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# **REPUBLIC OF YEMEN**

## **COMPREHENSIVE DEVELOPMENT REVIEW (PHASE I)**

### **Power and Energy Sector**

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**Middle East and North Africa Region**  
**Infrastructure Development Unit**

# **REPUBLIC OF YEMEN**

## **COMPREHENSIVE DEVELOPMENT REVIEW (PHASE I)**

### **Power and Energy Sector**

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## **CHAPTER I - BASIC DATA AND TRENDS**

### **A. Coverage and introduction identifying the Block**

#### **Coverage**

1.1 This Building Block covers oil and gas, electric power, and rural energy. It brings together the analysis of the problems in the sector, and reviews the prospects to achieve the development goals. In doing so, the report assesses the contribution of the sector to the Government's overall development objective, the links with other Building Blocks, and the state of development of the Yemen energy sector relative to countries in the region.

1.2 The common theme is the prospect of the contribution of the sector to poverty alleviation, and the need for the Government not only to strengthen resolve and commitment in implementing the sector strategy, but also to translate such resolve and commitment into concrete results.

#### **The challenge to the Government**

1.3 The Government recognizes that to meet its development policy objective of rapidly increasing incomes and alleviating poverty, the energy sector must play a key role. The challenge to the Government is, therefore to meet the energy needs of the country in an economic and environmentally sustainable manner. To address this challenge, the Government has adopted a three-pronged approach: (i) improve the efficiency of the sector by reforming existing utilities and expanding private sector participation in the development of the energy sector; (ii) focus on efficiency of Government expenditures; and (iii) promote partnership with community and local private sector in meeting the energy needs of the urban and rural poor. The strategy to achieve these goals is to develop the appropriate legal framework and reforms conducive to private sector involvement. For power, and under the Sana'a Emergency Power Project (SEPP), the Government issued a Statement of Power Sector Development Strategy (SPSD) in 1998, which provides the framework to achieve the goals in the sector. An Electricity Master-plan study is nearing completion, a power restructuring study is under preparation, and work on the development of a Rural Energy Strategy is to begin soon by IDA in collaboration with the Government.

#### **Sectoral Background**

##### ***Oil and Natural Gas***

1.4 Until the discovery of oil and gas in Yemen in early 1980, and the start of oil production about 1987, Yemen had depended entirely on imports of petroleum to meet its commercial energy needs. Total recoverable oil reserves are estimated to be about 1 billion barrels. Gas reserves are about 11 trillion cubic feet (equivalent to about 2 billion barrels of oil). The oil is of high grade quality with low content of sulfur and other

impurities. Since exports of oil began, it has become the major source of foreign exchange earnings for the country accounting for about 70% of export earnings, and about 55% of Government revenues. Some of the crude oil is refined locally into petroleum products for the domestic market. However, over the next 5-7 years, oil production is expected to decline significantly, which could have significant impacts on the economy. The Government, therefore, faces the challenge to develop and maintain sound fiscal policy aimed at improving efficiency of Government expenditures, and to increase revenue mobilization from other sectors of the economy.

1.5 The gas produced currently from the oil fields is mostly re-injected to improve oil recovery, and also for extraction of liquefied petroleum gas (LPG) for the domestic market. The Gas and Electricity Master-plan study commissioned by the Government under the ongoing SEPP will define the strategy for economic utilization of gas in the economy. The challenge of the future is to attract private investors for the development of the gas.

1.6 Oil drilling, production, and pipeline transmission is by the private sector in a production sharing arrangement with the Government. Petroleum products distribution by haulage transport is done by the Yemen Petroleum Company (YPC), and local private sector.

1.7 The Ministry of Petroleum and Mineral Resources has responsibility for oil and gas. The operating entities are the YPC and the Yemen Gas Company (YGC).

### ***Electric Power***

1.8 Electricity supply is done by both the public and private sectors. In spite of the significant growth, electricity supply has not expanded rapidly and efficiently enough to meet the rather rapid growth in demand from urbanization, and population growth. Currently, and with an installed capacity of about 800 MW, the system is characterized by supply shortages of about 12% of peak demand due to inadequate generation, transmission and distribution systems, high electricity losses, and weak management and financial capability. The Public Electricity Corporation (PEC) remains a financially weak institution, and heavily dependent on government budget subsidies for operations, and investments. PEC is responsible for the production and supply of about 80% of the electricity consumed in the country. The rest is by local community cooperatives, private industries, hotels, and individual private operators. Following the unification in 1994, the power systems of the north and south were interconnected into the present national electricity grid. PEC owns, develops, and operates the interconnected power grid, and the few isolated power grids in the rural areas. Community cooperatives, and the individual producers operate mostly in the rural areas.

1.9 Rural electrification is also carried out by the Government Authority for Rural Electrification and Water Supply (GAREWS). As its primary function, GAREWS provides the generator set, and basic wiring, which is then turned over to the rural community for connections to consumers, and operation of the system. The major issues remain the large number of on-going projects, which are selected on political

considerations, inadequacy of funding, and the high rate of project failure. The other major issue is the lack proper training of the communities to manage and operate the system. The success rate of projects have been poor on the whole.

1.10 Both PEC and GAREWS fall under the responsibility of the Ministry of Electricity and Water (MEW). A major issue is the lack of clarity in the responsibilities of the MEW and those of PEC and GAREWS.

