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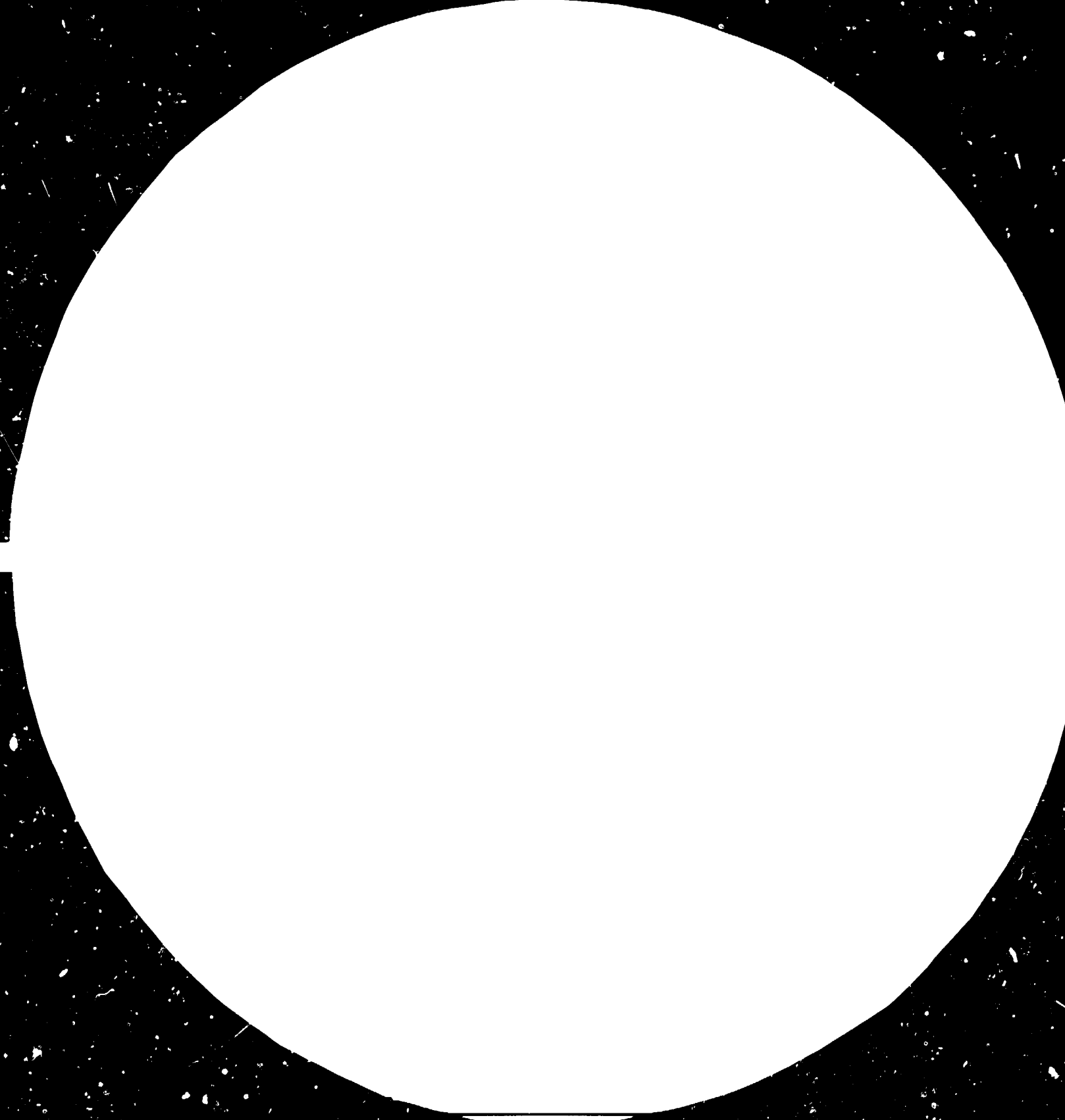
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MICROCOPY RESEARCH, INC. 300 NORTH ZEEB ROAD
ANN ARBOR, MICHIGAN 48106

