1983, p. 47).

[8]Host government refers to a government body receiving foreign assistance from a donor agency.

[9]USAID and AID are used interchangeably to mean the United States Agency for International Development.

[10]The following conversion rates were used by the Southern African Development Coordination Conference (SADCC) (1982) to calculate these estimates: 1 million tons oil equivalent = 1.55 million tons coal equivalent; 1.15 billion cubic meters gas; 12.60 tera watt hours; 45.37 peta joules.

CHAPTER 2

PROBLEM TO BE STUDIED

As the preceding discussion has attempted to demonstrate, obtaining a sound energy data base is essential to the formulation of effective policies aimed at addressing energy problems. Energy sector assessments and the specific energy sub-sector analyses that comprise these assessments are prime ingredients of such a data base.

Based on a review of relevant literature and on the experiences of individuals involved in energy planning in African and other developing countries it is hypothesized that:

1. currently existing energy information is insufficient to adequately define problems and propose solutions

2. additional training of host government personnel (particularly in areas of data collection and analysis) is needed in order to effectively develop policies and programs to address energy problems.

The problem addressed by this study is the lack of quality energy data in developing countries, as well as the absence of trained staff and analytical tools and equipment to produce these data.

Scope

Although there are wide differences in the information needs and capabilities within African countries, most African

nations share a number of the same problems associated with data collection and analysis. This study examines the data needs and the analysis capabilities of energy planning ministries in three African countries: Uganda, Liberia, and Sudan. Although these countries have very diverse histories, cultural traditions and approaches to government, all are faced with significant energy problems and consider long-term energy planning to be an important elemeent of the country's development.

This study focuses on three aspects of energy data collection and analysis: (a) the institutional resources available to conduct energy analysis; (b) the quality of the data; and (c) additional host government training needed to improve the quality of the data used by decision-makers. Additionally, the study identifies problems frequently encountered by energy analysts and defines specific areas of training needed to improve the agency or ministry's data collection and analysis capability. The quality of the national energy assessments conducted by energy planning bodies within the government, as well as those conducted by donor agencies, such as the World Bank are also examined.

Limitations

The chief limitation on this study is the length of time available to conduct institutional assessments in each country. A period of two weeks was not sufficient time to

conduct a detailed assessment of specific training needs. However, it is felt that the present work lays the groundwork for more in-depth analysis, which should include the development of a detailed training plan (including the identification of training candidates, dates and times for courses, appropriate curriculum and reading materials)

A second limitation on this type of analysis is the difficulty of generalizing results. For example, in a case study design it is not always possible to diferentiate between those factors which are unique to the countries under examination (such as individual personalities or political conditions) and those which are common to other developing countries.

It must also be kept in mind that assessments of data quality are based on subjective criteria. Many experts differ in their views regarding the procedures and conventions which should be used in analyzing energy statistics and constructing energy supply/demand balance statements. There is no "correct" format. There are, however, procedures which tend to work well under certain circumstances. This study attempts to take into account both the recommendations of "energy experts," prevailing circumstances in each country and existing data inadequacies.

Notes to Chapter 2

[1]It was originally planned to include a fourth country (Somalia) in this analysis. However, due to difficulties in obtaining data about energy planning ministries in Somalia, this country was not included in the study.

CHAPTER 3

LITERATURE REVIEW

NATIONAL ENERGY PLANNING AND ANALYSIS IN DEVELOPING COUNTRIES

Background

Although the general role of energy in development has been recognized for a number of years, it was only after the oil crisis of the 1970's that the critical influence that sudden changes in price and availability of basic fuels have on the development process was fully appreciated (Palmedo and Nathans, 1978). Prior to that time, energy policy was an area which was largely ignored, while other more urgent issues were pursued. In many countries, rather than viewing energy consumption as a problem, the national level of energy use was considered to be a barometer of socioeconomic development, and high levels of consumption were encouraged (Barron and Wilbanks, 1982).

Some LDC governments were involved in activities that were classified as "energy planning" activities before the oil embargo in 1973, but most of these efforts were concentrated on discrete, large-scale activities, such as building electrical power plants, mining for coal, drilling for oil, and so forth (Mubayi and Meier, 1981; Koshel, 1983). In few cases were the development of energy resources included among principal

objectives of country economic development plans. Similarly, little attention was paid to energy costs associated with other capital projects or to assuring adequate supplies of traditional fuels, such as fuelwood, charcoal, or agricultural residues. Electricity and petroleum pricing decisions were left almost exclusively to public utility commissions, finance ministries or private oil companies (Koshel, 1983).

The need for comprehensive energy planning and analysis has only been recently recognized by both developing and industrialized countries. Information about indigeneous energy resources and the most effective means to utilize them, as well as data about energy consumption trends, is frequently limited. In addition, the capability for compiling supply/demand data, for constructing energy supply/demand balances that fully take into account price effects and for analyzing alternative national energy strategies is frequently limited (U.S. Department of Energy, Office of Energy Assessments, 1981).

National energy plans are rare in developing countries, and where they do exist, they are usually confined to electricity and petroleum supply sectors and consist primarily of lists of project investments that are to be undertaken in given time periods. Some governments seek to relate these investment plans to projections of energy demand over given time periods. These projections are usually made on the basis of historical experience or on the basis of assumptions about future changes in price, income and economic growth.

The Role of the Energy Planner

According to Kohler, Kariisa, et al. (1982), energy planning provides the framework for a transition from the current situation of high dependence on traditional fuels and petroleum products to one that is adapted to the realities of higher petroleum prices and diminishing fuelwood supplies.

There are many differing views on the specific functions which should be carried out by energy planners. In Park's opinion (1982), the chief purpose of energy planning is to formulate an energy plan that will meet future energy needs and foster socio-economic development.

Koshel (1983) contends that planning should serve the role of ensuring the availablity of fuel sources at the lowest possible costs (economic, financial and social) in a way that is consistent with national development goals. In order to achieve this objective, energy planners must be concerned with issues relating not only to the development of domestic energy supplies but also with to management of energy demand, pricing policies and energy conservation programs.

The Relationship Between Planning and Policy-Making

Although the goals of energy planning and policy-making are similar in many respects (i.e., each is presumably aimed at achieving sustained economic growth), and the two functions often overlap, it must be kept in mind that planners and policy-makers usually perform separate functions. Barron and Wilbanks (1982) and Koshel (1983) maintain that the perspective of the

energy analyst is usually different than that of the policy-maker.

According to Barron and Wilbanks (1982) policy-makers are concerned with solving pressing problems using limited resources, while at the same time providing support for the institutions of government. In order to carry out this mandate, they must resolve conflicts among competing constituencies, identify options and assign priorities--usually on very short notice. Robinson (1985a) purports that third world policy-makers are faced with the dual problem of developing policies that are coherent and effective, while at the same time retaining popular support. According to Barron and Wilbanks (1982), policy-makers are often more concerned with making decisions that correspond with the priorities of their leaders and the public than with amassing scientific evidence on which to base decisions. Therefore, it is the use to which data will be put, rather than the process employed to collect it that is usually more important to them.

These authors assert that energy planners and analysts, on the other hand, focus on logic and objectivity; they eschew factors that are hard to quantify, but rather search for empirical evidence as a basis for decisions. They tend to mistrust hasty decisions and are more concerned with the process of analysis than the use or implications of the data.

There are a number of ways of establishing linkages between energy analysis and energy decision-making. Barron and Wilbanks (1982) and Koshel (1983) believe that the most

effective mechanism is a continuing process of national energy planning to provide a steady flow of information and options to policy-makers. The information flow must be a two-way process so that planners continuously receive questions and issues from policy-makers that will help them to determine what data are needed and what methodologies must be developed.

According to Barron and Wilbanks, (1982):

> ...planning becomes the meeting ground for the two cultures. Because it is inherently forward-looking, the planning process fits the need of the analyst to anticipate issues if he/she is to be prepared to assess them with confidence. Because it is inherently policy-focused, it fits the need of the policy-maker to address questions that are real, not academic. Because both kinds of people must be involved, planning requires that they get better acquainted and offers them opportunities to understand each other's perspective better. The end result is that public policy is more effective in solving national problems because it is better informed about benefits, costs, and risks associated with the various alternatives available. (p. 5)

Energy Information Needs

Creating an environment that facilites a continuous flow of information requires the development of a sound data base. Because energy sector issues are closely tied to overall national priorities, energy statistics can provide the critical support needed for effective policy and decision-making at the national level. (Hassell, 1982) and Carlson and Gibbs (1981) believe that the development of such a data base is critical to the task of setting targets and ensuring that energy demands can be met within the constraints of the country's economic development plans. Accurate energy data can assist decision-

makers in understanding the nature and the magnitude of the country's energy problems, as well as in monitoring the situation and assessing the the impact of various policy interventions (Dubourt, Gibbs, and Stevenson, 1983).

These authors also assert that while a number of approaches to energy planning may be employed, the most effective analytic methodology appears to be the "sector demand approach." Gibbs (1982) defines sectoral energy demand analysis as a "micro-level" study of a country's current and future energy needs. Dubourt, Gibbs and Stevenson (1983) describe this process as a flexible procedure for analyzing different sectors (such as transportation, industry, agriculture, residential and institutional) which allows analysis and policy formulation at incremental (sectoral, intersectoral and national stages) of aggregation.

They point out, however, that sector analysis is only one of several steps in the energy planning process, which includes interrelated activities such as supply/demand assessment, analysis of environmental impact, evaluation of policy options, policy formulation and implementation. The idea that energy issues should be considered in a full macroeconomic context is a recurrent theme in the energy planning literature. Most energy experts agree that much more than just the energy sector must be considered in energy planning. (See for example, Mubayi and Meier 1981; Evans 1983; Barron and Wilbanks, 1982; Munasinghe 1980; Park, 1982.)

Kohler, Kariisa, et al., (1982) maintain that the pattern of energy use throughout the entire economy must be analyzed in order to find the best options for bringing about necessary changes. They caution against concentrating exclusively on the energy sector because there is a danger of focusing too much on energy production, while ignoring important alternatives on the demand side.

Park (1982) identifies three levels of interrelationships that should be addressed by planners, including: (a) integration between the energy sector and the rest of the economy, (b) interactions between the different energy sub-sectors; and (c) activities in each sub-sector.

Barron and Wilbanks (1982) advise energy planners to make certain that energy issues are considered in light of national development objectives, and that energy planning objectives do not work at "cross-purposes" to broader national objectives. In addition, they stress the importance of carefully examining the interrelationships among the policies adopted in various energy sub-sectors.

Munasinghe (1980), a strong advocate of the analysis of linkages between the energy sector and the economy as a whole, states that:

> Such links include the input requirements of the energy sector, such as capital, [labour], and raw materials, as well as energy outputs such as electricity, petroleum products, woodfuels...and the impact of the economy on policies concerning availability of supply, energy prices, and so on, in relation to national objectives. (p. 62)

Ceceliski and Dunkerley (1980) elaborate on the nature of interconnections between energy and other sectors, highlighting some of the difficulties planners face in attempting to deal with these relationships. They maintain that energy use in developing countries is tightly interwoven with social, cultural, and productive segments of society. For example, the village "energy system," a subsistence economy in which little material output is wasted and, most energy is produced locally, is highly dependent upon agriculture.[1]

Government policies may also affect types, amounts, and efficiencies of energy consumption. The role of both present and future government policies must be taken into account when estimating future energy consumption. Ceceliski and Dunkerley (1980) illustrate this point by noting that government policy can affect both the price and the availability of certain energy supplies through energy pricing, household credit, taxation, and subsidization policies. Long run government planning and policies on housing, electrification and urban planning may also heavily influence energy use.

A common error that is made by planners is to begin collecting information and developing analytic methods before the objective of the analysis is clear. Munson, Palmedo, et al, (1983), contend that the first step should be to determine the questions which should be addressed and to allow information needs to decide what criteria and methods are to be applied.

Gibbs (1982) supports this assertion and advocates a structured approach to data collection in order to provide a systematic method for determining actual requirements for data collection. He identifies five separate tasks which comprise the structured approach. These include:

1. operationally defining the sectors
2. specifying the tabulation plan and data requirements leading to structuring of the subsectors
3. assessing existing data and identifying data gaps
4. developing data collection strategies and options
5. implementing data collection activities (p. 5).

He points out that the development of an energy data base can be both expensive and time-consuming. Rarely are all sources of existing information located in a coherent body in one central place. Instead, data may be scattered among a wide range of government agencies, ministries, airlines, or utility companies. Nevertheless, he concludes that such analyses are, in the long-run, cost-effective investments if the indigenous capacity to collect data is strenghtened and policy decisions are made on basis of sound information.

National Energy Assessments

The Assessment Process

One of the first steps in developing an energy information base is to conduct a national energy assessment. Koshel (1983) describes this procedure as an orderly process of information management and evaluation. National energy

assessments, sometimes called national planning studies, are useful foundations on which developing countries can build realistic energy sector plans and policies (Carlson and Gibbs, 1981).

According to Barron and Wilbanks (1982), the national energy assessment process involves six steps:

1. establishing assessment priorities
2. describing the country's current energy supplies and consumption
3. estimating the potential energy supply and options for improving efficiency
4. forecasting future energy supply and demand
5. evaluating the energy supply and efficiency improvement options as they relate to these future conditions
6. presenting the results to policy-makers.

The U.S. Department of Energy (1980) classified energy assessments into three basic categories: a) a relatively simple and cursory review of available supply and sectorial demand data, providing a picture at one point in time and oriented toward specific development projects; (b) large scale, multi-sectoral, continuing assessments; and (c) highly sophisticated econometric models.

According to this taxonomy, the first type of assessments are usually very modest in scope, requiring one to two person-years of consultant effort. There is little or no counterpart participation. Their primary purpose is to provide information for project or loan decision-making.

Assessments of the second type generally involve five to ten years of effort. They address both alternative energy strategies and relationships between energy and other sectors of the economy.

The third type of energy assessment may involve up to 15 years of effort, examining all supply and demand sectors, interactions between energy and the economy, as well as alternative energy strategies. Full counterpart participation is involved.

Most energy assessments in developing countries have tended to be in category one--relatively simple and cursory reviews.

National Energy Assessment Activities to Date

International Energy Development Program. Among the earliest efforts to assist developing countries in conducting national energy planning activities were energy assessments carried out by the International Energy Development Program (IEDP), a program jointly sponsored by U.S. Department of State and the U.S. Department of Energy, in conjunction with Argonne National Laboratory (U.S. DOE, 1980).

This program was conceived by the State Department (and funded partially by AID) in response to the Congressional Nuclear Non-Proliferation bill, in an effort to assist LDCs in assessing the potential for alternative energy sources (Cirillo, 1980). The assessment efforts were fraught with controversy from their inception, primarily because of

conflicts between AID and State over who should conduct the assessments and the manner in which they should be conducted. Some AID staff were dissatisfied because the Department of State entered into an agreement with the Department of Energy to conduct the assessments, when they felt that this activity should have fallen under the purvue of AID's Bureau of Science and Technology, Office of Energy.

Assessments were conducted in Egypt, Peru, and Portugal, during 1978 and 1979. Although the Argentinean Government was initially involved with the program, they later withdrew from participation, and assessments in that country never were completed. The program, which was originally intended to be a world-wide effort, was discontinued in 1979.

A description of the assessment process (U.S. DOE, 1981) claimed that host countries were actively involved in all stages of analysis. This report states:

> Active participation by the host governments in all phases of these assessments is an essential feature of the process. Counterparts include representatives not only from energy agencies, but also from ministries responsible for central planning, finance and budget, industry, mining and minerals, agriculture, rural development, transportation, housing, public construction, water resources and manpower. Such representation is present in a policy level group to oversee the effort, ensure support, and make policy level decisions such as selection of development scenarios and alternative energy strategies. A corresponding expert team works hands-on in the data assembly and on the integrated analysis. Both groups work in the U.S. as well as in the host country. (p. 7)

However, it was on the issue of host country participation that the assessment efforts received the most criticism. Munson and Palmedo (1983) were highly critical of the program, claiming that the information was simply shipped to the United States and computerized in existing mainframe computer models. They maintained that little effort was made to involve host government staff in the problem formulation or analysis stages. Although they conceded that subsequent activities focused on providing long- and short-term planning support in-country, Munson and Palmedo (1983) pointed out that no effort was made to ensure that the development of planning skills was accompanied by the development of planning technologies.

Similarly, Jacobs (USAID, Office of Science and Technology, Energy Division, 1985) contended that these efforts were extremely ineffectual because of the way in which they were conducted. He described the assessment program as a relatively incohesive effort by a large team of expatriates (approximately 35) who arrived in country uninformed, and indiscriminately gathered energy data for a period of six weeks.

<u>USAID energy assessment activities</u>. USAID has been involved in energy planning activities that include data collection and analysis in a number of developing countries. Particularly noteworthy are activities in the Sudan, Liberia,

Morocco, Tunisia, the Dominican Republic, and Indonesia. Efforts in these countries have generally been considered successful. Although the degree of success varies among these countries and can be attributed to a number of factors, one key element common to all seven countries has been the direct participation of host government staff in all stages of data collection and analysis.

Joint UNDP/World Bank Energy Assessment Program. Beginning in 1980, a series of energy assessments were initiated by the United Nations Development Program (UNDP), in conjunction with the World Bank for the purpose of helping developing countries identify serious problems and evaluate options for alleviating these problems. A total of 70 assessments are planned. In January 1986, 53 assessments had been completed, 13 were in progress and another 10 were scheduled. In African countries, 28 were completed, 9 were in progress and 3 remained to be conducted (UNDP/World Bank, January 1986).

The first few assessments were very cursory in nature, and country data collection was usually completed in two to three weeks. As the assessment program progressed, both the quality of the data and the duration of the field assessments increased. After the first 12 were completed (during the first two years), greater attention was focused on the household energy sector and on energy efficiency. The length of time

spent in the field was increased to about six weeks, and the analyses were in somewhat greater depth.

However, even the most recent assessments provide very little in-depth analysis and focus chiefly on policy-related issues. They generally fall into the "Type 1" category described by (U.S. DOE 1980). In addition, they rely on existing data rather than attempting to improve the energy data base. Participation by host government staff is minimal.

The UNDP/World Bank Energy Assessment team recognized early in the program, the need for strengthening institutional, managerial, training and staffing arrangements at all levels. Although the initial analyses were conducted almost exclusively by UNDP/World Bank staff, the involvement of host government staff in all stages of energy data gathering and analysis was considered to be a vital element of the program.

Further, UNDP/World Bank Analysts saw a need for developing a more effective framework for coordinating decisions and establishing energy management priorities that affect more than one agency within the country (UNDP/World Bank, April 1985).

Consequently, in April 1983, a second UNDP/World Bank program--the Energy Sector Management Assistance Program (ESMAP) was initiated to assist developing countries in carrying out actions recommended in the assessments. This program was designed to provide the continued involvement of the staff who initially conducted the assessment in more

detailed analyses of priority investments, technical assistance and policy options previously identified. By January 1986, assistance had been provided to 41 countries, pre-investment or other technical assistance was provided to 47 countries and assistance for 45 countries was in the preparation stage.

Energy Supply/Demand Balance

A tool commonly used by analysts in conducting national energy assessments is the energy supply/demand balance. The World Bank (October 1982) defines an energy balance as a "convenient framework for recording and analyzing the patterns of energy supply and consumption" (p. 1). According to the Statistical Office of the European Communities (SOEC) (1980), an overall energy balance sheet is a "uniform quantitative system" for recording both energy availability and use. It is a tool which allows the analyst to trace for a particular fuel, the relative contribution of indigenous production and imports, the transformation and distribution losses, and the distribution of that fuel to its final energy use (World Bank, October 1982). The process of converting energy to common energy units enables the assessment of the contribution of different fuels to the total energy supply.

This procedure has been criticized (Kooi, 1983 and Cough, 1984) primarily because it assumes that a unit of one form of energy (such as fuelwood) is equivalent to a unit of another fuel (such as petroleum) and implies that substitution is possible. However, the type of fuel which may be used in any particular application is dictated by the technology in

which it operates. Cough (1984) contends that because direct substitution is not always possible, separate energy balance sheets should be compiled which view different types of fuels separately.

The SOEC (1980) concedes that the practice of using an overall balance sheet would be more justifiable if complete and direct substitution were possible between all sources of energy (either in its primary form or at final end use). However, such substitutability can only take place between certain fuels and only at certain conventional thermal power stations. On the other hand, because it is extremely difficult to examine the effects of different energy sources separately, they conclude that even with only the partial substitution capabilities, the balance sheet is an invaluable tool for energy analysis.

Types of Balance Sheets

It has been noted by the SOEC (1980) that following the flows of energy from production to consumption is relatively simple when energy is consumed in its original form (e.g., coal used in a furnace or natural gas in a gas cooker). However, energy is rarely consumed in its initial state, but rather undergoes a series of transformations which alter both the form and content available for use.

Hence, the energy transformation (i.e., the difference between the quantities of energy entering transformation plants and the outputs in the form of derived production) must be

reflected on the energy balance sheet. According to the SOEC, (1980), differences in various types of energy balance sheets are largely reflected in differences in approaches to calculating this "transformation gap."[2] They contend that the way in which the analyst deals with this gap is far more than an accounting problem--it is a matter of principle which relates to how a product is expressed in terms of energy volume attributed to a derived product. One may evaluate this energy volume on the basis of "primary fuel input equivalent"[3] before transformation or on the basis of the actual energy content after transformation (SOEC, 1980).

The SOEC identified four types of energy balance sheets, including: (a) energy supplied balance sheet; (b) useful energy balance sheet; (c) primary fuel input equivalent of derived energy balance sheet; and (d) mixed balance sheets. The characteristics of each type of balance sheet, as described by SOEC (1980) are summarized below.

Energy supplied balance sheet. This balance sheet depicts all flows, production, foreign trade, stocks, transformation inputs and output, consumption, of the "actual energy content" of each source. It shows actual quantities of energy available to consumers, after losses in transformation have been accounted for. It records energy supply in "real terms" (i.e., all operations and energy sources without calculating primary fuel input equivalent and without a substitution hypothesis). Since this type of balance sheet provides the energy content of each product, a detailed

breakdown of energy sources can be provided. However, because the "energy supplied"[4] balance sheet contains only information about energy supplied to final end users,[5] it does not account for all losses occurring in the degradation of energy. Therefore, it does not reflect all losses occurring during the final transformation of energy on the premises of the consumer. The quality of energy supplied may differ from one form to another. The useful energy balance takes these factors into account.

Useful energy balance sheet. Deriving information from the "energy supplied" balance sheet the "useful energy" balance sheet carries the analysis a step further, describing energy "recuperated from devices owned by final consumers." It reports specific losses occurring during final transformation. Thus, this balance sheet is extremely useful in conducting economic analysis and forecasting demand.

Nevertheless, the use of such a balance requires information that may be impractical or (in developing countries) impossible to obtain, including: (a) the major type of devices used by the final consumer; (b) quantities used by each type of device; and (c) the average efficiency of each device.

Primary fuel input equivalent of derived energy balance sheet. This balance sheet depicts the quantities needed to satisfy final demand in terms of primary fuel input equivalence. Thus, all items are calculated with respect to

the volume of primary energy necessary for supply, expressed in common units, as though all requirements were met through one primary energy source (usually fossil fuel).

Consequently, all derived energy sources are calculated in accordance with their primary fuel input equivalent (quantity of primary energy required to produce them). In addition, because only transformation inputs are recorded transformation gaps or losses are not computed.

In order to calculate hydroelectric and electrical energy of geothermal or nuclear origin, it is necessary to make a "substitution hypotheses"[6] by computing the quantity of fuel that would have been burned in thermal power plants in order to produce the same of amount of electrical energy.

The SOEC (1980) maintains that these principles can only be partially applied in reality. They assert that although the balance sheet is less suitable for real energy accounting than the energy supplied balance sheet, it does have some value as an analysis balance sheet, under very specific condition (i.e., those that analyze the theoretical possibilities of substitution of energy sources).

Mixed balance sheets. Mixed balance sheets combine features of the three types of energy balances described above. This combination may take place with respect to products, where conversion factors are based on a different approach or to figures, where the goal is to make accurate

calculations of primary input equivalents and of actual energy content.

The UN Statistical Commission (1982) uses a similar system of classifying energy balances, dividing energy balances into the same four categories described above. Under the UN system, the "energy supplied" balance is called the "community energy balance," while the "primary fuel input equivalent" balance sheet is referred to as the "overall energy" balance.

Recognizing the need for better energy measures, the UN Statistical Commission in 1978 convened an "expert group" meeting to develop standard procedures for conducting energy supply and demand balances that would permit international comparisons. According to this group, the primary benefit of such a system would be agreement between major institutional organizations on a set of "harmonized" questionnaires that would be used for a variety of purposes, thus requiring that energy information be provided only once to organizations who make frequent informational demands, such as the European Economic Community (EEC), the Economic Commission for Europe (ECE), the Statistical Office of the European Community (SOEC), and the Council for Mutual Economic Assistance (CMEA).

After reviewing approximately 30 models for energy analysis, including those of the EEC, the ECE, the SOEC, and the CMEA, the group presented a report (UN Statistical Commission, 1982) containing recommendations for conducting energy analysis using standard definitions, procedures and

units of measurement (see appendix A). However, these procedures were designed chiefly for use in industrialized countries. Little follow-up has been conducted to determine the extent to which these guidelines are practical in light of the special data problems in developing countries.

The topics covered in the literature reviewed in this chapter and the authors writng on each subject are summarized in Table 3.1.

TABLE 3.1.
LITERATURE REVIEW SUMMARY

Topic	Authors/Date
Role of the energy planner	Kohler, Kariisa, et al., 1982 Robinson, 1985a Barron and Wilbanks, 1982
Energy information needs	Koshel, 1982 Hassell, 1982 Carlson and Gibbs, 1982 Gibbs, 1982 Dubourt, Gibbs and Stevenson, 1983 Mubayi and Meier, 1981 Munson, Palmedo, et al., 1983 Evans, 1983
Linkages between energy and the economy	Barron and Wilbanks, 1982 Munasinghe, 1980 Park, 1982 Kohler, Kariisa, et al., 1982 Ceceliski and Dunkerley, 1980
National energy assessments	Koshel, 1983 Barron and Wilbanks, 1982 USDOE, 1980 Munson and Palmedo, 1983 UNDP/World Bank, April 1985
Energy supply/demand balance	SOEC, 1980 UN Statistical Commission

Notes to Chapter 3

[1] A change in the number of livestock or the ratio of grain to straw (as in the introduction of high-yielding varieties) could upset the balanced subsistence village economy, which uses dung and straw. Labor availability for peak agricultrual seasons will be affected by time needed to collect fuelwood. Draft animals provide pulling energy and dung, and consume straw. Dung use as fuel rather than fertilizer affects soil fertility; and housing and cattle fodder compete for crop residues used as fuel (Celiski and Dunkerley, 1980, p. 27).

[2] The United Nations Statistical Office recommends that two supplementary lines be added to the balance sheet--one to indicate the quantities of energy entering the transformation plants, and the other to record the outputs of derived production.

[3] "Primary fuel input equivalent" is the amount of primary energy that would be required as direct energy input to the transformation process that has a particular secondary energy source as its output (UN Statistical Commission, 1982, p. 25).

[4] Energy supplied is defined as the delivery of primary energy from production stocks or net imports, in addition to secondary energy from transformation, stocks or net imports, to final energy users (UN Statistic Commission, 1982, p. 25).

[5] Final end users include all users outside the industries that produce or transform primary sources of energy (UN Statistical Commission, 1982, p. 15).

[6] This hypothesis assumes the replacement of hydroelectric energy and energy of geothermal and nuclear origin by electrical and energy produced in conventional thermal power station.

CHAPTER 4

METHOD

Country Selection

Countries were selected for inclusion in this study on the basis of discussions with AID's East Africa Regional Energy Advisor and World Bank staff, along with a review of available documents, such AID project documents, World Bank energy assessments and recent project evaluations. In addition, the selection was based on requests from the field missions, as well as on efforts to include countries covering a broad range of geographic locations and cultural traditions. Sudan is an Islamic country in Northeast Africa; Liberia is an Anglophone country in West Africa; and Uganda is an Anglophone country in East Africa. The availability of energy information was also taken into account.

All three countries have had some level of USAID-supported energy planning activities. (Figure 2.1 shows African countries with USAID funding.) The Governments of Sudan and Liberia are involved in substantial energy planning activities, and AID has funded energy planning activities in both countries, while Uganda is in the early stages of energy analysis.

UNDP/World Bank energy assessments have been completed in all three countries. In order to provide information useful

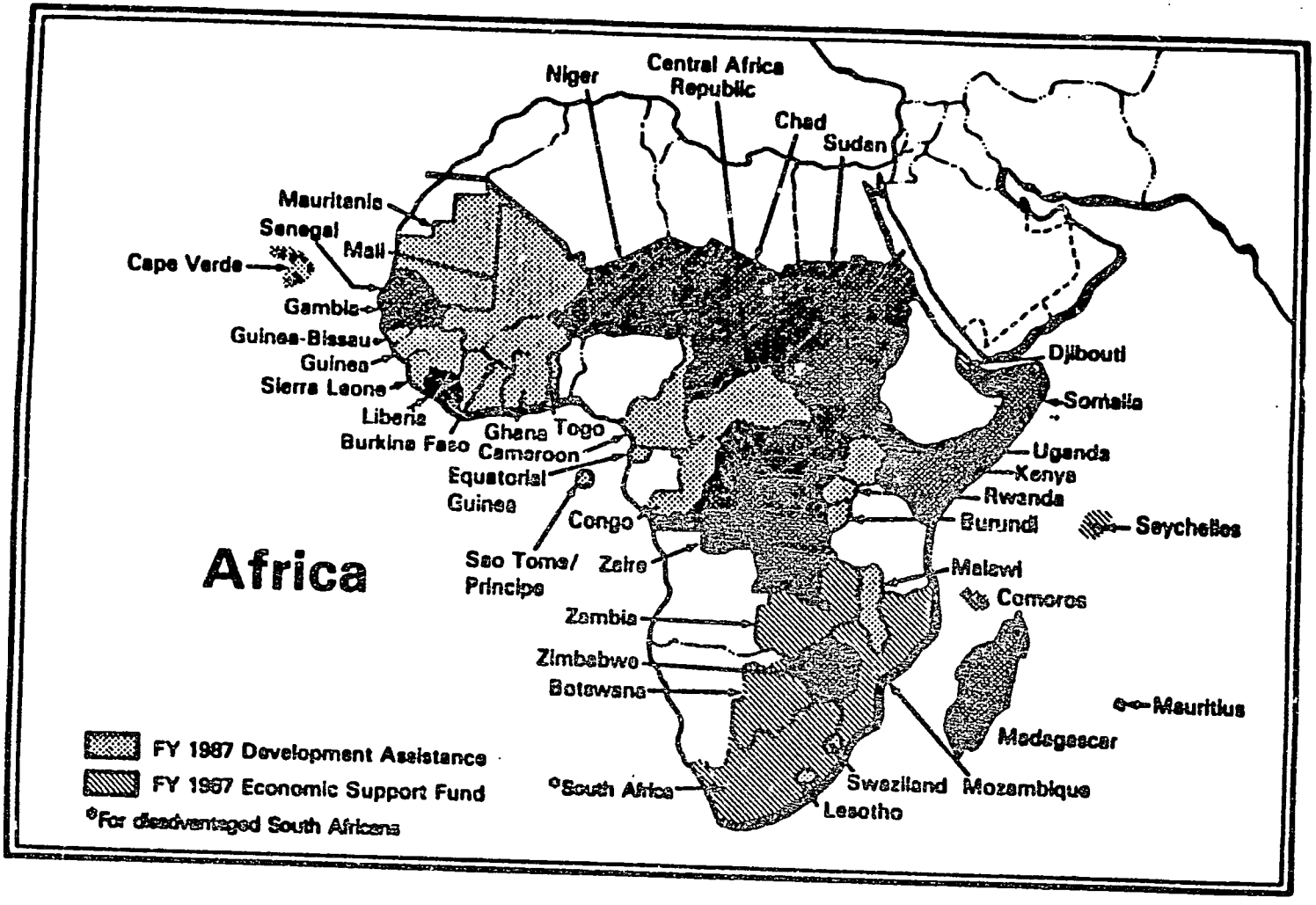

Figure 4.1. Map of African Countries With USAID Funding.

Source: Congressional Presentation, Fiscal Year 1987, Annex 1: Africa," U.S. Agency for International Development, March 1987, p. ii.

to countries at various stages in energy planning, it was considered important to examine the experiences of countries involved in data-collection efforts at both initial and advanced stages of development.

Pretest

A series of questionnaires and structured interview schedules was used for identifying sector analyses and energy assessments, for reviewing data quality, and for conducting institutional assessments were pretested prior to being used in the field. These are contained in Appendices B and C.

Questionnaires were reviewed by individuals who have had direct involvement with energy planning in the countries to be included in the study. Interviews with these individuals served as a pretest of the survey instrument. In addition, the questionnaires were revised after the first two interviews were conducted in the field, and the needed improvements in format and wording became evident. To ensure consistency in information, a second visit was made to these ministries after questionnaire revisions were completed.

Field Research

Institutional Resources and Training Needs

Host government ministries and agencies having responsibility for some aspect of energy planning in each country were visited, and the staff members involved in data collection and analysis were interviewed. Information was ascertained for each ministries/agency including their duties

and responsibilities, staff composition and training, analytic equipment available, and problems encountered in data gathering efforts. Listed below are the ministries/agencies in each country visited during this study.

Uganda

Ministry of Agriculture and Forestry (Forestry Department)

Ministry of Planning and Economic Development (Energy Department)

Ministry of Power, Posts and Telecommunications

Uganda Electricity Board

Bank of Uganda (Petroleum Desk)

National Research Council

Liberia

National Energy Committee

Ministry of Lands, Mines and Energy

Ministry of Planning and Economic Affairs

Liberia Electricity Corporation

Forestry Development Authority

Government of Liberia/USAID Energy Planning Project

Liberia Petroleum Refinery Corporation

Sudan

National Energy Administration

National Electricity Corporation

General Petroleum Corporation

Ministry of Energy and Mining (MEM) (Department of Forestry)

Interviews to assess institutional capabilities and training needs focused on the following questions:

1. What was the current number of professional staff, and what was their level of education?

2. How many professionals (at each educational level) were involved in the collection and analysis of energy-related information?

3. What was the agency's annual budget for energy data collection and analysis activities?

4. What training did professional staff receive in the areas of statistical sampling, research methodology, survey research and so forth?

5. What analytical equipment (programmable calculators, micro-computers, software packages) were available for use by staff?

6. What training did staff receive in the use of this equipment?

7. How was the equipment actually being used?

8. What plans did the agency have for expanding professional staff, equipment, or training?

9. What additional training was needed?

10. What institutions or organizations could provide this training?

11. What type of training was best suited for the agency's needs?

Quality of Data

The national energy assessments and energy supply/demand balance statements identified during the literature search and on-site visits were examined to determine the quality of the data. These data were assessed in a systematic fashion, using a standardized rating sheet. Recommendations of the UN Statistical Commission, as well as those emerging from a review

of other literature were considered in rating data quality. However, judgments about data quality were by nature subjective. The following questions were raised:

1. What methodology was used to gather data (sampling procedures and statistical analyses, and so forth)?

2. Was documentation adequate?

   a. Was information sufficient to replicate the study?

   b. Were sources cited?

   c. Were accounting units clearly defined?

   d. Were conversion units specified?

   e. Are recommendations consistent with findings?

3. Where are the gaps in information?

Due to the limitation of time spent in each country, only those documents relating to national energy assessments and the energy supply/demand balance sheets, along with their documentation were included for review. Studies relating to the energy area, but outside the above categories, such as energy pricing studies, macro-economic analysis, or feasibility studies were not included.

CHAPTER 5

UGANDA FINDINGS

General Characteristics

Uganda is a small, landlocked country, with 244 thousand square kilometers of land in central Africa (Government of Uganda, 1983). In mid-1985, the total population was 14.7 million, with an annual growth rate of 3.1 percent. The Ugandan economy is predominantly agricultural--in 1980 agriculture constituted the largest source of GNP[1] (46 percent). In addition, this sector employed 90 percent of the population and generated 97 percent of foreign exchange earnings (USAID, 1986).

Approximately 93 percent of the population live in rural areas and are engaged primarily in subsistence agriculture. Major subsistence crops are plantains, millet and cassava. A number of small-scale plantations raise cash crops, such as coffee, cotton, and tea. Statistics indicate a drastic decline in the production of cash crops, with only minimal recovery since the 1979 War (USAID, 1982; U.S. Department of State, August 1981). Uganda has limited proven mineral deposits, consisting chiefly of copper and tin (Jaenson, Harmsworth, Kabwegyere, et al., 1984).

The main ethnic groups in Uganda are the Bantu, Nilotic, and Nilo-Hamitic. Of these groups, the Bantu is the largest and includes the Baganda, which is the largest tribe. The second largest tribe is the Nilo-Hamitic Itesco, followed by the Banyankole and Basoga, both of Bantu extraction (US Department of State, 1982).

Historical Background

Many different tribes have coexisted in Uganda for centuries. In 1830 Arab traders moved inland from the area around the Indian Ocean coast of east Africa to the interior of Uganda. Thirty years later British explorers in search of the source of the Nile River arrived, followed by both Protestant and Catholic Missionaries in the late 1870's. From 1888 until 1893 the area was assigned by British royal charter to the Imperial British East African Company (U.S. Department of State, February 1982).

The Kingdom of Buganda was placed under a formal British royal protectorate in 1892, which was extended in 1894 to include the entire area of what is now called Uganda. This area was ruled by the British until 1962 when the country became an independent republic under the Kabaka of Bugada (U.S. Department of State, February 1982).

A number of constitutional changes took place, beginning in 1955, which led up to the Uganda's independence. A ministerial system of government, under which indigenous Ugandans were appointed ministers was established, and the

number of African members in the Legislative Council was increased in 1958 through direct elections (U.S. Department of State, February 1982).