***What has been IDA's involvement and its impacts?***

1.11 IDA's involvement in the energy sector dates from the mid-1970's. Focus has been primarily on developing the electric power system, where IDA has supported five projects, altogether. The assistance has been mainly in: (i) institutional development in establishing the public utility, capacity building in all aspects of power utility operations; (ii) the construction of the physical transmission and distribution networks, which presently constitute the interconnected national power grid; (iii) rural electrification; and more recently (iv) the rehabilitation and expansion of some existing generating plants under the SEPP. This involvement, together with the support of other multilateral (especially the Arab Fund and the Islamic Bank) and bilateral donor agencies, enabled the rapid expansion of the physical supply facilities, and some improvements in the technical areas of operations of the power utility. However, significant issue of efficiency improvements still remain.

1.12 In oil and gas, IDA has supported two technical assistance projects for oil exploration promotion, and for institutional strengthening and capacity building within the Ministry of Petroleum and Mineral Resources (MPMR), the YPC, and the YGC. These two projects were successful in attracting significant foreign venture capital for oil exploration and development.

**B. Brief overview of key indicators and trends**

1.13 The key indicators for the analysis of sector performance are:

- oil production, and reserve status;
- total and per capita commercial energy consumption, commercial energy use intensity
- natural gas production, and uses;
- total and per capita electricity consumption, electricity losses, and unserved demand, accessibility to electricity supply (electrification ratio);
- capital, and recurrent government budget expenditures in electric power;

- energy prices, and relation to international levels;
- financial performance indicators of PEC;
- non-conventional energy use; and
- status of sector reforms and private sector involvement.

1.14 The basic data and trends are based on our ongoing dialogue with the various key players and information available to the Bank from project appraisal documents, supervision reports, documents from public expenditure reviews pertaining the energy sector, country economic reports, and outside sources of information – the United Nations and OECD publications, and a recent consultant report of a Power Master-plan and gas utilization study for the Government. The key indicators are provided for each of the components of the sector, and indicate the performance of the sector components over the years, as well give indications of the utilization of energy in support of economic growth.

***Oil Production - Yemen's oil reserves are rapidly declining***

1.15 Recoverable reserves are estimated at about 660 million barrels in the Marib field, about 270 million barrels from the Masila, and about 70 million barrels from a number of smaller fields. Oil production began from the main fields in 1987 at about 150,000 barrels per day. By 1994, about 67% of the reserves in Marib, and 24% of the reserves in Masila had been exploited. Production in Marib and the smaller fields is by the Yemen Hunt Oil Company ( YHOC), and by Canadian Occidental Petroleum Company (CANOXY) in the Masila fields. Production reached a peak of about 350,000 barrels/day about mid-1998, as shown in Table 1.

**Table 1: Oil Production (000 barrels/day)**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Daily Oil Prod. & Exports	190	190	180	210	270	340	300	320	350	330

1.16 By end-2000, nearly 98% of the reserves in Marib and in Masila would have been exploited. From then onwards, production is expected to level at about 50,000 barrels per day mainly from the smaller fields up until about 2007, when known recoverable oil reserves would have been fully exploited.

### ***Gross and per capita commercial energy consumption***

1.17 Commercial energy (oil, gas, and electricity) utilization in the economy has grown with economic growth and increases in urbanization and population. The United Nations Energy Statistics provides the main source of data, which is available only up to 1995. Total commercial energy consumption grew at an average annual rate of about 13% per year in 1992-95. Earlier data before unification appears unreliable.

1.18 Over the same period, per capita energy consumption grew on the average by about 6% per year, even though per capita income grew much lower at about 4%. This is explained by the relatively low prices of petroleum products, and electricity maintained by the Government, as well as the rapid growth in commercial activity, which accounted for most of the increase in commercial energy consumption. The lower figure in 1994 reflect a break in the estimated population data from the unification of the country, and the population census. Table 2 summarizes commercial energy consumption.

**Table 2: Commercial Energy Consumption**

	1992	1993	1994	1995
Gross consumption (000toe)	2,485	2,679	2,637	3,624
Per capita consumption (kgoe)	193	197	184	241

### ***Energy intensity***

1.19 Energy intensity measures the efficiency with which energy is used in the production of economic output. It is estimated as economic output or gross domestic product (GDP) per unit of energy consumed. The estimate is influenced by the exchange rate regime if expressed in US\$/ kgoe. For Yemen, the estimates for 1992-94 are unreliable because of the over-valuation of the Rial. The estimate for 1995 reflects a change from the fixed exchange rate to a market determined rate of exchange, and appears more realistic. Table 3 provides the estimates of energy use intensity.

**Table 3: Energy Intensity (US\$/kgoe)**

	1992	1993	1994	1995
Intensity (US\$/kgoe)	6.12	6.83	8.49	3.02

### ***Natural Gas is the fuel of choice for the future***

1.20 Estimated reserves of natural gas are about 11 trillion cubic meters (TCF), equivalent to about 2 billion barrels of oil, and are expected to meet the needs of Yemen through substitution for oil in power generation, industrial, commercial, and households uses for the very long-term future. At the current annual level of commercial energy

consumption of about 4.6 million tons, the gas reserves could last for about 65 years, an indication that the reserves could last for the next century.

