SOUTHERN PERSPECTIVES on the RURAL ENERGY CRISIS

AMULYA KUMAR N. REDDY
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PHOTO CREDITS

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UNITS OF ENERGY

The two units of energy used in this paper are the kcal (one thousand calories; one calorie is the amount of energy required to raise the temperature of one cubic centimetre of pure water at standard temperature and pressure by one degree Centigrade) and the MJ (one million joules; a joule is the work of one newton-meter, also equal to 0.239 calories). One barrel of oil has about 6 billion joules. One kilogram of wood dryweight might have about 13 MJ, although this figure varies across the woods. One kilowatt-thermal [kW(t)] is a measure of power —one thousand joules/second. A conversion efficiency (ratio of electrical output to primary energy input) is required to measure the conversion of thermal energy to electrical energy [kW(e)]. A crude rule of thumb would be 30 to 40 percent. A power of one kw(e) applied for one hour produces energy of one kwh(e)-one kilowatt-hour (electrical). Similarly for thermal units.

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African village and overgrazing

About Nautilus:

Nautilus Inc. is a public-interest research and education group focussed on the interrelationship of energy, environment, and development. Our particular objective is to analyze and evaluate the development impacts of U.S. governmental and commercial policies on third world countries, especially in Asia-Pacific (and to determine impacts of these policies on the U.S.).

A key area of our concern is the export of U.S. nuclear technology to Asia. In 1979, *Pacific Research* published our study of a U.S.-Westinghouse nuclear export to the Philippines, "500 Mile Island." We are nearing completion of a book on the south Korean nuclear program—the most ambitious of any third world country —and the crucial role played by the U.S. Export-Import Bank in financing reactor-transfers (for more information, see page 48).

Nautilus frequently writes for popular magazines and journals, speaks to university students and citizen groups, and appears on radio programs.

Rice production, Philippines

Preface

Over two and a half billion people live in the villages of Asia, Africa, and Latin America. The daily struggle of these people to obtain energy is therefore an aspect of the global energy problem that affects more people than any other.

It took OPEC to bring energy to the center of global policy concerns. Belatedly for rural people in the Third World, attention is now being paid to the rural energy crisis. Villagers' vital energy statistics are being measured, their energy anatomy dissected, and their energy ills diagnosed.

In itself, information is harmless. But as the basis of the response to this crisis, information is also power. Villagers may use much of the anthropomorphic energy flows on the planet, but non-villagers —governments, international organisations, and transnational companies—clearly control most of the information about their energy plight. Villagers do not control the design of energy policies aimed at their energy problems. The gathering and interpretation of information about the energy dimension of their lives is therefore political.

It was to challenge some of the presuppositions about appropriate policy responses to the rural energy crisis—and thus some of the political ramifications of international policies aimed at redressing the crisis—that Nautilus decided to publish these essays. The essays are unabashedly provocative, and are designed to stimulate debate. They ask hard questions about the origins of the rural energy crisis, and while careful to supply pointers as to what might be done, the authors do not present easy solutions or short-cuts through the power-structure. Perhaps the most important point made by all the authors is that much of what is being done in the name of serving rural energy needs will actually make the situation worse for many of those most in need.

Most of what is being written on this problem emanates from international aid or development agencies, academic institutions, and consulting firms. The authors of these essays come from other quarters. Amulya Reddy's work with the Cell for the Application of Science and Technology to Rural Areas in central India is widely known for being a model of self-reliant work of the highest calibre. R.S. Ganapathy's work springs from an active interest in increasing citizen participation in international energy policies, especially at the UN. Peter Hayes, now a researcher with Nautilus, established the international network of *Soft Energy Notes*, aimed at transferring information—and sometimes warnings—about what is coming down the international energy pipeline to the third world.

Nautilus offers this publication in a spirit of debate, and we hope it will elicit dialogue. The authors' addresses appear at the beginning of each essay. Nautilus also solicits your comments and criticisms of this publication, and suggestions as to how it might be better next time.* The authors are responsible, of course, for the content of each essay.