Uganda's path to independence was not a smooth one but was hampered by strife between competing political factions within the country. The relationship between the politically dominant Kingdom of Buganda and the Ugandan government was shaky, at best, and competing factions often found themselves at odds. The first general election in Uganda took place in 1961--between Milton Obote, the candidate of Uganda People's Congress (UPC), and Benedicto Kiwanuka, of the Democratic Party. The election was boycotted by the Buganda Kingdom. The Democratic Party won by a narrow margin, making Kiwanuka the first prime minister of Uganda (U.S. Department of State, 1982).

Official independence was granted to Uganda on March 1, 1962. In the 1962 independence constitution, Buganda was allowed to retain much of its autonomy and many traditional customs. Similar agreements were reached with the smaller Ankole, Bunyoro and Toto kingdoms. Milton Obote, who became the head of the republic, introduced a new constitution in 1967, following a coup which had been initiated under his leadership the previous year. He was ousted by Idi Amin in 1971 (U.S. Department of State, 1982).

During Amin's reign, one of the most brutal in Africa's history, thousands of Lango and Archoli were massacred, and the

country's social and economic institutions were critically undermined. Amin survived a Tanzanian backed coup in 1972 but was overthrown when Tanzanian troops invaded Uganda in 1979. They remained in Uganda until June 1981.

During the months which followed the coup, two civilians, Yusufu Lule and Godfrey Binaisa, successfully held the Presidency until it was over-thrown by a bloodless military coup in 1980. With national elections organized and supervised by the Military Commission, Obote again became President (U.S. Department of State, February 1982). He remained in office until August 1985, when he was overthrown by the National Resistance Leader, Youweri Musoweni.[2]

Governmental Organization

The 1967 Constitution established the executive office of President. Parliament is the Supreme Legislature, consisting of the President and a National Assembly of 126 elected members. Although this charter was suspended by President Amin in 1971, the 1967 Constitution was reinstated by the Court of Appeals in 1980. Including the Office of the President, there are 27 Government Ministries in Uganda. The chief administrative officer of each Ministry is the Permanent Secretary. Professional Departments of Ministries are usually headed by a Commissioner or by an officer of similar or lower rank (Jaenson, Harmsworth, Kabwegyere, et al., 1984).

Institutional Issues

A USAID study of government institutions in Uganda was conducted to identify problems encountered by Ministry staff that inhibit effective service delivery (Jaenson, Harmsworth, Kabwegyere, et al., 1984). After interviewing approximately 44 Government employees, several problems were found to be common to all District-level ministry offices. Because of the impact these problems have on the daily operations of almost all ministries in Uganda, they are described below.

Lack of Transport

A problem frequently identified by staff was the lack of transport. Although some ministries have better transportation than others, no ministry office has sufficient transport facilities to carry out its administrative duties. Most officers have no access to motorized vehicles, and those who do usually share one vehicle with 60 to 100 other employees.

Lack of Operating and Program Funds

Approximately half of the officials interviewed (22) indicated that program funds were a major constraint to properly carrying out administrative duties. In many cases staff members must use their own money to buy office supplies or for travel. Most government institutions no longer make regular reports on their activities, partially due to the lack of paper and pens. Reimbursements for travel may take months, and in many cases, staff members are not reimbursed at all.

Lack of Housing and Office Accommodations

Many ministries are adversely affected by the lack of both office and residential facilities. This situation is due, in part to the absence of construction during the Amin years, and in part, to the re-drawing of District boundaries, an action that increased the number of Districts from 12 to 33. Because of the housing shortage, many employees are forced to live far from their place of work.

Delays in Salary and Allowance Payments

A chief constraint to motivation to work in the government sector in Uganda is related to salaries. Most Government of Uganda (GOU) employees are paid far below the cost of living, and without heavily subsidized government housing and household gardens, would not be able to survive on their monthly wages. In addition, remuneration is often delayed because checks are normally deposited into bank accounts of established officers, and banks are located only in District headquarters. The cost of traveling to headquarters to pick up salary checks often takes a substantial portion of the employee's salary. Consequently, checks are picked up infrequently. Further, salaries are paid on an irregular basis, i.e., only when money is available at District headquarters.

Lack of Staff Training

It is generally perceived that institutions providing technical training or higher education degenerated in quality

and in some cases closed altogether during the general decline of the 1970's. As a result ministry staff have been unable to update their earlier training.

Institutional Overlap

The problem of overlapping institutional functions has a significant impact on District-level development planning and implementation. There is considerable confusion about the responsibilities and functions of District Administration (the President's Office), the Ministry of Local Government, and technical ministry officers. According to respondents, "Duplication of functions in some areas, inability to marshal or control funds for a given project and the unclear lines of administrative hierarchy have resulted in little or no coherent development planning at the District level" (Jaenson, Harmsworth, Kabwegyere, et al., 1984, p. 13).

Economic Trends

At the time of independence in 1962, Uganda had one of the strongest agrarian economies in sub-Saharan Africa. The economy continued to thrive during the 1960's but began to deteriorate rapidly after the 1971 coup. The decline experienced by Uganda during the 1970's may be attributed to a number of factors, ranging from a long period of mismanagement which prevailed during Amin's regime and continued after his overthrow, to the effects of the 1978-1979 war. These difficulties were compounded by sharp increases in oil prices in 1973 and the world-wide recession in 1979 and 1980 (UNDP/World Bank, 1983).

During the period from 1972 to 1980, when the economy was in a state of general decline, subsistence agriculture increased substantially, while commercial farming, as well as agricultural processing and marketing, significantly decreased (UNDP/World Bank, 1983). A major contributor to this decline was the wholesale looting of farms, factories and capital stock. In addition, key institutions such as universities and agricultural research centers were totally ransacked, and almost all records, equipment, publications and consumable materials were lost or destroyed.

The impact of these developments on the economy was devastating, resulting in the complete collapse of both private business and government institutions for a short period and bringing social and economic research to a halt (Jaenson, Harmsworth, Kabwegyere, et al., 1984). Per capita incomes declined from 1970 to 1978. Few Ugandans retained savings during that period, and foreign capital inflows were extremely limited. Uganda's existing infrastructure and productive capability were severely eroded, while the country's ability to import essential goods was diminished (UNDP/World Bank, 1983).

Despite adverse economic conditions that prevailed over the 1970's, Uganda's economy has shown encouraging signs of recovery. Since 1981, when major policy reforms were introduced, Uganda has experienced a considerable increase in economic activity. In 1983, real Gross Domestic Product (GDP) rose by 7.3 percent to 7,375 million shillings at 1966 prices,

slightly lower than the 1972 peak of 7,542 million shillings. Subsistence agriculture has now surpassed its previous peak level of output. Real GDP per capita increased by 4.3 percent during 1983 (Republic of Uganda, Ministry of Planning and Economic Development, 1984).

A greater variety of goods is now available on the market, and exports have increased 60 percent since June 1981. In addition, domestic prices have stabilized somewhat, and by 1983, the rate of inflation had begun to slow (UNDP/World Bank, 1984). Until June 1984, Uganda upheld a dual currency rate of exchange. At present, the two "windows" have now converged, and a unified rate will be determined by weekly auctions.[3]

Energy Sector

Maintaining a reliable fuel supply is an important factor in Uganda's economic recovery, since sustained economic growth is contingent upon obtaining adequate energy. Inaccessible or inadequate energy supplies can severely hamper both industrial and agricultural productivity, as demonstrated during the late 1970's, when petroleum supplies were limited.

Overview of Energy Supply and Consumption

Energy consumption in Uganda consists chiefly of fuelwood, petroleum, and hydroelectricity. In 1980, per capita energy consumption in Uganda was estimated at 0.35 tons of oil equivalent (TOE), including 0.06 TOE of commercial energy consumption. The World Bank's analysts (1983) point out that even though this level may be low by world standards, it is

comparable to estimates for other low-income countries in Sub-Saharan Africa. For example, Kenya, Tanzania, Malawi, and Ethiopia all consumed less than 0.13 TOE commercial energy during 1980. Uganda's low level of commercial energy consumption reflects the large proportion of the population engaged in subsistence agriculture, as well as the country's low per capita income.

Thus, it is not surprising that the household sector was the largest energy user (consuming 80 percent of total energy and 37 percent of commercial energy in 1980), and that 95 percent of total energy and 71 percent of commercial energy in 1980 was supplied from woodfuel. Electricity supplied less than 4 percent of commercial energy consumption (Energy Development International, 1983). A total of 84 percent of Uganda's commercial energy was domestically produced in 1980, and 16 percent was provided by imported petroleum products. Approximately 7 percent of the net supply of commercial energy was consumed outside Uganda, including electricity exports to Kenya and smuggling to neighboring countries (UNDP/World Bank, 1983).

Petroleum

Uganda has no domestic oil production or refining capacity. All petroleum products are imported, and the importation and marketing is handled by six oil companies, of which, three share joint ownership with the Ugandan government. Petroleum imports to Uganda were highest (431,000 tons) in

1970. As the economy faltered and foreign exchange became unavailable, the volume of petroleum used as energy products fell below 250,000 tons per year during 1978-80. A large volume of oil imports were sold on the black-market to surrounding countries; it was estimated that as much of 40 percent of packed kerosene imports and 20 percent of auto diesel were smuggled to Rwanda, Zaire, and Kenya (UNDP/World Bank, 1983).

Consequently, Uganda's consumption of petroleum products during that period fell to half of the 1971 level. The largest user of petroleum was transportation, which used two-thirds of total consumption. Since international air services to Uganda ceased during this period, importation of aviation fuel sharply dropped. Likewise, industrial consumption declined severely during the 1970's to less than two-thirds of the 1970 peak level. Kerosene consumption used for domestic purposes also decreased, although the decline was less dramatic.

In 1981, retail price adjustments were initiated, leading to a decrease in domestic consumption, as well as a decline in smuggling of petroleum products. Further, a shortage of foreign exchange and refinery/pipeline problems in Kenya, the country's chief oil supplier, created supply constraints which exacerbated the decline. When demand increased during 1982, it could not be met by imports and led to a serious drain on petroleum stocks. However, recent

changes in supply arrangements have improved the situation considerably (UNDP/World Bank, 1983).

Currently, the Ugandan government sets retail prices for premium and regular gasoline, kerosene and automotive diesel. Retail prices have been gradually increased by the government since 1982, as a result of the depreciation of the exchange rate against the dollar. Premium gasoline, regular gasoline, kerosene and diesel have increased by 27, 29, 88 and 67 percent, respectively (UNDP, World Bank, 1984).

Woodfuels

Data on wood resources in Uganda are extremely limited. World Bank estimates are derived from "partial and outdated surveys, random samples around the Kampala area, and relevant experience of other countries in the region" (UNDP/World Bank, 1983, p. 11). These analysts warn that the figures can only be treated as preliminary until a more reliable data base is developed.

Based on these crude data, it is estimated that Uganda has 2.76 million hectares of forests and woodlands. This amounts to 12 percent of the country's total area, including inland waters. The total "growing stock" in the country is about 450 million tons of wood, providing a sustainable yield of 10.9 million tons (or 4.1 million TOF) of fuelwood per year. Another 110,000 TOE of crop residues and animal dung are provided for fuel. In addition, 3.2 million tons of wood are produced for use as poles, sawnwood, panels and paper

products. Close to one third of this comes from arable land and pastures, while less than one half is harvested from forests and woodlands.

Current wood consumption (including conversion losses in charcoal production) is estimated at 5.0 million TOE. This means that Uganda's seemingly abundant wood resources are in danger of being depleted, particularly in urban areas.

Electricity

Uganda has abundant hydroelectric potential, estimated at about 2,000 MW. Annual "firm generation capability" is 10,000 GWh. Currently, the Owen Falls Station near Lake Victoria on the Nile is the only major generating plant, with a generating capacity of 150 MW. Another 4.7 MW is supplied by six small diesel stations and one small hydroelectric station (0.5 MW) in the northern and western regions. The average annual generation capacity is about 800 GWh. The total generation capacity in 1981 was 517 GWh, of which 288 GWh were consumed in Uganda, and 179 GWh were sold to Kenya (Energy Development International, 1983).

It is estimated that five million people (40 percent of the population) live in an area served by the Owen Falls system and the isolated plants. However, the number of connections in 1981 was only 93,156 (with 71 percent used for domestic purposes). It has been calculated that only 0.4 million (eight percent) of the population living in the area served by the

facility, and three percent of the total population utilize electricity (UNDP/World Bank, 1983).

Uganda has one of the lowest per capita electricity consumption rates in the world, with only 2.1 KWh per capita. This is partially attributed to both limited access to electricity and declining economic activity over the past few years. Per capita consumption in the 1960's was more than twice today's levels. Industrial consumption decreased by more than 60 percent in 1969. During 1982, consumption in the household and commerce sectors declined as higher tariffs were enacted, but the industrial sector experienced a 34 percent increase. As Uganda's economic recovery continues, demand on electricity is expected to rise.

Based on studies by the Overseas Development Administration (ODA) and an ODA-financed feasibility study by Kennedy and Donkin, and Sir Alexander Gibb and Partners, rehabilitation of the Owens Falls station will be needed to accommodate increasing demands. Upgrading the existing plant would increase generating capacity from its present capability of 150 MW to 280 MW. Preliminary findings show that although it would be possible to increase capacity to 210 MW, it would not be economically justifiable.

Government of Uganda's Development Strategy

The present government's strategy for restoring the economy and precipitating development is based on quickly rehabilitating the existing productive sectors. Uganda's

program of economic reform and market orientation continues to show positive results, although continuous adjustments must be made.

External debt has stabilized, and the level of external arrears has been substantially reduced. Since May 1981, the government has successfully implemented three financial programs supported by International Monetary Fund (IMF)[4] standby arrangements. While the IMF closely monitors the government financial program, the share of government expenditures covered by domestic bank financing has fallen sharply.

The Ugandan Recovery Program, a package of monetary and fiscal reforms, was presented to the World-Bank-sponsored Consultative Group Meeting in Paris in May 1982. This program, which has undergone two revisions since its initiation, concentrates on foreign-exchange earning activities that will have a large impact on agricultural and industrial production. Included in the revised program are strategies for government price controls of petroleum, as well as for development of the country's forest resources.

Although a policy climate conducive to longer-term economic growth has been established, social/political problems associated with the military regime and subsequent administrative difficulties persevere. The country is still divided by ethnic differences, and national unity and stability continue to be elusive. Further, basic farm inputs such as hoes, plows, seeds, gunny sacks, and transportation are

inadequate to fulfill the country's agricultural potential. Although private sector and cooperative organizations are encouraged to produce these inputs, further assistance from donors is necessary. The recovery program focuses on expanding credit programs that enable farmers to purchase these tools and equipment. Another area of concentration is on health-related issues which affect the farm family's ability to produce crops.

USAID's Development Strategy

AID's development strategy is based on the priorities outlined in the Government of Uganda's Revised Recovery Program. This program emphasizes reviving existing productive capacity in agriculture and industry. AID's strategy has three general objectives:

1. to help restore productive capacity in foreign exchange/earning/saving areas of the agriculture and agriculture-related industry sector
2. to rehabilitate institutions that service small farmer needs
3. to closely monitor policy at the agriculture sector level and play an active role in policy issues related to specific AID assistance efforts.

At every level, AID will also attempt to promote the expansion of private enterprise and encourage market liberalization (USAID Congressional Presentation, 1984, p. 281). AID's program efforts are chiefly geared toward increasing agricultural output and efficiency, although limited funding is also provided for maternal/child health (oral rehydration) and family planning assistance, along with a small

($90,000) energy project designed to produce charcoal briquets from coffee hulls. A refugee resettlement project is also being undertaken. The main thrust of AID programming in Uganda, however, is on recapitalization of small-holder agriculture, improving institutional support services, strengthening private enterprise, developing human capital resources, and strengthening farmer organizations.

The AID Mission in Uganda is aware of the importance of energy in Uganda's economic development. Because of budgetary constraints and agency pressures to focus resources, the mission has elected to address energy issues primarily through the incorporation of energy considerations into its proposed agricultural and industrial development projects.

Overview of Ugandan Energy Institutions

The responsibility for the collection and analysis of energy data in Uganda is scattered among several ministries, with no agency or ministry having sole responsibility for energy planning activities. The primary governing bodies which deal with energy-related issues are:

Ministry of Planning and Economic Development

--Industrial Division

--Statistics Division

--National Research Council

Ministry of Power, Posts and Telecommunication

Uganda Electricity Board

Ministry of Agriculture and Forestry (Forestry Department)

Bank of Uganda (Petroleum Desk)

Ministry of Lands, Minerals and Water Resources (Geological Survey and Mines Department)

Information about each of these ministries/agencies--their duties and responsibilities, staff composition and training, analytic equipment, problems encountered in data gathering efforts, and specific training needs was ascertained by conducting interviews with individuals responsible for energy data in each organization. Appendix D provides a list of individuals interviewed.

Although a formal questionnaire was used to structure interviews, questions were asked informally, rather than by reading from questionnaires. Efforts were made to ask the questions in the same way to each respondent. In some cases, follow-up visits were required because information requested was not immediately available.

In addition, written information about each ministry (such as the 1984-85 Republic of Uganda budget and the Background to the Budget) were obtained whenever possible. Copies of Ministry energy studies, as well as those produced by outside donors and consultants, such as the World Bank national energy assessment were also obtained, when available. The information presented in the following sections was derived from a combination of these interviews and documents.

Ministry of Planning and Economic Development (MPED)

Duties

The MPED was established in 1961. Formerly titled the Ministry of Planning and Finance, the MPED serves as a general coordinating body for investments in the energy sector. Its formal mandate is to examine energy issues with respect to "inter-sectorial" priorities and resource requirements. At the time of this survey, 200 people were employed in six MPED divisions. However, this ministry has no staff assigned solely to the energy sector. Table 5.1 depicts the breakdown of MPED employees by division.

TABLE 5.1.

MINISTRY OF PLANNING AND ECONOMIC DEVELOPMENT

Division	Number[a] of Employees
Administration	52
Statistics	84
Manpower	26
Development	20
Industry	4
National Research Council	4
Total	200

[a] Includes clerical, administrative, and professional staff.

It is the responsibility of this ministry to advise which sub-sectors should be given attention and to assign priorities to activities in these sub-sectors. The ministry's involvement in these sectors includes:

1. Macro-sector--macro-economic analyses, (including balance of payments, employment growth rates)
2. Agriculture sector--agricultural production studies
3. Industrial sector--energy, mining, and processing
4. Transport sector--transportation issues
5. Social sector--water, health, education, and housing
6. Manpower sector--coordinates training with Ministry of Education
7. National Research Council--coordinates energy research, particularly in renewable energy (but does not actually conduct research)
8. Statistics Section--collects statistics for each of the sectors; conducts macro-economic analyses.

Three of the above MPED divisions are involved in energy activities, including the Industry Division, Statistics Division, and National Research Council. Individuals within each of these divisions were interviewed, and the results of these discussions are described below.

Staff Composition and Training

As depicted in Table 5.2, a total of 12 ministry employees have job titles of "Economist/Statistician," and 4 have jobs entitled "Generalist." However, not all of the Economists/Statisticians have degrees in economics or statistics. Further, there is no division within the ministry with clear responsibility for energy issues. Therefore, any of

these staff members may, at one time or another, be involved in energy data collection and analysis. Although precise information about the type of degree each employee holds was unavailable, it was indicated by interviewees that most of these individuals received "Generalist's" degrees from Makerere University located near Kampala. Only four MPED staff members have had formal training in statistical sampling procedures, survey methodology, and research design techniques. None of the staff members have received training in the use of computers, nor in energy assessment techniques.

TABLE 5.2.

MPED STAFF INVOLVED IN ENERGY DATA COLLECTION AND ANALYSIS

Sector/Division	Job Title	Degree	Number of Staff
Industry Sector	Generalist	Bachelor's	4
Statistics Section	Economist/ Statistics	Bachelor's	10
	Economics/ Statistics	Master's	2
National Research Council	-	-	0

Analytic Equipment

No programmable calculators, main frame computers or micro-computers are available to MPED staff. All calculations, including macro-economic analyses and growth projections, are

done either by hand or with the assistance of non-programmable calculators.

Energy Planning Activities

Very little actual energy planning has been conducted in the past by the MPED, and only a small portion of the overall budget is allocated to energy data collection and analysis. The total 1984-85 budget for the MPED was 345,129,000 shillings ($986,082). Few studies that focus solely on energy have been produced by this ministry. However, a number of studies have been undertaken that combine energy questions with other considerations. For example, in 1983 a survey of industrial production, which included questions about the amount and cost of energy consumed, was administered to all Ugandan industries having more than four employees. Additional statistics on industrial electricity consumption were provided by the Ugandan Electricity Board.

Upon the recommendation of the World Bank, the Government of Uganda has recently created a Department of Energy within the Ministry of Power, Posts and Telecommunications (MPPT). With the initiation of this department, it was expected that even fewer energy planning functions would be performed by the Ministry of Planning and Economic Development. However, at the time interviews were conducted, strengthening of the Statistics Section of the MPED was being considered. Furthermore, it was expected that the Statistics Section would be frequently be requested to assist the newly

established MPPT Energy Department in collecting and analyzing energy data.

The National Research Council, which is a part of the MPED serves as a coordinating body for renewable energy research but does not get involved in actual data collection and analysis, nor in energy planning activities.

Training Needs

Ministry staff described a need for training at all levels of energy data collection and analysis, particularly in the areas of statistical sampling and interpretation of results. The acquisition of microcomputers and training in their use for data analysis was also considered to be needed. Both the World Bank and Makerere University were listed as institutions capable of providing such training.

Ministry of Power, Posts, and Telecommunications (MPPT)

Duties

The Ministry of Power, Posts, and Telecommunications was established in 1981 and, as the name suggests, is responsible for the power sector, as well as posts and telecommunications. This ministry handles energy issues relating to all energy sources, including the electric power sector. However, the only energy sub-sector over which the MPPT exercises regulatory control is electricity. This function is carried out primarily through the arm of the Uganda Electricity Board.

As indicated earlier, an Energy Department of the MPPT has only recently been established. At the time this study was conducted (October 1984), the department had been in operation less than a month. Consequently, the MPPT was still in the process of recruiting staff and establishing the duties and responsibilities of the division. The current duties of the office involve coordinating all matters relating to energy with other ministries in Uganda. This department will be responsible for formulating and initiating recommendations for energy policies in Uganda, including the areas of:

1. supply and distribution (electricity/petroleum)
2. monetary developments in petroleum
3. data collection and analysis
4. world markets and trade for coal and petroleum products
5. general trends in the oil industry
6. preparation of a national energy plan
7. supply and development of wood and other renewable energy resources.

Staff Composition and Training

The MPPT employs approximately 55 staff members, of which 16 have university degrees. The Energy Department of this Ministry is comprised of five full-time staff members and two staff who are currently in training. Two of the full-time staff hold administrative/technician positions and have technical certification, while two Statisticians and one Economist hold bachelor's degrees in statistics and economics

from Makerere University. All of the professional staff have had course work in statistical sampling procedures, survey methodology, and research design. None have had training in the use of computers.

Analytic Equipment

No programmable calculators, main frame computers or micro-computers are available to MPPT staff. All calculations, including macro-economic analyses and growth projections, are done either by hand or with the assistance of non-programmable calculators.

Energy Planning Activities

Because this department has only recently become operational, it has not yet engaged in significant energy planning activities. Staff members interviewed expressed concern that the Energy Department does not have sufficient staff, training, or resources to enable them to carry out their mandate. The total 1984-85 budget for the MPPT was 66,558,000 shillings ($109,165). However, there is no money in the budget set aside specifically for data collection and analysis, nor for energy planning activities.

Training Needs

Individuals interviewed indicated a need for additional staff training in all areas of data collection and statistical analysis, as well as in the use of microcomputers (both local and overseas training). Makerere University was cited as an

institution that would be able to provide in-country training.

Bank of Uganda (Petroleum Desk)

Duties

The Petroleum Desk of the Bank of Uganda was established in 1982, and is charged with the following responsibilities:

1. monitoring petroleum imports and distribution
2. standardizing procedures for processing information at the petroleum desk
3. advising on format for quarterly status report
4. initiating dialogue between petroleum desk and oil companies in Uganda
5. identifying further technical assistance to strengthen oil import arrangements.

This office works very closely with the power sector and, in the future, will also coordinate with the new Energy Department of the MPPT.

Staff Composition and Training

The Bank of Uganda Petroleum Desk is comprised of eight staff members. Of these, four employees (one Generalist and three Economist/Statisticians) participate in energy data collection and analysis activities. All four employees hold Generalist's degrees. Each has completed one semester of statistical sampling procedures and one semester in economics at Makerere University. In addition, one staff member received four months' training from the International Monetary Fund in the use of main frame computers.

Analytic Equipment

No programmable calculators, main frame computers or micro-computers are available to the Bank of Uganda Petroleum Desk. All calculations are made with non-programmable calculators or by hand.

Energy Planning Activities

The total 1984-85 budget for the Bank of Uganda, Petroleum Desk was 60,000,000 shillings ($171,428). Of this total, approximately 50 percent is allocated to energy data collection and analysis. In early 1983, the World Bank provided technical assistance support to the Petroleum Desk under the Energy Sector Management Program (ESMAP). This assistance was focused on:

1. standardizing procedures for information processing at the Petroleum Desk
2. advising on the format of a quarterly status report
3. initiating a dialogue between Petroleum Desk and oil companies operating in Uganda
4. identifying further technical assistance to strengthen oil import arrangements in the country.

Bank of Uganda staff anticipate that the World Bank will provide further technical assistance for energy planning during the upcoming months.

Training Needs

Individuals interviewed indicated a need for staff training in the following areas:

1. data collection and analysis

2. supply/demand assessment techniques
3. use of microcomputers
4. economics of petroleum
5. energy production
6. technical aspects of energy.

Makerere University, as well as universities outside Uganda (not specified) were thought to be institutions capable of providing such training. No preference was expressed for either in-country or overseas training.

Ministry of Agriculture and Forestry (MAF)

Duties

The Ministry of Agriculture and Forestry was established in 1908 to replace the Scientific Department, which was created in 1894. The chief function of the Ministry of Agriculture and Forestry is to manage the forestry estates of Uganda, within the guidelines of the country's forestry policy. The Forestry Department has primary responsibility for wood production from forest plantations, natural forests and woodlands.

Staff Composition and Training

The Ministry of Agriculture and Forestry is staffed with over three thousand employees. The Forestry Department of this ministry employs approximately 346 professional staff, of which 140 have university degrees and 206 have forestry diplomas. Very few of these staff members become involved in data collection and analysis. It was estimated that only seven Forestry Department professional staff and ten technicians are

involved in data collection and analysis. Of the professionals, six have Bachelor's degrees and one has a Master's degree. These individuals all hold Generalist's degrees, with one or two courses in statistics and survey methods. One staff member is currently in India undergoing training in sampling design.

Analytic Equipment

No programmable calculators, main frame computers, or micro-computer are available to the MAF. All calculations are made with non programmable calculators or by hand. In times when earlier resource inventories were conducted, employees had access to a main frame computer at Makerere University. However, this computer is no longer operational.

Energy Planning Activities

The total 1984-85 MAF budget was 2,835,290 shillings ($810,082). Although this ministry has been involved in several efforts to document forestry resources, very little accurate information currently exists. In the 1920's an inventory of forest reserves was conducted in a few selected areas. In 1971 the Canadian International Development Agency (CIDA) conducted forestry resource surveys in two reserves. Although plans were made to document resources in other areas, efforts were abandoned because of political instability at the time. Much of the data were lost or destroyed during the tumultuous years which followed.

In more recent times, the Overseas Development Administration (ODA) has provided assistance for conducting an inventory of wood plantations. An inventory of natural forest reserves is planned for the same area.

Training Needs

Ministry staff cited the need for training in a number of areas. It was felt that short-term training (three to six months) for foresters is needed in resource inventory methodology. In addition, long-term (Master's level) training is called for in the areas of statistics, data processing, and aerial survey interpretation. Respondents felt that Makerere University, as well as universities abroad could provide such training.

Uganda Electricity Board (UEB)

The Uganda Electricity Board is a public corporation, responsible for the transmission and distribution of the electric power supply in Uganda. Established in 1950, this agency falls under the formal jurisdiction of the Ministry of Power, Posts, and Telecommunications, although, in reality, the UEB operates in a relatively autonomous fashion. The Electricity Board has a staff of approximately 2,800 people. The board is required by the legislature to provide information about its facilities and operations, but the UEB staff do not presently engage in actual data collection and analysis. Most electricity data consist of information about customer accounts

and electricity consumption, which is maintained on the UEB's main frame computer used for billing purposes.

Ministry of Lands, Mines and Water Resources (Geological Survey and Mines Department)

This Department is responsible for prospecting and mining all minerals, petroleum, and geothermal resources in Uganda. It has been involved in aeromagnetic studies in northwestern Uganda, and survey results have been reported. This agency has not participated in energy use surveys or other studies involving statistical sampling procedures. Therefore, it was not included in the institutional assessments of ministries/agencies in Uganda. UNDP/World Bank (1983) figures indicated that the department was staffed with 5 mine inspectors; 33 geologists, hydrologists, geophysicists and mineral prospectors and 17 chemists and other lab assistants.

Quality of Data

UNDP/World Bank Energy Assessments

Uganda's National Energy Assessment was conducted by an eight-person UNDP/World Bank assessment team, during a three week period in October-November 1982. Prior to the arrival of the assessment team, a two-person reconnaissance team visited Uganda in order to locate data sources and to make preliminary arrangements for the assessment. Like most UNDP/World Bank assessments, much of the field data collection took place with virtually no participation by Ugandan government staff. Once the data were collected, the information was analyzed at the World Bank headquarters in Washington D. C.

This procedure reflects the World Bank Energy Assessment Program staff's prevailing attitude that the data should be initially collected and analyzed by the "experts," in order to get an immediate picture of the energy situation. According to World Bank team members, the initial assessment should be followed by an extensive training program, designed to provide host government staff with the necessary skills to conduct their own analyses.

The supply/demand balance (see Appendix E) produced as a part of this assessment uses standard UNDP/World Bank format. Although the format differs somewhat from that recommended by the UN Statistical Commission (1982), these differences are minimal, and most of the same conventions recommended by the Commission were also utilized by the UNDP/World Bank team.

Conversion factors were clearly stated and data sources were usually cited. However, the basis on which some of the assumptions were made was not always stated. Furthermore, it appears that rather sweeping recommendations were made on the basis of limited and often unreliable data.

When asked to identify studies that had been "particularly useful" for making energy policy and planning decisions, Government of Uganda staff cited the UNDP/World Bank National Energy Assessment, along with an electric power study by the Overseas Development Administration (ODA). These data, which formed the basis for many planning decisions in the

energy sector, were in most cases the only sources of energy data available.

A number of Government of Uganda (GOU) actions have resulted, in part from UNDP/World Bank recommendations. For example:

1. in late 1982, the Government of Uganda established a Petroleum Desk responsible for monitoring petroleum imports and distribution

2. in response to the government's suggestion, oil companies took a number of steps to reduce oil costs by diversifying sources

3. in conjunction with Shell Oil, the GOU carried out a trial run for importing petroleum products via Dar-es-Salaam to reduce the heavy reliance on transport through Kenya

4. an Energy Department of the MPPT has recently been created to serve as an energy planning and coordinating body for the Government of Uganda (UNDP/World Bank, 1984).

A number of other policy and pricing decisions have resulted either directly or indirectly from UNDP/World Bank and ODA recommendations.

Summary and Conclusions

Ugandan Energy Institutions

In the course of this study, five ministries/agencies were visited, and individuals were queried about staff composition and training, as well as about types of problems staff have encountered while collecting and analyzing energy data. In addition, respondents were asked about the quality and usefulness of data provided by donors and consultants.

As illustrated in Table 5.3, approximately 43 technical and professional staff at various ministries and agencies are involved in energy data collection and analysis of some sort. Although the Uganda Electricity Board and the National Research Council are involved in the energy sector, no staff members at either of these agencies actually participate in data collection and analysis.

Of those employees whose job involves data collection and analysis, a total of 13 have technical certificates, 27 hold Bachelor's degrees, and 2 have Master's degrees. Three employees are currently undergoing overseas, long-term training. Even though a number of staff have job titles such as "Statistician/Economist," most hold "Generalist's" degrees, rather than degrees in statistics or economics. Table 5.4 depicts the number of staff members at each ministry/agency who have received training in statistical sampling, research methods, or computer programming.

Data Collection and Analysis Problems

As noted earlier, very little energy data has been collected by the various ministries dealing with energy issues, even though several ministries have mandates with formal responsibilities in the area of energy planning and analysis. For the most part, data collection has simply involved utilizing data already compiled by donors and consultants. However, where efforts were made to collect data, a number of

TABLE 5.3.

UGANDA MINISTRY/AGENCY STAFF INVOLVED IN DATA COLLECTION AND ANALYSIS

Institution	Degree[a]	Job Title	Number of Staff
Ministry of Planning and Economic Development (MPED)	Bachelor's	Generalist	4
	Bachelor's	Statistician/ Economist	10
	Master's	Statistician/ Economist	2
Ministry of Power Posts, and Telecommunications (MPPT)--Energy Department	Technical	Administrator	3
	Bachelor's	Generalist	2
	In Training	-	2
Bank of Uganda	Bachelor's	Generalist	1
	Bachelor's	Statistician/ Economist	3
Ministry of Agriculture and Forestry (MAF)	Technical	Technician	10
	Bachelor's	Generalist & Forester	7
	In Training	-	1
Uganda Electricity Board	-	-	0
National Research Council	-	-	0
Geological Survey & Mines Department	-	-	0
		Total	43

[a] Precise information on type of degree was not provided, although it was estimated that most staff holding both Generalist and Statistician/Economist job titles have Generalist's degrees.

TABLE 5.4.
UGANDA MINISTRY/AGENCY STAFF TRAINED IN DATA COLLECTION AND ANALYSIS

Institution	Type Training	Duration	Number[a] of Staff Trained
Ministry of Planning and Economic Development (MPED)	Statistical Sampling/ Survey Methodology	1 Semester	4
	Research Methods	1 Semester	4
Ministry of Power Posts, and Telecommunications (MPPT)--Energy Department	Statistical Sampling	3 Years	3
	" "	In Training	2
	Research Methods	3 Years	3
Bank of Uganda	Statistical Sampling/	1 Semester	4
	Computer Programming	4 Months	1
Ministry of Agriculture and Forestry (MAF)	Statistical Sampling	1 Semester	6
	" "	2 Semesters	1
	" "	In Training	1
	Research Methods	1 Semester	7
Uganda Electricity Board	-	-	0
National Research Council	-	-	0
Geological Survey & Mines Department	-	-	0.

[a]These numbers are not additive, since some staff received training in more than one subject area.

problems were encountered. According to those interviewed, most of these problems fall into two basic categories.

The first category relates to the availability of resources required to adequately collect and analyze data. The deficiencies most frequently encountered in this area stemmed from a lack of staff, funding, transportation and analytic equipment. Obtaining adequate transportation, in particular, seemed to be an obstacle encountered by most everyone interviewed. A number of respondents described data collection efforts which were severely hampered because vehicles were either unavailable or were incapacitated. In addition, computers and calculators were often totally unavailable.

The second problem area, insufficient staff training, appeared pervasive throughout the government sector. Training needs and issues relating to training programs are discussed in the section which follows.

Training Needs

Without exception, all ministry and agency staff interviewed indicated that additional training is needed in data collection and analysis, especially in the areas of statistical sampling and survey methodology. In particular, insufficient training of interviewers was high on the list of problems cited by those who have been associated with energy surveys and other data collection and analysis efforts in the energy sector. The Statistical Department of the Ministry of Planning and Economic Development, for example, which conducted

an industrial production and energy use survey, reported a number of difficulties stemming from insufficient interviewer training, including, but not limited to:

1. misunderstanding by both the interviewer and the respondent about the intent of the questions (due, in part, to poorly worded questions)
2. inconsistency among interviewers in the phrasing of questions
3. improperly completed questionnaires.

Although the overwhelming testimonial to the need for additional training is hardly surprising, this response may be associated with a number of factors. It is possible that respondents answered affirmatively to questions about whether more training is needed because they perceived that to be the "correct response" (i.e., what the researcher wanted to hear).

Second, because most government ministries in developing countries pay very low salaries, one of the compensating benefits of working for the government is participation in various training programs. Training is an integral part of the reward and incentive system, and often means donor-financed travel abroad--a luxury that most employees could never pay for themselves.

In addition, participation in training programs (usually overseas) is often a prerequisite for promotion. Consequently, the more training programs of any type that are available to an employee, the greater his or her chances of moving to a higher position. Under these circumstances, it seems logical that respondents would be likely to answer questions in a manner

that might lead to new training programs, irrespective of the actual need for such programs.

However, despite these factors, it appears from an examination of ministries' staff composition and backgrounds, that a "real" need exists for additional training in the area of data collection and analysis, since very few staff have had formal training in statistical sampling and research methodology. Most training has consisted of one or two undergraduate courses at Makerere University, with little or no data collection and analysis experience on the job. Findings from World Bank analysts (UNDP/World Bank, 1985) involved in a study of energy institutions in Uganda also support these conclusions.

Although data provided by outside consultants and donors are indeed useful, expatriate analyses cannot substitute for an in-country capability to assess and develop long-term solutions to energy/natural resource problems. It has often been found that if personnel do not participate in assessments and analyses, they may not trust or understand the information or conclusions. Thus, expatriate-directed studies run the risk of sitting unused on shelves. As with other types of data, statistics on energy supply and demand depict existing conditions at the time data were collected. Over the long-term, ministry staff must be capable of collecting and analyzing information for policy and decision-making on a continuous basis.

Training Institutions

Individuals interviewed were asked to list organizations and institutions that they thought would be able to provide needed training in energy data collection and analysis. Among the institutions named were the World Bank (Energy Assessments Division), the Overseas Development Agency, and Makerere University's Institute of Statistics and Applied Economics. A number of respondents considered the latter to be of high calibre, well suited to provide the kind of in-country training needed to enhance government staff's capabilities in energy data collection and analysis. The Institute of Statistics and Applied Economics is a three-year program leading to a Bachelor's Degree in Statistics from Makerere University. The emphasis is on practical application and on-the-job training, in conjunction with course work in theory and methodology. The curriculum consists of lectures, discussion groups, seminars, demonstrations and practicals using, whenever possible, real data from a variety of settings within African countries, along with participation in censuses, large-scale sample surveys, and other field projects.

