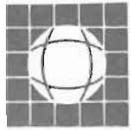


options



a IIASA
news report

... published quarterly
by the International Institute
for Applied Systems Analysis

'81

ONE

Energy in a Finite World

Ever since its foundation in 1972, one of IIASA's main research projects has focused on the global energy system and its possible future development. The result of this effort has just been published: *Energy in a Finite World*.

"It could be done" — this is the good news from IIASA's massive international study of the prospects of meeting global energy needs over the next fifty years. During this period the worldwide population will double to 8 billion, and even with only modest economic growth and extensive conservation, global energy demand is likely to expand to three to four times today's level. Nevertheless, the Institute's Energy Systems Program concluded that the technology and resources would be available to satisfy this greatly increased demand.

Energy in a Finite World, published by Ballinger Publishing Company, summarizes the findings of this seven-year investigation in a volume subtitled *Paths to a Sustainable Future*. A second volume, subtitled *A Global Systems Analysis*, contains the detailed technical analysis.

The study's not-so-good news is that to meet the growing worldwide demand, full use of all available energy sources — oil and gas, solar, renewables, and nuclear — will be required. Dirtier and more expensive fossil resources and vast quantities of synfuels will have to be developed, as well as both large-scale solar plants and nuclear breeder reactors. Small-scale solar and renewable resources will also play a growing role, but can only satisfy a modest fraction of the total demand during the next half century.

The IIASA analysis is the first truly global and long-term examination of the energy future, and the first in which

scientists from East and West have collaborated. By using a consistent model of worldwide energy supply and demand, it avoids the common tendency of separate national studies to assume that sufficient imports will always be available, without comparing the demands of all countries against the likely supplies. By looking fifty years ahead it accounts for the time it takes the energy system to undergo fundamental changes.

The principal goal of the study was to identify strategies for the transition from a globe reliant on oil and gas to one served by sustainable sources of energy. But the original expectation that this could be accomplished within the 50-year horizon of the study turned out to be too optimistic. Instead, the IIASA group found that there will have to be two transitions. The first, from relatively cheap and clean conventional sources of oil and gas to more expensive and dirtier unconventional ones will continue through 2030. The second, to the essentially infinite supplies of solar, nuclear, and renewable energy, will not be completed until late in the next century. But such a system would be sufficient to sustain the then anticipated global population of about 10 billion persons for many centuries.

While reaching conclusions more reassuring than some previous global studies, the analysis is not fully confident about the chances that the promising paths will be followed. The authors observe: "The transition from the present fossil era to

Contents

Energy in a Finite World	p. 1
Forest Sector: Heading for Structural Change	p. 4
New Books from IIASA	p. 6
News from IIASA	p. 7
Conference Report	p. 8

Continued page 2

Energy in a Finite World

Continued from page 2

an era based on inexhaustible energy resources will not be straightforward. We cannot even be sure it is possible. At the very least, it will require that national energy policies, corporate energy policies, and personal energy behavior be conceived with as clear an understanding of their relationship to the global energy problem as possible. For better or worse, we cannot isolate ourselves."

The authors point out that all future energy paths have their costs: lower energy use threatens more severe economic difficulties; higher energy use permits greater economic development, but poses more severe environmental dangers.

Liquid fuel supply is the "energy problem within the energy problem." Even though oil supplies will increase through the exploitation of costlier and dirtier resources, such as oil shales and tar sands, they will be insufficient to match the rapidly expanding and irreducible worldwide demand for liquid fuels for transportation. Vast quantities of coal will then have to be liquefied. With 90 percent of world coal supplies in the USA, USSR, and China, these nations will play a central role in the world market that will be needed to match supplies with demand. A similar market may also develop for the synthetic fuels produced from oil shales and tar sands, located primarily in the Americas and China.

Even so, the authors anticipate that in the first decades of the next century, the Persian Gulf will still be supplying large quantities of oil to the world. However, its principal customers will lie in Western Europe and Japan and in the developing nations of Africa and Southeast Asia. The Americas, Eastern Europe, and China will not be net importers of oil. They will be able to satisfy their liquid fuel demands with their own oil, gas, and coal resources.

