RENEWABLE ENERGY R&D AND AFRICA'S SOCIO ECONOMIC DEVELOPMENT

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ABSTRACT

The close correlation between the proximity of the energy resources to the potential beneficiaries, coupled with the favourable supply prospects, have led to an enormous increase in interest and activity among African governments, multilateral and bilateral aid agencies, the multinational companies and individual entrepreneurs in the development and utilisation of renewable energy resources in developing countries. This increased activity has resulted in a proliferation of the number of possible technical options. Although the development work is by no means complete, a number of technologies have been demonstrated to be technically feasible and thus ready to be considered as alternatives to the more conventional sources of energy.

This paper discusses the principal issues pertaining to the scientific research and technological development that must be considered if the enormous potential of renewable energy is to be translated into a beneficial facilitator of Africa's socio-economic development in the next century.

INTRODUCTION

The 1970's were dominated by two interlinking themes: energy and economic recession. For Africa and most other developing countries, the major impact of the massive increases in energy prices were to create severe constraints on the financial resources of most countries, as a direct consequence of the need to spend a substantial proportion of foreign exchange earnings on oil imports, which situation resulted in deep economic recessions in virtually all countries. The crisis demonstrated the close link between energy and socio-economic development and the importance of having secured sources of energy supply; which conditions were best guaranteed by the development and utilisation of indigenous energy resources. This development had to take account of the need to maintain existing levels of socio-economic development, as well as plan for future growth.

Most African countries possess enormous renewable energy resources. In most cases these already constitute the most substantial sources of supply to meet the demand of the majority of their populations. Given that the rural sectors, which are the major users, are also those that most require socio-economic improvement, it would appear that the development of the indigenous renewable energy resources could contribute substantially to easing both the energy and developmental problems of many African countries.

The close correlation between the proximity of the energy resources to the potential beneficiaries, coupled with the favourable supply prospects, have led to an enormous increase in interest and activity among African governments, multilateral and bilateral aid agencies, the multinational companies and individual entrepreneurs. This increased activity has resulted in a proliferation

of the range of technical options for renewable energy applications. Although the development work is by no means complete, a number of technologies have been demonstrated to be technically feasible and thus ready to to considered as alternatives to the more conventional sources of energy.

In the long run, if the major objectives of renewable energy resource development in Africa are to substitute for current oil imports and provide for the next generation of industrial development, then it is desirable, and eventually imperative that the development of all facets of the technologies must be carried out in the user countries.

AFRICA'S SOCIO-ECONOMIC DEVELOPMENT: HOPES VERSUS REALITIES

> "We view with distress, that our continent remains the least developed of all continents: the total Gross Domestic Production of our countries being only 2.7 per cent of the world's per capita income ..... Yet if the world economic forecast for the next decaxde is to be believed, the overall poor performance of the African Economy over the past 20 years may even be a golden age compared with future growth rate".
>
> Extracts from Preface to the Lagos Plan of Action 1980-2000 **(1)**

In acknowledging the failures of Africa's post-independence efforts at socio-economic development, the leaders of Africa also set out an agenda for future action. The Lagos Plan of Action represented an attempt to rationalise the multi-faceted issues of development into a coherent and sustainable policy for the next twenty years. (1980-2000). Sadly in the first five years of the Plan's birth, the prophetic forebodings for the future have already been borne out. At the same time, the great Plan is taking an inordinately long time to translate into practical action.

Africa's agricultural production has failed to achieve the minimum indicative goal set by the World Food Conference for the decade 1974-1983 **(2)**. The growth rate achieved was 1.9%, against a target of 3.9%, dropping to a low 1.6% between 1979-83. The latter represented a decline in per capita food production in the region of 1.4 per cent per annum. The industrial picture fared little better, with the continent contributing only 0.8 per cent of the world's manufactured added value in 1975, compared to Latin America's 5.1 per cent and Asia's 2.3 per cent. The 0.8 per cent figure translated to about 9% of the total GNP in 1979 **(3)**. Against this must be set the optimistic hopes of the Lagos Plan, which placed the emphasis for future action on Food and Agriculture, and Industry (Table 1).