The Statistics and Economics program is aimed at participants throughout the East Africa region, and is one of the few African institutions which offers such a program. Applicants are usually nominated by their government or organization, and each participating country has a limited quota of students who can be nominated. The Central

Statistical Office of the participating country is expected to work closely with the Institute in providing on-the-job training. Additionally, the nominating government is expected to absorb its nominees in its statistical services upon successful completion of the program.

This program is funded by UNDP and is closely associated with the UN Economic Commission and the UN Environmental Program in Nairobi. In addition to the regular academic program, the Institute holds area and regional seminars on selected special topics.

Not everyone interviewed was optimistic about the ability of this institute to provide the needed training in the energy area, maintaining that the university never fully recovered from the devastation of the Amin regime and the 1978/79 war. Citing examples of the destruction of books and facilities and the exodus of professors because of low salaries and frustration over the lack of funds and materials, they contended that the high quality programs for which the university was formerly known have severely deteriorated.

Recommendations

The findings of the examination of Ugandan energy planning institutions indicated that the ministries having responsibilities in the energy sector are seriously deficient in their capability to collect and analyze data necessary for effective energy planning and management. In order to correct this deficiency, a comprehensive system for providing energy

data on a continuous basis is required. The establishment of an Energy Department in the MPPT is a positive step toward providing such a system. However, if initial energy planning efforts are not well-focused and supported with adequate staff, budget, and technical assistance, they are unlikely to succeed, and the Energy Department may be abandoned altogether. This department is at a crucial stage of development at which technical assistance, as well as both long- and short-term training of Energy Department staff are urgently needed. Therefore, the following actions are recommend:

1. Technical assistance to the newly established Energy Planning Department of the Ministry of Power, Posts, and Telecommunications should be provided through the services of a long-term energy advisor. This individual should serve not only in an advisory/technical assistance capacity, but should also provide ongoing training for ministry staff in energy data collection and analysis techniques, project planning, and related areas. The World Bank has recently approved a technical assistance package as a part of its Energy Sector Management Assistance Program that will include the services of a two-year energy advisor, as well as short-term technical assistance (four months each) in statistics, woodfuels, energy efficiency, and petroleum to the Energy Department.[5] USAID and the World Bank should

collaborate on providing short-term technical assistance to the MPPT The mission should consider requesting that representatives of the UNDP/World Bank Energy Sector Assessment Program meet with the Africa Bureau (Technical Resources Office) and the project manager for the Energy Policy Development and Conservation (EPDAC) Project to discuss potential areas of collaboration.

Technical assistance is particularly needed in the areas of fuelwood resource inventory, energy efficiency and conservation, energy sector analysis, petroleum supply and demand forecasting, and electric power generation. A possible source of funding for such assistance is the EPDAC project described above. EPDAC sponsors both short- and long-term in-country services of energy planning specialists. EPDAC has provided short-term technical assistance to Liberia, Somalia, Sudan,and Haiti.

Under an Oak Ridge National Laboratory (ORNL)/AID agreement, experts from the ORNL staff, as well as a broad range of consultants and subcontractors, can be utilized to carry out short-term technical assistance activities. ORNL has strong capabilities

in such fields as electrical energy systems, conservation, biomass, energy information, and energy analysis and assessment. Its staff ranges from engineers to ecologists, social scientists, and information specialists.

Services of the US Bureau of Census (BUCEN) could also be obtained. BUCEN has had considerable experience in conducting energy sector assessments, household energy surveys, and data collection and analysis for national energy planing in developing countries.

The World Bank has recommended that the services of a statistics advisor be provided for a total of four months over the next two years. Should these services not be available in the near future, obtaining BUCEN services could provide an interim measure until a statistics advisor could be put in place. The MPPT Energy Department would probably benefit from a three to four-week visit by BUCEN specialists to lay out an initial training plan and training program for Energy Department staff in areas of data collection and analysis (such a survey methodology, statistical sampling, and energy sector

analysis techniques). Such a visit would entail identifying specific individuals to be trained, establishing training objectives and milestones, setting up timetables for implementing an on-the-job training to be coordinated with World Bank technical assistance.

2. Long-term training in energy planning and management should be provided to Department of Energy staff, as well as to staff in the MPED and the Bank of Uganda's Petroleum Desk who have responsibilities in the energy sector. A currently existing program which provides long-term training in the energy area is the Conventional Energy Training Program (CETP). This program is sponsored by USAID and administered by the Institute of International Education. Established in 1981, the CETP has provided training, ranging from a few months to up to two years in both academic and non-academic institutions to 200 energy professionals from developing countries. To date no Ugandans have elected to participate in this program. The CETP emphasizes training in areas such as the development and utilization of oil, gas, coal, electricity, and geothermal, as well as in energy conservation and management.

A 26-week course is planned for the 1986, which will focus on energy planning and management, including topics such as the use of computers, problem-solving methodology, introduction to energy technologies, biomass and fuelwood, and special energy planning issues. It is strongly recommended that one of the Energy Department staff participate in this course. Since two Department of Energy staff are currently away on long-term training, the absence of more than one staff member at this time might interfere with the ability of the Department to function effectively.

4. The World Bank and USAID should explore the possibility of initiating a series of collaborative, short-term seminars with Makerere University's Institute of Statistics and Applied Economics to train GOU ministry staff in statistical procedures relating to energy issues, such as survey methodology, energy supply/demand analysis, demand forecasting, etc. The mission should consider requesting that representatives of the UNDP/World Bank Energy Sector Assessment Program meet with the Africa Bureau Technical Resources Office and the project manager for EPDAC to discuss potential areas of collaboration.

Possible sources of assistance which might be considered for this endeavor are the Africa Bureau's Energy Initiatives for Africa Project, EPDAC, training funds from the Uganda mission or a combination of these sources. A number of U.S. institutions and organizations have had considerable experience in energy planning in African countries and in other LDCs, particularly in the areas of analyzing energy statistics, conducting national energy assessments and energy sector analyses, and could provide useful input into such seminars. These organizations include, but are not limited to, Oakridge National Laboratory, the US Bureau of Census, and Brookhaven National Laboratory, as well as private consultants such as Energy/Development International and the RAND Corporation.

According to the UNDP/World Bank (January 1985),, Makerere University conducts seminars on statistics for energy and environmental issues for government staff. Appendix F contains a series of topics are suggested for inclusion in the discussions.

Local training capability should be used as much as possible, including that of the Makerere University faculty. It is also suggested that host government

staff proficient in areas of data collection and analysis receive instruction in training techniques and serve as local trainers.

5. Microcomputers should be made available to ministries having responsibilities in the energy area, including the Ministry of Planning and Economic Development, the Energy Department of the Ministry of Power, Posts and Telecommunications, the Bank of Uganda Petroleum Desk, and the Ministry of Agriculture and Forestry. In addition, staff should receive training in the use of computers for energy planning and analysis. The UNDP/World Bank (January 1985) is planning, as part of its technical assistance, the purchase of an IBM personal computer and analytic software for use by the Energy Department. In addition, a plan to train staff in the use of computers has been formulated. The Bank should consider increasing the number of computers purchased and individuals trained to allow access to some of the other ministries who also have responsibilities in energy data collection and analysis. Ideally, the MPPT, Bank of Uganda--Petroleum Desk, MPED, and Ministry of Agriculture and Forestry should be provided with a microcomputer and the staff responsible for energy analysis should be trained in its use.

Notes to Chapter 5

[1]GNP (Gross National Product) is defined by American University (1982) as "GDP (Gross Domestic Product) plus the income received from abroad by residents, less payments remitted to abroad nonresidents." (p. 350) They define GDP as "The total value of goods and services produced within a country's borders during a fixed period, usually one year. [It is] obtained by adding the value contributed by each sector of the economy in the form of compensation of employees, profits, and depreciation (consumption of imputed rental value of owner-occupied dwellings." (p. 350)

[2]At the time field visits were made to Uganda, Obotoe was still in office. Since the coup, the USAID program has been temporarily suspended, and mission staff have been evacuated from Uganda.

[3]In 1983 the two windows had merged, and the unified rate was around USh350/$US (UNDP/World Bank, 1983, p. 1).

[4]According to American University (1982, p. 351), The International Monetary Fund (IMF), along with the Word Bank was established in 1945. It is "a specialized agency affiliated with the United Nations and is responsible for stabilizing international exchange rates and payments. The main business of the IMF is the provision of loans to is members (excluding industrialized and developing countries) when they experience balance of payment difficulties. The loans frequently carry conditions that require substantial internal economic adjustments by the recipients, most of whom are developing countries." (p. 350)

[5]A training program outlined in the Joint UNDP/World Bank Energy Sector Management Assistance "Program Activity Completion Report No. 029/85: Uganda Institutional Strengthening in the Energy Sector," January 1985, was approved.

CHAPTER 6

LIBERIA FINDINGS

General Characteristics

Liberia is a coastal West African country with an area of 112,000 kilometers, of which more than 50 percent is covered by natural forests. By the end of 1982, there were approximately 2.2 million people living in Liberia. By 1985 more than 37 percent were residing in urban areas (USAID, 1985).

Among the 16 major tribes, the most prevalent are the Kru, Kpelle, Mandingo, Gola, Loma, Bassa, Grebo, Vai, Mano, and Gio. Although some tribal customs have disappeared, many are still practiced. The primary religions are Christianity and Islam (U.S. Department of State, 1981).

More than 60 percent of the population are involved in subsistence farming (UNDP/World Bank, 1984), and agricultural activities employ almost 80 percent of the total work force. The main crops produced for domestic consumption are rice and cassava. Other products include eddoes (an edible tubular plant), yams, sugar cane, palm oil, greens, bananas, plantains, citrus fruits, pineapples, mangoes and papayas. Additional crops such as rubber, palm oil, cocas and coffee are exported. However, rubber production exceeds all other agricultural activity, with the Firestone Rubber Company, maintaining in

Liberia one of the world's largest rubber operations (UNDP/World Bank, December 1984).

Approximately seven percent of the population in Liberia is employed by industry. Another 14 percent is involved in the service sector, and about 14 percent of the Work force is unemployed, with joblessness reaching as high as 30 percent in urban areas (UNDP/World Bank, 1984).

Historical Background

Liberians take tremendous pride in the fact that Liberia is the oldest independent republic in Africa that has never been occupied by a foreign power since its founding (Kawi, 1977). A review of several historic accounts of Liberia's development (Wrubel, 1971; Beleky, 1973; Clapham, 1976; Carlson, 1977; Fulton, 1982; Boley, 1983; van der Kraaij, 1983; Carter, Ford, Handwerker et al., 1985) leads to the classification of Liberia's development into several distinct periods:

1. the early inhabitants
2. colonization - (1822-1938)
3. formation of the Commonwealth of Liberia (1838-1847)
4. early days of the Liberian Republic when the settler and native populations were largely segregated (1847-1984)
5. incorporation of the interior (1904-1944) which included the terms of President Arthur Barclay (1904-1912), President Howard (1912-1920), President King (1920-1930) and President Edwin Barclay (1930-1944)
6. the Tubman Era (1944-1971)

7. changes since 1971, including the reign of President Tolbert from 1971 until 1980, when Liberia's present Head of State Samuel Doe took over after a coup.

Early Inhabitants

Liberia's earliest inhabitants were pygmies or persons of small stature. These people are called "Jinna" by the Liberians (van der Kraaij, 1983). A second group of people reportedly from Western Sudan (called "Kumbas") ruled the area until the death of their leader, when the tribes splintered into six different groups. These were the Kpelle, the Loma, the Gbande, the Mende, and the Mano, all belonging to the same linguistic group (Karnga, 1926). The third group of people migrated to Liberia from the Ivory Coast. These included tribes such as the Kru, Bassa, Dei, Mamba and Grebo tribes (Karnga, 1926). The last group of tribes to migrate overland was the Mandingo-group, consisting of the Vai and Mandingo tribes (van der Kraaij, 1983).

During the fifteenth and sixteenth century, traders from France, England, Holland, Portugal and Spain conducted commerce with the region now known as Liberia, leaving a strong influence on the people of the area (Karnga, 1926).

Colonization/Commonwealth of Liberia

In 1821 a group of Black American freed slaves traveled to Liberia and Sierra Leone under the sponsorship of privately funded colonial societies (Wrubel, 1971). These settlers came from diverse backgrounds in the United States and West Indies, including people (called "Congos") released from slaving

vessels captured on the high seas by the U.S. Navy in the mid-1800's (van der Kraaij, 1983). They shared the dream of establishing an African state patterned after that of the U.S. government and founded on principles of democracy, education and Christianity. In short they sought to build a society similar to the one they had helped to perpetuate in the U.S., but to which they had been denied access (Carter, Ford, Handwerker, et al., 1984).

In 1838 the Commonwealth of Liberia was formed. It was comprised of eight settler towns and headed by Governor Thomas Buchanan, a white cousin of U.S. President James Buchanan.

Early Days of the Republic of Liberia

The Republic of Liberia was established by a Constitutional Convention convened in Monrovia in 1847. In the early days, the government functioned much like that of the U.S., with an Executive, Legislative, and Judicial Branch (van der Kraaij, 1983). A high premium was placed on formal education--a value that continues to permeate Liberian society today.

By the 1860's the government began to look toward the interior as a source of economic resources. However, during most of the nineteenth century, the intervention of the central government in the affairs of the interior inhabitants was primarily that of mediator in inter-tribal disputes (Carter, Ford, Handwerker, et al., 1984).

Incorporation of the Interior

During the Presidency of Arthur Barclay (1904-1912), an interior policy emerged that granted citizenship to Liberia's interior tribes. This was accomplished by co-opting traditional chiefs through both military force and negotiation. Participation was primarily in "name only," and the interior inhabitants had little input in the government's decision-making (van der Kraaij, 1983). This limited accountability led to the exploitation of the people of the interior.

Successive coastal administration built incrementally onto the Barclay Plan, and the executive branch became increasingly dominant in relation to the legislative and judicial branches. New rules were established by which the executive branch alone exercised powers over the other two branches--a clear violation of the 1847 Constitution. By the time of the Tubman Administration, the powers of the presidency were completely unchallenged (Carter, Ford, Handwerker, et al., 1984).

The Tubman Era

Unlike Edwin Barclay, who emphasized administrative efficiency and accountability, President Tubman focused on issues of national unification and foreign investment, relentlessly seeking the goal of consolidating government authority in the hinterland. In this pursuit, he reorganized the political system and expanded it to encompass the entire country.

Although Tubman utilized the military and the police to accomplish his objectives, he also relied on the development of a system of patronage in which appointments and gifts were used as rewards. He completely eradicated the notion of public accountability from the government sector. Tubman demanded respect and obedience in the same manner as a traditional chief. Respect was usually demonstrated by giving gifts to leaders or elders. For example, a new-employee might give half of his or her first month's salary to demonstrate gratitude to the employer. Respect was also demonstrated by performing services for the person in power (e.g., running errands, passing along rumors, attending to his personal business, and so forth) (Carter, Ford, Handwerker, et al., 1984).

According to Clapham (1976), Tubman recognized that continued economic stability depended not only on building a political power base but also on economic development. Consequently, an "open-door policy" of foreign trade was adopted in 1947.

Van der Kraaij (1983) maintains that Tubman's "open-door policy" consisted of accepting foreign loans, granting concessions to foreign capitalists, and opening the country to foreign trade. This author cites the following factors that had previously prohibited such a policy:

1. internal conflict in the settler community between mulattoes and blacks
2. conflict between settlers and the tribal populations

3. internal conflicts with European Powers and traders. (p. 12)

Upon the death of Tubman in 1971, after 28 years in the Executive office, President Tolbert became Head of State. He initially attempted to control official corruption, favoring formal qualification over age and experience. Tolbert fired many high-ranking officials and hired young professionals, creating rising expectations among young affiliates.

Although he publicly extolled the virtues of hard work and the importance of rewarding merit, Tolbert privately diverted substantial sums of money for his personal use. Unlike Tubman, however, Tolbert was unable to satisfy the ruling group and was intensely disliked.

In 1980 a group of officers in the Armed Forces of Liberia overthrew the government, and the country was placed under martial law. The Constitution was suspended and supreme legislative authority was vested in a 28-member People's Redemption Council (PRC), consisting mainly of noncommissioned officers (U.S. Department of State, 1981). Master Sergeant Samuel Doe became Head of State.

Economic Trends

A number of analysts (Bropheh, 1974; Kuhn, 1970; UNDP/World Bank, 1984) describe the Liberian economy in terms of three distinct sectors: (a) the modern sector, made up of urban dwellers; (b) the enclave sector, consisting of mining, forestry and rubber concessions; and (c) the traditional or rural sector, consisting of subsistence farmers.

During the period from 1960 until the mid-1970's, Liberia experienced high growth rates in the GDP, ranging from as high as six percent per annum in the 1960's to around four percent in mid-1970. These conditions were due mainly to flourishing iron ore and rubber industries (Liberia's primary source of foreign exchange) and favorable terms of trade (UNDP/World Bank, 1984). Industries, such as mining, forestry, and rubber, are run primarily by multinational corporations and account for over one-third of the GDP.

However, this period has been referred to as a period of "growth without development" in that the country's growth rate increased while the country remained largely undeveloped (Clower et al., 1966; Maynard, 1970; Kuhn, 1970; Mehmet, 1975; Bonaparte, 1979; and Fulton, 1982).

According to Fulton (1982), the "growth without development" thesis was originally set forth in a report by Northwest University and the Development Advisory Service of Harvard economic survey team in 1962 (Clower, et al., 1966) and was reiterated by a series of national evaluation teams organized by the International Labor Office (ILO) and the United Nations Development Program (UNDP). This intensely critical study provoked the ire of the Tubman administration, and its conclusions were largely rejected (Mehmet, 1975).

Tipoteh, in a 1974 publication, maintained that the lack of development in the presence of growth could be traced to the early emergence of a Western system of government and national

decision-making, dominated by the decendants of a repatriated group. He pointed out that the national education policy was designed to perpetuate a Western system in Liberia that precluded most Liberians from attaining the type of education that would allow their participation in national decision-making.

Miller and Carter (1972) attribute the country's "growth without development" to the Tubman's open-door policy which deprived Liberia of a national currency, gave control of the commercial sector to the Lebanese and drained the country of its capital.

Dalton and Walters (1969); Miller and Carter (1972); and Bropleh (1974) contend that the results of "growth without development" has been the development of a "classic dual enclave economy." The UNDP/World Bank (1984) describe the dual nature of the economy in terms of the sharp contrast between the enclave and traditional and modern sectors. They maintain that linkages between these sectors are extremely weak and the benefits of these industries are enjoyed by only a small proportion of the population. As evidence, they cite that estimated per capita GNP for Liberia in 1981 was US $520, as compared to US $1,620 for the enclave sector and US $780 for the entire modern sector.

Metcalf (1974) suggested that the enclave sector lacked the ability to generate a substantial multiplier effect. While importing capital equipment and labor to

extract raw materials, Liberia's concessions had little impact on the general population. This resulted in a large gap between rural and urban population and did little to ease unemployment problems. In the mid-1970's Liberia's growth came to a standstill, and with increases in oil prices, demand for Liberia's products declined dramatically. Worldwide adverse economic conditions, coupled with inefficient management practices in both the public and private sector, led to significant decreases in the GDP in Liberia UNDP/World Bank, 1984).

Between 1974 and 1979, GDP fell to an average of one percent per annum. In the period from 1979 to 1983, GDP in the modern (urban) sector declined by an average of 6 percent per annum in rea. terms. In 1983 the national modern sector output was $73 million, roughly 30 percent below 1979 level. (National Energy Committee, 1985). Terms of trade also began to deteriorate, dropping 24.5 percent from 1978 to 1982 (UNDP/World Bank, 1984).

Despite hopes of economic recovery sparked in 1978 and 1979 by short-lived increases in the price of iron-ore, rubber, and timber, external debt continued to rise and balance of payment problems were exacerbated (UNDP/World Bank, 1984).

The National Energy Committee (1985) asserts that "preliminary indications are that the economy continued

to decline for 1984 as a whole and that the trend has continued though mid-1985, with little prospect for recovery in the near term" (p. B-1). The economy during the period 1984-1985 has suffered from a rapidly evolving political situation, marked by a high level of uncertainty. This uncertainty has had dramatic impacts on the business climate, diminishing prospects for economic recovery (Barron, October 1985).

> According to Berg (1982), these difficulties can be attributed to many sources, including: a shortage of trained people and an under-developed system of administration; specialization in slow-growing exports; a rigid monetary system, heavy debt obligations due to recent borrowing on commercial terms and high interest rates; high oil prices, massive political dislocations; unparalleled budget and foreign exchange stresses. (p. i)

He identifies three principal economic factors: (a) a crisis in public-sector foreign exchange; (b) an intractable budget deficit; and (c) a stagnant economy.

The National Energy Committee (1985) also emphasizes the critical role of the oil situation in Liberia in the country's economy. They maintain that although Liberia's oil bills have declined somewhat in recent years, energy problems have grown over the same period. Liberia's energy problems and their impact on the country's economy are described in the discussion which follows.

Energy Sector

The cost of imported oil (both in dollar terms and as a percentage of total imports) reached an all-time high in 1980, when 28 percent of all import expenditures ($52 million) was for imported oil. Liberia officials were disappointed to discover, however, that declines in oil prices in the years that followed did not result in significant improvements in economic conditions (NEC, 1985).

According to the National Energy Committee, economic growth is largely determined by the performance of the modern sector. At the same time, growth in the modern sector is influenced both by cost and availability of imported oil. A country's ability to purchase imported oil is usually contingent upon its ability to export. Consequently, high oil costs and unreliable supplies undercut the ability of Liberia export industries to be competitive.

This has had severe consequences on Liberia's balance of payments. The UNDP/World Bank (1984) states:

> Not only is the impact of oil imports on the balance of payments every bit as severe in Liberia as in many other African economies, but because the foreign exchange for the procurement of petroleum products had to come from the public sector, the impact of oil procurement on Government fiscal external balance of payments was disastrous. Indeed, financing petroleum imports, together with debt service, have been the most important elements of the Government's external debt problems. (p. 2)

These analysts purport that the financing of petroleum product imports exists on a "shipment-by-shipment basis,"

thereby creating tremendous problems relating to the reliability of liquid fuel supplies. Unreliable petroleum supplies, in turn, have a large impact on the electricity supply, since most electricity in Liberia is generated with petroleum products (Barron, November 1985). Petroleum-driven electrical generation is estimated to be unreliable about 5 out of 12 months each year, with prolonged periods of load shedding (8 to 15 hours per day) occurring throughout the dry season.

Overview of Energy Supply and Consumption

Energy balance tables for Liberia for 1982 (National Energy Committee, 1984) are presented in Appendix H. Figures from the 1983 balance are cited in the discussion below. The gross supply of energy to the economy is estimated at 1.3 million TOE and final consumption after conversion losses at 0.9 million TOE. Biomass fuels (including charcoal) make up 69 percent of final consumption, electricity (both thermal and hydro) accounts for eight percent of the total, while petroleum comprises 23 percent. Table 6.1 depicts end use by sector.

As illustrated in Table 6.1, the largest energy consumer is the residential sector (69.7 percent), followed by transport (16.1 percent), while mining uses 10.7 percent. Commercial/government use 1.8 percent, and industry and agriculture consumes less than one percent.

Within individual sectors, 9 percent of residential end use is comprised of fuelwood (90 percent) and charcoal (8

percent) while commercial/government sector consumes 75 percent electricity and 25 percent petroleum. Energy consumption for mining is 56 percent electricity and 44 percent petroleum.

TABLE 6.1.

Final Energy Consumption in Liberia
(000 TOE)

	Fuel-wood	Char-coal	Elec-tricity	Petro-leum	Total	Share
Mining	--	--	53.1	44.8	95.3	10.7
Other Industry	4.4	--	2.8	1.6	8.8	0.9
Transport	--	--	--	147.6	147.6	16.1
Agriculture	--	--	1.9	5.7	7.6	0.8
Households (Residential)	556.2	69.5	9.0	4.5	639.2	69.7
Commerce/Govt			12.0	4.2	16.2	1.8
TOTAL	560.6	69.5	78.8	208.4	917.3	
Share	61.1	7.6	8.6	22.7		100.0

Source: "Liberia: Issues and Options in the Energy Sector, Annex 1," UNDP/World Bank, December 1984, p. 5.

Petroleum

Industrial end use is 50 percent fuelwood, 32 percent electricity, and 18 percent petroleum (UNDP/World Bank, 1984).

Until 1982, most of Liberia's petroleum came from crude oil processed at the government-owned Liberia Petroleum Refining Company (LPRC) in Monrovia. In December of that year, the refinery was closed, after which 90 percent of the country's petroleum was imported through LPRC's terminal and

distribution facilities at the port of Monrovia. The remainder was imported directly by two mining companies--LAMCO and the Bong Mining Company. By 1983 all Liberian petroleum products were purchased and imported from the "spot market". This situation has frequently resulted in shortages and interruptions in the power supply (UNDP/World Bank, 1984).

Woodfuels

More than 80 percent of Liberia's land area is covered with forests. Although outward appearances give the impression that Liberia's wood resources are more than adequate, the pressure of woodfuel demand is being felt in urban areas in and around Monrovia. Many urban dwellers now rely on charcoal for fuel and demand is growing rapidly. By 1998, it is expected that the demand for fuelwood will increase by one third (UNDP/World Bank, 1984).

Electricity

Liberia's electricity is generated under the authority of the Liberian Electricity Corporation (LEC), a statutory corporation in which the Government of Liberia is the sole shareholder. It is estimated that approximately 150,000 people (8 percent of the population) are served by LEC public power. This represents about 38 percent of the population residing within supply areas. Average per capita consumption in 1983 was 148 kWh. Almost half of the total installed generating capacity (including 94 percent of the hydropower capacity) resides with the LEC. The mining sector has 43 percent of

installed capacity; other major institutions, 4 percent; and the rural power grid, 4 percent of the total. Generating capacity is provided chiefly (82 percent) by oil-fired, oil-speed diesel engines. The remainder of generating capacity is hydropower (UNDP/World Bank, 1984).

Power supplied to Monrovia declined at a rate of nearly two percent per annum between 1980 and 1984. During this period, losses have averaged about 35 percent of generation, of which 20 percent was due to unbilled consumption (through illegal hook-ups) and 15 percent was the result of technical losses. LEC received payment for less than half of the electricity generated (UNDP/World Bank, 1984).

Current Governmental Organization

The People's Redemption Chairman (PRC), President Samuel Doe, serves as Liberia's Head of State, and the Co-Chairman serves as Vice-Head of State. The structure and responsibilities of the government ministries which existed prior to the current administration remains largely unchanged. A 19-member cabinet, which includes both military and civilian ministries, advises the Head of State (U.S. Department of State, 1981). These are depicted in Table 6.2. Additionally, there are 22 autonomous agencies with direct access to the Head of State. These are shown on Table 6.3.

The former Supreme Court was dissolved by the current administration and replaced by a Supreme Military Tribunal, and the unit of habeas corpus was discontinued. A system of

civilian lower courts with jurisdiction comparable to the previous system was initiated (U.S. Department of State, 1981).

TABLE 6.2.

LIBERIAN CABINET AGENCIES

Ministry of Agriculture
Ministry of Commerce, Industry and Transportation
Ministry of Finance
Ministry of Foreign Affairs
Ministry of Health and Social Welfare
Ministry of Information
Ministry of Internal Affairs
Ministry of Justice
Ministry of Labor
Ministry of Lands, Mines and Energy
Ministry of National Defense
Ministry of National Security
Ministry of Planning and Economic Affairs
Ministry of Posts and Telecommunications
Ministry of Public Works
Ministry of Rural Development
Ministry of State for Presidential Affairs
Ministry of Youth and Sports

Source: "Social Institutional Management Practices and Prospects: A Study of Liberian Agricultural Sector" by Jeanette Carter, Marten Ford, Penn Handwerker, et al., Institute for Development Anthropology, Berghamton, New York, August 1984.

TABLE 6.3

LIBERIAN AUTONOMOUS AGENCIES WITH DIRECT ACCESS TO THE HEAD OF STATE

Booker Washington Institute
Bureau of Immigration and Naturalization
Bureau of Budget
Centre for Documentation and Records
Civil Service Agency
Constitutional Advisory Assembly
Culture and Tourism
Economic Financial Management Committee

TABLE 6.3 (cont'd)

Highway Project
General Services Agency
Joint Security Committee
Liberian Institute of Public Administration
Monrovia City Corporation
National Archives
National Bank of Liberia
National Investment Commission
National Police Force
National Security Agency
Planning Council
Redemption Day Committee
Special Elections Commission

Source: "Social Institutional Management Practices and Prospects: A Study of Liberian Agricultural Sector" by Jeanette Carter, Marten Ford, Penn Handwerker, et al., Institute for Development Anthropology, Berghamton, New York, August 1984.

Liberia is divided into nine counties, which are further partitioned into districts and townships. Governmental power is centralized, with county superintendents and district commissioners appointed by the Head of State. These political divisions are administered by paramount, clan and town chiefs. The central government is responsible for administering public schools, hospitals, roads and police (U.S. Department of State, 1981).

Institutional Issues

A USAID/Ministry of Agriculture, Republic of Liberia funded study of government institutions in Liberia was conducted to identify problems which inhibit effective service delivery in Liberia (Carter, Ford, Handwerker, et al., 1984). The sponsors of this research requested an analysis of

management practices both within the Ministry and within parastatal organizations, concessions, and among private commercial farmers. Although the main focus of this study was agricultural institutions, a considerable amount of data were collected on other institutions in the public sector as well.

In addition to 200 farmers, over 100 managers and 162 Ministry employees were interviewed. Despite the agricultural emphasis on this study, the findings have broader implications for governmental institutions in a variety of sectors in Liberia.

The most prevalent finding was that Liberia's public sector institutions are characterized by a "patron-client" system in which managers at each level are accountable to leaders at the top, who are themselves bound by no system of accountability. This is an extension of the system originally begun as early as the Arthur Barclay administration (1904-1912) and solidified by William Tubman (1944-1971).

Carter, Ford Handwerker, et al. (1984) liken Liberia's governmental operations to those of the U.S. political boss, the late Chicago Major Daly, or to that of politicians in turn-of-the-century New York City. These authors attribute to Liberia's public sector institutions the following characteristics:

1. Authority is vested with the powerful patron (President), and influence is held by those closest to the source of patronage. Even though decisions are attributed to the appropriate institutions, it is widely

recognized that an informal decision structure is the "true" source of authority.

2. Policy and decision-making are generally made in an ad hoc, highly personalized way. Although arguments, and sometimes data, are presented on both sides of an issue, it is usually the status and personality of the patron that ultimately decides the issue.

3. Management systems in the principal staff agencies (e.g., budgeting, finance, procurement, and personnel are usually intentionally ad hoc. The system is based on personal allocation and extraction. The release of information about public spending is viewed as a dangerous practice.

4. Personnel appointments are frequently based on personal relationships rather than on competence or qualification. This leads to overstaffing, since it is rarely possible to terminate such employees unless they violate the trust of the patron.

5. This system is not totally devoid administrative responsibility but rather generates a type of reciprocal accountability is accountable to the source of his or her position, and the patron is accountable to clients in order to avoid factionalization which might lead to his or her demise. (p. 12)

Overview of Liberian Energy Institutions

Six Liberian energy institutions were visited and members of their staff were interviewed during a ten-day period in November 1984. Efforts were made to interview those having primary responsibility for data collection and analysis in ministries and agencies that play a major role in this area. It was not possible, however, during the limited time in Liberia to conduct a review of all institutions that interact with the energy sector. Members of the staff of each of the

agencies listed below were queried about energy planning activities, as well as about staff training and backgrounds and data-collection problems frequently encountered. Agencies visited included:

National Energy Committee (NEC)

Ministry of Lands, Mines and Energy (MLME)

Ministry of Planning and Economic Affairs (MPEA)

Forestry Development Authority (FDA)

Liberia Electricity Corporation (LEC)

Liberia Petroleum Refining Company (LPRC)

A USAID-funded energy planning project, conducted in conjunction with the National Energy Committee of the Government of Liberia (GOL) played a significant role in energy planning activities in Liberia. The findings of this chapter were based on the results of interviews with ministry and energy project staff, as well on written information providedby individuals interviewed. A complete list of individuals who were interviewed can be found in Appendix G.

National Energy Committee (NEC)

The NEC was established by the Government of Liberia in 1980 in order "to assess and evaluate Liberia's energy needs and its available energy resources, as well as to develop a national energy policy and coordinate its implementation." (Neufville and Barron, 1983, p. 3) According to National Energy Committee Assessment team members, prior to the coup

which occurred in 1980, the NEC was an ad hoc committee with no formal functions that operated only in times of energy crisis. After the new government came into being, a new committee was established with specific objectives, drawing membership from institutions having responsibilities related to energy matters. The NEC is now an inter-agency body, represented by six government ministries and three government-owned corporations. These include:

Ministries

Ministry of Lands, Mines and Energy (MLME)--Chairman
Ministry of Planning and Economic Affairs (MPEA)
Ministry of Commerce, Industry and Transportation
Ministry of Rural Development
Ministry of Agriculture
Ministry of Internal Affairs

Government Corporations and Authorities

Liberia Electricity Corporation (LEC)
Liberia Petroleum Refining Company (LPRC)
Forestry Development Authority (FDA)

In addition, Dr. A. E. Nyemah Jones was appointed to represent the Liberian Mining Sector, and Dr. Miedi-Himie Neufville was designated as head of NEC's Secretariat. The Ministry of Finance acts as an affiliated member of the NEC (Neufville and Barron, February 1983).

The Chairman and members of the NEC each designate a permanent proxy. Each proxy has full voting rights and is

responsible for energy matters in their respective organizations.These representatives make up a Technical Subcommittee, which also includes representatives from the University of Liberia and Cuttington University College. The NEC has no formal powers, but rather serves in an advisory capacity. Specifically, the functions of the NEC are:

1. to provide immediate and future policies and strategies for national energy supplies
2. to compile and analyze information on energy sources, distribution, availability and utilization for the development of energy policies
3. to provide regulations for energy resource development
4. to review and propose price and market structure guidelines for the energy sector
5. to propose measures for energy conservation and for the development of new energy supplies
6. to advise the government on all matters relating to energy (Neufville and Barron, February 1983; Barron and Neufville, November 1983).

Government of Liberia (GOL) organizational structure requires that all budget requests be submitted to the Ministry of Planning and Economic Affairs (MPEA) for review. Upon MPEA approval, actual disbursement of money is carried out by the Ministry of Finance.

Ministry of Lands, Energy and Mines (MLEM)

Duties/Staff Composition

The MLEM is comprised of two divisions--the Department of Energy and the Bureau of Hydrocarbons. Initially the Bureau of Hydrocarbons served as the Secretary for the National

Energy Committee. Because of the ad hoc fashion in which the NEC operated, the Government of Liberia, in 1983, created a separate entity, the Department of Energy (DOE) to coordinate all Liberian energy projects.

Bureau of Hydrocarbons. The Bureau of Hydrocarbons is responsible for compilation and analysis of hydrocarbon exploration data, including evaluation of hydrocarbon potential and monitoring oil company (AMOCO) activities. This bureau is comprised of six professionals, including two Petroleum Geologists who have Master's degrees, one Geophysicist with a Bachelor's degree, and three Geologists with Bachelor's degrees. Most of these individuals have had limited experience in conducting statistical analyses, either as a part of university coursework, or on the job.

Department of Energy (DOE). The Department of Energy serves as a coordinating agency for all energy projects in Liberia, and the head of this department presides over the Secretariat of the National Energy Committee. The DOE employs approximately 23 people, of which 11 are professionals. Most of the professional staff hold Bachelor of Science Degrees in areas such as geology, physics, chemistry, and economics and wererecruited directly from the University of Liberia. Some of the professional staff are engineers from the Bureau of Hydrocarbons who were originally involved in a training program in petroleum surveying and production. However, since manpower demands in those areas did not match the number of trained

staff, several staff members shifted to the DOE. Many of the technical staff are undergraduate university students.

An lytic Equipment

Until recently, the MLEM had access to only one microcomputer, provided by the World Bank. At the time of the survey, it was temporarily out of order. A second microcomputer has now been acquired through Oak Ridge National Laboratory. Both computers will be programmed using Basic and Fortran programs. At the time interviews were conducted, five professional staff and one secretary had been trained at the introductory level in the use of microcomputers. The computer firm from whom the new microcomputers was purchased will provide maintenance and training; two staff will be trained every four to six months.

Energy Planning Activities

Employees of the MLEM have been heavily involved in data collection and analysis activities conducted as a part of the GOL/USAID Energy Project. Prominent among these efforts were the National Energy Assessment and background studies, specific energy sector analyses, such as a residential energy use survey, and the "Integrated National Energy Program." The financial problems facing the Government of Liberia have had a negative effect on staff, training and transportation, frequently hampering the ability of MLEM staff to collect and analyze data.

In conducting the Residential Energy Survey, researchers often found it difficult to obtain the information they were seeking. Respondents frequently misunderstood the nature of the questions being asked or did not know how to answer the questions. According to MLEM staff, many respondents may have been afraid to answer questions accurately because they suspected that interviewers were representatives of the Liberia Electricity Corporation, attempting to entrap them into revealing information that would lead to the discovery of irregularities in their electricity meters or of illegal connections to the power grid. Some of the data-collection problems were associated with the inexperience of the individuals involved in designing the questionnaire and with inadequately trained interviewers.

Training Needs

The "Integrated National Energy Program" (NEC, 1985) recommended enhancing GOL energy planning staff capabilities by providing higher education, short courses, and on-the-job training. MLEM staff members who were interviewed described the need for additional training in areas of data collection and analysis (particularly in survey methods), statistical sampling and questionnaire construction. In addition, MLEM staff and other members of the NEC Technical Subcommittees who participate in energy research and planning activities expressed a need for at least five or six months of training in the use of microcomputers. Other areas of training deemed

useful by some MLEM staff included training in analysis of coal data and in the use of renewable energy technologies.

