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ENERGY STRATEGY FOR AFRICA'S INDUSTRIAL SECTOR

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INTRODUCTION

The disturbing energy situation is one of the major factors limiting Africa's economic development, particularly in industrial sector.

Primary energy production on the continent with the population of more than 11 per cent of the world's total remains very low, of about 6 per cent of the global output, and consumption is very different, with commercial energy concentrated in a very small part, urban and industry, and traditional energy for the rural areas.

Oil is still the major energy source in industrial sector, and accounts for 65-70 per cent of the regional commercial energy consumption; natural gas (10-12%) and coal (20-22%) account for another 30-35 per cent, with only 1 per cent for electricity.

With the exception of 7 oil exporting countries, which export some 65-70% of produced oil and gas, the rest of developing African countries are heavily depend (up to 100%), on imported energy, mainly petroleum products for their industries and transport.

The rural sector mainly uses traditional energy sources: wood, charcoal, vegetable and animal wastes, which are still account more than 50 per cent of the total energy consumed in Africa, and 80-90% of the energy consumed in rural areas.

In regard to electricity, the total installed capacity, both hydro and thermal, remains very low, only 5 per cent of the exploitable potential,moreover, 85% of this capacity is concentrated only in the ten countries, while the majority of African countries are endowed with abundant resources of cheap water power.

There are two main factors affect the present energy situation in Africa.

The first is that energy costs, particularly of petroleum products and electricity, are still very high, and in the late 1980s the majority (some 65%) of African countries spend up to 70 per cent of their export earnings on energy imports.

The second factor is the fact that energy consumption is on the large scale, and that creates a situation in which Africa needs all its exploitable energy resources, which must be harnessed in their entirety to cope with the rising demand for energy (in the range of some 20-30% for the decade).

In regard to industry, this sector is generally very weak in Africa, with only about 10 to 12 per cent for both manpower and energy consumed; moreover, the basic core industries such as metal, engineering and chemical, which are the major energy consumers, are concentrated in a few countries, and their energy supply is far from sufficient, on the level of 50-60 per cent of their requirements. This results in the very low level of industrial performance, with the average capacity utilization for the majority of industries in the range of 30 to 50 per cent.

In this connection, the purpose of this paper is to outline the current status and trends in development of energy resources, production and consumption in industrial sector with a point of view to rational energy strategies for use, efficiency and conservation.

1. ENERGY SITUATION IN AFRICA

1.1 Resources and production of commercial energy

Africa, with the population of 610 million or 11.5% of the world's total, possesses a significant potential in conventional and renewable sources of energy. The continent accounts for about 10 per cent of the world's both oil and coal reserves, for 8 per cent of natural gas and 16 per cent of exploitable hydropotential. A major concentrations of oil and natural gas are in the North and West subregions, coal is concentrated in the South-Eastern subregion, and hydropower energy is concentrated in the Central subregion.

Table 1 summarises Africa's energy resources, production, trade and consumption in 1990.

Oil African oil reserves are more than 81 billion barrels. Significant oil reserves have 18 African countries. The largest oil reserves are in Libya, Nigeria, Algeria and Egypt (about 80% of the region's total), these countries are also the major oil producers and exporters, accounting for over 80% of regional output. Among other 14 oil producing countries the significant producers are Angola, Gabon and Cameroon. The regional oil production in 1990 was 322 million tonnes. The rest of oil reserves including those in Sudan, Senegal, Chad and Madagascar are still remain undeveloped.

Natural gas African natural gas reserves are 8,500 billion m^3. The largest reserves are in Algeria, Nigeria, Libya, Egypt and Mozambique (90% of the region's total). Algeria is a major producer (70% of the region's total) and exporter of natural gas in the world. Most of Congo's and Nigeria's associated gas output is flared, and less than 10% is used in Nigerian industry. Other significant gas producers for domestic consumption are Libya, Egypt, Gabon and Angola. Regional production in 1990 was 182 million m^3 . The rest of natural gas reserves including those in Sudan, Senegal, Cameroon, Rwanda, Zaire, Ethiopia, Madagascar, Somalia and Tanzania are still remain undeveloped.

