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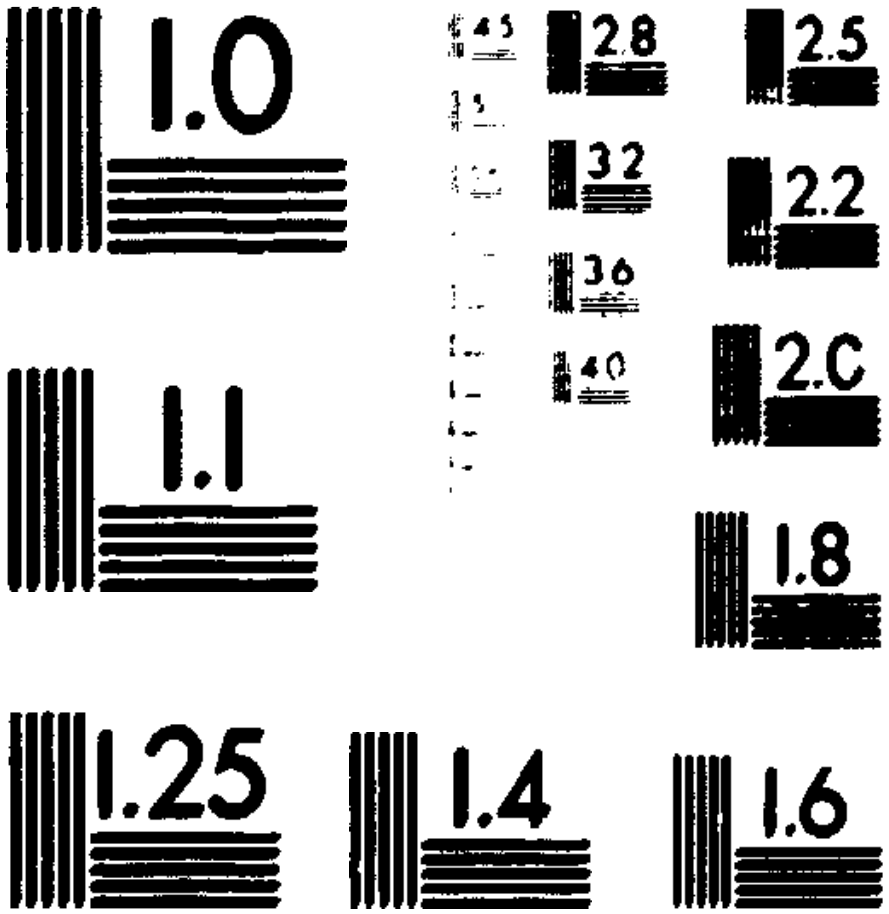

NEW ENERGY TECHNOLOGIES IN AFRICA.
THE NEED FOR RESEARCH AND DEVELOPMENT.

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ABSTRACT

The United Nations forecast for a 76 per cent increase in the African population by the year 2000 demands a strategic view of its future energy needs. The present and future uses of energy have been discussed and it has been estimated that an overall energy, equivalent to one billion tons of coal, would be needed. The need for a well co-ordinated Energy Research and Development Programme is recommended and its terms of reference outlined. Possible new forms of energy applicable to the African Continent are also mentioned.

INTRODUCTION

The population of the World increased by almost 75 per cent in the last 30 years, from 2.5 billion in 1950 to about 4.4 billion in 1980. The increase during this period was quite small in Europe, fewer than 100 million added to its population. The developing countries grew much more, both in numbers and rates. Their population almost doubled, increasing from 1.7 to 3.3 billion. Africa, in particular, doubled its population from 219 million to 469 million over this period. The prospects until the year 2000 are for a slowing of growth rates for all areas except Africa. Population projection of the United Nations anticipate a rapid population growth in less developed countries, with the largest proportionate increase coming from Africa (+76 per cent).

Because of the continued rise in oil prices since 1972 and the need to sustain any reasonable economic growth, then it is obvious that most African countries would incur dangerously growing foreign exchange deficits by the year 2000. Unless these countries can discover more fossil fuel resources within their borders or develop other sources of energy, the energy crises facing the African continent by the year 2000 would be alarmingly disastrous.

Research and development in enegy production, conversion and conservation should eventually allow local energy sources to be substituted for imported fuels. Some of the alternative sources of energy available to Africa are biomass energy, solar energy, hydroelectric and fire-wood energy.

This paper discusses the choice of alternate energy sources applicable to Africa, the need to institute a well co-ordinated Energy Research and Development Programme, and finally assesses the implications of new energy technologies for the Lagos Plan of Action.

FUTURE USES OF ENERGY IN AFRICA

The location and extent of the non-renewable fossil resources (coal, lignite, petroleum, natural gas liquids and natural gas) have been less accurately determined, and no more than guesses can be made concerning the fraction that could be recovered or the recovery costs. Most available statistics on energy use refer to so-called commercial energy, that is, energy from fossil fuels and hydroelectric installations. On average, the total energy use is about twice the amount of commercial energy. The major part of the difference is made up of biomass fuels -- wood, charcoal, agricultural residues and cattle dung -- and a significant fraction is accounted for by energy expended in human and animal labour.

In the past, the proportion of commercial energy has increased with time and economic growth. This increase resulted chiefly from the growth of the industrial and transportation sectors and partly because convenient commercial sources were substituted for traditional ones as people migrated to cities and towns from the country side.

Haefel (ref.1) has estimated that per capita energy consumption in the developing countries of Asia, Africa and Latin America should increase between three and five times over the next 50 years. His conclusion is supported if we examine future energy needs in Africa, which will probably contain 800 million people by the year 2000.

