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ENERGY POLICIES AND STRATEGIES IN AFRICA

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I. INTRODUCTION

1. A fundamental requirement for economic development of any country is an adequate energy supply and prospects for economic growth are closely linked to the provision of affordable and reliable energy. Therefore, the formulation of appropriate policies and strategies for the development and utilization of energy resources is of utmost importance since the financial resources available for this purpose to African countries are becoming more and more scarce.
2. This is why one of the major thrust in the ECA's activities during the last five years was to assist African member States in capacity building through seminars and workshops on the formulation of policies and strategies in the field of energy policy and planning and the environment, in collaboration with other sister institutions especially the Economic Development Institute (EDI) of the World Bank.
3. ECA has also organized, jointly with the EDI of the World Bank, a regional workshop to address specific problems related to the environmental sustainability and energy development in four IGADD member countries (Djibouti, Eritrea, Ethiopia and Sudan) in Addis Ababa: 6-10 March 1995; participants in the workshop were able to design country programmes in the field of energy development and the environment.
4. ECA has also organized two Ad-Hoc Expert Group Meetings to deal specifically with energy policies and strategies: (i) the Ad-Hoc Expert Group Meeting of Senior Advisers to ECA on energy strategies and policies (Addis Ababa: March 1993); and (ii) the Ad-Hoc Expert Group Meeting on policies and strategies for the development and utilization of natural resources and energy in Africa (Addis Ababa: June 1995).
5. In the past lack of commitment from donor agencies has prevented the abundant African natural gas reserves to be exploited; the ECA has organized, jointly with the World Bank, a symposium on issues and options for exploiting these reserves. The symposium gave the opportunity to participants from African countries with proven gas reserves to exchange views with experts from the World Bank and has come up with conclusions and recommendations that are being implemented in some countries with the Bank playing a leading role.
6. The African Development Bank has launched a study on the African Energy Programme which had the following objectives: (i) a detailed analysis of all aspects of the African energy situation; (ii) the definition of a regional strategy; and (iii) the formulation of an optimal development programme for the energy sector.
7. The following presentation is based on analysis of the studies carried out by the energy unit of UNECA as well as on the outcome and recommendations of the meetings held at UNECA with emphasis on formulation of energy policies and strategies in Africa. The paper examines a range of policy measures that might be taken in order to further both the objectives of energy security and environmental protection and specifically illustrates a conceptual framework within which policy choices might be made in the interface between energy and environment.

II. CURRENT ENERGY SITUATION

2.1 Energy Resources Endowments and their Developments

8. African continent is endowed with abundant primary energy resources although unevenly distributed among countries or within regions of the same country. Energy resources include oil, natural gas, hydropower potential, coal, peat, geothermal potential and fuelwood. Table 1 below gives an indication of these energy resources (1). It is intended to present a general picture rather than give accurate figures as much of the area has not been adequately surveyed or explored.

Table 1: Proven recoverable energy resources of Africa

Regions	Forests Mill. Ha	Hydro TWh p.a.	Oil Mega ton	Gas Tera m ³	Coal Mega ton	Uranium kilo tons
North	4	20	6020	4956	141	0
Central 1/	597	1415	2718	3094	5	326
South	1	6	0	28	55333	426
Africa	602	1441	8739	8078	60929	752

Source: Energy in Africa: A Review by R.K. Dutkiewicz

1/ Central Africa refers to all the countries of Sub-Saharan Africa excluding South Africa

9. In general the Southern African countries have the largest coal resources while the countries nearer the equator have relatively large hydro resources. Oil and gas reserves have been identified mainly in North Africa and smaller amounts along west coastline. The largest uranium reserves have been identified in Nigeria, Namibia and South Africa, while the largest wood resources are found near the equator. Zaire has the largest hydropower potential, while South Africa has the largest proven coal deposits. Nigeria, Libya and Algeria have most of Africa's oil reserves.

10. The range of fossil and new and renewable energy resources endowments remains largely undeveloped for the benefit of Africa's major socio-economic sectors: less than 4% of the hydropower potential has been harnessed so far, many countries are still generating their electricity from oil; for natural gas, only 9 out of 22 countries with proven gas reserves have already started producing gas for local consumption and/or export; for geothermal energy, only Kenya has started to produce a substantial amount of electricity from its geothermal field near the Lake Olkaria; despite the fact that almost 99% of the continent's coal reserves are concentrated in the Southern African region, their exploitation for local consumption and/or export is still marginal, except for South Africa and Zimbabwe.