Coal Africa accounts for more than 64 billion tonnes out of the world's total 610 bill,t. of coal reserves. Zimbabwe, Botswana and Mozambique are being endowed with the most extensive deposits (85% of total for 18 countries having coal reserves). Zimbabwe, Botswana, Morocco and Zambia are the largest coal producers in the region (90% of the total regional output of 7.6 million tonnes in 1990). Other coal producers are Swaziland, Tanzania, Mozambique,Malawi,Algeria,Egypt,Nigeria, Niger and Zaire. However, only few countries such as Algeria, Nigeria, Egypt and Zimbabwe are using coal in their iron and steel industries, and many coal deposits including those in Angola and Madagascar are still undeveloped.

Hydropotential Practically all African countries, with a few exceptions such as Algeria, Libya,Botswana Chad and Togo, have significant exploitable hydropotential for electricity production, as well as water resources for use in industry and for irrigation. Africa's technically exploitable hydropotential is estimated to be over 360 GW, with only Zaire river potential of more than 100 GW, and the remainder is associated with the Zambezi, Nile and Niger rivers and with the abundance of shorter rivers. Of this less than 5 per cent had been exploited, the total installed capacity (both hydro and thermal) is 45,000 MW. The major electricity producers (90% of the region) are 14 countries: Egypt, Libya, Algeria, Morocco, Tunisia, Ghana, Cote d'Ivoire, Nigeria, Cameroon, Zaire, Angola, Kenya, Zambia and Zimbabwe, while the majority of African countries have very limited electricity production.

The summary of energy resources and their exploitation in Africa is, therefore, as follows:

Eighteen African countries are endowed with the significant oil, gas and coal reserves, and the majority of the countries have significant hydropotential.

However, these reserves are distributed very uneven, and energy production is concentrated in several countries (14 for oil, 10 for gas, 13 for coal and 14 for electricity), while the bulk of African countries (34 out of 51 or 67%) are imported from 90 to 100 per cent of their energy requirements (see table 1).

At the same time the major part, some 70%, of the regional energy output is exported. As an example, Algeria, Egypt, Libya, Tunisia, Nigeria, Cameroon, Congo, Gabon, Zaire and Angola are exported from 50 to 90 per cent of their energy production to other African and overseas countries (see table 1).

1.2 Primary energy balance

Such a variable character of distribution, production, consumption and trade of African's energy results in insufficient primary energy balance. Comparison of the world's and Africa's energy balances is shown in Table 2, and indicates their significant difference.

Comparison shows that Africa, with its 11.5 % of the world's population requires only 3.5-4% of the world's energy and produces only 6-6.5% of the world's energy output, of which about 70% is exported. It means that the regional energy consumption (production minus exports plus imports) is on the level only 2-2.5% of the world's,or 5 times less than the world's average. Comparison per capita energy consumption, of 57 and 12 GG for the world and Africa respectively, clearly indicates very low energy consumption in the region.

Hence, despite of equal or at least substantial energy reserves, of 10 to 16% for the population of 11.5% comparatively with the world's total, African continent produces only 6% of the world's energy, or comparatively twice less and consumes only one third of produced energy or five -six times less of the world's average. Therefore the balance, about 40% of the total energy requirements, is carried by the traditional fuels, particularly in household and rural areas, which is six-seven times more than the world's average.

In contrast with the world's average figures for energy balance (coal-20%,nuclear-15%,petroleum-35-40%, gas-20%, electricity-5%, traditional fuels-6%), Africa's requirements comprise some 25% for both petroleum and coal, 10% for gas,1.5% for electricity, with the remaining 40% for traditional fuels. Trade is unbalanced, with 65-70% for exports and about 10% for imports.

Hence, the major indicators for African energy balance are: low energy production (6% of the world), low energy consumption (five times less than the world's average), low level of use of the major energy resources (50% less for gas and 5 times less for electricity

comparatively with the world average), high exports of energy, particularly petroleum, at the level of 65-70% of total output, and high energy imports for the majority of countries.

Taking into account that the figures in table 2 are average for the whole region, the energy balance for African subregions are shown in table 3, which indicates that the real situation in majority of the African countries with exception of the North Africa, is even much worse. As an example, the average sub-saharan energy consumption per capita is only 6 GG and share of traditional fuels is about 65%.

2. ENERGY DEMAND AND SUPPLY IN INDUSTRIAL SECTOR

From the above analysis of energy production,consumption and balance in Africa, it became clear that the current situation with the energy supply in industry is far from sufficient and requires very much to be improved.

Generally, with exception of the North Africa, the industrial sector itself in the majority of African countries is very weak. As one could see from table 1, the average percentage of economically active population employed in the industrial sector is about 30% for the North Africa, and only about 10% for the rest of the region with one half of African countries have less than 10% of population involved in industry.

