

Angola Energy Sector Needs Assessment: Mid-Long Term Vision and Needs Assessment Study

FINAL REPORT

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Acronyms and Abbreviations

| | |
|-------|---|
| ALNG | Angola Liquefied Natural Gas |
| bcm | billion cubic meters |
| BCI | Bank of Commerce and Industry |
| BOT | Build Operate Transfer |
| BP | British Petroleum |
| BPC | Bank of Savings and Credit |
| bpd | barrels per day |
| DNE | National Energy Directorate |
| DRC | Democratic Republic of Congo |
| E&P | Exploration and Production |
| EDEL | Empresa de Distribuicao de Electricidade |
| ENE | Empresa Nacional de Electricidade |
| ESMAP | Energy Sector Management Assistance Program |
| FEED | Front End Engineering Design |
| GDP | Gross Domestic Product |
| GOA | Government of Angola |
| GWh | Gegawatt hours |
| IMF | International Monetary Fund |
| IOC | International Oil Companies |
| IPP | Independent Power Producer |
| IRSE | Instituto Regulador do Sector Electrico |
| km | kilometer |
| kV | kilovolt |
| kVA | kilovolt ampere |
| LNG | Liquefied Natural Gas |
| LPG | Liquefied Petroleum Gas |
| MINEA | Ministry of Energy and Water |
| MOF | Ministry of Finance |
| MOP | Ministry of Petroleum |
| mtpa | million tons per annum |
| MW | Megawatt |
| NGO | Non-Government Organization |
| NRC | National Regulatory Commission |
| PSP | Private Sector Participation |
| PV | Photovoltaic |
| SAPP | Southern African Power Pool |
| SMP | Staff Monitored Program |
| TA | Technical Assistance |
| tcf | trillion cubic feet |
| UNITA | União Nacional para a Independência Total de Angola |
| USAID | United States Agency for International Development |

Section 1 Introduction

Nexant, under its contract with USAID, has been assigned the task of conducting a diagnostic needs assessment of the energy sector in Angola. Energy is fundamental to the economic development of the country. Currently, the majority of the population does not have accessible, reliable supplies of energy. Moreover, as the Government of Angola (GOA) transitions from a wartime economy to peacetime economy, its capacity and resources are being severely tested as it confronts innumerable decisions and countless priorities. Based on our discussions with GOA, the government recognizes that now that peace has been achieved it must demonstrate to the population at large, in a relatively short time, that the government can return the country to a normal economic environment which will provide the benefits of economic growth. Restoring reliable supplies of energy is a key priority of the GOA.

Understandably, the GOA focus is on the short term. However, the GOA must eventually confront the longer-term issues which confront the country. Energy will be one of these issues. A consistent policy and implementation program would reap significant benefits for the people of Angola. This study is a first step. In order to help frame what will be required we focus on the mid- long-term energy situation in this report.

This assessment was based on available information and data. In addition, a team comprised of power, petroleum and natural gas, finance, environmental, and human resource specialists conducted in depth meetings with key energy sector stakeholders over the period from June 10 to June 27, 2003. The findings of this report are based, for the most part, on the results of those meetings. In this regard we would like to express our appreciation to the US Embassy, USAID Mission in Angola, the Ministers of Energy and Water, Petroleum, and Finance, as well as the senior management of ENE, EDEL, and Sonangol for their generous assistance. A complete list of all meeting conducted in country is set out in Appendix A.

1.1 OBJECTIVES, SCOPE AND APPROACH

The objectives of this task are to determine the critical areas for technical assistance to Angola's energy sector to support rehabilitation, restoration and expansion of energy services to support economic development and facilitate and promote private sector investments in order to develop a commercially viable energy sector.

The scope for this task was comprehensive in that it included an examination of all aspects of the energy sector: power, petroleum, natural gas, rural energy, renewables and energy efficiency, finance and human resources. Our focus was also time differentiated into two components:

- A short term (current to 2 years) emergency assessment which focuses on the immediate needs to rebuild and rehabilitate the energy system
- A mid to long-term assessment (5 to 10 years) which focuses on technical assistance that will provide support for the transition of the energy sector to a more commercial basis (mid-term) and future development and growth (longer term)

This second report focuses on the mid to long-term needs assessment. It builds upon the Emergency Response Study, which provides a detailed assessment of the current situation and short term Technical Assistance (TA) for the sector. The purpose of this second report is to present a vision of how the sector could evolve, the issues confronting the GOA and the TA which could assist the sector participants in achieving this vision.

The approach was based on a combination of interviews, data collection, analysis and professional judgment. (Appendix B sets out a bibliography). We build on the assessment of the current situation developed in the Emergency Response Study as well as develop a provisional assessment of the future developments in the sector. We did not develop an energy strategy per se, as this was beyond the scope of this task, however it was necessary to understand what drives energy development in Angola. Based on this we: (a) provide an assessment of the outlook (vision) for the sector over the next 5 to 10 years and (b) identify the technical assistance programs that will encourage private investment and develop a reliable, efficient, transparent and commercially viable energy sector.

1.2 SUMMARY OF FINDINGS FROM THE EMERGENCY NEEDS ASSESSMENT

The Emergency Response Study focused on the current situation and the immediate needs of the energy sector for technical assistance and training. There are a number of key findings of an emergency nature, which emerged from our initial assessment. These are as follows:

- Although limited planning capacity exists in both the Ministry of Petroleum (MOP) and MENA, the GOA lacks a comprehensive energy planning and policy framework which addresses all sectors on a consistent basis. Energy data collection and reporting is not performed on comprehensive and consistent basis
- There is a critical lack of skilled staff in within the GOA and the power sector. This has significant implications for focused technical assistance capacity as it relates to finding suitable counterparts.
- While an electricity law exists which establishes the legal basis for a regulator no definitive action has been taken to staff the regulator although there is a desire to initiate the process by developing a organization and staffing plan
- Energy prices are heavily subsidized however there is a strong desire on the part of the GOA to reduce these subsidies in order to improve fiscal management. There are significant social and political implications which will affect the timing and magnitude of these reductions
- The MOP is in the process of drafting a new petroleum law however the law does not address downstream activities and the role of the private sector in these activities
- A plan for gas flaring reduction exists which focuses on re-injection, offshore processing and the development of LNG. However, its implementation will require close coordination of the IOC's, Sonangol and the MOP. Until all parties agree to the terms of the plan and the fiscal; arrangements gas flaring will continue.
- There is no fiscal regime or enabling legislation which addresses gas development

- The power sector is basically operating on a day to day basis and is focused solely on the rehabilitation of the system – the magnitude of the rehabilitation planning and implementation is beyond the capacity of ENE and EDEL
- Eighty percent of the provincial capitals do not have reliable supplies of energy.
- Both ENE and EDEL are incurring losses due to tariffs that do not recover costs coupled with inadequate metering, billing and collections. Both companies rely on subsidies from the Ministry of Finance (MOF), which is also responsible for setting tariffs.
- Given the GOA, ENE and EDEL's focus on rehabilitation very little attention is being given to rural energy – although this is addressed in the in the previously cited power sector strategy as a key area for future development
- The potential for private sector investment in the near term is highly unlikely although the potential exists for the use of selective management contracts
- There is a General Environmental Law with minimum enforcement by the GOA. There is essentially no environmental regulation of the power sector. There is a decree on environmental protection governing the activities in the petroleum sector but most International Oil Companies (IOC's) have their own corporate environmental management programs, which appear to be comprehensive.

These findings formed the basis for the basis for the Technical Assistance programs identified and discussed in the Emergency Response Study. They also form the basis for the Mid-Long Term assessment discussed in the sections below.

1.3 BALANCE OF THIS REPORT

The balance of this report is as follows:

- Section 2 sets out a vision and strategy for the sector and the technical assistance program
- Section 3 discusses the factors affecting energy development in Angola
- Section 4 addresses power sector development and technical assistance
- Section 5 addresses petroleum sector development and technical assistance
- Section 6 addresses natural gas sector development and technical assistance
- Section 7 addresses the role of renewable energy, energy efficiency and rural electrification in the near term
- Section 8 sets out our overall conclusions and recommendations

Section 2 A Vision And Strategy For Mid-Long Term Energy Sector Technical Assistance

The purpose of this section is to set out a overall sector vision and unifying framework for identifying technical assistance (TA) which will provide benefits in the mid term (i.e. 5 years) and longer term (i.e. ten years).

2.1 A LONG TERM VISION FOR THE ENERGY SECTOR

The appropriate starting point for gauging the needs of the energy sector is to postulate a long – term vision. The purpose of such a vision is to provide a common goal which everyone knows and understands and can work towards. Currently there exists no official vision for the sector. Based on our meetings with sector participants we have developed a sector vision statement which we believe captures their principle interests and goals:

To meet the energy needs of all segments of Angola’s population in the most efficient and cost-effective manner through private participation in the development of a market oriented energy sector which would promote economic development while at the same time ensuring long-term sustainability

Achieving this vision will require a commitment of resources and the political will to implement the required legal and institutional changes. In this regard, the proposed technical assistance discussed in the sections below will play a vital role in fostering and strengthening the development of the sector. One of the most important aspects of the above vision will be providing clean and affordable energy to all. This will entail several facets including:

- Promoting the design and establishment of decentralized energy service providers to establish greater access
- Designing energy services at differential prices to empower low income users to make a choice of services
- Rationalization of energy subsidies for more productive and efficient outcomes

The envisioned sector development cannot be achieved “overnight”. It will require incremental change to be successful. Accordingly, it can be viewed as occurring in three phases: the first phase (near term) comprises the rehabilitation and stabilization of the sector. This was the focus of the emergency needs assessment. The second phase (mid-term) can be characterized as a transition phase. During this phase the sector should be guided to implement and strengthen its legal and regulatory framework, establish the institutions needed to increase access to energy, and to develop a more commercial basis for the sector, which will encourage private sector participation. The third phase can be characterized as the development or growth phase. In this phase the goal will be to build out and strengthen the institutions and commercialized entities, to promote growth of the sector through private investment, and to assist in the implementation of programs to increase access to energy through private/public partnerships.

2.2 TA STRATEGIC FRAMEWORK

The TA strategy is designed around this three-phased approach and is an extension of that set out in the Emergency Report. Most importantly the framework represents a synthesis of the desires and needs of the GOA as expressed to us by key sector decision-makers during our fieldwork. The objective of this strategy is to assist the Angolan energy sector emerge from its rehabilitation phase and move forward to the second and third technical assistance phases described above, and therefore support efforts towards attaining the sector vision. The strategy builds on the four pillars identified in the emergency report.

These four strategic pillars are:

1. Strengthen the GOA's energy policy decision-making and planning framework
2. Build out the legal and regulatory framework and attendant institutional capacity for power, petroleum and natural gas
3. Strengthen the power sector ability to plan and implement an expansion program; and perform in a cost efficient and commercially viable basis
4. Develop mechanisms to improve access to energy and demonstrate how the private sector can play a role in rural energy

In addition to the above, we need to include a fifth and sixth pillar to fully reflect the long-term vision:

5. Develop programs to attract private sector participation, where it is lacking, in order to achieve sector development and growth and reduce the fiscal burden on the GOA
6. Promote the regional integration Angola into the regional energy market

We used this strategic framework to guide the development of the proposed TA programs discussed below. In other words we sought to identify those programs, which would support the operational implementation of the strategy. This helped to focused our efforts on those areas where TA would have clear benefits and away from those areas where contributions would be marginal.

Section 3 Factors Affecting The Outlook For Energy Development In Angola

The purpose of this section is to provide some insights as to the driving forces affecting the energy sector over the next ten years. It is meant to be suggestive rather than definitive as it is beyond the scope of this task to develop a comprehensive set of energy futures for Angola. The value of this assessment is that it establishes the overall context for defining the needs of the energy sector in the mid to longer term. The principal factors affecting the energy outlook will be:

- Macro-economic situation
- Government Policy
- Private Investment
- External environment

The Emergency Needs Report addressed the current problematic macro-economic situation confronting Angola. Looking out five to ten years the key question is how will the economy develop. In the broadest sense Angola has the potential to have strong diversified economy, which could create wealth and rising income levels for its population – compared to the current GDP per capita level of approximately US\$ 350. Angola is resource rich with significant petroleum, hydro, minerals and agricultural resources and has the potential to develop a manufacturing base, as was the case prior to the extended conflict. In order to materialize this potential will require a disciplined fiscal regime, a comprehensive policy package to promote economic growth, and significant private investment.

The current GAO macroeconomic policy objectives are focused entirely on the short-term. There is limited focus on longer-term development with the exception of the petroleum sector. Furthermore, the current macro-economic situation does not bode well for the mid-term growth. As discussed in the Emergency Report the GOA is currently confronting a potential fiscal crisis in terms of large deficits and heavy external borrowing by the GOA. Accordingly, this will constrain the GOA ability to spur economic growth. Approximately \$800 million has been budgeted in 2003-2004 for infrastructure rehabilitation. Of this amount approximately \$200 million is targeted for the power sector rehabilitation, however, this will not provide for the growth of the sector or improved access in rural areas.

The GOA is currently working with the IMF to establish its commitment to the IMF's staff monitored program (SMP) as a precursor to establishing a formal program with the IMF. This is the third attempt at establishing such a commitment. As part of the SMP the IMF has called on the GOA to reduce public expenditure, decrease inflation, and end general subsidies. There has been limited success to date. Establishing a formal commitment with the IMF will be a significant milestone and a prerequisite for assistance from the donor community. It will also send a positive signal to foreign investors that the GOA is committed to change; however, it unlikely that significant foreign investment will materialize until this point is reached.

From a policy perspective the GOA has taken some positive steps and laid the groundwork for development. These steps include the passage of a Law on Private Investment, Privatization Law and Electricity Law. It had also announced in 2001 a list of state companies to be privatized including the electric utilities ENE and EDEL. However, implementation of these laws will be a key test of the GOA's resolve to move forward.

Private investment into other sectors of the economy, besides the upstream petroleum segment, will be slow to materialize given the perceived high country risk and the lack of transparency on the part of the GOA for the reasons cited above. The mining sector may be an exception but here, as with the oil sector, spillover effects would be limited.

We must also be cognizant of the external environment and its impact on the Angolan economy. Angola's economy is highly dependent on oil exports. Oil and gas currently account for over 60 percent of GDP and 90 percent of exports. Accordingly, a sustained period of low prices would have a serious negative impact on the economy. In the mid-term, crude oil prices should remain reasonably stable, assuming no major supply disruptions. Longer term, of course there is more uncertainty, new supplies will be developed but at increasing marginal costs. At the same time demand for petroleum products will continue to grow particularly in Asia and in developing countries. Taken together this would imply more upward pressure on prices than the reverse.

From a development perspective, the high level of dependence on oil has important implications for developing a diversified modern economy. Most important are the negative implications of what has come to be known as the "Dutch Disease" which occurs with a large increase in resource wealth as Angola has and will be experiencing. This results in a strengthening of the currency and non-oil exports which are less competitive. While Angola does not confront this situation at present, its policy makers should be aware of it and take steps to deal with it by promoting policies which will encourage private investment and efficiency improvements in the non-oil sectors of the economy. It may also consider establishing an oil fund as Norway did to mollify the effects of the "disease".

Given the above, what then will drive economic development over the next five to ten years? Economic growth in Angola will for the most part continue to be driven by the petroleum sector. GDP growth for 2003 is estimated by the MOF to be approximately 3 percent in 2003 and 7 percent in 2004. It is probable that with the planned high levels of oil investment over the next five years that growth will average approximately 6 to 7 percent annually. However, oil sector driven growth is for the most part isolated with little spillover to the economy at large.

What are the implications for energy demand? There are two considerations. First, from a macro perspective there should be moderate incremental growth in demand as it is unlikely that overall income levels will rise significantly, given the uncertainty surrounding economic development. Second, and more importantly, demand will be supply constrained. Thus energy demand will grow in concert with the speed and the extent to which energy supplies and access are developed. As discussed above, the GOA lacks the fiscal wherewithal to accomplish this development single-handedly. Outside investment will and must play a vital role. This in turn will depend on the role of the donor community and the GOA commitment to reform the energy sector. In this

regard there is a clear and important role for technical assistance in the mid- to long term as discussed in detail below.

