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DEVELOPMENT AND INTERNATIONAL ECONOMIC CO-OPERATION:
TRADE AND DEVELOPMENT

Work of the United Nations Conference on Trade and Development on the strengthening of the technological capacity of the developing countries in the development of their energy resources

Report of the Secretary-General of UNCTAD

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PREFACE

In paragraph 7 of its resolution 37/251 of 21 December 1982 on the development of the energy resources of developing countries, the General Assembly welcomed the work being done in the United Nations Conference on Trade and Development (UNCTAD) in the implementation of section II.A of its resolution 112 (V), concerning the strengthening of the technological capacity of the developing countries in the development of their energy resources, and requested the Secretary-General of the Conference to submit a comprehensive report on that question to the Assembly at its thirty-eighth session. The present report has been prepared in accordance with that request.

INTRODUCTION

1. During the two decades from 1960 to 1980, the real income of developing countries as a whole increased at about 5.5 per cent annually. Their commercial energy consumption grew even more rapidly - at an annual rate of 6.5 per cent. 1/ Although the overall efficiency for generating income from each unit of energy consumed can be expected to improve, the energy requirements of the developing countries will, nevertheless, have to increase at substantial rates for decades to come in order to meet infrastructure investment requirements, promote industrialization, facilitate rural development and, generally, to sustain the efforts to bring about social and economic transformation in those countries.

2. The rising energy requirements obviously call for an increase in energy-supply capacity in the developing countries. Investments have to be made based on a balanced and efficient distribution of domestically available sources. Appropriate financing mechanisms have to be found to permit such investments and to procure the necessary technology. To carry out this entire process, the developing countries will need to strengthen considerably their technological capacity in the energy sector.

3. The importance of the build-up of the technological capacity stems from a number of considerations. First, the strategic role of the energy sector and the large-scale investments involved makes imperative the planning and management of the development of this sector. To carry out the latter task a score of national cadres has to be trained. Second, the uncertainty prevailing in the global energy situation has given rise to an intensification of efforts for technological development in numerous areas in order to improve the efficiency of existing technologies as well as develop new technologies. In other words, technology is changing, and this requires technological and related adjustment in the energy sector. Third, the developing countries, with the exception of a few countries, such as Brazil and India, have so far depended heavily on the supply of technology and manpower from the industrialized countries. This is in part a consequence of the control exercised by a small number of international companies over vital segments of the market for energy technologies. But it is in part also a consequence of the internal constraints faced by the developing countries, such as the lack of skilled manpower, in particular engineering and managerial skills, and the limited capacity to manufacture energy capital goods and to undertake relevant research and development activities.

4. In a number of developing countries, the recognition of these factors has led to systematic efforts to improve the conditions for the transfer and development of technology for the energy sector. 2/ The fact that energy sector activities in the developing countries take place largely in the public sector seem to lend force to such efforts. The mere size of energy investments, their impact on the whole economy and the role of the public sector in their implementation provide challenging opportunities also to other developing countries for reducing the current technological dependence in the energy sector.

5. At the international level, the energy technology concerns of developing countries have received increasing attention. It was at the Conference on International Economic Co-operation, held in Paris from December 1975 to June 1977, that explicit recognition was given for the first time to the crucial role of transfer and development of energy technology in the development process of developing countries. 3/ Since then, the international community has witnessed several initiatives. Within United Nations forums, the General Assembly, in its resolution 33/194 of 29 January 1979, addressed the question of multilateral development assistance for the exploration of natural resources; the United Nations Conference on New and Renewable Sources of Energy, held at Nairobi in 1981, adopted the Programme of Action for the Development and Utilization of New and Renewable Sources of Energy, which is being implemented; and policy measures relating to energy technology issues have been included in the text of the International Development Strategy for the Third United Nations Development Decade (General Assembly resolution 35/56, annex). All these movements culminated in Assembly resolution 37/251 on the development of the energy resources of developing countries, paragraph 5 of which read:

[The General Assembly]

"Recognizes the importance of strengthening the technological capacities of the developing countries in the energy sector ... and, in this regard, calls upon the international community to stimulate the transfer of appropriate technologies to the developing countries, to enhance financial and technical flows and to promote interdisciplinary research and analysis of the implications of, and requirements for, stepped-up energy exploration and development activities, as well as a gradual transition to a more diversified pattern of energy consumption, particularly in the developing countries."

