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SUBSTANTIVE PREPARATIONS FOR THE CONFERENCE

Activities of the relevant organs, organizations and
bodies of the United Nations system in the field of
new and renewable sources of energy

Addendum

Report submitted by the
United Nations Institute for Training and Research*

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THE UNITAR PERSPECTIVE ON FUTURE ENERGY SUPPLIES

UNITAR's work in the field of energy, including new and renewable sources of energy, has been concerned with the meaning of physical limits and supply constraints. The energy programme is carried on within the context of the Project on the Future, which was created by UNITAR's Board of Trustees in 1974. The activities of the energy programme are limited to research - no field work is done - and include (1) the issuance of a bulletin on energy and natural resources - Important for the Future first came out in 1976 and now appears quarterly; (2) the sponsorship of conferences on themes which we have developed and according to which we elaborate an agenda and commission papers (see annex I for a list of the UNITAR conferences); (3) the publication of the papers prepared for the conferences and of other research reports (see annex II for a list of our publications in the field of energy). Our work on energy is undertaken within a definite framework, which is described below.

The underlying approach of UNITAR's work in the field of energy is based on the recognition that future energy supplies are importantly determined by economics and technology, both of which are dynamic, i.e., constantly changing over time. They both directly affect the availability of all energy resources: an increase in prices can make previously uneconomic resources worthwhile to exploit, or the development of new technology can make previously unaccessible (or accessible at a very high cost) resources available for use. During the past decade their role has been particularly evident in the sharp increase in the price of oil.

As the principal source of commercial energy -- that is, energy for the developed countries and for the industrialized sectors of developing countries -- oil had previously become the predominant source on the energy market and the supplier of marginal demand, due not only to its relative abundance but also to the ease of transporting and storing it. Thus oil prices in general, and that of Arabian light crude in particular, came to be the benchmark against which other energy prices were compared. When in 1973 and again in the late 1970's, oil prices rose sharply, the whole nature of the energy market changed radically.

Higher energy prices across-the-board meant a vast expansion in the energy resources base, because as with all natural resources, high grade, low cost resources are exploited first and then as prices rise, lower grade resources are progressively developed. The extent to which this process takes place depends on the availability and location of the different grades of the resources, the technologies for exploiting them, and the possibilities for substitution. For gold (which has no ready replacement), deposits containing as low as one or two grams per ton have been worked. For other natural resources, grade varies greatly; for example, typical ore bodies extend from 20 to 90 ounces per ton for silver, to nine pounds per ton for copper. The quality of an oil deposit is determined by quite different factors: the gravity of the oil-in-place, the porosity of the reservoir rock in which it is found and other standard criteria such as the depth and thickness of the oil bearing strata. Also like other natural resources, the physical conditions of the location of the deposit (near a port, in an extreme hot or cold area, etc.) and its proximity to markets are factors bearing on its economic value.

These generalizations on how the market for natural resources responds to higher prices for natural resources (whether caused by increased demand or decreased supplies or other external market forces) can aid one in evaluating the outlines of a future situation, but a practical analysis of how a country can and/or should respond to a market disruption in energy must begin with a thorough assessment of all known and potential sources of supply: their size, cost, availability, technological and manpower requirements (including skill levels) and their environmental effects. The necessity of undertaking a national energy survey to serve as a basis for policy-making cannot be stressed

too strongly. Policies derived from global or multi-country aggregates should be avoided. Such global studies of necessity rely on average figures which mask the varieties and extremes of nature and society.

The importance of national differences can be readily appreciated in a brief comparison of the energy economies of, for example, the U.S. and Europe in the last century. Whereas in 1890, the United States continued to rely on wood and water for most of its energy, coal had taken over as the leading source in industrial Europe, most notably in England. Sixty years later (that is, in 1950) coal remained the dominant energy source in Europe, while petroleum had taken the lead among energy sources in the United States. The differences in the timing and pace of market infiltration by a new energy source, as in the case cited, is due to a number of factors not the least of which is the relative resource endowments of the two areas -- by the late 19th century there were still abundant forests and powerful rivers to be tapped in the U.S.A., while Europe had exploited these resources to a far greater degree; the plentiful existence of petroleum in the U.S.A. in contrast with its relative scarcity on the Continent adds to an explanation of the differences. Dissimilarities in industrial and social structure go further toward elucidating differences in energy supply patterns and therefore need to be examined in setting energy policy. By inviting member states to present papers on the topics of its conferences, UNITAR has hoped to encourage policy-makers to reflect carefully on the resource endowments of their countries and the impact of the development of the different resources.