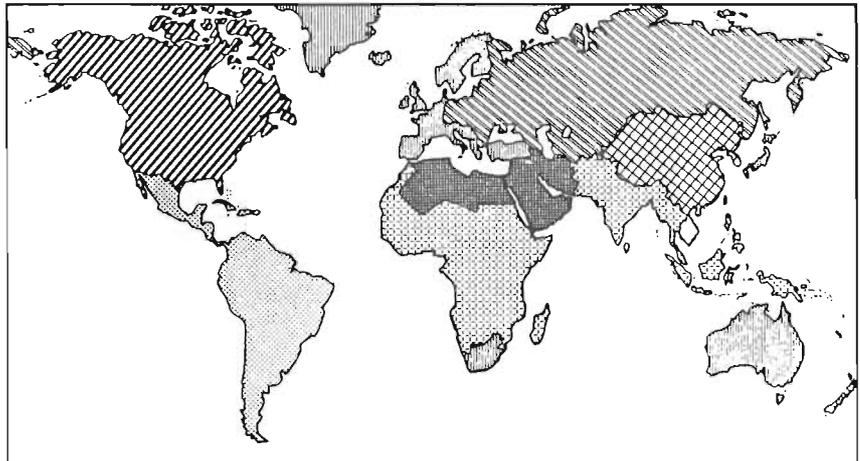
However, the authors warn that the increased use of fossil resources could be constrained by the resulting carbon dioxide releases to the atmosphere, which some scientists believe will lead to climatic changes.

The transition from today's oil, gas, and coal to fossil resources that require substantial transformation before use, and the development of renewable resources entail tremendous capital investments. While the industrial world is expected to be able to cope with this huge capital demand, the developing countries may find it difficult to provide the necessary funds.

The most precious — and scarce — resource, however, is time. In the past, new

primary energy sources, such as coal, oil, and gas, have required some 100 years to increase their global market share from one to fifty percent. Therefore, the main point in solving the energy problem is not which energy resources should be chosen, but how fast we will be able to develop them. For example,

large-scale solar energy deployment, such as solar power plants in desert areas, has not yet reached sufficient technological maturity to make a major impact on a global scale within the next fifty years. Solar power is expected to reach its full potential only in the second half of the next century.



The IIASA World Regions

The IIASA Energy Systems Program has divided the world into seven major regions, grouped on the basis of economic factors rather than geographic proximity. Region I, North America, has a highly developed market economy and is comparatively rich in energy resources. Region II, the USSR and the other European CMEA countries, has a developed planned economy and is also quite rich in energy resources. Region III, a far-flung entity consisting of Western Europe, Japan, Australia, New Zealand, South Africa, and Israel, is highly developed but rather poor in energy resources. Region IV, Latin America, is a developing region that is fairly rich in energy resources. Region V, which encompasses central Africa, southern Asia, and parts of southeastern Asia, is made up typically of less developed countries with scarce energy resources. Region VI includes the oil-rich developing countries of the Middle East and northern Africa. Region VII, China and the other centrally planned Asian economies, is a less developed area that is generally self-sufficient in energy.



Professor Wolf Häfele of the Federal Republic of Germany, leader of the IIASA Energy Systems Program. Before joining IIASA in 1973, he was with the Karlsruhe Research Center, where he was in charge of developing the FRG Fast Breeder Reactor. He is about to return to his country to assume his new position as Managing Director of the Research Center at Jülich.

Energy in a Finite World provides the factual basis for designing a world energy strategy to reach the goal of a global sustainable energy system. By identifying the problem areas, it can help politicians and policymakers reach decisions that will provide for an orderly growth of energy resources to satisfy growing world needs in peace.

The book investigates the global energy problem on three different levels:

- First, it explores the maximum global potential of the various global energy sources: oil and gas, coal, nuclear, solar, and renewables.
- Second, two scenarios — one with "High" and one with "Low" energy demand — are investigated. In addition to these two "benchmark" scenarios, three supplementary cases look at alternative paths of development: stronger deployment of nuclear power; a nuclear moratorium; and a very low demand development based on an unchanged average per capita energy consumption over the next fifty years (approximately two kilowatts per capita).
- Third, a number of conclusions are identified that are relevant to globally-oriented policies towards a sustainable future.

Energy in a Finite World does not provide easy answers, but for the first time it gives a global framework for decision makers all over the world. As Professor Häfele, IIASA's Deputy Director and Leader of the Energy Systems Program, put it: "It could be done, but only with pain and at high cost. However, if we fail to meet the challenge of the energy squeeze within the next couple of years, we may have to pay a much higher price in the long run. Time is our most scarce and valuable resource."

This study was primarily supported by the funds provided by the National Member Organizations of IIASA. Significant additional support, however, came from the United Nations Environment Programme (UNEP), the Volkswagen Foundation in the Federal Republic of Germany (FRG), the FRG Ministry of Research and Technology, and the Austrian National Bank. Also, major parts of the study were carried out in close cooperation with scientific institutions throughout the world, including, for example, the Meteorological Office, Bracknell, UK, the Nuclear Research Center, Karlsruhe, FRG, the National Center for Atmospheric Research, Boulder, Colorado, USA, the Siberian Power Institute, Irkutsk, USSR, the International Atomic Energy Agency, Vienna, and the Institute of Energy Economics and Law, Grenoble, France.