2.2 Energy Demand

11. The energy sector in Africa is characterized by a large dependence on traditional fuels in the form of fuelwood. The reliance on fuelwood varies from country to country, ranging from 14% for South Africa to 90% for Tanzania. The degree of dependence on fuelwood at an overall national level is broadly related to the level of economic development. It is estimated that on average Africa relies on fuelwood for 57% of its energy needs if South Africa is excluded and 48% if it is included.

12. The vast majority of fuelwood is consumed by the domestic sector for the preparation of food. Wood is also used for small-scale rural industries such as tea/coffee/tobacco processing, lime-making, and brick-making. Traditional fuel on average accounts for 90% of energy consumed by the domestic sector (excluding South Africa). The heavy reliance on traditional fuels can be attributed to the rural subsistence nature of a large proportion of the population of Africa, for whom commercial fuels are expensive and not easily accessible, together with the low level of economic development.

13. The heavy reliance by the population on traditional energy, coupled with the large population growths experienced, has resulted in increasing demand for fuelwood and the clearing of forests for agricultural production. This has led to deforestation and related environmental impacts, as well as a shortage of fuelwood in a number of areas. More and more time is being spent collecting fuelwood at the expense of other activities.

14. The demand for natural gas in the energy sector is quite insignificant in Africa except for some North African countries (Algeria, Tunisia, Libya and Egypt) where it is used for electricity generation and processing heat in industry and, to a less extent, Cote d'Ivoire and Nigeria where it is used in gas-fuelled thermal power plants. In most oil producing Sub-Saharan African countries, associated gas is wasted by flaring or reinjected instead of being utilized for electricity generation, in industry or for domestic uses.

15. The role of coal in the energy sector varies considerably within Africa with South Africa relying on coal for some 81% of its primary energy requirements. Zimbabwe comes second in coal demand for its Hwange coal-fired thermal power plant while Niger has a limited consumption for electricity generation to supply its uranium mining operations at Arlit. It is noteworthy to mention that Kenya is importing coal from Swaziland for the energy requirements of its cement factory near Mombasa.

16. All the countries in Africa rely on oil to a large extent. With the exception of South Africa and Zimbabwe, petroleum products represent the largest source of commercial energy and cause a drain on the scarce foreign exchange earnings of many African countries. Table 2 gives the total final consumption data for different forms of energy in 1992 (Mtoe).

17. According to findings of the African Energy Programme, total electricity production was 312 TWh (312 billion kWh) in 1992 to which hydropower contributed only 19%. The end use of electricity by sector in 1992 was as follows: industry and mining sector accounted for 57%, 26% for the residential sector, 12% for tertiary, 2% for the transport sector and 3% for Agriculture.

Table 2: Total final consumption data for 1992 (Mtoe)

Region	Coal	Oil	Gas	Electr	Total Comme	Vegetal	Total
North	2.0	34.1	7.5	7.7	51.3	2.7	54.0
Central 1/	2.8	24.4	0.9	4.9	32.9	108.5	141.4
South	14.6	14.5	0.5	10.9	40.5	6.6	47.1
Total	19.4	73.0	8.9	23.4	124.6	117.8	242.5

Source: Energy in Africa: A Review by R.K. Dutkiewicz

1/ Central Africa refers to all countries of Sub-Saharan Africa excluding South Africa

2.3 Energy Supply

18. Total installed capacity for electricity generation in Africa amounts to some 84 000 MW, with South Africa alone having some 39 000 MW and Egypt having 13 000 MW. With the exception of Egypt, South Africa and some other countries the infrastructure for electricity distribution and supply is still largely characterized by:

- i. isolated networks, with little or no interconnection between countries;
- ii. low fuel use efficiency;
- iii. low capacity factors, and
- iv. high distribution and transmission losses.

19. In some countries isolated sub-national grids are still found. This is largely due to the long transmission distances that would be required for relatively small loads. In Eastern and Southern Africa, there are great opportunities for expanding power interconnection throughout the continent, including the prospect of Angola, Botswana, Namibia, Mozambique, Zaire, Zambia and Zimbabwe, feeding to and being supplied from South Africa; there are excellent prospects for the interconnection of Sudan, Ethiopia and Djibouti, of Tanzania and Kenya, and the enhancement of the existing Kenya-Uganda interconnections.

20. In West Africa sub-region, it is noteworthy to mention the existing interconnections between Ghana, Cote d'Ivoire, Togo and Benin; and between Nigeria and Niger. The interconnection between Cote d'Ivoire and Burkina Faso is at the feasibility stage. There exists also interconnections between Eastern Zaire, Rwanda and Burundi in the framework of the Economic Community of the Great Lakes countries (CEPGL).