Another aspect which has guided our energy programme has been the observation that over time we have witnessed an exploitation of an ever increasing number of energy sources -- 'old' energy sources have not fallen into disuse, and new ones have constantly been found and harnessed. (This is of course one of the major goals of the U.N. Conference on New and Renewable Sources of Energy -- to accelerate the historical process of developing those alternative sources which today supply either small or negligible amounts of energy, except for wood, which is still of enormous significance in terms of the large number of people it serves and of the economic and environmental consequences associated with its use.) Wood, wind, water and animal power were the first sources of power, to be superseded by coal and supplemented by geothermal energy; oil and secondarily natural gas have overwhelmed them all, only to be challenged by nuclear power, in its various forms, and more recently, but for a more distant future, by photovoltaic cells, ocean thermal energy, salinity gradient energy and a veritable proliferation of other potential sources, some relying on more efficient uses of known energy sources, others drawing on novel ones, such as hydrogen, which could be produced, for example, by biophotolysis -- the splitting of the water molecule to produce oxygen and hydrogen. Serious consideration of these other sources would not have come about if oil had remained at \$2 a barrel; so from a certain perspective, increased prices can be viewed favorably, as they can only act to speed the process of diversifying our knowledge and capability to use different

energy sources. This process of diversification is doubtless benign, for it will in addition encourage self-sufficiency.

The effect of increased prices is actually so strong that it must be kept firmly in mind when establishing long- or medium-term energy policies. For example, when the United States suffered a shortage of natural gas in 1977, one of its reactions was to allow the price of natural gas to rise. At the same time it was entering into contracts with its neighbors -- Canada and Mexico -- for the delivery of natural gas via pipeline and negotiating agreements for the importation of liquefied natural gas from Algeria and other countries. The result, as lobbyists for independent gas producers in Texas and Louisiana were quick to point out they had predicted, was that the higher domestic natural gas prices spurred American producers to explore and produce greatly increased amounts, so much so that contracts with a number of Canadian suppliers were cut, and a virtual ban on liquefied natural gas imports has been imposed by the U.S. Government. Some analysts believe that when the final figures are in, new gas reserves in 1980 will match the amount consumed, the first time this has occurred since 1967.

By including all sources being presently produced and taking into account the identified new sources, UNITAR was able to speak of over forty energy sources at its Conference on Long-Term Energy Resources held in November/December 1979 in Montreal (see annex II for a list of the energy resources considered at the Conference). The Montreal Conference was significant for underlining a number of potential new resources on which research and development are just in the beginning stages. We can anticipate learning more about their exploitation and new ways of exploiting old ones in coming years. An implication of the expansion in the number and type of energy resources is that the probability a country or region (or even a village) will possess -- and possess in quantities or concentrations sufficient for economical development given local conditions -- one or more of these sources is much increased. This is why we consider that an important aim of our work at UNITAR through our publications and sponsorship of conferences is to increase awareness of the number and variety of energy sources and of experiences in developing them.