Distr.
LIMITED
ID/WG.402/4
9 August 1983
ENGLISH

12686



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**HIGH-LEVEL
EXPERT GROUP MEETINGS
PREPARATORY TO THE
FOURTH
GENERAL CONFERENCE
OF UNIDO**

*Energy and Industrialization
Oslo, Norway, 29 August - 2 September 1983*

**TECHNICAL CO-OPERATION IN ENERGY
AMONG DEVELOPING COUNTRIES**

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V.83-59254

Introduction

Energy is one of the factors upon which depends not only industrialization but also the general progress and well-being of man. Industry and energy are intimately related if we consider that 85 per cent of total world energy is consumed by industry and its products. The adjustment in energy costs during the past decade, especially the increase in the price of crude oil, has not only added another dimension to the current world crisis, but provided incentives to search for new, renewable and non-renewable sources of energy. The achievement of an effective energy plurality is a complex long-term effort which must be tackled at the national, regional and global levels.

The developing countries' accelerated socio-economic progress will continue to depend, firstly, on greater access to conventional sources of energy, although a significant contribution may be expected from the new and renewable sources; secondly, on assured access to new technologies. The development and utilization of new sources of energy, both renewable and non-renewable, entail not only a larger national capacity but also new and desirable schemes of international co-operation. Without doubt, maximum development of national potentials will be achieved within the framework of self-reliance and co-operation among developing countries.

This paper provides a suggested action programme under each of the five areas of co-operation among developing countries which are the subject matter of this meeting, and which were identified in the Caracas Programme of Action under paragraph 53(b), namely,

Training and manpower development;

Development of sub-regional, regional and inter-regional centres of excellence in technology;

Collective co-operation in consultancy and technical advisory services;

Mutual contribution, including shared financing, to the organization of research and development with participation in the results thereof;

Co-operation among institutions in developing countries engaged in similar activities.

Training and Manpower Development

The shortage of trained manpower has been a major handicap in establishing and implementing a comprehensive national energy policy. Hence, energy has become a subject for training in practically all developing countries. Although there is a difference in the nature and magnitude of the needs for training requirements among developing countries, the one common feature is that the need in all of them is substantial in many beyond their present capacities. Thus, countries having developed an oil production industry and those which have recently discovered oil or expect to do so, as well as those embarking on a programme for the exploitation of renewable energy resources, face the need for training their own workers, technologists and managers in the energy field. Training of persons for the many tasks in the energy field is required from the highest national central planning and policy making levels, to the bench and workshop industrial and transport operations. In the long run, training policies should aim at achieving self-sufficiency in meeting training requirements preferably at the national level or the regional and inter-regional levels among developing countries. For the short-term, specialized training in developed industrial countries is a necessary option, particularly in the emerging disciplines related to energy management including energy conservation and to the technologies in the use of renewable sources of energy.

Education and training are intimately related. Many developing countries have made striking progress in forming an educational base for their development, in terms of numbers and kinds of institutions and the percentage of the student population attending them. Educational structures, however, vary among countries, so that specified levels of educational achievement do not always represent the same degree of quality of education or technical training from one country to another.

This situation calls for a review of academic courses and syllabuses among universities and scientific institutions in developing countries. Meetings of representatives of academic institutions may be held at the regional and interregional levels with a view to sharing experiences in the development of energy technology educational systems. Some measure of harmonizing academic requirements and contents of the courses and syllabuses in the different specialities of energy may be necessary, not only to raise standards but also to facilitate the process of further training abroad.

Such meetings may be held periodically to which representatives of energy industries and concerned government officials may be invited.