Ministry of Planning and Economic Affairs (MPEA)

The Ministry of Planning and Economic Affairs was established in 1966 to replace the National Planning Ministry.

Duties

The MPEA is responsible for the following activities:

1. coordinating economic and statistical data in the public and private sector
2. conducting the national population census (every ten years)
3. promoting economic and technical relationships with multilateral and bilateral donors
4. monitoring and evaluating development projects and preparing and controlling development budgets.[1]

Staff Composition

The MPEA is comprised of 450 employees, of whom 60 percent work in the statistics division. Less than one percent (four or five employees) are involved in the energy area (chiefly with petroleum import data). Prior to the closing of the University of Liberia,[2] on-the-job training in statistics was being provided to MPEA employees through a collaborative program with the university, and almost all MPEA staff involved in data collection and analysis participated in some training. Although a few of MPEA staff have Bachelor's degrees, most have no formal degree. One Senior Planning Officer who works with energy data has a Master's Degree in Economics. A small

number of MPEA staff attended the Makevere University in Uganda.

The Ministry has experienced considerable difficulty in recruiting and keeping employees with university degrees. This Ministry, like most government organizations in Liberia, suffers from a high turnover rate and, consequently, a lack of continuity in planning efforts.

Analytic Equipment

In the past the MPEA rented an IBM computer, but when the cost became prohibitive, the Ministry decided to purchase a WANG computer, rather than to renew the rental agreement with IBM. This decision resulted in a number of difficulties and misunderstandings. IBM maintained that the computer was damaged and that MPEA should be held responsible; MPEA staffcharged IBM with manufacturing problems, claiming that IBM's action was in retaliation for the Ministry's termination of the rental agreement.

Problems were compounded when the delivery of the WANG computer was delayed, and upon its arrival, none of the staff were trained in its use. Further misunderstandings ensued as a result of confusion about the terms of the purchase agreement. The Ministry had understood that training was included in the price of the purchase. However, WANG representatives contended that training would only be provided at an additional cost to the Ministry. After a delay of six months, 15 to 20 ministry

staff who had worked with the IBM computer were finally trained at an additional cost. At the time this survey was conducted, the number of staff trained in computer use exceeded the workstation capacity, and the printer was out of service.

Energy Planning Activities

MPEA staff have been involved in several energy planning activities, including an analysis of energy issues contained in the Liberia Development Plan, and participation, along with the World Bank and the NEC, in a study on the viability of continuing the Liberia petroleum refinery operation.

Training Needs

MPEA staff maintain that, although additional training in data collection and analysis is needed, any program that is initiated must focus on training that will "improve the Ministry's effectiveness and efficiency." A frequent problemassociated with staff training programs has been the tendency for recipients to leave the agency once training is completed. MPEA staff suggested that this problem could be minimized if agencies that use energy statistics identify the candidates for training. Furthermore, training programs that are designed and developed locally are considered more useful than expatriate-designed programs. According to MPEA staff, an effective approach might be to train overseas one or two staff members, who could then return and manage a local training program.

Forestry Development Authority (FDA)

The Forestry Development Authority was established in 1976 by an act of the Senate and House of Representatives of the Government of Liberia. This agency was formerly the Ministry of Wildlife (Agriculture Division). The total 1984-85 operating budget for the FDA was $5,763,771. The present agency is comprised of five major divisions, including: (a) Administration, (b) Technical Service (Forest) Management; (c) Planning Research Statistics; (d) Technical Service Utilization; and (e) Financial Management.[3]

Duties

The principal function of the FDA is to monitor and control all forestry activities in the country. The major objectives of this authority, as designated in the Legislative Act (GOL, 1976) are, in summary, to:

1. establish and protect a permanent forest estate while bringing about the profitable harvesting of all forest products
2. devote all publicly owned forest lands to their most productive use for the permanent good of the whole people
3. conduct essential research in conservation of forests
4. give training in the practice of forestry
5. conserve recreational and wildlife resources concurrently with the development of forestry programs.

According to FDA staff, the agency has undergone several changes since its original mandate. When the FDA was first

created, a heavy emphasis was placed on forest exploitation. Recently, however, the agency's attention is more focused on reforestation. Secondly, because of the energy crisis facing Liberia, the agency is examining ways of producing alternative energy from biomass and is considering the feasibility of developing fuelwood plantations for biomass production. These additional areas of interest have caused some shift in staff responsibilities.

Staff Composition

A total of 599 people are employed by the FDA. Of those, three participate in data collection and analysis. The educational backgrounds and job titles of these individuals are shown on Table 6.4, and staff training in data collection and analysis are depicted in Table 6.5.

Analytic Equipment

Agency staff do not have access to either microcomputers or mainframe computers. One programmable calculator is available for staff use.

Planning Activities

The FDA has been involved in several data collection activities, such as gathering information on rubber-tree resources and, more recently, mapping forestry reserves. The latter exercise involved analysis of over 170,000 aerial photographs taken by flying over quadrants of three sections of the country. Deforestation rates were estimated by comparing photographs taken in 1953, 1969, 1979, and 1983. The World

Bank proposed a more extensive inventory, encompassing a 50-mile radius around Monrovia.

Data collection and analysis problems cited by FDA staff who have been involved in the activities described above included the lack of financial and logistical support, the absence of reliable base maps and lack of sufficient manpower to properly carry out the studies. Base maps were made from an old copy which was almost illegible, making it difficult for surveyors to plot their courses.

TABLE 6.4.

FORESTRY DEVELOPMENT AUTHORITY
STAFF INVOLVED IN DATA COLLECTION AND ANALYSIS

Type of Degree	Level of Degree	Job Title	Number of Staff
Forestry	Bachelor's	Planner	1
Wood Products Engineer	Bachelor's	Head--Woodbased Industries	1
Agricultural Economics	Master's	Head--Documentation Section	1

TABLE 6.5.

FORESTRY DEVELOPMENT AUTHORITY
STAFF TRAINED IN ENERGY DATA COLLECTION AND ANALYSIS

Organization/ Institution Providing Training	Duration of Training	Number of Staff Trained
USAID - USA	4 months	1
USAID - Brazil	3 months	1
USAID - Sweden	1 month	1

Studies conducted by other consultants or agencies that are frequently used by the FDA include a study of energy production from wood and wood waste in Liberia by the GTZ, (the German development assistance agency), Forestry Mission, in conjunction with the FDA; and the National Energy Assessment, conducted by the National Energy Committee and Oak Ridge National Laboratory.

Training Needs

FDA staff contended that both on-the-job and overseas training is needed in energy sector assessment methodology. However, they pointed out that when trainers are brought in, staff members do not usually receive certificates to verify their participation in the program, while overseas training is almost always accompanied by certification. Possession of training certificates affords prestige to the recipient and is often an important factor in decisions about promotions.

Institutions that FDA staff considered to be capable of providing training relevant to the needs of the agency were the Royal Training Institute, United Kingdom; University of Florida, USA; ITC, Holland; University of Ibadan, Nigeria; the World Bank; USAID; and the German Forestry Mission of the GTZ.

Liberia Electricity Corporation (LEC)

The LEC is a statuary corporation, under which the Government of Liberia is the sole shareholder, authorized to generate, transmit, and sell electricity to Liberia. The corporation was established by the Liberian legislature in 1973 as a subsidiary of the Public Utilities Authority but became autonomous when the authority was dissolved in February 1976. According to the UNDP/World Bank (1984), no legislation exists under which the purpose, functions, rights, and service standards of the LEC are mandated. They point out that "the absence of a clear right under law for the LEC to [penalise] for misappropriation of its goods and services has proven to be a significant deficiency" (UNDP/World Bank, 1984, p. 31).

Duties/Staff Composition

According to LEC staff, the duties and obligations of the LEC, as well as its policies and objectives are set by a Board of Directors, headed by a President (who appoints a General Manager to run day-to-day operations). The General Manager is assisted by a number of managing directors in areas of administration, operations, and finance. Two department

heads report directly to the General Manager: the Director of the Corporate Planning and Development Department and the Managing Director of Rural Electrification.

Even though there is presently no legal mandate governing the LEC, when LEC staff were asked to describe the corporation's formal duties and responsibilities, they referred to the 1973 Legislative Act.

In general, the LEC is responsible for providing public electricity supply throughout Liberia. However, the majority of its staff and resources are allocated to the Monrovia Power System. Nine small isolated power systems are operated by the government by the Rural Electrification Department, which is loosely affiliated with the LEC (see discussion below). Additionally, there is significant self-contained generation capacity maintained either as a back-up or as a main power source by many industries and businesses. Further, LEC has a power exchange agreement with the Bong Mining Company (UNDP/World Bank, 1984).

The LEC's operating budget is derived from two sources. Tariffs collected from electricity users are the chief source of revenue.[4] In addition, an annual budget is allocated by the GOL to make up the deficit remaining after tariffs have been collected. It is estimated by LEC staff that less than two percent of the LEC's budget is spent on data collection and analysis. Described below are various departments of the electricity corporation which play a major role in energy-planning activities.

Rural Electrification Department. As the name implies, this department is responsible for electric power generation in rural areas of Liberia. The head of the Rural Electrification Department reports directly to the General Manager. However, this department operates in a semi-autonomous fashion. Its budget is supplied directly by the GOL, and its staff are government employees.

Even though some LEC staff consider analysis of rural electric consumption to be an important function that should be performed by the rural electrification office, few records are kept, and virtually no data collection and analysis is conducted. Consequently, no fuel consumption or operational information is available for most of the rural areas. One factor contributing to this deficiency is the fact that many residents are illegally hooked up to the electric power grid, and many others deliberately break their meters so that their electric use cannot be accurately measured.

Corporate Planning and Development Department. The Corporate Planning and Development Department reports directly to the General Manager and provides basic information for decision-making. The predecessor to this department was the Technical Services (Planning and Engineering Services) Division, and its orientation was primarily engineering. The department now has responsibility for investment and manpower

planning, as well. Presently the Corporate Planning and Development Department is comprised of the following sections:

1. Block Mapping--conducts house to house meter reading

2. Research and Systems Studies Engineers--conducts research to ensure that correct equipment is utilized

3. Manpower Planning and Financial Studies--oversees manpower planning, as well as overall financial aspects of the LEC, including the development of the budget

4. Project Design and Feasibility--conducts feasibility studies and designs projects.

There are presently 17 professional staff employed by the Corporate Planning and Development Department. All 17 are college graduates from local or U.S. universities, and all participate in some type of data collection and analysis. Table 6.6 summarizes the academic training of the Corporate Planning and Development Department staff. Most of these individuals have had little or no previous job experience before coming to the LEC.

This department is currently being reorganized, and a staff cut of five or six positions has been proposed, along with the creation of two "Generation Analyst" positions which would be filled by existing staff. (This reorganization is described in greater detail in the discussion of LEC energy-planning activities.)

TABLE 6.6.

LEC CORPORATE PLANNING AND DEVELOPMENT DEPARTMENT STAFF EDUCATION

Level of Degree	Type of Degree	Number of Staff
Bachelor's	Engineering	2
Bachelor's	Statistics	1
Bachelor's	Economics/Finance	5
Bachelor's	Manpower Planning	7
Master's	Economics	2
	Total	17

Commercial Department. The Commercial Department is responsible for collecting data on electricity consumption and consists of 250 employees. Approximately five to eight people in this division do analyses. Most of the individuals involved in data analysis have Bachelor's degrees from the University of Liberia or from overseas institutions.

Generation Department. The Generation Department is responsible for overseeing the daily operations of electric power generation. In the past, little analysis has been conducted by this department. However, limited information about generation performance has regularly been collected and summarized in monthly reports by the Generation Department Statistician. For example, data on each engine are recorded, including electrical output, peak load, running hours, and fuel consumption (Barron, Botrol, et al., 1984).

General Services Department. This department is responsible for transport and maintenance, as well as for substations. One staff member, who has a Bachelor's degree in mathematics collects and analyzes statistics on gasoline consumption, as well as on the use of spare parts and incidences of repairs.

Analytic Equipment

A mainframe WANG computer with 256k of memory is used by the Commercial Department for billing, accounting, and payroll purposes. In addition, the Corporate Planning and Development Department uses an Apple II microcomputer, with 64k memory forconducting analyses. Three people are trained to use the microcomputer.

Energy-Planning Activities

Although various members of the LEC staff have, at times, conducted in-house analyses, as well as participated in studies led by outside consultants, there is presently no systematic method of collecting and disseminating information for decision-making in the LEC. Data sources are scattered among the various departments of the LEC and are rarely utilized for policy and planning purposes. Data collected by outside consultants are not systematically updated. Furthermore, LEC staff contend that consultants' figures are sometimes inaccurate--especially those in feasibility or pre-feasibility studies produced by engineering firms, where figures are usually skewed in a direction that supports the need for a project requiring the firm's services.

Based on past experiences, LEC planning staff determined that it soon would be necessary to make decisions regarding improvements in thermal-generating capacity and long-term expansion of the hydroelectric supply. In order to effectively analyze options and arrive the most cost-effective solution, it was determined that the LEC needed to establish "an in-house capability to track the operating costs and performance of its existing generating plants, to evaluate the consequences of actual versus desired maintenance programs and to carry out financial evaluations of options for investments in new capitalstock or modifications to the existing generating plants" (Barron, Botros, et al., 1984, p. 3).

It was felt that past practices of relying exclusively on expatriate and ad hoc studies as the basis for decisions were no longer acceptable. Although it was recognized that the need for such studies would continue, it was considered extremely important that the LEC utilize its in-house capability to carefully examine the methods and assumptions employed by outside consultants and to evaluate conclusions in light of existing realities in Liberia.

Thus, in response to a request from the Liberia Electricity Corporation and the National Energy Committee, the Resident Energy Advisor to the NEC and five staff members from the Corporate Planning Project investigated approaches to

strengthening LEC's internal planning capability. This study involved several steps:

1. reviewing the existing data collection system for information on electrical generation, including such inputs as fuel, spare parts and labor, as well as data on the mechanical performance of the generation equipment

2. determining data collection methodology

3. evaluating data accuracy

4. identifying the types of analyses which would be most useful to LEC management in its decisions regarding investments in its generation plants (Barron, Botros, et al., 1984).

The research team found that virtually all of the data needed for conducting performance evaluations were already being collected in the various departments of the LEC but werenot being systematically distributed. Therefore, it was concluded that data needs could be met without increasing staff but rather by redefining existing job descriptions. Based on this assumption, it was recommended that two "Generation Analyst" positions be created and filled by current personnel within the Corporate Planning and Development Department to analyze generation costs and conduct comparisons of alternative investments in generating capacity.

It was further suggested that one of the positions be filled by an engineer and the other by a person with extensive experience in financial analysis. The positions would also include the duties performed by the Mechanical Engineer in the Project Design and Feasibility Section and those of the

Financial Analyst in Manpower Planning and Financial Studies within the Corporate Planning and Development Department.

Job responsibilities would entail collecting and analyzing data on a regular basis and providing periodic reports to top LEC management on the financial aspects of electrical generation. The Generation Analysts would also work closely with other LEC analysts such as economists, manpower planners, and procurement specialists, as well as with experts outside the LEC in conducting pre-feasibility or feasibility studies of generation investment options. In addition, it was proposed that the analysts be included in the existing data distribution system for certain types of data currently being collected (Barron, Botros, et al., 1984). At the time of this writing, decisions about the implementation of these recommen- dations had not yet been made.

Training Needs

Interviews with LEC staff indicated that training is most needed in areas of data analysis and interpretation. Staff with little training in research methods have difficulty drawing conclusions from the data and would find additional training in this area to be particularly useful. A course on evaluation methodology (described in a later section) taught by the Resident Energy Advisor was thought to have been especially helpful, and LEC staff expressed an interest in participating in additional seminars of this nature.

Liberia Petroleum Refining Company (LPRC)

As previously noted, there are no known hydrocarbon reserves in Liberia. Until December 1982, most of Liberia's petroleum products were provided by imported crude oil processed by a refinery in Monrovia. The refinery was built in 1968 by Sun Oil and produced approximately 13,500 barrels per day. It was closed by a major fire in 1976, and in 1978 the refinery was purchased by the Liberian government, forming the Liberian Petroleum Refining Company (LPRC). Operated as a public sector corporation, with technical assistance from Lummus Operating Associates of New Jersey, LPRC produced up to 10,000 barrels per day.

Before the refinery's closing in 1982, crude oil for the refinery was obtained from Saudi Arabia under a term contract with a company called "Petromin". This arrangement was financed by a revolving letter of credit facility of US$75 million, arranged by the National Housing and Savings Bank of Liberia, in association with a syndicate of 25 international banks. The credit facility was reduced to US$50 in 1981 and finally closed in 1982, when the Liberian bank was unable to meet its US$10 million scheduled repayment on behalf of LPRC because of the lack of off shore reserves. The term-supply contract with Petromin was then suspended, and LPRC purchased crude oil on spot market prices during the remainder of 1982 before switching to refined petroleum products (UNDP/World Bank, 1984).

Following the collapse of crude oil procurement arrangements, and as a result of several efficiency studies and cost-benefit analyses by the NEC, private consulting firms and the World Bank, the refinery was closed--but not without generating considerable controversy. Although refinery operations have ceased, the LPRC has retained its 480 staff on the payroll, in hopes that operations will resume (LPRC interviews, 1984). The LPRC is still responsible for all aspects of petroleum supply, except that: "(a) the major concessions are permitted if the LPRC exceeds the 'fair world market prices' and (b) the major distributors and concessions (iron ore and rubber) are allowed to import products from the spot market" (UNDP/World Bank, 1984, p. 24).

Government of Liberia/ USAID Energy-Planning Project

In 1982, at the request of the National Energy Committee, USAID entered into an agreement with Oak Ridge National Laboratory (ORNL) to provide energy-planning assistance to the Government of Liberia. Phase I (funded by USAID, Bureau of Science and Technology) began in 1982 and concluded in early 1983. Dr. William Barron served as Chief of Party (Project Manager) for the U.S. team (composed of ORNL staff and consultants to ORNL). Dr. Barron was in Liberia less than 6 months out of the 12-month project period.

In October 1983, funding was provided for a long-term resident energy advisor under a USAID Africa-regional project entitled "Energy Initiatives for Africa (EIA)." Dr. Barron

returned to Liberia, as the Resident Energy Advisor, beginning in November 1983. The Bureau for Science of Technology also funded separate follow-on short-term technical assistance to complement the efforts of the resident advisor. Together this combination of long-term and short-term technical assistance is referred to as "Phase II" of the National Energy Assessment. The Science and Technology support ended in April 1985, and the EIA project ended in mid-October 1985.

Project Description

Phase I of the energy project concentrated on conducting a national energy assessment and on developing an energy data base (consisting chiefly of past and present energy consumption by sector and fuel type) as well as on projecting future energy demands, and reviewing potential fuel sources (Barron, eufville, November 1983). An Energy Assessment Team, consisting of representatives of the agencies in the NEC, the ORNL Energy Advisor and other U.S. short-term consultants was formed to conduct an assessment of Liberia's energy resources. Throughout this process the Assessment Team met regularly to report findings and discuss energy issues. (Barron, May 7, 1984; Barron, May 18, 1984; Barron, April 30, 1985),

Institutional Development

Institutional development has been an important component of the USAID/GOL Energy Project. A major factor in the success of this project has been the leadership and expertise provided by Dr. Neufville, the Secretary of the NEC.

Since the project's inception, Liberian counterparts have been involved in all phases of data collection and analysis. The Energy Advisor has emphasized Liberian participation and has provided guidance and training to a number of GOL staff. For example, he taught a short course (12 two-hour sessions) on the economics of project evaluation. This course was designed to enhance the capability of GOL staff from various agencies to evaluate project proposals and consultants' studies submitted to their agencies. A total of fourteen mid-level professionals attended the sessions. Class participation was reported to be good.

The NEC has been involved in deliberations concerning a number of serious policy issues. For example, in 1982, as a result of its comprehensive energy data base and in-house technical expertise, the NEC evaluated a number of options being considered to deal with oil payment problems. The NEC, as well as a number of consultants, including Arthur D. Little Corporation, and the World Bank, recommended the closing of the Liberian Petroleum Refining Company (LPRC).

Although the refinery was able to prevent the government from acting on these recommendations, in December 1982, the refinery management made the decision to "temporarily" close because of liquidity problems. However, as mentioned above, the refinery's staff remains on the payroll, and as of May 1985, not one person had been laid off at LPRC.

It appears that the World Bank may be able to force permanent closure (two and a half years after making the initial recommendation) by making closure a mandatory prerequisite for structural adjustment credit. However, even these efforts have yet to be realized, since the structural adjustment credit is on hold until the government reduces its arrears with the International Monetary Fund (IMF).

Energy planning activities have been hampered by institutional problems. One difficulty stems from the inadequate number of GOL staff actively involved in energy matters and the limited amount of time that they can devote to this area. It was noted in the "Integrated National Energy Program" (NEC, January 1985), that the staff involved in energy policy matters consists of only one senior and two mid-levelprofessionals, (along with the USAID-funded energy advisor). Two of the four junior-level GOL project staff were in the U.S. for energy training for the first few months of the USAID project (Barron, May 18, 1984).

While mid-level professional personnel from the member agencies of the NEC sometimes participate for a period of time, "the part-time, intermittent nature of this staffing arrangement makes it difficult for the NEC or the Secretary to quickly respond to policy questions or to sustain an active program of data collection and analysis" (NEC, 1985, p. 53). This situation is exacerbated by the fact that the Liberia project participants must divide their time between five different government agencies and must contend with unfavorable

working conditions. For example, employees are faced with salary cuts (averaging about 20 percent), pay checks are often three to four months late, and telephones are frequently inoperable.

In addition, material support from the member agencies of the NEC diminished somewhat during the second year, compared to interest that was shown in the beginning stages. In light of increasing financial burdens faced by these agencies, many potential project participants were reluctant to take on additional NEC responsibilities. Compounding these problems, several of the Liberian counterparts who participated in initial data-gathering efforts left to work on graduate degrees or to participate in short-term training in the U.S. Others received promotions or added responsibilities which preventedthem from making the same level of contribution that they had made in the past (Barron, May 18, 1984).

Because of the difficulties faced by the NEC under the present institutional arrangement, the "Integrated National Energy Program" recommended strengthening energy planning and policy analysis by creating a GOL energy planning agency to assume the role currently fulfilled by the Secretary of the NEC. Details of this proposal are provided in a later section of this report.

Quality of Data

A number of energy studies have been conducted by the National Energy Committee and others, as a part of the GOL/USAID Energy Planning Project. This discussion is focused

specifically on the National Energy Assessment (NEC, 1983) and on the revised version of the 1982 Liberian Energy Balance (Barron and Samuels, May 1984).

The primary objective of this examination of data quality is to determine whether:

1. units of measure and conversion factors, as well as routes to conversions, were adequately specified
2. terminologies were clearly defined
3. data collection methodology was specified
4. sources of information were properly documented, and studies can be easily replicated
5. calculations were accurate
6. limitations on data were delineated.

National Energy Assessment

The National Energy Assessment was conducted as part of GOL/USAID Energy Planning Project previously described. This study examined current energy use by end sector and fuel type, estimated future energy demand, and evaluated several alternative energy resources and technology options for Liberia.

Assessment activities were carried out over a one-year period, with U.S. project staff in Liberia for about 7 months of the 12-month project period and Liberian counterparts from various agencies participating on a part-time basis. The energy assessments consist of a main volume and appendices, which are listed on the pages that follow.

Energy Demand Projections

10. L. Hill, "The Liberian Macro-economy and Simulation of Sectoral Energy Demand: 1981-2000," ORNL, April 1983.

11. Technical Subcommittee of the NEC, "Possible Actions for the Near-Term Energy Conservation,"NEC, December 1982.

12. M.-H. Neufville and T. Wilbanks, "Domestic Petroleum As an Energy Supply Option for Liberia," ORNL, March 1983.

13. W. Barron, G. Samuels, and T. Wilbanks, "A Near-Term Alternative for Recycling Liberian Oil Imports (Wood Gasification)," ORNL, November 1982.

14. A. Compete, W. Griffith, and G. Samuels, "Liquid Fuels Substitution with Vegetable Oils and Alcohols," ORNL, March 1983.

15. B. Hobbs, "Background Paper on Costs of Alternative Electrical Generation Technologies for Liberia," ORNL, February 1983.

16. G. Samuels, "An Evaluation of the Economics of the Liberian Petroleum Refining Company Operations: Crude Oil Refining vs. Product Importation," ORNL, January 1983; W. Barron, R. Barnes, G. Samuels, B. Hobbs, and L. Hill, memorandum to Dr. M.-H. Neufville on "Estimates of Refinery Viability," ORNL, January 1983.

Overall, the analyses comprising the NEC National Energy Assessment and its appendices are of superior quality and rank highly on almost all criteria. Data sources are well documented and backup studies are provided in the appendices to the assessment. Units of measure, as well as conversion factors and routes to derive them, are consistently stated. Also, operational definitions are provided. Data-collection methodologies to the back-up studies are usually outlined, although not always in sufficient detail to enable other

Main Volume

W. Barron and M.-H. Neufville, "An Assessment of Energy Options for Liberia," ORNL, November 1983.

Appendices

Energy Balance

1(a). G. Samuels, "Liberian Energy Consumption and Sectoral Distribution for 1981," ORNL, March 1983.

1(b). W. Barron, "1982 Liberian Energy Balance," ORNL, May 1984.

Sector Analyses

2. C. Thomas, "Background Paper of Petroleum Refinery Operations, Mines and Industry in Liberia," ORNL, August 1982.

3. W. Barron, B. Hobbs, L. Kawah, and V. Sherif, "Background Paper on Electrical Services Provided by Liberia Electricity Corporation (LEC)," ORNL, January 1983.

4. L. Kawah, J. Sandikie, and W. Barron, "Project Paper on the Liberian Transport Sector," NEC, December 1982.

5. C. G. Knight, J. Dobson, and J. S. Sandikie, "Project Paper on Energy Use and Supply Potential in the Agricultural And Forestry Sectors in Liberia," ORNL, March 1983.

6. T. Wilbanks, and W. Barron, "Energy Use in the Governmental Sector in Liberia," ORNL, March 1983.

7. M.-H. Neufville and J. Sandikie, "Project Paper on Residential Energy Use in Liberia," NEC, March 1983.

8. W. Barron, "Background Paper on the Commercial Sector in Liberia," ORNL, September 1982.

9. R. Barnes and R. E. Rhinelander, "The Potential for Early Energy Conservation in the Light Industrial and Commercial Sector in the Liberian Economy," ORNL, November 1984.

analysts to replicate the study (e.g., NEC, "Possible Actions for Near-Term Energy Conservation, Appendix 11," NEC, December 1982).

It is important to note that even though researchers may adhere to rigorous standards of analysis, the validity of the data, and the level of confidence that can be placed on the results, are contingent on the quality of the information making up that analysis. Impediments to obtaining high quality data are frequently related to factors beyond the control of the researcher, such as information accessibility. In Liberia, as in other developing countries, critical data are often unavailable, and researchers are forced to rely on outdated information or on rough estimates. This is particularly true of Liberia's data on fuelwood and rural electrification. In such cases, it is extremely important that estimates of the accuracy of the data are provided and limitations explicitly stated. Most of the studies comprising the Liberian energy assessment fulfill this requirement.

In cases where data sources did not agree, the authors reconciled differences and documented the reconciliation procedures (e.g., C. Thomas, "Background Paper on Petroleum Refinery Operations, Mines and Industry in Liberia, Appendix 2" ORNL, August 1982; W. Barron, "Background Paper, on the Commercial Sector in Liberia, Appendix 8," ORNL 1982).

Some of the studies comprising the energy assessment contain methodological problems that cast doubt over

the validity of the results. The "Residential Energy Survey," for example, suffers from validity problems related to the research methodology.

An initial residential survey was conducted in 1979. It was recognized by the senior Liberian staff that this survey had significant methodological problems, such as unqualified interviewers and non-random sampling. Although efforts were made to draw a sample of households that was representative of Liberia as a whole, participants in the study indicated that the sampling design was not, in fact, truly random. The method of selecting households within each locality surveyed was one of convenience, rather than of random selection. The use of a sampling frame or a list of residents from which to select respondents was not employed. According to survey participants, researchers simply picked a street or group of houses in each locality and went from household to household until a designated number of houses had been surveyed. If respondents were not at home, the interviewer selected another house, a procedure which could create sampling bias, since certain types of respondents might be systematically eliminated from the sample.

Compounding these problems, training of interviewers was minimal, and there was no uniform method of conducting interviews. Consequently, both respondents and interviewers sometimes misinterpreted questions.

Another survey was undertaken in 1982 as a part of the Phase I National Energy Assessment. The questionnaire for this

effort was developed by the Liberian project staff and reviewed by the USAID Energy Advisor, the AID-Washington project manager and a representative of the U.S. Bureau of Census. Suggestions for improvement were made, and some of these changes were incorporated into the survey. The second survey was conducted with the help of Peace Corps volunteers.

Unfortunately, the Acting Peace Corps Director did not follow through on her promises for assistance, and the number of questionnaires administered by Peace Corps volunteers fell far short of expectations. Faced with a small sample, the Liberian staff, who had little training or experience in survey methodology, made the decision to add the results of the earlier survey. The survey's administration and analysis was carried out doing a period when AID project assistance was not being provided. Questions about the accuracy of the results led the NEC to the conclusion that the study should be repeated, using more statistically sound practices.

Supply/Demand Balance

The recommendations of the UN Statistical Commission were utilized as guidelines for examining procedures employed by the Resident Energy Advisor and representatives of the NEC in constructing the 1982 Liberia Energy Balance. It is not the intention of this author, nor of the UN Statistical Commission, to propose the Statistical Commission's format as "the correct format." Because the UN Commission's format was originally developed for industrialized countries (with a sample format

for developing countries), some of the recommendations do not work well in a developing-country context. However, many of the practices advocated by the Commission represent sound statistical and methodological procedures which should be observed, irrespective of the setting. (As noted in Chapter 3, a complete list of UN Statistical Commission Recommendations is contained in Appendix A.)

Although the Liberia Energy Balance is a part of the National Energy Assessment, for the purpose of this discussion, it is treated as a separate document. As previously noted, the UN Statistical Commission's recommendations are used as general guidelines for examining the quality and content of the Liberia Energy Balance.

Like the National Energy Assessment, the Liberia Energy Balance is presented in a professional manner, and the analyses are of high quality (see Appendix H).[5] The conventions used in preparing the balance statement adhere very closely to the standards set forth by the UN Statistical Commission. In general, sources are well documented, conversion factors and routes are specified, units of measure are clearly delineated, and operational definitions are provided. In addition, calculations appear to be correct.

A detailed listing of the differences between the NEC's Liberian Energy Balance and the Statistical Commission's recommendations are contained in Appendix I. Where the

Commission's recommendations are appropriate to Liberia's data needs and problems, suggestions are made as to changes which might be made when conducting future necessary to invest the additional time and effort required to revise the currently existing balance sheet. Appendix J illustrates how the Liberia Energy Balance might look if the Statistical Commission's suggested format for a developing country energy balance were used.[6]

As mentioned earlier, the differences between the two formats are relatively small. The first notable difference between these formats is the way in which information on the balances sheet are grouped together to form subtotals. The NEC format produces a "Total Available" figure (row d) for each energy source that includes production, imports, and stock changes. Using the UN Statistical Commission format, a subtotal is produced under the heading of "Total Inland Supply" (row 6) that includes these same values minus exports.

The second area that distinguishes the modified UN format from that used by the NEC is in the way that various sources of generation and losses are treated. The NEC format classifies generation and generation losses from mines, commercial, and agriculture/forestry under the category of "Sectoral Distribution," while the UN format designates a category on the balance sheet for all "Electricity Generation" (rows 7-7.3.4) and another category for all "Energy Sector Own Use and Losses" (rows 8-8.6).

Each of these formats has its advantages and disadvantages. The NEC format more clearly depicts the relationship between each source of electricity generation and its respective generation losses. The UN format, on the other hand, presents a concise picture of the electricity sector as a whole, rather than treating public electricity generation as separate from private sources.

Summary and Conclusions

Liberian Energy Institutions

A total of six ministries and government agencies, along with GOL/USAID Energy Planning Project participants were visited in November 1984, and interviews with staff members were conducted. A summary of the educational backgrounds of the professional staff involved in data collection and analysis at each of these institutions is depicted in Table 6.8. As illustrated, approximately 44 to 45 employees of the various ministries, committees and government agencies active in the energy sector in Liberia participate in energy data collection and analysis. This figure does not include staff of other participating agencies of the NEC who occasionally provide expertise to energy studies and policy decisions.

NEC agencies not included in this study are the Ministry of Commerce, Industry and Transportation, the Ministry of Rural Development, the Ministry of Agriculture and the Ministry of Internal Affairs. Also excluded from Table 6.8 are USAID-funded Oak Ridge National Laboratory staff who have

TABLE 6.8

MINISTRY/AGENCY STAFF INVOLVED
IN ENERGY DATA COLLECTION AND ANALYSIS

Institution	Degree	Type of Degree	Number of Staff
National Energy Committee (NEC)	Ph.D.	Geology	1
Ministry of Lands, Energy and Mines (MLEM):			
Bureau of Hydrocarbons	Bachelor's	Geophysics	1
	Bachelor's	Geology	3
	Master's	Petroleum Geology	3
Department of Energy (DOE)	Bachelor's	Geophysics/ Physics/ Chemistry/ Economics	11
Ministry of Planning and Economic Affairs (MPEA)	Bachelor's	Unknown	3-4
	Master's Economics		1
Forestry Development Authority	Bachelor's	Forestry	1
	Bachelor's	Wood Products	1
	Master's	Agricultural Economics	1
Liberia Electricity Corporation (LEC):			
Rural Electrification	--	--	--
Corporate Planning Development	Bachelor's	Engineering	2
	Bachelor's	Statistics	1
	Bachelor's	Economics/ Finance	5
	Bachelor's	Manpower Planning	7
	Master's	Economics	2
Generation	Unknown	Unknown	1
General Services	Bachelor's	Mathematics	1

provided both long-and short-term technical assistance to NEC members and ministry staff in conducting energy analyses.

Of those GOL employees listed on Table 6.8, one holds a Ph.d., approximately 7 or 8 have Master's Degrees and 34 to 36 have Bachelor's Degrees.

Data Quality

Overall, the analyses conducted as a part of the NEC National Energy Assessment are of high quality. Data sources are well documented and backup studies are provided in the appendices to the assessment. Units of measure, as well as conversion factors and routes to derive them, are consistently stated. Likewise, operational definitions are provided. Data collection methodologies to the back-up studies are usually outlined, although not always in sufficient detail to enable other analysts to replicate the study.

The household energy consumption survey, however, contains a number of methodological flaws which should be corrected. Questions about the accuracy of the results has led the NEC to the conclusion that the study should be repeated, using more statistically sound practices.

Data Collection and Analysis Problems

Interviews with GOL staff members involved in the energy area revealed three problems with energy data collection and analysis which are pervasive throughout the energy sector. These are: (a) finance; (b) organization; and (c) training.

Financial problems. Liberia's financial problems, which are not limited to the energy sector, but are evidenced in all sectors of the Liberian economy, have a significant impact on the ability of the National Energy Committee and its member agencies to carry out effective energy planning. Energy institutions share with other agencies problems of inadequate staff, equipment and other resources necessary to carry out informed policy analysis and decision making. Delayed paychecks and salary cuts, in particular, have had an extremely debilitating effect on staff motivation and performance within government ministries and agencies.

Organizational/institutional problems. The National Energy Committee and participants of the GOL/USAID Energy Project assert that although a number of successful energy planning activities have been carried out in the energy sector, the institutional arrangement under which the NEC presently operates severely hampers planning efforts. The UNDP/World Bank Assessment Team (1984) support this contention, identifying two major flaws in the present organizational structure in the energy sector: (a) the shortage of trained staff in the the Department of Energy; and (b) the isolation of the Ministry of Land, Mines and Energy from the locus of decision-making in the government.

The UNDP/World assessment (1984) states that because the NEC has only advisory powers, there is no policy framework for the development of the energy sector. In addition, the central

energy parastatals, such as the Liberian Electricity Corporation and the Liberia Petroleum Refining Company, rarely consult with the National Energy Committee or the Department of Energy before important decisions or plans are made. Plans frequently reach the higher echelons of the Ministry ofFinance, the MPEA or the Head of State for approval before the NEC or the DOE have had the opportunity to review them. Furthermore, World Bank staff believe that the Government of Liberia lacks the management experience and the familiarity with energy sector issues to adequately monitor the performance of its energy companies (UNDP/World Bank, 1984).

The "Integrated National Energy Program" (NEC, 1985) proposes a number of changes aimed at insuring that energy institutions, including public sector agencies and corporations, are managed (by Liberians) so as to provide reliable services at the lowest possible cost. The plan would strengthen energy planning and policy analysis by creating a GOL energy-planning agency to assume the role currently fulfilled by the Secretariat of the NEC. Two alternatives are proposed for accomplishing this objective. One approach is to strengthen the existing Department of Energy within the Ministry of Lands Mines and Energy. A second approach is to create an independent National Energy Commission with a full-time staff.

This plan suggests that the proposed planning agency should include the following:

1. in cooperation with the Ministry of Planning and Economic Affairs, continue to define a program of energy sector technical assistance and investment

2. gather the data and conduct analyses in support of responsibility #1 above

3. assist energy line agencies in resource inventories and identification of least-cost resources of energy supply, and future demand levels

4. provide oversight in defining and monitoring the objectives and performance of energy parastatals

5. develop and periodically update records of energy use and prices

6. carry out limited testing and measurements relating to evaluation of small-scale technologies

7. carry out other responsibilities associated with implementation of the "Integrated National Energy Program (INEP)" 1985 and any subsequent national energy plans (NEC, 1985, p. 54).

