

AN ENERGY ROADMAP FOR GHANA:

FROM CRISIS

TO

THE FUEL FOR 'ECONOMIC FREEDOM'

A REPORT BY A UNITED STATES GOVERNMENT INTERAGENCY TEAM

IN RESPONSE TO A REQUEST FROM

HIS EXCELLENCY THE VICE PRESIDENT JOHN ATTA MILLS

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Acronyms

EC	Energy Commission
ECG	Electricity Company of Ghana
GIPC	Ghana Investment Promotion Centre
GNPC	Ghana National Petroleum Corporation
gWh	Gigawatt hour
kWh	Kilowatt Hour
LBNL	Lawrence Berkeley National Laboratory
MOME	Ministry of Mines and Energy
MOU	Memorandum of Understanding
MW	Megawatt
NED	Northern Electricity Department
PPA	Power Purchase Agreement
PURC	Public Utilities Regulatory Commission
TAPCO	Takoradi Power Company
USAID	United States Agency for International Development
USDOE	United States Department of Energy
USDOT	United States Department of Transportation
USEIA	United States Energy Information Administration
USTDA	United States Trade and Development Agency
VALCO	Volta Aluminum Company
VRA	Volta River Authority
WAPP	West African Power Pool

A Future Vision — 2002 to 2020

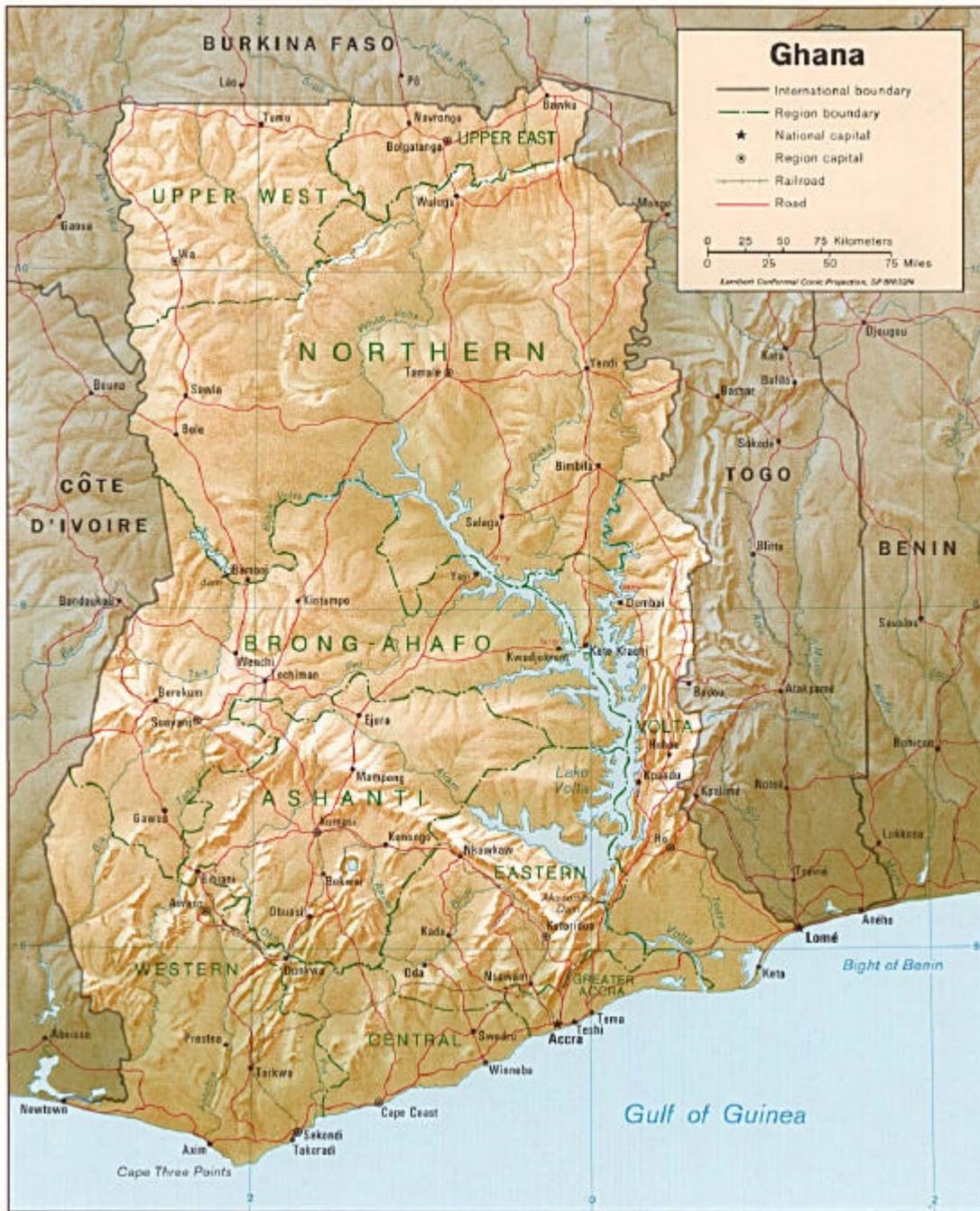
As Ghana crosses into the new millennium, the immediate electricity shortages should be left behind. The emergency power from barges and generation sets will be increasingly supplanted with steady supplies from new privately operated thermal facilities. As the power in the system grows, the reservoir behind Akosombo should recover more rapidly, preparing it to serve a new role in Ghana's energy future. Instead of being nearly the sole source of electric generation, the lake will be maintained as an available reservoir of energy. This resource should be able to operate steadily and maintain the ability to provide additional power for both emergencies and regular maintenance shutdowns for Ghana and its neighbors. The West African Power Pool will be developing and Akosombo will serve as the power supply response for the region's emergency needs.

In the first decade of the new millennium, hydro generated electricity will be increasingly augmented and replaced in West Africa by a new and abundant resource for power generation, natural gas. Natural gas will potentially replace all petroleum distillates used for power generation. It will enable Ghana to cost-effectively increase supplies of power as needed and enable the country to become a significant producer and exporter of power for the Economic Community of West African States. Electricity from Ghana, for example, could economically replace most power sources in the emerging minerals and industrial activities in Burkino Faso and Mali. Gas consumption in Ghana should grow rapidly beyond power production eventually replacing most, if not all, process requirements, allowing new mineral processing to begin, and potentially replacing transport fuels and most wood used for energy in the growing urban areas.

Natural gas will be the new cheap energy capable of propelling Ghana economically forward. Inexpensive and reliable long-term supplies of energy will make many industrial activities that capitalize on this fuel highly competitive worldwide. President Rawlings' Vision 2020 should be achievable, and the country and the region could be well on the road to the economic freedom he described during the Emancipation Celebrations on July 30, 1998.

The gateway to that road ahead is momentarily open. Now is the defining moment of opportunity in Ghana's history, and it will only be too late if the government and the private sector do not act decisively. The first and most important milestone on this road to a strong future is the finalization of the agreements for the construction and operation of the West Africa Gas Pipeline that have been under discussion for over a decade. Other milestones, possible curves, and even roadblocks ahead are described in this road map to sustainable energy for long-term competitive economic growth in Ghana.

Map of Ghana



Revised 10/25/04 (10/09/03) 5-16

Executive Summary

During the two-week period, July 15 to August 1, 1998, the United States Government sponsored an interagency team that visited a broad array of public and private sector representatives, conducting interviews and collecting information. This visit was focused on factors that would help pave the road to sustained economic growth well into the new millennium, and it explored where and how the United States might provide additional assistance supporting Ghana's energy sector initiatives.

This report is intended to be a starting point for an enhanced dialogue that will increase understanding and lead to consensus regarding the causes and possible solutions to Ghana's energy situation. The comments presented by this interagency team represent a response to a request from Vice President Atta Mills for an objective analysis of the current electricity crisis and recommended energy sector solutions, especially those the U.S. might help support.

Ghana's immediate energy crisis is an electricity crisis. The team finds that the Ministry of Mines and Energy has taken appropriate emergency actions, if executed as planned, to fully recover the provision of uninterrupted power to all existing customers by the end of 1998. Through December 1999, the Government of Ghana and the private sector will bring on line permanent additions to generating capacity that will provide greater reliability and gradually replace the more costly emergency generating units.

Ghana's real energy crisis is much more subtle than having the lights go dark. More than three-quarters of all energy used in Ghana comes from traditional fuels, i.e., fuelwood. In spite of a growing electricity grid and readily available petroleum products, fuelwood use in the overall economy has steadily increased, not decreased. A competitive economy cannot grow on these low density biomass fuels, nor can the current rate of deforestation in Ghana continue indefinitely.

All recommendations are predicated on the premise that no action should be taken that might jeopardize Ghana's longer term energy future and development. Although restructuring and privatization are important issues, it is suggested that these sectoral actions follow from longer term integrated planning for the entire energy sector. Moreover, while this report has concentrated on these more immediate term actions, it must be stressed that additional attention should be given to potential distribution bottlenecks that are likely to occur as new generation comes on line.

The action items for Ghana revolve around four overriding themes, all with a concurrent sense of urgency:

1. Negotiate and secure long-term supplies of natural gas;
2. Expeditiously finalize power purchase agreements for permanent new thermal generating capacity;
3. Raise electricity tariffs and immediately initiate an extensive energy efficiency public awareness campaign to educate consumers and mitigate the impact of higher costs;

4. Provide intensive support for the Public Utilities Regulatory Commission and Energy Commission so that they can develop and execute their critical role for a sustainable energy future for Ghana.

Upon acceptance of this strategy by all parties, the recommendations for possible follow-up U.S. Government assistance will be reviewed. It is anticipated that many aspects of this report may be of interest to other donors and that they will pursue supporting these and other facets of Ghana's longer term energy road as they find appropriate.