Section 4 Power Sector Outlook And Needs Assessment

Electricity will and must play a critical role in the future development of Angola. As discussed in the Emergency Needs Report the sector is currently focused on rehabilitation of the system which will require more than \$1 billion dollars over the next five years just to return it to the condition it was in prior to the conflict. In addition, the sector and the GOA will be confronted with many challenges:

- Only 20 percent of the population has access to electricity
- Significant non- technical losses through illegal connections
- Significant technical losses resulting in system instability and power quality problems
- Electricity tariffs are not cost recovering and highly subsidized resulting in losses for both ENE and EDEL
- Lack of system planning to focus on the longer term development of the sector
- Significant economic cost associated with the investment in standby generating capacity due to unreliability of the system
- Need to attract significant private investment for growth
- Inadequate management and commercial processes
- Need to rationalize human resource requirements
- Need for GOA to reallocate budgetary resources from the power sector to the social and public services

At the same time, there are opportunities that can be exploited for the benefit of the country. Angola has significant hydroelectric reserves that could provide the bases for power exports to the region and supplies for local access by the rural population. The above issues are not insurmountable and the opportunities await development.

Given the above, it is useful to set out a vision of how the sector could develop:

As the power sector emerges from the rehabilitation phase, there will be a renewed emphasis on long term planning and the development of a modern integrated power sector. In this regard, there will be the coordinated development of hydro and natural gas generation based on a least cost strategy which reflects national energy policy goals. The GOA will implement the Electricity Law allowing for eventual private sector participation in new generation and in both the management of ENE and EDEL. An electricity regulator will be established with the authority to issue licenses and approve tariffs and in general improve the transparency of the sector. The GOA in conjunction with the two utilities, - ENE and EDEL - will seek to improve their commercial and financial operation with the goal of creating self-sustaining and financially viable entities. In this regard the GOA, through an independent regulator, will seek to reduce all subsidies and establish economically and financially remunerative tariffs. With private sector participation and self-sustaining operations the system will expand, providing improved access

to the urban, peri-urban areas, and isolated systems . With the development of the sector Angola will become an active member in SAPP as it develops interconnections with neighboring countries and will become active in regional power trade.

The attainment of this vision lies in GOA resolve to develop and implement the appropriate policies, programs and institutions that will provide for reliable and accessible supplies of electricity and promote private investment in the system thus reducing the fiscal burden on GOA. In the following sections we examine how the sector could develop and identify the technical assistance that would support the development of this vision.

4.1 SETTING THE STAGE: POLICY AND PLANNING FOR THE SECTOR

The GOA will play a critical role in leading the development and reform of the power sector in the mid to long term. The key GOA institution will continue to be the Ministry of Energy and Water (MINEA). However MINEA will need to evolve and grow from its current structure as discussed in the Emergency Report. The principle roles envisioned for MINEA will be:

- Setting policy initiatives to drive sector reform
- Amending the legal framework for the sector as it develops
- Providing med-long term forecasts of demand and supply and maintaining a sector data base
- Lead institution in the reform and restructuring of the sector
- Economic assessments of sector issues
- Technology assessments and development of energy efficiency programs
- Coordination with other GOA institutions regarding the development of energy policy

We would envision that the roles currently held by MINEA in the area of licensing would eventually be transferred to the Regulator as discussed in Section 4.3. Thus MINEA would be structured into two divisions: Policy and Planning and Technology and Energy Management. This view of MINEA differs from the that currently held by MINEA which sees itself maintaining control over the power sector through the issuance of licenses and concessions for the sector.

Based on the above, there are several areas for TA support which would prepare MINEA for its evolving role in the sector in the mid to long term. The TA would build on the basic policy analysis and planning tools that were identified in the Emergency Response Study as part of the short term TA to be provided to MINEA. The recommended TA programs are as follows:

- Private Sector Participation in the Power Sector
- Power Sector Restructuring Strategy
- IPP Development Framework
- Energy Efficiency Program Development
- Renewable Energy Alternatives

The purpose of this TA would be to provide the MINEA staff and policy makers with the necessary analyses, international experience and recommendations needed to make informed policy decisions and lead sector reform. Each of these is described in Table 4-1.

In addition to the proposed TA, MINEA will require training to strengthen its capacity to implement the changes required. As mentioned in the Emergency Report, there are staffing issues that need to be resolved at MINEA before training and capacity building are to be implemented. These principally involve the recruitment of new staff and the possible reallocation of staff if there is a re-organization with the establishment of a regulator. We would expect that these would be resolved by the time the mid-long term training is provided. The proposed training would be as follows:

4.1.1 Power Sector Reform Workshop

This three-day workshop is designed to provide participants with a thorough understanding of the rationale, theory and principles underlying power sector reform. The workshop will review alternative approaches to power sector reform setting out the advantages and disadvantages of each. International experience in power sector reform will be discussed and lessons learned reviewed. The participants will be able to examine their own system and present their views as to an appropriate path.

Target Audience: MINEA, Ministry of Finance, ENE, and EDEL, Regulator, relevant consumer groups and NGO's

4.1.2 IPP Workshop

This one week workshop is designed to provide participants with an in-depth understanding of IPP's. The workshop will assist the GOA in the development of a consistent IPP framework that supports power sector reform. The workshop will provide an assessment and discussion of the development of IPP's and the requirements for successfully building an IPP market. It will present best practices based on international experiences, which will include detailed case studies, practical exercises and will include a discussion of key risk factors that contribute to the success or failure of these projects. There will also be a discussion of the fundamentals of IPP finance and project appraisal, closing transactions, development and negotiation of PPAs.

Target Audience: MINEA, Ministry of Finance, ENE, and EDEL, Regulator

4.1.3 Off Grid Renewable Energy (Mini-Hydro And Biomass) Development

This one week workshop is designed to enhance financial analysis capabilities of participants to provide them with the ability to evaluate off grid renewable energy projects and to select appropriate financing for mini-hydro and biomass projects. It will cover factors determining renewable energy financing structures, financing mechanisms, financing sources and requirements. The workshop will also cover how to successfully evaluate various financing structures and how to implement mini-hydro and biomass projects.

Target audience: Representatives of rural villages, farming associations, developer, bankers and GOA agencies.

Table 4-1 Mid and Long-Term Assistance Power Sector Program for MINEA

| Program | Executing Agency | Beneficiaries | Rationale and Objectives | Scope - Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|----------------------------------|------------------|---|--|--|--|--|--------------------------|
| 1. Private Sector Participation | MINEA | MINEA MoF ENE EDEL Customers | Develop framework for private sector in power <ul style="list-style-type: none"> Investment requirements Reduce GOA burden Private management will improve sector performance | <ul style="list-style-type: none"> Review GOA policies/laws Identify risks/barriers Input from private investors Assess financing alternatives Develop options and assess Develop framework Make recommendations | <ul style="list-style-type: none"> Private sector interest Investment PSP in ENE/EDEL | <ul style="list-style-type: none"> Options developed Strategy developed Report issued GOA accepts recommendations | 2005-2006 |
| 2. Sector Restructuring Strategy | MINEA | ENE EDEL Customers | Create a more competitive environment <ul style="list-style-type: none"> Need to improve efficient operations Will enhance development of resources Will improve access | <ul style="list-style-type: none"> Assess power sector performance Identify options for restructuring Assess options Discuss lessons learned from intl. experience Identify institutional \ legal\ regulatory changes required Develop recommendations Workshops to develop a consensus | Possible unbundling resulting in a more efficient competitive power sector | <ul style="list-style-type: none"> Counterpart team identified Options identified Report submitted GOA accepts recommendations | 2004-2005 |
| 3. IPP Framework | MINEA | ENE EDEL Isolated systems MoF Users | Develop a consistent framework for IPP transactions <ul style="list-style-type: none"> Need to reduce GOA involvement Need to develop internal capability | <ul style="list-style-type: none"> Assessment of role and need for IPPs Requirements for IPP entry Identify risks/barriers Financing techniques Review and discuss PPAs Review and discuss FPAs IPP procurement process Legal/regulatory changes | Clear and transparent strategy for tendering, evaluating and closing transactions | <ul style="list-style-type: none"> GOA agrees to TOR IPP role clarified Model PPA / FPAs developed Workshop Acceptance by GOA | 2004-2005 |
| 4. Energy Efficiency Program | MINEA | EDEL ENE USERS | Improve energy use <ul style="list-style-type: none"> Reduce costs Efficient use of resources | <ul style="list-style-type: none"> Current usage load patterns Identification of potential savings and cost Develop program alternatives Develop information outreach program Develop framework and agreements required Identify and develop needed legal/regulatory changes | <ul style="list-style-type: none"> Increased awareness of energy efficiency Initiation of trail programs | <ul style="list-style-type: none"> Potential savings identified Program alternatives developed Model agreements developed Utilities / MINEA agree with recommendations | 2007-2008 |
| 5. Renewable Energy Alternatives | MINEA | ENE Isolated systems Users | Diversify generation portfolio <ul style="list-style-type: none"> Improve access Potential for private development | <ul style="list-style-type: none"> Review existing program and policy Technology review Develop economic model Application survey Assessment of financing alternatives Develop program framework | Creates clear policy on use and investment in renewable technologies | <ul style="list-style-type: none"> MINEA counterpart team Identification of technologies Application programs developed MINEA incorporates results | 2005-2006 |

4.2 SYSTEM DEVELOPMENT IN THE MID-LONG TERM

The power system in Angola is currently undergoing rehabilitation to restore it to normative conditions as discussed in the Emergency Response Study. The purpose of this section is to gauge how the system may develop over the mid-long term. This in turn provides the basis for addressing TA, which would support ENE and EDEL in managing system development.

Power sector development objectives stated by MINEA during our meetings in June of 2003 included reconnecting the provincial capitals and connecting the north, central and south systems together. Rural electrification should follow the reconnection of the provincial capitols. These, in our view, are reasonable objectives for the mid-long term. We would also suggest that becoming an active member in SAPP by developing generation and transmission for export to the region should be another long-term objective.

4.2.1 Projected Load Growth

A forecast of load growth compared to plans for capacity expansion is necessary to develop a strategy for the mid to long term planning. There is little data on load growth forecasts for the different sectors of the country so it is imperative that a load study be conducted to assist in the planning for system expansion. After the load study determines the magnitude, type and location of the load increases, stability and reliability factors can be developed as determinants for the system expansion. The plans for capacity expansion in generation, transmission and distribution can be modified to fit the overall expansion plans. Accordingly, load forecast development is highly recommended as relevant mid-term TA.

The load study will determine the magnitude of the increases in base load and peak load in the geographic sections of the country. Base load will increase with an expansion of heavy industry while peak loads will increase with commercial and domestic expansions. The relative increases of base load and peak load will have an impact on the system load factor. There is also a multiplying effect with increases in manufacturing jobs as the steady production increases demand for supporting services. With the increase in jobs there is an attendant increase in commercial load to support demand created by steady employment.

It will be difficult to predict system expansion without detailed studies of load growth and a schedule of the efforts to rehabilitate the installed, but not operational, generation capacity, transmission lines and transformers. The electrical system in Angola is disjointed and undergoing repairs from damage incurred during many years of war. While a load study may predict load growth as a trend of gradual increases over time the actual increases will most likely come in discrete steps as transmission lines become reconnected or substation transformers become repaired.

Load growth in Luanda will most likely occur as a gradual increase as the electricity supply becomes more reliable and economic activity increases. In the rest of the country the increases in load growth will most likely occur in discrete steps as communities become reconnected to the system, generation is repaired and electricity supply becomes available. This will be especially true of municipalities that have distribution in place and are waiting to reconnect to the system. Municipalities that have there own thermal generation may want to shut it down to benefit from

the less expensive power generated by combined hydro and thermal generators. Discrete step increases will also be the result of new industrial loads from new facilities being built or expansion of existing factories.

4.2.2 System Expansion Possibilities

In developing the following assessment of system expansion we relied on several sources of information. MINEA issued a development strategy of the electric sector in July of 2002. The study forecasts increases in generation (GWh) and capacity (MW) coming on line for 2006, 2011 and 2016. Note that although well written, this Electric Sector Strategy suffers from a lack of data, no quantification of market demand factors, isolation from economic indices or strategies and, therefore, its projections may be unrealistic. Capacity expansion plans were also determined from information gathered during meetings while in country in June of 2003 and are presented in Emergency Response Study for generation capacity expansion and transmission line construction. The expansion plans reported from our meetings of June 2003 are a compilation of projects already in construction or tendering and did not appear to be part of an overall balanced strategy for the country.

For example, ENE has already expressed concern about reconnecting, Huambo, a former industrial center, because the generation capacity in the Central System, particularly at Biopio, will not be sufficient to support the increased load, while there is an excess of generation in the North System. In Lunda Sul, a 20 MW hydroelectric plant is being built by a private investor (Alrosa Mining) to provide 18 MW of power to the local diamond mine and 2 MW to the surrounding area. Increased economic activity supporting the diamond mine may require additional generation, which can be accommodated with careful planning.

4.2.2.1 Developing a Basis for Expansion Planning

In order to gauge how the Angolan system might grow, three cases were examined to develop a basis for recommendations for expansion planning. The three cases used the information cited above. There are several broad assumptions used in the development of these three cases, which are as follows:

- MoF estimates GDP growth in 2004 to be 7%
- MINEA estimates 7%-8% future growth in the electricity sector
- ENE estimates future growth in peak demand to be 10%
- ENE states that Luanda's peak load is 260 MW
- EDEL estimates future growth to be 10% to 12% in the initial years and leveling off

Analysis of the MINEA Report shows a load factor of 65.3% for 2001-2006; 65.2% for 2007-2011; and 64% for 2012-2016. Load growth and capacity increases for all systems were anticipated as follows:

Table 4-2 MINEA Forecast (percent change)

| Time Frame, Years | Generation, GWh | Capacity, MW |
|-------------------|-----------------|--------------|
| 2001 – 2006 | 11.14% | 11.66% |
| 2007 – 2011 | 7.4% | 7.44% |
| 2012 - 2016 | 6.57% | 6.95% |

Source: MINEA Electric Sector Strategy, July 2002

The three expansion cases are as follows:

- Case 1 assumes an initial growth in peak demand of 12% in the North System beginning in 2004 for two years, slowing to 10% growth for two years and leveling off at 8% growth in 2008. The same pattern of growth in peak demand is used for the Central and South Systems except beginning in 2007 when rehabilitation work should be complete. Isolated systems are assumed to grow in peak demand at 8%.
- Case 2 assumes annual growth in peak demand to be 10% for all systems beginning in 2004 through 2016.
- Case 3 assumes annual growth in peak to be the same as results of the analysis of the MINEA Report.

The specific assumptions that form the basis of the three cases are as follows:

- Non operational capacity, the difference between installed capacity and operational capacity shown in Table 5.3 of the Emergency Response Study, is assumed to be rehabilitated in a period of 2-4 years and is added capacity in 2006.
- Peak demand is assumed to be equal to operational capacity in 2003 except in the North where Luanda represents 75% of the country wide load with a 260 MW peak load.
- In the North System Units 1&2 (260 MW) of Capanda Dam come on line in '04.
- In the North System Units 3&4 (260 MW) of Capanda Dam are not scheduled to come on line and are not considered in any of the cases but are considered in the overall analysis.
- In the North System the Cambambe Dam will undergo long term maintenance after the first two units of Capanda Dam are on line. It is assumed that one (45 MW) of the four units at Cambambe Dam will be maintained at a time and the time to complete maintenance of all four units will take two years.
- In the Central System the fourth (14.4 MW) of four units at Biopio is being refurbished. It is assumed to be on line in 2004.
- In the South System the third (40.8 MW) of three units at Matala is being refurbished but will not go on line until Gove Dam is repaired. This is assumed to occur in 2005.
- In the South System there is a plan to add 45 MW of capacity when Gove Dam is restored. This is assumed to occur in 2005.
- Load Factor for the total of all systems is assumed to be 65% and is used for comparisons to the results of MINEA Report in 2006, 2011 and 2016.

- The cases do not take into account capacity needed to accommodate scheduled and unscheduled outages.