ENERGY IN A FINITE WORLD

Paths to a Sustainable Future

Report by the Energy Systems Program Group
of the International Institute for Applied Systems Analysis
Wolf Häfele, Program Leader

Written by Jeanne Anderer with
Alan McDonald and Nebojsa Nakicenovic

Energy in a Finite World, Volume 1: Paths to a Sustainable Future (ISBN 0-88410-641-1) and *Energy in a Finite World, Volume 2: A Global Systems Analysis* (ISBN 0-88410-642-X), published by Ballinger Publishing Company, Cambridge, Mass. (USA) can be obtained from your local bookseller, or from the following organizations:

Australia and New Zealand

Harper and Row Australasia
P.O. Box 266
Artarmon N.S.W. 2064
Australia

Brazil

Editoria Harper and Row do Brazil LTDA
Rua Joachim Tavora 663
04015 Sao Paulo — SP
Brazil

Europe (Except UK)

Harper and Row
10 Linde Laan
NL-1405 AK Bussum
Netherlands

India

Harper and Row Publishers
P-6 Hauz Khas Enclave
New Delhi 110016
India

Japan

Harper and Row Publishers
Ichise Bldg.
29, Kanda Jimbocho 1-Chome
Chiyoda-ku, Tokyo 101
Japan

Latin America (Except Brazil)

Harper and Row Latinamericano
HARLA, S.A. de C.V.
Apartado 30-546
Mexico 4 D.F.
Mexico

Mid-East Asia

Harper and Row Liaison Office
Seisgasse 2/19
1040 Vienna
Austria

South Africa

Harper and Row
P.O. Box 28170 Sunnyside
Pretoria
Transvaal
South Africa

UK

Harper and Row Ltd.
28 Tavistock Street
London WC2
UK

US & Canada

Ballinger Publishing
17 Dunster Street
Harvard Square
Cambridge, Mass. 02138
USA

Foreign

Harper and Row Publishers
International Department
10 E. 53rd Street
New York, N.Y. 10022
USA

IIASA has also published an Executive Summary of approximately 60 pages, which is available from the Institute. Single copies of this summary of *Energy in a Finite World* are available free of charge from the IIASA Publications Department.

Forest Sector: Heading for Structural Change

R. Seppälä and P. Uronen*

IIASA's Forest Sector Study

The ubiquity of synthetic materials makes it easy to forget our dependence on wood. In many less-developed countries forests play a critical role in providing charcoal, firewood, and building materials. And as countries develop, wood remains a basic raw material. Unlike most other resources, forests have a renewable feature. Even without the intervention of man, they will usually regenerate themselves if land is not used for other purposes.

Forests perform indispensable ecological services. They assist in the global cycling of water, oxygen, carbon, and nitrogen. They reduce the severity of floods and keep soil from washing off mountainsides. They keep sediment out of rivers and house millions of plant species that will disappear if forests are devastated.

In the mid-seventies, closed forests (wood areas that are of interest for industrial forestry) covered about one-fifth of the earth's land area. How many forests have been destroyed by man in the course of time is unknown, but if present trends continue the forest cover will decline to one-sixth of total land area by the year 2000. Most of this deforestation will be concentrated in less developed countries, mainly due to shifting cultivation and harvesting of firewood.

Only a fraction of the world's forests are sufficiently well managed and protected to provide optimal yields of timber and to carry out their function in the conservation of climatic, soil, and biospheric equilibrium. A substantial part of the world's forest potential will be needlessly lost, some of it forever, before the consequences of poor management are fully recognized.

The geographical distribution of forest resources is extremely uneven. In several heavily populated countries the potential for setting aside major areas for timber production is negligible. The largest untouched forest reserves are located far from the great population concentrations. For this reason further development of world trade in this sector is needed.

*Professor Risto Seppälä of the Finnish Forest Research Institute joined IIASA's Management and Technology Area in September 1980 to serve as Project Leader for the Forest Sector Study.

Professor Paavo Uronen of the University of Oulu joined IIASA's Management and Technology Area in July 1979 to work on management and information systems in the forest industry.

The belief that systems analysis can be of great value in solving the future problems of the forest sector provided the impetus for a major study on forestry at IIASA. In January 1980, an inaugural workshop was held at IIASA. Forty participants attended, representing 12 countries that account for 70 percent of the world trade in forest products.

The workshop ended with general consensus on two propositions. First, IIASA's current studies of information and management systems in forest industries should continue. Second, IIASA should develop proposals for two further studies — one on world trade in forest products, the other on existing national and regional forest sector models.

IIASA accepted these propositions and set up a pilot study to determine an appropriate and feasible research program. This planning phase included talks with interested people in industry, research institutions, and government, to obtain their input into the research design. The resulting proposal for a Forest Sector Study included four subtasks:

- Analysis of world trade in forest products;
- Forest sector modeling;
- Control, management, and information systems in the forest industry;
- Forests as a renewable natural resource.