I. Energy Sector Background

Although the recent energy debate in Ghana has centered on the critical shortage of electricity, the energy sector of the economy encompasses many other forms of energy. The major source of energy in Ghana is neither electricity nor petroleum; it is traditional fuels, including wood, charcoal, crop residues, and other biomass resources. Together these traditional energy sources account for approximately 67 percent of Ghana's energy consumption. Electricity accounts for roughly ten percent of total energy consumption and petroleum and other hydrocarbons represent the balance.

From 1980-1996 (Figure 1) commercial energy consumption¹ grew 39 percent while traditional energy grew by 59 percent. Traditional energy accounts for a greater share of total consumption now than it did in 1980. During the same period, the energy intensity of the economy remained relatively steady, that is, total energy use grew approximately at the same rate as the gross domestic product. Thus the amount of energy utilized per unit of production did not change. The interesting observation is that Ghana's forests have been fueling much of Ghana's economic growth. Industrial consumption of wood fuels rose over 46 percent from 1980-1996, while consumption of electricity remained relatively stable.² This may have worked in the past, but moving toward a more modern and competitive economy will require significant increases in the growth rates for consumption of commercial fuels: primarily, oil, gas, and electricity. Only these highly concentrated forms of commercial energy can provide Ghana the fuels for sustaining the levels of economic expansion necessary to achieve the *Vision 2020*.

To be sure, renewable energy resources should form an important part of a sustainable energy strategy, but Ghana's present consumption of traditional fuels is not sustainable. The team was unable to review issues related to the loss of forests and ground cover, but it is likely that Ghana's energy problem is more diffuse and long-term than the current electricity crisis.

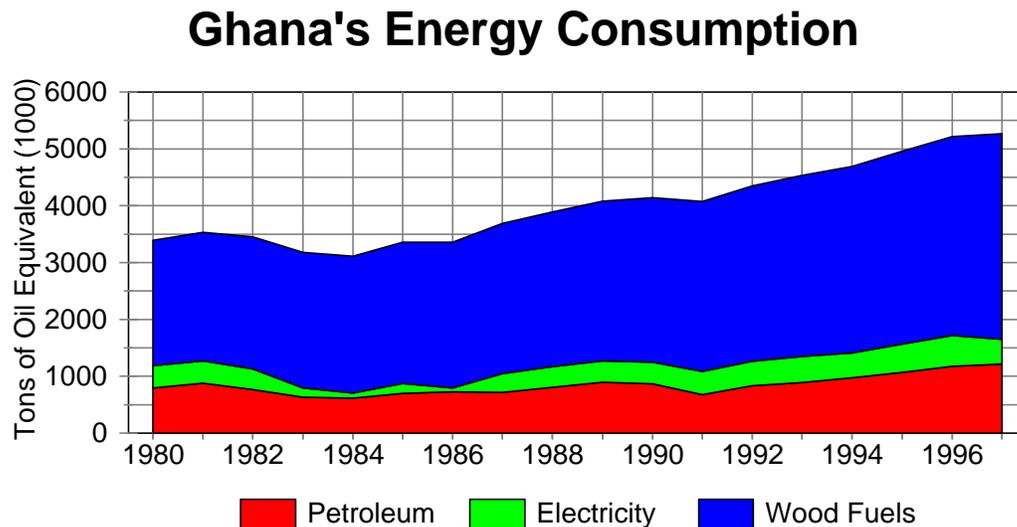
Electricity

Electricity generation in Ghana has long been dominated by the resources of the Volta River Authority (VRA), which was originally set up by the Volta River Development Act of 1961 to build, operate, and maintain the Akosombo Dam and Hydro power plant on the Volta River as well as the Kpong project. The VRA supplies electricity to the Electricity Company Ltd. of Ghana (ECG) and the Northern Electricity Department (NED) for distribution and, also, directly to some bulk end users.

¹ Commercial energy refers only to non-biomass fuels, although wood and charcoal are often traded commercially.

² National Energy Statistics, Table 8, MOME, 1998.

Figure 1.



The initial hydroelectric project, the Akosombo dam and power plant, was designed by Kaiser Engineers of the USA, and constructed by Impregilo of Italy. It was built in conjunction with the development of the smelting facilities of the Volta Aluminum Company (VALCO), owned 90 percent by Kaiser Aluminum and 10 percent by Reynolds Aluminum. VALCO's involvement was critical for the international loan guarantees that financed construction. The first four units of the Akosombo power plant were brought on line by early 1966, and installation was completed in 1972 with the total installed capacity of 912 MW. The Volta River Authority received technical assistance from Ontario Hydro for operation and maintenance until the late 1970s.

Following the successful implementation and operation of the Akosombo project, the Volta River Authority constructed the second downstream plant at Kpong by 1981. This project, which has an installed capacity of 160 MW, was designed by Acres of Canada and again construction was performed by Impregilo.

The Akosombo project has substantial storage. The lake formed by the dam has a surface area of some 8,500 km² and functions as a storage project. Although the lake formed by the Kpong project is relatively large, the plant has a very small operating range and functions as a run-of-river plant that is dependent on the flows from Akosombo. The river downstream of the plant at Kpong is shallow, and simultaneous operation of all units causes a tailwater rise that lowers the available head, and therefore, the output of the project.

The Existing Hydroelectric System

The high voltage (161 kV) grid system throughout the country was constructed as part of the first development of Akosombo, and it was enlarged and extended when the final two generating units were installed and during the rural electrification of the North. Connecting lines to interconnect Togo/Benin were constructed in 1972 and to Cote d'Ivoire in 1983. A high voltage connection to Burkino Faso is planned. VRA also operates the grid system.

VRA supply obligations are dominated by the contracted supply to VALCO, which had set up an aluminum smelter as the anchor load to render the project financially viable. The energy is dispatched in accordance with the original 1967 agreement, which was extended in 1997 for 20 years. Other negotiations were conducted from time to time during the original contract period concerning price and to obtain occasional agreements in pot line suppression principally because of *force majeure* conditions. The energy normally supplied to VALCO at the contracted price is proportional to the projected (and actual) total generation at the Akosombo Dam, and it is usually of the order of 44 percent of the energy.

As a developing nation, Ghana's domestic and industrial load has been relatively low, although it is increasing. When the Akosombo project was first completed, the peak demand from Ghana was 100 MW, less than 20 percent of the installed capacity. Thus, the connected regions of Ghana have enjoyed a relatively long era of abundant, economic hydropower. The maintenance of supply was ensured by periodic reviews of potential generation expansion; for example, a review in 1971 recommended the construction of Kpong and indicated a need to diversify the supply.

The conclusion that the generation mix should include thermal generation has long been accepted as a means to reduce the potential for variations in energy supply caused by the variations in the Volta River flows. However, thermal additions have been delayed. (See section II for a discussion of thermal energy issues.)

Petroleum

Upstream

Commercial quantities of oil and gas were first discovered in 1978 by Amoco in the offshore salt-pond field. Recently, concessions for offshore exploration have been granted to Hunt Oil, Nuevo Energy Company, Dana Petroleum, Santa Fe Energy, and West Oil. Industry interest is returning as recent seismic surveys have revealed several offshore prospects with moderate reserve potential. Although the onshore Voltaian Basin has not seen much exploration activity, Ghana National Petroleum Corporation (GNPC) plans to study and reinterpret the existing basin data with the goal of exploiting it.

In recent years, GNPC, in concert with the government has developed a flexible approach in negotiations to encourage the development of small or marginal fields and secure a fair share of the proceeds of profitable fields. GNPC's main objectives are to attain oil self-sufficiency and to phase out daily imports of crude oil. It also hopes to develop indigenous gas reserves for fueling power generation.

Downstream

Crude oil is delivered at the part of Tema, which has two downstream facilities. The Tema Oil Refinery has recently increased the daily refining capacity to 40,000 barrels per day and has plans to install a secondary reconversion unit. The refinery has difficulty producing the slate of products most needed by the country. Upgrading the refinery with computer-controlled systems would help the country more effectively meet its energy needs. The other sector of the downstream business is the Tema Lube Oil Company, which is a private company owned by a consortium of five companies. This company blends all types of lubricants to the specifications of the five partners. As a private company, the personnel are interested in obtaining the best value for their products and in expanding their options.

Transport and Storage

Major storage facilities exist at Tema, Takoradi, Accra, Akosombo, Kumasi, and to a lesser extent at points throughout the nation. The national storage network was built in the mid-1990s with assistance from the British, Koreans, and World Bank. This system is designed to improve availability and reliability of petroleum products distribution in all parts of the country.

A pipeline has been constructed to Akosombo to fill the depot and to supply upland areas by barge on Lake Akosombo. However, it is not fully operational, and the bulk of petroleum is transported by ocean transfer from Tema to Takoradi and by road tankers in most other parts of the country.

II. 1998 Energy Crisis³

At the time of the team's visit, the total installed capacity of the public electricity sector was approximately 1,300 MW. 82 percent of this capacity was at the two Volta projects, and the balance of 230 MW was at Takoradi (200 MW) and Tema (30 MW). The 1998 peak load was expected to be 1,145 MW, indicating a capacity reserve margin of approximately 15 percent. At the beginning of the year, energy demand for the year was estimated to be 8,100 gWh, but the energy estimated to be available from the Volta was 3,800 gWh (compared with the average 6,100 gWh based on long-term flow conditions). The Takoradi thermal plant was expected to contribute 1,800 gWh. Total estimated generation was expected to be 5,600 gWh indicating a shortfall "after invoking force majeure in the VALCO contract to reduce that entitlement by 960 gWh" of approximately 1,000 gWh in the energy available to domestic users.

Two significant factors have contributed to the current energy crisis. First, although the growth in load has been observed and documented, no additional generation facilities were implemented by VRA to ensure sufficient reserve margins of capacity or energy. The lack of available credit from the international community, due mainly to lower tariffs that did not allow for cost recovery, prevented capacity expansion.