The INEP further recommends that the energy planning institution be provided with at least four full-time senior and mid-level professionals, and the continued assistance from one or two full-time expatriate advisors, as well as short-term technical advisors in various fields. In addition, it calls for the equivalent of four individuals to be trained each year for a period of several years. The UNDP/World Bank energy assessment report (1984, p. ix) supports these recommendations, calling for the creation of a "well staffed and equipped full-time policy and planning agency closely associated with the

highest levels of Government decision making." The UNDP/World Bank (1984, p. ix) further advocates that the Government of Liberia carry out the following actions:

1. the formation of an energy policy and planning division within the DOE separate from any functions of the former Bureau of Hydrocarbons and dissolution of the NEC

2. the formulation of administrative procedures which would establish for this division a close advisory relationship with the Economic and Financial Management Committee of GOL

3. the representation of the head of the energy planning division or the Director of Energy on the boards of the LEC and the LPRC or its successor

4. the provision of at least three full-time, high-level professionals for the energy-planning division plus support staff and trainees and finance for at least four man-years of training per year.

However, in a subsequent document, (Energy Sector Management Assistance (ESMA) Report, March, 1985), the UNDP/World Bank calls for a different organizational structure than that recommended in the Bank's earlier energy assessment report (UNDP/World Bank, 1984). In the latter document, it is recommended that the Ministry of Planning and Economic Affairs (MPEA), rather than the Department of Energy (DOE), be primarily responsible for energy policy. This report recommends not only the continuation of the USAID-funded Resident Energy Advisor to the DOE, but also suggests that an Energy Investment and Policy Expert be provided to establish an energy-planning unit in the MPEA. Under this arrangement, the

role of the DOE Energy Advisor would be primarily technical in nature, while the advisor to the MPEA would deal with macro-economic issues.

The two advisors would work closely together to establish within the GOL an energy-planning function, which would include defining training needs and supervising staff development. The functions of the two positions (the report does not differentiate between the two roles) would be to:

1. prepare and maintain energy sector investment programs for a rolling ten-year period, with activities ranked in terms of priority
2. define and routinely update energy resource inventories for use by major production sub-sectors, and assist them in defining the least cost source of energy supply
3. maintain adequate records on economic and financial prices and costs and provide advice to the government on the advantages of pricing policy
4. provide assistance to the planning Department of Energy parastatals in identifying future markets and demand trends
5. assist the government as a shareholder in energy parastatals in monitoring the performance of each, and in reviewing plans and project proposals
6. work with the MPEA to define relative economic benefits and priorities of energy sector investments
7. provide direct advice to the Economics and Financial Management Committee (UNDP/World Bank, March 1985, pp. 18-20).

Training-related problems. Almost every staff member interviewed indicated that additional training is needed in areas of data collection and analysis. Areas of deficiency most frequently mentioned are statistical sampling, survey

methodology, and data analysis and interpretation. Both on-the-job and overseas training were deemed to be desirable by most staff members interviewed. However, several staff members considered in-country and on-the-job training to be less desirable because, unlike most overseas training programs, local training does not usually award certificates or diplomas for participation in the program and are often viewed by colleagues and supervisors as being less prestigious than overseas training.

Training institutions. A currently existing program which provides long-term training in the energy area is the Conventional Energy Training Program (CETP). This program is sponsored by USAID and administered by the Institute of International Education. Established in 1981, the CETP provides training ranging from a few months to up to two years in both academic and non-academic institutions to energy professionals from developing countries. As of May 1985, 13 GOL staff had completed training, 4 were enrolled, and 2 were pending candidates in this program. The CETP emphasizes training in areas such as the development and utilization of oil, gas, coal, electricity, and geothermal, as well as in energy conservation and management.

Although most GOL employees interviewed considered training to be extremely important, and almost everyone wanted to see more training programs, they pointed out that experiences with previous training programs in Liberia have not

been altogether positive. Among the problems associated with former training activities were: (a) the selection of participants on the basis of political favoritism, rather than on actual need or merit; (b) the tendency for training recipients to leave the government service once their training is completed; (c) the lack of local input into the design and implementation of training programs.

Recommendations

Substantial work has been done in the area of energy data collection and analysis in Liberia. Both the National Energy Assessment and the "Integrated National Energy Program" represent important milestones in the development of sound data on which to base energy policy and planning decisions. However, energy decisions must be viewed in the context of the economy as a whole. Like the overall economic situation, energy conditions, which are contingent upon a number of complex interactions, are in a constant state of flux. Energy planning, therefore, must be an iterative process that allows for continuous monitoring of supply-and-demand conditions and for systematic adjustments to plans as conditions change. Although the studies which have been conducted by the National Energy Commission and participants in the USAID-sponsored Energy Planning Project are indeed a step in the right

direction, they should be viewed as only the initial step. Therefore, the following actions are recommended:

1. <u>The services of a USAID-funded Resident Energy Advisor should be retained for two additional years.</u> During the time that the Resident Energy Advisor has been involved with the Energy Planning Project in Liberia, significant progress has been made toward developing the skills of GOL staff members in techniques for assessing energy conditions. GOL staff members have been involved in almost every phase of data collection and analysis. However, additional technical assistance is needed to insure that a smooth transition is made from the expatriate-assisted program to one that is operated by a staff fully trained in energy planning and analysis techniques. Technical assistance should be aimed at enhancing the skills of GOL staff in defining problems, conducting requisite analyses, identifying options, and formulating solutions. Particular attention should be focused on training of GOL staff in data collection and analysis techniques, including statistical sampling, energy sector analysis, and procedures for constructing energy supply/demand balances.

2. <u>An energy data collection and analysis training program should be established and managed by the USAID-funded Resident Energy Advisory and the Secretariat of the NEC</u>. This program should consist of a series of seminars and workshops of approximately three to six weeks duration per topic. Topics could include: (a) energy data for policy and planning; (b) measurement issues in energy statistics; (c) basic data-collection methods and issues; (d) data processing and analysis; (e) national energy assessment methodology; and (f) energy sector analysis. (See Appendix F for a proposed course outline for each topic.) The Resident Energy Advisor and participants in the national energy assessment might want to conduct seminars on national energy assessment methodology, while bringing in short- term consultants to hold training sessions on some of the other topics. For example, several staff members at the U.S. Bureau of Census have had considerable experience in providing training to LDCs in energy sector analysis techniques. A possible source of funding for this program is the Bureau of Science and Technology, Office of Energy (ST/EY), Energy Policy Development and Conservation (EPDAC) Project.

3. Short-term technical assistance should be continued to conduct studies in areas defined by the NEC and the Resident Energy Advisor.

4. Participation in the Conventional Energy Training Program should be continued. In addition to other CETP courses and academic degrees offered, a 26-week course at the University of Pennsylvania is planned for 1986 which will focus on energy planning and management. Seminars will include topics such as the use of computers, problem-solving methodology, introduction to energy technologies, biomass and fuelwood, and special energy planning issues. Potential candidates for participation should be identified.

5. The Residential Energy Survey should be repeated, using the technical assistance of an energy statistical analyst, perhaps through the U.S. Bureau of Census, to provide training to GOL staff in data collection and analysis techniques. It is suggested that funding from the Bureau of Science and Technology, Office of Energy (ST/EY), Energy Policy Development and Conservation (EPDAC) Project be utilized for this activity. Training should include actual GOL staff participation in all phases of the

survey design, as well as in data collection, analysis and interpretation. Particular emphasis should be placed on procedures for determining sample size, selecting a sampling strategy, selecting and designing a survey instrument, conducting interviews, and analyzing and interpreting results.

6. The NEC should explore the possibility of linking energy-survey efforts with other research activities going on in Liberia. For example, they might wish to determine the feasibility of incorporating questions on residential energy use into the national census.

7. As recommended in the "Integrated National Energy Program," energy planning and policy analysis should be strengthened by creating an energy-planning agency within the GOL. This agency should consist of at least four full-time, well-trained staff members who work closely with Government of Liberia decision makers. However, the establishment of an Energy Investment and Policy Expert to assist in creating an energy planning unit in the MPEA, as recommended in the UNDP/World Bank's (Energy Sector

Management Assistance (ESMA) Report, March, 1985), removes the planning and policy function from the Department of Energy, and could lead to potential bureaucratic conflict and duplication of effort between GOL agencies. This organizational arrangement would likely prove to be disruptive, since it undermines the planning and policy efforts that have been undertaken within the DOE in the last two years. Therefore, the GOL should not adopt the Bank's recommendation to place a separate planning agency within the MPEA.

8. A modified version of the format for energy supply and demand balances, specified by the UN Statistical Commission should be utilized to construct the next Liberia energy balance. No changes to the 1982 Liberia Energy Balance are necessary.

9. In order to carry out the activities outlined in recommendations 2, 5, and 6, the services of an energy statistical analyst should be utilized for a period of six weeks (2-3 weeks preparation in Washington and 3-4 weeks in Liberia), and the tasks in the following scope of work should be performed.

Scope of Work

Tasks

(1) Work with the GOL national census bureau to:

(a) determine how their statistical capability relates to Liberia's energy data needs

(b) determine the feasibiility of incorporating residential energy-survey questions into the national census

(2) Assist in the Residential Energy Survey design.

(3) Assist in organizing training sessions. Activities should include:

(a) working with the NEC to further refine seminar topics

(b) defining type of audience to whom seminars are most appropriate

(c) providing suggestions for seminar presentors

(d) assisting in making logistical arrangements

(4) Develop Seminar 1. (Two to three weeks preliminary preparation, including selection and reproduction of reading materials, development of lectures and participatory activities, etc., can be done in Washington).

(5) Present Seminar 1. Seminar sessions should be held over a period of at least three weeks (three to four hours per week) and should include the following areas of discussion (see Appendix F for more details).

Basic Data Collection Methods/Energy Statistics

I. Use of records

II. Use of surveys

A. Census vs. sample survey

B. Mandatory vs. voluntary

C. Preparation of survey schedule

D. Sampling issues

1. Ensuring representativeness

2. Selection/training of interviewers/enumerators

3. Questionnaire construction (length, wording, coding, format, accompanying explanatory text, etc.)

4. Pilot/field testing

5. Sources of error

6. Ensuring confidentiality

III. Measurement issues

A. Definition of terms & boundary problems

B. Classification of energy sources

1. Primary/secondary

2. Commercial/traditional/non-conventional

C. Rounding consistency

D. Internal and external consistency

E. Units of measure

1. Measurement of unit source materials weight, volume, capacity, and value

2. End-use measures

3. Double counting (and how to avoid it)

4. Distinction between primary/delivered/useful energy

IV. Conversion of primary to secondary energy

A. Conversion factors and routes

B. Role of refineries, power stations, charcoal converters, etc.

C. Energy distribution/delivery/handling

D. Losses

E. Stocks

F. Storable energy (e.g., solids, liquids, gases)

G. Non-storable energy (e.g., electricity, wind)

Qualifications

(a) Demonstrated familiarity with statistical analysis as related to energy information

(b) Demonstrated knowledge and understanding of special energy data problems and needs of developing countries

(c) Demonstrated familiarity with procedures for conducting energy assessments in developing countries

(d) Master's degree or equivalent

Notes to Chapter 6

[1] According to MPEA staff, this function is rarely carried out, since large sums of money are spent each year, and evaluations have little influence on project operations.

[2] The University of Liberia was closed by the government for several months in 1984, after students were killed in clashes with the military.

[3] The Financial Management Division is headed by the Comptroller and generates revenues through fees collected from logging.

[4] This year, no allocations for the LEC were included in the budget. LEC staff anticipate that a supplementary budget may still be provided.

[5] Only the main tables to this supply/demand balance are provided in Appendix H. These balance sheets were accompanied lengthy (23 pages) explanatory notes, which define terminologies and describe how figures were derived. However, the sake of brevity, the energy balance background nots were omitted from this report.

[6] The UN Statistical Commission suggested format was modified slightly to be more compatible with the energy supplies and uses in Liberia. For example LPG and bagasse were dropped as energy sources, and sugar and molasses were deleted from the list of final end uses. The UN Statistical Commission's convention of dividing electricity into "hydro" and "thermal" components was not adopted, but rather the NEC's technique of defining electricity in terms of "hydro" and "electricity" was used. This decision was made primarily to avoid duplication in the electricity column, since hydropower is fed into the central electricity grid.

CHAPTER 7

SUDAN FINDINGS

General Characteristics

Located in the northeastern portion of the continent, Sudan is Africa's largest country. It is bounded by Egypt, Ethiopia, Uganda, Kenya, Zaire, the Central African Republic, Chad and Libya. Sudan is a land of extreme contrasts, with tropical forests, savanna, and swamplands in the south and vast stretches of desert in the north. The average rainfall varies from less than one inch in the north to 80 inches in the south (UNDP/World Bank, July 1983). Most of Sudan's cultivation is dependent upon the Nile, which flows north from Uganda for 2,340 miles (3,760 kilometers) (U.S. Department of State, November 1982).

Sudan's population was estimated in mid-1985 to be approximately 23 million. About 29 percent of the population live in urban areas, principally in the metropolitan area surrounding the capital city of Khartoum, Omdurman, and Khartoum North (USAID, 1985). Agriculture accounts for more than 90 percent of the country's exports and 72 percent of its employment (UNDP/World Bank, July 1983).

Sudan is comprised of two very disparate cultures--the predominantly Arabic-speaking Muslims in the north and the

black African tribes in the south, who practice Christianity or tradition animist beliefs. Among the tribes in the north are Kababish of northern Kordofan, the Jaalin and Shaiqiyya tribes living along the rivers, the semi-nomadic Baggara of Kordofan and Darfur, the Hamitic-Beja in the Red Sea area and Nubians along the northern Nile. A large number of tribal groups are present in the south, each with their own tribal language. The Dinka is the largest of the black African tribes, with a population of about one million. Other tribes include,the Shilluks and the Nuer, (Nilotic tribes), along with the Azande, Bor and Jo Luo in the west, and the Acholi in the extreme south (U.S. Department of State, November 1982).

Historical Background

Excavation of archaeological sites on the Nile have revealed ample evidence of habitation in the river valley as early as the Paleolithic period. The earliest historical records of northern Sudan describe a lengthy history of early influence and domination of the area (then called "Cush") by Egyptians (American University, 1982).

During Sudan's early days, the influence of other competing forces, including that of the Coptic Christians and Arabs came to be felt as well. By the sixth century, the Islamic religion had gained a stronghold in northern Sudan. At the time of the death of the Prophet Muhammad in 632, his followers had unified most of Arabia under the Islamic [1]

religion, which according to American University, (1982):

> was conceived of as uniting the individual believer, the state, and society under the omnipotent will of God. Islamic rulers, therefore, exercised both temporal and religious authority, and Islamic law (sharia)[2] ...encompassed all aspects of the lives of believers, who were called Muslims ('those who submit' to the will of God) (p. 10).

During the next generation, Islamic religion was spread by conquering armies throughout the area known as Nubia (Egypt and northern Suda and political control was strictly imposed. However, it was not until around the fifteenth or sixteenth century that Muslims constituted the majority in the Nubian territories (Adams, 1977; Keating, 1963).

In 1517 Egypt was defeated by the Turks and incorporated into the Ottoman Empire as a "pashalik" (province). Under this rule, Egypt was divided into several provinces, each ruled by a "Mamluk bey" (governor) responsible to the "pasha," who in turn, answered to the "Porte." The Ottoman Empire survived for over 280 years, experiencing a succession of 100 pashas (American University, 1982; Keating, 1963; Holt, 1979).

During the eighteenth century, Mamluk beys, with battalions of slave armies to defend them, fought for control of the area. However, these power struggles came abruptly to an end in 1798, when the armies of Napolean Bonaparte conquered the emp e. Bonaparte was driven out in turn by British and Turkish forces in 1801. This period was followed by four chaotic years (Holt; 1979; Mercer, 1971).

In 1805 the Porte designated Mohammed Ali, an Albanian officer in the Ottoman army as pasha of Egypt. Using the armed forces at his command, Mohammed Ali decided to rid Egypt of the Mamluks, and embarked upon a seven-year campaign to suppress the revolt of the ultra-conservative Islamic sect. To rebuild his diminishing army, he relied upon slave recruits from Sudan (American University, 1982).

Although his predecessors had asked little of the Sudanese other than tribute for protection, this tradition ended with Mohammed Ali's reign. In 1820 he invaded Sudan with 4000 troops, in search of Mamluks, whom he suspected had taken refuge. The relationship between Sudan and Egypt was an exploitative one--Sudan was expected to be self-supporting, with no expenditures on the part of the Egyptians. Yet, heavy tariffs were extracted from the Sudanese (American University, 1982).

Several events led to the involvement of the British government in Egypt and the Sudan. Egyptian khedive (sovereign prince) Said in 1856 commissioned the construction of the Suez Canal. Because the venture proved to be far more costly than originally planned, Said's predecessor, khedive Ismail. was forced to sell shares of the Suez Canal company to the United Kingdom (American University, 1982; Fabunmi, 1960).

Ismail also appointed General Charles Gordon, a British officer, governor-general of Sudan in 1877. Both Gordon and Ismail were committed to the task of bringing a halt to the

slave-trade. Even though their efforts were successful, they aroused the ire of the Arab merchants, whose livelihood depended upon slave-trading. Gordon resigned his position in 1880, after Ismail was ousted, and the slave-trade was resumed (Fabunmi, 1960).

Relations between Sudan and Egypt worsened, as taxes were arbitrarily increased by tax collectors, and villages were plundered by unemployed soldiers from disbanded units (American University, 1982). Despite Egypt's dominance over most of Sudan during the nineteenth century, Egyptians were unable to establish effective control over the southern part of the country. This area consisted largely of fragmented tribes, who were the frequent target of slave-traders (Mahdi, 1965).

In 1881, a religious leader of the Ansars named Muhammed Ahmed ibn Abdalla declared himself the 'Mahdi' ('the expected one'). Taking advantage of the growing discontent among the Sudanese, he united tribes in western and central Sudan in a revolt against the Egyptian government. The British government, under the leadership Prime minister William Gladstone, was committed to limiting Britain's involvement in overseas affairs (Carrington, 1950). In order to prevent Britain from being drawn into the clash, Gladstone decided to abandon Sudan and ordered Egypt to withdraw (Collins, 1961; American University, 1982).

General Gordon was reappointed governor-general and dispatched to supervise the Egyptian withdrawal. Upon his

arrival in 1884, Gordon determined that it was impossible to extricate the two forces from battle. Refusing to abandon the situation, he decided to wait out the siege. Eventually, he called for reinforcements from Egypt and later from Britain. Yielding to public pressure, Prime Minister Gladstone sent troops up the Nile. Aided by flooding of the river, the Ansars easily defeated the garrison. Gordon was slain, and his head was delivered to the Mahdi (Farwell, 1967; Marlowe, 1965). Although the Mahdi died of typhus shortly thereafter, the new government ("the Mahdiya") lasted until 1898, when it was overthrown by, Kitchener (American University, 1982).

Led by Abdallahi, called "al Khalifa ("the successor"), the Mahdiya strictly enforced sharian laws and ancient Islamic practices were imposed. In 1892, under Britain's Conservative leadership, the struggle between the British, French and Belgians for control of the Nile became a critical political issue (Mahdi, 1965).

In 1898, in a venture funded by the Egyptians, Lord Kitchener led Egyptian and British troops into battle against the Mahdists. After losing the city of Dunqulah to British and Egyptian forces, the fighting shifted to Omdurman, where over 11,000 Mahdists were killed. The British, on the other hand, lost fewer than 48 men (American University, 1982; Magnus, 1959).

In an agreement between Egypt and the United Kingdom, Egypt's sovereignty over Sudan was officially restored, and a

"condominium" (joint authority) between Egypt and Britain was established. However, most of the policy decisions were made by the United Kingdom and carried out by British administrators (American University, 1982; Collins, 1961).

The British and Egyptians relinquished authority over the Sudanese in 1953, when Sudan's right to self-government was officially recognized and independence was granted. The following year, Sudan's provisional constitution was established and the first independent parliament was convened (U.S. Department of State, November 1982). The National Unionist party established the first cabinet. In a series of coups, Sudan's government changed hands a number of times during the next sixteen years. This period was also troubled by unrest in the south, where there was talk of regional autonomy or secession. Regional autonomy on internal matters was eventually granted in 1972. (U.S. Department of State, November 1982).

In 1969, the Revolutionary Command Council, headed by Gaafar Muhammed Nimeri, overthrew the civilian government and abolished the parliament. All political parties were banned and Nimeri was appointed prime minister. Nimeri was breifly overthrown in 1971 by the Sudan Communist Party. With the assistance of loyal supporters, however, he was back in power within a few days. Another unsuccessful coup attempt was perpetrated by the Ansar religious sect in 1976. Most of the

participants were captured and executed (U.S. Department of State, November 1982).

Sensing the need for reconciliation with the Ansars, President Nimeri met with their leader, Sadiq al Madhi in 1977. He agreed to pardon all political prisoners and grant amnesty to all opponents who agreed to live within the laws of the Sudan (U.S. Department of State, November 1982). Tensions were abated somewhat, but dissatisfaction with the Nimeri regime was never totally dispelled. Nimeri remained in power until 1985. However, Sudan's deteriorating economy was accompanied by growing public discontent. In 1983, he mandated the strict imposition of sharia law throughout Sudan, further alienating the predominantly Christian south. Unhappiness with his regime culminated in 1985, when the government announced drastic increases in bread and gasoline prices in an effort to stailize the country's collapsing economy. While President Nimeri was on a trip to the United States, the government was overthrown by the Transitional Military Council, headed by Suwar El Dahab.

Economic Trends

Sudan's economic activities have been characterized as a "classic dual economy," with strong divisions between the modern and traditional sector (American University, 1982). Sudan is predominantly an agriculture economy. In 1983, agriculture represented 31 percent of the GDP, compared to 13 percent for industry (including manufacturing, construction,

electricity and water). During the same year, agriculture accounted for more than 90 percent of exports and 72 percent of employment (USAID. 1986). Cash crops (cotton and cottonseed) alone accounted for 50 percent of Sudan's export earnings. Gum arabic were also a large export crop, representing 80 percent of the world's supply. The primary food crops were wheat, castor beans, sesame seeds and peanuts. In addition, many animals, such as camels and sheep were also exported (U.S. Department of State, November 1982). According to American University (1982), only one-third of the country's most important resource, arable land was being cultivated in 1982.

A large constraint to Sudan's economic development has been an inefficient transportation system and the high cost of hauling agricultural products over long distances (U.S. Department of State, 1982).

Following the end of civil war in 1972, the Government of Sudan embarked upon a program of major public investment to bring about rapid economic growth. GDP averaged almost eight percent per annum from 1973 to 1978. However, this growth rate diminished in the years that followed. Export volumes began to decline, leading to large annual trade deficits.

Many of Sudan's loans from foreign institutions fell into arrears. This led the country to secure large loans from private banks, exacerbating Sudan's economic problems (NEA, April 1984). The UNDP/World Bank (July 1983a) states that Sudan's economic difficulties are "further compounded by weak infrastructure, falling agricultural and industrial outputs,

critical energy shortages and an exodus of skilled manpower, mainly to the Gulf States." (p.2)

Energy Sector

Overview

Demand for energy increased measurably in Sudan from 1970 to 1980, partially as a result of the expansion of public investment program. Petroleum consumption increased by almost 50 percent, and electricity consumption almost doubled (NEA, July 1983a).

However, energy supply was substantially curtailed because of foreign exchange shortages and inadequate energy planning. Increased electricity demand led to frequent power failures, load shedding and power fluctuations. In order to cope with these conditions, Sudan initiated a "priority allocation system." The Nationl Energy Administration (NEA) contended that this measure resulted in "inefficient and ill-timed supplies and occasionally [in] fuel disruptions to many consumers." (NEA, 1982, p. 3)

Sudan's final energy consumption in 1983 totaled 6.1 million TOE, of which 82 percent was fuelwood, charcoal, and other biomass. The remainder (18 percent) was imported oil and hydroelectricity. Households consumed the largest percentage of fuel (77.8 percent), followed by transport (11.0 percent) and industry (5.8 percent). In 1983 almost all commercial energy in Sudan came from hydroelectricity and imported oil. (Petroleum imports accounted for 94.5 percent of commercial

energy consumption and hydroelectricity supplied 5.5 percent) (UNDP/World Bank, July 1983a).

Woodfuels

Limited data exists on Sudan's forestry resources. The results of a study carried out by the Forestry Administration, using 1972 Landsat imagery[3] in thirteen strata of the country (in conjunction with a study in the Blue Nile, White Nile and Kassala provinces in April and May 1980) estimated the total growing stock at approximately 1,994 cubic meters. However, a growing stock inventory carried out in selected areas, including the Blue Nile Province, revealed a serious reduction in growing stock, with estimates as low as one-third of previous figures (UNDP/World Bank, July 1983a).

Electricity

Most of Sudan's electrical power, is provided by the National Electricity Commission (NEC). The remainder is generated by private industry to meet their own needs. In FY 1981 NEC generation 965 GWh, amounting to 65 percent of total consumption. NEC's total generation capacity in 1982 was 311 MW, of which 160 MW was hydro-electric and the remainder was thermal. Because of the age of the equipment, the lack of spare parts, major overhauls and other problems, the "serviceable (or reliable)" capacity was 220 MW. Private generation is estimated to have grown approximately 70 percent since 1978 (UNDP/World Bank, July 1983a).

Petroleum was discovered in the southern part of Sudan in 1982. The amounts available are not yet known but considered by Chevron, the company carrying out exploration, to be large enough to justify development. Increases in consumption of petroleum products in the 1970's were about four percent per annum, when the GDP was growing at a rate of about 2.6 percent per annum. The increase in gasoline and gasoil was well above this average, reflecting a high growth rate in the transport sector. Roads were expanded during that time. From 1970 to 1980 road freight haulage increased by about 16 percent per annum, and taxis and autos increased at a rate of around 11 percent per annum. Personal automobiles increased at an average annual rate of about 13 percent (UNDP/World Bank, July 1983).

Verifiable figures were not available for petroleum consumption by sector. However, the UNDP/World Bank (July 1983) estimates that a major portion of the increase in consumption can be attributed to the transport sector. They further estimate that consumption in the industrial and agricultural sector was stagnant or increased only slightly, while the consumption of petroleum (mainly kerosene) in the household sector declined (UNDP/World Bank, July 1983).

Natural Gas

In the 1960's natural gas was discovered in the Red Sea. Although energy analysts believe that this source has certain potential for utilization in the domestic markets,

natural gas has not yet been used as an energy source in Sudan (American University, 1982, UNDP/World Bank, July 1983).

Overview of Sudanese Energy Institutions

There are several institutions and organizations involved in the energy sector in Sudan. According to the Republic of Sudan (1984), these can be classified into two basic categories:

1. those which fall directly under the jurisdiction of the Ministry of Energy and Mining, including the National Energy Administration (NEA), the National Electricity Corporation, (NEC), the General Petroleum Corporation (GPC), the Sudanese Mining Corporation (SMC), the Geological and Mining Resources Directorate (GMRD), and the National Water Corporation

2. those who were under the jurisdiction of other ministries whose objectives relate to the energy sector, including the Forestry Department of the Ministry of Agriculture and the Energy Research Council of the National Council for Research (Republic of Sudan, undated).

During a ten-day period in November 1984, a number of Sudanese energy institutions were visited, and members of their staff were interviewed. Efforts were made to interview those having primary responsibility for data collection and analysis in ministries and agencies that play a major role in this area. It was not possible, however, during the limited time in Sudan to conduct a review of all institutions that interact with the energy sector. Members of the staff of each of the agencies listed below were queried about energy planning activities, staff training and backgrounds, as well as about

data collection problems frequently encountered. A complete list of individuals interviewed is found in Appendix K. Agencies visited included:

Ministry of Energy and Mining

National Energy Administration

General Petroleum Corporation

National Electricity Corporation

Ministry of Agriculture (Forestry Department).

Ministry of Energy and Mining (MEM)

The Ministry of Energy and Mining was established in 1977 in response to the energy crisis. The purpose of this ministry is to coordinate the energy functions of the various Government of Sudan entities dealing with energy matters. The MEM is comprised of 47 members, including the Minister and State Minister (UNDP/World Bank, May 1983).

National Energy Administration (NEA)

Duties

The National Energy Administration was established in 1980 as the planning and coordinating arm of the Ministry of Energy and Mining (MEM). The objectives, as stated in the original mandate are:

1. to coordinate energy planning and analysis for the Ministry of Energy and Mining (MEM)

2. to initiate and operate programs in areas outside the sphere of the General Petroleum Corporation (GPC) and the National Energy Committee (NEC), particularly with respect to energy conservation and renewable energy (Republic of Sudan, undated, p. 2)

More specifically, the NEA's objectives are:

1. to collect, store and reproduce all information relevant to energy resources, processes, transmissions and distribution, and to avail such information for all energy institutions

2. to draft short- and long-term energy policy and planning for the Republic of Sudan and to follow-up its execution, in coordination with relevant institutions

3. to draft within the Energy Plan a national energy conservation program and to coordinate its implementation

4. to up-grade the technology presently used in Sudan in usage of new and renewable resources and to commercialize new technologies that proved economically feasible in other developing countries and adapt simple processes from industrial countries to the conditions of Sudan

5. to develop awareness of the Sudanese citizen to the economic impact of energy conservation in household and productive activities, through technical advertisement and different mass-media

6. to coordinate in the sphere of energy policy, energy planning and energy pricing and allocation among different units within the Ministry and outside governmental and private organizations

7. to develop private sector activities and initiatives within the energy sector and to get from government offices the maximum possible incentives, as well as to orient part of the international aid toward such activities, whenever needed (Shulli, 1983, p. 5).

Since the April 1985 change in government, Sudan has been in the process of reviewing its institutions. As part of this process, the NEA, under the leadership of Director General Dr. Abdel Rahman Shulli, began discussions with division managers, section heads representatives of the trade union and the USAID Energy Planning and Management Project staff in order to design a more effective organization. After extensive review, a revised organizational structure was tentatively developed, consisting of the following divisions:

1. Techno-Economic Studies Division--responsible for encouraging viable, efficient production and utilization of energy resources by conducting techno-economic studies, project evaluations and promotion activities, including government organizations and the private sector

2. Planning Division--responsible for providing overall energy planning at national and regional levels to ensure a well functioning energy sector for the short-and long-term

3. Information Systems and Studies Division--responsible for providing reliable, up to date information and studies for overall planning and decision-making

4. Financial and Administrative Affairs Division--responsible for providing support for NEA objectives through effective management systems (Goddard, 1985).

Figure 7.1 graphically depicts NEA's organizational structure and responsibilities.

Staff Composition and Training

Senior staff members of the NEA were drawn from the General Petroleum Corporation and the National Elecricity Corporation, the Ministry of Agriculture, and the Ministry of

NATIONAL ENERGY ADMINISTRATION
ORGANIZATIONAL STRUCTURE

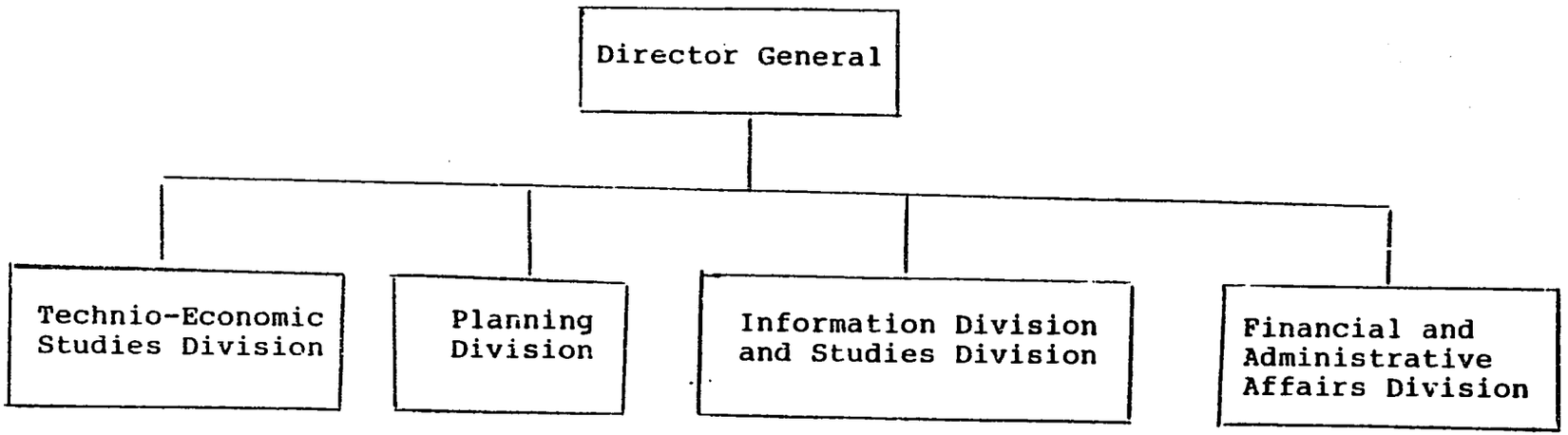

Figure 7.1. Source: "National Energy Administration Organizational Structure: A New Beginning," by Dr. Cathryn Goddard, Energy/Development International, Committee on Organizational Structure, National Energy Administration, Sudan Energy Planning and Management Project, Ministry of Energy, Industry and Mining/USAID, September 1985, p. 11.

Industry and Commerce. Table 7.1 depicts the educational backgrounds of NEA staff who participate in energy data collection and analysis.

TABLE 7.1.
NEA PROFESSIONAL STAFF INVOLVED IN ENERGY DATA COLLECTION AND ANALYSIS

Level of Degree	Type of Degree	Number of Staff
Bachelor's	Engineering	19
	General Sciences	15
	Information	1
	Economics	5
	Geology	2
	Agriculture[a]	11
Master's	Engineering	2
	Statistics	1
	Total	58

[a]Includes forestry

Source: "NEA Management: Organizational Structure--Review of Staff Qualifications" by Lona Wilson, January 1984. (Information verified in personal interviews with NEA staff in November 1984.)

At the time this survey was conducted, 40 of the 58 professional (degreed) had participated in some type of training. The distribution of trainees into each type of training is shown on Table 7.2.

TABLE 7.2.
NEA STAFF TRAINING

Type of Training	Number of Staff Trained
Long-term only	11
Short-term	29
Both long-and short-term	3
No training	18
Total	58

Source: "NEA Management: Organizational Structure--Review of Staff Qualifications" by Lona Wilson, January 1984. (Information verified in personal interviews with NEA staff in November 1984.)

One problem faced by the NEA is high staff turnover. In November 1984, 34 of the total 58 NEA positions were filled. The remaining 14 were away on long term training.

The NEA recognized that in order to accomplish its objectives, the organization must be able to attract and retain competent staff. In September 1985, in response to the need to restructure the organization in order to to become more effective, the NEA conducted an assessment of human resource development needs. According to the NEA (September 1985), institutional and organizational factors play a critical role in determining the composition and level of competence of an agency's staff. The NEA assessment identified a number of institutional shortcomings which impede the development of a pool of skilled staff in the NEA. These are summarized below.

1. The recruitment process is "haphazard" and is overly dependent upon the central establishment office and individual preferences for nomination and selection. Because staffing needs are inadequately determined and job candidates are insufficiently reviewed, there is often a mismatch between the capabilities of individual staff members and the capabilities required for the position.

2. No formal orientation is provided for new staff members, and it is sometimes unclear what is expected of them.

3. The promotion from probationary to permanent status is perfunctory, with little accountability. Promotion from junior level to section head occurs on the basis of seniority, rather than merit. Consequently, the person "next in line" is promoted, whether or not he or she possesses the skills areas required for the position.

4. It is difficult for staff to transfer form one section or division to another. Rather than encouraging personnel to move into positions commensurate with their skills, interests and backgrounds, the agency urges individuals to "fit-in with whatever part of the organization they are assigned." (p. 7)

5. Long term training opportunities are allocated chiefly on the basis of tenure, with performance only considered secondarily. Those who return from training are expected to make a greater contribution, but "in an unclear way." (p. 7) There is usually no specific job assignment awaiting trainees upon their return.

6. The expectations for a higher post exceed available opportunities.

7. Terms of service fall short of expectations for those who have marketable skills.

Based on these results, the NEA is in the process of building a career development program that focuses on: (a) recruitment; (b) career development (providing staff with the opportunity to advance in the organization along a definable career path while gaining skills, experience and

responsibility); (c) promotion (establishing and enforcing standards); (d) training ; and (e) work experience (designing and implementing a work program which achieves the organization's goals in a way that is meaningful to the individual (NEA, September 1985).

In order to carry out this program, the assessment team concluded that it was necessary to define career paths for NEA employees. This involves classifying jobs or positions at each level in the organization; defining the sequence of advancement; and clearly stating the expectations for performance at each level, as well as the standards for promotion.

Analytic Equipment

At the time interviews were conducted, three IBM/Harbir microcomputers were available to NEA staff. In addition, optimization software had been developed for use with the agency and at the time interviews were conducted, software designed specifically for use with energy statistics was being acquired. Eight staff members were regular users of this equipment. One operator and two assistants have received formal training on use of microcomputers.

Planning Activities

The National Energy Administration, in conjunction with the Sudan Energy Policy and Planning Project (SEPAP) and the Energy Planning and Management Project (EPM) have been involved in a number of energy planning activities. The most notable of

these were the National Energy Assessment, conducted in 1982 and Sudan's National Energy Plan. The National Energy Assessment consisted of a variety of analyses, including: (a) a fuel supply-demand analysis; (b) an analysis of alternative energy strategies; and (c) a policy analysis to establish priorities among various energy strategies.

Training Needs

The training need most frequently mentioned by NEA staff was the use of computers in the tabulation and analysis of data. Training in procedures for data collection were also considered to be lacking. In-country, on-the-job training of approximately two to three months in duration was thought to be best suited to the NEA's needs.

When asked to list institutions, organizations or individuals capable of providing such training, NEA staff listed the names of two computer companies who were scheduled to provide training, maintenance and service of microcomputers: Advanced Systems and El Waggie Commercial (Wang PC).

The results from the NEA training assessment (September 1985) described above indicated that a strong training program is fundamental to to improving organizational efficiency and effectiveness. Such a program attracts individuals to the NEA who are willing to accept lower terms of service in exchange for the chance to gain new skills, acquire a degree or travel

abroad. They maintained that without the NEA's emphasis on training the caliber of staff would be much lower.