6. It is against this background that the present report on the UNCTAD activities relating to the strengthening of the technological capacity of the developing countries in the development of their energy resources has been prepared. Chapter I of the report provides a brief summary of the main energy technology issues that have been dealt with in UNCTAD on the basis of Conference resolution 112 (V), section II A. Chapter II reports on the results of the UNCTAD Meeting of Governmental Experts on the Transfer, Application and Development of Technology in the Energy Sector, held at Geneva from 25 October to 2 November 1982; the agreed conclusions and recommendations of the Meeting are contained in the annex to this report. Particularly relevant to international consideration is the experts' recommendation that "when United Nations system-financed research and development projects in the energy sector, particularly relating to new and renewable energy technology, lead to innovations and inventions for which patents, inventor's or inventions certificates or interests in patents or patentable energy technology can be obtained by the United Nations system, such rights or other benefits associated therewith should be used to promote the development, production and wide availability of energy technology in the public interest, particularly that of developing countries". 4/ Finally, chapter III gives an account of the ongoing and planned future work of UNCTAD in the energy technology field.

CHAPTER I

MAJOR ISSUES IN THE STRENGTHENING OF THE TECHNOLOGICAL CAPACITY OF DEVELOPING COUNTRIES IN THE ENERGY SECTOR

7. The approach of UNCTAD to energy technology issues has been elaborated within a broader framework of its work on the role of technology, in particular transfer of technology, in the process of development which has evolved over the last several years. 5/ Conference resolution 112 (V) of 3 June 1979 on the strengthening of the technological capacity of developing countries, including accelerating their technological transformation, adopted at the fifth session of UNCTAD, held at Manila, embodies this framework.

8. Section II.A of Conference resolution 112 (V), to which specific reference was made in General Assembly resolution 37/251, was entitled "Action in specific areas and sectors and areas of critical importance to developing countries". It requested the Secretary-General of UNCTAD to "prepare, compile and complete studies on the technological problems" in a number of sectors, including energy, and further to organize and convene meetings of experts in order to "identify problems and issues concerning the transfer, application and development of the technologies" relating to three specific sectors, including energy. The following discussion of energy technology issues is based on the studies prepared in accordance with that resolution 6/ (the results of the Meeting of Governmental Experts on the Transfer, Application and Development of Technology in the Energy Sector will be discussed in chapter II).

9. The energy technology concerns of developing countries are numerous and varied, but for internationally concerted action to be effective, specific areas must be selected for concentrated attention by the international community. UNCTAD has so far concentrated its attention on the following three areas, which are of critical importance to a large number of developing countries:

(a) Acceleration of transfer of petroleum exploration technology;

(b) Improvement of power-plant procurement policy;

(c) Development and diffusion of renewable energy technology.

10. The main reason for selecting these areas is that petroleum, electricity and renewable energy are likely to constitute key elements in the energy balance of any country, at least in the next three to four decades. Petroleum exploration is undoubtedly a major concern for many developing countries in the short or immediate term. Power plants represent an area whose importance for developing countries will continue to grow in the medium and even the long term. Renewable energy technology is a long-term concern, since it is still in the embryonic stage. It is, however, of great potential relevance to the developing countries because of the possibility of its decentralized use and lower capital requirements (though the latter may not always apply with the development of more capital-intensive technologies).

A. Acceleration of the transfer of technology for petroleum exploration

11. The price increases for petroleum since the early 1970s have radically changed the economics of petroleum exploration and production. The price of oil has now reached a level that justifies increased expenditures on petroleum exploration. Given the changed economics of petroleum exploration and production, and the fact that developing countries as a whole have as much as 80 per cent of the world's total proven oil reserves, it might have been expected that petroleum exploration activities in developing countries would be intensified. Evidence shows, however, that this has not been the case so far. The level of petroleum exploration activity in developing countries, measured in terms of seismic prospecting work undertaken and exploratory wells drilled, declined slightly from the first to the second half of the 1970s. Moreover, the relative share of developing countries in the world's total petroleum exploration work actually went down markedly between those two periods.

12. There are a number of reasons for this phenomenon. The central fact, however, is that the international oil companies that supply the risk capital, as well as bring together a technology package, needed for petroleum exploration have focused on the developed countries' oil fields as a primary object of their exploration investments. Although the international market for individual oil technologies is not necessarily dominated by these companies, their capacity to assume risks and organize exploration ventures continues to have a predominant influence on the distribution of the global petroleum exploration activities.

13. During the last 30 years or so, a growing number of developing countries has introduced State participation in the petroleum operations. Some have entirely displaced the foreign companies by creating in their place national petroleum enterprises, which have acquired certain technical expertise. But, except for a few, most of them continue to depend extensively on the international oil companies, particularly for risk capital and more sophisticated technology. The developing countries, which are "newcomers" to petroleum exploration will have to continue to rely for some time to come on international oil companies because of those countries' lack of financial resources and technical capabilities. But it is esssential to start building up a basic knowledge of the technology involved. It is for this reason that acceleration of transfer of technology for petroleum exploration emerges as a key issue.