³ Note: In Ghana, as elsewhere, energy and electricity are words that are often used interchangeably. This report frequently uses the word energy when referring to electricity. In truth, the current situation is an electricity crisis. Ghana's long-term energy stability is hampered by low prices, lack of private provision of electricity, and inefficient and excessive combustion of wood and biomass resources.

Second, the low inflow to the reservoir during the whole of 1997, which totaled 26,520 million cubic meters contributed to the immediate problem. Although this inflow was only 71 percent of the long-term annual average flow, it must be noted that for the 54 years of records provided to the team, total annual Volta River flows were less than that recorded in 1997 in 15 different years, with a minimum of 8569 million cubic meters in 1983. In fact, for each of the four years, 1981 - 1984, total annual flow was below that recorded in 1997, and it was well below the long-term average of approximately 37,000 million cubic meters. Therefore, 1997 was not an unusually bad year for Lake Akosombo inflows; rather it was the confluence of other problems and a trend in reduced reserve energy and capacity.

Two other factors directly exacerbated the situation. First, there was a substantial reduction in the supply available from Cote d'Ivoire (to only 30 MW) but without a reduction in contractual obligations to Togo and Benin that averages 60 MW. Second, there have been some institutional and technical problems associated with the commissioning of the Takoradi thermal plant that delayed the addition of 200 MW to the system.

Unfortunately in 1997-1998, because of the above factors, there were only three short-term alternatives open to the electricity supply authorities — continue to draw down Akosombo Lake well below normal levels, declare *force majeure* and thus restrict deliveries to VALCO, and initiate rotating power cuts among the general industrial and domestic customers. All three policies have been pursued. Note that Ghana felt it could not completely abrogate its commitments to Togo and Benin.

At the time of the team's visit, Akosombo Lake had been drawn down so far that the power intakes were exposed, vortexes were forming at the intakes, and air was being drawn into the penstocks to the detriment of the units. Anti-vortex screens had been floated in place, but the water level had been drawn down so far that these might have been ineffective. Little can be done to overcome the short-term problems, and the hydro portion of the system is now extremely limited in the contribution that it can make. Therefore, Ghana must be prepared for the possibility of continued and extended load shedding unless all emergency units are commissioned soon.

The VRA should refine lake recovery plans to allow ongoing flexibility in the short-term planning of the energy sector and load shedding. In terms of managing the resource, it is notable that every year since 1993 the reservoir has been drawn down below its minimum operating level, and it has not been at its maximum level since 1991 when water was spilled. Clearly, the resource, the long-term cost, and the real value of electrical power have been substantially undervalued for most of the decade. It would be prudent to define scenarios of lake level recovery extending over one, two, or three years, so that the lake level can recover and the turbines can be allowed to operate at their design head and thus more efficiently. Past observations, for example in 1989, 1991, and 1994, indicate that the flows in the Volta are so variable that significant recovery is possible in one flood season but also highlight that low flows in consecutive years are not unknown.

The potential for short-term recovery of the lake levels in a single flood season will be unclear until at least the end of September 1998. Until that time, it would be prudent to assume recovery over at least two or three years. It must be recognized that recovery of the lake to reasonable

operating levels may well necessitate that turbines not be used (and load shedding continue) even though the lake level has recovered sufficiently that they could be operated without damage.

As part of the definition of the criteria for future operation of the electric system, it is recommended that a reserve margin be effectively guaranteed by reestablishment of a lowest operating level of the reservoir. This lowest level may be above the normal lowest level established already, at least until true economic pricing has been established in the sector.

III. The U.S. Government Response

Following a request made by Vice-President Mills during his visit to the United States in May 1998, the U.S. Government committed an Interagency team to review the situation. A multi-disciplinary team with representatives from the private and public sectors was dispatched to Ghana to investigate the energy situation. The team consisted of representatives from: U.S. Agency for International Development's (USAID) Office of Energy, Environment and Technology; U.S. Department of Energy's (USDOE) Office of Policy; USDOE's International Affairs and Office of Fossil Energy; U.S. Department of Transportation (USDOT); U.S. Trade and Development Agency (USTDA); and, technical consultants from the U.S. private sector. They were joined by Ghanaian government and private sector representatives.

The team devoted approximately two weeks (July 15 to August 1, 1998) in Ghana investigating the energy crisis and providing assistance where possible. Amongst the dozens of private and public sector individuals that met various team members, there was almost unanimous appreciation of the opportunity to interact with the team and review and gather comments on their perspectives and activities. The final outcome of the visit is this report of findings and recommendations, compiled and drafted by the USAID team members and one USAID sponsored consultant.

This report is intended to help serve as a road map for collaborative follow-on work between donor agencies and Ghanaian entities. The intent of this report is not to detract from the excellent efforts made by the Ghanaian Government, the utilities, and their advisors. Rather, it is intended to bring attention to those areas where roadblocks may slowdown progress. It is fully recognized that sufficient time has not elapsed between the enactment of laws and the development of implementing rules and regulations and the formation of these new institutions and the fulfillment of their obligations. It is hoped that this report can serve as a starting point to stimulate a national dialogue on the importance of energy and sound energy planning for Ghana's future.

The team investigated options to maximize private sector solutions and options that expand and diversify Ghana's energy resources in a cost-effective and environmentally sustainable fashion. Further, the team focused on solutions that consider a regional perspective.

The remainder of the report looks at the immediate, short- and long-term energy situation in Ghana. Each of these sections is further divided into the Government of Ghana's response, and the team's findings and recommendations. These initial technical and institutional recommendations are designed to assist Ghana with prioritizing and planning its local, national, and regional energy development.

Based on the team’s preliminary findings, a series of recommendations on possible United States government interventions to assist the Government of Ghana in addressing its energy crisis are suggested. At present, the possible contributions from other donors for energy related assistance are not well tabulated. The possibilities for U.S. assistance will be discussed, along with this report, with various agencies in Washington, D.C. once it has been accepted by all parties. Furthermore, these recommended interventions depend on the availability of resources and generally are designed to leverage additional resources that may be available from donor agencies, non-governmental organizations, and the private sector. Finally, any assistance provided by the U.S. Government would be in accordance with the following general principles: that primary reliance on resolving Ghana’s energy crisis should be with the private sector; options should examine regional solutions in addressing energy needs; and options presented by the U.S. Government would focus more on longer-term issues.

IV. The Situation Today

While recent attention has been focused on energy by the current power crisis, the potential for problems has been growing for some time. If Ghana is to continue its strong economic growth trend and avoid a long-term electricity crisis, change is necessary. The energy crisis facing Ghana today is much more than the short-term supply deficit it faces in 1999. Ghana has had electricity crises before, i.e., shortages measured by the difference between supply constrained sales (termed demand) and the system’s ability to supply.⁴ The first of these was in 1983-1984 and “for the second time within period of 4 years (1994-1997) the country’s electricity generation and supply has experienced shortfalls as a result of erratic rainfall in the Volta Basin”.⁵ However, Ghana has a more fundamental energy crisis: Demand has been consistently greater than supply. The immediate crisis has been brought on by:

Physical and natural causes —

- Low rainfall,
- Reduced supply from Cote d’Ivoire, and
- The delays at Takoradi I.

⁴ Energy demand has not been accurately measured. Using historical data when the system is supply constrained means that consumption is actually measured, not demand. Demand is what consumers are willing to buy while consumption is what was actually available for sale. The two coincide when supply is not constrained.

⁵ *Emergency Electric Demand Management Program for Industries and Public Education Campaign*, Ministry of Mines and Energy, 1998.

But more fundamentally by structural and institutional causes —

- Years of underpricing energy,
- High risk due to dependence upon one source of electricity,
- Ownership structures that do not promote efficiency,⁶
- The lack of integrated energy planning, and
- Lack of coordination of long-term plans and implementation.

In addition, public sector domination of the power sector along with administrative pricing has dissuaded any new power supply options in the past. ***The challenge is not only one of supplying more energy but rather of sustainably supplying the energy, establishing regulatory bodies, and promoting private sector participation in the provision of energy.*** If this is accomplished, these conditions will ensure a steady flow of investment in the energy sector and an acceptable tradeoff between the risk of supply shortfalls and the cost of reserve capacity.

In response to *Vision 2020*, the Government of Ghana has set laudable goals for the development and utilization of energy. It is seeking private participation in the provision of energy and energy services, economic pricing, the promotion of energy efficiency and renewable energy (e.g., solar), and long-term planning that seeks to develop sustainably the nation's energy resources in meeting reasonable energy demand. To this end, the country has recently made significant strides. It took the first steps by establishing the Energy Foundation and reaching consensus on a Power Sector Reform program. It has also enacted the Public Utilities Regulatory Commission (PURC) and Energy Commission (EC) Acts of 1997 to establish independent regulatory, planning, and advisory bodies. Further, the country's Petroleum Act is to be amended to conform to these other new Acts and to reinforce the goals of *Vision 2020* and to encourage domestic exploration and development.

These laws, policies, and new regulatory institutions are important precursors on the road to reaching Ghana's energy goals and economic freedom. However, by themselves they are not sufficient. For example, the law says that the EC will develop performance standards but it does not say what these standards, will be or how they will be developed. Laws and policies must be implemented. To be effectively implemented, they require clear, concise, and consistent rules and regulations. In turn, the development, monitoring, and enforcement of these rules and regulations requires institutions that are properly structured and staffed with trained and experienced personnel.

Current conditions provide an excellent opportunity for furthering fundamental reforms in Ghana's electricity sector leading to greater operational efficiency and competition, private sector participation, and development of an arm's length approach to regulation.