21. The current state of the petroleum products industry in Africa is poor and the cost of supply and distribution is thus excessively high. According to a World Bank study (2), there is a high degree of inefficiency in the supply and distribution of petroleum products in Sub-Saharan Africa. It suggests that open market policies, deregulation, and more efficient refining and distribution activities could generate savings of the order of US\$ 1.4 billion, a half of these savings requiring no initial investment outlay but would result from policy change alone.

22. The study has come to the conclusion that there is a large scope to rationalize the distribution of petroleum products at a country as well as at a sub-regional level by rehabilitating some of the existing infrastructure and by investing in new depots and more efficient transport facilities because the state of the transport facilities (railways, roads, and related rolling material) is in many cases responsible for unnecessary increase of the cost of petroleum supplies.

23. Although Africa has large coal resources, coal markets are poorly developed, except for South Africa which has the largest resources. The barrier to a satisfactory trade in coal in Africa is the inadequate railway system and the political situation. The need for trade in coal to ensure adequate supplies will increase with the general deterioration in the fuelwood situation of Africa. In Southern Africa sub-region, one of the strategies being implemented in the SADC member countries to mitigate the negative impact of fuelwood consumption on the environment is to substitute fuelwood by coal for households energy needs.

24. According to the findings of the African Energy Programme, Africa's consumption of natural gas was equivalent to 33 million toe in 1992 or 1.8% of world consumption. However, its utilization in other African countries could increase after the completion of the envisaged natural gas development projects such as Calub gasfield in Ethiopia, Songo Songo gasfield in Tanzania, Pande gasfield in Mozambique, Foxtrot, Lion and Panther gasfields in Cote d'Ivoire and Escravos project in Nigeria and the gas pipeline to Ghana via Benin and Togo.

25. As most use of fuelwood is used in the informal sector and outside the commercial channel, fuelwood supply figures are poor or non-existent, and accurate and reliable fuelwood demand data, for the household and informal industrial sector, are rarely available.

III. ENERGY POLICIES IN AFRICA

3.1 Preliminary Remarks

26. The central objective of energy policies in Africa remains increase of security of supply in both the short and long term in order to sustain economic well-being. The task of obtaining the necessary energy supplies on a secure basis and at reasonable costs is part of general economic policy; energy policies to a degree are dependent on other factors and need to be consistent with important government goals.

27. After the Rio Conference growing attention is now being paid to the evolution of environmental policies. The African ministers of energy and environment have repeatedly pointed out the necessity of jointly promoting both energy and environmental policies, giving due weight to respective consideration when formulating policies in both areas. This is why ECA has been organizing, jointly with the Economic Development Institute (EDI) of the World Bank, three regional workshops on energy development and the environment including energy planning aspects (Addis Ababa: March 1992; Abidjan: October 1993; and Addis Ababa: March 1995).

28. In the light of recent market developments there is need for correction of the energy policies developed in African member States and formulated in the Lagos Plan of Action. The overall context in which the energy policies were framed in Africa has changed considerably in recent years. Energy policies and strategies formulated in the Lagos Plan of Action included among other things:

- i. the lack of an energy policy in most countries and a short-, medium- and long term energy development programmes;
- ii. the non-integration of energy activities in overall national development planning efforts;
- iii. the need to undertake an exhaustive inventory of all energy resources, having regard to their potentials, possible development and utilization, and of energy needs including suitable equipment;
- iv. the need for African countries to undertake joint action for the development and utilization of existing energy resources on the continent, for which cooperation would have to be initiated or expanded (where it already exists) in the energy field at the sub-regional and regional levels;

- v. the difficulties existing in Africa in the transportation of energy, the lack of standardization in electricity sector, the shortage of qualified manpower (scientists, technicians and management cadres) and the exorbitant prices which African governments have to pay for imported energy and equipment.

29. Despite the fact that energy markets have undergone fundamental changes, most of the policies and strategies formulated in the Lagos Plan of Action are still relevant. In 1980, shortly after the second oil crisis, these policies and strategies were aimed at solving the problem of supply of petroleum and petroleum products; but since 1986, oil prices have dropped significantly. Increasing pressures on governmental budgets and to some extent reassessments of the effectiveness of government programmes frequently have led to cuts in energy programmes. Public concern for energy security may have weakened with the decline of energy prices, but meanwhile, public knowledge of environmental problems and risks has increased and concerns have intensified.

3.2 Exploration and Development of Indigenous Energy Resources

30. Although the African continent has about 15 million sq. km. of sedimentary basin (17.5% of the total sedimentary basin in the world) only 3 to 4 percent of total world petroleum exploration/production expenditure to-date has been in Africa. Nevertheless the extent and pace of petroleum exploration/production in Africa is at present decreasing rather than increasing.