1.21 Current *production of the gas is about 2220 million cubic feet per day (2220MMSCFd)* in a form of associated gas with oil and from condensate fields, which is processed to extract LPG, and natural gas liquids (NGL). About 5,000 barrels/day of NLG is blended with the crude oil and exported. LQP production is about 1,100 tons/day, of which about 800 tons/day is bottled for the domestic market. The rest, about 90% of the gas is re-injected in to the wells to enhance oil production

1.22 As a relatively low-cost, and clean source of energy, gas is expected to play a major role in the country's energy balance in the future. However, for the full economic potential of the gas to be realized, significant investments would be required for its development and supply, which is expected to be provided by the private sector. The Gas-Electricity Master-plan Study would provide the basis of economic utilization of gas for power generation, and other uses in the economy over the next 10-15 years.

### ***Electric Power has seen significant growth, but major issues remain***

1.23 In view of the continuous IDA involvement in electric power in Yemen over the past 20 years, the dialogue with the Government has been very active, and the information base on the system operated by PEC is broadly adequate. However, information on privately operated isolated rural power systems is very limited, but these account for less than 10% of total electricity consumed in the country.

1.24 Electricity is generated from oil-fired steam plants located at the coast, and diesel generating plants in the main urban areas, and in some isolated rural locations. The installed capacity operated by PEC is about 800 MW having grown from a rather low level in the early 1970's.

1.25 There has been significant growth in electricity consumption over the past years as the supply system went under rapid expansion to meet the needs of growing urban population, industrial and commercial activities:

- *electricity consumption* grew at an average annual rate of about 10% from 1978 – 1987, and about 6.4% in 1987-1998. Households account for nearly 60% of the consumption, followed by industry and commerce accounting for about 20%;
- about 40% of the population have *access to electricity supply* from both the public systems operated by PEC, and from community cooperatives, and private producers/ distributors. The electrification ratio is much higher in the urban areas averaging about 84% than in the rural areas with an average of about 26%;
- in spite of the rapid growth of the power system, *per capita electricity consumption* remains very low, about 150 kWh per year, which reflects the

low per capita income, and the fact that about 70% of the population live in rural areas;

- due to constraints in the supply networks, especially in the urban areas, *electricity losses amount to 28-30%*. The exact breakdown between technical and non-technical losses is not known due to inadequate metering system;
- *un-served demand* is equally high averaging about 80 MW, and reaching about 100 MW at peak demand periods

1.26 Table 4 below summarizes the demand and supply balance (1993-1999)

**Table 4: Summary Electricity Demand and Supply Balance**

	1993	1994	1995	1996	1997	1998	1999
Net Gen. (GWh)	2122	1957	2216	2242	2425	2716	2848
T&D losses (GWh)	537	478	643	677	691	778	786
(%)	25	24	29	30	29	29	28
Net Cons (GWh)	1585	1479	1573	1565	1734	1941	2062
Households	830	830	889	906	998	1118	1188
Bulk cons.	12	7	6	8	9	10	11
Commerce/ Industry	608	515	542	521	575	644	683
Others	135	127	136	130	152	169	180
Available Capacity (MW)	586	521	484	483	519	522	577
Maximum Demand (MW)	418	420	488	497	502	549	574
Reserve Margin:							
Estimate (MW)	168	101	-4	-14	17	-27	3
Required (MW)	63	63	73	74	75	82	86

***Government budget continues to be a major source of funding for electric power***

1.27 Information on the sector investment is available only on electric power. Total investment expenditures in electric power amounted to about YRs 22 billion (US\$137million) in 1999. The total contribution from the budget to electric power was about Yrs 18 billion (US\$ 112 million), about 80% of total power sector capital expenditures, and about 8% of total government budget expenditures. Of the government contributions, about Yrs 15 billion (US\$94 million) was for capital expenditures, and Yrs 3 billion for recurrent expenditures to cover the operating losses of PEC. This was in addition to the off-budget fuel subsidies to PEC. About 50% of the government capital contributions was for the rural electrification program managed by PEC, and about 20% for GAREWS' rural electrification program. This indicates the heavy dependence of the power sector on the government budget.

1.28 There are about two hundred rural electrification projects in the investment portfolio at different stages of completion, almost all have been under implementation since 1997. Because of the large number, and for political reasons, each project receives

a yearly allocation. The available funds are thinly spread over the projects, leading to delays in completing projects, and additional cost-overruns. *The recommendations from the recent expenditure reviews with the Government calls for re-alignment of priorities, and consolidation to finish projects at advanced stages of completion, as soon as possible.*

### **Energy Pricing**

1.29 Most energy prices are below international levels and rural consumers pay much higher prices than consumers on public supply. However, only good gasoline is priced above international levels to raise tax revenues for the Government. Other petroleum product prices are below international levels for political and social reasons, especially kerosene and LPG, which are used by households for cooking, lighting, and heating, as well as diesel fuel, because of its extensive use in transport, and water pumping for agriculture. However, rural consumers pay prices, which are about 50% higher than the government control price, as distribution margin of the private distributors. The intention of the Government is to eliminate the subsidies on fuel oil and diesel fuel in 2001. However, kerosene and LPG would continue to be subsidized on social grounds.