After reviewing the NEA's past and present training program, the following shortcomings were identified:

1. training needs have not been clearly defined
2. financing and decisions on courses and acceptances are controlled primarily by donors, over whom the NEA has little influence
3. opportunities appear sporadically, often with little notice
4. some staff enroll in programs which are not suitable to their background and skills, nor relevant to the needs of organization
5. at times the effectiveness of the NEA and other institutions has been hampered because too many staff members were away on training at the same time.
6. on-the-job and local training programs have been underutilized because many staff do not take local training seriously.

Despite these criticisms, the NEA assessment concluded that the benefits of the program far outweigh the negative aspects. At the time of the assessment, four staff members had returned from overseas training with M.sc.'s, of whom two had served as division managers, and a third was a section head. According to the NEA their expertise proved to be invaluable to the work program. In addition, it was felt that the availability of opportunities had attracted qualified individuals to the NEA. At the time the assessment was conducted, nine other staff members were expected to return to the NEA with Master's degrees within six months.

As a result of the training assessment, a tentative training program was defined which describes proposed training by level (i.e., entry, junior, middle and senior). This program stresses a broad range of skills, including engineering and economic principles, data collection and interpretation, use of computers, office administration, written communication, management, supervising skills, project design, negotiation, personal effectiveness, quantitative analysis for decision management and long-and short-term planning.

General Petroleum Corporation (GPC)

Duties

The General Petroleum Corporation was established in 1976 but did not actually become operational until an amendment was passed in 1980. Before 1973 private companies were the sole importers and distributors of petroleum products. However, the emergence of the international oil crisis in 1973 prompted the Government of Sudan to create the Petroleum General Corporation (GPC), a component of the Ministry of Mining and Industry. Once the GPC became operational in 1980, it incorporated both the functions and personnel of its predecessor. In addition, it took over the responsibility for managing the Port of Sudan--Khartoum pipeline and government shares in the Port of Sudan Refinery, adding a number of public sector activities related to oil exploration, production, refining and distribution (UNDP/World Bank, May 1983; personal interviews, November 1984).

According to the 1980 Amendment, the GPC shall carry out the following objectives:

1. to undertake exploration for petroleum materials refining, purchase, sale, distribution and transportation

2. to import crude petroleum and its derivatives and products, and to export the surplus

3. to own, purchase, sell and lease land and all types of industrial installations necessary for achieving its purposes

4. to participate in any national or foreign firm in order to achieve any of the corporations' purposes

5. to borrow in the Sudan or from abroad from banks or any other corporations for the purpose of achieving its objectives

6. to commence operations depending on its own fund for the purpose of realizing profits

7. to establish branches or offices within or outside the Sudan

8. to sign contracts and enter into any commitment the corporation deems necessary for fulfillment of its purposes, whether with the government or any other person in the country or abroad

9. to perform any other work assigned by the Minister of Energy. (Republic of Sudan, 1980, p. 1)

The GPC is comprised of three main General Administrations: (a) Refinery Distribution; (b) Transport of Petroleum Products; and (c) Exploration and Production. Each Administration is linked to units responsible for planning, finance, and personnel. The Economics and Planning Department carries out its mandate through service units, such as the

Statistics Department, the Computer Department, and the Library.

Staff Composition and Training

The GPC employs over 900 people, of which 32 are in the Economics and Planning Department. Several staff members in Port of Sudan General Administration participate in energy data collection and analysis. Table 7.3 depicts the educational background of the GPC Economics and Planning Department. Table 7.4 shows the energy data collection and analysis training programs in which GPC staff members have been involved.

Analytic Equipment

At the time interviews were conducted in, one mainframe computer and two IBM microcomputers were being used. Approximately 10 employees in the Exploration and Production

TABLE 7.3.

GPC STAFF INVOLVED IN ENERGY DATA COLLECTION AND ANALYSIS

Type of Degree	Level of Degree	Number of Staff
Engineering/ Economics/ Statistics	Bachelor's	30
Operations Research/ Forecasting	Master's	2
	Total	32

TABLE 7.4

GPC ECONOMICS AND PLANNING DEPARTMENT STAFF TRAINED IN DATA COLLECTION AND ANALYSIS

Institution Providing Training	Type of Training	Duration of Training	Number of Staff Trained
GPC/Govt. of Egypt	Statistical Sampling	8 weeks	most of staff
GPC/Govt. of Egypt/USAID	Evaluation Techniques	8 months	most of staff
Canadian International Development Agency (CIDA)/ United Arab Emirates (Kuwait)	Use of micro-computers/ programming	11 weeks	2
CIDA	Use of Software	3 weeks[a]	2
USAID[b]	Energy Sector Demand Analysis Techniques	6	1

[a]CIDA later returned and trained other staff in this area.

[b]Conventional Energy Training Program.

Department make use of the mainframe computer. Five new IBM microcomputers were being purchased (three for the Economics and Planning Department, one for the Financial Department and one for the Port of Sudan). Several commercial

software packages are frequently used, including LOTUS, Visicalc, Optimizer, and a software package developed by a Canadian company for processing data on refining, distribution and consumption are frequently used.

Planning Activities

The GPC Economics and Planning Department is primarily responsible for planning in the petroleum sector; for collaborating with NEA on national planning, for GPC investment planning related to projects and for developing annual plans. This department recently completed a feasibility study on the use of road tankers to solve transport problems, utilizing a market survey approach. In addition, the GPC produced a product quality report on the Port Sudan Refinery in 1979 and a report on refining and fuel losses in 1983.

Many studies have been produced by consultants. The GPC commissioned a study to conduct three pre-feasibility studies of an inland refinery, including examining options for: (a) a topping plant at Kosti; (b) blending crude oil at Port Sudan Refinery and; (c) a new refinery at Kosti or on the Red Sea.

Additionally, a review of options for the use of oil and gas was conducted in late 1984, under a World Bank Technical Assistance Project.

Training Needs

GPC staff members who were interviewed felt that the acquisition of microcomputers had solved many of the data and communication problems which had previously existed. However,

they thought that training was needed in the use of microcomputers and in developing and utilizing management information systems. Short-term, in-country training were deemed to be most useful.

National Electricity Corporation (NEC)

Duties

The NEC was created in 1982, when the former Electric and Water Authority was divided into two independent organizations. The NEC has recently been reorganized, and the distribution system was decentralized, with the intention of placing more authority in the hands of the regional governments. However, progress in that direction has been slow in coming.

According the 1982 NEC Act, the NEC has the following objectives:

1. to utilize the national energy resources economically in order to secure the country's needs of electricity power for the different sectors and to expand in its business in proportion to the growth of these needs

2. to carry out its activities on a commercial basis and to achieve annual return at such rates as may be specified by the Board to provide the necessary funds for implementing its development plans (Republic of Sudan, undated, p. 5).

In order to carry out these objectives, the NEC performs the following functions:

1. construction and management of the electrical plan of national grids for distribution to consuming areas

2. construction and management of electrical poles for the distribution network of Khartoum province

3. generation and transmission of electricity from national resources and from wholesale of the same to the regional administrations through the distribution networks that were connected to the national grid, in accordance with price lists and technical means determined by the corporation (Republic of Sudan, undated, p. 5).

The Corporate Planning Department has recently established a Management Information System to collect technical and non-technical data and to analyze energy data. This office will produce annual and quarterly implementation reports and data for donors and consultants.

Staff Composition and Training

Most data collection and analysis in the NEC is carried out by the Corporate Planning Department. This department is comprised of a director, four divisional managers, five engineers, and four economists. Table 7.5 depicts the educational backgrounds of the NEC Corporate Planning Department.

Nine NEC employees have been involved in short courses in conventional energy the United States. In addition, most NEC Corporate Planning Department staff members have been involved in courses taught under the Sudan Energy Planning and Management Project.

TABLE 7.5.

NEC CORPORATE PLANNING DEPARTMENT
EDUCATIONAL BACKGROUND

Degree/ Diploma	Number of Staff
Ph.D.	2
Master of Science	1
Bachelor of Science	3
Bachelor of Arts	2
Economics/Statistics Diploma	1
Engineering Diploma	3
Post Graduate Diploma Engineering	1
Post Graduate Diploma Economics	1
Total	14

Analytic Equipment

The NEC had access to one Apple microcomputer and one NCR mainframe computer. A UMIST software package is utilized. Six staff members utilize the microcomputer.

Planning Activities

The NEC has ben involved in a variety of energy planning activities. Some of the more prominent of these are listed below.

1. Pre-feasibility and feasibility study

   a. Power IV[4] Project feasibility study

   b. Marwawi hydropower dam pre-feasibility study

   c. study of the utilization of sources of power and the sugar industries

   d. town electrification pre-feasibility study (ranking of small towns for electrification)

   e. Port of Sudan Power Station and network feasibility study

   f. small hydropower in the south pre-feasibility study

2. Others:

   a. Khartoum area distribution network rehabilitation and reinforcement

   b. load management and reduction of energy losses

   c. rehabilitation

Studies conducted by outside consultants and other agencies that NEC staff deemed to be particularly useful included: (a) surveys of hydro potential in the south, by Bon Africa; (b) an analysis of the use of agricultural wastes and and assessment of mini-hydro in Geizra and Jabal Marra in western Sudan--both by Swedish Consultants (SWECO); (c) a study of the potential of wind and solar energy utilization in the Sudan (commissioned by the Swiss Government and carried out by the consultants Electrowatt); and (d) the National Energy Plan by the Ministry of Energy and Mines (with input from the NEC).

Training Needs

NEC staff consider additional training in the use of computers to be of high priority.

Ministry of Agriculture (Forestry Department)

Duties

The Ministry of Agriculture, Forestry Department was established in 1902. Its central responsibilities are to oversee the utilization of Sudan's forests; to work toward the prevention of deforestation and to develop forestry management plans aimed at achieving these objectives.

Staff Composition and Training

This department employs eight foresters (all of whom have bachelor's degrees in forestry) and one draftsman with a secondary school diploma. None have had training in data collection and analysis or in the use of computers. All forestry degrees require the completion of one course in statistics.

Analytic Equipment

No computers are available to the Ministry of Agriculture, Forestry Department.

Planning Activities

Very little forestry/fuelwood planning had been undertaken by this ministry in the past. However, ministry staff were collaborating with several donors in analyzing Sudan's forestry needs. A four-year project entitled "Fuelwood Development for Energy in Sudan," funded by the Netherlands and

executed by the Food and Agriculture Organization (FAO) began in September 1983.

In September, 1984, the Canadian Government conducted an inventory of natural resources in the Blue Nile and Bahr el Ghazal Provinces. The focus of the inventory was on resources of construction timber, rather than fuelwood reserves, however. The UNDP/World Bank (November 1984) recommended the using aerial photographs and the extension of these surveys to include all provinces.

The World Bank, at the request of the Government of Sudan is collaborating with a number of other donor agencies in conducting a detailed Forest Sector Review. This review began in November, 1984 and is expected to form the basis for future planning and development of forest resources (UNDP/World Bank, November 1984).

Training Needs

Forestry Department staff expressed the need for training in statistical sampling and in the use of computers. The preferred duration of training was medium (one year) to long term (two year master's program) overseas. The Netherlands International Training Institute was suggested as a potential source of training.

The Geological and Mining Resources Directorate (GMRD)

The GMRD is responsible for conducting geological studies, prospecting for minerals and monitoring petroleum exploration activities. It consists of two divisions: The

Mineral Resources Administration and the Petroleum Administration. Because the GMRD has little involvement in the type of energy data collection and analysis activities investigated in this study, it was not included in the analysis.

Government of Sudan/USAID Energy Planning Project

In August 1980, the Government of Sudan (GOS) and USAID entered into an agreement which began the Sudan Energy Policy and Planning Project (SEPAP) with the following objectives:

1. to assist the Government of the Sudan in drawing up an extensive energy data base, that would quantify the amounts of energy supplied and consumed in the Sudan by detailing the origin and supply of energy to all primary customers

2. to examine possible alternatives to current energy supplies

3. to...assist the NEA in its role as an information, monitoring and policy analysis arm of the MEM

4. to train Sudanese staff in energy data collection and analysis in all major supply and end-use (NEA,September 30, 1983, p. 2)

This agreement provided for two AID-funded long-term resident advisors and a number of other specialists available on an intermittent basis. Initially, the project called for a 65 person-month level of effort by U.S. experts over 18 months, at a cost of $650,000. The Government of Sudan agreed to provide approximately 100 person-months of effort (Arthur D. Little, Inc., 1984).

A contractor team consisting of International Science and Technology Institute, Inc. (ISTI), and Energy Development

International, Inc. (EDI) as subcontractor was selected to carry out the project.

The project began in January 1981 and was later expanded in response to GOS requests. It was concluded in March 1984. However, these activities were followed by the Energy Planning and Management Project (EPM), an AID/Sudan funded project, which continues to provide technical assistance.

The project was designed to work closely with other MEM agencies, as well as Sudanese and foreign agencies engaged in energy planning and monitoring. SEPAP activities consisted of two types: energy information and analysis; and institutional development. The former category involved data collection, information and development and analyses of energy issues. The later category consisted of organizational, advisory, and support activities (Arthur D. Little, Inc., 1984).

Energy Information and Analysis

Activities which may be classified under this category were primarily focused on the development of energy supply and demand data, the identification and analysis of energy issues, and the development of a national energy assessment. A national energy plan for Sudan was subsequently developed as a part of the follow-on the Energy Planning and Management Project.

Leading up to these activities were analyses in areas such as: energy utilization, energy supply and conversion, energy distribution, supply/demand balances, energy economics,

electricity generation, economic and environmental impact and analytical techniques.

Institutional Development

The chief accomplishment of SEPAP in the area of institutional development was in the establishment and development of the NEA into a viable institution. Project activities took the form of advising NEA on organizational, staffing, and compensation matters, training the staff, participating in policy deliberations and responding to requests by the MEM Minister for advice on energy and institutional matters (Arthur D. Little, Inc., 1984). Appendix L depicts the formal training program implemented in this project.

Quality of Data

A number of energy studies have been conducted by the NEA and others, as a part of SEPAP and EPM. This discussion focuses specifically on the National Energy Assessment and the Sudan Energy Balance (NEA, 1983).

The primary objective of this examination of data quality was to determine whether:

1. units of measure and conversion factors, as well as routes to conversions were adequately specified
2. terminologies were clearly defined
3. data collection methodology was specified
4. sources of information were properly documented, and studies can be easily replicated
5. calculations were accurate
6. limitations on data were delineated.

National Energy Assessment

Overview

The Sudan National Energy Assessment was carried out as a part of the GOS/USAID energy planning and policy project. It involved over two years of intensive work by project and National Energy Administration (NEA) staff. In conducting this analysis, NEA and project staff worked closely with a wide range of individuals, agencies and ministries in Sudan. Ten NEA permanent staff and approximately 50 staff members of other ministries were involved in this process. Four major energy sector committees were formed to assist in data collection and analysis. The committees and the organizations from which they were comprised are listed below.

1. Transport Committee:
   - o National Truck Owners Association
   - o Khartoum Union of Taxi Drivers
   - o General Petroleum Corporation (GPC)
   - o University of Khartoum
   - o private oil distribution companies
2. Agriculture Committee:
   - o Gezira Farmers Union
   - o Ministry of Irrigation
   - o Ministry of Agriculture
   - o Mechanized Farming Corporation
   - o University of Khartoum

- o Forestry Department
- o private farmers

3. Households Committee:

- o Desertification Control and Encroachment Rehabilitation Program
- o University of Khartoum Research\Institute
- o Land Use Department
- o private individuals, ministries and institutes

4. Industrial Committee:

- o private business community
- o public industrial corporations
- o Sudanese Industrial Association
- o National Electricity Corporation (NEC)

These committees met regularly for over a year and produced reports on specific energy-related topics. Project staff interacted extensively with the GPC and the NEC, along with many other agencies and private petroleum distribution companies.

Most of the actual field work was conducted by NEA staff, while it was estimated that 90 to 100 percent of the analysis was completed by expatriate project staff. However this exercise served as training for many NEA staff members who later participated in all stages of data collection and analysis for the Sudan National Energy Plan[5] which followed. The National Energy Assessment is comprised of an executive

summary, a main report, and six annexes. These are listed below.

"Executive Summary," NEA, October, 1983

"National Energy Assessment," NEA, September 30, 1983

"Annex 1: Base Year (1980) Energy Supply/Demand Balances and Demand Projection Methodology," NEA, March, 1983

"Annex 2: Transportation Sector," NEA, April 1983

"Annex 3: Forestry and Woodfuels Resources," NEA, May 1983

"Annex 4: Agricultural Sector," NEA, May 1983

"Annex 5: Household Sector," NEA, June 1983

In addition, numerous background reports were produced by the Energy Planning Project in compiling the main volume and annexes of the Sudan Energy Assessment, including:

"Energy Use in the Industrial Sector of Sudan," NEA, June 1981

"Investigation of Petroleum Supply and Distribution in Sudan," NEA, June 1981, Revised September 1981

"Recommendations for the Short-Range (1981-1986) and Reliability Improvement Programs," NEA, August 1981

"Long-Range Electricity Futures for Sudan: Two Scenarios, 1982-2000," NEA, September 1981

"An Examination of the Impact of Energy Supply Problems on Sudanese Industry and a Review of Energy Use and Energy Efficiency," NEA, November 1981

"A Comparison of Sudanese Export Performance with Key Petroleum Imports," NEA, December 1981

"Traffic Reform and Energy Conservation for Vehicles in the Capital-Khartoum Area," NEA, December 1981

"Renewable Energy Assessment for the Sudan," NEA, September 1982

"A Review of Laws Covering Importation of Energy Intensive Goods," NEA, April 1983

"The Nature of Land Laws in Sudan (with specific reference to forestry)," NEA, April 1983

"The Problem and Causes of Debris Accumulation at Roseires Dam: An Initial Survey," NEA, April 1983

"Current Population of Sudan and Projections to the Year 2000," NEA, April 1983.

According to Dr. Shulli (1984), the Sudan National Energy Assessment had a number of important implications for Sudan energy planning. First, the NEA collected a substantial amount of energy data, which for the first time, is located in one place.

Second, information was provided that is useful for further analyses. For the years 1980-1983, the assessment provided data on: (a) energy production coefficients; (b) consumption ratios by sector and region; (c) resource allocation for each sector and region; and (d) overall consumption; and economic losses due to deficient energy supplies (1983 only).

Third, for the first time, the energy situation could be analyzed, the dimensions of the energy problem could be examined in an integrated manner, and interrelationships could be discerned. The supply/demand balance information allowed comparisons to be made with other developing countries. Energy

balance tables could be used for forecasting purposes to illustrate the magnitude of future energy problems and to guide decisions on issues such as pricing. Fourth, official and public awareness of energy problems increased.

Data Collection Methodology

The National Energy Assessment covered 18 administrative provinces which were grouped into seven regions, forming the basis for regional data presented in the report. Six energy sub-sectors were analyzed, including: (a) household; (b) forestry and woodfuels; (c) agriculture; (d) industry; (e) transportation; and (f) commercial and government services. The methodology for conducting assessments in each of these areas is described below (NEA, April 1983; Shulli 1984; personal interviews with NEA staff, November 1984).

Household. Estimates of household energy consumption involved several surveys, as well as analyses of existing data. An estimate of urban and rural consumption of biomass resources, including firewood, charcoal, crop residues and animal wastes were estimated on the basis of household energy surveys.

A total of 24 staff members were involved in the survey, including ten NEA staff, eight staff from the Forestry Research Institute, and six from the Statistics Department. Household energy surveys took place in 30 provinces. One or two villages were selected from each province and 60 interviews were conducted in each village. Although a random sample was not

selected, areas surveyed were selected in such a way as to include a cross-section of income levels, ecological zones and so forth. Sample selection was not systematic, but rather the interviewers selected the households to be included in their sample, with these criteria in mind.

Individuals involved in the household energy surveys cited difficulty in obtaining information on which to base sample selection. Because it was not always possible to obtain an accurate estimate of the population in each province or village, it was extremely difficult to determine whether a statistically valid sample had been collected. However, ministry staff felt that the sample results were reasonable estimates of average biomass consumption in Sudan.

In addition to interviews with household members, typical daily fuel requirements were weighed at each household, using a spring balance. Estimates of household kerosene consumption were determined by examining government imports and Port Sudan refinery output of kerosene as well as sales of kerosene by the General Petroleum Corporation to each province.

Electricity household consumption estimates were obtained directly from the National Electricity and Corporation consisted of: (a) the number of residential sectors in each area serviced; (b) total sales ascribed to residential customers (NEA, June 1984).

Forestry and woodfuels. The National Energy Assessment expanded upon forestry data compiled in 1960 by the Food and Agriculture Organization (FAO) by conducting several analyses. First, a Sudanese specialist worked with the Nairobi Remote Sensing Facility in March and April of 1982 to draw up a complete vegetation map of Sudan. Landsat photographs covering Sudan from 1972 through 1979 were used to divide Sudan into 13 different vegetation strata and one sub-stratum.

Second, a series of aerial photographs were used in conjunction with landsat photographs taken in the 1960's, and numerous studies by Forestry Administration and donor agencies. In addition, field teams were sent to several provinces of central and eastern Sudan to conduct limited ground surveying and enumeration. These assessments were conducted in order to update estimates derived from other sources. These data were used to draft a strategy for wood resources for the National Energy Plan (NEA, May 1983(a); Shulli, 1984).

Agriculture. Energy in the agriculture sector was estimated from a detailed analysis of agricultural activities by area and by crop. Activities included were irrigation pumping and mechanized agricultural operation (i.e. land preparation, fertilizer application, and so forth) (NEA, May 1983(b); Shulli, 1984).

No real sampling frame was utilized, but rather teams visited all major agricultural systems (schemes)[6] and some small farms. The data collection procedure generally involved

sending field teams to meet with authorities in agricultural schemes in order to collect data on areas cropped each year, energy consumption on each scheme, as well as yields and production. Most of the schemes visited were run by the Government of the Sudan.[7] Consequently, good records were usually kept.

Records in the private sector farms were poorly kept. However, because the same procedures were usually followed by private farmers as on government farms, rough estimates were made where records were not available. Farmers were generally cooperative about answering questions because the government had a policy of providing for the fuel[8] needs of Sudanese farmers.

Estimates of fuel consumption for irrigation were derived from coefficients of fuel use per activity per feddan[9] of cultivation for various crops and schemes in Sudan. Gasoil consumption for irrigation was calculated based on running head volume of water lifted (NEA, 1984). Survey participants reported that energy consumption the production from rainfed schemes was very difficult to estimate because many people plant in areas outside designated planting areas.

NEA staff felt that the estimates of energy consumption in the agricultural sector were reasonably accurate. It was noted that prior to the assessments, many farmers were complaining that they were not receiving sufficient supplies of fuel. After fuel allocations were recalculated on the basis of

the surveys, complaints ceased. Plans are to continue these assessments, along with efforts to find ways of conserving fuel in the agricultural sector.

Industry. A questionnaire was used to collect energy consumption data in the Sudan's major industries. Operational efficiency, as well as fuel efficiency estimates were made on the basis of data provided by owners and managers. A total of 75 of the Sudan's 200 major factories were visited. These privately owned companies were located mainly in the Khartoum area and included among others, oil and soap, vegetable, sugar, textiles, cement, and brick-making factories.

Information in the industrial sector is characterized by bad record keeping and unreliable figures. In addition, most managers demonstrated little interest in cooperating with NEA interviewers. Among the problems cited by survey participants were:

1. the owners or managers of the factories were not aware of the purposes of the questionnaire, and therefore gave very imprecise responses
2. staff members conducting the surveys were not well trained
3. the questionnaire was complex and difficult for interviewers, as well as respondents to understand
4. most small firms have no log sheets for recording information
5. there were no standardized units of measure and units differed from company to company (e.g. tons, KWh, money)
6. survey staff had difficulty in converting units because of unstable prices of energy (black market prices)

7. inaccurate data were often provided to avoid paying taxes.

Commercial and government services. This sector analysis consisted of a set of unrelated activities, based on retail establishments, office buildings, hospitals, hotels, a broad range of other users that consume electricity; restaurants, tea houses and beer houses that consume charcoal and firewood. Also included were the activities of the construction industry (buildings and roads) and of petroleum exploration companies.

Eight of the major road construction companies were interviewed by NEA staff. The consumption of gasoil by petroleum exploration companies was recorded by petroleum distribution companies, and these data were obtained by NEA staff.

Estimations of firewood and charcoal consumption in the services sector were derived from Sudan's seven administrative regions. Consumption in the services sector was then calculated for each region separately. The 1973 census was used to determine rural, urban and total population (NEA March 1983).

Very little information was available about the actual procedures which were utilized in conducting these analyses. According to NEA staff, no random sampling procedures were employed in this study.

Transportation. Estimates of fuel consumed by motor vehicles were calculated on the basis of interviews, traffic statistics on vehicle registration, and on sales statistics of the petroleum distribution companies. Very little written information was provided about the specific procedures used in conducting these surveys. According to NEA transportation survey participants, traffic density figures were estimated by locating surveyors at the five major entrances at various times of the day, particularly at rush hour and counting the number of vehicles by type (i.e. private automobiles, taxis, buses, lorries) during a given period. In addition, the total number of registered vehicles was obtained from the Registrar and utilized in estimating energy consumption for motor vehicles. Similar procedures were used in other towns in Sudan. No random sampling procedures were employed.

Fuel consumption figures for railways were obtained from Sudan Railways and the General Petroleum Corporation. The River Transport Corporation provided river transport statistics. Sudan Airways was the primary source of information about air transport (NEA, April 1983b).

General Quality of Assessments

The national energy assessments represent a substantial amount of data collection and analysis on the part of a large number of people. When they were initiated, almost no energy information was available. Much of the data comprising these assessments required a considerable amount of primary data

gathering and estimation. The compilation of this information represents real progress toward the development of a useful base of information on which to base energy decisions and plan programs.

In general, calculations appeared to be accurate, and conversion units were specified, using standard practices. However, there were a number of areas where the assessment process could be improved.

Although most of the figures comprising the assessments were accompanied by source citations, the documentation, in many cases was very general in nature and did not provide enough specific information to enable replication. For example, terms such as "NEA surveys" or "Ministry of Agriculture estimates" were frequently used to describe data origin. Furthermore, terminologies were not alwasys clearly defined.

Survey data collection methodology was seldom described in detail. Interviews with survey participants indicated that random sampling procedures were not employed, although efforts were usually made to include a cross-section of the population under observation. Limitations on data were not explicitly stated, nor were efforts made to estimate the percentage error of the figures comprising the analyses.

Although the National Energy Assessment proved to be a major source of critical information, participants in these assessments pointed to a number of shortcomings in the data.

According to interviewees, a substantial amount of data collected had very little utility. It was felt that not enough thought was given to how the information would be used. In many cases the studies were not clearly defined at the outset.

Some of the earlier data, particularly the petroleum supply figures, were inaccurate and contained obvious inconsistencies. For example, the 1983 energy balance figures were substantially less than those the 1980 balance because of errors which were made in initial estimates.

Data Collection and Analysis Problems

The most pervasive problem cited by those involved in the national energy assessments was the lack of training of participants in four key areas: (a) questionnaire design; (b) statistical sampling procedures; (c) interviewing techniques; and (d) data analysis.

As previously noted, participants in energy surveys, particularly the household energy survey found it extremely difficult to determine proper sample size because of the lack of information about total population in various areas of Sudan.

One difficulty experienced during the assessment process was that of staff turn-over. In many cases, once the staff members had been trained in data collection procedures, either through on-the-job or through donor-funded overseas university programs, they moved into other positions or left to assume

higher paying positions in othr countries, especially the Gulf States.

Energy Supply/Demand Balance

Technical cooperation between donor countries, the World Bank and other international organizations, such as USAID and UNDP, and the Government of Sudan resulted in developing a Sudan Energy Balance (see Appendix M). This balance included resource extraction, refining, conversion, transmission and distribution and end use. Data comprising this table were derived from information collected as a part of the National Energy Assessment.

The recommendations of the UN Statistical Commission were utilized as guidelines by the author for examining procedures employed in constructing the Sudan Energy Balance. (As noted in Chapter 3, a complete list of UN Statistical Commission Recommendations is contained in Appendix A.)

Overall the national energy balance was presented in a very professional manner. For the most part, the format follows procedures consistent with those outlined by the UN Statistical Commission.

Differences between the Commission's recommendations and the Sudan balance sheet were depicted in Appendix N. Appendix O illustrates how the balance sheet would look if it were organized according to the sample format provided by the Statistical Commission. Since it was possible to construct this revised balance sheet using information presented on the

1982/1983 Sudan energy balance, no changes to the original balance sheet were called for.

Similarly, appropriate conversion factors were used and calculations were correct. However, as noted in the review of the energy assessments, improvements could be made in the documentation of data sources. Likewise, conversion factors should be more explicitly stated on the table or in accompanying footnotes, rather than simply referring the reader to referenced UNDP/World Bank documents.

The primary problem with the energy balance sheet is not with the format, nor the procedures used to construct them, but with the data from which these figures were derived. Better statistical sampling and data collection procedures were needed in order to obtain reliable data.

Further, Shulli (1984) maintained that the utility of an energy balance table is limited in several respects. Even though the energy balance provides a fairly accurate picture of the current energy situation, it is inadequate for developing an energy policy and plan for two reasons.

1. it provides a snapshot of the energy situation in a given year, that cannot be extrapolated to the future without assuming a static structure for the economy and its energy interactions

2. such an approach fails to consider pertinent factors such as migration to urban areas, substitution of traditional energy for commercial energy and energy conservation efforts.

Other members of the assessment team contended that supply/demand balances are insufficient for making investment decisions--that more accurate data were required. They maintained that because the information contained in the National Energy Assessment and the balance tables are limited to issues of supply and demand--neglecting areas of energy technology and electricity power options--they are inadequate for decision-making.

Some of the interviewees asserted that many policies and programs relating to the energy area are defined by individual agencies, who rely on their own forecasts or on their personal knowledge and experience in the area, rather than on NEA data.

Summary and Conclusions

Sudan Energy Institutions

A total of five ministries and government agencies, along with the GOS/USAID Energy Planning Project participants were visited in November 1984, and interviews with staff members were conducted. A summary of the educational backgrounds of the professional staff involved in data collection and analysis at each of these institutions is depicted in Table 7.6. As shown, approximately 109 employees of the various ministries and agencies active in the energy sector in Sudan participate in energy data collection and analysis.

TABLE 7.6.

MINISTRY/AGENCY STAFF INVOLVED IN ENERGY DATA COLLECTION AND ANALYSIS

Institution	Degree	Type of Degree	Number of Staff
National Energy Administration (NEA)	Bachelor's	Engineering	19
		General Sciences	15
		Information	1
		Economics	5
		Geology	2
		Architecture	11
	Master's	Engineering	2
		Statistics	1
General Petroleum Corporation (GPC)	Bachelor's	Engineering/ Economics/ Statistics	30
	Master'	Operations Research	2
National Electricity Corporation (NEC)	Post-Graduate	Economics	1
		Engineering	3
	Technical (Engineering) Diploma	Engineering	3
	Bachelor of Science	Unknown	3
	Master of Science	Unknown	1
	Ph.D.	Unknown	2
Ministry of Agriculture (Forestry Department)	Secondary Diploma	Draftsman	1
		Forestry	8
Ministry of Energy	Ph.D.	Unknown	1
		Total	109

Of the employees listed on this table, one holds a Secondary Diploma, two hold Post Graduate Diplomas, three hold Technical (engineering) Diplomas, 93 hold Bachelor's Degrees, and six hold Master's Degrees.

Data Quality

A number of areas for improvement were identified in the analysis of data quality, including:

1. more detailed information is needed in source citations
2. more explicit definitions of terminologies is needed
3. limitations on data should be more clearly stated and estimates of the percentage of error should be calculated
4. the data collection methodology should be described in greater detail
5. efforts should be made to employ random sampling procedures wherever possible

Data Collection and Analysis Problems

The primary data collection and analysis problems encountered by National Energy Assessment participants centered around a lack of training in areas of: (a) questionnaire design; (b) statistical sampling procedures; (c) interviewing techniques. Random sampling was difficult to carry out in many cases, because of insufficient information about the general population.

Other problems arose because of inadequate record-keeping by those from whom information was sought. In addition, a lack of cooperation from interviewees was often experienced for a variety of reasons, ranging from the

respondents' misunderstanding of the intent of the surveys to a general fear of giving out information to a government official.

Training Needs

As indicated above, training in all aspects in energy data collection and analysis are needed in Sudan's energy-related ministries. A comprehensive training program is being designed to meet those needs.

Recommendations

A number of institutional, as well as data collection and analysis problems were identified in this study. The NEA's reorganization, with its current emphasis on human resource development goes a long way toward alleviating those problems. The following suggestions are offered for developing a comprehensive program that addresses Sudan's data problems:

1. In training courses designed to address data collection and analysis issues, emphasis should be placed on areas in which weaknesses were identified (i.e., statistical sampling procedures, questionnaire construction and interviewing techniques).

2. At least one training course should focus on the the analysis of energy supplies and consumption, and the relationship of energy to the overall economy.

Instruction should include procedures for constructing an supply/demand balance sheet, as well as methods for converting units of measure.

3. The importance of citing sources of information conversion factors and specific data collection methodology in such a way that studies can be replicated for future analysis should be stressed.

Notes to Chapter 7

[1]Islam literally means "submission" (American University, 982, p. 10).

[2]Sharia is defined as "the body of formally established, sacred Islamic law. It is based primarily on commandments found in the Quran (Islamic scriptures believed by Muslims to be God's revelations). In theory it governs religious matters and also regulates political, economic, civil, criminal, ethical, social, and domestic affairs of Muslim countries. In practice, however, the sharia is commonly supplemented by the customary law of a region and by government legislation and administrative practice." (American University, 1982, p. 352)

[3]Landsat photographs are photographs taken by satellite.

[4]This is a World Bank-funded power project.

[5]The National Energy Plan took a year and a half to complete. It involved five months of consultant time and the use of computer facilities in Washington. Approximately 15 to 20 NEA staff were involved. Approximately 20 to 40 percent of the work was done by expatriate project staff. Most NEA staff members hold Bachelor's or Master's degrees in Engineering. Additionally, most participants were slated to go into overseas training.

[6]There are three distinct crop farming systems (schemes) in the Sudan:

a. irrigation farming with fairly extensive use of modern inputs such as machinery, fertilizers, pesticides and herbicides

b. rainfed mechanized crop production involving extensive use of machinery but no other modern inputs

c. rainfed traditional crop production, involving neither machinery nor any other modern inputs (NEA, May 1983)

[7]Most of the Sudan's irrigated farming is organized as large public sector schemes where the cultivators are tenants of the government. The government provides irrigation water, as well as a major portion of the material and machinery inputs. Tenants are responsible for all manual operations and must follow the cropping sheme determined by management (NEA May, 1983).

[8] The General Petroleum Corporation (GPC) allocates the fuel to the schemes according to historical supply data. The schemes usually submit their requirements to the GPC. However, due to a national fuel shortage, it is not always possible to give every scheme its total amount required. A new system proposed by the NEA is to provide fuel on the basis of actual field requirements as computed for the per unit area consumption for agricultural operations and irrigation. This factor can be used to calculate the fuel needs of any crop for any given area (NEA, May 1983).

[9] A feddan is defined by American Univeristy (1982) as "a measurement of area used in Sudan and Egypt. One feddan equals 0.42 hectares or 1.04 acres; one hectare encompasses 2.38 feddans." (p.350)

CHAPTER 8

SUMMARY AND CONCLUSIONS

General Country Characteristics

Three countries, Uganda, Liberia and Sudan were included in this assessment. Although each country is unique in many respects, there are a number of similarities between them.

Both Uganda and Sudan were at one time ruled by colonial powers. Liberia on the other hand, is the only country in Africa that has never been governed by another nation. All three countries are currently headed by autocratic governments, installed after the military overthrow of the previous regime. Since field visits were made to each of these countries in the fall of 1984, two of the countries (Uganda and Sudan) have undergone changes in government resulting from military coups. The Liberian government faced an unsuccessful coup attempt in 1985.

Table 8.1 depicts selected demographic and economic characteristics for these countries. Average life expectancy in all three countries is less than 50 years of age. All three nations rely upon subsistence agriculture, and their export earnings are derived chiefly from the sale of agricultural products. Agricultural employs 90, 80 and 72 percent of the population, respectively in Uganda, Liberia and Sudan.

TABLE 8.1

COUNTRY CHARACTERISTICS[a]

	UGANDA	LIBERIA	SUDAN
Population in thousands (mid-1985	14,689	2,232	22,972
Population growth rate (1978)	3.0%	3.1%	3.7%
(1985)	3.1%	3.3%	-0.2%
Population density/sq. km of agricultural land (1982)	124	327	29
Proportion of population in urban areas (1970)	8.0%	26.0%	16.0%
(1985)	7.0%	37.0%	29.0%
Per capita GNP U.S. dollars (1983)	220	480	400
Annual per capita real GNP growth rate (1965-83)	4.4%	0.8%	1.3%
Annual rate of inflation (1973-83)	62.7	7.2%	18.0%
Agricultural production as percent of GDP[b]	79.0%	32.0%	31.0%
Proportion employed in agriculture (1980)[d]	90.0%	80.0%	72.0%
Percent of energy consumption for traditional fuel (1980)[d]	80.0%	58.0%	82.0%
Life expectancy at birth in years (1970)	48.4%	43.4%	41.8%
(1985)	49.1%	52.1%	48.3%

Sources:

[a]Except where otherwise noted, all figures came from the "FY 1987. Congressional Presentation Annex 1: Africa," U.S. Agency for International Development, Washington D. C., March 1986.

[b]Figures cited in "FY 1987 Congressional Presentations Annex 1: Africa" (U.S. Agency for International Development, March 1986) are 1981 figures for Uganda and 1983 figures for Sudan and Liberia.

[c]Sources are as follows: Uganda--U.S. Agency for International Developement (1984); Liberia--NEC (November 1983); Sudan--U.S. Agency for International Development (1986).