31. During the ECA/IBRD Symposium on Issues and Options for Exploiting African Gas Reserves, it was recognized that initiative such as the revision of the existing legislation on the hydrocarbons exploration licenses to include specific incentives for natural gas projects (pricing, safety, production sharing, ...etc.) and the continuation of exploratory works to increase availability of reserves could result in attracting foreign investors in this high risk sector.

32. Important improvements have recently been made, especially in providing necessary incentives for the further development of indigenous energy resources through changes in licensing, royalty and taxation schemes, deregulation of oil and gas industries, adjustment of pricing and taxation policies, removal of some barriers to free energy trade and further efforts to rationalise domestic high-cost coal production.

3.3 Energy Institutions

33. In many African countries, formal institutions are often inadequate and are replaced in many instances by informal institutions. This results in a dualistic economy, with a formal sector and an informal sector. The formal sector is characterized by significant government intervention through State ownership and/or regulation of strategic sectors of the economy, foreign exchange controls, trade restrictions, licensing and heavy taxation. Few governments have sought to play more than a nominal role in the informal sector which responsible of, among other things, the supply of traditional energy on which the majority of the rural populations and peri-urban households depend to an overwhelming extent.

34. The dualistic nature of the energy economy creates a major institutional weakness. There is a serious need to integrate energy sector activities, but this is difficult to achieve for several reasons; the most important one is that most informal sector activity is related to biomass fuels, and the responsibility of this is often delegated to Ministries other than those primarily responsible for energy matters.

35. In many countries the performance of the energy sector is inadequate due to inappropriate economic policies, weak energy institutions, over-control of the supply side, uneconomic pricing due to government intervention, and an ad-hoc and often negative interference by governments in energy supply industries. Regulatory mechanisms include statutory monopoly powers, price controls, subsidies and taxes.

36. This is why, most of African countries which are implementing Structural Adjustment Programme (SAP) with the support of the World Bank and the IMF are being encouraged by financial institutions to initiate institutional reforms and the deregulation and privatisation of public enterprises; especially the electricity subsector.

37. Cote d'Ivoire was the first African country to privatize its electricity supply company (EECI-Energie Electrique de Cote d'Ivoire) for electricity distribution branch in late 1990. This activity of distribution was entrusted to a sole company, CIE (Compagnie Ivoirienne d'Electricité), which was able to yield positive results just after one year of operation.

3.4 Rural Energies Supply Policies

38. In Africa, rural energies consumed by the majority of the population are traditional fuels (fuelwood, charcoal, agricultural residues and cow dung) to meet domestic energy requirements mainly for cooking and lighting for low-income households. Therefore, availability of these traditional fuels should be given the highest priority when discussing energy policies and strategies in Africa. Traditional fuels in the majority of African countries contribute over 70% of total energy use; this share is more than 90% in most of the 32 LDCs.

39. The majority of African LDCs are located in arid and semi-arid lands (ASAL), in the Sahel and some in the ASAL in the Southern half of the region. In the extremely fragile ecologies of ASAL, heavy dependence on biomass for energy exacerbates rapid devegetation of the environment due to cutting of trees and other biomass for a wide range of uses in addition to land-clearing for expanded agricultural production of food and export commodities.

40. Although many African countries face a fuelwood crisis in the long run, it is commonly recognized that countries located in arid-zones such as the sudano-sahelian belt are a higher risk. This is the reason why, in these countries, strategies and policies aimed at enhancing the management of forests and woodlands are being implemented, especially as regarding the organization of cooperatives of charcoal makers and the regulations for tree-cutting licences.

41. In order to reduce the pressure on the demand for traditional fuels, most of those countries have initiated inter-fuel substitution programmes; i.e. i) replacing fuelwood and charcoal by LPG or kerosene for cooking in urban households; and ii) designing and disseminating improved fuelwood and charcoal stoves, gas stoves and multifuel stoves.

42. Any energy strategies and policies aimed at ensuring the steady supply of energy to rural areas should consider, not only traditional fuels for cooking and heating, but also options to meet energy requirements of other essential activities such as energy for agriculture, water supply, health and education, rural industry, etc.

43. Increasing agricultural production in order to ensure food security despite the population growth, for example, requires the utilization of highly productive and intensive technologies which need more modern sources of energy such as petroleum products for the mechanization of cultivation techniques, energy for pumping drinking water and for irrigation and natural gas as feedstock for the production of fertilizers.