Peter Hayes

*Nautilus Inc., Box 353, Bolinas, California, 94924, U.S.A.

I. Energy Options for the Third World

Amulya Reddy[*]

1. INTRODUCTION

Third world countries differ from each other in many ways, but the most important difference which has been stresed since 1973 is that between oil-*exporting* and oil-*importing* developing countries. The former are considered to be "the blessed," and the latter, "the unfortunates." This is because most oil-exporting developing countries have the resource base of conventional energy to repeat the evolution of the energy consumption patterns of the industrialized countries; and therefore, their discussions on energy options can be restricted to considerations of various *paths* to western goals. It is not so with the oil-importing third world countries. In their case, energy options must imply choices with regard to *goals*, as well as *paths* to chosen goals. In this sense, their constraints (with respect to conventional energy sources) compel them to exercise an extra dimension of freedom—the freedom to choose what magnitude and structure of energy targets their societies shall strive for.

It follows that an essential part of any discussion of energy options for third world oil-importing countries must be directed towards the main options with regard to the magnitude and structure of energy targets.

2. THE MAGNITUDE AND STRUCTURE OF ENERGY TARGETS

The *magnitude* of a society's energy requirements depends, first, on its population—obviously, the larger the population, the greater will be its energy requirements, and second, on its per capita energy consumption—the larger the direct and indirect per capita energy consumption in a society, the greater will be the energy requirements of a society. It is important, however, to realize that these two factors of population and per capita energy consumption are not unrelated—invariably, the lower the per capita energy consumption, the greater is its need for muscle power, and therefore, the larger is its rate of population growth likely to be.

The choice of an energy goal hinges, therefore, on targets for population and for per capita energy consumption. Population planning is outside the scope of this paper, so attention will be restricted to per capita energy consumption, which in turn depends upon several factors.

The first factor is the degree of "affluence" of the society, usually expressed as the per capita GNP —the more the goods and services produced, distributed and consumed per person, the greater will be the per capita energy consumption, according to the well-known per capita energy consumption vs per capita GNP "correlation." The use of this "correlation" to define energy targets for developing countries involves two assumptions: (1) that these countries should follow the patterns of industrialization and energy utilization adopted by the developed countries, even though these patterns were historically determined by the low oil prices of the pre-1973 era, and (2) that the goal of third world countries should be the growth of GNP. Both these assumptions are questionable— the first may not be realizable, and the second may not be acceptable.

The second factor determining the per capita energy consumption is the "lifestyle" of the society as revealed by the composition of the GNP. This lifestyle comes into the energy picture because different products and services are associated with different energy consumption values. For example, a lifestyle based on individual transportation by automobiles requires more energy than one based on mass transportation

[*]Professor, Indian Institute of Science, Bangalore—560 012, Convener, ASTRA (Cell for the Application of Science and Technology to Rural Areas), Indian Institute of Science; and Secretary, Karnataka State Council for Science and Technology, Indian Institute of Science, Bangalore—560 012 (India).

by buses.

The third factor is the degree of centralization of production. The point is that the greater the average distance between the centers of production and of consumption, the larger becomes the energy which must be spent on processing, packaging, storage, transport and distribution. Centralized production for distant markets invariably requires more energy than decentralized production for local consumption.

The last factor which determines the per capita energy consumption concerns the technologies chosen for the production, distribution and consumption of goods and services. Here, the point is that different ways of producing, distributing and consuming goods and services are associated with different energies. For instance, most production technologies of the developed countries are energy-intensive, because these technologies were generated in countries which were able to obtain oil at low prices from the oil-exporting countries. Green revolution agriculture is a prime example of such an energy-intensive production technology. For perhaps similar reasons, a bias towards energy-intensive distribution or transport technologies can be observed in the industrialized countries, for example, goods transport by rail has given way to the energetically more expensive truck transport. Consumption technologies, too, are important because some ways of consuming goods and services consume more energies than others, for example, space heating by electricity costs more energy than the use of waste heat.