14. Transfer of technology for oil exploration usually takes place as part of packaged exploration contracts. For developing countries to begin to develop their domestic technological capacity in the petroleum sector, it is essential to open this package and define the type of skills and know-how that need to be acquired. While the exact requirements may vary from country to country, one may generally consider the following four categories of skills as critical to technological capacity for planning, negotiation and implementation of oil sector development:

(a) Managerial experience for organizing the national oil exploration and development programme as a whole;

(b) Technological expertise for taking decisions at critical stages of exploration and development;

(c) Knowledge of the oilfield service and equipment market for effecting appropriate procurement policy;

(d) Oilfield skills, in particular those of tool-pushers and maintenance personnel.

15. Developing countries may acquire these skills and technical know-how through two channels: (a) petroleum exploration contracts, and (b) technology agreements and official co-operation agreements. The first channel, petroleum exploration contracts, has not been a uniformly effective instrument for the transfer of technology, since the primary objective of a developing country in negotiating such a contract has been to secure the risk capital. Although the exploration contract may include such technology-related elements as provision of training and scholarships, employment of nationals, local procurement of equipment and services, the commitment is usually nominal. It is imperative, therefore, that developing countries reassess the role of the exploration contract in the transfer of technology.

16. The second channel - various contractual arrangements for transfer of technology - has been used increasingly in recent years, particularly by those developing countries that have begun to participate directly in petroleum sector activities. The suppliers of technology in such arrangements include not only the international companies specializing in the provision of individual technical services and equipment but also national oil companies from both developed and developing countries. Technical co-operation arrangements have also been made by some developing countries with regional and multilateral organizations, in particular the United Nations. The strengthening of such arrangements would permit a widening of alternative sources for energy technology.

17. From the point of view of developing countries, these two channels of technology transfer are quite compatible, and appropriate combinations of the two may be called for, according to the particular technological needs of the country concerned. However, for these channels to serve as effective mechanisms of transfer and to contribute to the acceleration of such transfer, concerted efforts need to be made at the national, regional and international levels to improve the conditions under which the channels are used.

B. Improvement of power-plant procurement policies in developing countries

18. Although the level of electricity consumption in developing countries is still very low, the demand for electric power in these countries has been growing very rapidly. The annual rate of growth of their publicly generated electricity consumption during the period 1970-1979 was 9.2 per cent. It was much faster than the growth rate of their total energy consumption - 6.8 per cent - for the corresponding period, and it will no doubt continue to grow substantially, given the rising requirements of industrialization and development.

19. The expansion of electricity supply capacity, however, poses several problems for developing countries. First of all, the financial requirements for investment in facilities for generation, transmission and distribution of electricity are considerable, claiming 7-8 per cent of the total investment resources of developing countries. Second, aside from a few countries, such as Brazil and India, the domestic technological and industrial capacity for supplying power equipment and related services is very limited in developing countries and, consequently, developing countries are dependent on foreign sources for their supply. This not only makes the foreign exchange content of electricity investment in these countries relatively high but, in the case of bilateral aid projects, leads to tied schemes for equipment supply. Third, the supply side of the market for heavy electrical equipment is controlled by a relatively small number of large firms based in some industrialized countries, which not only command technological leadership but also enjoy a dominant market position owing to their well-established reputation and their provision of supplier's credits and, in the case of member firms of the International Electrical Asociation, to a cartel arrangement. Fourth, the expansion of electricity supply capacity in developing countries is taking place in a period of considerable uncertainty concerning the appropriate fuel mix and, therefore, the choice of appropriate equipment.

20. The problems no doubt are complex. However, the fact that the development of the power sector commits a huge amount of investment resources assures considerable gains from reducing the negative impact of these problems. One basic approach to tackling these problems lies in the rationalization of power-plant procurement, since it is in connection with the acquisition of new units that the question of electricity-generating capacity expansion arises. Complementary measures are needed to increase the efficiency of operation of the electricity system.

21. Measures to be taken at the national level to bring about improvement in power-plant procurement practices need to be elaborated within the framework of the power sector development plan, taking into consideration existing technological and industrial capacities.