1.30 Electricity prices to consumers on the PEC supply system average about Yrs 8.7/kWh ( \$0.054/kWh), are below both financial and economic costs of service. The price paid by industrial and commercial consumers is much higher than for households and other low voltage consumers. Because of the low price of diesel, private industries and hotels with own generation are able to produce at lower cost than the purchase price from PEC. *Rural households on private electricity supply pay prices which are about 3-5 times the price paid by households on public supply.* An electricity pricing study is to be undertaken by consultants for the Government, which will provide the basis of setting tariffs for economic efficiency, financial viability, and social considerations. *Table 5 shows prevailing energy prices.*

**Table 5: Energy Prices (December 1999)**

Product	US\$	% of international level
Gasoline/liter	0.22	182
Kerosene/liter	0.064	56
Diesel/liter	0.064	56
LPG/12.5kg	1.56	10
Electricity - US\$/kWh:		Estimate of economic cost**
(i) households*	0.03	0.109
(ii) industry/commercial	0.075	0.09
(iii) bulk industry	0.075	0.085
(iv) Government Admn.	0.035	0.109
(v) Av. Fin. Cost/kWh***	0.063	

\* Average of increasing block life-line rate structure. 1- 200kWh priced at Yrs. 3/kWh.

\*\* Preliminary estimate of long-run marginal cost.

\*\*\* Cash operating cost/kWh sold.

***PEC is a financially weak entity***

1.31 The combined effects of high levels of inefficiencies, and low tariffs have resulted in weak financial performance of PEC. Tariff increases agreed under the SEPP have not been made by the Government. PEC continues to receive subsidies on diesel fuel, and fuel oil. In the short-term, tariff increases are inevitable, however, greater emphasis should be placed on improving efficiency in the medium term to avoid further deterioration, and increasing dependence on the budget. *Table 6* shows some key financial performance indicators.

**Table 6: Key Financial Performance Indicators (1998)**

Energy sales growth (1998/1997)	17%
Operating ratio:	70%
Debt service coverage	negative
Contribution to investment	negative
Receivable days	113 days
Average Rev./kWh	US\$0.054

***Non-conventional and rural energy use***

1.32 Based on the 1994 population census, about 70% of rural households, and 50% of all households use wood for cooking. However, data on consumption volumes are unavailable. The extensive use of wood is leading to rapid deforestation of the meager forest resource in Yemen. In addition, the use of wood for indoor cooking has adverse impacts on human health. Because rural households spend significant time collecting wood, less time is available to engage in other productive economic activity. The Government's policy is to improve the penetration of commercial energy into the rural areas. The current strategy is based on expanding rural electrification, and enhancement of the infrastructure for the distribution of petroleum products. The Rural Energy Strategy study is expected to provide the basis of meeting the energy needs in an economically and environmentally sustainable manner.

***Reform status and private sector involvement***

1.33 Though still limited, private sector involvement in the energy sector is not a recent event. Local private sector has been involved in petroleum products distribution for a long time, and similarly for electricity production and distribution. Electricity supply in Sana'a was privately owned until it was nationalized by the Government in the early 1960's with the creation of the Yemen General Electricity Corporation (YGEC) as the state-owned utility for the overall responsibility for the production and distribution in the country. All major private enterprises have own generation. Private electricity supply in the rural areas has also been prevalent. Community owned electricity supply systems are a more recent development.

1.34 For petroleum foreign direct investments began following the exploration and development promotion campaign by the Government assisted by IDA. There was

significant response from the international oil companies (IOCs) in venture capital investments in exploration, which led to the discovery of oil and gas in early 1980. Since then foreign direct investments in oil exploration and development grew to about US\$ 6 billion, and were made mainly by YHOC - about \$4 billion, and about \$1.2 billion by CANOXY. YHOC investments were in upstream petroleum exploration, development, construction of a refinery at the oil field, and pipeline transport system from the oil field to the coast. The production sharing arrangement entitles the Government to about 20% of the export revenues of the oil.

1.35 It is the policy of the Government to attract private investments in a significant way, from both foreign and local sources, for the future development of the energy sector. The reforms to create the enabling environment have just began. For electric power, the basis of the reforms and the implementation are being developed by consultants for the Government under the SEPP, which would include the drafting of the primary electricity legislation, the restructuring of PEC into independent companies, and the development of the secondary legislation. The development of a comprehensive petroleum law, covering oil and gas should be given urgent priority attention by the Government.

### **C. Role Of The Block In Yemen's Broader Development And With Particular Respect To Poverty Reduction**

#### **The Role of Energy in the Economy**

1.36 Energy is a major element in Yemen's economy, being a major input to economic activity. The expansion and improvements in electricity supply has been very catalytic in the rapid urbanization growth, industrialization, and the rapid growth of the commercial and services sector. Electric power has contributed indirectly to poverty alleviation through employment creation brought about by growth in the economy, especially in the urban areas.

1.37 *Income from oil exports, and local taxes on petroleum constitute a significant revenues source for the budget. In 1998, total revenues from oil and gas amounted to Yrs 125.2 billion (US\$ 800 million), about 55% of total government revenues, and about 45% of budget expenditures in 1998. Oil and gas revenues are key to the Government's ability to fund infrastructure and social projects. The expected fall in such revenues due to the declining oil reserves in the future would have important impacts on the Government's ability to support the social sector. It is expected that revenues from natural gas through its substitution for oil in electricity production, and industrial applications would fill in the gap in oil revenues. However, this will require a sound pricing policy that would provide incentive for efficient use of gas, as well as be a source of revenue for the Government.*

1.38 Pricing of diesel fuel, kerosene, and LPG below international levels is depriving Government from additional revenues, which would contribute to reducing the budget deficit. It is expected that the subsidies on these fuels will be eliminated by end-2001.

1.39 Creation of the proper legal and regulatory systems, which would assure *equitable and transparent governance, and efficient use of public resources, increased market competition and public safety, and for the sector, on the whole, to become a net contributor to the budget, would lead to protection of public interest, and increase the sector's contribution to the development of the social sectors. Private investments would free government resources for the social sectors, which would benefit the poor.* In addition, the efficiency improvements in energy delivery through private participation will also benefit the poor.