⁶ Inefficiency can be the result of several factors. In publicly owned enterprises it can result because of the lack of the profit motive, political influence, or national objectives that compromise financial viability. The intent here is not to assign blame to VRA or ECG but rather to acknowledge that even if the corporations themselves were inherently efficient, the political control of their prices and investments often results in inefficiency.

V. Options for Meeting Ghana's Energy Needs

This section addresses many of the measures recommended by various Government organizations or corporations for meeting Ghana's near-term electricity needs. Actions and proposed actions by the Government of Ghana are presented followed by comment and recommendations. The Government's immediate solution depends critically on several underlying assumptions: power supply from Cote d'Ivoire will grow, inflows into Akosombo Lake will be average, capacity additions can be financed, and that the demand forecast is accurate. To the degree that these assumptions are less than correct, the current shortages may persist.

IMMEDIATE — THE CRISIS OF 1997 - 1998

For Ghana, the immediate time-frame is through the end of 1998. During these remaining 5 months of the year, Ghana should be able to restore sufficient electricity supplies to the system to meet all existing demand in 1999. Reports of the short-run macro economic impacts vary widely, but most indicate the impact is not yet too severe. However, the team expects that from anecdotal evidence, that the final statistics for 1998 will be considerably more disappointing than the range of unofficial government estimates that were proffered. The economic slowdown will clearly reduce tax revenues and profits, and it will eventually affect the Government's budget allocations.

Government of Ghana Response

One reason industrial output may not suffer as much in the coming months as it has in the last few is that energy is being dispatched and directed to them on a priority basis. In addition, it is reported that virtually all private industries using more than 100 kW have already installed or are awaiting arrival of back-up diesel generators for supply of their critical electricity requirements. Whether additional supplies have come from emergency generation or their own diesel generators, these are not viable long-run options because of their cost: Much of Ghana's industry was built on inexpensive electric energy and major structural changes will be necessary to adjust to significantly higher prices. For the short term, Ghanaian industries may suffer losses in order to protect market share, but unless permanent cheaper power, preferably based on natural gas, soon replaces the emergency generation, the long-term costs to the economy will mount.

From the Government's side, actions have included:

- Seek two to three year supply contracts with leasing companies for diesel power plants, providing fuel and paying only for capacity (thus far only 30 MW are operational, i.e., the Aggreko project.);
- Work with industry to agree upon allocations and jointly monitor dispatch of electricity to load centers;
- Institute rolling load shedding throughout residential areas;
- Make provision for the purchase of power from industrial operations, such as the Tema refinery;

- Reduce the allocation of electricity to VALCO and purchase VALCO's contractual allocation;
- Bring the ECG Tema diesel into operation (30 MW of which only 15 MW is deliverable);
- Anticipate having in place by December 1998 the Global Aero power barges (192 MW);
- Negotiated a firm commitment of 100 MW from Cote d'Ivoire that is used to partially fulfill VRA commitments to Togo/Benin;
- Implement a quota and surcharge scheme to reduce consumption; and,
- Increase tariffs in February and again in September.

**Table 1. Summary of Immediate New Supplies
Expected to be On-Line by December 1998**

Project	Capacity	Status
Aggreko Diesels	30 MW	operating
Takoradi 1 Steam cycle	55 MW 55 MW	operational by 12/98 operational by 3/99
ECG Tema Diesel	15 MW	operating
Cummings Diesels	30 MW	operational by 12/98
Faroe Atlantic	70 MW	operational by 12/98
Global Aero Barge mounted Combustion Turbines	192 MW	operational by 12/98
GNPC El Paso at Effasu	130 MW	operational by 12/98
Firm Contract w/ Cote d'Ivoire	100 MW with approximately 65 MW wheeled to Togo/Benin	operating

Team Findings

There will be a total of 672 MW (excluding "surpluses" from Cote d'Ivoire) if all these projects came on line by January 1999. The team believes this schedule is possible and should be followed and encouraged. This amount will adequately assure uninterrupted supply and sufficient reserve margin and with luck an additional 100 MW may be available from Akosombo, preferably for peaking loads. The team was unable to adequately review the process for acquiring emergency generation and is, therefore, not in a position to comment on the delays or the lessons learned. However, two principal reasons for the delays cited by the Government of Ghana have been their inability to meet financial requirements for the escrow accounts and the inability of some independent power producers to meet deadlines.⁷

⁷ Source: Ministry of Mines and Energy, October 1998.

SHORT TERM — AVERTING A PROLONGED CRISIS

For Ghana, the short term is defined as the minimum period for definitively turning this electricity shortage around. By December 1999, the government and private sector should be well on the way to paving a solid road for Ghana's long-term energy future.

The short-run response should be designed to avert a prolonged crisis without sacrificing the long-term goal of efficient, sustainable energy. The specific findings and suggestions for these next 17 months, a period during which the U.S. and other donors should be actively pursued, are the subjects of the remainder of this report.

Government of Ghana Response

There are now several options, as a result of the restructuring plan, for averting a prolonged crisis. Together, these options would not appear to be sufficient to make up the gap except that they are augmented by some of the combustion turbines anticipated for immediate supply, which will remain operating beyond December 1999. The options presented to the team include:

- Fast tracking the first phase of Takoradi-2 Thermal power plant expansion of 100 MW (anticipated May 1999);
- OECF funded 120 MW power barge on line by July 1999;
- GNPC-El Paso 130 MW power barge on line by December 1999, 87 percent financed by the U.S. Government;
- Rehabilitation and modernization on Tema diesel to add 15 MW;
- Increases in retail tariffs;
- VRA compact fluorescent lamp program to offset 12 MW of power;
- National "save a watt" campaign; and,
- Replacement of consumer billing meters with pre-payment meters.

Team Findings

By far the two most important measures will be the increases in thermal capacity and in retail prices. The team views the VRA plan on compact fluorescent lamps as an important start that may not proceed as rapidly or successfully as anticipated. Replacement of billing meters with prepayment instruments may increase cash flow but is unlikely to have a significant impact on electricity demand.

The team was astounded by the extravagant use of residential electricity it observed in the face of this shortage. Consumers are doing without power during blackouts; however, when there is electricity, they do not use it sparingly. Residential electricity demand, although a small percentage of total consumption, has been the fastest rising use. Increased connections, rising per capita income, availability of appliances in higher income households, and no apparent incentives for more efficient utilization account for this increased use. The ECG has attempted to deal with the residential load problem through the imposition of quotas and a surcharge. This response is fraught with problems and has been seen as unfair given the ECG's meter reading practices.

It is recognized that beyond some point, residential consumers should pay the full cost their use imposes on the system. It can be argued that increased residential demand takes away from the industrial sector. The economic cost this imposes on the country is not the cost of supply from Cote d'Ivoire (the basis for the highest tariff class) but rather the elevated cost of the emergency power supply options. Presumably, these high emergency costs will abate when cheaper long-term plants begin operating.

Recommendations:

- The team urges the PURC and ECG to study the imposition of higher tariffs for consumption beyond the lifeline tariff block and an increase in the number of blocks, as a replacement to the quotas. Thus, some consideration should be given to adding more blocks in the increasing block tariffs and pricing them incrementally higher with the highest block equal to the short-run marginal cost of supply. This will have both short- and long-term implications.
- Along with the tariff increases, the Government of Ghana should initiate an aggressive publicity campaign to assist consumers in adjusting to new prices. Both pricing and energy efficiency issues are discussed further in section C (Long Run — Sustainable Energy Promotes Economic Growth and Development).
- In the short run, high-end users will reduce the use of appliances such as air conditioners and, perhaps, cut back on lighting and other uses. In the long term, this will slow the penetration of appliances such as air conditioners, refrigerators, and electric stoves as well as shift consumer purchase to more energy efficient appliances. This will slow both the total residential demand and the demand at peak. In addition, other non-price measures need to be increased in promoting energy efficiency and conservation.
- The comments on the short-term actions are all equally relevant to Ghana's longer term energy future. Similarly, the recommendations in the remainder of this report should all be initiated in this near term, up to 2000.

U.S. Government Assistance Currently Provided:

- ▶ The U.S. Government has been offering assistance in the area of energy efficiency with assistance and participation by USAID, USDOE, and the Alliance to Save Energy. Through this assistance the Government of Ghana, in cooperation with Ghana's private sector, has developed the Energy Foundation, which is a non government organization designed to promote development of energy efficiency and renewable energy resources in Ghana. The Energy Foundation brings together a broad array of private sector and government entities to address these issues and develop cost-effective solutions that provide environmental benefits and expand the diversity of Ghana's energy resource base.
- ▶ USAID provided energy-related training to over 400 Ghanaians who have visited the United States or participated in courses conducted in Ghana.

- ▶ USAID is funding the Lawrence Berkeley Laboratories to assist with appliance standards and codes.
- ▶ The USTDA is pursuing the possibility of funding prefeasibility and feasibility studies for a cogeneration investment at the Tema refinery, ASRI generation, and Hemang hydro.
- ▶ USDOT through the U.S. Maritime Administration (MARAD) is providing \$67.5 million to finance 87.5 percent of a 130 MW barge to be part of the South Tano project.
- ▶ The U.S. Export-Import Bank has provided a \$294 million line of credit to GNPC to develop the South Tano fields.

Prospects for new U.S. supported energy assistance are presented in Section VII of this report.

LONG RUN — SUSTAINABLE ENERGY PROMOTES ECONOMIC GROWTH AND DEVELOPMENT

Ghana's future depends upon continued economic growth and development. The continuation of existing growth trends will not be possible unless Ghana employs its energy resources rationally, prices energy properly, reduces its reliance on biomass fuels, and takes advantage of the low cost natural gas in the region. This section addresses these concerns and presents the team's findings and recommendations for addressing Ghana's longer term energy development.