In addition to the magnitude of the energy target, the *structure* of the target is also important. There are four aspects to this structure. First, there is the distribution of the total energy requirements over different energy-consuming sectors, e.g., industry, agriculture, transportation, etc. Actually, it is much better to seek the task-wise distribution over various energy-consuming tasks, viz., low-, medium- and high-temperature heating, lighting, stationary and mobile motive power, electronic controls and communication, etc. Such a distribution indicates the category of energy-consuming tasks, and the magnitude of energy required for each category. This way of looking at the energy target is important because different categories of energy-consuming tasks are best satisfied by different energy forms—as will be elaborated later. The second aspect is the spatial distribution of energy requirements, in particular, the urban-rural distribution. The third aspect, and the one invariably neglected in energy discussions, concerns the distribution of energy in societies characterized by marked income disparities. The fourth aspect relates to the mix of energy sources —in most third world countries, the sources of energy used differ among the different income groups, mainly because different energy sources are usually associated with differing costs.

Thus, a definition of options with regard to energy targets for third world countries must be based on answers to a number of key questions:

Magnitude of the energy target

(i) What is the population corresponding to the target?

(ii) What per capita energy consumption will be attempted? i.e.,

(a) what extent of affluence, or per capita GNP?

(b) what type of lifestyle, or composition of GNP?

(c) what degree of centralization of production?

(d) what technologies of production, distribution and consumption?

Structure of the energy target

(i) What will be the break-up of the energy target according to sectors and categories of energy-consuming tasks?

(ii) What will be the spatial distribution of energy, e.g., between urban and rural areas?

(iii) What will be the energy distribution between various income groups in the stratified society?

(iv) What will be the mix of energy sources?

3. THE GROWTH OR KEEPING-UP-WITH-THE-JONESES OPTION

There are two distinctly different approaches to these questions and, therefore, to the definition of energy goals.

The first is a *more-of-the-same* approach based on a continuation of current trends of energy consumption, and hence, the assumptions and value-judgments underlying these trends. This approach leads to what may be called the *growth or keeping-up-with-the-Joneses option.*

In this context, one must not fail to note that most third world countries are in fact dual societies, with small, affluent, largely urban-based elites (10-20% of the population) and large masses of poverty-stricken people, most of whom live in rural areas. Further, the elites are heavily influenced by the life-styles of the developed countries and practice an outlook best described thus: "all that is rural is bad, all that is urban is better and all that is western is best!" This dual nature of society is clearly reflected in the energy consumption patterns.

The per capita energy consumption targets aimed at by decision-making elites are those based on attempting "to catch up with the west." This attempt is manifested as:

(a) the striving for continuously increasing values of per capita energy consumption, which are unquestioningly assumed to be the basis of per capita GNP, the growth of which has been the crucial socio-economic objective of most industrialized countries;

(b) the economic aim of emulating the composition of the GNP characteristic of the industrialized countries, and therefore generating the energy required to produce a similar bundle of goods and services;

(c) the belief that developing countries must necessarily follow the path of industrialization of the developed countries, in which centralized production for remote markets resulted in large energy expenditures on distribution, even though production for local consumption is traditional to the third world countries;

(d) the view that, in industrializing their economies, third world countries have no option except to adopt the package of production, distribution and consumption technologies adopted in the developed countries, even though these technologies were evolved to suit their specific historical circumstances of capital abundance, labor shortage and cheap energy.