1.40 Improvements in rural electrification have contributed to economic activity leading to improvements in incomes, and the quality of life. Evidence from the 1994 census between electrified and non-electrified villages confirm this. *Further improvements in access to commercial energy in the rural areas would further improve incomes, and reduce rural-urban migration, reduce de-forestation and adverse human health impacts of fuel wood use, and promote improved health and productivity in the rural and poor urban areas.*

1.41 Even though the budget contributions to electric power amount to only 8% of total Government expenditure, improving efficiency of use of the expenditures would enable timely completion of rural electrification projects and increase in supply to consumers. Elimination of the fuel subsidies to PEC and to private electricity producers would contribute to reducing the Government budget deficit.

***What are the links to other Blocks?***

1.42 Energy is essentially linked to the following blocks in view of the cross-cutting issues, and strategy formulation for integrated development:

- (i) *Macro-economy*: the linkages are through the sector's impact on the economy as discussed above;
- (ii) *Public sector management*: Reforms and restructuring of the sector to create a competitive market in oil and gas and in electricity, and private sector participation would lead to redefining the role of the Government in the sector.
- (iii) *PSD/privatization/FDI*: The energy sector would constitute the main area that would be attractive to foreign private investors. Activities on private sector development, such as the development of the general privatization law, the competition law, etc would be critical to the legislation in electric power, and the manner of future private sector involvement;
- (iv) *The Infrastructure Blocks*: (a) the *Transport Block*- there is specific earmarked fund from gasoline taxes for road development. Strategy, and development of roads is linked to policy on gasoline pricing; (b) *Urban Strategy Block*- in terms of meeting the energy needs of the urban poor for cooking, lighting and heating in an affordable, and environmentally safe manner. Energy bill absorbs a significant proportion of the disposable income of the urban poor. This has implications for the development of strategy aimed at improving the well-being

of the urban poor; and (c) *Water Resources Block* – electricity, and diesel fuel are major inputs in the operations of NWSA, and in irrigation for water pumping. Economic pricing of electricity and diesel fuel should lead to efficient water resource management.

- (v) *Rural Strategy Block*: Efficient and reliable energy supply is a key element of an integrated rural development strategy to provide basis of support for improved economic activity. Because of the under-developed state of the infrastructure, and inefficient energy delivery systems, the cost of energy to the rural poor is disproportionately too high compared to urban areas as discussed earlier. The rural energy strategy is to be developed within the context of integrated rural development.
- (vi) *Environment Block*: Energy production and use has adverse environmental impacts due to pollutant emissions ( sulfur and nitrous oxides) from the thermal power plants, emissions of sulfur and lead from transport, and other pollutants from the use of wood for indoor cooking and heating in addition to the deforestation from wood cutting. The Bank's environmental strategy for energy cites Yemen as one of the cases with adverse environmental impacts of energy use.

#### **D. Key aspects of Energy-Block specific knowledge base**

1.43 This deals with the strengths and weaknesses in the information. The strength lies in the long-term IDA involvement in the sector. The weakness lies in the inaccuracies in some of the data. Since Yemen was two different countries before the unification, consistent time series data over long period are not available. The main gaps in the information are:

- Inadequate data on commercial energy use by sectors to assess energy intensity by sectors;
- Information on aggregate commercial energy use is available only for the period 1992-95;
- Information on rural energy use other than electricity is available only for one year, and dates from the population census in 1994;
- Limited information exists for assessing status of the rural electrification program managed by GAREWS.

1.44 The approach to filling-in the information gap is discussed in Chapter IV.

## CHAPTER II – INTERNATIONAL COMPARISONS

2.1 All the key indicators in energy reflect the low per capita income of the country, the lowest in the region, and the relatively underdeveloped state of infrastructure in Yemen compared to the other countries in the region, and countries of similar income levels. The comparison of the key indicators is limited by the available data on the countries.

### Commercial Energy Consumption

#### *Per Capita Consumption*

2.2 Per capita commercial energy consumption, although grew about 6% per year in 1992-95 in Yemen, remains the lowest in the region as shown in *Table 7*

**Table 7: Comparison of per capita Commercial Energy Consumption (kgoe)**

	1992	1993	1994	1995
<b>Yemen</b>	<b>193</b>	<b>197</b>	<b>184</b>	<b>241</b>
Egypt	363	400	364	429
Morocco	225	248	273	250
Tunisia	445	437	460	450
Syria	508	504	509	517
Jordan	750	748	754	768
Lebanon	761	712	740	765

The comparison also indicates that countries with higher per capita income have higher per capita commercial energy consumption. Currently Lebanon's per capita income is about \$3,000, nearly ten times that of Yemen. This illustrates that improvements in incomes, and improvements in access to commercial energy, especially in the rural areas where the majority of the population live, would be essential in improving economic well-being.

#### *Energy Intensity*

2.3 Intensity of energy use in Yemen is about the average of the countries in the region. Comparison is made for 1995 only. Earlier estimates for Yemen are unreliable because of the over-valuation of the Rial relative to the US\$ in the earlier years. Intensities are higher in Jordan, and in Egypt, because of the relative higher component of industrial commercial energy use. Comparison is provided in Table 8.