[d]Sources are as follows: Uganda--UNDP/World Bank (July 1983); Liberia--UNDP/World Bank (December 1984); Sudan--UNDP/World Bank (July 1983).

Although Liberia and Sudan have a small industrial sector, Uganda's industry is virtually non-existent. None of the three countries have an annual GNP over $500. Agricultural production represents almost 63 percent of the GDP, while it reflects only 7.2 percent for Liberia and 18 percent for Sudan. Both Uganda and Liberia have experienced relatively high population growth rates in the past few years (above three percent). However, Sudan's growth rate has diminished from 3.7 percent to -0.2 percent.

All three countries have suffered in recent years from stagnating economies and severe balance of payment problems, due to a variety of factors, ranging from political instability and administrative mismanagement to staggering oil import costs. Both Liberia and Uganda experienced relatively high growth rates in the 1960's, followed by a sharp decline in the 1970's. All three countries were adversely affected by the high costs of oil imports associated with the Organization of Petroleum Exporting Countries (OPEC) price hikes of the 1970's.

Like most African countries, they each receive foreign assistance from USAID, the World Bank and numerous other donors. Both Sudan and Liberia have had extensive USAID-funded energy planning and management projects, in which energy analysis was a major component. Similarly, such assistance from the World Bank is in the early stage of implementation in Uganda.

Institutional Issues

Despite the differences between the three countries included in this analysis, they have in common many organizational and institutional factors that affect the effectiveness of activities in the energy sector. All face obstacles confronted by most developing countries related to inadequate resources, such as very low or unpredictable operating funds, salaries and allowances or inadequate transportation. In Uganda, for example, it was reported that individuals in several offices were unable to complete reports because they had no pens, pencils or typewriters with which to write.

None of the forestry service agencies in Sudan, Liberia or Uganda had access to computers for conducting analyses and had to do all calculations by hand. Institutions in each of these countries also suffer from motivational problems stemming from poor working conditions, as well as a lack accountability. Because employees in many agencies were unable to see a link between performance and tangible rewards, such as choice assignments, promotions, participation in training programs or other forms of recognition, there was little incentive to achieve.

In all three countries recruitment and promotion procedures were unsystematic. Staff selection and promotion in Uganda and Liberia were reportedly based chiefly on a patronage system, in which personal affiliation and loyalty were valued

above individual qualifications. Sudan's civil service system which based promotions on seniority, rather than qualifications or performance, yielded little better results. In the NEA, there were a large number of employees simply occupying desks, with no particular assignment or tasks to perform.

Political instability is another factor that affects the effectiveness of organizations in all sectors. Fear of reprisal for "disloyalty" or for taking an unpopular stance places a very real constraint on individuals in institutions in all three countries. Uganda has undergone years of turmoil, resulting in frequent organizational upheaval and the loss of a substantial number of lives. In Liberia, critics of the government (or favored programs) face the possibility of arrest or execution, as well. Similarly, the most recent change in government in Sudan resulted in the imprisonment of many government Ministers, including the head of the Ministry of Energy and Mining and his deputy. Under such conditions, it is not surprising that progress is slow.

The Role of the Coordinating Agency in the Energy Sector

As in most developing countries, energy activities (including data collection and analysis) in Uganda, Liberia and Sudan are conducted by a wide variety of ministries, agencies and organizations. In response to the need to coordinate the activities of the various energy agencies, both Liberia and Sudan have established a coordinating body to perform this function.

In Sudan, the National Energy Administration (NEA) is the coordinating arm of the Ministry of Energy and Mining; in Liberia, the National Energy Committee (NEC) chaired by the Secretariat of Ministry of Lands, Mines and Energy serves in this capacity. Both the NEA and the NEC are made up of representatives of the many agencies and ministries that interact with the energy sector.

In Uganda, no independent agency or organization performs this function. However, a Planning Division has recently been established within the Ministry of Power, Posts and Telecommunications (MPPT) to coordinate energy activities. Unlike the coordinating bodies in Sudan and Liberia, this task is not performed by an inter-agency committee, but rather by a small and relatively inexperienced staff within the Planning Division.

A number of individuals who have been directly involved in energy planning activities in developing countries have attested to the significance of establishing a coordinating body. Barron, Neufville and Koshel (1984) point out that although data collection and analysis are critical to effective energy planning, data alone seldom provide unambiguous resolutions to policy questions. On any given issue, there are usually a plethora of competing interest groups who place different values on particular program evaluation criteria, (such as capital requirements, lead times for impacts to appear, regional development impacts, and so forth).

These analysts contend that many factors influence the decision-making process, and the favored option may change when the "relative weights" attached to different evaluation criteria change. They go on to explain that if no single agency exists to coordinate energy activities, each interest group may lobby independently at high political levels for the acceptance of its favored programs. Lacking adequate information on issues associated with the proposal, (e.g., the probable impact on other sectors and its merits relative to other options) those in higher levels of decision-making cannot effectively evaluate competing proposals.

Although the establishment of coordinating bodies in Sudan and Liberia did not preclude individual interest groups from influencing decisions in the energy sector, energy planners in both countries reported substantial improvements in the decision process subsequent to their formulation.

Garribba (1984) proposes two models for coordinating energy planning: (a) an energy planning Commission or inter-ministerial Energy Advisory Board of the Council of Ministers, responsible directly to the Chief Executive or Council of Ministers; and (b) the creation of a Ministry of Energy. He contends that the Commission approach offers a broader policy purview and can be more flexible in making policy recommendations. The Energy Ministry, on the other hand serves a more specialized function and tends to carry greater weight as an equal among other institutions. Garribba (1984) purports

that although it is possible, under certain conditions, to develop a coordinating body to operate successfully within an existing agency, an independently operating agency stands a greater chance of success.

Representatives of the NEA in Sudan and the NEC in Liberia have, at various times, argued the merits of moving the coordinating function from the status of an inter-agency commission to that of an independent agency. Despite reorganizations which have taken place, however, neither the NEA nor the NEC have been elevated to the agency level.

The Relationship of Coordinating Bodies to Other Agencies

It has been frequently observed that most agencies have a tendency to protect against interference in what they deem to be their personal domain or "turf." Energy agencies in Sudan, Liberia and Uganda are no exception, and all have all experienced some degree of "territorialism." In Sudan, for example, the NEA initially met with resistance from various energy agencies, who viewed NEA's role as duplicative or conflicting with their own.

Over time, however, the NEA has played a role in the policy and decision-making process and its acceptance as a viable institution among the other agencies has grown substantially (Arthur D. Little, 1984). Since the change in government in 1985, the former head of the NEA has been promoted to Minister of the Ministry of Energy and Mines.

Through its assessment work, the NEC in Liberia has also been recognized by in-country agencies, as well as foreign assistance agencies as a source of technical information in the energy sector. It gradually came to serve as a principal liaison point for energy sector activities and inquiries (Barron, November 1985).

One problem which has not been totally resolved in either Sudan or Liberia is the lack of sufficient influence over larger policy issues. Both the NEA and the NEC conduct analyses and make policy recommendations but neither have had formal authority to enforce them. In Uganda, the problem is even more evident, since the Planning Division of the MPPT has no outside representation. In Liberia, Barron, Neufville and Koshel (1984) attribute part of the problem to the technical nature of the NEC's functions and their limited sphere of influence. In both Sudan and Liberia, the NEC and the NEA are often isolated from the higher echelons of the power structure, and decisions are sometimes made on the basis of criteria totally unrelated to the energy sector or the results of sound information policy or analysis.

Barron (November 1985), maintains that national government decision-making in Liberia is becoming increasingly centralized. He observed that in all sectors, there appears to be a trend toward less reliance on technical information as a significant input into policy formulation.

Composition of Energy Coordinating Bodies

According to Barron, Neufville and Koshel (1984) the participation of a large number of energy agencies in the national energy assessment and other analyses has been a source of initial strength for the NEC. They attribute a large measure of NEC's success to its diverse composition. Conversely, they point out that such inter-agency composition can also have certain drawbacks.

Individuals in both Liberia and Sudan described managerial difficulties stemming largely from the absence of a full-time, permanent staff involved in analyses (such as the national energy assessment). Many participants were involved intermittently on an "on-loan" basis from their own agencies.

This situation has led to a lack of continuity in the assessment process and has often interfered with participants' duties at their own agencies. Such an arrangement was not conducive to the development of a cadre of trained staff who can apply the benefit of their experiences to future assessments. In addition, staff members were sometimes caught up in conflicts over policy issues between the coordinating body and their employing agencies.

Quality of Data

Extensive national energy assessments have been conducted in both Sudan and Liberia. More limited, short-term analyses were also undertaken as a part of the UNDP/World Bank Energy Assessment Program in all three countries. However, to

a certain extent, all three countries suffer from problems of insufficient quality data in the energy area. This is particularly true in Uganda, where little actual assessment work has been done, and much of the existing data has been destroyed. The energy data in Liberia and Sudan has been substantially improved in recent years, as result of the energy coordinating bodies, national energy assessments and USAID energy planning projects. Nevertheless, much remains to be done toward establishing a reliable pool of energy data.

In both Sudan and Liberia, significant progress was made toward developing the institutional capability within government agencies to collect and analyze energy data. Ministry staff were involved at various stages of data collection and analysis in the national energy assessments. However, in both countries, (except for the involvement of the head the NEA in Sudan and the NEC in Liberia) host government participation was largely in the data collection stages, with most of the analysis conducted by expatriate advisors. UNDP/World Bank assessments were carried out almost exclusively by expatriate analysts. Future efforts should focus greater attention on involving host government staff in the analytic process.

Problems With Data Collection and Analysis

Overall, the analyses associated with both the national energy assessments and the energy supply/demand balance sheets were of high quality and followed standard practices

recommended by the U.N. Statistical Commission (1984). The analyses in Liberia were particularly well-done, with great attention to detail. The greatest shortcoming in all three countries (including analyses conducted by the UNDP/World Bank), was inadequate documentation of sources and failure to specify assumption underlying analyses and the methods used to derive them.

This problem was pervasive in the analyses in Sudan and Uganda and in some of the back-up studies used to compile the Liberian energy assessment. Sources in the UNDP/World Bank analyses sometimes consisted of "World Bank estimates," or "Ministry of Finance survey." Similar citations were found in the Sudanese analyses, as well. Often, the original surveys comprising the assessments in all three counties provided little or no detail about the basis on which samples were selected, how the surveys were carried out, or what geographic areas were included in the study.

Individuals involved in energy data collection and analysis cited a variety of constraints which they had encountered in conducting the national energy assessments and other analyses. There was little difference between the problems described in each of the three countries visited. The most prevalent problems reported were:

1. inadequate resources, including transportation, analytic equipment, maps, and so forth
2. lack of understanding of basic sampling procedures

and interviewing techniques, as well as inadequate training on the use computers and statistical analysis procedures

3. lack of cooperation by respondents because of: (a) a failure to understand the purpose of the study or the intent of the questions; or (b) intentional misrepresentation due to fear of reprisal (e.g., additional taxes, assessment of payment for illegal electricity hookups, prosecution for sale of government allocated fuel supplies on the black market)

4. lack of data due to poor record-keeping on the part of respondents

5. misunderstanding of the questions by interviewers, leading to inconsistencies in interpretation by various survey participant.

Training Needs

Research findings indicated that there is a need for training in all aspects of energy data collection and analysis in each of the countries visited. Areas of deficiency most frequently encountered were: (a) statistical sampling: (b) survey methodology; (c) questionnaire construction and interviewing techniques; and (d) statistical analysis procedures. Another need of data analysis relevant to individuals working the energy area was training in procedures for constructing energy supply/demand balances. Instruction in the use of computers for organization and analysis of data was also needed.

A number of problems with training programs also emerged. These are:

1. training is not always provided to the apropriate people

2. once an individual is trained he or she may not return to the agency

3. expectations exceed opportunities

4. individuals who return from training may not have a specific assignment

5. in some cases, (such as in Sudan) too many people have been involved in training at once, thus leaving the agency with inadequate staff.

Currently planned training programs in Uganda and Sudan are aimed at addressing these needs. A UNDP/World Bank training program is also underway in Uganda, which offers promise in addressing many of data collection and analysis problems in Ugandan energy institutions. However, the USAID-funded energy planning assistance in Liberia has concluded, and it appears that no further funding will be provided in the near term. In order to continue with the energy assessment work that has begun, the continued involvement of donor agencies in providing technical assistance and training will be necessary.

Factors for Successful Planning In LDC's

In conducting this study, a large number of individuals were interviewed, including both host government energy planning agency personnel and USAID energy planning and management project staff. In addition, numerous AID project evaluations, internal memorandums and inter-agency correspondence were reviewed. This study has identified a number of factors which play a vital role in the energy planning process. Although developing a data base of accurate

energy data on which to base decisions is essential to effective planning, it is only one of many factors. A host of other variables, such as economic considerations, individual personalities, political conditions, and organizational structure, also affect the outcome of energy planning decisions.

Many of the constraints to effective planning fall outside the realm of energy data collection and cannot be easily remedied by a particular project or training program. However, it is critical that planners and project managers understand the implications of these factors on the energy sector, so that they can be taken into consideration in the planning process. In many cases, the outcome of a planning effort (whether is a donor-assisted project or host-government initiated activity) is contingent upon the ability of the planner to understand and work around the many factors that interact with energy-sector decisions. Solutions to such external constraints lie outside the realm of this study, and the author does not purport to have a formula for addressing them. However, some of these factors and possible responses are summarized in the following table.

TABLE 8.2

FACTORS BEYOND ENERGY DATA COLLECTION BOUNDARY THAT AFFECT THE SUCCESS OF ENERGY PLANNING PROJECTS

Factor	Response
1. Low life expectancy 2. Unstable government conditions 3. Deteriorating economic conditions	Donors and host countries work toward improvements in education, GNP and balance between population and resources
4. Higher paying professional and technical jobs elsewhere	Host country increase national sense of purpose and increase quality of life indicators
5. Frequently, analyses conducted by expatriates are neither understood, nor used by host governments	Host government insistence on collaborative inquiry; donor recognition of its essential importance
6. Lack of interest in empirical "facts" on part of decision-makers 7. Lack of access to decision-makers	Host government personnel and donors make analysis known to wide audience, including decision-makers, private sector and non-governmental organizations--

TABLE 8.2 (continued)

FACTORS BEYOND ENERGY DATA COLLECTION BOUNDARY
THAT AFFECT THE SUCCESS OF ENERGY PLANNING PROJECTS

Factor	Response
7. Lack of access to decision-makers (continued)	--good information is better than than no information, even if it is only partially used; change is often slow and incremental in nature; the establishment of coordinating councils for energy, represent-competing interests may result in improved communication
8. Poor civil service management, inadequate resources and low salaries	Host governments improve match of expertise to priority tasks; Host government improve hiring and firing practices and incentives for out-standing performance, including "merit awards combined with binding agreements (e.g., four years of service required in return for training); award diplomas or certificates for in-country training Donor and host governments more carefully assess and prioritize: (a) personnel and training needs;

TABLE 8.2 (continued)

FACTORS BEYOND ENERGY DATA COLLECTION BOUNDARY THAT AFFECT THE SUCCESS OF ENERGY PLANNING PROJECTS

Factor	Response
8. poor civil service (continued) management, inadequate resources and low salaries	(b) operational needs, e.g., transportation, hand calculators, office supplies. (Donors are especially guilty of paying insufficient attention to what appear to be "insignificant" operational needs).

Recommendations for Improving Data Collection and Analysis

In addition to the factors discussed above, ten key suggestions for improving energy data collection and analysis have emerged from this study, which may be helpful to these and other countries in carrying similar activities in the future.

1. It is crucial that both the host government officials at high levels of decision-making and donor agency personnel recognize energy as an important element in the country's economic development.

2. Long-technical assistance is required in order to see measurable improvements--results are not likely to be immediate.

3. It is preferable that individuals providing long-term technical assistance have broad backgrounds in economics or planning. They can then draw upon more specialized short-term technical assistance services.

4. Considerable effort should be invested in building close, effective counterpart relationships.

5. Project success will depend to some degree on the personal working approaches of the individual advisors/analysts and their counterparts; to the maximum extent possible, this should be considered in recruitment and counterpart identification. Poor hiring and counterpart selection can doom a project activity from the outset.

6. It is important to prioritize problems and needs, set benchmarks and work toward measurable goals.

7. Training should be of two types:

   (a) long-term degree training in statistics and economics for individuals who will be trainers and program managers

   (b) short-term training primarily in-country on specific topics such as sampling procedures, questionnaire construction, interviewing techniques, conventions for constructing energy supply/demand balances, and in procedures for conducting sector analyses (e.g., household energy surveys).

8. A team of local government personnel should be trained as "trainers" in areas of energy data collection and analysis.

9. UN Statistical Commission recommendations should be used in constructing energy supply/demand balances, with modifications to accomodate individual country circumstances and special needs. The actual format of the balance table is not as important as the procedures for conducting the analysis (i.e., specification of conversion factors, documentation of sources, etc.).

10. Improved primary data collection depends on increasing the trust of respondents, or on use of data collection techniques which obtain needed

information indirectly (e.g., utility company records, sales of petroleum, aerial surveys of forest resources).

11. Finally, it is imperative to coordinate closely with relevant economic assistance agencies to develop reinforcing approaches and to identify potential financial support for recommended activities. Host country staff should establish priorities and control the number and size of donor projects to avoid project proliferation beyond the host country's institutional capacity to manage project activities. Donors should be especially sensitive to the effect of project proliferation on host country management capacity and should make more systematic efforts to coordinate assistance among themselves and with the host country.

Relevance of Findings to Other Countries

Although this study was focused on Sudan, Liberia and Uganda, many of the findings herein are relevant to other developing countries as well, particularly in Africa. Despite the many differences in political environment, organizational structures and social setting, most LDC's share the same types of problems (i. e., low levels of economic development, political instability, competition among various agencies for power and resources, and so forth.) It is felt that the lessons learned from these three examples can be of benefit to countries in initial stages of energy planning, as well as those who have had extensive involvement in the energy sector.

Recommendations for Further Research

A large number of developing countries are in the initial stages of developing and energy planning capability. It is recommended that one of the first steps in that process

be the analysis of institutional capabilities in data collection and analysis It is hoped that many of the lessons learned from this analysis will be of use to LDC governments either beginning energy planning activities or at more advanced stage. These lessons may also be useful to donor agencies contemplating the design and development of an energy planning projects.

APPENDIX A

APPENDIX A

UNITED NATIONS STATISTICAL COMMISSION RECOMMENDATIONS

CONCEPTS AND TERMINOLOGY

1. Primary energy should be used to designate those sources that only involve extraction or capture, with or without separation from contiguous material, cleaning or grading, before the energy embodied in that source can be converted into heat or mechanical work (para. 29; see also 16).

2. Secondary energy should be used to designate all sources of energy that result from transformation of primary sources. Fuels, alone, should be used only when describing those energy sources, whether primary or secondary, that must be subjected to combustion or fission in order to release for use the energy stored up inside them (para. 29)

3. Imports, exports and stock changes in secondary energy should be treated in an energy balance in the same way as to changes in the supply and use of primary energy. These flows of secondary energy should be designated as primary energy equivalent. Bunkers should be treated in the same way, as part of the "primary equivalent flows" (para. 30)

QUALITY OF DATA.

4. National and international statistical offices should consider seriously attempting to assess the sensitivity of each major published aggregate in their energy statistics to errors of plus or minus 5 or 10% in the less reliable components of such aggregates.

5. National and international statistical offices, and bodies that advise them or undertake work for them, should always define clearly the accounting units or presentation units employed in published analysis. The conversion factors and the route used to convert original physical units into the chosen common accounting unit or units should also be stated, or a readily available published source where they may be found should be cited. It should also be made clear whether energy units are defined on a gross or net calorific basis (see chap. IV. sect. G).

BOUNDARIES

Energy & Non Energy Flows

6. Energy balances should cover only all the supplies and uses of primary and secondary energy sources, showing clearly the non-energy use of such sources.

Commercial & Non-Commercial Energy Sources

7.(a) An overall energy balance should cover all flows of energy including the so-called "non-commercial" sources. Coverage of such sources should be as extensive as possible. When such sources are known to be important but little data exist, such steps as sample surveys should be instituted to improve the amount and quality of data.

(b) Autogeneration of electricity from purchased fuels, with or without the joint production of heat, should be treated as part of the transformation sector.

(c) Autogeneration from industry's own hydropower should be treated as primary production of electricity.

(d) Steam or hot water produced by the combustion of industrial (or urban) wastes or by exothermic or other heat recovered within industry, should be recorded as primary production.

(e) Each method of electricity generation contributing a significant amount of the total supply of electricity should be assigned a separate row in an energy balance.

Energy Industries & Other Industries

8.(a) Energy balances should only cover all hydrocarbon commodities as defined by a list either embodied in or accompanying the balance table (see chap. V).

(b) The problems of defining and obtaining more complete data on the gross and net energy flows between oil refineries on the one hand and petrochemical plants on the other should be investigated more fully. Satellite tables to an overall energy balance could usefully show as fully possible at least the more important flows of energy by-products (and recovered heat) within the major branches of the chemical industry.

Energy Production & Distribution

9. Published energy balances, whether of particular energy sources or for all energy sources in a single table, should always make clear whether flows represent production, deliveries, receipts or consumption; and the coverage of stock changes (and stock levels) should make clear whether r not they cover producers, importers, transformers, distributors, and final users' stocks.

Production and Waste

10. Production of coal should be defined as extraction from the ground less waste and screening plus recoveries from the waste heap.

11. All production of associated gas should be treated as part of production of gas, and that part that is flared should be so described. In this way, the change in the output of the production of oil and gas will not show a "step-change" when the use of part of the gas changes. By analogy, total production of coke oven gas and blast furnace gas should be recorded in an energy balance, with amounts bled to waste shown as losses.

Production & Stocks

12. With production of gas, either associated or non-associated with crude petroleum, should be recorded net of injection of gas into gas or oil fields. If injected gas is later extracted for a second time, it should be treated as production then for the first time.

ACCOUNTING LEVEL AND ACCOUNTING UNITS

Primary Energy Input to Final Demand

13. An energy balance should show all flows at each level that can be adequately recorded with exiting data, so that the relationships between primary energy inputs to transformation and transformation losses can be clearly seen. For some purposes, as a supplementary statistic, the primary fuel input equivalent of secondary energy sources delivered to final energy users is useful but may be difficult to estimate because of lack of sufficient data.

Primary Energy Input to Nuclear and Hydroelectricity

(Nuclear electricity)

14. The primary energy input to nuclear electricity should in principle be defined as the heat released by reactors during the accounting period. In practice, a proxy for this may need to be used, namely the figure obtained by dividing generation of nuclear electricity by the average efficiency of all nuclear power stations.

(Hydromechanical power)

15. The primary energy input to hydroelectricity should be defined as the energy value of the electricity itself. The fossil fuel equivalent energy should be recorded as an additional statistic, using for simplicity, either the average thermal efficiency of all classical thermal stations in the country concerned or a standard efficiency of (e.g. 35%).

(Renewable Sources of Energy)

16. The primary energy corresponding to the so-called renewable sources of energy should be defined as follows and applied to the output of the first stage in an energy capturing process that yields a measurable output of heat, electrical or mechanical energy:

(a) Solar
Biomass--Heat output of the fermentation, distillation or combustion device
Photovoltaic cell-Electric energy output
Other collecting device--Heat output of the device

(b) Water & Air--Mechanical, heat or electrical output of the device

(c) Geothermal and ocean thermal--Heat output of capturing installation

(Primary Fuel Inputs to Trade)

17. Imports and exports of secondary sources of energy should be recorded for an overall energy balance in terms of the energy contents of the fuels (or electricity) that actually flow across national frontiers. If a more detailed analysis is needed of the energy input to foreign trade, such an analysis can be made but it should be additional to, and not part of, the overall energy balance. Trade in non-energy products derived from primary energy sources (e.g. lubricants, carbon black, electrodes) should be recorded in the main energy balance.

(Invisible Energy Trade)

18. International trade in embodied energy is a proper subject for a detailed assessment of energy problems. Nevertheless and overall energy balance should be constructed in the first place on the basis of, among other flows, only visible trade in energy sources.

(Gross & Net Calorific Values)

19. When expressing the energy content of primary and secondary fossil energy sources in terms of a common energy accounting unit, net calorific value (NCV) should be used in preference to gross calorific values (GCV). If and when recuperation of a significant part of the difference between GCV and NCV from exhaust gases becomes a practical possibility and seems likely to become a reality, this recommended basis may need to be reconsidered.

(Other Accounting Units)

20. Given that the joule, and multiples of it by raising it to powers of 103, is the only energy unit in the SI, international and national statistical offices should consider adopting the joule (1 joule = 0.239 calorie) as the rigorous accounting unit for energy balances. The TOE (1 TOE = 107 kcal NCV and/or the TCE (1 TCE = 7 x 106 kcal NCV) may be used as supplementary presentation units. Whenever they are used, they should be clearly defined in terms of the joule, and the route used for converting original data to TOE or TCE should be clearly described.

BALANCE FORMATS

21. Overall energy balances should be constructed in matrix form with the following characteristics:

Columns show energy sources (energy commodities)

Rows show flows from originals to uses of energy (energy transactions)

Separate sub-matricies show, respectively:

(a) Supplies of primary sources and equivalents;

(b) Transformation inputs (with negative signs) and outputs (with positive signs); transformation losses in the total column (with negative signs); energy industries' own use; tansmission and other losses;

(c) Final uses.

Other Balance Problems

(Pumped Storage Generation)

22. Electricity output from pumped storage should not be added to electricity produced by other methods (because the latter already includes the electricity that is redistributed through time by means of pumped storage) when compiling and energy balance. The difference between the input to and the output from pumping should be treated as part of the electricity industry's own use.

(Oils Returned to Refineries)

23. Materials returned to oil refineries should be included as inputs to refining, even though such materials have previously been accounted for in refinery output. Refinery fuel should also be included both as part of output and as part of own use.

(Original Units and Common Units)

24. The relationship between the original-unit data as used for an energy balance and as published in the usual statistics about each energy industry should always be made clear.

(Conversion Factors)

25. Energy balances should contain in the column headings for each energy source the average conversion factor (appropriate for expressing the original units in (or underlying) that column in terms of the common accounting unit as shown in the balance). Such average factors should be complemented in foot-notes or accompanying text, with clear descriptions of the routes and stages followed in any conversions that are not adequately defined by the average factors.

Current Treatment of Energy

26. Existing classification and definitions of crude hydrocarbons and derived products should be examined with a view to establishing an agreed international set of designations, groupings and definitions.

Final Energy Uses

(Useful Energy)

27. National and international statistical offices should consider publishing estimates of the quantities of useful energy consumed by each final consumption sector. Such estimates should be accompanied by details of the methodology used.

(End Use by Purpose)

28. National statistical offices should consider constructing end-use analyses of the type illustrated in the attached table. (See attachment.)

OTHER ENERGY STATISTICS

(National Accounts Terminology)

29. In order to avoid possible confusion between the meanings of "final" (and "intermediate") in national accounts input/output and other economic analyses on the one hand, and in energy balances on the other, tables and texts that refer to the flows involving the energy transformation of industries and/or final users of energy should always make clear what is meant by "final" (and - if the term is used - "intermediate").

APPENDIX B

APPENDIX B

INSTITUTIONAL ASSESSMENT

Country _____

I. General

1. Agency Name and Address

2. Name of person interviewed _____

3. Department _____

4. How many people employed by the ministry/ agency? _____

5. When was the ministry/agency established? _____

6. Briefly describe the official duties and responsibilities of the ministry/agency. (Attach organizational chart and list number of staff in each division, if available.)

7. How have the duties and responsibilities of the ministry/ agency changed in the past?

8. How do you expect the duties and responsibilities to change in the future?

9. Please indicate which of the following equipment is available for use by ministry/agency staff:

	Number	Type	Number of Regular Users
(a) Programmable calculators	_____	_____	_____
(b) Microcomputers	_____	_____	_____
(c) Main frame computer	_____	_____	_____
(d) Analytic software (e.g., SPSS, SAS, LOTUS, DBASE)	_____	_____	_____

10. What is the total 1984-85 budget for your ministry? List for each division if available. (List only official Government sources.)_____Total (Local currency)

11. What percent of this budget is allocated to energy data collection and analysis?_____

12. How many people employed by the ministry/agency are currently involved in energy data collection and analysis activities? _____

13. Do you anticipate increases in budget or staff size during the next few years?

_____Yes _____No _____Don't Know

14. If yes, describe anticipated changes.

15. Please list energy studies which have been conducted by your agency/ministry and provide the information indicated below.

Title	Principal Researchers (ministry staff & outside technical assistance)	Type of Study (e.g., energy pricing study, macroeconomic analysis, sub-sector demand analysis, national energy assessment, etc.)	Method Used (e.g., household survey, mailed questionnaire, rough estimate, etc.)	Main Sources of Data

16. Please list energy studies which have been provided to your ministry/agency by outside consultants or organizations (e.g., USAID, World Bank, IMF, private consulting firms, etc.), and provide the information indicated below.

Title	Principal Researcher (Name of organization, individual, or Ministry)	Type of Study (e.g., pricing, study, macro-economic analysis, sub-sector demand analysis, national energy assessment, etc.)	Quality/ Accuracy of Data (High, Medium, Low)	Usefulness of Information to Ministry (e.g., Very useful, Somewhat Useful, Not Useful)	Extent to Which Data is Used to Determine Policy

17. Please describe changes in programs or policies that have resulted from studies listed in questions 15 and 16.

18. What data collection and analysis problems have been encountered in conducting energy studies?

19. What, if any, additional studies are needed?

20. Do you think it is worth investing more money to collect better energy data?

_____Yes _____No _____Don't Know

21. What, if any, additional training in energy data collection and analysis is needed for ministry staff? For each category of training, indicate the length of time and the location of the training that would be most useful for your needs.

Type of Training Needed (e.g., statistical sampling, energy sector (e.g., assessment methodology)	Preferred Duration of Training	Preferred Location of Training U.S., local (university, on the job)

22. Please list the names and locations of any institutions, organizations, or individuals who you think would be able to provide such training.

II. Staff Education/Training

23. Of those staff members involved in energy data collection and analysis activities, indicate the number of staff with degrees at each educational level and designate the area of study for which their highest degree was obtained:

Education	Type of Degree (e.g., Engineering, Economics, etc.)	Job Title	Number of Staff
High School/ Technical Training			
Bachelor's Degree			
Master's Degree			
Doctorate Degree			

24. Please provide the following information about training in which staff members have participated:

	Number of Staff Trained	Duration of Training	Organization/ Institution Providing Training/ Location
Statistical Sampling Procedures			
Survey Methodology			
Research Design			
Evaluation Techniques			
Use of Microcomputers			
Use of main frame computers			
Use of analytic software			
Energy Sector Demand Analysis Techniques			
Energy/Supply Demand Balance Methodology			
Energy Assessment Methodology			
Other (specify) _____			

APPENDIX C

APPENDIX C

NATIONAL ENERGY ASSESSMENT RATING SHEET

Country_____

1. Title of Study_____

_____

2. Date of Publication_____

3. Type of Study _____

4. Length of Time to Complete_____(months)

5. Host Government Principal Investigator(s)

Name	Title	Agency	Training (Degree/Area)

6. Technical Assistance

Name	Title	Agency	Training (Degree/Area)

7. Estimate the percent of data collection and analysis activities conducted by each of the following:

	Percent
Host Government Staff	_____
Donors/Other Technical Advisors	_____

8.

Cost of Study	Name of Funding Agency
_____	_____
_____	_____
_____	_____
_____	_____

9. Agencies providing supporting data:

10. Methodology:

11. Quality of Data:

a. Documentation

____ Poor
____ Fair
____ Good
____ Excellent

b. Replicability

____ Poor
____ Fair
____ Good
____ Excellent

c. Operational Definitions

____ Poor
____ Fair
____ Good
____ Excellent

d. Units of Measures (Specify Type Used) _____

_____

	Yes	No	Unable to Determine
Adequately Defined	___	___	___
Appropriate/Consistently Used	___	___	___

e. Conversion Factors (Specify Type Used) _____

_____

	Yes	No	Unable to Determine
Adequately Defined	___	___	___
Appropriate/Consistently Used	___	___	___

12. Data collection problems encountered

13. Backup studies (original source of data)

Author	Title	Agency

APPENDIX D

APPENDIX D

UGANDA CONTACT LIST

Mr. Kenneth Frances Tugame
Ministry of Power, Posts and Telecommunications
Room B201
Amber House
Box 7270
Kampala, Uganda

Mr. Vincent Eduku
Bank of Uganda
Petroleum Desk - Box 7210
Kampala, Uganda

Mr. J.N. Muwanga
Ministry of Planning and Economic Development
Industrial Division
Box 7086
Kampala, Uganda

Mr. Joshep Torres
Mr. Neil Huff
CARE - Uganda
15 MacKinnon Road
Box 7280
Kampala, Uganda

Mr. Martin Lobo
Project Manager
Ministry of Cooperatives and Marketing
Coffee Mill
Jinja, Uganda

Mr. Paul Mugula
Uganda Electricity Board
Kampala, Uganda

Professor Sam Tugya-Muhika
Director of Statistics
Makerere University
Kampala, Uganda

Director, Irwin Coker
Dr. Fenton Sands
Mr. Winston McFee
Mr. Bruno Komakech
USAID
Kampala, Uganda

APPENDIX E

APPENDIX E

UGANDA ENERGY BALANCE 1980

Table 1.6: ESTIMATED ENERGY BALANCE FOR 1980
(In '000 TOE) a/

Energy Source	SUPPLY: Production	Imports	Total Primary Supply	Supply After Transformation	Transmission & Distribution Losses	Net Supply Available for Consumption	CONSUMPTION: Household	Commerce	Industry	Transport	Total Uganda Consumption	Exports
A. Commercial energy												
Aviation fuel	-	13	13	13	-	13	-	-	-	13	13	-
Gasoline	-	89	89	89	-	89	-	-	-	89	89	-
Kerosene	-	48	48	48	-	48	28	-	-	-	28	20 c/
Auto. diesel	-	72	72	72	-	72	-	-	-	58	58	14
Industrial diesel	-	1	1	1	-	1	-	-	1	-	1	-
Fuel oil	-	23	23	22	-	22	-	-	22	-	22	-
L. P. gas	-	1	1	1	-	1	1	-	-	-	1	-
Electricity - hydro	156	-	153	53	9 b/	44)	7	6	8	-	21	24
- thermal	-	-	-	1	-	1)						
Fuelwood	1,121	-	1,121	533	-	533	146	96	141	-	383	-
Charcoal	-	-	-	177	-	177	112	65	-	-	177	-
Total	1,280	247	1,527	850	9	851	295	167	172	160	794	57
Conversion losses - electricity				106								
- fuelwood				244								
Total commercial energy	1,280	247	1,527	1,527		851	295	167	172	160	794	57
B. Noncommercial energy												
Fuelwood	3,642	-	3,642	3,642		3,642	3,247	331	44	-	3,642	-
C. Total energy	4,922	247	5,169	5,169		4,513	3,542	518	136	160	4,456	57

a/ See front of report for conversions to TOE.
b/ Includes illegal connections.
c/ Unofficial exports (i.e., smuggling).

Source: "Issues and Options in the Energy Sector," (Report No. 4453-UF), UNDP/World Bank, July 1983, p. 23.

APPENDIX F

APPENDIX F

CURRICULUM FOR PROPOSED SEMINARS

Seminar 1
Energy Data for Policy and Planning

I. Policy makers' and planners' problems and objectives

   A. Range of policy options

   B. Types of planning decisions.

      1. Investment

      2. Policy

      3. Pricing

      4. Balance of payments and macroeconomic issues (e.g., optimum level of oil imports consistent with national economic growth and export objectives)

      5. Technology assessment

II. Data Needs for Policy and Programming Decisions

   A. Types of data sources.

      1. Sources with energy content

      2. Energy specific sources

   B. Existing sources of energy data (official/commercial/academic)

   C. Making use of existing information & data gathering efforts (e.g., building energy questions into other surveys, such as agricultural survey, the national census, etc.)

      1. Frequency/timeliness/adequacy

      2. Consistency/comparability/reference period/imputation, etc.

      3. Improving coordination between agencies

   D. Cost of collecting new data vs. cost of error

      1. Timeliness/accuracy/adequacy

2. Time/resources (people, equipment,funds, transportation) needed to collect data

E. Using data to establish priorities (to determine where energy considerations fit into overall development objectives; to rank energy sub-sector priorities)

Estimated time required is 2 to 3 days at 8 hours per day.

Seminar 2
Issues in Energy Statistics

I. Measurement issues

A. Definition of terms & boundary problems

B. Classification of energy sources

1. Primary/secondary

2. Commercial/traditional/non-conventional

B. Rounding consistency

C. Internal and external consistency

D. Units of measure

1. Measurement of unit source materials (weight, volume, capacity, and value)

2. End use measures

(a) direct measurement of energy calories, joules, etc.

(b) aggregation in terms of energy equivalence (such as calories, joules, TOE, etc.)

3. Double counting (and how to avoid it)

4. Distinction between primary/delivered/useful energy

II. Conversion of primary to secondary energy

A. Conversion Factors and Routes

B. Energy distribution/delivery/handling

C. Losses

D. Stocks

E. Storable energy (e.g., solids, liquids, gases)

F. Non-storable energy (e.g., electricity, wind)

Estimated time required is 2 to 3 days at 8 hours each day.

Seminar 3
Basic Data Collection Methods and Issues

I. Use of records

A. Administrative

B. Commercial

C. Research results

II. Use of surveys

A. Census vs. sample survey

B. Mandatory vs. voluntary

C. Preparation of survey schedule

D. Sampling issues

1. Ensuring representativeness

(a) types of samples (random vs. non-random; simple multi-stage; stratification & clustering)

(b) sample size

2. Selection/training of interviewers/enumerators

3. Questionnaire construction (length, wording coding, format, accompanying explanatory text etc.)

4. Pilot/field testing

5. Sources of error

(a) sampling & non-sampling error

(b) sources of bias

(c) confidence intervals

6. Ensuring confidentiality

Estimated time required is 8 hours.

