A PERSPECTIVE ON ENERGY ACTIVITIES IN AFRICA

FINAL REPORT

PREPARED UNDER

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DELIVERY ORDER NO. 7

PREPARED FOR

OFFICE OF ENERGY

BUREAU OF SCIENCE AND TECHNOLOGY

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D.C.

PREPARED BY

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SECTION 1

THE CASE FOR ENERGY ACTIVITIES IN AFRICA

1.1 WHY ENERGY ACTIVITIES ARE IMPORTANT

Energy issues continue to be important in determining the development of countries in Africa. This reality is not always recognized by those who do not deal directly with energy matters, partly due to impressions that the fall in international energy prices solved many of the problems and due to a general lack of familiarity with the many energy dimensions of overall development. Amongst the important factors with which USAID staff should be familiar are the following:

- at the household level, particularly the lower income households which are important targeted beneficiaries of USAID assistance, fuel purchases often consume as much as 20 to 30 percent of incomes;

- also at the household level, almost any strategy for increasing household income, particularly rural farm income, will necessitate changes in energy use - more efficient use and increased use of modern energy and/or energy intensive commodities (fertilizer);

- the above is again true at the firm level; in many sectors almost any strategy for increasing firm productivity and income will necessitate changes in energy use - correct choice of energy using technology, more efficient energy use and increased use of modern energy forms;

- at the national level, the energy sector share of the development budget is usually 25 percent or more; much of this goes to the power subsector and yet in most cases these budgets are highly constrained;

- also at the national level, even with lower oil prices the foreign exchange burden for oil imports continues to be a major constraint, particularly when viewed from the perspective of shifts in terms of trade for these countries' principal exports;

- constrained development budget expenditures and oil import burdens often result in both oil product and power shortages being endemic; some of the shortages are quite costly in economic terms;

- many of the public sector firms and institutions with responsibility for energy supply operate poorly; and in addition to failing to provide adequate and reliable supplies needed for development, their losses are often a drain on the exchequer; and

- the environmental/natural resource management problems of deforestation, soil erosion, etc., which are intertwined with fuelwood issues, remain serious and are largely unabated.

1.2 DIFFERENT APPROACHES ARE NEEDED AND ARE POSSIBLE

The continuing and sometimes growing nature of the energy dimensions of the development problems argues strongly for different approaches to solve the problems and

- as a result of fiscal burdens and development needs both governments and international assistance agencies are increasingly aware of the need to consider new institutional, financial and technical approaches to energy supply;

- such new approaches require significantly different assistance from the multilateral and bilateral agencies;

- rather than only conventional energy supply project focused lending and technical assistance, increased activities targeted to policy changes, such as increasing the role of the private sector in energy supply and fostering more "commercial-like" operations in the parastal supply organizations, are needed; and

- some of such needed assistance should be integrated assistance targeted to broader macroeconomic objectives and policy changes.

1.3 LINK TO AGENCY, BUREAU AND MISSION AGENDA AND THEMES

The need for different approaches to the energy dimensions of development needs and the role of development assistance agencies in stimulating such new approaches very much fit within some of the agendas of the African Bureau. Specifically:

- Energy use is an excellent example of the Bureau's Policy logic, namely the inefficiency of resource use and insufficiency of resources, both of which characterize energy use in Africa and constrain economic growth.

- Bureau policy of helping overcome these constraints by supporting the development of private markets (by both private and public actions) and supporting the complementary provision of key public goods and services logically argues for activities aimed at the energy market which, after agriculture, is usually the largest market in most African countries.

- Energy markets encompass the traditional fuels' markets which are usually totally unregulated yet only sometimes competitive and rarely efficient (in either financial or economic terms). Energy markets also encompass the petroleum product and electricity markets which are usually totally (but poorly) regulated and usually uncompetitive, and rarely efficient (in either financial or economic terms). Opportunities for improvement of market performance are many and encompass:

  1. regulatory reform of both prices and market entry;
  2. overcoming constraints of high information and transaction costs;
  3. overcoming limitations of indigenous capital markets; and
  4. increasing the capability and capacity of local entrepreneurs.

  There are many development support activities which could be geared to these four opportunities for improvement of energy market performance. Many such development support activities would also be complementary to other non-energy sector specific development goals such as those in agriculture, employment, private sector, environment, health, etc.

- Intersectoral links with energy exist for nearly all sectors, and for some sectors such as agriculture, industry and environment, these links are both direct and important. More often than not, adequately designed and implemented development support activities in agriculture, industry and environment should have components with particular focus on energy and energy using technology aspects.