Government of Ghana Response

Ghana has a power sector strategy and petroleum strategy that are designed to move Ghana's energy sector on to a sustainable path. The team has reviewed these policies, as embodied in several documents, and found them to be thorough and realistic. However, the team was unable to find a single integrated energy policy plan that sets forth the longer term vision considering all sources and uses of energy together. Thus, if all resources are not considered in an integrated fashion, it is likely that a less than optimal solution to Ghana's energy challenges will be forthcoming. The salient points of the Government's policy include:

- Adding to productive capacity based on the least cost method;
- Rationalizing energy prices;
- Promoting the use of renewables (solar, hydro, and non-traditional forms of biomass, e.g., combustion of wood wastes that are otherwise discarded);
- Promoting energy efficiency;
- Promoting the private provision of energy;
- Restructuring the energy sector to promote competition;
- Making the procedures for tariffs transparent and consistent; and,
- Establishing rules for non-price regulation of the energy industry, for example, by setting performance standards.

Team Findings and Recommendations

Accepting the efficacy of the Government's long-term plan, making it operational means acting immediately. The team's observations address both the immediate needs of the plan as well as gaps in the strategy.

FOLLOW THE PLAN — AVOID A TRAFFIC JAM

Despite Ghana's sound and relatively thorough electricity sector reform plan, a major concern is that the plan is not being followed as developed but rather in an ad hoc manner. This is partly due to resources being stretched too thinly, or conversely, the prioritization of tasks has been insufficient.

The final plan for power sector reform sets forth a definitive strategy for a transition from the highly subsidized, public sector provision of energy to a competitive, efficient energy sector with private participation. A fully functioning EC is required to implement that plan. The EC has only recently been formed. Among other important functions, it was to have set licensing requirements, performance standards, and indicative expansion plans. These would then pave the way to acquire and operate the most efficient supply and promote competition.

The problem of relying too heavily on the public sector and the need to make all issues surrounding energy more transparent has been mentioned by all entities interviewed. Moreover, the Government's policy, as set forth in the Power Sector Reform Committee's Final Report, calls for a competitive bidding process for regulated power. Clearly, there is a lot more at stake here than just transparency. Competition is more than just competition in dispatch. It is competition in building and operating a power plant, and the current process does not ensure that the forces of competition will drive the cost of new power to a minimum.

In addition, until the conditions for a fully contestable market for power are developed, the least-cost expansion path needs to be ensured. This can be accomplished by the use of what the Government of Ghana calls the *Indicative Power System Development Plan*. It appears that if the majority of the potential projects come on line, there might be too much power. (See Table 2) That power will likely have to be paid for in the form of higher rates. The result of not following the plan will mean that restructuring will drive regulation of what is negotiated now and in the near term rather than the other way around. This is clearly not optimal.

TABLE 2 Possible Permanent Additions To Capacity

Project	Capacity (MW)	Status	Power Purchaser
Takoradi II	330	PPA under negotiation	VRA
GNPC El Paso at Effasu (MARAD)	130	PPA signed with Western power	MOME
GNPC OECF	120	Construction has begun on civil works & the barge	
Marathon	300	MOU signed with VRA	VRA
KMR	220	MOU signed with Ashanti, ECG selected as purchasing agent	Private Sector & ECG
ASR, Inc.	160	to be generated in Cote d'Ivoire and wheeled to Ghana - PPA to be negotiated	
Bui Hydro	400	Feasibility study completed.	Not a near term project
Hemang Hydro	90	possible prefeasibility through USTDA	

There is another very important and compelling reason for putting the brakes on and going step-by-step: Planning, policy, and regulation should drive the restructuring of the industry not be driven by it.

The first step in reaching the long-term energy goals has been taken with the creation of the EC and PURC. The next step is building the enabling framework that will promote competition, efficiency, and sustainability. This framework should be in place prior to the unbundling of the industry, so that the correct price signals will be in place to guide the economy in its use of resources. This step is critical: An unbundled utility without the correct prices is worth far less than a vertically integrated, government-owned utility facing prices and costs that reflect true resource scarcity. ***What is important is not whether there will five or six distribution companies, two or three generating companies, or an independent system operator but rather that the conditions and the framework are in place that will provide market based signals and incentives to use Ghana's resources prudently and to invest in new energy infrastructure.*** With the proper conditions in place and the will to move to private ownership, the market will determine its own best structure -- guided, of course, by the parameters and framework established by the EC and the PURC.

Recommendation:

- Until the EC develops an indicative expansion plan, new independent power producers selling into the regulated market should be allowed only on the basis of open, competitive bid. This would apply to all independent power producers except the expansion of Takoradi, the Tano Barges, and independent power producers selling into unregulated markets.

- Moreover, unbundling of the utilities should not be considered until the PURC and EC have the necessary enabling frameworks in place and better management and accounting systems have been put in place in the utilities.
- Finally, the generating capacity supply/demand balance should be developed using accurate and objective forecasts of demand and resources. Sophisticated computer-based probabilistic reliability modeling should be instituted to provide a basis for analysis of key uncertainties, such as persistent dry and wet periods, high/low load growth, constraints on the transmission and distribution systems, and delays and forced outages of thermal additions. U.S. Government assistance could be considered by selecting and implementing appropriate models for power system reliability planning, probabilistic power/water studies for major hydroelectric facilities, and electric demand forecasting. In addition, training could be provided to appropriate personnel in the theory and practice of power system reliability planning, hydro modeling, and demand forecasting.

STAKEHOLDER INVOLVEMENT — *USE ROAD SIGNS*

There is too little involvement of stakeholders in the regulatory and reform process.

While many Government players were involved in the electricity reform process, there appears to have been too few stakeholders from other areas, such as industry and consumers groups and non governmental organizations including the Center for Economic Policy Analysis. The team believes that this broader input is important not only for the reform process but also in regulation and planning. Their views are important because the process of planning and rate setting tries to anticipate the stakeholders' needs and reactions. It is also important because these stakeholders represent a valuable source of information and assistance, and potentially investment, that can help the Government as it moves the energy sector forward.

Recommendation:

- The Government of Ghana should consider a mechanism to immediately involve all stakeholders (including consumers and consumer representatives, such as the Energy Foundation) in the planning, policy, and regulatory process. It should also investigate mechanisms for institutionalizing this involvement.

ENERGY EFFICIENCY/COGENERATION — *MOTORING WITH NO REGRETS*

Meeting long-term energy goals will require increased investment in energy efficiency, renewable energy, and cogeneration.

These important activities are being hampered by low energy prices and insufficiently explicit coverage in Ghana's energy policy. For example, if electricity prices are not sufficiently high, consumers will not switch from incandescent bulbs to compact fluorescent lamps — even though compact fluorescent lamps use over 40 percent less electricity for the same level of lighting. One of the least cost and most environmentally friendly ways to increase electricity production is

through the use of cogeneration. However, traditional electricity supply systems are often biased against cogenerators, and this bias is compounded when electricity prices are artificially lower relative to petroleum prices. Cogeneration requires a push in these circumstances. All energy efficiency measures require that price and non price (import tariffs, taxes, lack of standards or certification) barriers be reduced. By avoiding the need for new generation capacity, energy efficiency efforts that are encouraged in a well-formulated energy policy are the least costly investments for increasing supply and reducing demand.

ENERGY EFFICIENCY — *THE ROAD LESS TRAVELED*

This section of the report moves away from primarily supply-side issues to those that can be effected by the energy customers on the demand-side. Incentives for supply-side efficiency improvements will be found in the generation, transmission, and distribution companies as a consequence of better business practices to cut commercial and technical losses, improved metering, billing, etc. Yet, even energy efficiency makes supply side contributions by postponing requirements for new electricity generation.

The Government of Ghana's first foray on inefficient use of energy came in response to the drought of 1982-84. Subsequently, a variety of programs have been undertaken, including: Energy Sector Management Assistance Program (ESMAP) of the World Bank's industrial energy rationalization study (1988); Industrial Energy Efficiency Program (1990); ESMAP power factor study (1994); USDOE exchanges beginning in 1995, standards and labeling; and the creation of the Energy Foundation (through USAID Assistance). The MOME has formally transferred its role in the promotion and execution of energy efficiency programs to the Energy Foundation. The Energy Foundation plans to do more under the World Bank funded Ghana Thermal Power Project technical assistance component which is supporting programs in power factor improvement, load management and monitoring and targeting, and energy management schemes.

All that has been done so far indicates that despite the progress made, there are still major obstacles, such as:

- lack of awareness;
- lack of local expertise;
- lack of confidence in utility demand-side management programs;
- poor incentives structure;
- financing problems; and,
- no long-term commitment to energy conservation.

To this, one must add, the conclusion found in so many other countries: Even when prices of energy are based on market outcomes, energy conservation investments will be less than optimal due to the presence of external and market imperfections.

Anecdotal evidence is even more telling. In spite of the electricity shortages, outdoor lights were observed turned on during sunny daylight hours. The team was told that many people were taught as children that turning switches on and off wasted power, so the lights were left on

around the clock. Others perceive that government attempts to encourage efficiency are actually motivated by a desire to shift the blame for shortages from state-owned utilities to consumers. *Clearly, the landscape is fertile for a comprehensive education campaign on energy conservation.* Strategically, VRA, ECG, and the Government should immediately launch an aggressive energy conservation campaign to provide consumers with the information they need to understand and better control their rising electricity bills. Financing such public awareness efforts should be directed through the Energy Foundation, which is preparing materials and a plan to educate electricity users on conservation and potential savings.

Optimal energy efficiency will require a legislative or regulatory push. Standards and labeling for efficient equipment could be utilized. Building codes with energy standards could be implemented. Performance contract protocols along with energy engineer certification could be encouraged. When the Energy Fund is established by the EC it should certainly have programs that provide incentives for the investment in more energy efficient equipment and buildings.