WHAT ROLE ENERGY RESOURCES?

A fair proportion of the blame for the failures of Africa's socio-economic development in the recent years has been attributed to the problems created by our favourite bogey **"The Energy Crisis"**. Indeed, there is an almost "Pavlovian" tendency to confine the conceptualisation of the issues behind Africa's recent failures simply to the consequences of the trends and impacts of global energy supply and price structures. In my humble view, this approach is flawed on two basic counts in respect to Africa:

Firstly, it presents a blinkered assessment of the energy picture in Africa, concentrating on the so-called "commercial energy" resources. For at best, these sources are estimated to account for no more than 10 to 20% of the continents' total energy demand (Table 2).

Africa's demand structure for energy can be represented broadly as comprising of three main sources (Table 3):

(1) Traditional renewable energy: mainly fuelwood, but encompassing charcoal, crop and other plant residues and animal waste (dung); these form the bulk of energy sources to meet subsistence needs;

(2) Commercial energy: which comprises not only hydro-carbons, oil gas and coal, but also include the renewables of nuclear and hydroelectric power;

(3) Unexploited renewables: such as solar, geothermal, wind, ocean and waves.

The classification given here is not quite in line with accepted trends. For example, commonly accepted renewables such as hydropower and nuclear energy are grouped under the commercial classification. Also the renewables are split into "traditional" and "underexploited". The regrouping is quite deliberate and is intended to introduce the notion of "Indigenisation" into the perceptions of global energy resources and demand considerations. It is also worth noting that the word "alternative" has not been used in either the classification or sub-groupings. The reason being a wish to avoid the implications that the fossil resources equals mainstreem orthodoxy for all countries and that renewables are somehow of fringe interest. The notion is real enough, given that in the developed world, enthusiasm for renewables is highest amongst the so-called environmental (Green) parties.

The second problem of the conventional versus alternative approach is that it automatically couples the level of scientific and technological activity on renewable energy resources to the prevailing global perceptions of fossil fuel supply and price. This is as true of the pre-colonial Drake period of the late 18th and 19th Century, which saw the development of many solar technologies, to the current 1985 situation of falling oil prices on the Amsterdam spot markets.

Thus, in the space of a decade, we seem to have moved from a serious crisis in the energy field to the benign quizzical enquiry of **"CRISIS, WHAT CRISIS?"**

In most of the developed world, the result of the recent falls in oil prices has been a massive disengagement from research and development activities or renewables, though the effects have not been limited to these countries. For developing countries in general, and Africa in particular, a most welcome outfall of the R&D programme of developed countries was the opportunity to share in the results of scientific and technological innovations. The combinations of a high level of technical capability (95% of the world's R&D capability) and generous research grants created the climate in the developed world for an exciting and challenging investigation of "future" energy sources. As long as the price of oil held, we were all confident of near-term technological breakthroughs, to the extent of being able to set target dates for technical and commercial viability.

Alas, we have come to the end of the unofficial "Renewable Energy Decade" of 1974-1984. As with most such euphoric expressions of international concern, the major results seem to have been thus:

> "the problems have been thoroughly aired, yet the problems are still with us"

Reputations have been made, as well as fortunes and careers. At the end of it all the label ALTERNATIVE has shifted to some other concern, be it the 'implications of new technologies', 'sustainable development' or 'fragile earth'. However, we are left with a still persistent and growing problem and a smaller, albeit dedicated cadre of scientists, technologists and resources to investigate and secure rational and sustained solutions.