- Effective and efficient energy systems may have different players engaged in the market starting from upstream supply or import to downstream transport and delivery through to provision and use of end-use technology. These players may be firms and enterprises ranging from small local enterprise to large multinational firms, employing both sophisticated high-technology and mature and often labor intensive technology. Hence, in energy systems there are multiple

opportunities for enterprise development and private sector stimulation. These opportunities exist in both the traditional and the modern fuels' components of the energy system and for firms both large and small.

The compatibility of aspects of the Africa Bureau's focus with many of the development assistance needs is complemented by the comparative advantage of the U.S. experience and the capability of S&T/EY's capacity to draw on this experience. What is needed is the conception of development assistance activities which, while dealing with the energy dimensions of development, are focused on such objectives as enterprise development and improving the efficiency of markets and use of resources. Candidates for such activities are discussed in the next Section.

SECTION 2

EXAMPLES OF RELEVANT CANDIDATE DEVELOPMENT ASSISTANCE ACTIVITIES (WITH AN ENERGY DIMENSION) FOR AFRICA

2.1 INTRODUCTION

The examples of relevant candidate development assistance activities (with an energy dimension) which are discussed in this section are not meant to be exhaustive; rather they are chosen for a combination of three characteristics:

- o compatibility with the Africa Bureau's program themes;
- o S&T/EY's capability to assist in such efforts; and
- o the potential to leverage such development assistance efforts through subsequent actions by USAID, other agencies and the private sector.

The examples of relevant candidate development assistance discussed below are grouped as follows:

1. activities to support enterprise development and other interventions which promote more efficient and reliable end-use energy utilization;
2. activities to support private power generation (and distribution), with particular focus on small power systems such as those for market towns; and
3. activities to support more efficient and reliable market systems for the production and delivery of both traditional and modern fuels and electricity; a subset of these activities concern energy pricing and other policy reforms.

2.2 DEVELOPMENT SUPPORT FOR ENTERPRISE CREATION AND OTHER INTERVENTIONS TO PROMOTE LESS COSTLY, MORE EFFICIENT, AND MORE RELIABLE END-USE ENERGY UTILIZATION

In African as well as other developing countries, end-use energy utilization is often quite inefficient and, in some end uses such as small engines, also unreliable. In some cases fuel switching to less costly options exist but must be organized. Understanding the structure of the market and roles played by firms on the supply side is

important in determining what must be done to promote more efficient and reliable end-use energy utilization. In industrialized country energy markets one of the forces, in addition to energy prices, leading to more efficient and reliable end-use energy utilization is the firm which supplies equipment and services to the end-use customers in the household, industrial or agriculture sectors. Such firms provide both information and technology (and in some instances financing for end-use technology retrofit). In effect, such service and/or equipment supply firms lower the information and transaction costs for the end-use consumer.

In the industrialized countries, such enterprises to provide such services and technology are naturally formed because the market for such services and equipment is large enough and because the synergies of an abundance of complementary equipment manufacture, debt and equity financing, technical know-how and entrepreneurship exist. This is not the case in less developed market situations as is the situation in most African countries. Yet the importance of dealing with the continuing inefficient (and unreliable) end-use utilization of, or switching to, less costly (often domestic) energy forms remains.

In some situations there have been development assistance activities aimed at the fuel substitution possibility. For example, in Burundi, assistance has helped to develop the production of local peat and there has been some substitution achieved. Much more is possible but it requires aggressive marketing and delivery of services, technology and peat (deLucia and Associates, 1988).

There have also been efforts aimed at the efficiency problem. In a number of countries, such as Senegal and Cote d'Ivoire, there have been assistance efforts aimed at the low efficiency of energy use in industry. Generally this has consisted of supporting audits in end-user firms to identify the inefficiencies and suggest changes. In other instances the assistance has been to provide training and equipment for a particular end user (such as engine repair for an agricultural parastatal). Other than effecting limited housekeeping/behavioral changes or equipment improvement at a particular enterprise, such limited assistance efforts are often inadequate to effect broad-scale market-wide changes in the absence of:

- reinforcing policy reforms if needed; and
- establishing firms which provide services and technologies to fill the needed market.

It is to effect such changes that the possible development assistance activities outlined below is aimed. Four different, but analogous development assistance activities are outlined below, each

aimed at the creation of firms to meet the needs of improving the end-use energy efficiency and/or reliability for specific end users. In each case, as preliminary steps, it would be necessary, if not done previously, to examine:

1. the critical policy and regulatory factors, such as energy prices and debt financing availability for technology retrofits, which would impact the viability of such new enterprises;

2. analogous experience from elsewhere, both industrialized and developing countries, that could be useful in designing and implementing such enterprises;

3. the likely size and profitability of the market for the services and technology to be offered;

4. identification of existing firms and/or entrepreneurs who might provide part of the starting basis for such enterprises; and

5. a feasibility analysis for enterprise creation and an implementation plan including how, through development assistance efforts, initial business plan and enterprise start-up will be accomplished.

