

# **Energy Requirements and Utilization in Rural and Urban Low–Income Settlements**



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## FOREWORD

Particularly in rural areas, the difficulty of providing energy for human settlements is becoming one of the greatest constraints on the improvement of living conditions. It cannot be expected that the great mass of poor rural people will be able to upgrade their shelter and settlements, unless we can find cheap, practical solutions to the problem of energy supply. For this reason, the International Year of Shelter for the Homeless is vitally concerned with the issue.

This report provides a review of the energy needs of poor settlements, rural and urban, and of some of the avenues to be explored in meeting those needs. It is intended to suggest general guidelines for energy policy which can be considered by the governments of developing countries. It should, however, be seen as part of the over-all effort to upgrade the shelter and settlement conditions of the poor and disadvantaged in developing countries within the framework of the International Year of Shelter for the Homeless.

The technical aspects of most energy solutions are fairly well known, with the small exception of some new technologies still under development. However, there has been a general failure to apply known techniques and adapt them to particular country situations. It is hoped that this report will give some stimulus to the adoption of practical energy programmes for low-income human settlements.

A handwritten signature in dark ink, reading "Arcot Ramachandran".

Dr. Arcot Ramachandran  
Under-Secretary-General  
Executive Director

## SUMMARY

Problems of energy and human settlements should be considered on the basis of the short (5–10 years), medium (10–20 years) and long terms (over 20 years). Some of the critical factors which will have to be taken into account are the ecological impact of energy systems, deforestation caused by increases in wood-fuel consumption, energy requirements for food production, economic and social impacts of new technologies in rural settlements, patterns of energy consumption of the urban and rural poor, and capital-intensive and energy-intensive industrialization policies. Experience in many countries indicates that there is a need to plan and implement energy and settlement policies with extensive public participation.

It is necessary to examine new technologies for improved fuel-conversion efficiency. The objectives of introducing innovative energy technologies in human settlements are:

- (a) To reduce human labour (especially for women and children engaged in collection of primary energy resources such as fuelwood and vegetable and animal wastes) expended in meeting domestic energy needs and, thus, to improve the quality of life;

- (b) To increase the energy base and, hence, productivity in economic development sectors related to human settlements;
- (c) To manage production and consumption of non-commercial fuels and increase their conversion efficiencies;
- (d) To minimize the impact on the environment of fuel production and use.

The use of non-petroleum energy technologies is particularly relevant to the needs of oil-importing developing countries. In order to shift the energy patterns of an oil-based economy to those of a non-oil-based one and to ensure an adequate and uninterrupted supply of energy to the domestic sector, it is necessary to consider renewable energy resource options, such as solar, wind, biomass, small-scale hydro and decentralized non-oil-based integrated energy systems. At the current level of development, renewable sources of energy probably play a very limited role globally, but their importance at the local level should not be underestimated, and their use should be promoted. Surveys are needed in every developing country to establish the potential of locally available renewable sources of energy which can be harnessed to meet the needs of rural and urban settlements.

A programme for meeting the energy needs of low-income households would include exploiting new energy resources and rationalizing use of commercial fuels. While the technical feasibility of many new energy processes has been established, it is not certain that it will be possible to bring their cost down to levels which will make them economically attractive for large-scale usage. The development and large-scale introduction of an integrated total energy package can only be successfully achieved as part of a national programme, and such an energy programme would have to form part of a subnational development plan, since the varying needs of each region would have to be taken into account, and the technological solutions would have to be adapted and modified to suit local needs.

In view of the escalating cost of energy, the potential for energy conservation should be assessed. The investigation should include:

- (a) The potential for energy conservation in heating and cooling existing buildings;
- (b) The applicability of bioclimatic design principles in the design of new buildings and planning of new settlements;
- (c) The efficiencies of converting fossil fuels into other sources of energy for industry, domestic uses, agriculture and transportation;
- (d) The conversion efficiencies of the so-called non-commercial fuels used in domestic, agricultural and small-scale industrial sectors;
- (e) The options for energy substitution in performing various functional tasks with a view to conserving non-renewable energy resources;
- (f) The potential for improvement of various modes of transportation used in urban and rural settlements.

An integrated approach involving the exploitation of all locally available energy resources would not only optimize the benefits that could be obtained from renewable energy resources but also ensure an uninterrupted supply of energy to meet the needs of the domestic, agricultural and small-scale industrial sectors of rural settlements. In order to establish optimal energy systems, it is desirable to initiate pilot and demonstration projects in a variety of settlement conditions to obtain field data on technological, socio-economic and operational/management problems which must be solved for large-scale application. In order to provide the methodologies for planning human settlements with attention to energy requirements and conservation, it is essential that planning guidelines be developed for various climatic, social and economic environments.