To produce the needed food supplies, approximately 350 million tons of food grain equivalent (with an energy content equal to that in 160 million tons of coal) would be needed. Thermal energy used in rural households would

total 45 million tons, and transportation of agricultural harvests, rural industrial products, farm inputs, and human beings could use as much as 150 million tons of coal equivalent. Energy expenditures in rural industry would be between 100 and 160 million tons. Household lighting could add 0.25 kilowatt - hour per person per day or 4 million tons. It would be expected that rural incomes would still be considerably lower than those of the urban populations, consequently, because of the close relationship between income and energy, urban energy use per capita would be between 1 and 2 tons of coal equivalent i.e. 500 million tons. Thus the overall energy demand would be approximately 1 billion tons of coal equivalent -- 4 times present energy use.

For very few countries, with their large reserves of petroleum, such an increase in energy demand, would not seriously endanger their socio-economical programme. Whereas for most countries in Africa, their present known energy sources could not sustain the large increase required for social and economic development. These countries will either need to find and develope new energy resources or depend on large-scale imports of fossil fuels. For the first alternative, long-range research and development will be essential. The second alternative is, of necessity, being followed by a short-range basis, with potentially disastrous results.

ENERGY RESEARCH AND DEVELOPMENT PROGRAMME

Such a programme, would need to be undertaken within the African continent with a special thrust and emphasis; and should be mandated to research into the

(i) production;
(ii) conversion;

(iii) transportation;
(iv) storage;
(v) conservation.

of new forms of energy. Their economic and social implications must not be overlooked.

A systematic search for oil and gas deposits in offshore areas on the continent appears to be especially promising. Significant results have already been obtained. Other kinds of potential energy sources, such as wind, small-scale hydro-power, solar, geothermal and fire-wood would be needed in the near future. The technology for extracting power from wind is rapidly developing outside Africa. But all wind system are constrained by two relationships; the power produced varies with the cube of the wind velocity, and no power is produced below a certain threshold wind speed (ref. 2). It is now known that strong, steady winds are most likely near the sea coast, hence countries which have a relatively long seacoast, compared with its area, may be able to meet a significant fraction of their energy demands by installing windmills (ref. 3).

An investigation into the annual variations in flow of small and medium streams in hilly regions would be very useful for installing micro- or mini- hydroelectric generators. In Nepal and Thailand, an estimated 500 mega watts year round power have been extracted using these generators (ref. 4).

The technology of solar energy is fairly well advanced, but the argument that this form of energy contributes an insignificant amount to the global energy demand, remains active. An effective density of 20 watt per square metre for

the production of solar electricity, would take only 5000,000 square kilometres to install a capacity of 10TW-electric. For instance, large solar power machines could be installed in the Sahara. The technological and material costs of solar energy is considerably high and research to minimize them is being actively pursued.

A search for sources of geothermal energy has been successfully in the Philippines (ref.5), where the planned electric generating capacity may be 1900 MW by 1988. Research in this field may be useful in Africa.

Firewood is the principal source of energy for cooking and other domestic uses in the rural areas of most countries in Africa. In most of these countries, the forests are being rapidly destroyed as populations grow, not only because of the growing needs for fuel wood but also because of destructive logging for timber, clearing of land for settled agriculture, and shortening of the rotation cycle for slash-and-burn agriculture. In consequence, the upland areas are subjected to destructive erosion, which result in turn, in rapid silting of irrigation and destructive floods in downstream areas.

It is therefore of vital importance, that if firewood is considered as a major source of energy in the future, a well managed Firewood Industry should be established some fast-growing trees for fuel production have been discovered; these include Acacia auriculiformis, Acacia albida, acacia mangium Casurina equisetifolia, Calliandra callothyrsus, and Eucalyptus camaldulensis. Much research, development and demonstration should be undertaken to determine the fast-growing species best suited to local climate, soil, topographic and social environments. The methods of protection against fire, insects, diseases and browsing animals must also be determined.

Wherever, it can be obtained at sufficiently low cost, especially in developing countries, it has been shown that charcoal is preferred over wood as a domestic fuel. Charcoal has an efficiency of 15 to 20 per cent, whereas wood stoves are only 5 to 10 per cent efficient. Because of its high energy density, charcoal costs much lesss to transprt than wood with an equivalent energy content. In Sierra Leone, the National Workshop and the University are currently carrying out research into making charcoal from rice husks, wood and sawmill wastes. Africa can derive much from the experience gained by Indonesia, Sri Lanka, Bangladesh and Thailand in the field of wood production.

Research into new forms of energy must include energy conversion. The problem to be investigated may include converting wood to charcoal, pyrolysis of organic waste, wood combustion, the mocrobiobiology of anaerobic production of methane from human, animal and vegatable waste, nitrogen fixation and the use of solar energy for heating water and drying crops and wood.

The problems of energy transportation, storage and conservation may also be the task of the research team. In all these different fields of energy research, co-operation with groups of international scientists and technicians would be needed.

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CONCLUSIONS

The attempts to substitute other forms of energy for that of petroleum fuels are gaining considerable momentum and impetus. One of the tasks of national energy planners, now and in the future, will be to assess the benefits and costs of these alternative sources for different energy functions. All available energy sources and all energy uses within a particular geographical area must be considered as parts of an interacting system in which goods and services are produced on a sustainable basis to meet human needs. The next 20 years is too brief a period for a complete transition from fossil to non-fossil energy sources.

The African energy problem, and indeed that of the entire World, can be solved. But this will require great effort, will power, determination and a strategic view and prudence.