44. Rural electrification is also needed for increasing agricultural production, promoting rural industries, effecting improvements in the field of health, education, training and the standards of living in general and generating employment opportunities which will reduce migration from the countryside to the towns. The off-grid electricity generation options include diesel, small scale hydropower, a variety of biomass-fuelled boilers, gasifiers, wind turbines and solar energy.
45. Energy required to meet some of these essential needs could be supplied through the development of new and renewable sources of energy: draught animal energy could be seen as a first step in the mechanization of agriculture while facilitating the transport of agricultural products; windmills or solar pumps could be the least-cost solution for water supply in remote areas; animal residues could be converted into biogas which is suitable as a fuel for cooking, lighting and electricity generation.
46. The applications of solar energy could play an important role in food preservation with solar dryers (fish and agricultural products), in producing electricity with photovoltaic systems (PVs) needed for lighting (households, schools, health centres, public buildings, etc.), for the preservation of vaccines in health centres, for operation of radio and TV as well as relay stations of telecommunications. Certain applications of solar energy such as PV systems, solar dryers and water heaters are considered as mature technologies.

3.5 Energy Efficiency and Conservation

47. Lower energy prices have had an impact on the economics and market forces affecting conservation activity. Lower prices, more abundant supplies and budget constraints have led to a change in priorities in many African countries both among the public generally and also among government policy makers. There are now signs of rising energy demand and a substantial slowing in the rate of efficiency improvements in new vehicles, buildings and equipment. The rate of growth in energy demand will be dampened, however, by the irreversibility of installed efficient plants and equipment, and by the gradual replacement of older less efficient stock by more efficient new plants and new technologies. (4)
48. Effective and economic energy conservation measures are important for long-term economic well-being because the more efficient use of energy will extend the availability of depletable energy resources and thus contribute to energy security. Higher energy efficiency can reduce environmental consequences of energy production and use. Energy conservation investments often make economic sense by providing at the margin a better return than investments in energy supply and they can often be undertaken in small increments and therefore offer a high degree of flexibility.
49. Limitations exist in African energy markets which tend to prevent the economic potential for further efficiency improvements from being fully realised. These limitations include a continuing lack of reliable information on the energy efficiency of major energy-saving products and investments, split responsibilities between renters and owners, investment decision which focus on first costs rather than life cycle costs, and imbalances between the criteria used for energy conservation investments and other types of investment. This is an area where carefully planned government policies can be effective.
50. Energy efficiency and energy conservation are by no means a new concept in Africa, although in the past its application has been somewhat uneven and the benefits at least variable. In most African countries, it is only in the mid-1980s that conservation measures started to be implemented under the Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP).

51. Tunisia can be considered as a pioneer in this field because, in 1985, the Government created an independent conservation Agency (Agence de Maitrise de l'Energie: AME) which conducted energy audits mandated by the government for the 200 largest industrial, transport and commercial companies, representing 80% of Tunisia's total commercial energy consumption. The Agency offers a variety of tax, import and loan incentives, financed in part through sales tax on petroleum products.

52. As a result, Tunisia's marginal energy intensity dropped from 1.3 in 1985 to 0.8 in 1989, attributable in part to these efforts. In the highly energy-intensive cement industry, energy consumption decreased by 40% during the same period, in large part because of the agency's auditing, training and implementation work with the industry.

53. In Cote d'Ivoire, the Bureau des Economies d'Energie (BEE) was established in 1986 within the Ministry of Mines and Energy. The BEE has achieved significant results in the field of energy efficiency and conservation in the electricity consumption of public buildings; it has also prepared codes and standards related to the energy quality of buildings and air conditioners.

54. The Institute de l'Energie des Pays ayant en commun l'usage Francais (IEPF) is promoting energy efficiency and conservation through its PRISME programme. They organized a training seminar for technicians from 11 countries in Yaounde (Cameroon) in May-June 1993 in the field of energy audits of public buildings, the trainees were provided with the hardware and software as well as with tools needed to carry out energy audits in their home countries.

55. The very comprehensive programme on energy efficiency was carried out by the Technical Administrative Unit (TAU) of the Southern African Development Community (SADC) for member States of the subregion. The major achievements of the programme were widely published in Africa. Energy efficiency programmes in the end-use of traditional fuels (fuelwood and charcoal) have received a significant support from the World Bank and bilateral donors as part of ESMAP. The activities undertaken in this area were: (i) designing and dissemination of improved and charcoal stoves (especially in most of Sahelian countries), (ii) training of charcoal makers in the utilization of improved kilns, and (iii) interfuel substitution (biogas and peat in Burundi, LPG and kerosene in the Sahel subregion).