Seminar 4
Data Processing & Analysis

I. Manual method

A. Data tabulation

B. Statistical analyses (frequency distributions, means & proportions, standard deviation & range, etc.)

II. Use of computers

A. Scope and limitations of computerized data handling

B. Impact on questionnaire design

C. Access problems

D. Contingency planning for computer failure

1. Manual and disk copy backup

2. Dealing with data losses

E. Updating/validation/estimation of missing data

F. Role of microcomputers in energy modeling/projections/forecasting

III. Interpretation of data

A. Statistical analyses

B. Report writing and presentation of results

C. Use of data in energy planning process

Estimated time required is 8 hours.

Seminar 5
National Energy Assessments

I. Role of national energy assessments in energy planning

   A. Definition

   B. Purpose

   C. Updating information

      1. Methods for updating

      2. How often to update

   D. Limitations on data

II. Supply/demand balances

   A. Comparison of methods/formats

   B. Level of detail needed

   C. Measurement issues

      1. Definition of terms & boundary problems

      2. Classification of energy sources

      3. Rounding consistency

      4. Internal and external consistency

      5. Specification of units of measure

      6. Double counting (and how to avoid it)

   D. Critical data needed (fuelwood, petroleum, etc.)

   E. Special requirements for assessing and analyzing Traditional Fuels

---

Estimated time required is 8 hours

Seminar 6
Energy Sector Analysis

I. Definition

II. Purpose

III. Cost/time/manpower required

IV. Structured approach to sector analysis

A. Operationally defining sectors

1. Industry

2. Transportation

3. Agriculture

4. Residential (household)

5. Institutional/commercial

6. Other

B. Specifying tabulation plan and data requirements leading to structuring of subsectors

C. Assessing existing data and identifying gaps

D. Developing data collection options

E. Implementing data collection activities

F. Analyzing information

V. Data collection problems likely to be encountered and Methods of Overcoming Them

---

Estimated time required is 8 hours.

APPENDIX G

APPENDIX G

LIBERIA CONTACT LIST

Mr. Chris Neyor
Liberia Electricity Corporation (LEC)

Mr. Keller
Liberia Electricity Corporation (LEC)

Ms. Lucille Kawah
Liberia Electricity Corporation (LEC)

Mr. Morley Reeves
Ministry of Planning and Economic Affairs (MPEA)

Mr. Philip Davis
Liberia Petroleum and Refining Corporation (LPRC)

Mr. Shad Kadea
Forestry Development Authority (FDA)

Dr. Miedi-Himie Neufville
Secretariat of National Energy Committee (NEC)
Assistant Minister
Department of Energy
Ministry of Lands, Mines and Energy

Mr. Emile Rhinelander
Department of Energy (DOE)

Mr. Joel King
Department of Energy (DOE)

Mr. Jimmy Davis
Department of Energy (DOE)

Mr. Joseph Kemara
Department of Energy (DOE)

Mr. Oliver Blay
Ministry of Lands, Mines and Energy
Acting Director
Bureau of Hydrocarbons

Mrs. Diger Tjoubor
Ministry of Lands, Mines and Energy
Geologist
Bureau of Hydrocarbons

Mr. Budoin-Brutus J. Cooper
Ministry of Lands, Mines and Energy
Bureau of Hydrocarbons

Mr. Gar-Melvin Smith
Ministry of Lnads, Mines and Energy
Bureau of Hydrocarbons

Dr. William Barron
Energy Advisor
Oak Ridge National Labs

Mr. James Pagano
Energy Advisor
USAID
Monrovia, Liberia

Director Lois Richards
Mission Director
USAID
Monrovia, Liberia

APPENDIX H

APPENDIX H

1982 ENERGY BALANCE FOR LIBERIA

(Units in 1,000 TOE)

MAY 1984

	PRIMARY ENERGY				SECONDARY ENERGY							TOTALS	
	1 Fuel Wood	2 Hydro Elec.	3. Crude Oil	4 Char-coal	5 Elec-tric	6 Fuel Oil	7 Gas Oil	8 Gaso-line	9 Kero-sene	10 Jet Fuel	11 Other Petro	12 Total Energy	13 Total Petro
a) Production	1158.8	70.6	---	---	---	---	---	---	---	---	---	1229.4	---
b) LPRC Imports	---	---	349.1	---	---	21.6	48.8	7.4	---	5.6	---	432.5	432.5
c) Stock Ch/Dir.Imp.	---	---	4.9	---	---	49.2	25.0	3.5	0.4	-0.8	2.7	84.9	84.9
d) Total Available	1158.8	70.6	354.0	---	---	70.8	73.8	10.9	0.4	4.8	2.7	1746.8	517.4
e) Charcoal Prod.	-305.4	---	---	305.4	---	---	---	---	---	---	---	---	---
f) Char. Prod. Loss	---	---	---	-244.4	---	---	---	---	---	---	---	-244.4	---
g) Petrol. Refining	---	---	-354.0	---	---	186.6	75.0	56.1	4.4	21.8	10.1	---	---
h) Petrol. Ref. Loss	---	---	---	---	---	-13.0	-1.6	-0.3	---	---	-7.9	-22.8	-22.8
i) Exports/Quasi Exp.	---	---	---	---	---	-26.1	-2.0	-3.1	---	-24.7	-4.0	-59.9	-59.9
j) Net Domestic Avail.	853.4	70.6	---	61.0	---	218.3	145.2	63.6	4.8	1.9	0.9	1419.7	434.7
k) LEC Generation	---	-65.6	---	---	105.7	-15.0	-25.1	---	---	---	---	---	-40.1
l) LEC Gen. Losses	---	---	---	---	-73.3	---	---	---	---	---	---	-73.3	---
m) LEC Tran/Dis. Loss	---	---	---	---	-4.9	---	---	---	---	---	---	-4.9	---
n) Sectoral Distribut.	853.4	5.0	---	61.0	27.5	203.3	120.1	63.6	4.8	1.9	0.9	1341.5	394.6

Source: Barron, W., Rhinelander, et al., 1982 Energy Balance for Liberia: A report issued by the Secretariate of the National Energy Committee, Government of Liberia, May 1984.

1982 ENERGY BALANCE FOR LIBERIA (page 2)
(Units in 1,000 TOE)

MAY 1984

SECTORAL ENERGY DISTRIBUTION (from Row "n" page 1)

	1 Fuel Wood	2 Hydro Elec	3 Crude Oil	4 Char-coal	5 Elec-tric	6 Fuel Oil	7 Gas Oil	8 Gaso-line	9 Kero-sene	10 Jet Fuel	11 Other Petro	12 Total Energy	13 Total Petro
n) Sectoral Distribut.	853.4	5.0	---	61.0	27.5	203.3	120.1	63.6	4.8	1.9	0.9	1343.5	394.6
o) Transport Total	---	---	---	---	---	---	-47.9	-60.8	---	-1.9	-0.5	-111.1	-111.1
(p) Road	---	---	---	---	---	---	-33.6	-60.2	---	---	-0.5	-94.3	-94.3
(q) Railroad	---	---	---	---	---	---	-13.5	---	---	---	---	-13.5	-13.5
(r) Sea/Air	---	---	---	---	---	---	-0.8	-0.6	---	-1.9	---	-3.3	-3.3
s) Mines End Use	---	---	---	---	-50.5	-49.2	-29.5	---	---	---	---	-129.2	-78.7
t) Mines El.Generat	---	---	---	---	177.8	-153.1	-24.7	---	---	---	---	---	-177.8
u) Mines El.Gen. Loss	---	---	---	---	-120.9	---	---	---	---	---	---	-120.9	---
v) Industry	-2.0	---	---	---	-2.5	-1.0	-2.0	---	---	---	---	- 7.5	-3.0
w) Residential	-845.5	---	---	-60.0	-19.0	---	-0.4	---	-3.4	---	-0.4	-928.7	-4.2
x) Commercial End Use	-1.9	---	---	-1.0	-10.4	---	-0.7	---	-1.4	---	---	- 15.4	-2.1
y) Comm. El.Generat	---	---	---	---	4.8	---	-4.8	---	---	---	---	---	-4.8
z) Comm. El.Gen. Loss	---	---	---	---	-3.6	---	---	---	---	---	---	-3.6	---
aa) Government*	---	---	---	---	-3.1	---	---	---	---	---	---	-3.1	---
ab) Ag.& For.End Use	-4.0	---	---	---	-3.1	---	-6.8	-2.8	---	---	---	-16.7	-9.6
ac) Ag.& For.El.Gener.	---	-5.0	---	---	8.3	---	-3.3	---	---	---	---	---	-3.3
ad) Ag.& For.El.Loss	---	---	---	---	-5.6	---	---	---	---	---	---	-5.6	---

*Note: Due to the manner in which records are kept in Liberia, energy use by the Liberian government owned corporations are included in the commercial sector. If such use were added to the "government" row, total energy usage would increase by about 120%. In addition, transportation energy use for government is included in the "transport" sector.

1982 SUMMARY ENERGY BALANCE
FOR LIBERIA
(Units in 1,000 TOE)*

May 1984

	PRIMARY ENERGY				SECONDARY ENERGY							TOTALS	
	Fuel Wood	Hydro	Crude Oil	Char-coal	Elec-tric	Fuel Oil	Gas Oil	Gaso-line	Kero-sene	Jet Fuel	Other Petro**	Total Energy	Total Dir. Petroleum
Production	1159	71	---	---	---	---	---	---	---	---	---	1230	---
Refinery Imports	---	---	349	---	---	22	49	7	---	6	---	433	433
Other Imp/Stock Ch	---	---	5	---	---	49	25	4	1	-1	-2	85	85
Total Avail.	1159	71	354	---	---	71	74	11	1	5	2	1748	518
Char. Product	-306	---	---	306	---	---	---	---	---	---	---	---	---
Petro.Refining**	---	---	-354	---	---	187	75	56	4	22	10	---	---
Elec. Generation	---	-71	---	---	297	-168	-58	---	---	---	---	---	-226
Conversion Losses***	---	---	---	-245	-209	-13	-2	---	---	---	-8	-477	-23
Exp./Quasi Export****	---	---	---	---	---	-26	-2	-3	---	-25	-4	-60	-60
Net Domestic Avail	853	---	---	61	88	57	57	64	5	2	---	1211	209
SECTORAL BREAKDOWN													
Transportation	---	---	---	---	---	---	-48	-61	---	-2	---	-111	-111
Iron Ore Mines	---	---	---	---	-50	-50	-30	---	---	---	---	-130	-80
Industry	-2	---	---	---	-2	-1	-2	---	---	---	---	-7	-3
Residential	-845	---	---	-60	-19	---	---	---	-4	---	---	-928	-4
Commercial	-2	---	---	-1	-11	---	-1	---	-1	---	---	-16	-2
Governmental*****	---	---	---	---	-3	---	---	---	---	---	---	-3	---
Agricul.& Forest	-4	---	---	---	-3	---	-6	-3	---	---	---	-16	- 9

APPENDIX I

APPENDIX I

NEC/UN STATISTICAL COMMISSION ENERGY BALANCE COMPARISON
LIBERIA 1982 ENERGY BALANCE

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
1. Definition of primary energy	Consistent with UN Statistical Commission Recommendations	See Note 1
2. Definition of secondary energy	Consistent with UN Statistical Commission Recommendations	See Note 1
3. Treatment of imports, exports and stock changes in secondary energy and use of primary energy equivlents/bunkers	Consistent with UN Statistical Commission Recommendations	None
4. Assessment of sensitivity of each major published aggregate in energy statistics (to errors of (+) or (-) 5 or 10%)	Does not calculate exact percentage of estimated error, but it does does state weaknesses of various data sources	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
5. Definition of accounting units and conversion factors; Specification of gross or net calorific value (GCV or NCV)	Specifies conversion factors and routes used to convert original units, including calorific value for charcoal in terms of GCV	None
6. Coverage of all supplies and uses of primary and secondary energy sources (including non-energy uses)	Non-energy uses, such as naptha, and asphalt are classified as "other." No other non-energy uses are specified.	If significant amounts of non-energy sources are present, they should be included. Otherwise, no changes are recommended.
7(a) Coverage of non-commercial sources,	Consistent with UN Statistical Commission Recommendations	None
(b) Autogeneration of electricity from purchased fuels as a part of transformation sector	" "	" "
(c) Autogeneration of industry's hydropower as primary production	" "	" "

STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
(d) Steam or hot water produced from conversion of waste	Not Applicable (N.A.)	" "
(e) Method of electricity generation	Consistent with UN Statistical Commission Recommendations	None
8(a) Coverage of hydrocarbon commodities	Consistent with UN Statistical Commission Recommendations	None
(b) Coverage of flows of energy by-products and recovered heat from refineries	Does not show recovered heat from refineries	None-- Since the LPRC is no longer operating, this recommendation is not applicable to future energy balances.
9. Classification of energy flows as "production, deliveries, receipts,or consumption;" specification of coverage of stock changes as to whether they include "producers, importers, transformers, distributors and final users'" stocks	Energy flows are not explicitly defined in in terms of "deliveries or receipts." However, it is assumed that the term "exports" refers to "deliveries," and that "imports" refers to "receipts."	Add to the notes section definitions that make clear the distinction between "production, deliveries, receipts, or consumption," as well as between "producers, importers, transformers, distributors and final users' stocks."

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
10. Coal production	N.A.	None
11. Production of associated gas	N.A.	None
12. Production of gas associated or non-associated with crude petroleum	N.A.	None
13. Relationship of primary energy outputs to transformation, and transformation losses	Consistent with UN Statistical Commission Recommendations	None
14. Primary energy input to nuclear electricity	N.A.	None
15. Primary energy input to hydroelectricity, fossil fuel equivalent to energy	Consistent with UN Statistical Commission Recommendations (Uses 32% thermal efficiency)	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
16. Primary energy of renewable energy sources	Specifies primary energy of biomass (wood fuels) but does not include other sources, such as solar or wind	Data on renewable sources are currently unavailable. NEC should carefully weigh the need for providing this type of data against the cost of collecting it for use in future balance statements
17. Specification of imports and exports of secondary sources in terms of the content of the fuels that cross national boundaries	Consistent with UN Statistical Commission Recommendations	None
18. Specification of visible trade in energy sources	Consistent with UN Statistical Commission Recommendations	None
19. Energy content of primary and secondary fossil energy (use of Net Calorific Value (NCV) and Gross (Calorific Value (GCV)	Consistent with UN Statistical Commission Recommendations	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
20. Suggested accounting units: 1 joule = 0.239 calorie 1 TOE = kcal NCV 1 TCE = 7 x 106 kcal NCV	Clearly defines accounting units. Does not always use values prescribed by UN Statistical Commission. NEC uses: 1 TOE = 44.4852 Gjoules = 42.514 MBTU = 4215 KWh	Use value of 1 TOE = 41.84 Gjoules (See Note 2)
21. Energy balance format:		
(a) supplies of primary sources	N.A.	None
(b) transformation inputs (-); transformation outputs (+); transmission losses	" "	" "
(c) final uses	Does not use the term "final use," but final use is implied in "sectoral distribution"	See attached energy balance (Figure 6.1)
22. Pumped storage	Consistent with UN Statistical Commission Recommendations	None
23. Materials returned to refinery	Does not list materials returned to refinery	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
24. Relationship between original unit and data used for energy balance	Does not always indicate original unit in energy balance table	Develop additional tables as part of notes showing original units
25. Average conversion factors	Does not provide conversion factors in column headings, but these are listed in accompanying notes	None
26. Classifications and definitions of crude hydrocarbons and derived products	Consistent with UN Statistical Commission	None
27. Estimates of useful energy (See Note 3.)	Does not provide estimates of useful energy	NEC should carefully weigh the need for providing this type of table against the cost of collecting additional data. It is likely that these data fall into the "nice to have" category but are not essential.

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEC APPROACH	SUGGESTED CHANGES
28. End use analysis	Does not provide information in this format but back-up studies and the national energy assessment provide much of the same information. Therefore, it does not seem necessary to conduct additional analyses in the UN Statistical Commission format.	None
29. Definition of terms "final" and "intermediate"	NEC format does not use these terms.	If NEC format is used, definitions are not needed. If UN Statistical Commission format is adopted, these terms should be operationally defined.

NOTES TO APPENDIX I

1(a) The Liberia Energy Balance distinguishes between primary and secondary energy. (Although the balance sheet groups charcoal with primary energy on the column head, it correctly treats charcoal as secondary energy in the body of the table (see NEC Energy Balance 4a and 4e). This could be corrected by grouping charcoal with the secondary energy sources designated in the column head, or by using the energy balance format in Appendix J.

1(b) A United Nations, 1983 publication (Energy Balance 1977-1980 and Electricity Profiles 1967-1981 for Selected Developing Countries and Areas provides a series of comprehensive definitions of various types of petroleum products. These are illustrative of the type of definitions which might prove useful to the Liberia Energy Balance. Examples of these are:

Crude petroleum comprises the liquid product obtained from oil wells consisting of non-aromatic hydrocarbons (paraffinic, cyclanic, etc.), provided that they have not been subjected to any further processes other than those of decantation, dehydration, or stabilization (removal of certain dissolved hydrocarbon gases for convenience of transport), or to which only hydrocarbons previously recovered by physical methods during the course of the above processes have been added. Data for crude petroleum include shale-oil and field condensate but exclude natural gas liquids from plants and oils obtained from the distillation of solid fuels. Jet fuel comprises fuel meeting the required properties for use in jet engines and aircraft turbine engines, mainly refined from kerosene. Gasoline-type jet fuel (light hydrocarbons, also naptha-type, intended for use in aviation gas-turbine units as opposed to piston power units) is included.

Kerosene comprises mixtures of hydrocarbons with a flash point above 38 degrees centigrade distilling less than 90 percent in volume at 210 degrees centigrade, including losses. It is a refined crude petroleum fuel, in volatility between motor gasoline and gas oil, free of gasolines and heavy hydrocarbons such as gas oil and lubricating oil. It is used as an illuminant and as a fuel in certain types of spark-ignition engines, such as those used for agricultural tractors and stationary engines. The data include those products commonly termed burning oil, vaporizing oil, power kerosene and illuminating oil. [This definition, developed for use in industrialized countries, does not

include the use of kerosene for cooking, which should be incorporated into a definition used for developing country energy balances.]

Although these definitions may not be appropriate for defining the fuels comprising Liberia's energy balance, it would be useful to develop similar definitions that explicitly define each primary and secondary fuel source used on the balance sheet.

2. Using UN Statistical Commission recommended values of 1 joule = 0.239 calories and 1 TOE = 107 Kcal NCV,

then 1 joule/.239 calories = 4.184, and

1 TOE = 4.184 x 107 kilojoules (where 1 kilojoule = 1000 joules)

= 4.184 x 1010 joules

= 41.84 x 109 joules

= 41.84 Gigajoules

Therefore, 1 TOE = 41.84 Gigajoules

It should be noted that there is not universal agreement about conversion values and routes used to derive these values. For example, for the Organisation for Economic Cooperation and Development/International Energy Agency energy balances, TOE is defined as having an NCV of 10 Gcal (= 41.9 GJ), whereas for the United Kingdom balances, the unit is not formally defined in terms of its calorific value but is defined implicitly in terms of the weighted average GCV of all petroleum products in recent years (UN Statistical Commission, 1982, p. 39).

3. Useful energy is defined as "the energy effectively transformed into useful work in the equipment and processes of final energy uses, such as the work obtained from a motor car , or the light obtained from a filament bulb or a fluorescent tube, or the heat obtained in the steam produced by burning fossil fuel beneath a boiler. These amounts of useful work reflect the combined effects of the theoretical efficiency of the appliance or the equipment or the the process, and its intensity and mode of use" (U.N. Statistical Commission, 1982, p. 89).

APPENDIX J

APPENDIX J

1982 REVISED ENERGY BALANCE FOR LIBERIA

Tonnes of oil equivalent (TOE) x 10^3

Flow / Source	(a) Crude Oil	(b) Fuel Oil	(c) Gas Oil	(d) Gaso-line	(e) Kero-sene	(f) Jet Fuel	(g) Other Petrol.	(h) Hydro	(i) Electri-city	(j) Fuel-wood	(k) Char-coal	(l) Total Petro-leum	(m) Total Energy
1. Primary Production	--	--	--	--	--	--	--	70.6	--	1158.8	--	--	1229.4
2. Imports/LPCR	349.1	21.6	48.8	7.4	--	5.6	--	--	--		--	432.5	432.5
3. Exports	-	-26.1	-2.0	-3.1	--	-24.7	-4.0	--	--		--	-59.9	-59.9
4. Bunkers	--	--	--	--	--	--	--	--	--	--	--	--	--
5. Stock Change/Dir. Imp. (rise (-) fall (+))	4.9	49.2	25.0	3.5	0.4	-0.8	2.7	--	--		--	84.9	84.9
6. Inland Supply 1+2-(3 +4)+5	354.0	44.7	71.8	7.8	0.4	-19.9	-1.3	70.6	--	1158.3		457.5	1689.7
7. Transformation (input (-) ouptut (+))													
7.1 Charcoal Conversion	--	--	--	--	--	--	--	--	--	-305.4	305.4	--	--
7.2 Refinery	-354.0	186.6	75.0	56.1	4.4	21.8	10.1	--	--	--	--	--	--
7.3 Electricity Generation	--	--											
7.3.1 Public (LEC)	--	-15.0	-25.1	--	--	--	--	-65.6	105.7	--	--	-40.1	--
7.3.2 Ag & Forestry (Firestone)	--	--	-3.3	--	--	--	--	-5.0	8.3	--	--	-3.3	--
7.3.3 Mines	--	-153.1	-24.7	--	--	--	--	--	177.8	--	--	-177.8	--
7.3.4 Commercial	--	--	--4.8	--	--	--	--	--	4.8	--	--	--4.8	--
8. Energy Sector Own Use and Losses:													
8.1 Charcoal Production	--	--	--	--	--	--	--	--	--	--	-244.4	--	-244.4
8.2 Refinery	--	-13.0	-1.6	-0.3	--	--	-7.9	--	--	--	--	-22.8	-22.8
8.3 LEC Generation Loss	--	--	--	--		--	--	--	-73.3		--	--	-73.3
8.4 Ag & Forestry El. Generator Loss	--	--	--	--	--	--	--	--	-5.6	--	--	--	-5.6
8.5 Mines El. Generator Loss	--	--	--	--	--	--	--	--	-120.9	--	--	--	-120.9
8.6 Commercial El. Generator Loss	--	--	--	--	--	--	--	--	-3.6	--	--	--	-3.6
9. LEC Transmission/ Dest Loss	--	--	--	--	--	--	--	--	-4.9	--	--	--	-4.9
10. Non Energy Uses	--	--	--	--	--	--	--	--	--	--	--	--	--
11. Final Energy Use 6+7-(8+9+10) (Sector Distribution)	--	50.2	87.3	63.6	4.8	1.9	0.9	--	88.3	853.4	61.0	208.7	1211.4
11.1 Agriculture	--	--	-6.8	-2.8	--	--	--	--	-3.1	-4.0	--	-9.6	-16.7
11.2 Mines	--	-49.2	-29.5	--	--	--	--	--	-50.3	--	--	-78.7	-128.9
11.3 Industry	--	-1.0	-2.0	--	--	--	--	--	-2.5	-2.0	--	-3.0	-7.5
11.4 Residential	--	--	-0.4	--	-3.4	--	-0.4	--	-19.0	-845.5	-60.0	-4.2	-928.7
11.5 Government	--	--	--	--	--	--	--	--	-3.0	--	--	--	-3.0
11.6 Commercial	--	--	-0.7	--	-1.4	--	--	--	-10.4	-1.9	-1.0	-2.1	-15.4
11.7 Transport	--	--	-47.9	-60.8	--	-1.9	-0.5	--	--	--	--	-111.1	-111.1
11.7.1 Road	--	--	-33.6	-60.2	--	--	-0.5	--	--	--	--	-94.3	-94.3
11.7.2 Railroad	--	--	-13.5	--	--		--	--	--	--	--	-13.5	-13.5
11.7.3 Sea	--	--	-0.8	-0.6		-1.9	--	--	--	--	--	-3.3	-3.3

APPENDIX K

APPENDIX K

SUDAN CONTACT LIST

Dr. Abdul Rahman Shulli*
Minister
Minstry of Lands, Energy and Mines
Khartoum, Sudan

Mr. A./Bagi A. Dalla A. Hassan
Manager
Planning Division
General Petroleum Corporation
Khartoum, Sudan

Mr. John Gindi
Director
Corporate Planning
National Electricity Corporation
Khartoum, Sudan

Mr. George R. Farham
Training Assistant
USAID Training Office
Khartoum, Sudan

Mr. Ismail S. E. El Shafei
Head of Project Evaluation Section
National Energy Administration
Khartoum, Sudan

Mr. Farah K. Mageed
Information Section
National Energy Administration
Khartoum, Sudan

Mr. Amin Sabri Ahmed
Head of Information Section
National Energy Administration
Khartoum, Sudan

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*At the time interviews were conducted (November 1984), Dr. Shulli was Director General, National Energy Administration. He has since been promoted to the level of Minister.

Mr. Mohamed Isman
Energy Research Council/
USAID Renewable Energy Project
Khartoum, Sudan

Mr. Mohamedain Ltigni Seifelnas
Transportation Section
National Energy Administration
Khartoum, Sudan

Mr. Mohamed/Fawz
Section Head
Regional Energy Planning Section
National Energy Administration
Khartoum, Sudan

Director, Robert Brown
Mission Director
U. S. Agency for International Development
Khartoum, Sudan

Mr. Marc Daudon
Energy/Development International
Energy Planning and Management Project
Khartoum, Sudan

Mr. Dennis Moynaghan
Former Chief of Party
Energy/Development International
Energy Planning and Management Project
Khartoum, Sudan

APPENDIX L

APPENDIX L

TABLE 3

IN-COUNTRY FORMAL CLASSROOM TRAINING PROGRAM

Date Mo./Yr.	Title of Program	Instructors	Affiliation	Objectives of Program	Approximate Duration of Program (Hours)	Approximate Number of Participants
02/81	Energy Assessment Overview and Methodology	Hale	EDI	Define energy assessment; describe methodology; identify sources of data by sector; identify uses of reference energy system; identify points of consumption for which energy use can be estimated based on readily-accessible data.	2	11
03/81	The Reference Energy System	Cough	ISTI		1.5	9
04/81	Energy Demand Analysis and the Use of Generic Data	Cough	ISTI		2	10
04/81	Petroleum Products Markets: The Western European Case	Potter	Independent Consultant	Describe how petroleum products are refined marketed and distributed (in W. Europe).	4.5	11
05/81	Petroleum Products Distribution	MacDonald	EDI	Describe distribution process in the Sudan.	4.5	12
06/81	Electricity Supply Planning and Issues (Part 1)	Dhar	Consulting Firm	Discuss concepts of: firm capacity; ready capacity; reliability levels.	6	9
07/81	Introduction to Energy Issues	Bess Mukhtar	ISTI NEA	Background knowledge.	2.5	13
07/81	Petroleum Issues	Beshir El Zein	NEA NEA	Background knowledge of petroleum sector.	2.5	15
07/81	Petroleum Distribution and Transport	El Dawla	NEA	Background knowledge of petroleum sector.	2.5	13
07/81	Electricity Generation and Distribution	Gindi Bagi	NEC NEA	Background knowledge of electricity sector.	2.5	11

Source: "Evaluation of Sudan Energy Policy and Planning Project, (SEPAP)," Arthur D. Little, Inc., for USAID, Bureau for Science and Technology, Office of Energy, Washington, D. C. , June 1984, p. 31.

APPENDIX M

APPENDIX M

SUDAN ENERGY BALANCE 1982/83

	Primary Energy						Petroleum Products					
	Fuelwood Biomass[a]		Hydroelectricity	Crude Oil	Charcoal	Electricity	LPG	Gasoline	Kerosene	Gasoil	Fuelol	Total
Gross Supply												
Production	[illegible]	457	157									
Imports				728			4	110	22	[illegible]		7564
Stock decrease (increase)				(7)								1225
												(7)
Total Available Supply	[illegible]	457	157	721			4	110	22	[illegible]		[illegible]
Conversion												
Petroleum Refining				(685)			4	112	47	242	280	0
Charcoal Production[b]	(1539)				1539							0
Elect. Generation			(157)			207				(47)	(40)	0
Conversion losses[c]	(2306)			(36)		(199)						(2041)
Trans./Distrib. losses						(28)						(28)
Net Supply Available	[illegible]	457	0	0	1539	62	8	222	70	[illegible]	237	[illegible]
Exports											(95)	(95)
Distributors Stock decrease (increase)							(1)	7	9	(23)	(6)	(14)
Net Consumption	[illegible]	457			1539	62	7	229	79	[illegible]	135	[illegible]
Consuming Sectors												
Agriculture												
Industry	62	50				7				106	36	159
Transport						24				43	60	300
Household	2371	457			1448	27		225	47	[illegible]	9	[illegible]
Public/Other	48				43	4	7	4	22	35		425
									10	[illegible]		[illegible]

a) crop resisues, animal wastes, veg. oil

b) one ton of charcoal requires 6 tons of fuelwood

c) fuel consumption and conversion losses in thermal electricity generation. Total conversion losses (10,000TOE) include also a hypothetical fugure for electricity based on 34% efficiency.

Source: NEA and Mission estimates using World Bank suggested figures. Chart from "Role of Energy Data in Energy Importing Developing Countries, With Special Reference to Sudan, Dr. Abdel Rahman Shulli, Director general, National Energy Administration. Paper presented at Workshop on Energy Data, Brussels, January 5-10, 1984, p. 15.

APPENDIX N

APPENDIX N

NEA/UN STATISTICAL COMMISSION ENERGY BALANCE COMPARISON
SUDAN 1982/3 ENERGY BALANCE

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
1. Definition of primary energy	Consistent with UN Statistical Commission Recommendations	None
2. Definition of secondary energy	Consistent with UN Statistical Commission Recommendations	None
3. Treatment of imports, exports and stock changes in secondary energy and use of primary energy equivalents/bunkers	Consistent with UN Statistical Commission Recommendations but does not provide information about bunkers	None
4. Assessment of sensitivity of each major published aggregate in energy statistics (to errors of (+) or (-) 5 or 10%)	Does not provide an assessment of the percentage of estimated error	State weaknesses of data and estimate error
5. Definition of accounting units and conversion factors; Specification of gross or net calorific value (GCV or NCV)	Notes that World Bank suggested conversion factors are used but does not state factors on balance sheet	Add conversion factors to balance sheet

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
6. Coverage of all supplies and uses of primary and secondary energy sources (including non-energy uses)	Does not list non-energy uses	If significant amounts of non-energy sources are present, they should be included--otherwise, no changes are recommended.
7(a) Coverage of non-commercial sources, (including non-energy uses)	Consistent with UN Statistical Commission Recommendations	None
(b) Autogeneration of electricity from purchased fuels as a part of transformation sector	" "	" "
(c) Autogeneration of industry's hydropower as primary production	" "	" "
(d) Steam or hot water produced from conversion of waste	Not Applicable (N.A.)	" "
(e) Method of electricity generation	Consistent with UN Statistical Commission Recommendations	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
8(a) Coverage of hydrocarbon commodities	Consistent with UN Statistical Commission Recommendations	None
(b) Coverage of flows of energy by-products and recovered heat from refineries	Does not show recovered heat from refineries	Satellite tables to an overall energy balance sheet could be used to show the more important flows of energy by-products recovered, if chemical industries are of sufficient size to warrant.
9. Classification of energy flows as "production, deliveries, receipts,or consumption;" specification of coverage of stock changes as to whether they include "producers, importers, transformers, distributors and final users'" stocks	Energy flows are not explicitly defined in in terms of "deliveries or receipts." However, it is assumed that the term "exports" refers to "deliveries," and that "imports" refers to "receipts."	Add to the notes section definitions that make clear the distinction between "production, deliveries, receipts, or consumption," as well as between "producers, importers, transformers, distributors and final users' stocks."
10. Coal production	N.A.	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
11. Production of associated gas	N.A.	None
12. Production of gas associated or non-associated with crude petroleum	N.A.	None
13. Relationship of primary energy outputs to transformation, and transformation losses	Consistent with UN Statistical Commission Recommendations	None
14. Primary energy input to nuclear electricity	N.A.	None
15. Primary energy input to hydroelectricity, fossil fuel equivalent to energy	Consistent with UN Statistical Commission Recommendations (Uses 34% thermal efficiency)	None
16. Primary energy of renewable energy sources	Specifies primary energy of biomass (woodfuels) but does not include other sources, such as solar or wind	Data on renewable sources are currently unavailable. NEC should carefully weigh the need for providing this type of data against the cost of collecting

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
		it for use in future balance statements.
17. Specification of imports and exports of secondary sources in terms of the content of the fuels that cross national boundaries	Consistent with UN Statistical Commission Recommendations	None
18. Specification of visible trade in energy sources	Consistent with UN Statistical Commission Recommendations	None
19. Energy content of primary and secondary fossil energy (use of Net Calorific Value (NCV) and Gross (Calorific Value (GCV)	Consistent with UN Statistical Commission Recommendations	None
20. Suggested accounting units: 1 joule = 0.239 calorie 1 TOE = kcal NCV 1 TCE = 7×10^6 kcal NCV	Uses World Bank recommended accounting units: 1 TOE = 10.2 million kcal = 40.5 million BTU = 42.7 Gjoules 1 kcal = 3.968 BTU 1 kcal =4.19 x 10 Gjoules 1 MWh = 860,000 kcal = 0.248 TOE	The UN Statistical Commission's recommended accounting units of: 1 TOE = 44.4852 Gjoules = 42.514 MBTU = 4215 kWh difers slightly from from that of the World Bank's recommended:

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
	at 34% efficiency in thermal (oil) generation	1 TOE = 42.7 Gjoules = 40.5 million BTU Since there are no universally accepted conversion factors, no changes are recommended.
21. Energy balance format:		
(a) supplies of primary sources	N.A.	None
(b) transformation inputs (-); transformation outputs (+); transmission losses	" "	" "
(c) final uses	Consistent with UN Statistical Commission Recommendations	None
22. Pumped storage	Consistent with UN Statistical Commission Recommendations	None
23. Materials returned to refinery	Does not list materials returned to refinery	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
24. Relationship between original unit and data used for energy balance	Does not always indicate original unit in energy balance table	Develop additional tables as part of notes showing original units
25. Average conversion factors	Does not provide conversion factors in column headings	Add conversion factors to column headings or to footnote to table
26. Classifications and definitions of crude hydrocarbons and derived products	Consistent with UN Statistical Commission	None
27. Estimates of useful energy	Does not provide estimates of useful energy	NEA should carefully weigh the need for providing this type of table against the cost of collecting additional data. It is likely that these data fall into the "nice to have" category but are not essential.
28. End use analysis	Does not provide information in this format, but back-up studies and the national energy assessment provide much of	None

UN STATISTICAL COMMISSION RECOMMENDATIONS (TOPIC SUMMARY)	NEA APPROACH	SUGGESTED CHANGES
	the same information. Therefore, it does not seem necessary to conduct additional analyses in the UN Statistical Commission format.	
29. Definition of terms "final" and "intermediate"	NEA format does not use these terms.	If NEA format is used, definitions are not needed. If UN Statistical Commission format is adopted, these terms should be operationally defined.

APPENDIX O

APPENDIX 0

SUDAN ENERGY BALANCE 1982

1 TOE = 10.2 million kcal = 40.5 million BTU = 42.7 GJ
1 kcal = 3.968 BTU-6

1 kcal = 4.19 x 10 GJ
1 MWh = 860,000 kcal = 0.249 TOE at 34% efficiency in thermal oil generation

Flow	Source	Crude	L.P.G.	Gasoline	Kerosene	Gas-Oil	Fuel Oil	Thermal Electricity	Hydro Electricity	Fuel wood	Charcoal	Biomass	Total Petroleum	Total Energy
1. Primary Production		--	--	--	--	--	--		197	6880	--	487	--	7564
2. Imports		728	4	110	23	360	--	--	--	--	--	--	1225	1225
3. Exports		--	--	--	--	--	-95	--	--	--	--	--	-95	-95
4. Bunkers*		--	--	--	--	--	--	--	--	--	--	--	--	--
5. Stock Change/Dir. Imp. (rise (-) fall (+))		-7	-1	7	9	-23	-6	--	--		--		-21	-21
6. Inland Supply (Total Primary Supply) 1+2 - (3+4)+5		721	3	117	32	337	-101	--	197	6880	--	487	1109	--
7. Transformation (input (-) output (+))														
7.1 Charcoal conversion		--	--	--	--	--	--	--	--	-1539	1539	--	0	0
7.2 Refinery		-685	4	112	47	242	280	--	--	--		--	0	0
7.3 Electricity Generation		--	--	--	--	-47	-43	287	-197	--	--	--	0	0
8. Energy Sector Own Use & Losses														
8.1 Charcoal Production		--	--	--	--	--	--	--	--	-2806	--	--	--	-2806
8.2 Refinery		-36	--	--	--	--	--	--	---	--	--	--	-36	-36
8.3 Electricity Conversion		--	--	--	--	--	--	-199	--	--	--	--	-199	-199
9. Transmission/Dist. Losses		--	--	--	--	--	--	-26	--	--	--	--	-26	-26
10. Non Energy Uses**		--	--	--	--	--	--	--	--	--	--	--	--	--
11. Final Energy Uses (Net Consumption) (0+7-(8+9+10))		0	7	229	79	532	136	62	0	2535	1539	487	983	5606
11.1 Agriculture		--	--	--	--	108	38	7	--	--	--	--	108	153
11.2 Industrial		--	--	--	--	46	89	24	--	82	--	59	46	300
11.3 Transport		--	--	225	47	328	9	--	--		--	--	609	609
11.4 Household		--	7	--	22	25	--	27	--	2371	1446	428	54	4326
11.5 Public/Other		--	--	4	10	25	--	4	--	82	93	--	39	218

Source: Figures derived from 1982 Sudan Energy Balance, National Energy Administration.

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