22. Standardization of thermal-power units to be installed by public power authorities could contribute significantly to a rationalization of the procurement process and procedures. Not only does it lead to improved technical and economic efficiency by facilitating the task of maintenance and spare parts management and of training in operational skills but, more importantly, it makes the negotiation of power-plant purchases easier by minimizing the need to search for information and allowing a more rapid accumulation of procurement know-how. Standardization, in other words, accelerates the process of learning associated with power-plant purchases.

23. Ensuring the adequate testing of power equipment to be installed is another important measure related to procurement. The public power authorities need to build up their capacity to assess the technical and economic performance of power equipment. In countries where such capacity is still lacking, it is important to monitor closely the performance-guarantee testing that is normally provided by the equipment suppliers as part of the power-plant contract.

24. Although the main source of procurement of power equipment and related services may continue to be foreign suppliers, the Governments of developing countries may be in a position to shape their procurement policy in such a way as to ensure the participation of domestic enterprises. Unpackaging of the power project is a prerequisite for this. This will require, no doubt, material efforts for building up a broad range of skills and capabilities.

25. Finally, there is an important scope for co-operation among developing countries, particularly to improve the bargaining position relative to international electrical equipment suppliers. The fact that the developing countries account for more than one third of the international sales of electrical equipment suppliers should provide leverage for such collective efforts. Joint elaboration of a scheme for standardization of procurement procedures may be a promising area, as it will complement the national efforts by individual developing countries.

C. Development and diffusion of renewable energy technology

26. Renewable energy represents a promising area of endeavour for developing countries because of the variety of sources involved, the multiplicity of end-uses and the existence of vast resources in these countries. For some of these resources, such as mini-hydroelectric power and biogas, the technology already exists at reasonable costs, and the problem seems to lie in its diffusion, which is limited for a number of reasons, including the problem of social acceptance of innovations.

27. For other resources, such as solar energy and biomass, although the technology has not yet attained competitiveness except in certain limited uses, it has been developing quite rapidly. Although developing countries are well endowed with these resources, the development of the relevant technology is taking place mainly in the industrialized countries. Access to the evolving technologies is hindered both by domestic and external constraints. Domestic constraints relate to lack of an appropriate research and development infrastructure, lack of a financing mechanism, scarcity of skills needed for developmental work and insufficient industrial capacity to manufacture the relevant equipment. The external constraints are even more paramount and relate to the conditions and modalities of access to the changing technologies. The growing involvement of large oil, electrical machinery, electronic and agro-industry firms in the development of these technologies cause some concern, as they can combine their financial, technical and marketing capabilities and, eventually, support from public funds from their home countries to influence the shape of the future technology market, which may imply continued technological dependence for developing countries.

28. In order to bring the benefits of renewable energy technologies to developing countries, concerted efforts need to be made to accelerate the transfer of financial resources and technology to developing countries. The Nairobi Programme of Action adopted at the United Nations Conference on New and Renewable Sources of Energy acknowledges that "the success of an effective energy transition will depend, inter alia, upon the extent to which the critical issues of mobilization of

resources for, and transfer of technology available to, in particular, developing countries can be effectively tackled". 7/ It also highlighted the concern of the international community over the problem of transfer, acquisition and development of renewable energy technology by formally identifying, among five broad policy areas for concerted action, one on research and development and another on transfer of technology.

29. Efforts by developing countries at the national level should start with the elaboration of a systematic policy on renewable energy development. Given the early phases of development of some important renewable energy technologies, a national programme on research and development should constitute a major component in such a policy. In the case of simpler technologies, the designs of which are well known and internationally available, research on policies to promote their diffusion would be required.

30. The area of renewable energy technology offers an opportunity for a co-operative effort at the regional and subregional levels, given the similarity of resource endowment and complementarities in skill and financial resources. Furthermore, significant progress at an early stage of development is bound to result from a concentrated effort rather than from individual and scattered activities. Such co-operation could take the form of a concentrated regional or subregional programme of research and development, pooling existing human and financial resources for those renewable energy technologies that are expensive and require high skills, such as those related to methanol, plant genetics and photovoltaics.

31. A second possible area for regional co-operation is in the field of standardization and quality control. Technical specifications, common norms and standards could be formulated in order to facilitate the flows of technology among the countries of the region. Standardization should also include the reporting of the performance of equipment, so that people at a distance can compare renewable energy technologies and assist developing countries in negotiating transfer of renewable energy technology agreements with developed countries.

32. The nature of the problem involved and the high concentration of the innovative capacities in developed countries also calls for the identification of specific measures for action at the international level. Such measures may include the promotion of co-operative efforts between developed and developing countries with respect to research and development and inclusion of developing-country-oriented projects in the research and development programmes of developed countries.