For the purpose of formulating and implementing a training programme in energy as well as initiating collaboration programmes among developing countries, Governments may consider the following actions:

- 1- An assessment of the current stock of technical and managerial personnel involved in energy.
- 2- Identification and analysis of the required skills and specializations in energy, i.e. an assessment of manpower needs.
- 3- An inventory of training institutions together with an assessment of their energy training capacities, including training material, methodologies and techniques.
- 4- An inventory of research and laboratory facilities and an assessment of their training capacities and equipment.
- 5- An inventory of energy producing facilities of various types and an assessment of their capacities to offer in-plant and field training.

The above information and data would enable Governments to formulate and implement appropriate national training policies which would meet the requirements of the national energy programme. Furthermore, it would enable Governments to work out mutual collaboration programmes at the regional and interregional levels. The following steps may be considered by Governments to reach a satisfactory interaction and co-operation in energy training among developing countries:

- 1- The exchange of available information and data described above.
- 2- The granting of access to training facilities for nationals of other developing countries including opportunities for in-plant and field training; also offering free training to trainees from the LDCs.
- 3- The tailoring of certain training programmes to respond to the requirements of other developing countries.

- 4- The adaption of a programme for the exchange of professors and instructors, and a programme for teacher training.
- 5- The setting-up of regional facilities for specialized training or the conversion of an existing national institution to serve a region. Collaboration in a regional facility is especially useful for training in the use of non-conventional energy resources.
- 6- Similarly, the setting-up of an interregional facility may cater for training needs in highly advanced technologies.
- 7- The setting-up of a fund or some other modality for training purposes to assist national, regional and interregional institutions to build capacities within the framework of collective self-reliance.

As indicated above, the development of energy skills and capabilities may take place through various training arrangements among developing countries. However, co-operation with developed countries may continue to be crucial in view of the great number of people to be trained, particularly in the field of energy technology related to non-conventional energy resources.

UNIDO will continue to promote training programmes in this sector in co-operation with multilateral, regional and national organizations and to assist developing countries in strengthening their own capacities either individually or collectively. UNIDO will also assist developing countries in the important task of formulating and implementing national energy policies as well as energy policies at the regional and interregional levels.

Development of sub-regional, regional and inter-regional
Centres of Excellence in Technology

The rising cost and demand for energy has prompted the development of technologies in the following directions. Any of these modes might be the subject of concern to centres of excellence.

1. To conserve consumption of hydrocarbons, i.e. more efficient use of these fuels. This approach has been especially significant in industrialized countries.
2. To produce synthetic fuels to replace petroleum. To process and improve heavy crude oil, bituminous sands and lutites, as well as the development of technologies for gasification and liquification of coal. Proven technologies still do not exist and further advances are hoped for.
3. To promote coal exploitation, improve its efficiency and productivity and minimize its harmful effects on the environment. This activity holds promise to those developing countries with proven coal reserves and to those that have prospects.
4. To generate nuclear power. This approach has been relevant to industrialized countries and to a few developing countries. There are still technical and environmental difficulties which would limit its wide-spread use.
5. To harness solar energy, wind, geothermal and hydropower. There are prospects for developing countries in these energy forms provided that technologies imported from developed countries are adapted to local conditions and needs in developing countries.
6. To produce biomass energy. This activity holds great potential in many countries. For these developing countries a programme of research and development of appropriate technology is a worthwhile venture.

Although the above areas cover both renewable and non-renewable energy sources, it is the former that has been attracting most attention, partly because the technologies in the use of renewable energy lay far behind those of non-renewable energy and partly because they offer the only hope for many developing countries to supplement their current energy needs and lessen their dependence on hydrocarbons. In view of the great potential that these forms of renewable energy may have in store, the developing countries may take greater interest in their development.

The new technologies for the use of renewable sources of energy are concentrated in the industrialized countries and the efforts of these countries are directed, as is natural, to the search for solutions to their needs and not to those of the developing countries. Many technologies of potential use in the developing countries have been minimally tested in these countries, while their cost is often beyond the means of the prospective users.