## INTRODUCTION

The availability of energy is an important determinant of the quality of life in human settlements. Most countries, in particular, the oil-importing developing countries, have been seriously affected by the current high cost of energy, which has created widespread balance-of-payments difficulties. Although both developed and developing countries have been adversely affected by recent changing energy economics, the force of the impact and the associated problems and issues of energy supply-and-demand patterns have varied from region to region and between and within countries.

The following energy factors have had a crucial impact on recent human settlements development:

- (a) The sudden increase in energy prices caught most human settlements unprepared and thus affected the long-term development goals of many communities;
- (b) The changing energy situation created complex problems for human settlement planners, most of whom were trained during periods of declining energy prices and have always worked with an implicit assumption of uninterrupted flow of primary energy sources;
- (c) Proven technologies for putting to efficient use the primary energy in various sectors of the economy, particularly in the household sector, were unavailable owing in part to a lack of incentives for developing such technologies during the period of declining energy prices;
- (d) Technical and economic difficulties interfered with efforts to retro-fit existing buildings and housing stock;
- (e) In developing countries with a low technological base, where commercial fuel played a relatively modest role in energy usage, noncommercial fuel accounted for the greatest share of energy consumption but was increasingly scarce, owing, among other factors, to dwindling forest resources.

Conversely, the changing patterns of human settlements have had a significant impact on energy economics. For example:

- (a) Current trends in the growth and concentration of population in urban settlements have entailed large expenditures on energy in order to keep the economic sectors viable and to increase productivity and employment;
- (b) In developing countries, economic development and improvement in the quality of life of low-income urban and rural settlements have usually resulted in an increase in energy utilization and in the substitution of commercial fuels for non-commercial fuels.

The relationships between energy and human settlements highlight the urgent need to examine both energy and human settlements planning in the context of national development goals. In general, integrated and comprehensive settlement planning or upgrading of existing settlement patterns should mean, among other things, energy economy and efficiency in energy conversion to heat, lighting, power etc. Efforts must be made to evolve appropriate policies, in order to:

- (a) Minimize the adverse effects on human settlements that result from fluctuations in energy-supply patterns;
- (b) Plan economically viable human settlements based on an appropriate energy mix which minimizes investment and maximizes productivity and employment.

Habitat: United Nations Conference on Human Settlements recognized that human settlements are consuming increasing quantities of energy just when mankind is aware of the need to halt environmentally degrading and wasteful use of non-renewable energy resources. Proper utilization of energy and suitable combinations of energy production processes should be given special consideration in the choice of designs and technologies for human settlements. Those objectives may be achieved by:

- (a) Reducing energy consumption by land-use planning, building design, and appropriate transportation systems;

- (b) Promoting efficient use of energy resources – for example, through innovative approaches to design and energy management and through incentives for energy conservation or disincentives for wasteful consumption;
- (c) Adapting techniques for the production of building materials, for building construction and for the operation of buildings which lower energy requirements, taking into account initial and maintenance costs as well as environmental and social considerations;
- (d) Emphasizing the use of renewable over non-renewable energy sources and the rationalization of technologies which are currently known to be hazardous to the environment;
- (e) Using energy systems which are less susceptible to power failures over large areas because of disasters;
- (f) Developing and implementing small-scale energy conversion, utilization and conservation systems appropriate for meeting the basic energy needs of the rural and urban poor. 1/

The present report deals with various aspects of energy consumption by and energy requirements of the low-income population in urban and rural settlements in developing countries. It also deals with technological options available to meet energy needs in the domestic sector, the potential of renewable energy resources, and institutional and financial issues relating to the utilization of renewable energy resources in developing countries. The emphasis of the report is on the implications of introducing certain energy systems into rural and low-income urban settlements and on policy options for supplying energy needs in the domestic sector.

## **Chapter I. ENERGY AND HUMAN SETTLEMENTS IN DEVELOPING COUNTRIES**

In many developing countries, the living conditions of the majority of the poor have improved very little, especially in rural areas, despite the considerable advances in raising total output during the 1960s and 1970s. This failure to improve the situation of the poor, even in those developing countries where economic growth has been rapid, has led a number of Governments and international agencies to recommend that the prime goal of development should be to meet the basic needs of all sectors of the population.

The process of economic growth is traceable in large part to the substitution of energy for muscle in the performance of every type of agricultural, industrial and domestic task. Moreover, many of the pesticides, herbicides and fertilizers on which successful agriculture in industrialized nations depends are derived from fossil fuel sources. It is hardly surprising, then, that prospects for growth in critical sectors of the less developed economies are linked, at least in part, to the development and exploitation of energy resources available to them.

In many developing countries, economic conditions are such that the bulk of the population is poor and depends mainly on non-commercial fuels. The financial problems of people below the poverty line result in their use of fuelwood and/or cow-dung cake which are the most easily available and cheapest fuels they can get. However, the exploitation of forests and natural fertilizers leads to environmental degradation which reduces the productivity of soil in the long run. Hence, the energy-use patterns increase poverty, and there is

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