The results of each case study are shown in tables 4-3, 4-4, and 4-5. The base year of 2003 is shown along with years 2006, 2011 and 2016 for comparison to the MINEA Report. Other years are shown where there is a capacity deficit. Isolated systems, including Cabinda and Lunda Norte are designated as “Other”.

The conclusions which emerge from these cases are as follows:

Overall:

- Based on the peak load growth assumptions it is likely that there will be an oversupply of generation in the country, particularly in the North over the next decade.
- Deficits start to appear in Other (i.e. Isolated) Systems as early as 2009 but to determine actual impact and location of the deficit will take more detailed study.
- The deficit in the North System does not exceed the capacity of Units 3&4 at Capanda until after 2016 for all cases.
- Conclusions about capacity for the whole country can only be finalized after the impact of connecting all systems, including isolated systems, and determining if the transmission line capacity is sufficient for excess capacity to feed load in other parts of the country.
- Results of cases 1&3 compare favorably with the results of the MINEA Report. Case 2 with a sustained 10% growth in peak load over the next 13 years is the most aggressive case.

Specific Conclusions From Each Case Assessment:

Case 1:

- There is sufficient capacity in the North System until 2014.
- There is sufficient capacity in the country until 2015, with the exception of the isolated systems

Case 2:

- There is sufficient capacity in the North System until 2013.
- There is sufficient capacity in the country until 2014, with the exception of the isolated systems

Case 3:

- There is sufficient capacity in the North System until 2015.
- There is sufficient capacity in the country until 2016, with the exception of the isolated systems

Table 4-3 Case 1: Annual Growth in Peak, Growth at 12%, 10%, 8%

| | 2003 | 2006 | 2011 | 2013 | 2014 | 2016 |
|------------------------|------|------|------|------|------|-------|
| North | | | | | | |
| Installed Capacity, MW | 358 | 643 | 643 | 643 | 643 | 643 |
| Peak Load, MW | 260 | 359 | 537 | 626 | 676 | 789 |
| Excess (Deficit), MW | 98 | 284 | 106 | 17 | (33) | (146) |
| Central | | | | | | |
| Installed Capacity, MW | 37 | 121 | 121 | 121 | 121 | 121 |
| Peak Load, MW | 37 | 47 | 76 | 91 | 98 | 114 |
| Excess (Deficit), MW | 0 | 75 | 45 | 31 | 23 | 7 |
| South | | | | | | |
| Installed Capacity, MW | 27 | 158 | 158 | 158 | 158 | 158 |
| Peak Load, MW | 27 | 34 | 56 | 65 | 70 | 82 |
| Excess (Deficit), MW | 0 | 124 | 102 | 93 | 88 | 76 |
| Other | | | | | | |
| Installed Capacity, MW | 28 | 48 | 48 | 48 | 48 | 48 |
| Peak Load, MW | 28 | 35 | 52 | 60 | 65 | 76 |
| Excess (Deficit), MW | 0 | 13 | (4) | (12) | (17) | (28) |
| Total | | | | | | |
| Installed Capacity, MW | 450 | 970 | 970 | 970 | 970 | 970 |
| Peak Load, MW | 352 | 475 | 721 | 842 | 910 | 1061 |
| Excess (Deficit), MW | 98 | 496 | 249 | 128 | 60 | (90) |
| Energy, GWh @65% LF | 2004 | 2703 | 4105 | 4797 | 5181 | 6043 |
| MINEA Projection | | 2804 | 4007 | | | 5506 |

Source: Nexant estimates

Table 4-4 Case 2: Annual Growth in Peak, Growth at 10%

| | 2003 | 2006 | 2011 | 2013 | 2014 | 2016 |
|------------------------|------|------|------|------|------|-------|
| North | | | | | | |
| Installed Capacity, MW | 358 | 643 | 643 | 643 | 643 | 643 |
| Peak Load, MW | 260 | 346 | 557 | 674 | 742 | 898 |
| Excess (Deficit), MW | 98 | 297 | 86 | (31) | (99) | (255) |
| Central | | | | | | |
| Installed Capacity, MW | 37 | 121 | 121 | 121 | 121 | 121 |
| Peak Load, MW | 37 | 49 | 79 | 96 | 106 | 128 |
| Excess (Deficit), MW | 0 | 72 | 42 | 25 | 16 | (6) |
| South | | | | | | |
| Installed Capacity, MW | 27 | 158 | 158 | 158 | 158 | 158 |
| Peak Load, MW | 27 | 36 | 58 | 70 | 77 | 93 |
| Excess (Deficit), MW | 0 | 122 | 100 | 88 | 81 | 65 |
| Other | | | | | | |
| Installed Capacity, MW | 28 | 48 | 48 | 48 | 48 | 48 |
| Peak Load, MW | 28 | 37 | 60 | 73 | 80 | 97 |
| Excess (Deficit), MW | 0 | 11 | (12) | (25) | (32) | (49) |
| Total | | | | | | |
| Installed Capacity, MW | 450 | 970 | 970 | 970 | 970 | 970 |
| Peak Load, MW | 352 | 469 | 755 | 913 | 1004 | 1215 |
| Excess (Deficit), MW | 98 | 502 | 216 | 57 | (34) | (245) |
| Energy, GWh @65% LF | 2004 | 2668 | 4296 | 5199 | 5718 | 6919 |
| MINEA Projection | | 2804 | 4006 | | | 5506 |

Source: Nexant estimates

Table 4-5 Case 3: Annual Growth in Peak, Growth at 11.6%, 7.4%, 6.9%

| | 2003 | 2006 | 2011 | 2013 | 2014 | 2016 |
|------------------------|------|------|------|------|------|------|
| North | | | | | | |
| Installed Capacity, MW | 358 | 643 | 643 | 643 | 643 | 643 |
| Peak Load, MW | 260 | 362 | 518 | 593 | 634 | 725 |
| Excess (Deficit), MW | 98 | 281 | 125 | 50 | 9 | (82) |
| Central | | | | | | |
| Installed Capacity, MW | 37 | 121 | 121 | 121 | 121 | 121 |
| Peak Load, MW | 37 | 52 | 74 | 84 | 90 | 103 |
| Excess (Deficit), MW | 0 | 70 | 48 | 37 | 31 | 18 |
| South | | | | | | |
| Installed Capacity, MW | 27 | 158 | 158 | 158 | 158 | 158 |
| Peak Load, MW | 27 | 38 | 54 | 62 | 66 | 75 |
| Excess (Deficit), MW | 0 | 120 | 104 | 96 | 92 | 83 |
| Other | | | | | | |
| Installed Capacity, MW | 28 | 48 | 48 | 48 | 48 | 48 |
| Peak Load, MW | 28 | 39 | 56 | 64 | 68 | 78 |
| Excess (Deficit), MW | 0 | 9 | (8) | (16) | (20) | (30) |
| Total | | | | | | |
| Installed Capacity, MW | 450 | 970 | 970 | 970 | 970 | 970 |
| Peak Load, MW | 352 | 490 | 701 | 802 | 858 | 981 |
| Excess (Deficit), MW | 98 | 480 | 269 | 168 | 112 | (11) |
| Energy, GWh @65% LF | 2004 | 2790 | 3994 | 4568 | 4886 | 5588 |
| MINEA Projection | | 2804 | 4006 | | | 5506 |

Source: Nexant estimates

4.2.3 System Development Mid-Term to Long Term

4.2.3.1 Building an Integrated System

The Emergency Response Study focused on rehabilitation and repairs of installed generation and transmission. There will be an excess of generation capacity after Units 1&2 of Capanda Dam come on line in 2004. Repairs to transmission lines, as well as completion of new transmission lines planned for supplying Luanda will greatly improve the reliability of the system, particularly in the North.

Planning for the development of an integrated system should commence in the mid-term so that the first steps toward the overall system can begin when the rehabilitation program is coming to a close. Integral to this planning is a detailed load forecast, a stability study and a reliability study. The results of these studies are necessary as a foundation for the plans to connect the North System to the Central and South Systems as well as connect the Isolated Systems and the provincial capitols.

4.2.3.2 ENE Study of Transmission Line Alternatives

During our meetings of June 2003 ENE provided information that showed alternative transmission line routings that would connect the North System to the Central and South Systems at 220 kV. It also provided plans for providing power to all of the provincial capitols but not

necessarily by interconnection to the integrated system. There was no analyses provided that supported the selection alternative transmission line routings. The following table identifies the routings being studied.

Table 4-6 Transmission Line Routings Under Study

| | | | | |
|-----------------------|-----------|-----------------------|-----------------|-----------------------|
| North System | to | Central System | to | Central System |
| Capanda | 220kV | Huambo | | |
| Capanda | 220kV | Gabela | 220kV | Lomaum |
| | | Gabela | 220kV | Quileva |
| | | Gabela | 220kV | Biopio |
| | | | | |
| Central System | | South System | | |
| Huambo | 220kV | Matala | | |
| Lomaum | 220kV | Matala, Lubango | | |
| Biopio | 220kV | Matala, Lubango | | |
| Quileva | 220kV | Lubango | | |
| | | | | |
| Lunda Norte | 150kV | Lunda Sul | 150kV | Moxico |
| | | | | |
| South System | 60kV | Ondjiva | 30kV (existing) | Namibia Border |

Source: ENE

The system that would result if these transmission line alternatives were built would integrate the North, Central and South Systems. It would expand the Norte System through the connection to Lunda Sul and Moxico. However this would remain an isolated system. Three provinces would remain isolated, Kuando Kubango, Zaire and Cabinda. However, Cabinda is geographically isolated and has installed generation capacity developed by the IOCs.

There does not appear to be any plan, at this time, to extend transmission to the border of the Democratic Republic of the Congo (DRC) or to strengthen the ties at the border of Namibia.

The definitive selection of the transmission line routings and the interconnection plan could be resolved when the results of the proposed load, stability study and reliability study are completed. The cases that would be investigated will determine the size of the line, optimum connection, and alternatives for generation outages or line outages.

4.2.3.3 Building for Export and Interconnecting with Southern Africa Power Pool

The Emergency Response Study identified a future long term plan for the “Western Corridor Project” a 3000 MW line from Inga in the Democratic Republic of the Congo. This line may be a 765kV AC line or a high voltage DC line to supply power to South Africa through Namibia. This project has been under consideration for some time by SAPP but little has been done to date.

Within the next ten years there is significant potential for building generation capacity for export. As stated before there is an oversupply of generation capacity in the North System, especially when Units 3&4 of the Capanda Dam come on line. Depending on the results of the load study

this generation capacity could be used as reserve on the system to cover scheduled and unscheduled outages or, if there is sufficient other reserve, could be considered for export. Furthermore, there is approximately 16 thousand MW of hydro potential that awaits development.

There is no tie in the transmission system at the border with Zambia or the Democratic Republic of the Congo, nor are there plans to build a tie at present. There is a tie to Namibia at Ondjina in Cunene Province; however, this is a small point to point connection.

Plans to build for export to the Southern Africa Power Pool should consider the following actions:

- Study transmission ties to the DRC to utilize the DRC capacity there
- Study strengthening transmission ties with Namibia in the South
- Study the potential for increasing generation capacity in the South
- Determine the priority, configuration and cost of transmission lines from north to south to facilitate export of power through Namibia and make use of the generation potential of the north.
- Determine the interconnection capabilities on the other side of the Namibia and DRC borders.
- Determine the appropriate contracting and pricing schemes

4.2.4 Proposed Technical Assistance and Training

System growth and integration will severely test the technical capabilities of both ENE and EDEL as well as MINEA. Accordingly, there will be a clear and important need for technical assistance. The following TA Programs are recommended:

4.2.4.1 Load Forecasting and System Expansion Plan

The System Expansion Plan would include load forecast development and encompass studies to assess future load growth, load factor and apply stability and reliability criteria. The System Expansion Plan would also incorporate the goals of the rehabilitation plans, and take into account mid to long term goals such as system integration and generation for export. The expansion of the system would also assess the establishment of a system operator which would include dispatch.

4.2.4.2 Export to the Southern Africa Power Pool (SAPP)

The third component is to provide technical support for cross border trade supporting the plan to export power to SAPP. Much of this support will be for ENE and its participation in SAPP.

The scope for the third component of the technical assistance would include:

- Investigation of the infrastructure at the cross border connections,
- Development of technical specifications,

- Establishment of applicable codes and standards
- Development of the technical aspects of the agreements necessary to export power such as power purchase, wheeling, imbalance and implementation.
- Support in the assessment of the “Western Corridor Project”
- Development of appropriate pricing and contracting mechanisms

Table 4-7 sets out the proposed technical assistance program.

Training would also be provided to ENE, EDEL and MINEA staff to insure that the tools used in the development of the system planning would become an integral part of the planning process. The following training is recommended:

4.2.4.3 Load Forecasting Tools and Techniques

This one week course would present and review the latest tools and techniques used by utilities and governments in forecasting load. The course would review basic concepts and theories. It would the review the tools available and their application. Case studies would be reviewed and discussed. There would be hands-on application using sample data.

Target audience: ENE, EDEL and MINEA staff

4.2.4.4 System Planning Workshop

This one week course would present and review the latest tools and techniques used by utilities and governments in system planning. The course would review basic concepts and theories. It would the review the tools available and their application. Case studies would be reviewed and discussed. There would be hands-on application using sample data.

Target audience: ENE, EDEL and MINEA staff

Table 4.7: Mid-Long Term Technical Assistance Program: Power Sector System Development

| Program | Executing Agency | Beneficiaries | Rational And Objectives | Scope - Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|--|------------------|--|---|--|---|---|--------------------------|
| 1. Load Forecasts | ENE EDEL | ENE EDEL | Provide tools to conduct load forecasting <ul style="list-style-type: none"> Lack of forecasting tools Required for resource planning Required for tariff design | <ul style="list-style-type: none"> Define customer classes Model selection Model installation Data collection Define and develop cases Evaluate results Present findings Workshops | <ul style="list-style-type: none"> Detailed load forecast for mid and long term ENE/EDEL capacity to perform load forecasts | <ul style="list-style-type: none"> Buy in from EDEL/ENE Model selection Model installation Forecasts completed Acceptance by ENE/EDEL | 2004-2005 |
| 2. System Expansion Plan | ENE | MINEA ENE EDEL Municipalities | Provide country wide plan for system integration and expansion <ul style="list-style-type: none"> Expand system to support system stability, load growth and reliability | <ul style="list-style-type: none"> Criteria for performing expansion plan Model selection Data collection Define alternative scenarios Develop least cost generation plan Develop transmission plan Recommendations | <ul style="list-style-type: none"> Logical sequence and schedule of work Optimize system expansion .Expansion to meet national priorities Expansion to meet load growth with a stable and reliable system | <ul style="list-style-type: none"> Schedule consistent with priority criteria, Generation plan Optimal transmission line and substation planning Transmission system plan supports system stability, load growth, and reliability | 2004-2005 |
| 3. Technical Assistance to develop and tender design and construction contracts to execute System Expansion Plan | ENE | ENE EDEL Municipalities Provinces not served by ENE | Provide assistance for executing the building of capacity called for in System Expansion Plan | <ul style="list-style-type: none"> Develop tech specs and tender documents for design and construction of generation, transmission and dist, capacity and for a National Dispatch Center | <ul style="list-style-type: none"> Bids in response to tenders Contractors to perform work Construction of new capacity | <ul style="list-style-type: none"> Schedule consistent with priority criteria Transparent tendering process Competitive bids to select contractors New capacity constructed to specifications | 2006-2010 |
| 4. Export to Southern Africa Power Pool | ENE | ENE MINEA Customers | <ul style="list-style-type: none"> Export hydro resource in form of electricity Cross border trade | <ul style="list-style-type: none"> Develop interconnection plan Develop tech specs and contract docs to support export | <ul style="list-style-type: none"> Build capacity to export power Cross border agreements to compensate for exported power | <ul style="list-style-type: none"> Technical specifications sufficient to build capacity Agreements to facilitate export of power | 2007-2012 |

4.3 SECTOR STRUCTURE AND PRIVATE SECTOR PARTICIPATION

As discussed in the Emergency Response Study the power sector is currently dominated by the two state owned enterprises – ENE and EDEL. Both operate as monopolies although neither has an exclusive franchise under the electricity law. Both utilities are incurring losses and will need significant capital infusions just to normalize the systems. Based on the assessment in the previous section, while additional capacity will be needed there could be a surplus of supply over the next ten years. The critical issue going forward is what is the most appropriate reform strategy for the sector and what role should the private sector play in this reform. The purpose here is not to answer this question, which is beyond the scope of this report, but rather to identify relevant considerations and the TA which would support the design and implementation of any such reform program.