In regard to energy use in industry, assessments show that in developed countries the major industrial users of energy are metal industries (primary metal processing and fabrication), accounting for some 50% of total energy, chemical industries (including petrochemical and rubber)- for another 30%, and the remaining 20% is consumed by the light industries (food, textile, leather, wood, paper,etc.). Typical sectoral energy use for developed countries is 40-50% for industry, 20-30% for transport and 30-40% for household.

Due to the weakness of industrial sector in Africa, particularly those for basic industries, such as metal, chemical and engineering, the picture for industrial use of energy in the continent

is quite different of those of the world. The major energy consuming industries such as metal, chemical and engineering are established only in few African countries. As an example, integrated iron and steel complexes and related metalworking industries exist only in 6 countries (Algeria, Egypt, Libya,Tunisia, Nigeria and Zimbabwe); the chemical industries are established also in few countries (Algeria,Egypt, Libya, Nigeria. Moreover, the majority of the heavy basic industries are mainly located in the North Africa with the few exceptions for the rest of the region.

Therefore, as could be seen from table 1, the sectoral energy consumption in Africa is as follows, per cent of total:

	Industry	Transport	Household
North Africa	38.5	21.5	40.0
West Africa	9.5	16.3	74.2
Central Africa	7.7	5.5	86.8
East/South.Africa	20.5	11.5	68.0
Sub-Saharan Africa	12.5	12.5	75.0

While for the North Africa sectoral energy consumption is near to those for the worlds' average, for Sub-Saharan Africa, the industry and transport each consumed some 12.5% of total energy with the remaining 75% for household.

Except for the low indicators for industry (19% of population employed, 12.5% of total energy consumption, concentration of industry only in the few, mainly North African countries). it should be taken into account that presently practically all major industrial sectors are working at a very low level of their capacity utilization, in the range 30 to 50 per cent. Among the main reasons for such a low level of performance of industrial sector are the shortage and interruptions of energy supply and the high energy prices.

As an example, in some African countries,particularly in the West and Central subregions the price of electricity is in the range 0.3-0.4 US$.

In regard to the energy supply in industry, the present situation in the region is as follows:

Energy	Demand	Supply	% of demand
Petroleum (Mill.t.) (Sub-Saharan Africa)	3.9	2.1	55
Natural gas ('000 toe)	3,750	2,250	60
Coal ('000 t.)	1,250	750	60
Electricity (mill. KWH)	20,000	10,000	50

It is clear, that energy deficit in industry is in the range of 50-60% which corresponds the present level of installed capacity utilization.

The figures above are calculated taking into account that presently energy demand for industry is some 15-20% of total, and supply is on the level of 12.5%.

Demand forecast for the major energy resources in Africa for the period 1990-2000, taking into account an average growth rate of 2-3% and share of energy in industry of 15-20% of total is as follows:

Year	1900		1995		2000	
	Total	Industry	Total	Industry	Total	Industry
Petroleum (Mill . t.) (SubSaharan Africa)	31	6	35-36	7	39-40	8
Natural gas ('000 toe)	30,000	6,000	35,000	7,000	42,000	9,000
Coal ('000 t.)	10,000	2,000	12,000	2,500	14,000	3,000
Electricity, (Mill.KWH)	160,000	30,000	180,000	35,000	200,000	40,000

From the present situation with energy supply in industry and demand forecast for the year 2000 it is clear that some measures should be undertaken to improve industrial energy supply, particularly in the context of the Second Industrial Development decade for Africa (IDDA-II), 1991-2000.

3. STRATEGY FOR ENERGY USE IN INDUSTRY

During the forthcoming decade, the African countries will continue to rely heavily on oil for their industrial sectors, and will expand their use of natural gas. Given the increasing oil prices, coal is likely to make a significant comeback at the regional level. Presently, both coal and electricity consumption is very low, in the range of only 2-3% of the total energy.

The commercial energy sources such as coal, oil, natural gas, hydroelectricity require capital intensive technologies for their exploitation, transformation, transport, distribution and utilization. benefit to cost ratio for the development and utilization of commercial energy resources became acceptable when supplies are furnished to large scale such as industries and transport. due to that reason, the significant part of known exploitable energy reserves in the region is still remains undeveloped. For further development energy production and its use in industry, the following major factors should be taken into account:

- the African industrial sector is currently supplied with energy quite insufficiently, on the level of 50-60% of requirements;

- energy prices are very high, particularly for the petroleum products and electricity, the major imported industrial energy sources for the most African countries;

- the basic industries such as mining, metal, engineering, chemical, and also some others as paper, leather, etc. create highly polluted industrial areas;

- consumption of coal and electricity in industry is very low and should be increased;

- many of African known exploitable energy reserves still remain undeveloped.