**Table 8: Comparison of Energy Intensities (US\$/kgoe) - 1995**

<b>Yemen</b>	<b>3.02</b>
Jordan	2.09
Tunisia	4.45
Morocco	4.93
Egypt	2.26

## Electric Power

### *Electrification Ratio (Accessibility)*

2.4 While only 40% of the Yemen population have access to electricity, rural electrification ratio is much less, and is the lowest in the region. Again, an indication of the relatively lower state of development of the energy supply infrastructure and incomes compared to other countries. Table 9 provides the comparison.

**Table 9: Electrification Ratios - percent of population**

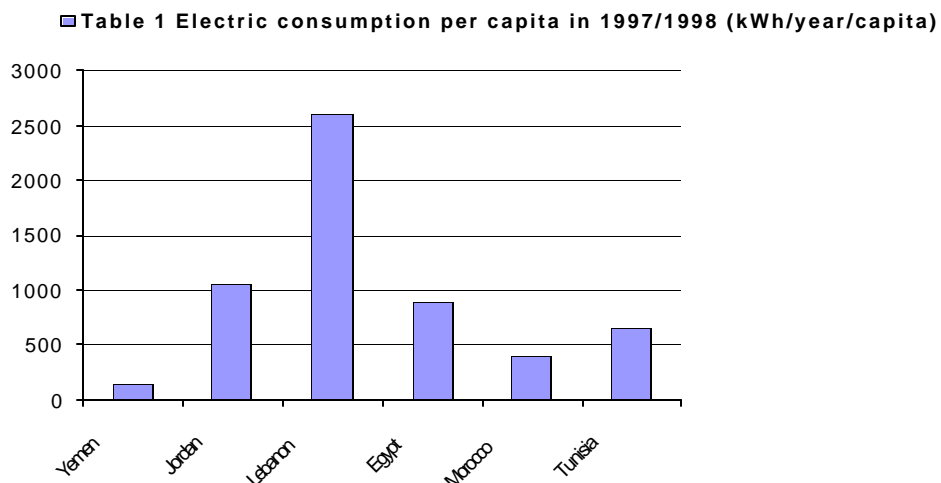
Country	Total (%)	Urban (%)	Rural (%)
<b>Yemen</b>	<b>40</b>	<b>84</b>	<b>26</b>
Jordan	99.8	100	98.9
Morocco	46	68	20
Egypt	98	100	95
Lebanon	98	100	96
Tunisia	98	100	93

2.5 The above is further confirmed by the comparison of the per capita electricity consumption as shown in Table 10 and in Figure 1.

**Table 10: Per capita electricity consumption (kWh/year)**

Country	Per capita cons.	Year
<b>Yemen</b>	<b>150</b>	<b>1998</b>
Jordan	2,050	1998
Lebanon	2,600	1998
Morocco	400	1996
Tunisia	665	1996
Egypt	900	1997

**Figure 1: Electricity consumption per capita in 1997/1998 (kWh/year/capita)**



## Energy Pricing

2.6 The energy pricing policies of Governments in the region seek to assure financial viability of the sector entities, while providing explicit subsidies to households in the form of life line rates for electricity, and pricing LPG used by households for cooking, and lighting below international level. Prices in Yemen are the lowest for most products, except LPG. Petroleum product prices, with the exception of LPG are above international levels in the other countries shown below. For electricity, the prices are averages by consumer category, and no attempt is made to compare with economic levels for lack of information, which will be later updated. Table 11 provides comparison of typical petroleum products and electricity prices.

**Table 11: Comparison of Energy Prices (US\$)**

Country/Product	Gasoline (liter)	Kerosene (liter)	Diesel (liter)	LPG (12.5kg)
<b>Yemen</b>	<b>0.35</b>	<b>0.064</b>	<b>0.064</b>	<b>1.56</b>
Jordan	0.50	0.20	0.20	2.70
Lebanon	0.41	0.18	0.18	0.35
Morocco	0.75	0.40	0.20	0.20
Tunisia	0.52	0.20	0.35	0.20

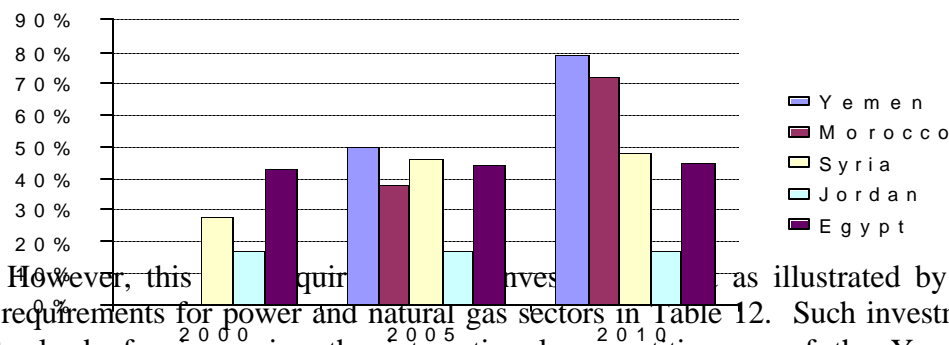
Electricity/US\$(/kWh)			
	Residential	Industry/Commercial	Average
<b>Yemen*</b>	<b>Urban Av. 0.03</b> <b>Rural Av. 0.047</b>	<b>0.075</b>	<b>0.054</b>
Jordan*	Av. 0.057	0.05/0.084	0.062
Egypt*	Av. 0.025	0.084	0.042
Algeria (1997)	0.028	0.026	0.024
Tunisia	0.07	0.053	0.058
Lebanon	0.07	0.12	0.086
WBG	0.15	0.15	0.15

\* average including life-line rates; \*\* West Bank & Gaza flat rate for all consumers.

