
Renewable Energy Resources and Rural Applications in the Developing World

Edited by Norman L. Brown

AAAS Selected Symposium

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About the Book

The energy situation in developing countries is desperate. Because these countries are primarily dependent on fossil fuels--chiefly oil--for industrial growth, they have been hard hit by oil price increases. Further, in the rural areas, where most of the population lives, there are limited supplies of increasingly expensive diesel fuel or kerosene. Noncommercial energy sources such as firewood, dung, and agricultural residues are generally used in rural areas, but under the pressure of growing populations the forests are disappearing. This is resulting in a critical shortage of firewood for cooking and heating, as well as in the destruction of the environment. In addition, when dung and agricultural residues are burned, valuable fertilizers are destroyed. Thus, the rural areas--the sources of food and fiber--face a particularly alarming situation.

Small-scale, decentralized technologies for exploiting the sun's energy, received directly or as wind, flowing water, or biomass, provide potential solutions to the problem of rural energy needs. These technologies have been the subject of numerous studies, including two by the National Academy of Sciences. In this volume, members of the two academy study panels have joined with other experts to discuss the status of these technologies and to place them in a realistic context.

Foreword

The AAAS *Selected Symposia Series* was begun in 1977 to provide a means for more permanently recording and more widely disseminating some of the valuable material which is discussed at the AAAS Annual National Meetings. The volumes in this *Series* are based on symposia held at the Meetings which address topics of current and continuing significance, both within and among the sciences, and in the areas in which science and technology impact on public policy. The *Series* format is designed to provide for rapid dissemination of information, so the papers are not typeset but are reproduced directly from the camera copy submitted by the authors, without copy editing. The papers are reviewed and edited by the symposia organizers who then become the editors of the various volumes. Most papers published in this *Series* are original contributions which have not been previously published, although in some cases additional papers from other sources have been added by an editor to provide a more comprehensive view of a particular topic. Symposia may be reports of new research or reviews of established work, particularly work of an interdisciplinary nature, since the AAAS Annual Meeting typically embraces the full range of the sciences and their societal implications.

WILLIAM D. CAREY
Executive Officer
American Association for
the Advancement of Science

About the Editor and Authors

Norman L. Brown is country program specialist with the Office of International Affairs at the Department of Energy. As such, he is chief technical adviser to DOE's program of energy development with less developed countries. His international interdisciplinary background in science and technology, particularly energy and food problems, has involved him in seeking and encouraging appropriate technological solutions. He was the staff study director for Energy for Rural Development (National Academy of Sciences, 1976).

Joseph J. Ermenc, professor of engineering at Dartmouth College, specializes in mechanical engineering and the history and philosophy of technology development. He is the author of an 8-volume series, Dartmouth Readings on Technology, and 38 volumes of interviews with outstanding innovators. He was a member of the NAS panel that contributed to Energy for Rural Development (NAS, 1976).

Raymond C. Loehr, director of the Environmental Studies Program and professor of civil, environmental and agricultural engineering at Cornell University, has published over 100 technical papers and three books, including Agricultural Waste Management (Academic Press, 1974) and Land as a Waste Management Alternative, which he edited. He is also an advisor to various governmental and private organizations.

George O. G. Löf, director of the Solar Energy Applications Laboratory at Colorado State University and vice-president of the Solaron Corporation in Denver, is the author of over 100 books and papers on energy conservation, solar energy utilization, heat transfer, and environmental engineering. He is former president of the International Solar Energy Society and in 1976 received the Lyndon Baines Johnson Foundation award for contribution to the betterment of

mankind. He too was a member of the NAS panel on Energy for Rural Development.

José M. Miccolis is special assistant to the president of the National Council for Scientific Development of Brazil in Rio de Janeiro, and director of the Brazilian Science Policy Project at George Washington University. He is the author of several publications concerning energy policy in Brazil.

John W. Powell, director of the Technology Consultancy Centre at the University of Science and Technology in Kumasi, Ghana, has conducted a six-year study of small industries in Ghana. He is the author and editor of two books in mechanical engineering.