In the following paragraphs, the creation of firms to serve particular end-use energy market niches are discussed as is the type of enterprises most likely needed.

2.2.1 Firms to Provide Energy Conservation Consulting Services and Mechanical and Electrical Services and Equipment: Focus on Industrial Process Heat

Experience in a number of industrialized and developing countries, including examples in Africa, indicate that industrial process heat end use is inefficient. However, the opportunities for savings (from both financial and economic perspectives) are often not taken advantage of due to exchange inefficiencies: high risks/uncertainty, high transaction costs, and lack of information.[1] Neither energy end

[1]These high transaction costs are usually not adequately reflected in conventional discounted cash flow analysis that examines the return (economic or financial) of potential conservation investments. In the case of industrial end users, there is almost always a high scarcity premium placed not just on capital but also on senior technical and managerial time. Given the absence of knowledgeable suppliers of

users nor potential suppliers of service and technology (local consulting firms and metal and mechanical fabricators) have complete and certain information regarding either proper audit procedures or the right equipment choices for improving end use.

The opportunities for significant energy savings often exist amongst both industrial users of modern commercial energy, such as fuel oil and electricity; and industrial (often agro-industrial) users of traditional (but commercial) woodfuels and other biomass. In most countries in which hydro is the basis for the electric supply (e.g., Ghana and Zaire), industry is the major oil consumer and should be the primary focus of energy efficiency improvements. But even in countries in which electric power is thermal based (Sierra Leone) and thus for which improvements in oil use in the power sector are most important, improving energy use in industry is also important. Also, in a number of countries, improving industry's use of traditional fuels can also be a major opportunity. In some countries, e.g., Malawi, Sierra Leone and elsewhere throughout much of Africa, industries such as tobacco curing represent a large portion of woodfuel consumption, and efficiency improvements continue to be needed (in the case of Malawi such improvements have been the focus of a World Bank project).

Support of the creation of firms to supply both consulting services and the necessary equipment fabrication (or partial fabrication and import) and installation could be an important development assistance activity. The creation of such firms (or evolution from existing firms to offer additional product or service)

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services and equipment, it is this scarce managerial and technical time which will have to be spent getting the information, doing the audits, picking the equipment, etc. In many African and other situations, such allocation of scarce managerial and technical time will rarely be made; there are more pressing production or marketing problems. Unlike a potential supplier of such services or equipment, an end-user's investment in gathering the information brings only the return from one installation. If this information and related capability is invested in a supplier of services, there are economies of scale as return is earned from many installations. In this sense, support for the creation of such firms with necessary technical information and training has many of the characteristics of a public good as the ultimate consumption of this information will be by many end users.

would serve more than just energy related needs. Such firms, in addition to providing skilled (both technician and engineer) employment opportunities, also reinforce the general engineering and metal fabricating/light industry capacity so critical to broader economic development. And of course the difficulty in developing such firms, or strengthening existing ones, would be dependent on the stage of development of the existing light engineering, metal mechanical and consulting engineering communities. In situations such as Zimbabwe and Senegal there are firms to assist and strengthen; in situations such as Chad few such capabilities exist. Such enterprise development can also help in other ways; efficiency improvement in the use of woodfuels would also help deal with broader natural resource issues.

Support would likely require (after completion of the five steps outlined above) provision of training, information and technical assistance as well as perhaps some debt or equity financing assistance to the new or evolving firms. A complementary effort would be to work with local development finance institutions (DFIs). Such assistance could be to provide the DFIs with additional capital, information and assistance to lower transaction costs such that these DFIs might make debt equity available to the enterprises and their industrialists customers (for the conservation or fuel switching investments).

A special case of enterprise development would be the creation (or evolution) of firms also capable of providing the services and equipment for cogeneration systems, including cogeneration with surplus being fed to the grid. The technical requirements - both the mechanical/pressure vessel (boiler) and synchronous electrical controls - would likely require that part of the creation of such firms would involve the structuring of cooperative or joint venture relationships with foreign partners. USAID could also assist in this as part of a development assistance effort.

2.2.2 Firms to Provide Small Engine Maintenance and Repair Services

Use of small engines (for auto-generation, pumping, grinding/milling and numerous other applications) is critical to the development process. Experience in many developing countries, however, including countries in Africa, indicates that this is a particularly troublesome energy end use. Inefficient fuel use may be less of a problem than equipment reliability and long down-time. Anyone who has been involved in engine dependent (diesel) irrigation or water supply, or small agro-industry or electrification in such countries as Chad or Niger in West Africa and Sudan or Tanzania in East Africa and Zambia in Southern Africa knows that the problem is generic and extensive. The reasons for the problems are varied, but are reflective of the small

and underdeveloped nature of the market for equipment and support services: too many equipment types (many purchased offshore under foreign assistance projects), absence of local manufacturers' representatives, and lack of small-engine repair firms except in the capital and other large cities.