Taking (at that time - 1976) an unpopular stand, our starting point was an attempt to demonstrate the great potential of remaining petroleum and natural gas resources. In the wake of the first Club of Rome report, "Limits to Growth," and the contrived scarcities deriving from political instabilities and disproportionate reliance on Middle Eastern oil, this was a bit unorthodox. There was no dearth of studies repeating the litany of the inevitable, if not imminent, exhaustibility of our energy resources. Instead of figuring demand and supply curves which were based on exploration success rates and consumption patterns which when quantified, pointed to an energy supply gas as early as 1985, our approach was perhaps more empirical if less sophisticated: to organize a conference of experts who confronted one another in assessing the prospects for petroleum. Important among our conclusions were the

following: 1) the by now common observation that in most of the world, oil exploration has been at best superficial; 2) that lower grade oil resources were plentiful and largely passed over in the development of (formerly) abundant light crudes; and 3) that natural gas resources existed in more than a dozen forms (some of which the U.N. will be discussing at its conference in Nairobi) and that the total size of these resources was likely larger than petroleum resources. In sum, we were decidedly more optimistic than the prevailing opinion, inasmuch as we saw a longer and therefore less astringent transition period.

The first of these findings has since been enshrined in the policy prescriptions of most energy specialists and has become institutionalized in the evolving programme of the World Bank in support of petroleum exploration and development in oil-importing developing countries. However, a sign which more truly confirms this line of analysis is the minor oil boom taking place along the west coast of Africa; from Ghana and Benin down to Gabon and Angola new drilling projects abound, and the finds by Exxon and Phillips in the Ivory Coast promise to make that country a major oil exporter in the 1980's.

Later, we had the opportunity to delve more deeply into the second of these conclusions at our Conference on the Future of Heavy Crude and Tar Sands held in Edmonton, Canada in 1979. If the intensity of technological innovation and the size of planned investments which were shown at the Conference are indicators of the significance of these resources, they will surely be taking a larger share of the future energy market. The interest in these petroleum resources has in fact been so great that UNITAR is organizing a follow-up meeting on them in Caracas next year.

The wide impact of the Edmonton Conference was soon apparent in the new policy initiatives encouraging the exploitation of heavy crude oils in several countries. The most durable of the recommendations of the Edmonton Conference will probably be the establishment of an international Information Centre on Heavy Crude and Tar Sands. Organized jointly by UNITAR and UNDP, the Information Centre will seek to promote the development of these lower grade petroleum resources by maintaining a comprehensive, world-wide data base on the resources (size, quality, location, etc.), the production rates, recovery technologies, upgrading and refining processes, transport methods, environmental questions, and the economic and policy aspects relevant for each of the stages. By having intergovernmental and governmental organizations, national and private companies, research institutes and other interested entities associated in this undertaking, UNITAR and UNDP are hoping to tap new sources for the support of energy development and to create new connexions between the public and private sectors.

Another line of thought that we have been pursuing involves the development of small energy resources. Although this approach was first broached by us several years ago, we will in September 1981 concentrate on it in a Conference on Small Energy Resources to be held in Los Angeles

with the co-sponsorship of a number of organizations and the moral support of the U.N. Energy Conference. Here our idea is to encourage the development of energy resources on a local level thereby acting also as an engine for development by increasing employment and stimulating local industry, besides saving foreign exchange and avoiding the environmental disruption occasioned by big projects. Then too, the tensions associated with the implantation of large entities with their decision centres far from the site of activity, can be minimized by enhancing the opportunities for developing the numerous small resources with which all countries are endowed. There are other advantages; small projects can be put into production faster, and the effect of many of them contributes to decentralization at a time when many countries are paying the social and economic costs of unplanned and over-crowded cities. In the case of underground resources, the exploration risks for small energy resources are also very much less than the risk for large ones, which are much rarer and more difficult to find.

The preceding paragraphs are meant to provide an outline of the philosophy of the UNITAR programme. It is carried out more by example than by systematic analysis: the case study not the computer is our modus operandi. However, while our work could be characterised as heuristic, we have proposed to undertake a comprehensive, quantitative, country-by-country survey of global energy resources as a next phase. The first stage in that survey was our Conference in Montreal on Long-Term Energy Resources. Through it, we were able to gain a fuller appreciation of the size and variety of energy resources world-wide, which remains a basic goal. The fundamental premise of this work is to assist policy-makers by increasing their knowledge of the options available. A corollary of increased knowledge is the capability to avoid costly mistakes. In energy development, where the potential for waste is enormous and sometimes irreversible, efficient allocation of resources is especially crucial.