CHAPTER II

MEETING OF GOVERNMENTAL EXPERTS ON THE TRANSFER, APPLICATION AND DEVELOPMENT OF TECHNOLOGY IN THE ENERGY SECTOR

33. In accordance with Conference resolution 112 (V), which was followed by resolution 241 (XXIII) of the Trade and Development Board, UNCTAD organized a Meeting of Governmental Experts on the Transfer, Application and Development of

Technology in the Energy Sector, which was held at Geneva from 25 October to 2 November 1982. The purpose of the Meeting was to "identify and examine in depth the problems and issues concerning the transfer, application and development of technology in the energy sector, taking into account the interrelationships between the technological needs and development objectives of the developing countries, and make recommendations thereon for consideration by the Committee on Transfer of Technology, bearing in mind the role which the Nairobi Programme of Action for the Development and Utilization of New and Renewable Sources of Energy expects the organs, organizations and bodies of the United Nations system to play in the implementation of the Programme" (Board resolution 241 (XXIII), para. 1 (b)).

34. Sixty-four States members of UNCTAD were represented at the Meeting, as were some 20 United Nations and other organizations.

35. The discussions focused both on the general question of the role of technology in the development of the energy sector in developing countries and on specific technology issues relating to petroleum exploration, power-plant procurement and renewable energy development as outlined in chapter I.

36. The results of the Meeting were embodied in its conclusions and recommendations (see annex) and a few of the main features are noted below.

37. First, the Governmental Experts recognized the vital role of technology for achieving better control and efficient management of the existing energy resources in developing countries and in enabling their orderly transition to an energy system increasingly based on more diversified energy sources. They therefore agreed that concerted efforts should be made to improve the access of those countries to existing energy technology on mutually beneficial terms and conditions and to strengthen their technological capacity in the energy sector.

38. Second, within the above perspective, the Governmental Experts agreed that priority should be given to the following three areas:

(a) Implementation of the Nairobi Programme of Action for the Development and Utilization of New and Renewable Sources of Energy;

(b) Negotiation of petroleum exploration contracts on the basis of mutually agreed beneficial and optimum terms and conditions, particularly with a view towards optimum transfer of all types of technology to developing countries;

(c) Appropriate attention to long-term technological needs of developing countries in power-plant procurement arrangements.

39. Third, the Governmental Experts also made recommendations for policy actions to be considered by the developing countries, individually and collectively. One specific recommendation was for expanding technical co-operation among the developing countries by the setting up of (a) a forum of public utilities for improving power-equipment procurement practice, exchange of experience in power-plant management, and co-ordination of research and development and training; (b) co-operative arrangements for promoting the development of new and renewable

energy technology and co-ordinating research and development activities carried out by national and regional organizations; and (c) co-operative arrangements between consultancy and engineering organizations of developing countries in the energy sector.

40. Fourth, the Governmental Experts agreed that developed countries should contribute actively to strengthening the technological capacity of developing countries by giving due consideration to measures such as the encouragement of the transfer of technology to developing countries; continuing access by students from developing countries to energy-related studies at their universities; facilitating, as far as possible, the participation of personnel from developing countries in research and development programmes and in-plant training programmes being implemented in developed countries; and giving developing countries the freest and fullest possible access to technologies the transfer of which is not subject to private decisions.

41. Finally, the Governmental Experts recommended that, when United Nations system-financed research and development projects in the energy sector, particularly relating to new and renewable energy technology, lead to innovations and inventions for which patents, inventor's or inventions certificates or interests in patents or patentable energy technology can be obtained by the United Nations system, such rights or other benefits associated therewith should be used to promote the development, production and wide availability of energy technology in the public interest, particularly that of developing countries.

42. The report of the Meeting of Governmental Experts 8/ was subsequently submitted to the UNCTAD Committee on Transfer of Technology at its fourth session, held in November 1982, which endorsed the conclusions and recommendations of the Meeting. It was also decided that, at the fifth session of the Committee, to be held in the autumn of 1984, a sessional committee would be established to deal with follow-up work on sectors of critical importance, including the energy sector.

CHAPTER III

ONGOING AND PLANNED FUTURE WORK OF UNCTAD IN THE ENERGY TECHNOLOGY FIELD

43. The ongoing and planned future work of UNCTAD is guided by the agreed conclusions and recommendations of the Meeting of Governmental Experts (see annex) and has two broad orientations. One direction concerns the elaboraton of alternative approaches to energy technology policy at the national level in developing countries. The other has to do with identification and promotion of measures for regional and international co-operation in the area of energy technology.