Potential suppliers of service and technology (local manufacturers' representatives for other equipment, firms repairing cars and trucks) may have either incomplete information regarding the possible market or inadequate capital (for spares inventory) and trained staff to adequately fill the market niche. Potential suppliers may be scarce or non-existent.

Support of the creation of firms (or evolution from existing firms to offer additional product or service) could be an important development assistance activity. Such firms would serve more than just energy related needs. As in the previous market niche, support would likely require (after completion of the five steps outlined above) provision of training, information and technical assistance as well as perhaps some debt or equity financing assistance to new or evolving firms.

2.2.3 Firms to Manufacture and to Sell More Efficient Stoves

Energy end use in stoves is the largest fuel use in most West African countries. The inefficiency of this end use, particularly in traditional fuel stoves, is well known and documented. But many stoves used for LPG and kerosene are also less efficient than need be. USAID and other development assistance agencies have sponsored work on improved stoves in many African countries (e.g., Kenya, Sudan, Rwanda, Ethiopia, Tanzania, Guinea, Ghana, Mali and Sierra Leone). Success has been limited. But where success has been greatest, in terms of number of stoves in continuing use with documented higher efficiencies, the diffusion mechanisms have relied on market forces with some assistance. Successes are based on the supplier, artisans or small manufacturing organizations, earning adequate financial return. Success also requires that the user save enough (and perceiving it) to both continue to use the stove and to provide the "word of mouth" advertisement inducing neighbors and others to also buy and use the improved stoves.

There are now examples of stove successes both with artisanal producers in informal markets and with firms using small manufacturing techniques with increased emphasis on quality control to produce stoves with longer life. There is also the start of ongoing networking activities to share some of this experience so that it may be modified as needed and lead to similar successes elsewhere. USAID has been

instrumental in supporting this networking in East Africa and there is a role for transfer and cross fertilization of this experience with the experience that exists in other west African markets. There is finally the great need to go beyond such networking to assist existing and potential entrepreneurs. It is important that any development assistance efforts to assist entrepreneurs focus as much on the broader small business development issues as they do on the specifics of the technology. Such efforts would fit ideally within the mandated micro-enterprise initiatives that are to be part of Mission activities.

2.3 POWER FOR MARKET TOWNS

The provision of electric power to rural communities is a distant dream for much of Africa. Grid extension is unprofitably expensive and few countries have managed to install, operate and maintain a far-flung system of isolated diesel generators. The logistical difficulties have proven overwhelming for short-staffed and poorly funded central electricity authorities.

The private sector can provide power to rural communities, given a suitable regulatory climate, access to information, and ability to import requisite equipment. There are few easier ways to stimulate entrepreneurial enterprise than through fostering the provision of electric power to market towns, electric power that is often an adjunct to a primary business based on shaft power, such as many agro-processing activities.

Unlike other development assistance activities suggested in this report, power for market towns is currently a focus of discussion within the Africa Bureau. Possible examples that have been cited in these discussions include such specific cases as Liberia and Sudan. The opportunities for such initiatives exist throughout Africa. Special cases of interest would be situations in which the private power system could be developed from renewable energy sources. This is the case, for example, in the Sudan and Swaziland sugar mill based scheme that has already been the focus of S&T/EY efforts, but other renewable opportunities abound. For example, in Ethiopia and Cote d'Ivoire, earlier World Bank/UNDP work has identified significant agro-industrial and forest products residue based resources that might be the basis for electrification of adjacent towns. In some countries unexploited hydro is an option (as in Madagascar and Guinea), and in some countries (e.g., Zambia and Zaire) surplus existing hydro power might be the basis for private investment in distribution only. Smaller scale private power systems have been successfully developed elsewhere. Some examination of these successes and their characteristics might be useful background for such initiatives in Africa and other possible next steps appear warranted and are outlined below.

2.3.1 Document Private Power in Asia

In a few countries of Asia, such as Pakistan, Nepal and Indonesia, entrepreneurs have seized the opportunity to generate and sell electricity to eager customers.[2] These entrepreneurs have found a regulatory "gap" and have scrambled to supply a demand. In most cases the entrepreneurs themselves needed shaft or electric power and found it profitable to sell excess to neighbors.