56. In Africa, there exists a high potential of energy savings in the cement industry and the sugar refineries. In Tunisia, for example, the total energy consumed in the cement industry was reduced by 40% between 1985 and 1989; in modern sugar refineries bagasse is dried and used to produce both electric power and steam needed for the refining process while molasses are fermented to produce ethanol fuel used as a substitute to gasoline in light vehicles (Malawi, Kenya and Zimbabwe).

57. In the electric power subsector, energy enterprises should be encouraged to adopt marketing strategies to improve plant load factors, reduce peak loads and reduce the need for high-cost peaking plant in order to minimize the construction of new power plants and to avoid burning fuel needlessly.

58. In the transport sector, approaches to traffic management include segregation of motorized and non motorized traffic, encouragement of the wider use of bicycles and development of special facilities for them, creation of vehicle-free precincts for pedestrians, incentives for higher vehicle-occupancy rates and parking controls. Most of African countries have not yet considered such schemes which would result in significant reduction of vehicle fuel consumption in main cities.

59. From both economic and environmental viewpoints, it has been demonstrated that energy efficiency investments represent enormous untapped opportunities to save immense amounts of

energy, capital and environmental damage. Producing and consuming energy more efficiently will have to become an increasingly important "source" of new energy supply. Apart from being a "source", energy conservation is a way of mitigating the environmental impacts of energy production and use.

3.6 Energy Pricing and Taxation Policies

60. Energy pricing and taxation systems vary to a considerable degree among African countries. In many countries, price controls exist to varying degrees, with some countries still controlling or supervising most fuel prices.

61. However, in the electricity subsector for example, the regulatory authority must provide clear pricing guidelines to the power enterprises, which should reflect the sometimes conflicting objectives of (i) a commercially-based allocation of costs among consumers according to the burdens they impose on the system, (ii) assurances of a reasonable degree of prices stability, (iii) provisions, where economically feasible, of a minimum level of service to low-income consumers, (iv) power prices generating sufficient revenues to meet the financial requirements of the sector and (v) a tariff structure simple enough to facilitate metering and billing of customers.

62. In many African countries, power entities should be encouraged to be more market oriented in setting prices and to offer a variety of pricing and service options which reflect the actual costs of providing service to customers. Peak load and time-of-day pricing, as well as prices which reflect different voltages, consumer classes and different levels of reliability and availability should all be part of the pricing structure.

63. Energy pricing and related taxation and regulatory policies have long been considered world-over to be important policy instruments in the regulation of individual energy sub-sectors; now energy pricing and related taxation issues are increasingly viewed by analysts as important policy instruments in the achievement of sustainable development, macro-economic policy, and as part of coordinated planning, investment and management decisions for the entire energy sector.

64. In the oil subsector, lower world energy prices have been passed to end-users to varying degrees, not only because of exchange rate effects and different fuel-specific pass-through rates and pricing principles, but in many countries because of deliberate taxation decisions. In some countries taxation schemes have the effect of encouraging the use of certain fuels. However, taxation of various energies is decided upon by governments mainly on economic and fiscal grounds.

65. The taxes on different fuels vary greatly, as does the income derived. There are, for example, considerable differences in gasoline taxes among African countries. Taxes on energy production have been flexibly adjusted in some countries in line with lower energy prices to bring relief to producing industries; tax credits and other benefits have also been increasingly used to encourage continuing R&D efforts when companies tended to cut spending in this areas because of reduced cash flow.

3.7 Government R,D&D Policies

66. As has been repeatedly pointed out above, the development of new technologies plays a major role in providing alternatives for a more balanced and diversified energy mix to ensure medium and long-term security of energy supply. There is continuing need to promote technologies which are at an early stage of their development, such as Renewable Energy Technologies (RET).

67. Unfortunately it is easily forgotten that today's methods of energy production, conveyance and use are themselves a result of past investment elsewhere in R&D that led to discoveries in the energy sector or were side-benefits of R&D in other scientific disciplines. Therefore, Governments have a special responsibility in supporting research and development activities.

68. The introduction of improved technology on an economic basis is fundamental both to securing the more efficient use of energy and to resolving the environmental question associated with energy production, conversion, transport and consumption. There is still room for much improvement in environmentally acceptable energy production and use. Reliable technologies and methods exist to control most of the environmental impacts associated with energy-related activities. Further R,D&D efforts are necessary, and in the present energy situation environmental regulations can be one of the major driving forces for energy-related technological innovation.

3.8 Energy and Human Resources Development

69. There is a close link between human resources and economic development. In many African countries, the inadequacy of professionally and technically experienced personnel is the most binding constraint to development and human resources development in the energy sector should be one of the important activities in those countries.