In fact, these assumptions may not be tenable at all. Untempered pursuit of GNP *per se* only aggravates the inequalities of a dual society, and must, therefore, be abandoned as a socio-economic objective, and with it, the so-called "correlation" between per capita GNP and the per capita energy consumption. The composition of the GNP can be far more important than the magnitude of GNP in determining the quality of life, particularly for those below the poverty line—skyscraper office buildings (and the energy that goes into them) must be counted in the GNP (and the per capita energy consumption), even though they cannot easily substitute for low income housing. The switch from traditional decentralized production for local consumption to centralized production for distant markets invariably increases the energy bill due to energy costs for processing, storage, transport, and marketting, and at the same time prices the goods and services beyond the means of the poorest sections. Finally, the energy- and capital-intensity of the production, distribution and consumption technologies of the developed countries, along with their labor-saving character, make them intrinsically inappropriate for oil-importing developing countries, most of which are grappling with continuously increasing unemployment and desperate shortages of energy and capital.

Apart from all these considerations, it is fairly certain that if the entire populations of developing countries were to have the same per capita energy consumption as the developed countries, say the USA, then the energy demand would become too high to be sustained with the present pattern of usage of energy resources. For instance, on the basis of US per capita energy consumption figures, India alone would require about three times the total energy now consumed by the USA—a requirement which is 150 times the present production of commercial energy in India. Thus, energy resource limitations may make it impossible for third world countries to achieve the growth or "keeping-up-with-the-Joneses" option—the Joneses can use so much energy only because the Singhs use so much less. The more-of-the-same option for energy targets is just not feasible if the per capita energy consumption levels of the developed countries are used as norms.

The outlook is not any brighter with the structure of energy targets.

The sectoral distribution of commercial energy in many developing countries seems to be based on an emulation of the industrialized countries, even though third world countries are primarily agricultural, e.g., the comparison between USA and India.

TABLE 1. SECTORAL DISTRIBUTION OF COMMERCIAL ENERGY

Sector	Energy consumption (percentage)	
	India	USA
Industry	39.1	30.3
Transport	32.3	25.2
Domestic	18.0	14.0
Agriculture	4.6	4.0
Miscellaneous	6.0	26.5

The spatial distribution of energy in developing countries is even more alarming (Table 2)—the urban-rural disparities in energy consumption show that commercial energy production hardly flows to rural areas, even though the bulk of the population lives there. The existence of these urban islands of energy affluence amidst vast oceans of rural energy deprivation is another characteristic of dual societies. They result from the energy supply system responding only to energy demands and ignoring energy needs which cannot be backed up with purchasing power.

TABLE 2. URBAN-RURAL DISTRIBUTION OF COMMERCIAL ENERGY IN THIRD WORLD INDUSTRIES

	Asia	Africa	Latin America
Rural share of commercial energy	23%	4%	23%
Rural poopulation	75%	91%	50%

Finally, there is a highly skewed distribution of energy between different strata in dual societies—a reflection of the skewing of incomes. The inequalities in energy consumption are not merely in the magnitude of energy consumption, but also in the forms of energy used. The point is that various types of energy—electricity, oil, coal, non-commercial

energy (firewood, animal dung and agricultural wastes)—have differing costs, and the poorer the section of society, the cheaper the energy source it uses. And the poorest sections of third world countries survive on non-commercial energy. This non-commercial energy can be gathered at "zero" private cost, but there are very high-social environmental costs in the form of environmental degredation (deforestation, soil erosion and desertification) and lost social opportunities of diverting the labor now spent on gathering non-commercial fuels to socially productive activities. No wonder that developing countries rely to a great extent on non-commercial energy, which for example accounts for 50% and 90% of the total energy consumption in India and East Africa respectively.

Thus, energy targets based on the growth or keeping-up-with-the-Joneses option will only preserve and accentuate:

(a) the energy-deprivation of the agricultural sector,

(b) the urban-rural disparities in energy consumption,

(c) the highly skewed distribution of energy over the different income groups,

(d) the dependence of rural areas and the poorest sections on non-commercial energy.

These unwelcome features of current patterns of energy consumption in third world countries are an essential part of their dual societies. In this sense, the growth or keeping-up-with-the-Joneses option is an offspring of dual societies, and only serves to consolidate and acerbate the inequalities and injustices of such societies—it inhibits the development of third world countries.