In this connection, the relevant coherent energy strategies should be elaborated by African countries, particularly in the context of IDDA-II, in identifying of high priority projects and requirements in the energy sector and its use in industry.

This strategy should contain the following major actions:

(i) Africa must mobilize all its energy resources for its future development, including:

- Acceleration of hydrocarbons exploration within prospective areas including oil shales and tar sands;

- Development and utilization of a larger scale of coal, lignite and peat resources;

- Increase in utilization of natural gas;

- Accelerated development of hydropower resources through multinational participation and co-operation;

- Development of new and renewable sources of energy;

- Development of energy conservation programmes.

(ii) Industrial sector should use all energy sources more efficiently including:

- Accelerated use of cheap and "clean" energy sources, such as hydropower, which also has renewable character;

- Develop the technologies for more efficient and "clean" use of coal;

- Create appropriate pricing and taxation policies of energy products to encourage energy resources efficiency and conservation;

- Accelerated development of industrial technologies, particularly in metal and chemical subsectors which are based on using of local natural resources (coal and gas), energy saving, energy wastes utilization and in environmentally acceptable way.

UN Economic Commission for Africa plays a significant role in formulation, preparation and implementation of such a strategy to be accepted by all African countries and should be based on their co-operation.

As a good example of implementation of such a strategy in industry based on local resources, energy savings and less polluting energy using is recent establishment of modern gas-based direct reduction iron and steel complexes in Nigeria, Egypt and Libya. Another good example is the regional workshop, organized by ECA this year, on possibilities to produce basic chemicals from natural gas, which is of great interest of many African countries.

Development of conventional and renewable energy technologies goes hand in hand with measures to improve the efficiency with which energy is used in industry, for there is a little point in increasing the available range of energy supplies without taking steps to make the best use of it.

Table 3. Primary energy balance in Africa, 1990
(% of total)

Commodity / Subregion	Oil	Gas	Coal	Electricity	Traditional Fuels	Consumption per capital, GG
North Africa	50.6	26.8	3.8	2.8	16.0	32
West Africa	31.6	0.7	0.5	2.4	64.8	4
Central Africa	27.4	0.8	0.2	4.3	67.3	7
East and South Africa	27.3	0.4	2.9	4.6	64.8	6
African total	34.2	7.2	1.8	3.5	16/65.6 --- 53.2	32/6/12

Table 2. Primary energy requirement, production, trade and consumption in the world and Africa
(x000 TG/% of total; GG per head)

Requirements							Production, trade and consumption							
Total	Solids	Liquids	Gas	Electri-city	Tradi-tional fuel	Per capita	Total	Solids	Liquids	Gas	Electri-city	Consump-tion per head	Imports	Exports
							World							
268432/100	76888/28.6	112452/41.9	53795/20.0	8775/3.3	16517/6.2	60	269244/100	76878/28.6	129586/48.1	53998/20	8782/3.3	56	95109/35.3	94204/35.0
288776/100	90999/31.5	105590/36.6	60911/21.1	12510/4.3	18699/6.5	59	280034/100	89735/32.0	116790/41.7	60997/21.8	12512/4.5	56	82008/29.3	79566/28.4
321103/100	97523/30.4	16679/36.3	72176/28.5	15125/4.7	19529/6.1	60	318735/100	97199/30.5	133393/41.9	73083/22.9	15059/4.7	57	103936/32.6	103313/32.4
							Africa							
9110/100	2175/23.9	2493/27.4	704/7.7	219/2.4	3419/38.6	19 6.3	16921/100	2879/17.0	12790/75.6	1032/6.1	219/1.3	12	2084/12.3	12475/73.7
10632/100	2778/26.1	2796/26.3	731/6.9	183/1.7	4143/39.0	19 6.0	16778/100	4000/23.8	10986/65.5	1610/9.6	182/1.1	12	1909/11.4	10944/65.2
12733/100	2956/23.2	3359/26.4	1551/12.2	184/1.4	4683/36.8	20 6.5	2073/100	4085/19.7	13679/66.0	2772/13.4	195/0.95	13	2120/10.2	13591/65.6

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African total	34.2	7.2	1.8	3.5	16/65.6 --- 53.2	32/6/12