Documentation of these experiences would illustrate some sets of conditions under which entrepreneurs have grasped market opportunities. The following countries' experiences should be examined, to be supplemented by other countries if deemed appropriate:

a. Pakistan has seen areas in the Karachi/Sind region supplied with electricity by businesses that bought used diesel generators from scrapped ships and installed them, together with a rudimentary distribution system, in towns not served by the public utility.

b. Nepal encourages private owners of water turbines, installed for rice and maize processing, to generate electricity at night for sale in the village. Government subsidies, loans and technical assistance are available for such schemes.

c. Indonesia has a diversified, decentralized rural electrification situation. In the past many towns and villages have received power from private businesses that either sold excess power or generated power specifically to sell as their primary activity.

2.3.2 Document African Experience and Constraints

For selected priority African countries, there is a need to identify the critical factors inhibiting private power development in

[2]The countries cited are ones in which there are "small" private power systems; other developing countries also have "large" systems such as the Indian electric power companies which are part of the Tata group of companies. For other examples and a discussion of the possible roles of the private sector in electric power supply see Roth (1987), particularly Chapter 3.

isolated (off-the-grid) market towns. These could be either towns with no power supply or towns with defunct central authority power plants.

This task views power supply through the eyes of prospective entrepreneurs. Their identification of constraints to enterprise establishment is of key importance. Included in this task are the following issues:

a. government policy regarding rural power supply
b. existing regulations regarding rural power supply, e.g., pricing, technical standards, quality of service
c. credit availability
d. equipment import procedures and barriers
e. availability of technical information
f. availability of trained installation, operation and maintenance technicians
g. governmental receptivity to altered policy and regulations to facilitate private sector development of market town power.

2.3.3 Small Hydropower Assessment

Africa's wealth in hydropower potential is frequently noted (World Bank, August 1984); however, for a number of reasons, hydropower exploitation on a large scale must proceed deliberately. On the other hand, small hydropower development opportunities abound (Zaire, Guinea, Chad), and the special case of hydropower as a basis for private market town electrification schemes was mentioned above (Madagascar).

An advantage of small hydropower development is the relatively short time from scheme inception to power production. Given a favorable institutional framework, private entrepreneurs can generate and distribute electricity from small hydropower. They can do this in some countries using a significant fraction of locally manufactured components, thus stimulating private enterprise in the mechanical and electrical equipment trades. In the short run, moreover, there will be created a demand for U.S. equipment and expertise and an edge on what could prove to be a vast Africa-wide market for hydropower and electrical system equipment.

It is time, therefore, for generalizations about hydropower to yield to an assessment of the small hydropower potential in countries of particular interest to USAID in Africa. Such an assessment should estimate:

a) potential (for units under 500kW) by geographic region within each selected country;

b) most likely technology choice for each region;
c) characteristics of demand (in relation to supply) within each region, including shaft power demand;
d) the institutional policy and regulatory framework for small hydropower development within each country; and
e) needs and resources within each country for training, information, equipment manufacture and repair, and project financing.

A first step should be to review data assembled in the past and studies undertaken both by USAID and other agencies (both international donors and local institutions). Based upon the assessment for Africa, selected feasibility studies can be prepared for one or two countries (see Section 2.3.5).

2.3.4 Market Potential

One output of Task Two (Section 2.3.2 above) is identification of countries with promising policy and regulatory climates. For this subset of selected countries, market potential needs to be assessed in order to estimate potential impact of a project, training needs, information needs, capital financing requirements, equipment manufacture and import requirements.

Most of this task can be accomplished through examination of population and industrial censuses. Rapid surveys of selected market towns to ascertain approximate measures of demand and willingness to pay will also be necessary.

The greater the extent to which this activity can be undertaken with the cooperation and participation of potential entrepreneurs, the more successful the implementation of the project is likely to be.

2.3.5 Project Feasibility Study

Based on the tasks outlined above, for one or more selected African countries with promising regulatory climate and satisfactory market potential, the technical, financial and institutional needs for project implementation need to be detailed.

The first step is a careful examination of the specific policy and regulatory changes required to implement a pilot project. This will necessitate, in most cases, institutional changes to be detailed in the feasibility study.

Because a major argument for private sector development is that the market will dictate appropriate technical choices, it will be counter-productive to over-detail the technical design of the project. Sufficient detail is necessary, however, to identify:

a. indicative equipment import requirements
b. local manufacturing opportunities
c. training needs
d. information/extension needs

Most interesting would be a mix of two power supply options, e.g., diesel and micro-hydropower, depending on the specific conditions in the selected countries.

Finally, financing needs careful attention both from the points-of-view of entrepreneurs' requirements and of alternative institutional arrangements.

2.3.6 Market Town Electrification - Pilot Project(s)

The feasibility study (Task Five) identifies technical, financial and institutional requirements to support private power supply in a selected country. This is the basis for a project paper. It is expected that A.I.D. support to such a pilot project would include the following:

a. assistance with necessary policy, regulatory, and institutional changes;
b. identify potential entrepreneurs and assistance in developing a business plan;
c. assistance in organizer debt and/or equity financing;
d. training of potential entrepreneurs and technicians;
e. import of equipment; and
f. establishment of a monitoring and evaluation system to track project progress, identify problems early and evaluate lessons of relevance to replicability to other countries.