70. There is a need to have a strong and well manned sector coordination mechanism for the implementation of energy programmes at the national level since many players are to be involved in the decision-making process (ministries, public energy-supply enterprises, oil and gas private marketing companies, central banks for the balance of payment issues, etc.). There is also a need to increase the level of expertise in all subsectors related to energy development which requires identification of needs and assessment of the training facilities in African region.

71. In the electricity subsector, it is noteworthy to mention the Inter-African Electrical Engineering College (IEEC) located at Bingerville (near Abidjan) which provides training for high quality bilingual (French-English) engineers, operational upon graduation and organizes a career development programme for technicians to be promoted into senior staff position. It was established under the sponsorship of UPDEA (Union for Producers, Conveyors and Distributors of Electric Power in Africa) which regrouped 27 African electricity supply corporations.

72. In the petroleum subsector, there exists one method that has been used effectively to build up indigenous capacity in the upstream part of the sector; it is to institutionalize human resources development as part and parcel of project development and project implementation. In nearly all model petroleum production sharing agreements, the foreign contractor undertakes to set aside a fixed amount of money, upfront, that will be used for human resources development. In the SADC subregion, a project exists for the development of the Regional Petroleum Centre at Sumbe in Angola which could benefit countries of the subregion.

3.9 Energy and the Environment

73. In the field of Energy and the Environment, the ECA jointly with the EDI/World Bank has organized two training seminars (Addis Ababa: November 1992 and Abidjan: October 1993), another training workshop was organized from 6-10 March 1995 in Addis Ababa. ENDA Tiers-Mode, an international non-profit organization based in Dakar has also organized training courses in the area of energy including its environmental impact for more than 300 African highly qualified technicians and officials.

74. The inter-relationship between energy and environmental policies is becoming increasingly important. Nearly all energy production, conversion, transport and consumption can have negative effects on the environment. According to a World Bank report (6), on a global scale, the production and use of energy accounts for between 50 and 60 percent of the greenhouse trace gas emissions in the atmosphere and deforestation accounts for about 14 percent of the global sectoral contribution to greenhouse gases.
75. In the electricity subsector, the environmental impact of hydropower development arises mainly from the need to create large dams and reservoirs to store water. Displacement of people, loss of flora and fauna and other natural heritage and ecological effects downstream of the dams are some of the considerations which have to be taken into account at early stages of project design. In petroleum and coal fired power stations, the environmental impact arises mainly from the emission of pollutants such as sulphur dioxide, carbon dioxide and other greenhouse gases resulting from the combustion of oil and coal.
76. In the petroleum subsector, production, refining, transportation and use also similarly impact on the environment. Upstream petroleum activities are potential pollutants because the possibility exists for oil spills and gas blowouts with severe consequences on marine and terrestrial life. Oil refineries also discharge effluent. Leakages in oil pipelines are a common occurrence whose frequency is a function of the age and quality of maintenance of a pipeline.
77. When there are choices about the way in which environmental objectives can be sought and there often are, it is important to follow courses which do not introduce an unnecessary bias on the choice of fuels. Environmental objectives should be clearly articulated but regulations should allow maximum flexibility on the methods of achieving the objective.
78. The reconciliation of energy and environmental objectives will be assisted if the costs of measures to protect the environment are carried by polluters - the "polluter pays" principle. They will then be reflected in prices to the consumer to the extent that market forces permit, with the result that the operation of the market will tend to promote the more environmentally favourable energy mix. However, in practice, even rigorous application of the "polluter pays principle" will not necessarily result in environmental costs being fully incorporated in energy prices. Therefore, the analysis of this issue should be wide enough to capture all the major sources of pollution, all the major ways of limiting pollution production and all the major costs and benefits involved.
79. Action on these lines will not resolve all conflicts between energy and environmental policies. There will inevitably be cases when the pursuit of legitimate environmental goals will work against, or at least increase the costs of achieving energy security, effective arrangements to co-ordinate energy and environmental policies are therefore essential at both national and international levels with a view to ensuring that the inter-relation between them is taken into account at an early stage in policy formulation.
80. Resolution of the issues which arise on energy and the environment may be made easier by international collaboration. At present, there are important variations among countries in emission limits and other legal environmental requirements that have a bearing on energy production and use. Efforts to achieve a certain degree of international co-ordination of standards and procedures to avoid competitive imbalances and impacts on international markets are increasing. Collaboration seems advisable to resolve such issues as priorities in the control of atmospheric emissions (from stationary and mobile sources); appraisal of environmental consequences in the very long term and the type of possible government actions.