The widespread application of these technologies can be brought about by the establishment in developing countries of capabilities to undertake the development and adaptation of technologies locally.

To develop local technological capacity in renewable energy, each developing country may attempt to develop a centre of excellence. These centres would be entrusted with the tasks of implementing a national research programme aimed at adapting imported technologies to the local environment and to improve on traditional local technologies. After thorough and successful testing and demonstration, steps should be taken for the dissemination of information about these technologies. Subsequently, Governments should arrange for the local manufacture and distribution of the equipment or device. The centre may issue a publication containing information on the results of its research effort and on the developed technologies which have reached the application stage.

Depending on the natural endowments of the country, the center may concentrate its research efforts on a particular form of renewable energy and its applications such as solar energy, biomass, geothermal, etc.

While these centres may not have been established with the primary objective of performing a training function, experience has shown that after an institution has acquired the technical capacity to perform its functions, there are advantages to expanding its activities to include training. The introduction of training activities would form the basis for expanding the supply of technologists who

can deal with the assessment and utilization of non-conventional resources and technologies and provide industry with trained manpower for the manufacture of the developed equipment or process. In fact these centres could provide the most suitable means of training technologists in the highly specialized areas of new and renewable energy.

Developing countries should manage in common efforts to stimulate the research and development of new technologies adapted to their needs. Many developing countries have common economic and socio-cultural backgrounds and similar technological needs to warrant regional co-operation among them. Effective co-operation at the regional level depends on co-operation among centres of excellence, government agencies concerned with technology policy, manufacturing firms and consulting and engineering organizations. Linkages and divisions of work programmes may be worked out bilaterally or multilaterally between centres of excellence.

Countries with strong technology research and training institutions and substantial manufacturing base may agree to establish regional or inter-regional centres of excellence. The details of co-operation will be worked out among the members. On the other hand, mechanisms for joint manufacture of equipment may be reached. Assistance to countries that lack indigenous capacity may be offered by other developing countries capable of doing so. It may be useful to convene meetings to discuss collective co-operation in this sphere.

The People's Republic of China has volunteered to set up a Regional Centre for Small Hydro Power as a Centre of Excellence for training, co-operative research and development, information services and advisory services. This experience may be examined with a view to adapting it in other regions for other technologies.

Collective co-operation in consultancy and technical advisory services

The need has increased in recent years for consultancy and technical advisory services as developing countries undertake to formulate and implement national energy policies and programmes. Consultancy and technical advisory services need to be tailored to local conditions and problems. There are considerable advantages to be derived in setting up a national consultancy and technical advisory service. Such centers could:

- 1) provide training in all aspects of energy management, conservation and use;
- 2) provide energy audit and consultancy services to industry;
- 3) conduct studies on various energy management and conservation measures;
- 4) recommend appropriate policies and programmes;
- 5) introduce and demonstrate technologies appropriate to the country or region.

Consultancy and technical advisory services in the developing countries could make a positive effort to advance the quality and scope of their own activities. Emphasis should be placed on sharing experience, undertaking joint activities and fully utilizing the resources and skills available in the country. The pooling of resources would not exclude the use of foreign inputs, either joint ventures or individual consultants from industrialized countries to carry out specialized tasks. It should be borne in mind that the technologies in the use of renewable energy are concentrated in the industrialized countries.

A national consultancy service need not take the form of an institution with elaborate technical staff. It may consist of a network system through which queries are relayed from industry (i.e. plant level) through a central bureau in the capital city to the research institute or center of excellence which may be concerned with the problem at hand. The technical information is relayed back through the same network channels. This system provides an excellent linkage between industry and the research and technology service within a country. UNIDO has been assisting some countries to introduce this system

under its Technology Services Delivery System Programme.