World Trade in Forest Products

At present, trade in forest products is small in relation to total world production. Moreover, it flows in quite circumscribed paths and so is of unequal significance to different countries and regions. But there is nothing immutable in either the volume or the pattern of this trade. For example, the decline of accessible forests in Southeast Asia (affecting supplies to Japan) or a successful US drive toward self-sufficiency in pulp and paper products would certainly have an impact on trade patterns.

Advances in electronic information technologies and the diffusion of these new technologies may affect the demand for certain forest products, such as newsprint. In some countries this will become noticeable more quickly than in others.

Some developed nations may become self-sufficient or begin to find themselves with surpluses of some products; in this case these nations and their former suppliers will have to seek markets elsewhere. Here again trade patterns and volumes face change. Currently no means of systematically exploring the first- and second-order effects of such changes in the pattern and volume of trade seem to exist.

The primary objective of the first subtask of the IIASA forestry project is to explore and define the structure and mechanisms of world trade in forest products. Within this context a secondary objective is to examine and record the future prospects of the forest industry on a world, regional, and national level. The intention is to create a global framework within which the policy issues and plans of individual countries and industries can be explored.

The method of analysis selected for these investigations involves the construction of a computer-based *model system of world trade in forest products*. The system resembles the network approach of IIASA's Food and Agriculture Program (see *OPTIONS '80*, Volume Four). The analysis will focus on a limited set of countries that adequately cover the world forest sector, especially international trade in forest products.

National policy models will be the basic elements of the model system. Each model should reflect specific national physical and institutional conditions. Still, all the models must have some common features, such as product classification, and must conform to some technical requirements — especially those concerning input and output channels — to permit model linkage.

A prototype model will be prepared at IIASA, as a basis for ensuring adequate uniformity of national models. In addition to serving as a design guide for national modelers, the prototype will be used as a standard dummy module for countries that cannot participate in the project but ought to be included.

Because the world market in forest products is a geopolitical-economic system of great complexity, significant changes in its structure, mechanism, and behavior can seldom be made in the short term. The IIASA analysis will therefore focus mainly on long-term policy issues, using a horizon of 20 or 30 years. In particular, it will attempt to identify policies that, if adopted during the 1980s, are

likely to produce a favorable future for forest product industries in the two subsequent decades.

Forest Sector Modeling

Many individuals have constructed national or regional forest sector models, for the most part with little exchange of ideas. A convenient forum for communication has been lacking. IIASA proposes to fulfil this function: to provide a locus for information exchange in the area of forest sector modeling, to review international developments, to carry out comparative studies, and to provide advice where possible.

IIASA is now conducting a worldwide survey of existing forest sector models — a first step toward producing a state-of-the-art report on regional and national models for this sector. The material obtained during the survey will be input to an IIASA *Forest Sector Model Bibliography* — a modest supplement to the comparative studies.

This bibliography and the prototype forest sector model (constructed to provide a framework for the national models in the world trade analysis of forest products) will form the basis for a brief *Handbook for Forest Sector Modeling*. This will be a supplement to the *Handbook of Systems Analysis*, now being prepared in IIASA's General Research Area.

Management and Information Systems in the Forest Industry

The use of computers in process control applications and in management and administrative tasks has increased rapidly in the forest industry and other process industries. Briefly stated, there have been three "generations" of industrial computer applications. First, attempts were made to solve all tasks with one big computer during the 1960s. Then, during the 1970s, the minicomputer-based process control packages led to differentiation between process control systems and mainframe-based management systems. Finally, in the 1980s we can see clearly a trend toward integration of all these systems, using distributed hardware, common data bases, and real-time communications.

Figure 1 depicts the situation in integrated forest industry enterprises as it typically exists today. Real-time process

control systems are advanced and widely used. For example, more than 90 percent of paper machines in Finland have an on-line computer control system; in the US this figure is about 50 percent, and it is expected to reach 90 percent by 1990. Today distributed microprocessor-based instrumentation systems make full automation at this level very flexible. Gradually the border between computer control systems and traditional instrumentation will diminish, i.e., the two lowest levels of the system hierarchy will be fully integrated.

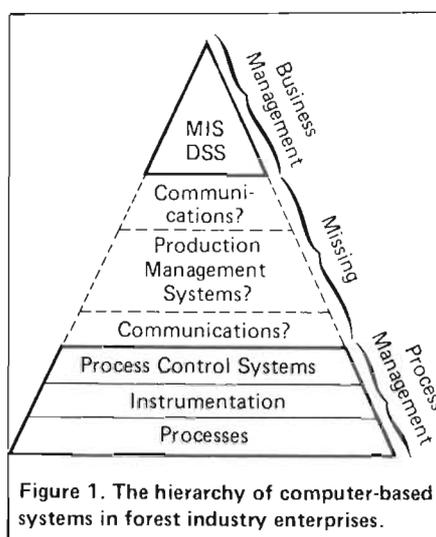


Figure 1. The hierarchy of computer-based systems in forest industry enterprises.