## Future Role of Gas

2.7 Like many countries in MENA region, Yemen is expected to shift its energy balance towards natural gas and to do so more aggressively (Figure 2) given (i) the recent gas reserves discoveries that could supply the domestic market, (ii) the rising demand driven by electricity that will further increase the gap between supply and demand in energy and, (iii) the need to free up oil for export.

**Figure 2: Gas Penetration in the Power Generation**



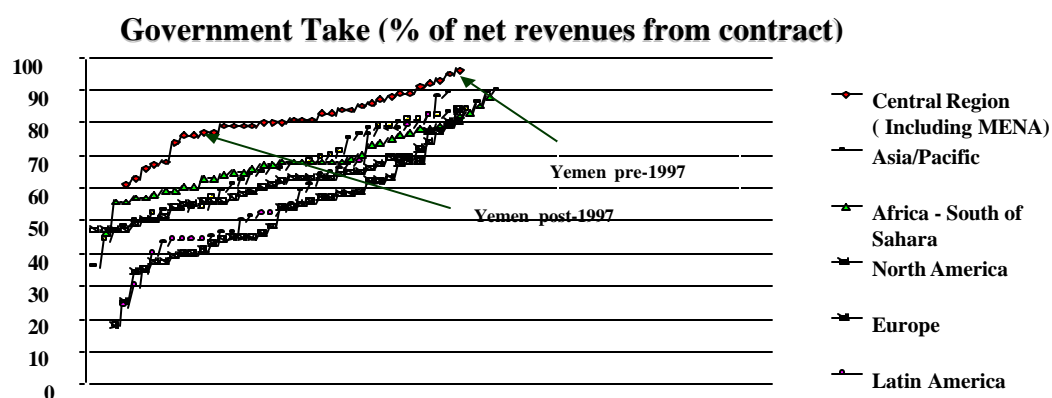
2.8 However, this requires investments as illustrated by the investment requirements for power and natural gas sectors in Table 12. Such investment requirement pleads for improving the international competitiveness of the Yemen's business enterprises particularly in the upstream hydrocarbons and in the generation and distribution in the Power sector

**Table 12: Investment Requirement in the period 2000-2010 (million US\$)**

	Power			Gas		
	Generation	T/D	Total	Upstream	Infrastructure	Total
<b>Yemen</b>	<b>550</b>	<b>470</b>	<b>1020</b>	<b>230</b>	<b>490</b>	<b>720</b>
Jordan	750	430	1170	20	40	60
Egypt	5280	3200	8480	1650	2040	3690
Syria	5470	2970	8430	700	1460	2160
Lebanon	1910	790	2700	0	0	0
Morocco	1900	1560	3460	0	250	250

Source: Gas and Power in the Developing World, PennWell.

2.9 Exploration for additional hydrocarbons reserves and new investments from foreign companies began to decline in 1994, due to (i) political circumstances, (ii) low rate of success of new hydrocarbon discoveries and (iii) unattractive exploration and production contractual conditions. However, exploration activity picked up again in 1997 when government started to offer more attractive contract terms under production sharing contracts (Chart below).



**Note: Each point represents a country typical government take**

2.10 The above chart represents Government take as percentage of net revenues. Contractual terms offered by Yemen are competitive when compared to countries in the region (with an average Government take of about 80%). The majority of those countries have been able to impose tough fiscal regimes as they hold very attractive oil potential and have established a track record in oil and gas production. Yemen's contractual terms, however, are in a comparative disadvantage with countries that, like Yemen, have less oil reserves or limited hydrocarbon production track record - Table 13.

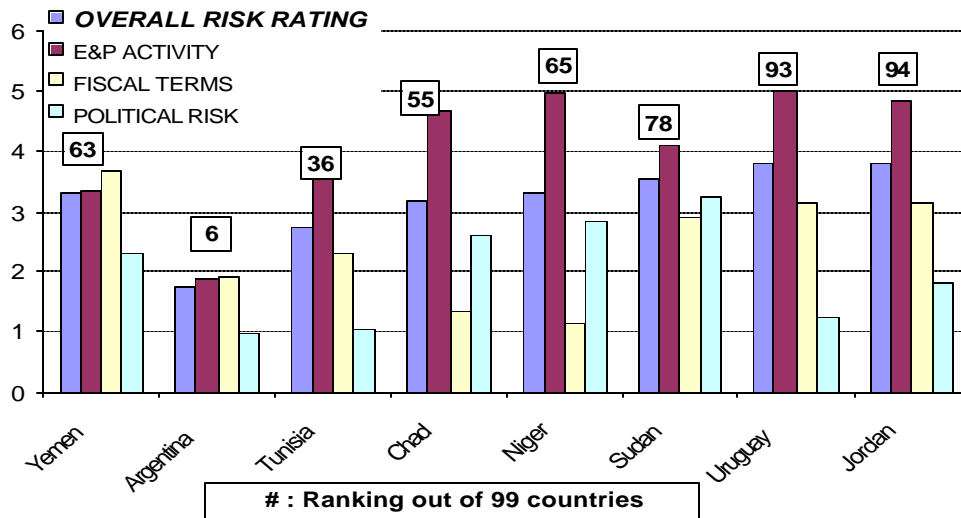
**Table 13: Comparative Analysis of Contractual Terms with Peer Group Countries**

	<b>Reserves</b>	<b>Producing since</b>	<b>Production (1997)</b>	<b>Government Take 1/</b>
<b>Yemen</b>	<b>4.0</b>	<b>1986</b>	<b>385,000</b>	<b>157</b>
Chad	1.2	0	0	38
Tunisia	0.3	<1980	90,000	132
Sudan	0.3	1991	5,000	162
Uruguay	n/a	n/a	n/a	3
Argentina	2.6	<1980	834,000	27

1/ Ranking out of 226 fiscal terms worldwide

2/ Sources IEA. Reserves in billion barrels, production in barrel per day.