Detailed examination of the experience some developing countries have gained in building national consultancy services would provide valuable insight which could be considered in other countries. Although the setting up of a national consultancy and technical advisory service is a desirable step to be taken by each developing country, there are cases where this may not be feasible as yet. There are also cases where the established service may not have the capacity to deal with all aspects in the energy field. Hence, the need arises for collective co-operation among developing countries on a regional and inter-regional basis. The benefits of regional co-operation in this field are apparent:

1. The shifting of certain problems or activities which cannot be handled locally for lack of expertise to the regional service;
2. The regional service could undertake training tasks for the personnel of the member countries;
3. The regional service could handle more complicated tasks because of its accessibility to experienced and trained personnel;
4. The regional service being an autonomous organization could attract talent at competitive remunerations from within member countries and from other developing countries;
5. The regional service would be a good vehicle for the exchange of information and the dissemination of the results of their studies;
6. The regional service is likely to succeed in establishing confidence among its members, enabling it to compete with similar services from developed countries.

To reap the above-mentioned benefits an independent regional service may be formed with a base in one of the member countries. Its potential role to be defined, the required inputs ascertained and the mode of the organization and its operation established.

Generally speaking a consultancy organization is constituted by a central nucleus of experts which is complemented by drawing on external resources both domestic and foreign. If a regional organization is conceived along these lines, it can establish co-operative arrangements with national organizations, both those with similar specializations and objectives (horizontal co-operation) and those with different

but complementary fields (vertical co-operation).

The regional organization will undertake consultancy and advisory services at the request of member countries for a fee and in some cases free of charge depending on the financial ability of the beneficiary country. It will also undertake training activities and encourage the formation or strengthening of counterpart local units in the member countries with which it would maintain working relationships aimed at decentralizing certain functions and activities.

On the other hand, regional organizations providing consultancy and advisory services will establish working relationships and contacts for the purpose of exchanging information, publications, loaning of advisers, and encourage rotation of personnel.

In order to implement the above mentioned proposal, a stock of existing organizations, national, regional, and inter-regional may be taken, and assessing their adequacy in relation to the needs. A study may be undertaken on (a) the possibility of converting a national organization into a regional one, and (b) strengthening the capabilities of existing regional or sub-regional organizations. It is assumed that most developing countries have compiled their own rosters of national experts in the different energy sectors. These rosters may be published and exchanged among the developing countries. By way of example, it may be mentioned that through a joint effort of UNIDO and ESCAP a roster of experts in Small Hydro Power Development was compiled. Similarly, ESCAP compiled expert rosters for Solar Energy, Biogas and Wind Energy.

Mutual contribution, including shared financing, to the organization of research and development with participation in the results thereof

Research and development is an area vital to the development of national energy programmes. It was mentioned earlier in this paper that, for instance, imported technologies need to be adapted to local conditions to ensure their successful use, not only from the technical point of view but also from the socio-economic point of view. Furthermore, local conditions may dictate the need for certain types of technologies which are peculiar to developing countries and which can only be developed by those countries themselves. Also the establishment of national research and development centres will result in a wider base from which to draw scientists, experts and specialized personnel for a variety of other occupations. There are, of course, other well recognized material benefits.

Collective co-operation among developing countries in this field is necessary to promote self-reliance, to reduce the cost burden for each country, to spread the risks among the participating countries, to conserve scarce financial resources which are usually not adequate for this kind of activity, to bring to bear on the research activity the various accumulated individual experiences, to widen the marketability of the conceived technology, to facilitate the feed-back of information on the use of the equipment, and to avoid duplication and wasteful use of resources.

In order to implement a policy of collective effort in research and development, firstly a list of research projects both under way and planned at the national level may be compiled together with details on the status of progress in each case and on the capacity of the institution executing the project. Secondly, this list would be examined with a view to identifying those research projects which have a common objective or end-use and which will be candidates for regional and interregional co-operation.

On the basis of this list, an estimate could be made of the total financial requirements for executing these projects. Third, an agreement could be reached on the selection of the most qualified institutions which would undertake the research and development activities concerning the projects in question on behalf of the other countries.