4.3.1 Potential Reform of the Sector

As the emergency rehabilitation programs are completed and the system returns to a normal state of operation, there will be a growing imperative to shift from short-term to longer-term decision-making in order to set the path for long-term development and growth. The goal should be to provide world-class electricity service to the citizens of Angola. This will require utilities' whose managements' aspire to develop world-class utility companies consistent with the sector vision set out earlier in this section. Obviously this cannot be accomplished overnight and will require a well-developed reform program. What should be the key considerations of such a program? At a minimum, the following must form the basic building blocks of a reform program:

- Commercially viable utilities whose services are provided in the most efficient manner
- Senior management capacity and skill to achieve world class performance
- Longer-term creating a competitive environment

One of the most important considerations must be to insure that both ENE and EDEL operate in a commercial manner reflecting best practices in utility management. This has several dimensions. First and foremost there must be rationalization of electricity pricing to reflect cost of service and a reasonable return. Second, building on the recommendations of the Emergency Response Study, the revenue enhancement programs involving metering, billing, and collection programs should move to the implementation stage. Third, there must be a review and assessment of the operational and financial management procedures. This would include plant operation and maintenance, procurement as well as treasury, capital budgeting, financial and accounting functions. Finally, the mechanisms for contracting should be upgraded to reflect the potential for private sector participation. All of this presumes that some action will have been taken with respect to the organizational and staffing issues and recommendations made in the KPMG study commissioned by ENE. A similar effort should be conducted for EDEL.

Senior management has a critical role to play in the reform program. Accordingly, it is vital that they possess the appropriate skills and exposure to best practices. There are two dimensions to this consideration. First, how can we improve the capacity of current management? Here the obvious answer would be through relevant training. More significantly is the second dimension – whether there is a need for outside management to take on a discrete role in managing these

companies under some form of management services contract. This alternative would provide the benefits of outside experience and specific performance targets. It would also give existing management exposure to international best practices through on the job training.

Lastly, consideration must be given to the potential for creating a competitive environment. What is the most appropriate way to insure the sector operates in the most efficient manner? This will entail several steps. First, consideration should be given to allowing the entry of private generation. Second, both ENE, and EDEL can take steps to establish to separate accounting for the functional areas of generation, transmission and distribution to enhance transparency and to set the stage for full functional unbundling in the long term, if deemed appropriate. Third, interconnecting with SAPP would provide for longer term potential benefits of regional competition. In order to accomplish this a strategy should be developed which sets out the necessary steps and associated costs of achieving a more competitive environment.

4.3.2 Creating a Role for the Private Sector

The Emergency Response Study indicated that currently the potential for private sector participation (PSP) in the power sector is minimal. The Study recommended that the most viable near term option for PSP would be in the form of management contracts. However, if the proposed sector vision is to be attained, the private sector must play a larger role. There are a number of possible options, which include:

- **IPP Development**- this presents a clear role for the private sector in terms of developing the generation resources in the country and reducing the investment from ENE. It would also set the stage for competition.
- **Leasing Agreements** - ENE and/or EDEL would continue to be responsible for carrying out most major investments however the assets are leased to a third party. The lessee would be responsible for managing costs and revenues. The lessee would also have full responsibility for managing profits as well as long-term maintenance of the leased assets. The advantage of lease arrangements are that they introduce private sector managers, who are subject to penalties and incentives built into the lease, in order to improve operational performance of the utility.
- **BOT or Concession with Capital Expenditure Commitment** – A project company is typically created with responsibility for a specific project’s capital investment, operating and maintenance costs, revenues, and profits. Its corporate aim is to be profitable over the concession period. Ownership would revert back to ENE and/or EDEL at the end of the concession period.
- **Public Private Partnership or Joint Stock Company** - A joint stock company is typically created with responsibilities for all investments, costs, revenues, and profits. ENE and/or EDEL would become shareholders in the joint venture with asset management responsibilities. They would also receive a stream of dividends in profitable years.
- **Divestiture or Privatization** – ENE and/or EDEL would be offered for competitive sale, probably with an initial share offering representing 51 percent of the outstanding shares of these companies, followed by share increases over time matching paid in capital as

new investments are required. All investments, financing, operations and maintenance would be carried out by the newly privatized company with tariff regulation and oversight by an independent regulator.

Given the above options, the table below sets out possible forms of PSP in the power sector over the mid to long term. These options build on those recommended for the near term Emergency Response Study.

Table 4- 8 Suggested PSP Options for the Mid-Long term

| Time Horizon for Implementation | Urban and Grid Connected Areas | Provincial and Municipal Towns | Peri-Urban and Off Grid Load Centers |
|---------------------------------|--|--|--|
| Mid-Term (Years 3 – 5) | Convert the Four ENE Administrative Services Contracts to Full Management Operations Contracts; OR Consider Concession for ENE, EDEL | Advertise and Select Investors/Operators for Participation in Public Private Partnerships with ENE in Selected Provincial Capitals | Continue to Develop and Formalize Licenses for Small Off Grid Electricity Providers |
| | Make Available Selected Hydro and Thermal Power Plant Site Opportunities on a BOO/BOT Basis through Competitive Tenders | | |
| Long-Term (Years 5 – 10) | Continue to Operate Both ENE and EDEL under Full Management Operations Contracts to Restore Overall Financial Viability | Continue to Expand Public Private Partnerships into Additional Provincial Capitals and also Municipal Towns | Merge Adjacent Small Electricity Providers into Existing Public Private Partnerships |
| | Begin the Process of Restructuring the Electricity Sector by Unbundling Generation, Transmission, and Distribution | | |
| Longer-Term (Beyond Year 10) | Consider Divestiture of the Government's Generation and Distribution Assets | | |

4.3.3 Proposed TA and Training

The development of the power sector will be at a critical juncture as it emerges from its near term rehabilitation stage. Accordingly, the judicious provision of technical support for sector reform can provide the guidance needed to assist the sector in achieving the long-term vision. Based on our above assessment, the following TA is recommended:

- Power Sector Restructuring Strategy
- Commercialization Assistance
- Pricing and Tariff Study
- IPP Framework
- PSP study

Table 4-9 sets the recommended TA program for a power sector reform program. Some elements of the program, notably the IPP Framework, the PSP study and the Power Sector Restructuring Strategy were set out in Table 4-1.

As discussed in the previous sections, there is a great need for technical skill in the electric sector that is largely unmet. This current need will also be a mid to long-term need as well. While some

training assistance may be of value in meeting this need, the need can only be met in a sustained way by rehabilitating the educational system in Angola, especially the secondary and university programs. There has been some small progress in these areas, but much more will be needed. It is unlikely that much assistance can be offered in this area until more progress is made.

Assistance can be offered at the university level by assisting the engineering and technical departments in strengthening their programs. This will depend on how the educational sector is rehabilitated.

The two major utilities in Angola are presently occupied with the rehabilitation of their physical plant. The electric sector strategy is based on rehabilitation, consolidation and strengthening performance, and then expansion. This will take time, money and manpower. The electric sector has started on this road and is making progress. However, the source of money for this program is the government. It is unlikely, in light of the social and other infrastructure needs of Angola, that the government will be able to fund all that is planned and the sector will have to turn to other sources of financing. This will mean that the utilities will have to devote more time and resources on the financial issues in their companies in order to qualify for these loans. Assistance can be provided when this need arises in the future and the following training courses are offered based on this mid to long term need.

4.3.3.1 Strategic Investment And Utility Planning

A one-week workshop designed to introduce participants to evaluate policy options and programs that will cover all the utility long-term needs at minimum cost. The workshop will cover utility corporate planning, including assessment of options to ensure a competitive market, role of private sector and that of governmental and regulatory entities, options to incorporate public policy and encouraging energy efficiency and renewable energy.

Target audience: Mid to senior level representatives from ENE and EDEL planning departments.

4.3.3.2 Accounting And Financial Management Of A Utility Company

A one-week workshop designed to equip participants with the skills to help them efficiently manage the financial and accounting aspects of a utility company. The objective of the workshop will be to assist the participants in the modernization of utility accounting systems, help interface utility accounting with the new regulatory body, rating agencies and commercial lenders and to improve financial management systems based on international practices and creation of effective management information systems for effective implementation of these changes.

Target audience: Mid to senior level representatives from ENE and EDEL accounting and financial departments.

Table 4- 9 Mid and Long-Term Assistance Program for Power Sector Reform

| Program | Executing Agency | Beneficiaries | Rational And Objectives | Scope - Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|---|------------------|--|---|--|--|---|--------------------------|
| 1. Pricing and Tariff Study | MINEA | ENE EDEL MoF Private developers | Cost reflective pricing <ul style="list-style-type: none"> ▪ Improve financial performance ▪ Reduce need for subsidies ▪ Improve efficiency ▪ Requirement for psp | <ul style="list-style-type: none"> ▪ Develop LR marginal cost for ENE ▪ Conduct cost of service study – ENE/EDEL ▪ Review financial requirements ▪ Develop revenue requirements ▪ Develop tariff design ▪ Calculate tariffs ▪ Make recommendations | Cost based tariffs adopted | <ul style="list-style-type: none"> ▪ Buy in by ENE /EDEL ▪ Cost of service / Revenue requirements ▪ Tariffs developed ▪ Accepted by GOA | 2005-2006 |
| 2. Commercialization Assistance | ENE EDEL | ENE EDEL Users | Improve performance of ENE and EDEL <ul style="list-style-type: none"> ▪ Reduce losses ▪ Improve service ▪ Reduce costs ▪ Important for PSP | <ul style="list-style-type: none"> ▪ Review of ENE/EDEL operations- diagnostic ▪ Identify target areas for improvement ▪ Process/reengineering assessment ▪ Identify best practices ▪ Review with Senior management and agree ▪ Implementation of practices and systems ▪ Management/employee Workshops | Adoption of best practices resulting in improved profitability | <ul style="list-style-type: none"> ▪ Buy in by EDEL and ENE ▪ Creation of counterpart teams ▪ Target areas identified ▪ Best practices identified ▪ Recommendations accepted ▪ Installation completed | 2005-2007 |
| 3. PSP Options (See Table 4.1) | | | | | | | |
| 4. IPP Framework- (See Table 4.1) | | | | | | | |

4.4 REGULATION

With the proposed changes in the power sector discussed above and the anticipated increasing role for the private sector, it will be necessary to establish a regulatory entity. This will be a pre-condition for any significant involvement by the private sector. As discussed in the Emergency Response Study the legal basis for the regulator currently exists; however, it remains to be implemented, principally because of the GOA focus on near term rehabilitation. In our discussions with MINEA the importance of the establishing a regulator was recognized; however, the regulator's autonomy and its role were areas where clarification and resolution will be needed. As a result, in the Emergency Study we proposed TA which would develop a regulatory roadmap for MINEA thereby providing a means to move forward. The TA proposed in this section would build on this roadmap through implementation.

4.4.1 Creation of the Regulator

The most significant mid term need will be to establish the National Regulatory Commission (NRC) for the sector. The rationale for this need is that an independent and autonomous body will be a requirement for effective oversight of the enterprises providing essential services (electricity, gas or water) or exhibiting significant market power. A fully functioning, independent, effective and accountable regulatory agency is needed for the mutual benefit of the sector participants, consumers, investors and government. The regulatory commission should have the following characteristics:

- **Autonomy** (Appointed Commissioners; Competitive Salary Scales; Imposition of Licensing Fees and High Level Government Budget Approval; Removal from Office Only for Cause)
- **Authority** (Tariff Setting; License Issuance; Electricity Market Reform and Oversight; Performance Monitoring and Enforcement)
- **Accountability** (Public Participation and Transparency; Annual Report/Audit; Appeals to Courts; Budget Review; Code of Ethics; Removal from Office for Cause Only)

The effort anticipated for implementing the NRC for the electricity sector will be significant and should strive to achieve the characteristics noted above. Many important resources, including the human resources, that are crucial for implementation are lacking in the country. This deficit is compounded when it is also recognized that the NRC will be the first of its kind for overseeing a public enterprise. Accordingly, a multi-stepped process is envisioned. This would involve the following:

- Resolution of the relationship of the NRC to MINEA and possible amendments to the electricity law
- Development of staffing specifications, identification of personnel and staffing
- Development of criteria for commissioners
- Appointment of Commissioners
- Development of operational and management procedures
- Develop procedures for administrative hearings

- Development of appropriate funding and penalty mechanisms

4.4.2 Scope of Regulation

Creating the regulator will be a necessary but not sufficient condition for sector oversight. The NRC must be given the appropriate authority. Accordingly, it will also be important to clarify and define the scope of regulation for the NRC. Currently, the view held by the GOA is that the regulator would be more of an advisory board with limited decision-making authority. Under the present law the regulator has no tariff setting or licensing authority. In order for the power sector to develop and attract private sector investment as envisioned it is important that the NRC be vested with the appropriate authority to review and approve tariffs and to issue licenses. As the sector evolves and the role of the private sector grows the NRC should also be responsible for overseeing the performance of the management contracts and any concessions. In this regard the NRC would also be responsible for reviewing the capital investment plans and of both ENE and EDEL or its successors. The NRC, at this stage, will also need to define and establish a review or hearing process, which provides adequate protection for stakeholders and also provides for public participation. The development of the NRC's scope and authority will require agreement by the GOA and amendments to the electricity law. Once this has been accomplished, it will be necessary for the NRC to accomplish the following:

- Draft implementing regulations
- Develop tariff policies and procedures
- Develop licenses and licensing procedures
- Develop customer service procedures
- Develop quality of service requirements

4.4.3 Proposed TA and Training

Broad based technical assistance for the development of initial competencies for all aspects of the newly formed commission will be required. The scope of the TA should include assistance with tariff setting, internal rules, staff selection and training, appointing commissioners, code of ethics, license development and market rules development. Table 4- 10 sets out the envisioned TA regulatory program.

Training will be vital part of establishing an effective regulator. Set out below is the recommended initial round of training which would be required for the NRC

Table 4-10 Mid and Long-Term Assistance Program – Power Sector Regulation

| Program | Executing Agency | Beneficiaries | Rational And Objectives | Scope - Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|------------------------------|------------------|---|---|--|-----------------------------------|---|--------------------------|
| 1. Organizational Assistance | MINEA Regulator | Consumers ENE/EDEL Private investors | Implement Regulatory Entity <ul style="list-style-type: none"> ▪ Lack of in-country capacity Required for sector development ▪ Effective transparent oversight required | <ul style="list-style-type: none"> ▪ Clarify role and responsibilities ▪ Develop legal amendments if needed ▪ Develop organization plan ▪ Develop code of ethics ▪ Develop operational procedures ▪ Develop staffing criteria ▪ Selection of staff ▪ Operating plan and budget ▪ MI system design | Competent independent regulator | <ul style="list-style-type: none"> ▪ Buy in from MINEA ▪ Functioning Regulator: <ul style="list-style-type: none"> ▪ Autonomous ▪ Authority ▪ Accountable | 2004-2006 |
| 2. Regulation | MINEA Regulator | Consumers ENE/EDEL Private investors GOA | Develop implementing regulations <ul style="list-style-type: none"> ▪ -Required for sector development | <ul style="list-style-type: none"> ▪ Module 1- tariff methodologies and regulation ▪ Module 2- licensing design and issuance and regulations ▪ Module 3- Market reform and oversight ▪ Module 4 – Performance monitoring and regulations | Transparent procedures | Buy -in from MINEA and MoF | 2005-2007 |
| 3. Regulatory Support | Regulator | Regulator ENE/EDEL Consumers | Insure regulator fulfills its mandate <ul style="list-style-type: none"> ▪ Lack of in-country capacity | <ul style="list-style-type: none"> ▪ Ongoing assistance to support local staff in the implementation or the regulations | Effective, transparent regulation | <ul style="list-style-type: none"> ▪ Successful application of regulations ▪ Refined regulations | 2006-2008 |

4.4.3.1 Power Sector Regulation

A one-week workshop on understanding how an independent and technically competent regulatory agency oversees all aspects of the power sector and why it is essential for promoting effective competition and protection of all consumers. The training will introduce key decision makers to the elements of electricity regulation processes and procedures including the role of the regulatory agency, the need for financial independence, organizational and operational requirements, rate making and regulatory procedures.