2.11 Finally, while the petroleum industry is perceiving Yemen as holding a good hydrocarbon potential – the lower the bar-chart, the lower the associated perceived risk-, the overall risk perception is boosted up as a result of (i) the perceived political risk and (ii) the toughness of the fiscal terms (Figure 3 below).



## CHAPTER III – DEVELOPMENT GOALS AND PROSPECTS

### Development Goals:

3.1 The Government's development goal for the energy sector is to improve its efficiency of development and operations in order to meet the energy needs of the country at least-economic cost, and in an environmentally sustainable manner. In this way the sector would contribute to increasing income growth, and alleviation of poverty.

3.2 The strategy of the Government to achieve this goal in the energy sector is to involve active private participation, which will bring new technologies and the capital needed for the development of the sector.

3.3 Active private sector involvement began with the discovery of oil. Total foreign direct investment in oil exploration and development is estimated to be of the order of about \$6 billion. With oil reserves on the decline, the goal of the Government is to actively seek the development of the country's vast gas reserves to substitute for oil based on private sector investments. To achieve this, the Government needs to develop the appropriate legal and regulatory framework.

3.4 For electric power the goals are clearly defined in the Government SSDP. These are stated as short term, and medium-long term goals.

#### 3.5 *Short-term goals*

- Improve operational efficiency of PEC to achieve financial solvency ;
- Introduce economic pricing of electricity;
- Define the basis of restructuring the PEC, through an institutional organization study;
- Complete and submit a draft electricity legislation to Parliament for consideration;
- Complete a Gas-Electricity Master Plan study to define strategy for economic utilization of gas; and
- Define a rural energy strategy.

#### 3.6 *Medium – long term goals*

- Complete sector restructuring, and the development of the legal and regulatory systems conducive to private sector participation;
- Develop the next power generating station based on domestic natural gas as private sector venture;

- Attract private investments in power distribution;
- Raise rural access to electricity to 50% of rural population in partnership with communities, and the local private sector; and improve overall rural access to commercial energy; and
- Achieve proper integration of energy and environment, with developed environmental regulations.

3.7 Achieving these goals will require a clear understanding of the Government and stakeholders of the issues involved, because of the significant changes that would have to take place. In addition, there must be the ability to translate commitments into concrete actions. The political climate requires consensus building from the start. This should begin with wide dissemination of the recommendations of the Institutional Organization study, and the Gas-Electricity Master plan study, as well as the overall policy and strategy of the Government.

### *Prospects of achievement*

3.8 Even-though these goals have been articulated, the weak understanding of the goals and how they could be achieved poses a constraint. This, combined with lack of Government commitment, makes prospects of achievement rather bleak.

3.9 The Government has so far failed on its commitments to take the agreed measures, including the necessary tariff adjustments, that will bring about efficiency improvements for PEC to achieve financial solvency. Even-though the various studies have been initiated, the key issue would be the implementation of the recommendations.

3.10 Based on the experience in private participation in oil, the Government has shown its commitment to further deepen the involvement of the private sector also in electric power development. The recommendation is for the Government to follow a transparent competitive process in the negotiations and selection of would be private sector investors for the realization of the benefits of meaningful private sector participation for the country. It is unclear whether this would be the process that the Government would follow in the case of the on-going discussions with a would-be private developer of the next power station. The recommendations of the Gas-Electricity Master plan study should be discussed in order to establish a clear strategy for economic utilization of gas in the country, before closing deals on private sector investments.

3.11 The major decisions on the changes in the sector would be made by the Parliament through the appropriate legislation. Since experience is limited on the part of the Government, the processes could be lengthy, which could lead to lost of interest, and momentum.

3.12 In the face of resource constraints to improve energy supplies in the rural areas, it is important that projects be selected on the basis of economic criteria, with improvements in efficiency of project execution.

3.13 It may be too early to judge the prospects of achievement of the goals. IDA's policy advice would be important, together with close collaboration with other donors and lenders to the Government on the issue of strategy.

## CHAPTER IV - NEXT STEPS

4.1 The following are the next steps to complete the review.

- (a) *Discussions with the Government and the sector agencies* of (i) this initial draft report to seek views on the paper, and to fill in the gaps in the information; (ii) the report on the Gas-Electricity Master-plan study, and to agree the medium to long-term least cost development program for expansion of the power system, and the strategy for the future development and utilization of gas in the other sectors of the economy, and households; terms of reference and agree the timetable for carrying out the rural energy strategy study. These will be done as part of the sector supervision mission planned in March, 2000;
- (b) desk work to collect additional information for the international comparisons, especially, on some countries outside the Region with similar economic characteristics like Yemen;
- (c) discussions on cross-cutting issues and recommendations with the other Blocks linked with the energy block; and
- (d) prepare a revised report of Phase I, and complete the draft for Phase II.