4. THE DEVELOPMENT OPTION

An alternative approach to energy goals can be based on the development option, in which the energy sector is used as a mechanism for promoting development. The magnitude and structure of energy targets must therefore be chosen with this perspective.

Of course, much will depend upon the definition of development. In this context, the recent UN definition constitutes an excellent basis. According to this definition, development is viewed as a process which is primarily directed towards:

(a) the satisfaction of basic human needs (material and non-material), starting with the needs of the neediest, in order to achieve a reduction of inequalities between and within countries;

(b) endogenous self-reliance through social participation and control; and

(c) harmony with the environment.

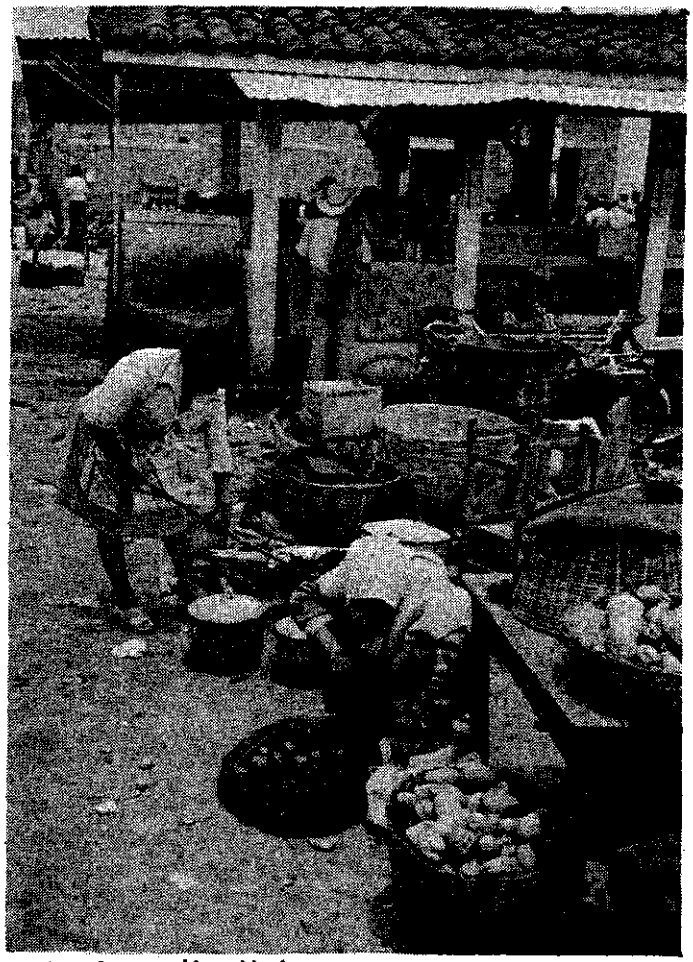
The commitment to development, rather than to growth *per se*, as a socio-economic objective has major implications with regard to energy targets for third world countries.

First, the viewpoint that growth of GNP should be a by-product, rather than basis of, development results in a liberation from a dependence on the "correlation" (between per capita energy consumption and per capita GNP) as a source of energy targets. Instead, per capita energy targets must be derived from development objectives, and in particular from the objective of satisfaction of basic human needs.

Second, the emphasis on development requires that the composition of the GNP, i.e., the product-mix, of third world countries be radically different from that in the developed countries. In particular, the basic needs of the neediest may have to be satisfied by simple life-styles. This requirement of simplicity *may* involve natural rather than energy-intensive synthetic fibers, renewable rather than depletable materials which have to be extracted at considerable energy expenditures, shared communal facilities (e.g., mass transportation systems) rather than energy-intensive luxuries for individual use (e.g., private automobiles).