Recommendation:

- A study should be conducted to examine the role of legislation and regulation in helping the country achieve its energy efficiency objectives, and the study should provide concrete recommendations for legislation and implementing regulations. This study will provide increased incentives for the development and promotion of the local energy service company industry. The silver-lining to the shortages is that the public will be ready to learn about energy efficiency as a way they can help their country avoid future shortages. Now is the very best time to initiate a broad public awareness campaign, using school and church-based education programs, to teach consumers how to reduce energy bills when uninterrupted power is restored. This electricity crisis should be managed. The Government of Ghana (VRA, ECG, and MOME) should support the Energy Foundation in conducting a major national energy efficiency campaign. With financing from the Government of Ghana for publicity, publication, and dissemination, the U.S. Government would be prepared to help the Energy Foundation refine the content and orientation of its campaign.
- In addition, ways of overcoming the so-called first-cost problem are need. Consumers are often unable to take advantage of the reduced energy bills from conservation because the first cost is so high. The first-cost problem explains behavior that appears inconsistent with economic maximization principals. People often purchase items that have shorter lives and end up costing more than alternatives simply because they can't afford the up-front cost of the better alternative. *The initial costs of more efficient lighting and fans will be an important obstacle in their widespread adoption. An additional study is recommended that will investigate innovative financing of consumer-related energy efficiency investments; provide an implementation strategy and plan; and estimate the cost and benefits to the country, the utility, and the consumer.*

COGENERATION — A NO COST MILEAGE INCREASE

Cogeneration, is a classic “win-win” case of expanding generation with a positive environmental and economic gain. It can often be brought on-line quickly. This option is, however, usually overlooked for a variety of reasons including the grid code, interconnect requirements, price of fuels versus price of electricity, and general bias of traditional utilities. The cogeneration potential in Ghana is small, perhaps no more than 30-50 MW at this time. But as the economy expands, electricity prices rise to their economic levels, and gas is made available, the potential for cogeneration will increase considerably.

Recommendation:

- Now is the time to “level the playing the field” for cogeneration, or even provide some incentives with a long-term perspective. The Energy Foundation should be encouraged to review prospects for cogeneration in current and planned industrial activities. The EC should incorporate cogeneration into expansion plans. A grid code encouraging renewables and cogeneration should be developed, and a small power purchase agreement should be developed for use with all cogeneration facilities. The PURC should investigate the use of a special rate for cogeneration.
- The USTDA is investigating funding for prefeasibility/feasibility studies for cogeneration possibilities at the Tema Refinery and with wood wastes in Kumasi.

INSTITUTIONAL STRENGTHENING — *THE FOUNDATION TO A SMOOTH HIGHWAY*

The institutions necessary to guide and regulate the energy sector do not have sufficient resources, need to coordinate and work closely with each other and may become potential bottlenecks.

The PURC and the EC are intended to create the enabling environment, improve the financial stability of the industry and attract private investment to the energy sector.

Appointed by the President in consultation with the Council of State for 5-year terms, the nine member PURC includes a Chairman, one member from the Trades Union Congress, one member from the Association of Ghana Industries, one member representing domestic consumers, the Executive Director, and four other members with knowledge in relevant matters. The functions of the PURC include:

- protecting the interests of consumers and providers of utility services;
- approving rates for the provision of utility services;
- monitoring standards of performance;
- promoting fair competition among public utilities;
- collecting and compiling data on public utilities;
- determining valuation of public utility property; and
- maintaining a register of public utilities.

The utilities had asked the PURC to approve a price increase for electricity of 270 percent effective in January 1998. The PURC had approved rate increases in February and September 1998, but these were less than the MOME, the utilities, or World Bank expected.

The EC was the second new institution created by Parliament in 1998. Its functions include:

- Developing a long-term energy strategy for Ghana, including least-cost expansion plans;
- Issuing licenses for electricity suppliers, independent power producers and the National Grid Company;
- Developing operational, safety, and reliability standards for industry participants;

The EC also has the responsibility for managing the Energy Fund, originally established under the National Energy Boards law in 1983, with revenues provided by a levy on electricity, natural gas, and petroleum products; money that accrues to the EC in the performance of its functions; and from grants. The fund is to be used to promote energy efficiency, develop renewable energy resources, support human resource development in the energy sector, and for other relevant purposes.

Both the EC and the PURC have very important tasks to perform both now and in the future. They must take the policy and laws and give them form through implementing rules and regulations. The PURC has started this process by setting *Draft Guidelines for Rates Chargeable for Electric Services* and for the Disconnection of Nonpaying Customers. Much remains to be done.

The EC, recently formed and without technical staff yet, is not operating. Many of the ECs jobs need to be in place now, while others are important in the long run. Much of what the EC can, and will, do impacts the consumers' price or the price that generators will need to make a project profitable. The EC will set standards that the PURC is to enforce. These considerations require both organizations to work closely together, yet no institutional mechanism exists to provide the incentives the organizations need to work collaboratively on common issues.

The MOME has new responsibilities in this restructured energy sector, and it too requires assistance.

Recommendation:

- One way of institutionalizing cooperation is to make rotating inter-locking appointments. This means that a member of the PURC will always serve on the EC and vice versa. (Other team's recommendations are in the following sections covering the individual topics in greater detail.
- Additional assistance will be required in the form of "twinning" (such as electric utilities, public utility commissions, and the U.S. Energy Information Administration working with local counterparts), technical assistance to help these new Institutions meet critical needs such as licensing and tariffs, and training.

INTEGRATED BUT INDEPENDENT PLANNING — *ALL ROADS DON'T BEGIN IN ACCRA*

Meeting long-term energy goals will require independent and integrated energy planning.

Reaching the important energy goals of the nation will require the coordinated use of all the country's energy resources, carefully balancing the costs and the benefits. The needs of one sector must be weighted against the capabilities and contributions of another. In the past, there has been considerable lack of coordination among the energy subsectors: petroleum, gas, power, and renewables. For example, the liquids pipeline that runs to Akosombo and the accompanying terminals pipeline remains unused because planning for the pipeline did not coordinate the needs of all stakeholders. Other examples abound and point to the challenges of coordination and the potential benefits.

Long-term integrated planning is also important given the lead times for developing energy resources and the sheer size of the required investments relative to the Ghanaian economy. In addition, some of the resources are undervalued in the marketplace. It is accepted that Government intervention is required to handle appropriately their production and use. Moreover, during Ghana's transition to a freely functioning market for energy and energy services, it is important that the Government anticipates and effectively detours around potential conflicts between energy use and economic development. This requires both long-term strategic and integrated planning, emphasizing productive deployment of all resources.

Other areas requiring attention in planning include: the level and role of captive power; off-grid electrification and renewable energy; and the environmental impacts of expanded wood and biomass energy consumption.

In the short run, the EC plans to rely on VRA and ECG to carry out planning or forecasting. This is understandable given their resource constraints, but in the long run independent planning is required, i.e., planning and forecasting by an independent body not by interested parties with their own goals that may conflict with broader sector goals.

A key area of focus for the new independent planning agency will be forecasting demand, which has been difficult due to suppressed demand. For example, in 1993 MOME stated "Recent projections indicate that domestic electricity consumption will grow by about 2.4 percent annually, up to the year 2010.⁸" Actual consumption from 1993 to 1997 grew at a rate of 4.3 percent per year. This growth was constrained by the availability of water for generation, and in 1996 and 1997 consumption grew at over 10 percent per annum.

Independent planning and forecasting is not yet apparent. As mentioned earlier, the individual forecasts and plans by VRA, ECG, and other energy entities will now be integrated by the EC. The EC must be independent of these biases, and to do so must rely on its own resources in the long run.

Recommendation: The team's recommendations are presented in the sections covering these topics in greater detail.

⁸ Energy & Ghana's Socio-economic Development, 1993, Ministry of Energy, page 3.

Meeting Ghana's long-term energy goals requires regional integration of electricity grids and cooperative development of cheaper gas resources.

Power Trade

Power is traded on a bilateral basis with Ghana at the center. This bilateral trade began in 1972 with VRA exports of power to Togo and Benin, and was continued in 1983 with exports to Cote d'Ivoire. Beginning in 1995, Ghana began to import power. The Cote d'Ivoire interconnection has reduced the magnitude of the current shortfall and provided valuable foreign exchange in the past. The Togo interconnection has been a major source of supply for that country, and Ghana and Togo have an agreement for joint dispatch of their systems. Cote d'Ivoire is connected to Mali and Burkino Faso, and Benin is likely to be connected to Nigeria in the near future.

To take full advantage of the benefits from trade, a power pool is required. Power pooling has the potential advantage of reducing reserve requirements, facilitating reservoir management at the Akosombo project, reducing generating costs, providing assistance in emergencies, and allowing the pursuit of regional generating projects. The Economic Community of West African States countries have signed an agreement forming the West Africa Power Pool (WAPP). However, there remains much to be done to make WAPP operational. In addition to expanded transmission and dispatch facilities, a number of institutional and other technical issues must be resolved. For example, tariff and technical harmonization is required and rules of trade must be established. This type of work is best facilitated by outside consultants and through training and partnerships with other power pools.

Gas Trade

Ghana's industrialization was spurred by an era of relatively cheap and abundant hydro electricity that has ended. If Ghana's economy is to continue growing, it must find abundant low cost energy resources. Natural gas from neighboring countries holds that promise as does indigenous natural gas. Gas will be the fuel of choice for power, and new industries will spring up to take advantage of natural gas while others will substitute gas for liquid fuels. There is one other important and compelling reason for the use of natural gas — the environment. Not only is natural gas a relatively clean fuel but in Nigeria over two billion cubic feet per day is flared. This is both an economic and an environmental tragedy. Putting this gas to constructive economic work will result in a solution to both energy and environmental problems, the classic "win win" solution.