44. For the task of elaborating alternative approaches to national energy technology policy, the UNCTAD secretariat is presently undertaking a programme of research, with the financial support of the Swedish Government through the Swedish Agency for Research Co-operation with Developing Countries. The programme will

focus on the identification and examination of the technology issues involved in planning the development of the energy sector at the national level in developing countries. In order to enrich the empirical basis of such work, a series of case studies are being prepared on developing countries with different endowments of energy resource and energy technology; the studies will cover different energy technology issues. Following these case studies, a document containing policy implications for strengthening technological capacity in the energy sector will be prepared. It is particularly intended to help in providing a context for the consideration of medium- and long-term energy policy options in developing countries.

45. In respect of regional and international co-operation on energy technology, the UNCTAD secretariat is exploring the feasibility of a few of the schemes that have been discussed at the Meeting of Governmental Experts mentioned in chapter II. One such scheme concerns co-operation among developing countries in petroleum exploration technology. The UNCTAD secretariat, jointly with the United Nations Department of Technical Co-operation for Development, has circulated a questionnaire on the technological capacity of developing countries in the exploration of petroleum resources. The results of this questionnaire should indicate where complementarities may lie between those that have acquired certain experience in this domain and those that are in need of particular technologies and skills. Another such scheme has to do with a forum of public utilities from developing countries, or some similar arrangements, which may begin to tackle some of the common problems faced by developing countries in the area of power-plant procurement and management. Other promising schemes concern the increased participation of public bodies in the energy sector of developed countries - for example, national oil companies, public research and development institutes, national electricity authorities, and so forth - in the transfer of energy technology to developing countries. The UNCTAD secretariat will, in the course of its future work, prepare studies to consider the feasibility of some of these schemes.

46. It is perhaps clear from the above that the work of UNCTAD, on the strengthening of the technological capacity of the developing countries in the development of their energy sector has moved from the discussion of general policy ideas and concepts to the formulation and implementation of concrete policies. The need for such an orientation is amply clear in view of the critical importance of the energy sector in the development process of the developing countries and the uncertainties prevailing in the global energy situation.

47. Finally, it should be stressed that the strengthening of the technological capacity in the energy sector of developing countries cannot be totally independent of other technology policy concerns of these countries. The transfer of energy technology will be greatly facilitated if Governments agree on an international code of conduct on the transfer of technology. 9/ At the national level in developing countries, energy technology policy will also have to be elaborated with due consideration to the development of other important sectors and, most fundamentally, to long-term development concerns. Thus, the question of strengthening the technological capacity of developing countries in the energy and other individual sectors has to be looked at with a broad policy perspective at

both the national and international levels. The discussion of the technological transformation of developing countries, which has been initiated within UNCTAD during the last few years, is a step in this direction. 10/

Notes

1/ This is in striking contrast to the experience of the developed market-economy countries whose commercial energy consumption grew much more slowly than their income; for the same period (1960-1980), the annual rate of growth of energy consumption and income was 3.3 per cent and 4.2 per cent, respectively. Similarly, for the socialist countries of Eastern Europe, energy consumption growth was much slower than their income growth: 4.5 per cent as compared to 6 per cent.

2/ For a survey of the technology experience of developing countries in the energy sector, see Energy Supplies for Developing Countries: Issues in Transfer and Development of Technology, study by the UNCTAD secretariat (TD/B/C.6/31/Rev.1), United Nations publication: Sales No. E.80.II.D.3, part III.

3/ For a brief summary of the outcome of this aspect of negotiations at the Conference on International Economic Co-operation see "Major technology issues in the energy sector of developing countries", report by the UNCTAD secretariat (TD/B/C.6/65), paras. 10-14.

4/ This principle was given further meaning in paragraph 19 of Conference resolution 143 (VI), which requested the Secretary-General of UNCTAD to examine the modalities for the commercialization of the results of United Nations system-funded research and development.

5/ For a summary picture of the ongoing work of UNCTAD in the area of transfer and development of technology, see "Work programme of UNCTAD in the development and transfer of technology" (TD/284), which was submitted to the sixth session of UNCTAD.

6/ These studies include: "The energy sector in the developing countries: issues in the transfer, application and development of technology" (TD/B/C.6/AC.9/2); "Trends in the procurement of electricity generating plant in developing countries", a report prepared at the request of the UNCTAD secretariat by Mr. John Surrey (TD/B/C.6/AC.9/3); "Renewable energy technology: issues in the transfer, application and development of technology in developing countries" (TD/B/C.6/AC.9/4) and "Petroleum exploration contracts and agreements and the transfer of technology" (TD/B/C.6/AC.9/5).