3.10 Regional Cooperation and Energy Trade

81. It is well-known that Africa is endowed with substantial energy resources although unevenly distributed among countries and subregions. This situation has created many opportunities of mutual beneficial cooperation between neighbouring countries, especially in the electricity subsector, through the interconnection of electrical grids and/or the joint development of hydropower resources which otherwise would not be feasible.

82. For example, Ghana is exporting excess electricity produced at Akosombo hydropower plant to Cote d'Ivoire, Benin and Togo; Uganda supplies electricity to Kenya from the Owen Falls hydropower plant; Nigeria supplies Niger from Kiandji hydropower plant; in Southern Africa subregion, many national electrical grids are interconnected.

83. Some African countries have undertaken the joint development of hydropower resources. This is the case for Ruzizi II (CEPGL countries: Burundi, Rwanda and Zaire), Nangbeto (Benin and Togo), Manantali (OMVS member countries: Mali, Mauritania and Senegal) and Epupa hydroelectrical scheme (Namibia and Angola with the possibility of exporting excess electricity to South Africa).

84. In the petroleum subsector, African countries should explore and exploit opportunities for mutually beneficial cooperation on a regional basis. Such opportunities exist in the area of petroleum procurement, where economies of scale could be exploited; regional cooperation in refining and inter-country storage; and distribution and marketing of products.

85. In the field of natural gas, North Africa subregion has been on the forefront of regional cooperation: Algeria, which has the largest reserves of natural gas and has been exporting it to Italy through the TRANSMED gas pipeline since almost 10 years, has given the possibility to the Tunisian government to levy transit fees in the form of a given volume of gas. Nigeria is considering to supply Ghana via Benin and Togo when its Escravos project is completed.

3.11 Financing of Energy Investments

86. Financing of investments has been and will continue to be the most challenging constraint for the development of the energy sector in Africa. There are major constraints on the availability of international concessionary and commercial bank finance, as well as on domestic public resources. Domestic capital markets in many countries are weak, and it will take time to develop strong and viable markets.

87. According to a World Bank report, realizing the benefits of alternative financing options such as the BOO (Build, Own and Operate) and BOOT (Build, Own, Operate and Transfer) schemes which encourage the private sector investing in electric power generation, involves a strategy to (i) reform legislative, legal and regulatory arrangements to promote increased competition among energy suppliers, partly by increasing the private provision of risk capital; (ii) strengthen the accountability and the internal organizational structure of energy supply enterprises; and (iii) shift investment resources at the margin from increasing capacity to improving efficiency in both supply and end use.

88. The main reason put forward for the failure of BOO/BOOT schemes in some countries in Asia is that the governments have not had sufficient commitment or political will to address fundamental problems of governance; specify a clear legal framework; put in place a transparent regulatory structure; or allow commercially-based tariffs which reflect real costs.

89. There exists also a new source of funding energy projects which have an generic impact of reducing greenhouse gas emissions; the Global Environment Facility (GEF) which was established in 1990. The prioritization of eligible projects are done taking into account the following factors:

- i. the importance of CO₂ due to emissions arising from the combustion of fossil fuels and land-use changes, and CH₄ emissions induced by human activities;
- ii. the cost effectiveness of the technology deployed to reduce greenhouse gas emissions.

IV. CONCLUSION

90. Most of the energy policies and strategies formulated in the Lagos Plan of Action are still relevant but should be adapted to present situation where energy prices are low and financial resources made available to African countries by donor agencies to implement energy projects are becoming more and more scarce. It is expected that some changes in priorities may occur and necessary incentives for implementation of the adopted policies are provided.

91. A supply-oriented strategies which accept current projections of development energy demands, and seek to satisfy them, based on acquiring capital intensive technologies requiring imported fuels are doom to failure. African countries which follow such strategies will be unable to meet either their energy needs or the basic development needs of their people.

92. The opposite of supply-oriented strategies are demand-side management. Demand-side management of energy must be recognized by governments as a cost effective method of economic development and they must be made aware that investment by government in demand-side management has a high economic return in deferring investments in new supply infrastructure.

93. Commercially available or near-commercial energy efficient technologies will permit African countries to raise the standard of living with only a modest increase in per capita energy consumption. African governments should seriously consider joint efforts to develop regional energy policies and strategies through cooperation and solidarity with a view to safeguarding their sustainable economic development.

94. In view of the large energy resources and the disparity in their location there a significant scope for regional cooperation in their development. Regional cooperation must be recognized as a means of minimizing costs in the development and utilization of African energy resources.

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