2.4 DEVELOPMENT SUPPORT AIMED AT THE MORE EFFICIENT AND RELIABLE FUNCTION OF THE MARKET SYSTEMS FOR PRODUCTION AND DELIVERY OF BOTH TRADITIONAL AND MODERN FUELS AND ELECTRICITY

Electricity and fuels' supply and delivery are embodied in market systems in all countries. As mentioned above, these markets may be largely unregulated but still not necessarily competitive or efficient as is the case for traditional fuels. The markets may be regulated and noncompetitive and yet inefficient as is often the case for modern

fuels and electricity. In the current environment of scarce resources, African countries cannot afford such inefficiencies, as these markets represent large financial flows from both a national, household or firm perspective. Development assistance efforts aimed at reducing these inefficiencies appear to be warranted. For electricity and petroleum fuels (and gas or coal), as well as for traditional fuels, the following steps would be involved in designing and implementing such targeted development assistance:

- o examination of the market organization with particular emphasis on the role and cost structure of players involved (in electric power there may be only one player) with each distinct link (production/import, refining or generation, transport/distribution and retailing) on the supply side (some of this may be available from existing studies);
- o comparative technical and cost analysis of each link in the market system to identify inefficiencies and non-competitiveness;
- o determination of the feasibility of regulatory, pricing, market entry promotion or other interventions to decrease inefficiencies identified; and
- o support for the implementation of such interventions.

Likely areas of inefficiencies that will be identified and possible interventions that might be the target of development support are outlined in the following discussion which examines separately petroleum (and gas and coal), power and traditional fuel systems.

2.4.1 Improving the Efficiency of Modern Fuels (petroleum, gas and coal) Market Systems

In the current international oil price environment the in-country costs of refining (if done), storage, transport and retail marketing can often represent more than half of total petroleum product costs to the consumer (exclusive of taxes). Efficient systems are ones which minimize both the offshore/import costs (FOB and CIF) and the in-country costs. Studies such as those under the World Bank/UNDP have identified inefficiencies in both the offshore and in-country components of these market systems as generic problems in many countries all over the continent (e.g., Gabon, Congo, Sierra Leone, Gambia and Burundi). Remedies can include:

- o regulatory reform such as (i) allowing more competition in both offshore (procurement) and in-country components of the particular fuel system, (ii) allowing more private refining

and/or marketing companies to operate or in cases where private firms are excluded opening the market, and (iii) allowing new/additional local firms with compatible experience (e.g., transport companies) to enter segments of the market.

- o pricing reform (if not some degree of deregulation with prices only regulated in terms of upper limits) to make differential prices (by sector and regional markets) more closely reflect differential costs of serving those markets; and

- o where there are domestic resources or options to competitively import other fuels (gas, coal), introduce regulatory and investment reforms and allow market entry and technology transfer to foster competition between fuels.[3]

These are areas in which the U.S. has a strong comparative advantage. While USAID development activities in support of such changes have not been extensive, there have been some efforts in other countries. In a number of instances USAID has focused on reforms in analogous in-country distribution and marketing of energy intensive commodities such as fertilizer. Given the greater financial flows in fuels markets (in comparison to fertilizer) and the great scope for improvement, development assistance initiatives appear warranted

2.4.2 Improving the Efficiency of Traditional Fuels Market Systems

Traditional fuels systems are of great importance for at least the following reasons:

- o after agricultural commodities, these are usually the markets with the greatest financial flows in most non-oil producing, low income developing countries;

- o they are the source of household fuels for the majority of people in Africa;

- o their production, conversion (charcoal making), transport, storage and marketing provide much employment and represent the capture of financial flows that would otherwise (if substituted by modern fuels) go overseas; and

[3] In some instances, the investment rules and regulatory changes required to attract the necessary foreign technology and investment may

- where supply is based on natural forests, generally this resource is being exploited/depleted at alarming rates and presents critical but almost intractable resource management and regulatory problems.

Traditional fuel systems often exhibit a number of inefficiencies in resource use. Among them are:

1. In economic terms, given the last factor cited above, such systems are inefficient in that the financial price (at the point of tree cutting) is below the economic efficient price as defined by one that reflects true resource costs.

2. Lack of knowledge, capital or other constraints prevent the introduction of "new" supplies such as briquettes made from agricultural residues.

3. Downstream conversion (charcoal production) uses inefficient technology due to:

   a. lack of knowledge regarding more efficient technology;

   b. insufficient capital (on the part of artisanal groups or small firms) to employ more efficient technology; or

   c. regulations which inhibit the use of such technology (often charcoal making is done illegally).