7/ Report of the United Nations Conference on New and Renewable Sources of Energy, Nairobi, 10-21 August 1981 (A/CONF.100/11), United Nations publication, Sales No. E.81.I.24, p. 4.

8/ For the report of the Meeting, see TD/B/C.6/94-TD/B/C.6/AC.9/6.

9/ For the state of negotiations on such a code in the United Nations conference established for this purpose, see "Draft International Code of Conduct on the Transfer of Technology" (TD/CODE TOT/33) and "Report of the Interim Committee of the United Nations Conference on an International Code of Conduct on the Transfer of Technology" (TD/CODE TOT/35).

10/ For a discussion of a strategy for technological transformation in developing countries, see "A Strategy for the Technological Transformation of Developing Countries" (TD/277).

ANNEX

Conclusions and recommendations adopted at the Meeting of Governmental Experts on the Transfer, Application and Development of Technology in the Energy Sector, organized by UNCTAD and held at Geneva from 25 October to 2 November 1982

1. In accordance with resolution 241 (XXIII) of the Trade and Development Board, the Meeting of Governmental Experts on the Transfer, Application and Development of Technology in the Energy Sector was convened at Geneva from 25 October to 2 November 1982. The Meeting considered the following documents:

(a) The energy sector in developing countries: issues in the transfer, application and development of technology (TD/B/C.6/AC.9/2);

(b) Trends in the procurement of electricity generating plant in developing countries (TD/B/C.6/AC.9/3);

(c) Renewable energy technology: issues in the transfer, application and development of technology in developing countries (TD/B/C.6/AC.9/4);

(d) Petroleum exploration contracts and agreements and the transfer of technology (TD/B/C.6/AC.9/5).

2. The Governmental Experts adopted the following conclusions and recommendations:

(a) In all countries there is a considerable degree of correlation between economic growth and energy demand. All countries should adopt strategies and policies within the context of their overall industrialization and development strategies that take into account the interrelationships between various sources of energy - particularly those indigenous to the country - their natural endowments, development priorities, possibilities for energy conservation and the suitability of different energy technologies. The international community should adopt policies that will promote international co-operation in the energy sector under mutually beneficial terms and on a non-discriminatory basis, taking into account the growing energy needs of the developing countries;

(b) Building up of the energy sector is a fundamental requirement for the development and industrialization of developing countries, particularly the least developed among them, and an important opportunity for the development of their national industrial and technological capacities. These countries should be encouraged to adopt appropriate plans and policies to develop their energy sector, taking into account, among other considerations, their energy resources endowment and requirements, and based on short-, medium- and long-term considerations;

(c) Technology plays a particularly important role in the building up of the energy sector in developing countries. Not only is it vital to a better control and efficient management of the existing energy resources in these countries, but it also holds a key to their orderly transition to an energy system increasingly

based on more diversified energy sources. Concerted efforts, therefore, should be made at the national, regional and international levels to improve the access of these countries to existing energy technology on mutually beneficial terms and conditions and to strengthen their technological capacity in the energy sector. Within this perspective, priority should be given to the following three areas:

(i) Implementation of the Nairobi Programme of Action for the Development and Utilization of New and Renewable Sources of Energy, as representing an internationally agreed set of policy measures and priorities relating to new and renewable sources of energy;

(ii) Petroleum exploration contracts involving developing countries should be negotiated on the basis of mutually agreed beneficial and optimum terms and conditions, particularly with a view towards optimum transfer of all types of technology (for example, geological, geophysical, drilling and other techniques) to developing countries;

(iii) The arrangements in power-plant procurement involving developing countries should give appropriate attention to the long-term technological needs of these countries. Relevant organizations, in assisting the developing countries, should provide advice and should co-operate in the transfer of such technologies in a manner consistent with the technological needs and economic development of developing countries;

(d) In pursuing technological development and building up the domestic technological capacity in the energy sector, developing countries should, within the framework of their national policies and plans:

(i) Formulate comprehensive technology policies in planning the development of the energy sector;

(ii) Examine the arrangements for the supply of technology, particularly in the areas of petroleum exploration and power generation and the institutional machinery in this regard, with a view to ensuring mutually agreed beneficial and optimum terms and conditions of its supply and to increasing the domestic contribution;

(iii) Accelerate the formation of skilled manpower at all levels, including not only the capacities for operating the energy installations but also for consultancy and engineering capabilities to plan and manage the development of the energy sector;

(iv) Stimulate the development and diffusion of efficient production processes responding to the energy needs of individual countries;