This type of approach will continue to have an essential place in the wider energy programme of the U.N. system which will undoubtedly result from the Nairobi Conference, because, although covering only an aspect of the energy problematique, it addresses itself to the factor of maximum uncertainty: the existence of resources and the likelihood and probable sequence of their development.

UNITAR Conferences on Energy and Natural Resources

The Future Supply of Nature-Made Petroleum and Gas - 5-16 July 1976,

Laxenburg, Austria - proceedings available from Pergamon Press

Microbial Energy Conversion - 4-8 October 1976, Göttingen, Federal

Republic of Germany - Proceedings available from Pergamon Press

Alternative Strategies for Desert Development and Management -

31 May-10 June 1977, Sacramento, California, U.S.A. -

proceedings available from Pergamon Press

The Future of Small-Scale Mining - 27 November-5 December 1978,

Jurica, Queretaro, Mexico - proceedings available from

McGraw-Hill Mining Informational Services

The Future of Heavy Crude and Tar Sands - 4-12 June 1979, Edmonton,

Alberta, Canada - proceedings available from McGraw-Hill

Mining Informational Services

Long-Term Energy Resources - 26 November-7 December 1979,

Montreal, Quebec, Canada - proceedings available from

Pitman Publishing

forthcoming:

Small Energy Resources - 9-13 September 1981, Los Angeles, California

Second Conference on Heavy Crude and Tar Sands - 7-17 February 1982,

Caracas, Venezuela

Energy Titles from UNITAR's PROJECT ON THE FUTURE

Long-Term Energy Resources

edited by R.F. Meyer and J.C. Olson (Pitman Publishing:
Marshfield, Mass., 1981)

The First International Conference on the Future of Heavy Crude and
Tar Sands

edited by R.F. Meyer (McGraw-Hill Mining Informational Services:
New York, 1980)

The Future of Small-Scale Mining

edited by R.F. Meyer (McGraw-Hill Mining Informational Services:
New York, 1980)

Crisis in Forecasting and Emergence of Prospective Methods: Case
Studies of Energy and Air Transport

by Michel Godet (Pergamon Press: Elmsford, N.Y., 1979)

Global Models and the International Economic Order

by Sam Cole (Pergamon Press: Elmsford, N.Y., 1977)

The Future Supply of Nature-Made Petroleum and Gas, Technical Papers
submitted to the UNITAR-IIASA Conference

edited by R.F. Meyer (Pergamon Press: Elmsford, N.Y., 1977)

Microbial Energy Conversion, Report on the UNITAR-BMFT Seminar

edited by H.G. Schlegel and J. Barnea (Pergamon Press:
Elmsford, N.Y., 1976)

The Energy Crisis and the Future

by Joseph Barnea (U.N.: New York, 1975)

Alternative Strategies for Desert Development and Management, Papers
submitted to the UNITAR-State of California Conference

edited by J. Schechter (Pergamon Press: forthcoming)

Energy Resources Considered at the Montreal Conference

Petroleum

- light oil
- heavy oil
- tar sands
- oil shale

Natural Gas

- natural gas liquids
- associated gas (wet gas)
- non-associated gas (dry gas)
- gas occluded in coal seams
- gas in low permeability sandstones
- gas in fractured shales
- gas hydrates
- gas in stratified water bodies
- gas in underground water
- marsh gas

Coal

- anthracite and bituminous coals
- brown coal (subbituminous coal)
- lignite
- peat

Geothermal energy

- low-enthalpy fields
- hot water fields
- dry steam fields
- geopressured zones
- magma
- hot dry rock

Hydropower

- large dam sites
- low head sites
- glacial waters

Solar energy

- direct solar heating
- solar cooling
- solar ponds
- solar cells
- solar power towers
- solar power satellites

Wind nergy

Ocean energy

- tidal
- wave
- ocean current
- ocean thermal difference

Biomass

- wood
- plant material
- aquatic biomass
- urban and industrial waste
- sludge gas
- landfill gas
- dung

Nuclear energy

Other energy sources

- hydrogen
- salinity gradient
- electrostatic