Morton B. Prince is acting director for photovoltaics of the Division of Solar Energy at the Department of Energy. In 1954, he developed the Bell Solar Battery at the Bell Telephone Laboratories, and later developed commercial applications of the silicon photovoltaic cell at the Hoffman Electronics Corporation.

*Roger Revelle is professor of science and public policy at the University of California, San Diego, and the Richard Saltonstall Professor of Population Policy at Harvard University. He is former president of the American Association for the Advancement of Science, a member of the National Academy of Sciences, and the recipient of numerous honorary degrees. His numerous publications in the areas of geophysics, national resource development, and population studies include *Survival Equation: Man, Resources, and His Environment* (Houghton Mifflin, 1971) and *Population and Social Change* (Crane-Russak, 1972), both of which he coedited.*

Sharat K. Tewari, a scientist with the Wind Energy Group at the National Aeronautical Laboratory in Bangalore, India, is involved in analysis of wind energy as an alternative energy source, and hardware development in wind power. He has written several papers in this field.

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Introduction

Norman L. Brown

The developing countries that are not fortunate enough to be oil producers are faced with energy needs that are growing more and more difficult to meet. Primarily dependent on oil for industrial growth and agricultural development, they have been hard hit by oil price increases. With little or no flexibility to meet these energy needs with other energy resources and generally unable to compensate for increased oil prices by increasing their exports, the less developed countries (LDCs) find themselves in a progressively worsening position to compete for the limited supplies of fossil fuel.

In most of these countries only a small proportion of the population is served by a power distribution network. The rural areas, where the majority of the LDC population lives, generally depend on limited supplies of diesel fuel or kerosene -- with more or less uncertain transport -- or "noncommercial" energy sources such as firewood, dung, and agricultural residues.

Thus, the LDCs have two distinct energy needs. On the one hand, industrial growth is dependent on conventional urban energy systems that use commercial energy sources and technologies that are already in use or are being developed in the industrialized countries. Agricultural development schemes -- the "green revolution," for example -- pegged to mechanization and manufactured nitrogenous fertilizers also depend on these energy sources and technologies. On the other hand, the majority of the population in most LDCs, living in the rural areas, is isolated from central power distribution. They would therefore particularly benefit from development of technologies to exploit renewable energy resources of the sun, wind, and flowing water.

Most of the energy-related assistance that has been provided the less developed countries to-date has focussed attention on urban/industrial-sector requirements. Only recently have development-assistance organizations focussed attention on the needs of the rural areas. This shift stems from a growing awareness of the importance of the way energy is gathered and used, and an increased understanding, on the part of the donor nations, of the necessity to focus on the needs of the rural populations of the less developed countries.

The choice of energy technology made by developing countries will have a long-term impact on their development that is more widespread and significant than that of any other technological choice currently facing them. Choosing conventional large-scale capital-intensive technologies implies a priori decisions, conscious or not, about many important policies. These include the course of urban development, expanding industrialization, environmental impact, large-scale borrowing (or foreign investment) with long-term indebtedness and problems of debt servicing, increased dependence on fossil fuels or commitment to nuclear energy, and last but not least, the foreign policy stance dictated by these requirements.

On the other hand, the choice of small-scale decentralized power systems (e.g., solar heating, cooling, and generation of electricity; windmills; small-scale hydroelectric plants) implies a different set of a priori decisions. These include, for example, de-emphasis of western-style industrialization as the sole or primary immediate goal of development; dispersal of industry and, perhaps, changes in financial mechanisms; and a shift from western agricultural techniques to emphasis on improvement of indigenous agricultural practices, with consequent reduced demand for energy-consuming nitrogenous fertilizers. All of these factors could contribute significantly to a slowing down of migration to the cities and urban growth, with important effects on the rate of growth of dependence on commercial energy supplies.

In making these choices, less developed countries must decide on the relative importance of the commercial-sector energy needs versus those of the traditional rural sector. Interest in small-scale technologies for exploiting energy received from the sun - whether directly or in the form of biomass, wind, or flowing water - has been increasing recently in both the industrialized and the developing world. In a recent report (1) the National Academy of Sciences examined these technologies in terms of their near- and long-term availability, particularly for use in rural areas of the less