Financing these activities has to be considered through mobilization of internal and external resources. Countries may offer contributions in kind and in cash. It is relatively easy for the "host" country to offer contributions in kind, i.e. existing facilities (buildings and equipment) and staff. However, the facilities or the staff requirements may not be adequate and there are other costs associated with testing and gestations etc. Participating countries may agree to share in the budget for the project through payment in cash. There may be some financial returns resulting from the research effort through the sale of manufacturing rights, in terms of patent use and royalties, which may be ploughed back into research activities of the centre.

Another approach would be to set up a fund for research and development preferably at the global level to which all countries, developed and developing, may be invited to contribute. It is in the interest of the international community to finance research activities which will be expected to reduce the excessive dependence on hydrocarbons through energy conservation measures and the use of renewable energy resources. The fund's role should be catalytic, identifying research projects with regional or interregional scope, farming out the research work to technically capable national institutions in developing countries and meeting the required finance.

To mobilize an international support for the fund, a pledging conference may be held to which representatives from donor countries, donor agencies, foundations, international and regional organizations, development banks, development funds, petroleum and industrial concerns will be invited. The basic document for this conference would contain a five-year research programme in the energy sector compiled on the basis of material obtained from the studies suggested above. The document would also reflect project by project the funding requirements of the programme, and an indication of the magnitude of external resources, as well as the matching possibilities of developing countries. In view of the very wide scope of the energy field it would be an advantage to present the material in separate documents grouped by subject matter. It would be necessary for the success of this pledging conference that the working documents be circulated a couple of months ahead of the scheduled date of the conference. It would also be preferable that the conference be held and sponsored by one of the oil producing developing countries.

Co-operation among Institutions in Developing Countries engaged in similar activities

Throughout this paper, emphasis was placed on the need to strengthen inter-institution and inter-country co-operation. Under each of the substantive headings the advantages of co-operation among institutions engaged in similar activities were briefly noted. The corner stone for the success of the principle of collective self-reliance rests on the equitable exchange of experiences between institutions in different countries and in sharing technological and other knowledge mutually.

For the expansion of TCDC existing linkages among institutions may be examined for adequacy and fulfilment. Steps may be taken to establish new links where necessary to connect national training and educational institutions, centres of excellence and other research institutions, consultancy and advisory services, offices and focal points dealing with energy, energy commissions and ministries, and financial institutions and development banks.

Periodic meetings and exchange of personnel may be encouraged among parallel institutions at the regional level. At such meetings a programme for co-operation, harmonization and promotion of joint ventures may be set up and ways and means defined to implement it. Perhaps co-operation among parallel institutions at the regional level may be the easiest to undertake as it requires no secretariat to implement it. At the first regional meeting, one institution may be designated as the "lead institution" for future follow-up. The lead institution would perform the role of co-ordinator and would ensure the fulfilment of the objectives of the programme.

However, parallel institutions should not co-ordinate their work in isolation of what goes on in other institutions dealing with other aspects of energy. Moreover, as often the case policy is decided by political bodies extraneous to the institution. To fill this gap, a regional co-ordinating body needs to be created. The Latin American region has already its own regional organization, namely, OLADE, the Latin American Energy Organization, which was created on 2 November 1973. Its functions are

wide and comprehensive covering all aspects of the energy sector. Its achievements have been remarkable in the face of certain financial and other constraints.

It is indispensable that a similar organization be set up for each of the African and the Asian region. The experience gained by OLADE may form a good basis for setting up these two regional bodies. In brief, the important functions of these regional bodies would be to establish permanent channels of communication and information among member countries which would lead to the sharing and exchange of relevant knowledge and experience. Also these regional bodies would serve as a dynamic link between the three regions in question to bring to bear an interregional dimension to their activities. They would also constitute the mechanism for negotiations with the developed countries on matters concerning energy development.