(v) Establish, promote and intensify a national programme of research and development, including technical as well as policy-oriented research, for the relevant energy sources aimed at the development, adaptation and commercialization of technology, particularly taking into account, inter alia, the energy needs of their rural population and the need to increase reliance on renewable energy resources;

(e) In their efforts to develop the energy sector, developing countries should maximize the benefits to be gained from the strengthening of co-operative links among themselves on the basis of complementarity in technological and industrial capacity and their experience in the development of this sector. Such co-operation as it exists in subregional and regional organizations should be encouraged and all possibilities for enlarging it through the adoption of new initiatives, including interregional linkages among them, should be actively promoted;

(f) Developing countries, in order to expand technical co-operation among themselves and to direct their scientific and technological capacity to their specific needs in the energy sector, should give consideration to setting up:

(i) A forum of public utilities for improving power-equipment procurement practice, exchange of experience in power-plant management, and co-ordination of research and development and training;

(ii) Co-operative arrangements for promoting the development of new and renewable energy technology and co-ordinating research and development activities carried out by national and regional organizations;

(iii) Co-operative arrangements between consultancy and engineering organizations of developing countries in the energy sector;

(g) Developed countries should contribute actively to strengthening the technological capacity of the developing countries in the energy sector by giving due consideration to measures such as:

(i) Encouragement of the transfer of technology to developing countries through appropriate mechanisms in the public and private sectors. In establishing such mechanisms, the suppliers should take into account the need for accelerated and effective technological development of the acquiring party;

(ii) Continuing access by students from developing countries to energy-related studies at their universities, and facilitating, as far as possible, the participation of personnel from developing countries in research and development programmes and in-plant training programmes being implemented in developed countries;

(iii) Expanding in their public research and development programmes projects that are oriented towards the needs of developing countries, particularly the least developed among them;

(iv) Giving developing countries the freest and fullest possible access to technologies the transfer of which is not subject to private decisions;

(v) Advising the relevant enterprises and organizations of the need to ensure an adequate supply of spare parts and components and training of operating personnel to enable better utilization of energy installations established through different contractual arrangements;

(h) The international community should continue to support the technological development of the energy sector in developing countries, particularly the least developed among them, through technical assistance to these countries, taking into account the needs and priorities of individual countries in their efforts to:

(i) Create, co-ordinate and strengthen their research and development activities;

(ii) Develop an adequate institutional infrastructure to support technological improvements in the energy sector;

(iii) Assist educational institutions in developing countries to develop curricula necessary for providing essential skills in the energy field, and to launch programmes designed to bring the latest knowledge in the energy field to practising engineers;

(iv) Facilitate the exchange of personnel at all levels between developed and developing countries and provide scholarship support for the participation of technicians from developing countries in training courses in institutes and industries in developed countries or in other developing countries;

(v) Strengthen use-oriented science and technology information services specialized in the development and production of energy geared to the requirements of both the public and private sectors in developing countries;

(i) When United Nations system-financed research and development projects in the energy sector, particularly relating to new and renewable energy technology, lead to innovations and inventions for which patents, inventor's or inventions certificates or interests in patents or patentable energy technology can be obtained by the United Nations system, such rights or other benefits associated therewith should be used to promote the development, production and wide availability of energy technology in the public interest, particularly that of developing countries;

(j) The UNCTAD secretariat should particularly work closely with the new institutional machinery being developed at United Nations Headquarters to implement the Nairobi Programme of Action for the Development and Utilization of New and Renewable Sources of Energy. The UNCTAD secretariat should report on the results of the work to the Committee on the Transfer of Technology;

(k) In co-operation with relevant international and regional organizations and institutions, and bearing in mind the role that the Nairobi Programme of Action expects the organs, organizations and bodies of the United Nations system to play in the implementation of the Programme, the UNCTAD secretariat should continue to identify and examine policy issues of relevance to the transfer, development and application of technology in the energy sectors of developing countries;

(l) The UNCTAD secretariat, in co-operation with relevant international and regional organizations, should expand and strengthen within existing budgetary resources and project and programme support, technical assistance and training programmes to developing countries in the transfer, application and development of technology in the energy sector;

(m) The UNCTAD secretariat, in reporting to the Committee on Transfer of Technology on the work of the Advisory Service on Transfer of Technology, should describe the activities of the Advisory Service in the energy sector, and the possibility of the Advisory Service undertaking additional work in this sector within existing budgetary resources and projects and programme support;

(n) The UNCTAD Committee on Transfer of Technology should decide, at its fourth session, on the appropriate means for the follow-up, within UNCTAD, of the above recommendations.