Target Audience: Mid to senior level representatives from the ministry of water and power and staff of the regulatory agency.

4.4.3.2 Regulatory Accounting

This course covers basic accounting requirements for utilities, including the important differences between standard accounting and regulatory accounting. Topics include accounting for regulated assets and timing differences between standard accounting and regulatory accounting. Differentiating between capital and operating costs and test year basis accounting will also be covered.

Target Audience: Mid to senior level representatives from the ministry of water and power and staff of the regulatory agency.

4.4.3.3 Granting And Regulating Concessions

This course covers the issues relating to the granting of concessions. Topics include concession fees, time span of concession agreements, what to include in concessions, what to exclude from concessions, the relationships between the concession and other regulatory rules and regulations, quality of service and expansion of service (universal service) principles.

Target Audience: Mid to senior level representatives from the ministry of water and power and staff of the regulatory agency.

4.4.3.4 Revenue Requirements, Cost Allocation And Electric Rate Design

An intensive course covering the components of a utilities revenue requirements including return on investment, operation and maintenance expenses, functional cost allocation, customer class cost allocation, tariff design, test year concepts, inflation, annualization, normalization, out-of-period and other types of adjustments to test year data and cost of capital principles. Several exercises applying the principles taught will be used to verify that participants understand the concepts and can apply them in a practical way.

Section 5 Petroleum Sector Development And Technical Needs

The petroleum sector will continue to be the lynchpin of development not only for the energy sector but for the Angolan economy as well. There is already significant private sector participation in the sector and Angola's long term development hinges on the rational development and use of the revenues from the sector. A possible vision of the sector is one *where the GOA promotes the efficient development of its hydrocarbon resources in a transparent manner becoming a significant supplier of crude oil supplies to the world market. The Ministry of Petroleum is given a broader mandate not only for policy but also for resource management. Sonangols charter becomes focused on upstream and downstream development. The GOA promotes the efficient development of the downstream petroleum sector by pricing of petroleum products to reflect market conditions and eventually eliminating subsidies. There is greater private sector participation in refining and distribution which will promote competition and improve development and access to supplies.*

The sections below discuss the factors and issues which will affect the attainment of such a vision.

5.1 SECTOR OUTLOOK (UPSTREAM)

In the coming five to ten years, the outlook for the oil sector will continue to be dominated by upstream activities where a substantial amount of foreign investments are expected to take place. The downstream segment should record increasing distribution/marketing activities with active private sector involvement, provided that adequate mechanisms are put in place by the government for this happen. The present subsection focuses on the upstream segment, which is the vital segment of Angola's hydrocarbon industry, and is followed by a subsection on the downstream element.

Angola's present proven and probable crude oil reserves are estimated at 11 billion barrels with just over 5 billion barrels of proven reserves. Recent ultra-deep water discoveries, which are not included in these estimates, will expand the country's crude oil reserve base. But, it is not fully known at this stage by how much the reserve base will increase. Substantial investments, estimated at \$22 billion, will be required between 2003 and 2007 to develop deepwater reserves. As shown in Table 5-1, 64% of the total capital expenditures are expected to be allocated to the development of Block 15 operated by ExxonMobil.

Table 5-1 Estimated Required Investments 2003-2007

| Deepwater Developments | Operator (Interest share) | Partners (Interest share) | Required Investment (US\$ billion) |
|------------------------|---------------------------|--|------------------------------------|
| Block 15 | ExxonMobil (40%) | BP (26.6%), Eni (20%), Statoil (13.3%) | 14 |
| Block 17 | Total (40%) | ExxonMobil (20%), BP (16.6%), Statoil (13.3%), Norsk Hydro (10%) | 5 |
| Block 18 | BP (50%) | Shell (50%) | 3 |

Source: Oil & Gas Journal, 2003

In addition to these water developments, \$3.5 billion are also planned to be invested between 2003 and 2007 in currently producing areas in Blocks 0, 2, 3 and 14. Over 70% of this total investment will be in Block 0 and Block 14 operated by ChevronTexaco.

According to the Ministry of Petroleum, crude oil production in 2003 will average 940,000 barrels per day (bpd). Next year, in 2004, a production level of 1 million bpd, or more, is expected to be easily reached. This will be followed by a projected production of 1.5 million bpd in 2005. With the development of deep and ultra-deep water discoveries, the country's production capacity could reach the 2 million bpd mark by 2007-08. Analysts believe that by 2010, Angola's production capacity could exceed 2.5 million bpd.¹ However, without a significant expansion of the reserve base, there are concerns about the long-term sustainability of such production levels. As a result of this, a resource conservation policy has been put in place by the government aiming at phasing the development of hydrocarbon resources.

Angola's upstream sector, which is presently dominated by ChevronTexaco and France's Total, will in the second part of this decade see the emergence of other international companies, namely ExxonMobil, BP, Shell and the Norway's Statoil and Norsk Hydro. Thus, in the next five to ten years, we should expect increased IOC activity in Angola's upstream activities with Sonangol's share of total production decreasing over time.

5.2 REFINING AND PRODUCT DISTRIBUTION

5.2.1 Refining

Refining activities are presently limited to the output of the small Luanda refinery. There are plans to expand this refinery's capacity from 40-45,000 bpd to 60,000 bpd, but no decision has been made yet. This would probably depend on the plan to build a large refinery north of the city Lobito, about 500 km south of Luanda. This proposed new refinery would have a 200,000 bpd processing capacity and would be designed to process acidic crude oil. Kellogg Brown & Root conducted feasibility studies for this planned refinery and Sonangol appointed Dresdner Kleinwort Wasserstein in September 2002 as project financial adviser.

Given Angola's limited refined products demand potential, the bulk of this planned refinery's output would be for exports. The project's implementation would depend on the identification of commercially viable markets for these exports. The obvious challenge for this project, which will be competing with the South African refineries, will be its funding.² The capital cost of this new refinery is estimated at \$3.6 billion or the equivalent of about 30% of the country's gross domestic product (GDP) in 2001. Thus, it is crucial for Sonangol to find strong international sponsor/partner(s) to move forward the project. As the Nexant team did not have access to any of this project's studies, it is difficult to comment on this project's prospect.

If the Lobito refinery project goes ahead within the next ten years, the Lobito area (Benguela province) could become a key industrial pole in Angola. The access to the port of Lobito and a

1 Merrill Lynch, 2003.

2 According to Sonangol, the following financing structure is proposed: Sonangol (40%); technology partners (20%), financial partners (20%), SADC governments (10%), private sector in Angola (10%).

rehabilitated Benguela railway system are two key elements that will certainly favor this area's industrial development. The construction of the new refinery project, if it proves to be feasible, should be considered along with the integrated development of the area's industrial pole potential. Thus, there is a need for energy and industrial policy makers to coordinate their medium to long-term development plans (see also Section on Gas and industrial development of the Soyo area).

5.2.2 Product Distribution and Marketing

State-owned Sonangol presently controls the distribution of petroleum products in Angola, including the activities of the Sonangalp joint venture. However, this situation is expected to change in the coming five to ten years with an increase in products demand not only in Luanda but also in other provinces. According to Sonangol, total petroleum products sales are projected to grow by 9% between 2002 and 2006. With the reconstruction efforts and increased transport activities, petroleum products demand will increase and require both public and private sector investments in distribution and marketing activities.

In the coming five to ten years, we should expect active involvement of the private sector (foreign and local) in the country's product distribution/marketing activities. But this will need to be preceded by the putting in place of an adequate regulatory framework not only to encourage private sector investment but also to protect consumers (prices, environmental and safety aspects). This framework will need to address, *inter alia*, the issues of domestic energy pricing (proper targeting of subsidies), competition and non-discriminatory access to distribution/marketing infrastructures. Given the present poor conditions of the distribution infrastructure (including storage), especially outside Luanda, it is recommended that a comprehensive assessment of the state of the country's infrastructure be conducted. This should be followed by a master plan for the optimal rehabilitation and development of the country's distribution/storage facilities.

5.3 PETROLEUM SECTOR STRUCTURE IN MID TO LONG-TERM

The list of main actors of the petroleum scene in Angola in the coming five to ten years is likely to include:

- Ministry of Petroleum (MoP)
- Sonangol with its subsidiaries and joint ventures
- International Oil Companies (IOCs)
- New public/private and private downstream entities
- Mega project companies such as the Angola LNG project or the Lobito refinery project

With the projected increase in upstream and downstream activities, the Ministry of Petroleum is expected to play an active role in energy policy and planning issues and in the development of an adequate legal and regulatory framework. The new petroleum law once approved and implemented may transfer some key activities from Sonangol to the Ministry of Petroleum. As a result of this new role and the expected increasing upstream and downstream activities, the MoP will need a significant capacity building effort at different levels. This effort will need

coordination among the different bilateral aid agencies operating in Angola to rationalize the technical assistance offered to the country.

However, ten years are not enough to undertake a major restructuring of the country's petroleum sector. Sonangol may continue to maintain its dominant position, but there could be a move towards a more decentralized policymaking process within its different branches. This change will also require a certain level of capacity building assistance. With the increasing number of international oil companies (IOCs) operating and producing crude oil in Angola, we should expect an increasing role/influence of the IOCs in the country's oil activities. This will also result in a decrease in Sonangol's share of crude oil production.

5.4 EVOLUTION OF LEGAL AND REGULATORY ENVIRONMENT

A positive and enabling evolution of the legal and regulatory framework is obviously crucial to the development of the petroleum sector and involvement of private sector investments, especially in the downstream segment of the sector. Since the draft revised petroleum law is reported to focus on the upstream activities, it is expected that in the coming years the government will concentrate its efforts on the formulation of a downstream regulatory framework (see recommendations of Emergency Needs report).

On the upstream side, it is important that the new petroleum (Nexant did not have access to any of the drafts of this new law) clarify the roles and responsibilities of the Ministry of Petroleum and Sonangol in the running of the country's hydrocarbon industry. Will the existing role played by Sonangol vis à vis the International Oil Companies be transferred to the MoP or will it be allocated to a separate regulatory entity? It is crucial that these roles are clarified and capabilities to handle such roles are prepared and made available whenever this change takes place. In the coming five to ten years, it is possible that a transition phase takes place, where a separate unit within Sonangol be set up and prepared before it is wholly transferred to the Ministry of Petroleum or to a separate regulatory agency. What is important/vital to the country's economy is that the transfer or structure change does not cause a void and negatively affect the upstream activities.

5.5 MEDIUM AND LONG TERM TECHNICAL ASSISTANCE NEEDS

The technical assistance needs identified in this section to assist the government in the development of the petroleum sector in the next five to ten years include actions for the development of the country's downstream segment and encouragement of private sector participation plus key capacity building programs to prepare and to support the expected new roles of the Ministry of Petroleum and Sonangol and/or any new hydrocarbon regulatory entity. These actions are as follows and are tabulated in Table 5-2:

- Review/Assessment of formulation of draft downstream legal and regulatory framework recommended in the Emergency Needs report and plan to encourage private sector participation in downstream activities.
- Masterplan for rehabilitation and development of the country's distribution/storage infrastructure.

- Capacity building programs aimed at preparing and supporting the Ministry of Petroleum and Sonangol (and/or any new regulatory entity) in their new roles, preceded by a training needs assessment.

Table 5-2 Mid and Long-Term Assistance Program – Oil Sector

| Program | Executing Agency | Beneficiaries | Rational And Objectives | Scope - Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|--|---|--|--|--|--|--|--------------------------|
| Review / assessment of formulation of draft downstream legal and regulatory framework | MoP | MoP | Make sure that there is progress in formulation of draft downstream legal & regulatory framework; address any problems or bottlenecks. This framework is crucial to development of downstream segment | <ul style="list-style-type: none"> ▪ Meet with MoP and other government agencies and set-up task-force to assess/move forward formulation. ▪ Work on a plan to encourage private sector investment participation in downstream segment | <ul style="list-style-type: none"> ▪ Avoid delay in development of draft legal framework for the downstream petroleum sector ▪ Plan to encourage private sector investment participation in downstream segment | <ul style="list-style-type: none"> ▪ Timely Buy in by MoP and identification of counterparts ▪ Agreement on scope ▪ Acceptance by MoP ▪ Acceptance by Sonangol ▪ Expression of interest by Private Sector | 2004 - 2005 |
| Masterplan for rehabilitation and development of the country's distribution / storage infrastructure | Sonangol | MoP Sonangol Potential Private Investors | Given present poor conditions of the distribution/storage infrastructure, a comprehensive assessment of the state of the country's infrastructure is needed followed by a master plan for the optimal rehabilitation and development of the country's distribution/storage facilities. | <ul style="list-style-type: none"> ▪ Assessment of state of existing distribution and storage infrastructure. ▪ Establish medium to long-term distribution/storage needs. ▪ Develop in association with relevant stakeholders optimal plan for the rehabilitation and development of the country's distribution / storage facilities. | Master plan for the optimal rehabilitation and development of the country's distribution / storage facilities. | Acceptance by MoP, Sonangol and other relevant entities. | 2004 |
| Capacity building programs aimed at preparing and supporting the Ministry of Petroleum and Sonangol | MoP, Sonangol Any new hydrocarbon regulatory entity | MoP, Sonangol Any new hydrocarbon regulatory entity | The preparation of the MoP, Sonangol and/or any new hydrocarbon regulatory entity in their new roles to avoid a negative impact of this structure change on upstream activities so vital to the country's economy. | <ul style="list-style-type: none"> ▪ Multi-disciplinary capacity building programs aimed at preparing and supporting the Ministry of Petroleum and Sonangol (and/or any new regulatory entity) in their new roles, preceded by a training needs assessment | Preparation of MoP and Sonangol for their new roles as per the new draft petroleum law | Acceptance by MoP, Sonangol and other relevant entities. | 2004 - 2006 |

Section 6 Gas Sector Development And Technical Needs

6.1 OUTLOOK FOR GAS

Presently, there is no gas industry in Angola. Only less than 10% of the gas produced in association with crude oil is used as a fuel by existing oil operations, whilst over 60% of the associated gas produced is flared and 30% is re-injected in oil fields. The development of domestic gas uses will pose challenges at each segment of the gas chain (upstream, midstream and downstream) somehow different from those of the oil industry.

Crude oil in Angola is currently produced offshore with the bulk of the oil and liquids lifted and marketed directly from the offshore areas. However, the development of a local gas industry requires the setting up of capital-intensive onshore facilities, something that was not possible to undertake during the long civil war that affected Angola. Following the signing of the Peace Agreement in April 2002, the Ministry of Petroleum and Sonangol have been planning the development of a gas and gas-based industry.

The launching of a domestic gas industry will require:

- Development of an adequate legal, regulatory and commercial framework for upstream, midstream and downstream activities to enable the implementation of gas and gas-based projects
- Identification of commercially viable outlets for the large volumes of associated gas currently flared and for the non-associated fields that could be developed

On the supply side, there are enough proven gas reserves to launch at least a gas export project. Sonangol estimates the country's total proven and probable gas reserves at 12 to 15 trillion cubic feet (tcf) or about 340 to 425 billion cubic meters (bcm). Sonangol did not provide a break down between proven and probable reserves. However, outside sources indicate that the country's proven reserves were estimated at 13 tcf or about 370 bcm as of January 2002.³ In addition, Sonangol estimates at about 3 tcf or about 85 bcm the proven and probable reserves of non-associated gas located in Block 1 and Block 2.

Since there is no single large non-associated gas field, the main challenge on the supply side is to develop an optimal cost-effective gas supply scheme to collect associated and non-associated gases from the different offshore blocks and to deliver supplies to onshore treatment facilities. One key difficulty on the supply side will be the delivery of gas supplies located north of the Congo River from the Cabinda province, where the bulk of the oil and associated gas are presently produced. The pipeline transportation of the gas across the Congo River and onshore into the mainland is reported to require a difficult deep-water crossing. Thus, Cabinda gas is unlikely to be used in the initial phase of gas development projects unless a cost-effective solution is found to this issue of river crossing.