SETTING THE FRAMEWORK FOR R&D

The international Conference and R&D of Renewable Energy Technologies in Africa is called to review Africa's scientific and technological responses to the problems of energy resources and socio-economic development. It marks the end of almost six years of collaboration among researchers from both developed and developing countries under the umbrella of the African Energy Programme (AEP). Nevertheless, our judgement as to success or failure of the various endeavours should not be restricted merely to the technological advances or innovations that are reported in the various technical presentations. There is a need to reflect on the changing climate for support of research and development and its possible consequences for the future. Also, due note should be taken of the changing international perceptions as to priorities for external aid support to development projects.

For many of us, the challenges of the 1970's were instrumental in shaping the directions of our future intellectual development. We have acquired the basic academic and technological tools necessary to make a meaningful contribution to Africa's energy problems.

Now, as we enter a period of relative decline in popularity in our chosen disciplines, perhaps we can take solace as well as inspiration from the examples of some of our developed country colleagues, a number of whom have devoted a substantial proportion of their lifes to addressing the very same problems of renewable energy development and exploitation. A few have carried out their tasks for over 30 years in such unlikely settings such as the United Kingdom. Others have practiced in more beckoning environents such as Australia. Whatever the setting has been, these scientists and technologists have sustained their investigations and enthusiasm for many years, and have been able to make significant contributions to our current understanding of the principles and technologies of solar energy application and utilisation.

The dedication of these scientists serves both as an example and inspiration for us, and this conference provides a welcome opportunity to share in their expertise for our own efforts in Africa. For me, the most excising discovery when I began to look at the possibilities for solar energy was the realisation that many of the fundamental scientific concepts and principles had been brought together as far back as 1961 at the United Nations Conference on New and Renewable Energy Resources.

Apart from the sustained efforts of scientists, it is also useful to note that the countries which have been most successful in exploiting renewable energy have been those who have developed and sustained rational national programmes over several years, such as Australia, Israel, Cyprus, South Africa and Zimbabwe.

A recent study of global energy prospects has suggested that in the long-term, biogas and charcoal could meet up to 16 per cent of Africa's household and industrial final energy needs by the year 2010. All renewables combined (including hydroelectric) could account for between 20-30 per cent of total primary energy by 2030. The important point is not necessarily the projected percentage. It is the fact that the first of the target dates is still 25 years away. It is also about the remaining period of productive working life for most of the African scientists attending the conference. It would be comforting to be able to think that we will be able to sustain our commitment to this intellectually satisfying and technologically relevant research and development of Africa's renewable energy resources to assist its socio-economic development.

A CONDUCIVE ENVIRONMENT FOR RESEARCH

The climate for scientific research and development in Africa has never been particularly encouraging. Unfortunately, the situation is in many cases, deteriorating as the numbers of trained scientists and technologists increase. The combination of economic difficulties, lack of support and recognition and the burdens of bureaucratic overload have all conspired to deprive Africa of a sustained scientific and technological intellectual base. It is nowadays a rare sight to encounter an African researcher who has actively pursued their discipline for more than 10 years.

The importance of human resources to a country's development is well recognised. A distinguished academician, Prof Frederic Harbison states **(4)**:

> "Human resources constitute the ultimate basis for the wealth of nations. Capital and natural resources are passive factors of production; human beings are the active agents who accumulate capital, exploit natural resources, build social, economic and political organisations and carry forward national development. Clearly, a country which is unable to develop the skills and knowledge of its people and to utilise them effectively in the national economy will be unable to develop anything else".

EVOLVING A CREDIBLE STRATEGY

To achieve the Lagos Plan targets for Food and Agriculture Production, it is estimated, will require financial investments of $125 billion (1980) over the 15 year period of 1975-1990; a figure that excludes the investments in infrastructure and other support services such as research, extension and training. The Lima Declaration set for Africa to achieve a share of manufacturing added value of 2.0% in 2000, as against the 1975 level of 0.9%. For Africa the implications for future development of energy resources would seem quite clear.

The achievement of the Lagos and Lima Plan's targets would demand substantial energy inputs. For many countries the only realistic long-term option for supplies of energy are the indigenous "traditional and unexploited" renewable resources. Even for the oil-rich African countries, renewables will be just as

important if the thrust of future developmental efforts is to be in the rural areas.