As well, the forest industry enterprises have large EDP departments that develop and use different Management Information Systems (MIS), corporate models, etc., to help in strategic planning and in other managerial tasks. New concepts such as Decision Support Systems (DSS) have also been studied for applications at this level.

Unfortunately, as shown in Figure 1, there is very little communication or integration between process management and business management systems. This is surely not the optimal way to apply computer-based information and control systems. One reason for this lack of integration has certainly been the differing objectives and backgrounds of people using these systems. At the process management level staff members are technically trained and their objectives are technical; at the business management level the staff consists mainly of economists and their objectives are to achieve economic efficiency.

The subtask on management and information systems focuses on the state-of-the-art of computer-based systems in the forestry sector — especially on future trends and needs. In order to get updated

information and to elicit users' needs and opinions from the industry, a large questionnaire has been mailed to approximately 300 companies in 15 countries. The final report of this subtask, based on the feedback provided by the questionnaires, will be ready in the autumn of 1981.

Forests as a Renewable Natural Resource

At least one-third of the world's population depends on firewood as its main source of fuel. In the developing countries the use of wood for fuel, either in its original form or converted into charcoal, represents nearly 90% of total wood consumption. But although the harvesting of firewood is one reason for the destruction of forests in these regions, the greatest losses of woodlands are associated with the agricultural practice of shifting cultivation, i.e., felling and burning forests to release the nutrient content of the living plants.

The evidence collected thus far points to a *conflict between agriculture, energy, and forestry sectors in developing countries*. This conflict is under consideration as a suitable problem area for study at IIASA.

Another problem area relates to permanent changes in the world's environmental conditions caused by the industrial activities of the last few decades. Although still mostly invisible, these changes steadily affect living organisms, especially vegetation. For instance, various pollutants, such as sulfur dioxide, dust, and acidic precipitation, are annihilating certain tree species in heavily industrialized areas. Tree growth has been observed to decrease even in areas far from the centers of pollutant releases. While carbon dioxide, which is released during the combustion of fossil fuels, is expected to increase photosynthetic production, it is also responsible for the so-called greenhouse effect. Little is known about the synergistic effects that take place when all these factors act together.

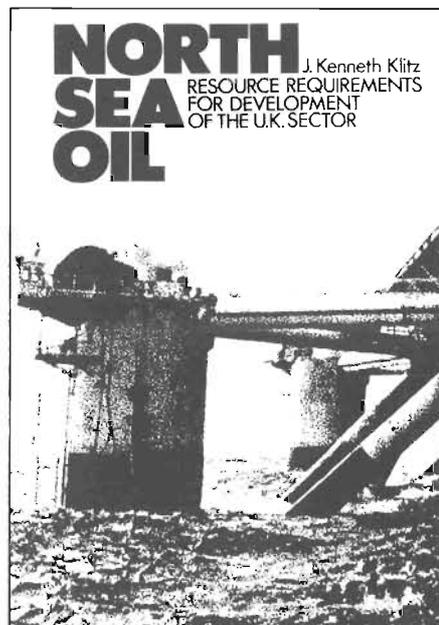
The effects of air pollution on forest yield has been chosen as the second research topic connected with forests as a renewable natural resource. In the beginning, we shall concentrate our efforts on state-of-the-art surveys about acid rain and carbon dioxide. Later, if resources permit, we will include the synergistic effects of all air pollutants on forest yield in the study program.

New Books from IIASA

Energy "Spin-offs"

Energy in a Finite World was not the only product of the IIASA Energy Systems Program — a number of other books have appeared, authored by scientists who contributed to the Program at some point in its seven-year history. The books presented below have all been written by former members of the Program and relate directly to its work.

Only one of the books was actually published through IIASA: *North Sea Oil — Resource Requirements for Development of the U.K. Sector* by J. Kenneth Klitz (Pergamon Press, 1980). Making use of the WELMM method developed at IIASA — an approach that analyzes costs for resource development in terms of water, energy, land, manpower, and materials — the author examined the British sector of the North Sea oil and gas industry. He investigated the energy "pay-back times" for North Sea oil and gas fields and drew lessons for the operation of other offshore fields.



The oil companies operating in this area provided the author with extensive details about production rates, reserves, field installations, pipelines, and so forth. This enabled him to make a comprehensive assessment of North Sea oil deployment. The author shows that the energy used to develop a North Sea oil field, produce one metric ton of offshore oil, and transport it to the refinery is recovered in 33 days of oil production. Gas fields in the area give an even better return on the water, energy, land, manpower, and material investments.