³ Cedigaz, Paris, 2003.

The country's outlook for gas development will be driven by:

- Local and international concerns about the high levels of gas flaring;
- Identification of commercially viable and financeable gas use alternatives;

The first such alternative identified by the Ministry of Petroleum, Sonangol and the international oil companies is a proposed liquefied natural gas (LNG) project to export liquefied gas supplies on board LNG vessels equipped with cryogenic tanks. Implementation plan for this Angola LNG project is presented in the ensuing section. Such high capital-intensive gas projects are characterized by long (and sometimes very long) gestation periods.

Thus, we should expect the development of the Angola LNG (ALNG) project to dominate the gas scene in the next five to ten year period. This project's implementation will be critical to the launching of a domestic gas industry. The structure of the nascent gas industry during this time horizon will also reflect the fact that the industry will be dominated by a large gas project (ALNG). As explained in the ensuing subsections, it is unlikely that large gas transmission projects take place during the next five to ten years. If the ALNG project is implemented, gas development will be centered on the Soyo area.

In the ensuing subsections, the LNG project and potential gas use options are reviewed.

6.2 LNG DEVELOPMENT AND THE POTENTIAL FOR DOMESTIC GAS UTILIZATION

6.2.1 Angola LNG Project

The planned installed capacity of the one-train ALNG plant, to be sited in Soyo 500 km north of Luanda, is 4 million tons per annum (mtpa) or 5.4 billion cubic meters (bcm) per year. Total gas requirements, including plant fuel use, for this LNG project would be about 6 bcm per annum.

According to Sonangol, the ALNG on-shore and offshore pre-FEED (Front End Engineering Design) studies have been conducted and the FEED study is scheduled to start during the last quarter of 2003. The contract for the Environmental Impact Assessment has been awarded and initial data gathering has started this summer. On the issue of financing, ALNG's main shareholders, ChevronTexaco (through its affiliate company Texaco Angola Natural Gas Inc) and Sonangol appointed in May 2003 Taylor-DeJongh as the project Financial Advisor. The Final Investment Decision is expected for the first quarter of 2005.

As indicated previously, one of the main factors that led to the identification of this gas export project is the high level of gas flaring in Angola. However, this reason is not enough to launch such a highly capital-intensive scheme. Without the prospects of commercially attractive gas export markets, the IOCs will find it difficult to go ahead with the project. In addition, the project sponsors will need some fiscal incentives to improve the project economics. The gas composition of the final gas supply portfolio to feed the LNG project is not known yet. But, the project economics would obviously be improved with the marketing of natural gas liquids.

With regard to export outlets, it is not clear whether it is going to be both American and European gas markets that will be targeted for exports from this planned LNG plant or only

American markets. The main challenge for the securing of markets for exports from the ALNG project will be competition from the existing and expanding Atlantic-based LNG exporters: Nigeria LNG (NLNG) and Trinidad's Atlantic LNG and to a certain extent from other existing and new LNG producers, especially Mediterranean gas producers and marketers.

It is expected that the crucial issue of identification of commercially viable markets for the Angola LNG project will be one of the main focuses of the newly appointed project financial advisor. Can the ALNG project be launched without or with a limited share of long-term gas purchase commitments? If that is the case, we would be looking at a situation where the sponsors may have to finance the whole project, i.e. a 100% equity funding.⁴ Are the sponsors, including Sonangol and consequently the government of Angola, ready to take such a multi-billion project risk? This remains to be assessed.

It should be stressed again that the development of the Angola LNG (ALNG) project is very crucial to the development of a domestic gas and gas-based industry in Angola. The ALNG project is expected to act as a sort of anchor for the development of the country's gas industry. In what follows we look at potential gas use alternatives.

6.2.2 Potential Domestic Gas Uses

The domestic use of natural gas supplies include:

- Use of gas as a fuel in the generation of electricity;
- Use of gas as a feedstock for the development of gas-based industries such as methanol and fertilizer production for local use and exports;
- Use of gas as fuel in energy-intensive industries such as aluminium smelting.

In Angola, the use of gas in the power sector is expected to be very limited due to the country's large hydro-electrical potential capacity. Fuel substitution in thermal power units is limited to two gas-turbine units located in Luanda, and the potential for substitution would very much depend on a competitive price level for gas. It is unlikely that a 500 km gas pipeline from Soyo to Luanda would be viable to supply these two units totalling about 114 MW.

The situation could be different for developments in remote locations not linked to the grid (or that cannot be supplied from the grid) and close to future gas pipeline landfall points such as the proposed area for the LNG project. The viability of such schemes would depend on the size of power capacity required and the expected delivered gas price. However, such opportunities that could include industrial developments in different regions or areas are presently very limited due to the country's current low level of economic development. In fact, Angola is just starting its economic reconstruction efforts.

With regard to the use of gas as a feedstock, methanol and fertilizer gas-based industries have been identified by some studies conducted for the Ministry of Petroleum and Sonangol as the main options for domestic gas uses. At present, the domestic demand for these two types of

⁴ That was initially the case for Nigeria LNG.

products is very limited in relation to the plant capacities that will need to be developed to make such gas-based industries worth considering. Therefore, any methanol or fertilizer projects to be considered would need to be almost entirely for export markets⁵. The green-field development of petrochemical and fertilizer projects will need to take into consideration these industries' high product price volatility and very aggressive international competition. One of the key elements would be the delivered price of gas that would need to be highly competitive compared to existing and future international competitors. Thus, the competitiveness position of planned Angolan petrochemicals and fertilizers would need to be fully and cautiously assessed.

Natural gas can also be used by energy-intensive industries such as aluminium smelting. Gas is used as a fuel for the generation of dedicated power for an aluminium smelter project. The main key factors for the development of such project are the cost of electricity, which will need to be below US\$0.02/kWh, and the availability of deep-water port facilities. To be able to generate electricity at less than 2 cents per kWh, the delivered gas price to the dedicated power station would need to be well below US\$ 1/MMBtu and it would need to be sited close the gas source and close to a deep-water port.

6.2.3 Summary

In the absence of potential gas use opportunities in the power sector that would launch the creation of a domestic gas industry, energy policy makers are forced to consider large-scale gas export projects. Therefore, the development of the Angola LNG project is crucial to the launching of gas-based industries. Without the LNG project, the commercial development of the country's gas sector would take much longer to materialize and would lack the anchor element that is necessary to its launch. The impact of the ALNG project will not only be on the reduction of unit costs (economies of scale) but also on the issue of investors' confidence. It is clear that Angola is presently not a sought after destination for gas-based industrial projects. Therefore, the commitment by international companies such as ChevronTexaco, BP and ExxonMobil to move ahead with the LNG project will be perceived as a positive sign by potential investors.

It should be noted that the synergies that can be achieved by integrating the LNG project with the gas-based industries would be significant. For example, sites for the methanol, fertilizer and aluminum smelter projects would need to be close to the gas source or gas landfall point and close to a deep-water port, as it is the case for the LNG project.

Apart from the potential for gas-based industries to be developed in the Soyo area next to the ALNG scheme, it is unlikely that other domestic natural gas developments could take place in the coming five to ten years. Depending on the commercial viability of such industries and interest of strong international sponsors to undertake their developments, gas infrastructure development will be limited to the Soyo area and developed jointly by the international sponsors and Sonangol.

The Soyo area, where the ALNG is planned to be sited, could be considered as a potential industrial development zone, including the LNG project, gas-based and energy-intensive

⁵ A world-scale methanol plant would consume about 1 bcm of gas per year. A world-scale fertilizer complex (ammonia-urea) would require 0.7 bcm of gas per year.

industries and possibly other industries. However, we must stress that assessment of the technical, commercial, social and environmental impact of such projects will need to be initiated well ahead of time and synergies between on-going and future gas and gas-based projects identified early on. This can be best achieved by undertaking a medium to long-term Master Plan for the industrial development of the Soyo area.

In the next five to ten years, if the ALNG project goes ahead as scheduled and if gas supplies are relatively limited, the Government of Angola will at some stage face the situation where it will have to decide on whether to allocate gas supplies to gas-based industries or to the expansion of the ALNG project by the addition of new LNG trains. The financial and economic impact of such decision would need to be assessed early on against the spelled out medium to long-term energy policy objectives of the Government (adding-value locally, employment or generation of foreign currency receipts, etc..).

6.3 LEGAL AND REGULATORY ENVIRONMENT

From a regulatory point of view, depending on the outcome of the new petroleum law and the implementation of a new gas regulatory framework, the Ministry of Petroleum and probably other relevant key ministries (Ministry of Industry and Local Authorities) are expected to play key roles in the regulation of the new gas industry.

In the next five to ten years, the gas sector in Angola would include the Angola LNG project and possibly one or two gas-based industries. How much of a regulatory structure would be required to monitor these gas activities? Given the crucial role of the LNG project, it is possible that a special status will be accorded to the ALNG project. Initially the Ministry of Petroleum and Ministry of Local Authorities will be involved in the regulation of the nascent gas industry.

Following the implementation of the Gas Regulatory Law, a regulatory entity may be created or may be merged with the electricity regulatory body. But the scope of the regulatory entity would be limited. The evolution of the legal and regulatory framework will need to take into consideration and reflect the expected level of gas sector development in Angola and the crucial need to attract sustainable private sector investments. Beyond the ten-year horizon, as the gas market develops and a certain level of market maturity is achieved, the emphasis would be on creating a more competitive environment. However, it should be stressed that gas markets in Angola are likely to evolve much more slowly than markets in the developed economies of Europe and North America. Thus, the design and structure of the evolving legal and regulatory framework would need to reflect this specificity.

6.4 MEDIUM AND LONG TERM TECHNICAL ASSISTANCE

6.4.1 Technical Assistance Needs

It is clear throughout this section that the development of a domestic gas sector in Angola will pose several challenges and is very much dependent on the implementation of the planned Angola LNG project as the anchor project. Within the next five to ten years, the domestic gas industry is likely to be limited to the ALNG project and few gas-based industries. All these gas projects are capital-intensive gas use options requiring substantial funding from both potential

international investors and the government of Angola. Therefore, policy makers in Angola should undertake a realistic approach of what can be achieved within the ten-year period. This should be considered against the background of a flexible gas regulatory framework reflecting the staged development of the country's gas sector.

Opportunities emerging for these gas projects with impact beyond the hydrocarbon sector should also be identified.

The following items, presented also in Table 6.1, summarize the recommended technical assistance needs for this medium to long-term period.

- Support for development of a flexible and adaptable National Natural Gas Strategy incorporating a phased development of the country's gas and gas-based industry and based on the proposed consolidated up-to-date assessment of alternatives domestic gas development options (as recommended in the Emergency Needs Draft Report)
- Design of an evolving Gas Regulatory Framework consistent with the likely development of Angola gas sector
- Master Plan study for the Soyo area as a future industrial development pole

The potential development of the gas sector will require the development and negotiation of an entirely new set of commercial arrangements and contracts. This capacity is currently lacking in the Ministry of Petroleum. Accordingly, it would be beneficial to provide training in the mid-term to develop these skills. The following training course would be of benefit.

6.4.1.1 Natural Gas Negotiations

The principal objective of this workshop is to cover the principles and provisions of long term exploration and production and long term gas sales and purchase agreements. It will enhance the participants negotiating skills and management of long-term GS&P agreements. Negotiation of E&P agreements will be conducted between GOA officials and international oil companies involved in bidding for E&P blocks. For those blocks being successful in discovering of natural gas, negotiations of GS&P and management of the E&P agreements become essential.

Target audience: Mid to senior level representatives from the ministry of petroleum, Ministry of finance and Sonangol.

Table 6-1 Mid and Long-Term Assistance Program – Gas Sector

| Program | Executing Agency | Beneficiaries | Rational And Objectives | Scope - Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|--|------------------------------------|---------------|--|--|---|-----------------------------|--------------------------|
| Support for development of a flexible and adaptable National Natural Gas Strategy | MoP | MoP | The development of a domestic gas sector in Angola poses several significant challenges. Design of flexible and adaptable National Natural Gas Strategy incorporating a phased development of the country's gas and gas-based industry is crucial to this sector's development. | Support the MoP in the design of a national natural gas strategy based on the full assessment and consolidation of existing gas analyses and studies and GoA's medium to long-term energy and economic policy objectives | Flexible and adaptable National Natural Gas Strategy. | Acceptance by GoA | 2004 - 2005 |
| Design of an evolving Gas Regulatory Framework consistent with the likely development of Angola gas sector | MoP | MoP | The domestic gas sector in Angola will need a long time to develop and it would be a mistake to try to apply any gas regulatory framework that is not consistent with the likely slow development of the gas industry in Angola. | Work closely with the MoP, Ministry of Industry and other relevant government agencies and consult international stakeholders in the design of all the aspects of this evolving gas regulatory framework. | Draft Gas Law | Acceptance of Draft Gas Law | 2004 - 2005 |
| Master Plan study for the Soyo area as a future industrial development pole | MoP and Ministry of Industry (Mol) | MoP and Mol | The Soyo area, where the ALNG is planned to be sited, could be considered as a potential industrial development zone, including the LNG project, gas-based and energy-intensive industries and possibly other industries. This would create synergies that would benefit all industries. | <ul style="list-style-type: none"> ▪ Assessment of site conditions; ▪ Identification and timing of existing, on-going and planned projects; ▪ Various infrastructure and utility needs of these projects; ▪ Identification of synergies; ▪ Development plan for the area's industrial development to be discussed and agreed with Government and international project stakeholders | Medium to long-term Master Plan for the Industrial Development of the Soyo Area | Acceptance by GoA | 2004 |

Section 7 Access to Energy in the Peri-Urban and Rural Areas: Renewable Energy and Energy Efficiency Issues

7.1 OVERVIEW OF CURRENT SITUATION/CURRENT 'FORECASTS'

Any discussion of consumer access to modern fuels must be set against the availability and supply infrastructure for those energy commodities. The overall status of the electricity infrastructure, its capacity and current production are addressed in more detail in Section 4 of this report. ENE is responsible for all electricity generation in the country, with the exception of Lunda Norte and Lunda Sul where ENE has a 45% participation in the 16 MW hydroelectric plant that the diamond concessionaire ENDIAMA has developed, primarily for its own power needs, which includes a small distribution system (about 2 MW) for local consumption around the provincial capitals in Lucapa and Saurimo. ENE provides some power to 13 of the other 16 provinces, with Cunene, Cuando Cubango and Zaire provinces only having what the local municipalities might provide. Outside of the provincial capitals, other small isolated systems exist for which ENE also provides some technical support.

Of the provinces serviced by ENE, on a per capita basis Cabinda is currently the best served, followed by Luanda province. However, Cabinda is more of an exception due to the large presence of the IOSs who have developed generation there. The asymmetry in availability of and consumption of electricity is large. Although per capita use of electricity in 2001 could be calculated at 97 kWh/year this is far behind use in Namibia (650 kWh/habitant/year) or Zambia (550 kWh/year) (even recognizing the distortions created by enclave mining industries). Currently, no more than 20% of the population has access to electricity, and for those outside the three partially operating grids, that access is only for a few hours in the evening.

The Electric Sector Strategy developed by MINEA includes moderate projections for growth in both access and installed capacity through 2016. These were discussed in Section 4. During the period to 2016, the Strategy projects access increasing to 28% by 2006, 36% by 2011 and 46% by 2016 however there is no justification for these results. The summary of where new capacity will be added, and peak load as presented in Table 7-1 and 7-2 respectively, emphasizes the disparities between urban and rural consumption.