The combination of inadequate technical capabilities and competing sectoral claims on limited financial resources will require us to evolve achievable and pragmatic programmes of future R&D. To ensure its continuing relevance, the overall scheme must involve a strategy that focuses on meeting existing needs, whilst at the same time searching for new technological approaches and innovations. Such a strategy might involve a sequential scale of priorities that:

(1) strengthens the efficiency of current applications; such as improvements in fuelwood and charcoal stoves;

(2) substitutes renewable resources which indicate near-term technical and economic viability; such as solar water heaters for domestic and industrial applications;

(3) establishes long-term research schemes to increase the resource base and to develop new technologies for secondary powre generation; such as afforestation and development of biomass conversion technologies.

WHAT OF THE FUTURE

This Conference provides a timely opportunity to evolve such a straetegy as an essential element of the review of our efforts over the past "ten years of plenty". In order to arrive at some sensible conclusions as to past achievements and future needs, we must address ourselves to the following four questions:

(1) What constitutes Africa's primary renewable energy resources and how much of each is available?;

(2) What useful energy forms can be produced from these primary resources and what are the available technological options?;

(3) What end-uses and processes lend themselves to renewable energy applications; and

(4) Which combinations of resources, technologies and end-uses would be most beneficial to the socio-economic developmental efforts of individual countries?

Therein lies the rationale for the technical framework developed for the Conference, namely:

(1) ENERGY RESOURCES ASSESSMENT:

(2) ENERGY CONVERSION TECHNOLOGIES:

(3) ENERGY UTILISATION TECHNOLOGIES:

(4) POLICY PLANNING & IMPLEMENTATION.

A former United States Cabinet Secretary made the following observation of renewable energy resources:

> "Solar Energy will have as much impact as a flea's bite on an elephant's fanny"
>
> James Patterson.

Should we arrive at a similar conclusion at the end of this Conference, we should all prepare to join the current alternative bandwagons.

Somehow I know we shall finish up admiring the wit and not the substance of that remark.

TABLE 1: SECTORAL GROWTH TARGETS FOR LAGOS PLAN OF ACTION (1)

SECTOR	Rate of Growth (% p.a.) (at constant 1980 prices)
GDP	7.0
Agriculture	4.0
Manufacturing	9.5
Exports	7.0
Imports	8.2

TABLE 2: ESTIMATED NATIONAL RELIANCE ON TRADITIONAL FUELS IN AFRICA (5)
(each group arranged in ascending order of per capita GNP)

Modest Reliance (less than half)	Medium Reliance (approximately one-half to three-quarters)	Heavy reliance (three-quarters or more)
Mauritius	Togo	Benin
Morocco	Gabon	Burundi
Zimbabwe	Liberia	Cameroon
Egypt	Mauritania	Cape Verde
Algeria	Senegal	Central African Empire
Tunisia	Zambia	Chad
Libya		Ethiopia
		Gambia
		Guinea
		Guinea Bissau
		Kenya
		Lesotho
		Madagascar
		Malawi
		Mali
		Mozambique
		Niger
		Rwanda
		Sierra Leone
		Somalia
		Sudan
		Tanzania
		Uganda
		Upper Volta
		Zaire
		Angola
		Botswana
		Congo
		Eq. Guinea
		Ghana
		Nigeria
		Swaziland

Source: Energy Strategies for Developing Nations, Johns Hopkins University Press, 1981.

TABLE 3: CLASSIFICATION OF AFRICA'S ENERGY RESOURCES STRUCTURE

	CLASS	CONSTITUENTS
A.	Traditional Renewable Energy	Fuelwood, including charcoal; agro waste, draught animal power.
B.	Commercial Energy	Oil, gas, coal, nuclear power, hydroelectric power.
C.	Unexploited renewables	Solar thermal & photovoltaic, geothermal, wind, ocean power, & wave power.

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