4. Other downstream market components are inefficient due to:

   a. lack of knowledge regarding such questions of optimal moisture content at which to transport and market wood (moving water versus moving more dry mass);

   b. insufficient capital or lack of financially stronger market players, such as government entities, to "make a market" in the woodfuel commodities as is often done in foodgrain cereals: buy during surplus periods (e.g., before the start of rainy season) and sell during shortage periods (e.g., later in the rainy season);

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be quite significant. This can be the case with domestic natural gas or low grade coal, both of which are likely only viable for local markets and then only at high investment costs and/or with specialized small scale technologies (e.g., compressed natural gas).

c. lack of competition and hence significant financial rents in transport and/or marketing.

Interventions can be designed to overcome one or more of the above (perhaps with the exception of the most important and almost intractable item 1 above).[a] The World Bank has begun comprehensive household fuels programs in some countries (e.g., Kenya Urban Fuelwood Project), and is addressing aspects of the problem as part of broader energy sector efforts. USAID missions have addressed some of these sources of inefficiencies in earlier programs, but with too much attention to activities such as demonstrating more efficient charcoal production and not corollary actions. The latter should encompass small enterprise development, including the financing of improved technology; assistance to foster market entry where competition is lacking; capitalizing woodfuel "market making" operations; and other such unconventional interventions as suggested by analysis that looks not just at the technology but the market organization and how it should change to be more efficient.

2.4.3 Improving Power System Efficiency

All reviews of the energy sector in Africa pinpoint power system inefficiency and unreliability as critical problems. In the July 1988 report, "Energy in West and Central Africa: Issues, Problems and Donor Activities," for example, a major issue in Zaire is:

> "Lack of maintenance and technical expertise in the power sector has resulted in high losses and unreliable supply. Power subsector issues include: poor performance of isolated plants due to lack of maintenance and spares; nearly all power plants, particularly isolated thermal and hydroplants, need rehabilitation owing to limited technical capability and irregular maintenance during period of foreign exchange scarcity; lack of regular maintenance; practically all T & D systems, especially those associated with isolated thermal and hydroplants, need rehabilitation."

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[a] This is not meant to be dismissive of such interventions as the use of stumpage fees to bring such financial prices closer to efficiency prices; but rather to note the very difficult nature of designing and implementing regulatory or other interventions which cannot be easily circumvented and/or that are administratively feasible without "armies of enforcement agents" and their associated costs.

In Senegal:

> "Deteriorating power supply. Rehabilitation...required... The distribution system in the Dakar region has not been adequately expanded or properly maintained, resulting in poor quality of service at high (about 16 percent) losses."

Similar themes recur in nearly all countries.

Total system losses in the Nigerian Electric Power Authority system are 40 percent and it has been estimated by the World Bank that a reduction of one percent in system losses is worth over US$ 2 million per year to the utility. Thus, there is a big payoff by paying attention to improving power system efficiency. (Such efficiency improvements generally translate into reliability improvements as well, further increasing the impact, particularly for key industries.)

Several activities can be proposed to improve the situation:

1) power system efficiency strategy studies and pilot projects,
2) emphasis on cost recovery to improve the financial situation of utilities,
3) establishment of spares stores in instances where the government and the utility agree to institutional reforms that will facilitate efficient allocation and replenishment of spares,
4) technical assistance to selected utilities in developing modified technical standards to effect substantial (20-40 percent) cost savings in distribution system construction,
5) support of new institutional arrangements such as performance contracting between utilities and the private sector and between utilities and the government in order to improve power system efficiency, and
6) arranging the financing of rehabilitation work.

Discussion of each of these activities is presented below.

1. Power System Efficiency Strategy Studies and Pilot Projects

The first effort needed in any country is an efficiency improvement strategy study that identifies initial issues affecting power system efficiency and reliability. Because all utilities in Africa are likely to need inputs in the categories of technical assistance, training, spare parts, rehabilitation, personnel policy changes, cost recovery/pricing policy changes and import or foreign

exchange availability, to merely list these as needs leads to monetary expenditures with little assurance of effective sequencing, interactions among interventions or institutional change.

As a consequence the strategy study recommended here disaggregates the power system of a selected country of high priority to A.I.D. into:

a. generation, transmission, distribution, revenue collection;
b. urban, peri-urban, rural; and
c. regions.

For each power system component an estimate is made of efficiency and returns to investment in needed inputs such as training, T.A., spare parts, rehabilitation, or improved management procedures (re-organization, MIS, accounting, etc.) From these estimates a strategy can be developed and implemented. Important inputs to this work would be the UNDP/World Bank ESMAP studies on power system efficiency or loss reduction in over 10 countries in all regions of Africa.

Some or all of the following activities may complement such a strategy.