Table 7-1: Estimates for future electric generation by system (GWh)

| Year | Northern System | Central System | Southern System | Uíge | Bié | Cabinda | Others | Total |
|------------------|-----------------|----------------|-----------------|------|-----|---------|--------|-------|
| 2006 | 2130 | 409 | 143 | 11 | 10 | 88 | 12 | 2803 |
| 2011 | 3006 | 608 | 191 | 16 | 14 | 153 | 18 | 4007 |
| 2016 | 4110 | 855 | 260 | 22 | 18 | 215 | 25 | 5505 |
| kWh/hab, in 2016 | 454 | 206 | 154 | 12 | 9 | 533 | 37 | 216 |

Source: MINEA Electricity Strategy Paper, July 2002

Table 7-2: Projected Installed Peak Capacity by System and Year

| Year | Northern System | Central System | Southern System | Uíge | Bié | Cabinda | Others | Total |
|------|-----------------|----------------|-----------------|------|-----|---------|--------|-------|
| 2006 | 372,7 | 71,6 | 25,0 | 1,9 | 1,7 | 15,3 | 2,0 | 490,3 |
| 2011 | 526,5 | 106,5 | 33,4 | 2,8 | 2,4 | 26,8 | 3,2 | 701,7 |
| 2016 | 719,0 | 149,6 | 45,5 | 3,9 | 3,2 | 37,6 | 4,4 | 982,0 |

Source: MINEA Electricity Strategy Paper, July 2002

Clearly, any economic revival will significantly alter these projections. Even more significant will be government policy and any concerted efforts to revive the economy could yield much larger increases in capacity. Suppressed demand for power in Luanda alone is already so large that it is estimated that there may be as many additional ‘informal’ customers as those approximately 100,000 already registered by EDEL.

The urgent need to begin to ‘formalize’ (i.e. officially connect, meter and bill) these unregistered users has been discussed in the Emergency Response Study. ‘Formalization’ of supply to these outlying users will eventually reduce their costs, improve the profitability of EDEL and increase consumption further as the system is regulated and supply becomes more reliable.

Access to petroleum products including LPG, gasoline and diesel beyond Luanda, Benguela, and Lobito is limited. Gasoline/diesel stations outside of Luanda are very scarce. Liquid petroleum products are trucked in or flown in to any retail points in country. Sonangol has plans to increase distribution and is establishing depots or warehouses, particularly for LPG, in other cities. Sixty percent of the LPG in the country is imported, yet Sonangol currently sells LPG (and other petroleum products) at a subsidized price that represents just 20% of the world market price. Even these subsidized prices have not led to extensive penetration amongst the urban slums of Luanda. The initial price barrier, of both the stove and the LPG canister/tank, constrains many potential consumers, who at the same time apparently prefer their traditional methods of food preparation.

7.2 THE PERI-URBAN CONUNDRUM

Peri-Urban areas in Angola, at the present, refer primarily to Luanda, especially as pertains to the electric sector. Luanda alone accounts for over 60% of the urban population. There also exist relatively large peri-urban settlements surrounding some of the other provincial capitals as people migrated there to reduce the risks of being caught in the conflict. However, only in Luanda, where the peri-urban population is three or four times the size of the more established city infrastructure, are some urban services formally or ‘informally’ available in the urban periphery.

Luanda and its peri-urban population, with an estimated total of nearly 4 million people, consume close to 80% of the total amount of energy generated in Angola, or approximately 1600 Gwh. Of this amount EDEL reports that at least 60% can be attributed to residential customers. The electricity demand curve has a pronounced peak from the early evening (dusk) until about 10PM, linked prominently to the demand for lighting.

The insufficiency of the EDEL distribution grid is continually exacerbated by the downward spiral (referred to in the Electric Sector Strategy, paragraph 57)⁶, where 1) the lack of investment leads to 2) no new access and precarious quality, leading to 3) suppressed demand, leading to 4) collection difficulties, which means no receipts and no new investment.

Another way to gain a quick insight into the severity of the ‘peri-urban power shortage’ is through the limited survey data. These suggest that although many people admit to or appear to have some electricity access, very few, perhaps less than 1/3 are registered EDEL customers. The Electric Sector Strategy document suggests that private transformers and small private diesel operators are providing expensive power to eager users in the ‘musseques’ (peri-urban slums). The peri-urban electrification challenges are essentially the same challenges that face the rehabilitation and operation of the electric infrastructure of ENE and EDEL. Organization, investment and regulation, as discussed in Section 4, are required to begin to make electricity more accessible to the still growing urban populations.

This situation reinforces the core recommendations of the Emergency Response Study and Section 4:

- EDEL needs to outsource metering, billing and collection services
- MINEA and DNE must move on establishing the IRSE (Instituto Regulador do Sector Electrico)
- IRSE should rationalize tariffs and permitting for private operators
- MINEA and DNE should proceed with data collection to improve their demand and consumption forecasts.

⁶ Ibid

7.3 THE RURAL ECONOMY AND ENERGY

This subject is vast and poorly understood in Angola. In spite of rapid urbanization in Angola during the last several decades (urban areas accounted for only 15% of the population in 1970), more than 50% of the population is still considered to be rural. Over 4 million people were displaced by the ongoing conflict after it resumed its intensity in 1998. Of these displaced persons over 70% are women and children, many of them malnourished and ill. Of the almost two million people who sought refuge in the IDPs (internally displaced person) camps more than half have begun to re-establish their lives during the last year. Many are reportedly returning to the rural lands, but there is also evidence that freer post-conflict movement is actually increasing the migration to the more urbanized environments. Many of these new peri-urban residents actually maintain some linkage with their rural agricultural heritage, deriving at least part of their new livelihood from food production.

With the population in flux, any meaningful measure of the rural economic and social conditions is difficult. It is reported that as many as 50% of the rural households are headed by women with minimal means of sustaining the family. The few statistics that are cast about are alarming and have given rise to large NGO involvement, including over 60 international NGOs and over 200 domestic Angolan NGOs. This burgeoning NGO involvement is largely focused on short-term humanitarian goals for food, clothing and shelter. Good survey data on the social and economic characteristics of 'households' everywhere in Angola, but particularly in the rural areas is non-existent. The European Union has begun to collect data in several provinces, but the information has not yet been assembled for reporting. These early survey efforts are emphasizing data related to the structures of civil society, the needs for health clinics, schools and community organization. These are essential building blocks that will reinforce the regeneration of civil society, but these same surveys tend to overlook some critical infrastructure constraints, such as availability of transport, water and energy. Since the central government does not have the capacity nor budget, it will be useful to begin to include questions related to the consumption patterns for energy and what current energy requirements might sustain minimal services.

The severity of the dislocation and destruction of rural infrastructure is an enormous constraint to much near term attention being given to rural electrification. The international community has necessarily focused on emergency aid, humanitarian interventions and filling immediate needs for food or clothing. However, it is not too early to begin making a strong case for looking beyond emergency hand-outs towards more intensive and systematic efforts to create the conditions for eventual self-sufficiency. Energy will be critical for everything from nutrition, to water pumping, to community facilities, schools, health centers, food preservation and eventually food processing and non-agricultural rural employment. Modern energy availability will be one of the keys to future economic activity, be it rural or urban.

7.4 CHARCOAL, FUEL WOOD, AND DEFORESTATION

The rural areas of Angola (specifically the more wooded areas) produce as much as 70% of the total annual domestic energy consumed.⁷ Yet these same areas, despite their importance in energy production, do not present the socio-economic conditions to realistically make rapid transitions to modern fuels (electricity or petroleum).

Anecdotally, the rural cash economy, outside the provincial capitals, is still extremely limited. The main ‘cash crop’ or product being traded, produced by the poorer and landless populations, throughout the country, is charcoal. Charcoal in Kwanza Norte, 150 kilometers east of Luanda currently sells for 500 Kwanzas (~US\$ 6.50) for a bag containing approximately 25 pounds of soft, traditional charcoal. In Luanda the price can be double that.

Other agricultural production is returning very slowly and several of the NGOs offer seeds and tools as part of their assistance programs. However crop surpluses for market are still small and localized. Even many Luanda residents spend part of their time in agricultural activities in fields and gardens outside the city. In the provinces the most notable consequence of continuing dependence on fuel wood and charcoal by the vast majority of Angolans is that the forested perimeters of all urban and rural population concentrations have disappeared.

7.5 RURAL ELECTRIFICATION STRATEGY

The Electric Sector Strategy of Angola⁸ recognizes the urgency of providing power to the more concentrated peri-urban populations first. This Strategy also recognizes that the electric grid could then be slowly extended to attend new consumers, but that “low levels of consumption and the absence of economic activity” would not justify investment. Until the questions about where and what type of economic activity might grow that could finance initial electricity consumption are addressed rural electrification will remain distant. Rural electrification, which will be essential to the development of much of Angola, can only be addressed in the broader context of ‘integrated rural development strategies’. This integrated approach will require data collection and extensive dialog between Ministries and government bodies that currently have little interaction.

7.6 BROAD, BUT ESSENTIAL, RECOMMENDATIONS – RURAL ENERGY DEVELOPMENT

Currently modern fuels (or commercial fuel networks) in the rural areas are essentially nonexistent. However, the provision of new energy can only be considered in the context of an integrated rural development strategy. This will have to start with education and involvement of the communities themselves. Participation in civil society, simple principles of governance and consultation in decision-making are essential to ensure the responsibility and ‘ownership’ of the energy infrastructure, be it a bottle of LPG and a stove or an electric connection to a small-hydro or photovoltaic system.

⁷ The “Angolan Electric Sector Development Strategy”, *Ibid*, uses the World Bank – ESMAP calculations, 65% biomass, 33% petroleum derivatives, 2% electricity. For many reasons the distribution and consumption of petroleum products and electricity availability have fallen.

⁸ *Ibid* paragraphs 154 to 163

Rural energy development at a local level will require, at the minimum:

- Understanding the community social structure
- Decentralization of authority and resources to provincial and local governments
- Providing education to the community
- Inclusive local consultation and participation
- Anticipated in-kind and financial contribution from the end-users
- Cooperative management, organization and operation
- Focus on productive social and economic activities

At a national level:

- Political will and commitment to allow rural growth and autonomy
- Inter-governmental coordination and collaboration
- Development of associated infrastructure for economic activity to grow
- Concerted efforts to provide registration and title to land
- Delegation of subsidized resources to Provinces and NGOs
- Fiscal accountability to encourage Donor and private sector involvement

All of this will take time, but without attention to these considerations, especially at the community level, experience has proven that the new energy systems are likely to fail to reach their objectives. In the longer run it will also be critical to better understand the natural resource base that supports these rural settlements. In order to make a long-term productive contribution to Angola these communities will have to manage their resource bases in a more sustainable manner. Reforestation and watershed management will be integral to the long-term livelihood of these communities.

7.7 RENEWABLE ENERGY

The extent of the challenge to begin to provide reliable commercial fuels is formidable. In 2002 more than 2000 diesel generator sets are estimated to have been sold in Luanda. This is one clear indicator that people are willing to pay for reliable energy supplies. However the investment in these generators only increases the inefficiencies of energy in the economy and will curtail ENE and EDEL from rationalizing their roles.

Renewable energy technologies could contribute significantly to Angola's efforts to bring modern energy to its citizens. Renewable energy technologies will be essential to any integrated national energy planning or re-development programs, however, their relative priority will probably be low in light of the fiscal constraints and the devastated condition of existing energy infrastructure. Either using officially stated policy (Electric Sector Strategy), which emphasizes the near term economic leverage of each investment, or the 'de facto' political process that

allocates scarce funds, renewable energy is unlikely to compete well with lower cost and more quickly available petroleum fueled alternatives.

This said, the National Energy Directorate (DNE) asserts that in the highest levels of Government there exists recognition that renewable energy will be important to Angola's future. The DNE reports that it has a budget of \$750,000 for 2003, for small-scale renewable energy pilots and studies. Although DNE's focus is solar photovoltaic technologies, Angola has a large and, yet to be estimated, potential for small and micro-hydro resources. For larger hydro resources the Portuguese did extensive surveys and modeling, reporting a potential hydro generation capacity of over 150,000 GWh/year, indicating that the current hydro exploitation of 1,200 GWh/year represents less than 1%.

As government and donor attention begins to turn beyond immediate survival and humanitarian issues, stakeholders will recognize the pivotal role that subsidized renewable energy technologies can contribute to more sustainable community development. Subsidization will be necessary and need not be contrary to sustainability in the case of reviving Angola's rural sector. Financial support to bringing energy as part of an integrated approach to rural Angola should be encouraged.

The DNE was recently authorized to increase the staff in the New and Renewable Energy Sources group from one to four professionals. The existing renewable specialist, an engineer with several years experience, will be complimented by the addition of two chemical engineers and an economist. DNE has had some limited experience with photovoltaic systems installed in the provincial capital, Menogue, of Cuando Cubango (2001) where a hospital/health center, a police station and a military command post were electrified with PV systems. However mismanagement of these systems has caused them all to fail and diesel is being flown in at high costs. More recently (2002-2003), in the province of Uige and, nearer to Luanda, in the town of Barra du Dande, Bengo, DNE has also installed PV systems for the medical centers and schools. With support from the World Solar Program, funded by UNESCO, a community center, health clinic and school have also been electrified with PV. The current status of these facilities is undetermined. In the near future, with the full financial support from BP Solar and possibly donor assistance, it is anticipated that a 15 kW peak system will be installed near Cachito in the municipality of Paranhos, Bengo. This town has a 20 Kva diesel set that is on line approximately 4 hours each day. The town has about 300 houses of which 50 are residence to former UNITA combatants. The focus will be providing electricity to the medical center, school and community buildings but the system may also service some of the houses.

The issue for renewable energy technologies (specifically hydro and solar) in Angola will not be technological. Whether they are new micro-hydro systems or photovoltaic, the constraint is not the technology as much as the management, the organization, operation and maintenance of the systems. The sine qua non for the survival and longevity of these early experiences will be adequate local participation. In the longer term, the building and maintenance of small distributed energy sources will be made possible by a legislative and regulatory regime that allows entrepreneurs or local communal organizations to construct and operate these systems.

Recommendations:

- Survey micro-hydro potential near candidate communities
- Closely monitor the photovoltaic pilots
- Conduct surveys of rural village energy consumption and needs
- Work with IRSE to define access and autonomy for these systems
- Always consider grid extension as a first option
- Concentrate on communities where there is some ability and willingness to pay
- Seek to integrate renewable energy development into integrated rural development strategies of local government or NGOs
- Help create incentives for private participation and donor cooperation

The complexity of the issues surrounding increased application of renewable sources in rural Angola limits the utility of getting more specific about options at this time. Renewable energy technologies must be considered on a case-by-case basis. Specific opportunities need to be investigated in the context of the specific community, its needs and the potential application. Suffice it to say that with time, renewable energy technologies could play a significant role in the longer term development strategy for rural Angola.

7.8 ENERGY EFFICIENCY

Unfortunately, the current economic circumstances place energy efficiency issues very low on the priority ranking for near term energy needs in Angola. There is currently an urgent need to distribute electricity and fuels and then impose a rational pricing structure. Once people have access to modern fuels at world prices energy efficiency will become more relevant.

The greatest current energy efficiency issues and the incentives to promote efficiencies are on the supply side. Generation efficiencies are particularly low in the smaller diesel generator sets and the isolated municipal systems that ENE operates. Costs using international fuel prices and imposing proper maintenance regimes would approach \$0.20/KWh produced, yet even with transmission and distribution costs added ENE sells at an average price of \$0.012/KWh. Yet, ENE's ability to provide reliable electricity supplies is so low that the total amount of privately owned, stand-by generation capacity in the country may well exceed the installed available generation capacity that ENE operates.

We visited a number of dealers to gain some insights to this phenomenon in Angola. The majority of these gen-sets average from 30 to 1000 Kva. Because of outages and voltage fluctuations, even when the public grid is producing energy, many of these individual generators are run as much as 12 hours/day. There are no import statistics, but three separate dealers estimated that annual sales in Luanda of these smaller gen-sets exceeded 2000 units/year.

The potential for demand side energy efficiency will have more relevance in the mid to long term. Most likely, it will first be the private sector that responds to the needs for energy efficiency but only when consistent availability and clear price signals justify energy efficiency

investments. Some indications of the potential for private sector energy efficiency based on limited anecdotal information gained through our interviews are discussed below.