As Klitz points out, the North Sea will continue to be an economical oil supplier in the future; even when necessary energy "investments" increase by a factor of five, as would be required for chemical flooding in the case of tertiary oil pro-

duction, the additional energy inputs would still be only about 10 percent of the caloric value of the oil produced. In Klitz's opinion, tertiary methods may be expected to produce an additional 50–200 million metric tons of crude oil.

Other study results include the following figures:

- The amount of structural steel used for the 29 operating platforms in the North Sea is equal to 173 Eiffel Towers;
- 29.6 million tons of both fresh and sea water were needed during the development of the oil fields;
- 950 miles (1,529 kilometers) of pipeline were constructed and laid;
- 858 exploration and appraisal wells were drilled, as well as 629 production wells;
- 330,000 man-years of direct labor will have been expended from the first seismic surveys in 1964 to mid-1985.

North Sea Oil — Resource Requirements for Development of the U.K. Sector by J.K. Klitz, ISBN 0 08 024442 4, can be ordered from Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 0BW, England. The price is US \$36.00.

Michel Grenon's *The Nuclear Apple and the Solar Orange — Alternatives in World Energy* was first published in French in late 1978 (*La Pomme Nucleaire et l'Orange Solaire*). Although the book is not — strictly speaking — an IIASA product, it is very much in line with the Institute's approach to the global energy problem. This is to be expected, since the author, Professor Michel Grenon (well known to readers of *OPTIONS*), was with the Institute from 1974 to 1980. During his stay his work focused on the systems aspects of energy and other natural resources, and methods for estimating world oil, gas, and coal resources. As leader of the Institute's "Resources Group," he developed the WELMM approach for assessing water, energy, land, manpower, and material requirements for resource development. In his book Grenon aims to provide a balanced view of available energy options, including nuclear and solar energy, as well as oil, gas, and coal.

As the prominent French newspaper *Le Monde* stated in a review of the book, "Mr. Grenon teaches us above all a lesson of humility — a humility that has not always been exercised by experts and forecasters; this was substantiated by the general failure to foresee the 1973 crisis . . ." In the view of *Le Monde* too much importance should not be given to the convergence of the results of analyses carried out by oil company

experts; these experts work in the same way, follow the same criteria, and often use the same basic data . . . A Belgian journalist wrote: "Rather than proposing solutions, Mr. Grenon helps us to choose the options that permit an equilibrium between society and its energy systems."

The Nuclear Apple and the Solar Orange — Alternatives in World Energy by M. Grenon, ISBN 0 08 026157 4, can be ordered from Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 0BW, England. The price is US \$36.00.

Energy Systems and Development

CONSTRAINTS, DEMAND AND SUPPLY OF ENERGY FOR DEVELOPING REGIONS

JYOTI K. PARIKH

Jyoti K. Parikh's book *Energy Systems and Development* is the product of work carried out with the support of the World Bank and IIASA. In this volume the author aims to obtain a better understanding of the energy requirements of the developing countries in Africa, Asia, and Latin America, and the possible sources of future energy supply. During her stay at the Institute, Dr. Parikh, a Senior Consultant to the Energy Division of the Indian Planning Commission, provided the IIASA Energy Program with firsthand information about the energy situation in the developing world. In her book she considers both commercial and noncommercial sources of energy supply in an integrated manner.

The scope of *Energy Systems and Development* is threefold. First, it reviews past and present patterns of consumption of commercial and noncommercial energy sources, in both rural and urban areas. Second, it projects future energy requirements to the year 2000 for three world regions, including sectoral energy requirements, i.e., the consumption of energy in the transportation, industrial, household, and agricultural sectors. Finally, it analyses energy supply alternatives and examines the policy implications that follow from the available alternatives.

Energy Systems and Development — Constraints, Demand and Supply of Energy for Developing Regions by J.K. Parikh, ISBN 19 561193 4, can be ordered from Oxford University Press, 2/11 Ansari Road, Daryaganj, New Delhi 110002. The price is approximately US \$9.50.

News from IIASA

IIASA in NMO Countries

Strengthening IIASA's contacts with its National Member Organizations (NMOs) is becoming increasingly important as the Institute places greater emphasis on the dissemination of its research findings and on building effective collaborative networks for ongoing activities. Therefore, IIASA has begun a series of national meetings in cooperation with NMOs.

The first such meeting was arranged by the Swedish NMO in Stockholm on 10–11 December, with the aim of presenting IIASA activities to a broad national audience and emphasizing the dissemination of IIASA research results of special relevance to Swedish planners. Presentations made by Swedish scientists who have been involved in IIASA work were followed by discussions of potential or actual uses made of the results. The topics dealt with at this meeting ranged from regional water management in the Western Skåne region of Sweden to models of growth and structural change in small open economies. The two-day meeting closed with a general discussion on the experience gained by Swedish scientists from their work at Laxenburg, and on ways Sweden could participate in initiating new research projects at IIASA.