All of the existing -- and planned -- thermal power projects in Ghana, except those being developed by GNPC, are based on liquid fuels. Those based on combustion turbine technology can be easily modified for natural gas combustion. The future cost of electricity from natural gas, from Nigeria for example, is potentially lower than that for liquid fuels. However, natural gas supply contracts are structured differently from liquid fuel contracts. This will have competitive and economic dispatch implications. It will be important that the regulation of the restructured power sector in Ghana have the flexibility to allow, and encourage, such a shift in fuels if it is in the interests of the consumer.

Facilitating natural gas supply from the region will require agreement on tariffs, environmental assessments, rules of trade, and technical standards similar to those utilized by WAPP. This will best be facilitated by outside consultants with no stake in the pipeline, its operation, or sales.

Recommendation:

- Creating the political will and setting the enabling environment for the gas pipeline and the WAPP should be priority activities. However, given the often competing interest of energy sector players, it is recommended that regional integration activities be elevated to a higher level. This also makes sense given the bilateral negotiations and agreements that are required to make this a reality. To accomplish this, the team recommends that the Government consider appointing a Regional Energy Integration Chief attached to the EC but reporting to the Minister of Mines and Energy. The following assistance is recommended: Twinning with a U.S. power pool; a definitional mission to assist the Government of Ghana to defining the critical requirement for operationalizing the WAPP and the pipeline; a regional workshop with senior policy makers and utility officials involving all area governments on regional integration and the West African Power Pool and gas pipelines; technical assistance in the economic, financial, commercial, and regulatory aspects of trans-national gas pipeline development projects and regional power pools; and technical assistance in areas such as operations, environment, tariffs, etc.

ENERGY PRICING— *TRAFFIC SIGNALS*

Much work remains to be done in the area of tariffs, and this should be a priority item as it impacts both the financial viability of the existing utilities and the ability to obtain least cost independent power producers.

The Government has established the PURC to regulate electricity prices and espoused a policy of economic pricing of energy. Both of these are positive measures but they are only the first step on a much longer journey. Tariff guidelines must be transparent,⁹ be easily understood, and provide an acceptable rate of return. If they are not, too few resources will be invested in the supply of power. If VRA had been given adequate tariffs, it would have been in a better position to contract for, and obtain, the emergency power the country needed. But instead the MOME has had to guarantee the emergency purchases.

While the PURC sets rates, the *Draft Guidelines for Rates Chargeable for Electric Services* are not fully developed. Many of the details are missing. Some examples include:

⁹ In a meeting with one of the PURC Commissioners the team was explained the latest rates and the problems that the utilities had in understanding that the new rates were no significantly different from what they had requested. This is a concrete example of the lack of clarity that will, no doubt, improve as the PURC grows and as both the regulators and the regulated develop a closer working relationship. However, until that time it highlights the difficulties that established companies face, much more the same for potential IPPs.

Generation Tariffs

The “cost of electricity production from the thermals (Takoradi Power Company and independent power producers) shall be set to cover investment cost (capacity charges), fuel and other operation and maintenance costs (energy charges). The investment cost (capacity charge) shall be based on a benchmark value while energy charges will be regulated to ensure efficiency in fuel procurement and other variable cost elements. The relevant benchmarks shall be determined by the PURC in consultation with the utility companies.” While descriptive of the factors considered in setting the tariff, the vagueness at this time would not allow the generator to determine its potential allowable price or how it will be impacted by change in items such as the fuel price, increased labor costs, or new environmental guidelines.

Transmission Tariffs

The guidelines for transmission charges state that “transmission and transformation losses shall be established by the PURC and shall be accounted for in the rates through appropriate expansion factors.” The loss rates and expansion factors have not been established. The mechanism for review by the transmission company has also not been established. The PURC will need assistance in developing tariff methodologies for standby reserve, synchronized reserve, and other support services.

The Value of Water

So far Ghana has planned, priced, and operated its provision of electricity as if water is free and always abundant. It clearly is not, and water is a real economic value that is not yet accounted for in the tariffs. Some provision for the value of water is excluded from hydro prices, and this will mean that:

- too few resources will be spent in new generation form other energy sources;
- too much of the water in the reservoir will be used; and
- a precious finite Ghanaian resource is being wasted.

This apparent oversight will have implications for resource utilization since dispatch is on the basis of cost. It means that existing hydro may serve baseload with the thermal plants operating to fill the gap. Both convention and economics might suggest another path, and this will also have a significant impact on private power.

Retail Tariffs

As mentioned earlier, the role of additional block tariffs and the effects of tariffs in managing demand and reflecting the real cost of power needs further examination. When the PURC set tariffs in February 1998, the marginal cost of power was the imports from Cote d’Ivoire. Now, the marginal cost is set by the cost of emergency power. Not only should this be examined but, perhaps, a mechanism explored to automatically adjust tariffs. Other areas of tariff work include examining the life line rate break point and rate progression.

The PURC is developing and defining these guidelines and much has been accomplished in the short time they have been operating. However, without significant near-term tariff adjustments

VRA and ECG will be unable to service existing debt and thereby further constrained in financing new investment.

When should tariffs equal the cost of power?

There appears to be a consensus with all parties that if Ghana is to have the power it needs, rates must eventually equal the cost of power. The debate is actually when they should reach the long run marginal cost. The PURC has decided that tariffs will be raised to their economic levels for industrial and residential users in 3 and 4 years, respectively, and provided for some increase in September of 1998. The VRA, ECG, World Bank, and others wanted a much more dramatic increase and a shorter time to reach economic prices.

Raising prices too quickly can have serious social, environmental, and economic consequences. However, not raising them soon enough can also bring hardship to utilities and those in short supply of power. This is a delicate balancing act that requires more than goodwill to find the solution.

Recommendation:

- The following assistance is recommended: commission a study to simulate the impact of different tariff scenarios. The study would attempt to quantify the tradeoffs of different tariff escalation regimes; provide technical assistance to help PURC develop tariff methodologies that are immediately required; increase participation of the PURC in a twinning program with the Pennsylvania Public Utilities Commission (currently World Bank funded) or with another PUC regulating a more hydro-dominated system; and, provide training.

PRIVATE POWER — TOLL ROADS PAY FOR THEMSELVES

One of the principal keys to Ghana's energy future lies in attracting private investment, management, and ownership in the provision of energy and energy services. Legislating private participation is the first step but only the first step in the process. Independent power producers are now showing interest in Ghana, acquiring local representatives, and signing letters of interest and memoranda of understanding (MOUs). Companies express interest and sign MOUs for many reasons, including to cover strategic interests in other countries; to lock out competition until more can be learned; and to develop the perceived potential in private power.

A successful power deal requires more than good intentions. It requires a volume and price for power that will yield at least a reasonable profit — reasonable as defined by the companies' own alternative investment opportunities. The higher the costs or the greater the uncertainty surrounding price and/or expected sales, the higher will be the return (and therefore, price) required by independent power producers. In the Ghanaian context, independent power producers need:

- To be able to understand the rules of the game;
- Have easy access to information;
- Feel reasonably comfortable that these rules are not subject to frequent change or interpretation;
- Have a price that allows them to earn a realistic risk adjusted rate of return;

- Be secure that a specified minimum capacity will be purchased; and,
- Have a power purchase agreement signed with a financially viable entity.

In the team's attempt to understand the environment for private power the team met with the MOME, Ghana Investment Promotion Centre (GIPC), PURC, EC, GNPC, VRA, and private power developers. The laws and policies are being formulated but implementation remains uncertain. The ground rules are neither clear, well developed, nor easy to access. For example, the team has heard from many of those interviewed that there is not necessarily a relationship between the power purchase agreement and the power actually purchased — dispatch will be governed not by agreement but by price. It is claimed that plants will be dispatched on economic merit order. On the other hand, the team has heard from potential players that they expect a firm power purchase agreement. The *Draft Guidelines for Rates Chargeable for Electric Services* are silent on the power purchase agreements but rather talk about how generation tariffs will be set. Similarly, the current guidelines require much more definition before the potential investor can easily determine expected sales. How will requirements such as reserve margin be handled? How will rulings made by the EC on operating conditions be entered into rates by the PURC?

Having realistic prices and clear rules of the game are just two of the requirements for a cost-effective independent power producer program. Another requirement, given the current state of Ghanaian power market, is the need to have signed power purchase agreements with entities that are financially sound. This stems from the need to assure lenders of the creditworthiness of the project. All of these requirements, together with the current situation, mean that successful independent power producers will seek either Government of Ghana power purchase guarantees or strong financial partners, such as VRA or large industrial users.

Competitive bidding for independent power production is a must if Ghana is to get additional power at the least cost.

The Power Sector Reform Committee's Final Report is rational and well constructed. At this point, key conditions of the plan are not being followed. Consequently, many of the achievements that Ghana hoped to achieve through this plan may either be diluted or simply not materialize.

Recommendation:

- Immediate assistance is required for the EC and the PURC to carry out quickly some of their critical functions. Once the PURC has completed the details of tariffs and dispatch and the EC has finalized the indicative expansion plan, an outside expert should prepare a promotional package that sets out all official requirements for independent power producers.

DISTRIBUTION SYSTEM DEVELOPMENT – THE QUICKEST PATH BETWEEN TWO POINTS IS A STRAIGHT LINE

An integrated approach to planning considers not only the supply-side actions but also demand-side actions that contribute to solving the current crisis. The U.S. team focused on distribution as a secondary consideration during the study trip, because we believe that the first priority is to restore supply to the pre-crisis level to meet the requirements of existing customers. However, MOME rightly points out the critical importance of improving distribution efficiency to increase the supply

of power for all consumers. Likewise, reliability and efficiency improvements to the transmission system and existing generating plants must be prioritized within an integrated plan. The situation now is that ECG has distribution bottlenecks that will potentially offset the impact of efforts to increase the generation margin far above the present crisis line. Due to lack of funding, development of the distribution system is not keeping pace with the current load growth. While efforts are being made to address commercial losses in ECG, the growing distribution system overload conditions continue to increase technical loss figures far above acceptable margins. This presents an opportunity for energy efficiency that pays off by increasing the ECG's ability to serve additional load.