2. Emphasis on Cost Recovery to Improve the Financial Situation of Utilities

Most utilities in Africa, particularly those whose generation is thermal based, suffer from severe financial deficits because of failure to recover a significant fraction of costs.[5] They thus become a burden on the general budget and are forced to neglect maintenance and other "postponable" expenditures.

Sometimes the need is for pricing policy changes and tariff structure reform. Such changes are often required not only for financial reasons but also to promote more efficient resource allocation and equity. (For example, it is normal for general revenues to be used to subsidize provision of electricity to the rich; this is inefficient, inequitable, and financially disastrous.) Beyond tariff

[5]Hydro based utilities also have fiscal difficulties. However, in some cases, utilities distributing hydro based electricity have been relieved from the direct fiscal burdens of large under utilized hydro capability; the fiscal burden lying either with government or special authorities.

reform is the difficulty of collection for power consumed. In some cases stealing, bribery and lack of political will combine to effectively nullify the advantage of even a well-defined tariff. In many instances meters are not installed (or utilized) for any but the largest customers, and billing and accounting procedures are unsystematic at best.

The solution to this problem is different in each country but its analysis and the proposal of solutions are necessary ingredients to any serious effort to improve system efficiency. As we shall discuss below, one approach to a solution is performance contracting with local firms who do collections and share in increased collection revenues.

3. Establishment of Spares Stores

Another straightforward activity for A.I.D. is the financing of the import of spare parts and the establishment of a spare parts inventory. Such an activity should be of interest to U.S. firms. Other development agencies are funding such stores in, for example, Cape Verde, Mali, and Togo.

This activity only makes sense if it is consistent with a country power system efficiency strategy study and if it is accompanied by policy and institutional reforms that will facilitate future allocation and replenishment of spare parts. For example, it may have to be contingent upon changes in import and foreign exchange allocation policy to ensure that spares inventories can be maintained.

4. Cost Savings Through Modified Standards

Many countries in Africa have inherited technical standards for urban and rural distribution systems that result in substantial over-design. Cost savings, due to modified standards, are likely to be significant (20 to 40 percent according to a recent study in Pakistan), thus facilitating investments in system rehabilitation.

To examine the viability of different technical options, design studies must be carried out for generalized cases within specific countries.

Options include cheaper poles, economic conductors, single phase systems, conversion of LT to HT lines, matching of transformer capacity with demand, and conversion to higher primary voltage.

Planning and design criteria, equipment and material specifications, standards and guidelines, all must be examined in the context of this activity.

5. Arranging the Financing of Rehabilitation Work

Major rehabilitation work is a need in most if not all power systems in Africa. A.I.D. can play a useful role in assisting with the arranging of international financing for such work, as the work is identified as critical in the country power system efficiency strategy study discussed above.

6. New Institutional Arrangements such as Performance Contracting

When the circumstances are such that it is clear that "things just are not working and are at or near crisis conditions" there is sometimes a greater receptivity to make the significant and often difficult changes to alleviate the problems. This is clearly the case with respect to problems with power utilities in Africa. Reportedly in at least one case utility management responsibility has been put in the hands of a team supplied by a bilateral European donor and in two other countries negotiations are ongoing which may lead to the foreign utilities taking on the utility management role. Other changing institutional arrangements deserve serious consideration and some are being considered with the assistance of the World Bank and others. Some changes are geared to fostering more "commercial or business like" operating norms by the public utilities; other options are to increase the role of the private sector in any or all aspects of the power systems - generation, transmission, distribution or commercial (billing and collection, etc.). These are areas in which U.S. experience and expertise, which includes both private and public utilities and important regulatory and contractual changes to stimulate more efficient energy markets, could be most helpful to African utilities.

A possible approach to lower cost generation is to allow the sale to the grid of private generation or cogeneration supplies as fostered in U.S. energy markets by federal legislation (PURPU). Other institutional, regulatory and contractual changes also appear promising. One such promising approach to improving the operational efficiency of electrical utilities in Africa is through energy performance contracting. Energy performance contracting may in some countries be a solution to the widespread problem of government controls interfering with efficient utility operation. There are currently two principal types of performance contracting. In the U.S., contractors effect savings in energy consumption for industrial and

commercial facilities in exchange for a share of the savings. In developing countries, performance contracts have been proposed between governments and utilities whereby utilities commit to efficiency improvements in exchange for increased autonomy with respect to salaries, procurement and operations decisions.

Although the idea of performance contracting between an LDC utility and a private firm has not been tested in practice, the promise is sufficiently attractive to merit serious attention as an approach to power system efficiency improvements and to private enterprise development. There is a clear role for U.S. development assistance to help African governments and utilities consider these and other institutional and regulator changes.

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ANNEX A

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