In January, the American Association for the Advancement of Science (AAAS) held its annual meeting in Toronto (Canada). At that meeting, a special session was devoted to IIASA, entitled "International Analysis of International Problems: Science in the Service of Peace." The purpose of the symposium was to present the lessons learned in IIASA's first eight years of development and to use them to improve the application of science to the problems of mankind and the promotion of peace. On this occasion, Dr. Roger Levien, Dr. Verne Chant (Canada), Prof. Andrei Rogers (USA), and Prof. C.S. Holling (Canada) reported on IIASA's energy, urbanization, and environmental work as examples of international analysis applied to international problems.

In February, the National Research Council (CNR) of Italy sponsored a seminar in Rome aimed at broadening knowledge about IIASA research among a cross section of Italian academic researchers, scientists, politicians, and industrialists. Professor Pier Luigi Romita, Minister of Scientific Research and Technology, and Professor Ernesto Quagliariello, President of the CNR, welcomed the approximately 200 participants to the meeting. Following formal presentations by Dr. Levien and Prof. Häfele, there was a lively afternoon

discussion on current collaborative research such as the case study of economic development of the Tuscany region; the discussion also branched out to include prospective joint work on problems of energy, agriculture, and the environment.

Dialogue with Industry

The development of IIASA's relations with industry is a high priority for the Institute. Beyond mutual interest in substantive areas, financial contributions, and the secondment of staff, IIASA/industry interactions must include a two-way flow of people and ideas. To further this interaction, IIASA organized a two-day meeting in November, entitled "IIASA Dialogue with Industry"; the goal of this meeting was to provide information to industrial representatives on recent IIASA research results, plans, and interests. The meeting also served to increase IIASA's awareness of both important issues and problems facing industry and ways to foster collaboration with industry.

The meeting was more than a series of presentations. As a dialogue, it included ample time for face-to-face discussions among the 48 outside participants and 14 IIASA research leaders from both East and West. The questions and issues for possible research raised at this meeting formed a basis for the active exchange of ideas and the beginning of an understanding of the perspectives of East and West, and of industrialists and scientists, toward important world industrial problems. During the two days of discussions, the participants addressed four broad areas of research for IIASA:

- Future world resources. Many key resources constitute important factors for future industrial development.
- Technological forces, such as information technology and biological technology. Their effect on the development of industry needs to be examined.
- Demand arising from such factors as population growth and the changing distribution of people across the globe. Related topics concern forecasting the availability of labor.
- The general shape of the socioeconomic development of the population. This includes its wealth and well-being, and the distribution of these benefits among populations North and South, rural and urban.

Dr. Roger Levien, Director of IIASA, pointed out that IIASA could offer to be a focal point for joint work, but the participation and collaboration of industries and nations would have to be vital inputs to any research effort.

The meeting has already had its first practical result: some participants are investigating the possibilities for interaction with IIASA, expanding the already existing collaborative efforts between IIASA and industry.

Energy: Spreading the Message

Two important events aiding in the dissemination of the IIASA Energy Systems Program's research results recently took place at Laxenburg. First, 76 outside participants attended a five-day course in early November to learn about the approaches and techniques used by the IIASA Energy Program and to discuss the conclusions of the Program with Institute scholars. To avoid time-consuming introductions to the research, each participant had received prior to the meeting a pre-publication issue of "Energy in a Finite World", the final report of the Energy Systems Program. Because of the large number of participants — considerably more than initially expected — the originally planned workshop format had to be changed. A lecture format was used, with IIASA scientists holding "office hours" in parallel with the main sessions. Formal parallel sessions were avoided since the objective of the course was to provide information on the many facets and perspectives of the Institute's Energy Study while avoiding a fragmented presentation. Both substantively and organizationally, the course appeared successful in meeting its objective; the results of the Energy Systems Program were disseminated to a specialized audience in more detail than could be provided even in the two volumes reporting the Program's findings, to be published by Ballinger Publishing Company in March 1981.

The second major event along this line was a "Workshop on Future Energy Prospects", held at the Laxenburg Conference Center on November 24 and 25. In the words of Academician Jermen Gvishiani (Chairman of both the IIASA Council and the Executive Committee of the "International Council for New Initiatives in East–West Cooperation" — the co-sponsors of the meeting) the aims of the workshop were to work out concrete new steps toward East–West cooperation in energy — to consider ways and means of furthering mutual assistance in solving national and international energy problems. The 36 high-level workshop participants suggested that an all-European conference on energy development should be organized, to generate recommendations concerning future cooperation on energy matters. The participants also proposed that future efforts be connected with work done by the Economic Commission for Europe, IIASA, and other international institutions.