Recommendation:

- U.S. Government assistance could be used to prioritize generation, transmission, and distribution projects within an integrated resource plan for the power sector. Such a study would provide a road map to ensure a balanced approach to achieving the greatest payoff for capital expenditures and to ensure that Ghana does not drift into a “distribution crisis” soon after coming out of the “generation crisis.” This might best be achieved through the utility twinning program.

SETTING PRIORITIES — READING THE MAP

Recognize that Ghana can't effectively transform the energy sector, attract the least cost independent power producers, establish new regulatory and planning institutions, unbundle the utilities, and deal with the energy crisis all at once.

Ghana simply does not have the resources to carry out all of these activities concurrently. This can be seen, for example, from the fact that it has taken more than 7 months since the passage of the EC Act to actually appoint Commissioners and begin the Commission's activities. Staff requirements for the PURC and EC compete with the needs of the VRA, ECG, and independent power producers as they form new business units, restructure, and enter into operations. So it is important that the Government prioritize what must be done. This is an issue of both strategic planning and resource management.

Recommendation:

The following prioritization may help Ghanaian decision makers to move forward with critical actions. All are important and when possible should be pursued simultaneously. The suggested order is:

1. Finalize emergency electricity purchase plans;
2. Simultaneously, move forward on regional integration (An individual or entity should serve as the focal point and decision maker for the gas pipeline and power pool);
3. Finalize Takoradi II and Tano power projects and those for which financing is clear to the exclusion of other independent power producers;
4. Initiate an energy efficiency campaign including a vigorous promotion of energy efficiency options and measures;

5. Assist the Energy Commission to license, set performance standards, collect data, and produce indicative least-cost expansion plans;
6. Assist the PURC for tariffs, data collection, and monitoring of utilities;
7. Seek additional new generation only after the indicative least cost plans are developed; and,
8. Restructure/unbundle VRA and ECG.

SUMMARY LIST OF LONG-TERM CONSTRAINTS AND NEEDS

Ghana is taking the right turns on the road to economic freedom. The team has been impressed with the operation of the nations' electric utilities, the thoroughness of its electricity sector reform program, and manner in which the PURC is setting about its tasks. The team acknowledges that VRA has been a powerful force in the development of the country and is a relatively efficient electric utility. Given these positive beginnings, the team is confident that the country will meet the challenges ahead in a positive and concrete manner. The following is a summary list of long-term constraints and needs for the road ahead:

- Although Ghana has developed a sound and relatively thorough electricity sector reform plan, it is not being followed as developed but rather in an ad hoc manner.
- Planning, policy, and regulation should drive the restructuring of the industry as opposed to allowing subsectoral corporatization drive the national planning process.
- There is too little involvement of stakeholders in the regulatory and reform process. The public, in general, needs to know more about the importance of energy to their future.
- Capacity at the institutions charged with bringing about Ghana's long-term energy goals is thin for restructuring, attracting private power, and establishing regulatory and planning functions.
- New institutions for regulation and planning (PURC and EC) have insufficient capacity and resources and, therefore, are at risk of becoming bottlenecks.
- The existing plans are good but not integrated and not being followed in implementing sectoral reform.
- Meeting Ghana's long-term goals requires integrated and independent planning.
- Efficiency, renewables, power, gas, and cogeneration need to be planned together, not in isolation from each other.
- Meeting Ghana's long-term goals also requires regional integration in the power pooling and exploitation of natural gas.

- No significant efforts to promote energy efficiency have been made yet.
- Although much work has been done on tariffs and regulation, much remains to be done, particularly with regard to efficiency, renewable energy, cogeneration, standby reserve, wheeling, and competitive bidding for new power.
- Recognizing that Ghana can't effectively transform the energy sector, attract the least cost independent power producers, establish new regulatory and planning institutions, unbundle the utilities, and deal with the energy crisis all at once, priorities should be set.

VI. Possible Mechanisms for U.S. Government Assistance

On page 17, this report described U.S. Government assistance currently provided. There are a number of existing mechanisms through which the U.S. Government could provide additional assistance. Some of these mechanisms are already active providing initial assistance in Ghana. These could be used as a basis for expanding the areas of cooperation between the two governments. They include:

- The USDOE has an MOU with the MOME to provide technical assistance and training in a number of areas. Activities regarding renewable energy technologies and energy efficiency are currently ongoing.
- USAID is currently providing assistance in energy efficiency by assisting the Energy Foundation through the Alliance to Save Energy and with training. Currently the commitment is through the year 2000 and opportunities to speed up assistance activities under this program will be explored.
- USAID continues to provide training on a wide variety of energy and environmental issues. Over 300 Ghanaians have been trained since the program started. Additional training in all critical areas can be provided through USAID.
- Through the USDOE's Lawrence Berkeley National Laboratory, USAID is providing technical assistance to the MOME in energy efficiency standards and labeling, through the Energy Foundation.
- USAID's Global Bureau has a number of programs and projects that might possibly be brought to include Ghana. These include:
 - (1) Energy and Environmental Indefinite Quantity Contract — technical assistance in energy efficiency, renewable energy, energy policy, and regulation.
 - (2) Energy Training Contract— training in all aspects of energy.
 - (3) A cooperative agreement with the United States Energy Association to provide twinning and exchanges between utilities and regulatory bodies.

In fact, the Energy and Environment contract just released a task order for work in Sub-Saharan Africa to provide assistance and training to create and expand transnational markets in electricity; to tap market resources such as new private capital for private power, renovation, and modernization, and new technology; and to create market incentives such as restructuring and private provision of electricity services, policy reform, and tariff reform.

- Current efforts by the USDOE Office of Energy Efficiency and Renewables could be augmented to provide additional assistance to the Ghana Energy Foundation, the PURC, EC, and ECG on options for promoting energy efficiency and renewable energy technologies in Ghana's electricity sector. Emphasis would be on identifying opportunities to promote energy efficiency in Ghana's small manufacturing and residential sectors and in using renewable energy technologies to achieve cost-effective expansion of electricity service to rural areas.

VII. Recommended Priority Assistance Activities

Based on its analysis of the critical path of the energy sector development, it has developed a list of priority assistance activities. The order recognizes the need to have regulation drive restructuring and the need to ensure that short-term solutions do not negatively impact the long-term goals. Moreover, these activities are designed to track the priorities recommended for Government of Ghana actions. The list of proposed assistance activities is followed by recommended next steps. Although the U.S. Government may provide some support for many of these assistance needs, it is expected that help is available from other donors. For example, concurrent with the USAID team's mission to Ghana, the World Bank was investigating possibilities for assistance to the PURC. Other areas may be added, depending upon the needs and priorities of the Ghanaian Government in relation to other donors and further discussions in Washington, D.C. Priorities in providing assistance are as follows:

1. Technical assistance to the Government of Ghana on quick negotiation and execution of immediate actions to advance private power. (U.S. Government possible support for items such as model power purchase and fuel supply agreement; however, more targeted assistance needs should be defined by the Ghanaian Government.
2. Technical assistance to the EC in the areas of licensing and least cost planning. (USAID provided technical expertise looking at pro forma procedures being applied in other countries.)
3. Technical assistance to the PURC to determine the impact of various tariff escalation scenarios and in general tariff design. (USAID will provide assistance in this area.) This activity is in the planning stage.
4. USAID support to the Government of Ghana to define the critical requirement for operationalizing the WAPP and a regional workshop with senior policy makers and utility officials on regional integration for the WAPP and Gas Pipelines. (Additional policy study on competitive advantages for certain process heat intensive industries to be located in Ghana and the prospects for electric power exports from Ghana.)

5. Technical assistance and training for the PURC and EC in the areas of electricity sector restructuring, utility regulation, pricing reform, staffing and operational areas, and to the Energy Foundation to assist in recommending draft legislation and policy in energy efficiency. (To be supported by an U.S. Government funded twinning arrangement with U.S. regulatory offices.)
6. Further assistance to the Energy Foundation to assist establishing energy service companies, energy efficiency standards, and performance contracting mechanisms. (Ongoing and additional support planned by USTDA,)
7. Cogeneration feasibility studies for GNPC cogeneration and wood waste fired cogeneration to possibly be funded by USAID.
8. USAID funding of technical assistance to help the Energy Foundation design information for the energy efficiency publicity campaign once Government of Ghana financing is confirmed.
9. Technical assistance and legal expertise for the PURC, EC, and other GOG and regional entities on the development, operation, and regulation of natural gas pipelines and services. (Possible support from USDOE.)
10. Technical assistance and training for the PURC, EC, and other appropriate entities to develop a comprehensive national energy policy plan and energy data collection, analysis and modeling techniques. (From USAID or USDOE.)
11. Technical and legal expertise for the PURC, EC, VRA, and ECG on development and operation of a regional electricity power pool. (From USAID and others, also, possibilities for peer exchanges with U.S. power pools.)
12. For the long term, support in renewables development is essential, particularly photovoltaics, in order to achieve the levels of electrification sought in *Vision 2020*. (Possible support from USAID and USDOE.)

VIII. The Road Ahead

The work of the team, both Ghanaian and U.S., does not end in sharing the team's findings and recommendations with the Government of Ghana. This is but a beginning. It is anticipated that flowing from this work will be a national energy forum to bring all stakeholders together, obtain a consensus on the direction, and provide those that must implement the plan a set of concrete, clear priorities and directions. This report may form the basis for the forum and a tool to help participants understand the complex issues involved. It is further anticipated that this report will provide a framework for defining U.S. Government assistance and that of other donors. The team will share this document with donors such as the World Bank and fully anticipates coordination with those donors active in Ghana.