The cement fabrication facility outside of Luanda is the largest single consumer of electricity in Angola, using 8.5 MW to operate and will increase to 13MW when the plant expansion is completed. The second largest user is the petroleum refinery which uses less than 5 MW and the third largest user is said to be the Coca Cola bottling plant. On the process heat side, the cement plant currently uses fuel oil for which it pays \$120/ton, but is considering importing coal when prices rise. These and other large private electricity consumers are already seeking ways to modernize their facilities and increase the efficiency of their energy use. All three are foreign owned (cement is Scansem-Norwegian, refinery is Total-French) and have the expertise to make efficient retrofits. Other industries will eventually get some support from the staffing of an EE unit in the DNE and from donors as foreign public support returns.

The residential end-user, particularly the peri-urban, informal electricity buyer, will be the most effected by any rationalization of billing and collection and or price adjustments instituted by the electricity distributors. Even though some of these end users may already be paying high prices because of the middlemen in the 'informal' distribution network, the majority are either not paying or receiving very subsidized power. ENE/EDEL expect to institute a form of 'life-line' tariffs when rates are adjusted. Thus until such time as these tariffs and collection procedures are implemented the average residential user will have little incentive to consider more efficient energy use in the future.

On the end-use side, those who can afford it, use window air-conditioners. Only a very few of the newest buildings and a few major renovations have central air-conditioning. In those buildings with individually inserted air-conditioners it would be conservative to say that air-conditioning accounts for 70% of the load during the hot season. As to appliances, nine individual dealerships of major appliances representing manufacturers throughout Europe were visited. The appliances were not labeled for energy efficiency nor did the technical staff in any of the outlets have those specifications available.

Recommendations:

- Establish EE as one of the areas for responsibility in DNE
- As fuel prices increase, begin public awareness campaigns to assist and support the adjustment to rising costs
- Maintain labeling available from major appliance suppliers
- Work closely with Regulatory Authority, when created to incorporate concerns for EE
- Possibly create a small wires charge for supporting investment in EE and renewable energy.

7.9 ROLE OF THE GOVERNMENT OF ANGOLA FOR CONSUMER ENERGY ACCESS AND ENERGY EFFICIENCY

To effectively increase access to modern energy the GOA must eventually shift its role from being the primary provider of services to planning and stimulating national policy and programs while also being a facilitator of private investment and private management of energy supply and delivery.

The importance of the commitment and political will of the GOA in realizing its ambitions to extend access to electricity cannot be underestimated. Once the existing system has been rehabilitated and is operating more commercially, on going financial and policy support will be essential for the sector to grow and serve new consumers. The primary motivation for promoting increased access is to increase productivity and participation in the revival of the national economy. The secondary, yet equally important need, is the national imperative to slow the rapid rate of urbanization and stimulate growth in the rural agriculture and non-farm economy. The large, but addressable, constraints that the GOA faces are mobilizing the financial capital and the human capacity to organize, restructure, rebuild, expand and operate the institutions and infrastructure that is needed.

The GOA needs to outline a national plan for electrification, beyond the immediate needs of rehabilitation. Such a plan will be integral to any projections and programs for economic recovery and growth. Both new generation and extensive new distribution lines are needed for electricity access. On the petroleum side distribution networks for gasoline, diesel and LPG will be needed. The GOA must exercise tenacity to invigorate a National Dialog on the country's redevelopment and the pivotal role energy resources will continue to have.

Again, because of the large capital requirements the GOA must shift its role from that of system/infrastructure operator to a role that compliments and encourages private investment. Subsidies will still be required, but these should eventually be employed as incentives for the expansion of access to new energy services in rural and unattended peri-urban areas. Favorable tax regimes and implementation of the Regulatory Authority and licensing of private generators and distributors as foreseen in the LGE will need to be carried out.

Table 7-3 sets out the recommended TA Program. The program anticipates the assignment of a long term advisor to the 'Electrification' unit that should be established in DNE. This new unit would be responsible for extensive inter governmental coordination. The existing Renewable Energy group in DNE could be assigned to this Electrification group and energy efficiency issues could be added. The unit, with a title of 'Energy Access' could also be responsible for assisting the planning and stimulating distribution of petroleum products. To allow this new unit to have the objectivity and harmonization skills this function will require, DNE should become increasingly autonomous from the MINEA and simultaneously increase linkages with the Ministry of Agriculture and Rural Development, the Ministry of Petroleum and the Central Bank.

Expansion of access to modern fuels, particularly electricity, is an interest that other donors support. The US – UK dialog on assistance to the energy sector of Angola may well consider

rural electrification, including the technical assistance for institutional and organizational strengthening and the analysis and possible financing of appropriate models for the introduction and productive application of new energy sources as a priority focus. Other donor assistance should also be sought for the rehabilitation and extension of the energy infrastructure and services once the donor community is satisfied that the GOA's intentions are serious and the need to move beyond humanitarian relief becomes increasingly evident.

Table 7.3: Technical Assistance Program for Access to Electricity and Petroleum

| Program | Beneficiary | Rational and Objectives | Scope – Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|--|---|---|--|---|---|---|
| National Dialog on Energy and Development | Citizens, Cities and the Country | After decades of conflict there is enormous need for reconciliation and inclusion of broader public in the countries redevelopment | With external TA foment a forum for dialog and debate amongst governmental and private sector advocates for change | Increased participation, increased rationality and increased support for National redevelopment efforts | <ul style="list-style-type: none"> ▪ GOA commitment to a National dialog. ▪ Support and commitment of resources from donors. ▪ Participation from diverse businesses and diverse regions of the country. | Starting 2004, should start an on going increase in dialog and participation |
| National Electrification Planning and Rural and Urban Electrification and Petroleum supply | Rural and Urban Residents | Objective: Develop strategy, tools, procedures and plan for implementation of rural generation and distribution along with billing, collections and metering program. | <p>Create Electrification Unit within DNE that works closely with other Ministries.</p> <ul style="list-style-type: none"> ▪ Long Term ExPat TA to support Unit. ▪ Quantify revenue loss and non-technical losses ▪ Develop alternatives and associated costs ▪ Develop effective subsidy structure which promotes rational investment and use ▪ Select most viable approach ▪ Develop implementation plan and budget. | Concerted Program of Government supported incentives for private sector participation in electrification programs for residential consumers and community uses. | <ul style="list-style-type: none"> ▪ Identification and quantification of workable alternatives that stimulate both investment and appropriate consumption. ▪ Clear indication of potential costs and benefits of electrification. Clearly defined role of regulator and ENE. | 2004 - 2006 However, planning and revisions will be an on going responsibility of the DNE Electrification Unit |
| Integrated Rural Development Programs | The entire Country, but especially rural resident | A rural development strategy is a critical subset of any National Development Strategy and any dialog on the role of energy in changing economy | <ul style="list-style-type: none"> ▪ Community education, ▪ Community participation, ▪ Data collection and analysis, prioritization of investments ▪ Design of appropriate subsidy mechanisms based on the identification of the end user benefits | Empowerment of rural communities in their control and ownership of their future | <ul style="list-style-type: none"> ▪ Communities help build, finance and maintain their energy and water supply infrastructure. ▪ Decisions on productive applications are made. | 2004 - 2006 These programs must be dynamic and subject to frequent revision |

| Program | Beneficiary | Rational and Objectives | Scope – Key Activities | Expected Outcome | Performance Criteria | Implementation Timeframe |
|---------------------------|--|--|---|--|---|--------------------------|
| Private Sector Investment | Rural and Peri-urban residents Energy entrepreneurs | <p>Policies for private investment in infrastructure.</p> <p>Design of appropriate subsidies to encourage investment and reduce financing costs</p> <p>Permits and concessions or other programs that attracts large private commitment to generation and distribution to large segments of the population still without access to electric power.</p> | ENE and EDEL are restructured or privatized and significant support for LGE rules for concessionaire permitting are effected. | New private investment begins to be deployed in long term infrastructure development | <ul style="list-style-type: none"> ▪ Public and donor capital is increasingly complimented and supplanted with private investment in energy infrastructure | 2006 and beyond |

Section 8 Overall Conclusions and Recommendations

This report has presented an assessment of the mid to long-term energy situation in Angola. It provides a vision of how the sector could evolve under the right conditions and discusses those factors that will drive development of the sector. This study builds on the findings of the Emergency Response Study which provided a diagnostic of the current and near term situation and recommended appropriate TA to support Angola rehabilitation efforts.

Based on our understanding and perspective of the energy sector we have developed a global vision of the sector, which could and should be the basis for developing an energy program. It is worth repeating this vision:

To meet the energy needs of all segments of Angola's population in the most efficient and cost-effective manner through private participation in the development of a market oriented energy sector which would promote economic development while at the same time ensuring long-term sustainability

The GOA recognizes that energy is crucial to the economic development of the country. However given the critical needs of the energy sector and the country in general its focus is, out of necessity, on the short term. However, it is important that a longer-term perspective evolve soon particularly for the capital-intensive energy sector if the proposed vision is to be attained. In degree, this study takes the initial but important step in that direction.

Based on our diagnostic assessment we would observe the following about the longer term development of the energy sector:

- Unless the GOA significantly improves its fiscal management there will, with the exception of the upstream petroleum sector, continue to be a severe limitation of funds to develop the energy sector. An important aspect of this fiscal management will be the rationalization of subsidies and the pricing of energy at commercial levels. In regard to any additional external funding, it may be appropriate to consider the design of an output based aid scheme for the sector tied to meeting demonstrable performance targets for services provided to designated eligible user groups.
- It is critical therefore that the private sector play an increasing role in the sector- this may be the only way our proposed vision for the sector would be achieved
- Any energy projections at this time must be considered as indicative and subject to large uncertainties given the lack of data and analysis. While it appears that energy demand will grow moderately, in fact, energy demand will likely be supply constrained and could grow as quickly as service is extended in parallel with economic development
- Petroleum development will continue to drive growth in Angola over the mid to long term. Ideally this should exert less influence over the longer-term as the economy grows and diversifies but this hinges heavily on the GOAs development policies and programs

- Angola will become a significant supplier of crude oil to world markets in the next ten years. This will require an examination of the appropriate roles for Sonangol and the Ministry of Petroleum as well as Angola's position in the region.
- The development of the downstream petroleum sector is an area which requires investment and has significant potential for private sector participation. Development of this segment would also improve access to much needed energy supplies
- Reliable supplies of electricity are essential for economic development. While supplies appear to be adequate over the next ten years, this surplus could quickly disappear as the economy develops and demand is added. Furthermore, reliability and quality of supply are seriously inadequate. The power sector as currently structured will not be able to meet the needs of a modernizing economy. There is a significant need for private sector participation in the sector. However this will not be forthcoming without the appropriate regulation in place.
- Gas development is a longer-term issue and will hinge on the development of the proposed LNG facility. Even with the development of the plant gas use will be localized given the plants proposed location.
- Rural energy, while recognized as an important issue by the GOA, is beyond the capacity of the government to address in a comprehensive way in terms of the commitment, institutions and resources required to achieve significant improvement in access in the long -term

Given the above, our principle recommendations for mid-long term assistance, which are discussed in detail in the foregoing sections, are as follows:

- The power sector should be the primary target of any assistance program. Its future operation and performance will be critical to economic development. Accordingly recommended assistance would seek to improve basic planning. There is also a need to provide commercialization, and pricing assistance. Power sector reform will also require a restructuring strategy. TA should also focus on developing the necessary incentives and instruments to attract private sector participation.
- Vitally important to the development of the power sector and the attraction of private investment will be independent, authoritative regulation. TA should be provided to establish an electricity regulator, develop the necessary tools and procedures, as well as design the implementing regulations
- Petroleum Sector assistance should be focused on downstream product supply and distribution developing the appropriate plan and regulations for attracting private sector participation.
- Gas Sector assistance will be longer term depending on the progress in developing the LNG facility it would be focused on developing a master plan for localized demand for gas
- Energy Accessibility in Peri-Urban and Rural Areas: TA provided to the power sector and downstream petroleum sector would be a starting point for improving accessibility.

However there is a significant and vital need to commence developing a policy, plan and the social/political infrastructure to insure the success of recommended programs

The technical assistance programs and training identified in this report can have significant benefits in the mid to long term. In order to be successful they will require comprehensive management. The most appropriate way to accomplish this coordination would be through an in-county advisor. However, just as important, if not more so, will be the commitment and willingness by the GOA to support these programs and the provision of a counterpart team that is committed to its success.

Appendix A
List of Meetings

International Government and Donor Institutions

U.S. Embassy, Angola: Mr. Christopher Dell (Ambassador), and Mr. William Ayala (Economic-Commercial Officer)

USAID Mission, Angola: Mr. Robert Hellyer (Mission Director)

British Embassy, Angola: Mr. Steven Graham (Second Secretary, Commercial), and Mr. Paulo Boa (Commercial Officer)

Royal Norwegian Embassy: Ms. Vibeke Skauerud (Program Officer)

The World Bank: Ms. Olinda M. Vieira Dias (Resource Management Analyst), and Ms. Lisa Maier (Operations Assistant)

DFID: Mr. Martin Johnston (Country Representative)

IMF: Mr. Carlos Leite (Resident Representative)

European Commission: Mr. Robert Steinlechner

Government of Angola Institutions

Ministry of Energy and Water: Mr. Botelho de Vascancelos (Minister), Mr. Rui Augusto Tito (Vice Minister), Mr. Francisco Talino (National Director of Energy), Mr. Paulo Fernando Matos (Planning Director), Mr. Diogini Orsini (Electricity), Mr. Munzila Jackson (Renewable Energy), and Mr. Serafim Silveira (Licensing & Inspection)

Ministry of Petroleum: Mr. Herold Ekke (Resident Advisor)

Ministry of Finance: Mr. Pedro de Morais (Minister)

ENE: Mr. Eduardo Gomes Nelumba (Director), Mr. Luis Mourão Garcês da Silva (Commercial Administrator), Mr. Kilele wa Tshama (Planning Administrator), Mr. David Feixeira de Carvalho (Commercial Director), Mr. Mateus Gaspar (Human Resources Director), Mr. José Marinho (Generation and Transmission Director), and Mr. Alcino Jai Junior (Finance Administrator)

EDEL: Mr. Armando João (Director General, Investments), and Mr. Carlos Ferreira

Sonangol Holding: Mr. Syanga Abilio (Vice President), Mr. José M.J. Sousa (Production Director), Mr. Antonio Orfao (Director Concessions), and Mr. Fernando Santos (Director Legal Department)

Cambambe Hydropower Station: Field Trip

Sonangol Distribuidora: Mr. Fernando J. Roberto (Executive Director, Trade and Commerce)

Ministry of Environment: Mr. Carlos Santos (National Director Environment)

Ministry of Fisheries: Mr. Jon Klepsvik (Advisor to the Ministry)

Foreign Investment Institute: Dr. Castorio

BAI: Dr. Ricardo de Abrio

BCI (Bank of Commerce and Industry): Mr. Generoso Hermenegildo Gaspar de Almeida (President)

BPC (Bank of Savings and Credit): Dr. José Massano (Administrator)

FDES (Fundo de Desenvolvimento Economico e Social): Mr. Paixao Franco (President), Mr. Amandio Esteves (Administrator), Mr. Joao Quipipa (Economist), and Mr. Daniel Antonio (Lawyer)

International Petroleum Companies

ChevronTexaco: Mr. Mike Allison (General Manager), Ms. Ana Major (General Counsel),
Mr. Thomas Mitro (General Manager, Finance)

British Petroleum: Mr. Chris Spaulding (Deputy General Manager Block 18/31)

TotalFinaElf: Mr. Hubert des Longchamps (Director General), Mr. Michel Treier (Director
General, Refinery) Mr. Rui Diogo (Sustainable Development Manager), and Mr. Patrick
Toutain (Director Safety and Environment)

ExxonMobil: Business Representative

Non-Government and Other Organizations

Care International: Mr. Douglas Steinberg (Country Director)

Nova Cimangola: Mr. Steffen Kasa (Managing Director), Mr. Bruce Willis (Technical Director)

Blackwood Hodge: Mr. Carlos Pacheco (Director General)

JEMBAS: Paul Wesson (Commercial Director)

ADRA (Associacao de Desenvolvimento Rural e Ambiente): Mr. Luis Monteiro (Director), and
Mr. Fernando Pacheco

Appendix B

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