Conference Report

FAP Status Report

In late February, the Institute's Food and Agriculture Program organized a Status Report Meeting, which gave over 100 specialists in the field and members of collaborating institutions a chance to review the Program's work thus far and to discuss the next steps in their joint research.

During the past five years, IIASA has developed — together with groups of scientists all over the world — a system of computer simulation models representing national agricultural and food systems and the international food market. Although this research effort is far from completion, the model system is now yielding its first results.

Professor Ferenc Rabar (Hungary), Leader of the IIASA Program, reported to the conference participants that the mechanisms of the global food market could hinder relief for the 460 million people in the world who suffer from hunger. The initial simulation of the world food market using IIASA's model system indicated that putting the necessary amounts of food on the international market is not sufficient. The market would quickly adjust and absorb whatever additional food is available.

"The hunger in the world could be eradicated without too much effort — at least from a production point of view. But we don't know how to get the food to the people", said Professor Rabar. "According to many different estimates, we would require some additional 20 to 30 million tons of wheat per year, which is only about 1.5 percent of present world grain production. Yet a run of our computer model of the world food market showed that market mechanisms would absorb the 30 million tons of wheat on the international market, so that it would not reach the hungry people who need it".

The IIASA Food and Agriculture Program used the following working hypothesis: a country enters the market offering 30 million tons of wheat per year, disregarding prices. In the model simulation, the market adjusted to this increase in supply in a very short time; wheat exporters reduced exports because of depressed prices, while importers increased their imports and demands. However, the whole quantity of wheat could not be absorbed by the market and prices stayed depressed. This led to a secondary adjustment: exporters and importers changed their production structure, substituting other agricultural

products, such as rice or nonfood products, for wheat production, and almost no poor country was positively affected by the outcome. The 30 million tons disappeared on the market, wheat stocks increased, production stopped, the rich ate a little more meat, and the poor stayed hungry.

"This shows that not just any kind of help works", noted Professor Rabar. "What we are trying to do here at IIASA is to find out how the world market can be used to improve the situation. For the last five years we have been working on a set of computer simulation models representing most of the countries of the world and on what we call a linking-model, which simulates the international market".

As announced at the meeting, the IIASA Food and Agriculture Program expects to present its final results in about three years, after a total of eight years of research involving collaborators from over twenty countries, including both the industrialized countries in the East and the West and many of the world's developing countries.

Recently Published

RR-81-1. Estimation of Farm Supply Response and Acreage Allocation: A Case Study of Indian Agriculture, N.S.S. Narayana, K.S. Parikh, February 1981, \$5.00 AS60

RR-81-2. Mathematical Modelling — A Management Tool for Aquatic Ecosystems? K. Fedra, March 1981, reprinted from *Helgoländer Meeresuntersuchungen*, volume 34(1980)

RR-81-3. Witches, Floods, and Wonder Drugs: Historical Perspectives on Risk Management, W.C. Clark, March 1981, reprinted from *Societal Risk Assessment: How Safe is Safe Enough?* New York: Plenum Press, 1980

RR-81-4. Hard or Soft Environmental Systems? M.B. Beck, March 1981, reprinted from *Ecological Modelling*, volume 11(1981)

RR-81-5. Economic Evolutions and Their Resilience? A Model, M. Breitenecker, H.R. Grumm, April 1981, \$5.00 AS60

RR-81-6. Advances in Multiregional Demography, A. Rogers, editor, May 1981, \$12.50 AS150

For orders please contact the IIASA Publications Department. Single copies of journal reprints and status reports are available free of charge as long as the supply lasts.

IIASA's National Member Organizations [NMOs]

The Academy of Sciences, Union of Soviet Socialist Republics

The Canadian Committee for the International Institute for Applied Systems Analysis

The Committee for the International Institute for Applied Systems Analysis of the Czechoslovak Socialist Republic

The French Association for the Development of Systems Analysis

The Academy of Sciences of the German Democratic Republic

The Japan Committee for the International Institute for Applied Systems Analysis

The Max Planck Society for the Advancement of Sciences, Federal Republic of Germany

The National Committee for Applied Systems Analysis and Management, Bulgaria

The National Academy of Sciences, United States of America

The National Research Council, Italy

The Polish Academy of Sciences

The Royal Society of London, United Kingdom

The Austrian Academy of Sciences

The Hungarian Committee for Applied Systems Analysis

The Swedish Committee for Systems Analysis

The Finnish Committee for the International Institute for Applied Systems Analysis

The Foundation IIASA-Netherlands

OPTIONS

a IIASA news report
Published quarterly by
The International Institute
for Applied Systems Analysis
Public Information Section
A-2361 Laxenburg, Austria
phone 02236/71521
telex 079137
Editor: Peter R. Schlifke
Layout: Atelier Dorfinger-Klapetz
Printed by Novographic
Vienna, Austria