Third, many cases of highly centralized production for massive markets have evolved at high energy costs only to satisfy the profit-seeking motives of large corporations, even though decentralized production for local consumption may be adequate for the satisfaction of basic needs. Industrialized food systems are an example. The change-over from production for small, local markets to production for nationwide, or even world-wide markets, is inevitably associated with increasing off-the-farm energy expenditures on food processing, packaging, transport, distribution and storage. Today, this off-the-farm energy expenditure accounts for about 75% of the total energy consumption of the industrial food system of the USA. This energy price will have to be paid if third world countries "westernize" their agricultural sectors.

Fourth, a decision to avoid imitating the historically-conditioned path of industrialization of the developed countries means that the choice of technologies need not be restricted to their package of technologies. This widening of the choice has dramatic implications for the energy question. The point is that every technology is generated in response to certain ranges of factor prices, including the price of energy, and therefore, most technologies of the developed countries are very much the product of the



Market-place cooking, Mexico

pre-1973 low oil prices. Had the current oil prices prevailed over the past fifty years, it is almost certain that a radically different pattern of energy-saving technologies would have emerged in the industrialized countries. Today, the developed countries may not be able to dismantle their energy-intensive technologies, but the third world countries, precisely because they are in the very early stages of industrialization, can opt for available or generatable alternative energy-saving technologies. This would be a far wiser policy than importing and establishing western-type energy-intensive technologies and inevitably landing in a serious energy crisis from which they will have to extricate themselves painfully. The argument can be particularly well illustrated by the green revolution agriculture which is well-known to be a major sink for energy, rather than a source of energy, which is what one would expect from the phenomenon of photosynthesis.

All this means that the development approach to norms for per capita consumption is totally different from that based on keeping-up-with-the-Joneses. Unfortunately, hardly any research has been done in this new direction.

A significant step, however, was taken by Hafner (1979) who estimated the minimum per capita energy requirements for a North American to have a satisfactory life (Table 3). This minimum is about one-third the current US per capita energy consumption. But even this minimum is a high figure and can be reduced substantially. For instance, one can deduct the space heating component, which is about 10% of the 31,000 kcals per capita per day, because most third world countries are fortunately located in sun-drenched tropics. Thus, the per capita energy consumption figure gets reduced to 28,000 kcals per capita per day. But, still further reductions are possible by adopting (a) needs-oriented product-mixes, (b) where sensible and feasible, decentralized production for local consumption, and (c) alternative energy-saving technologies for production, distribution and consumption. The magnitudes of these reductions can only emerge from detailed research, but they may result in substantial reductions, perhaps even 50% to yield a per capita consumption figure of about 14,000 kcal per capita per day.

TABLE 3. MINIMUM ENERGY BUDGET FOR A SATISFACTORY LIFE IN USA

Basic Need	Energy requirement	percentage
Food	6,200 kcal/day	20
Housing	6,200 kcal/day	20
Clothing	2,065 kcal/day	6.7
Transportation	4,130 kcal/day	13.3
Leisure	12,400 kcal/day	40
Total	30,955 kcal/day	100

Source: Hafner, 1979.

Some such drastically reduced figure multiplied by the projected population will yield the energy target corresponding to the period for which the population projection has been made. Thereafter, it is a question of ensuring that the energy targets keep pace with the population growth. An important point to note with regard to the magnitude of development-based energy targets is that they are very much lower, and therefore more accessible and feasible, than the growth-oriented targets based on attempts to keep-up-with-the-Jonses.

In addition, the adoption of a development-oriented approach to energy targets has major implications with regard to the structure of these targets.

First, they demand substantial inter-sectoral shifts towards agriculture and agro-industries. The argument for such a shift is simple. In the context of growing unemployment, an employment-oriented strategy of development is unavoidable, and the sector which can generate the most employment in the predominantly agricultural third world countries is the agricultural and agro-related sector, particularly the processing, storage and marketting of agricultural produce and wastes. To ensure that the capital-output ratios in such agro-industries are sufficiently low, adequate inputs of inanimate energy may be es-