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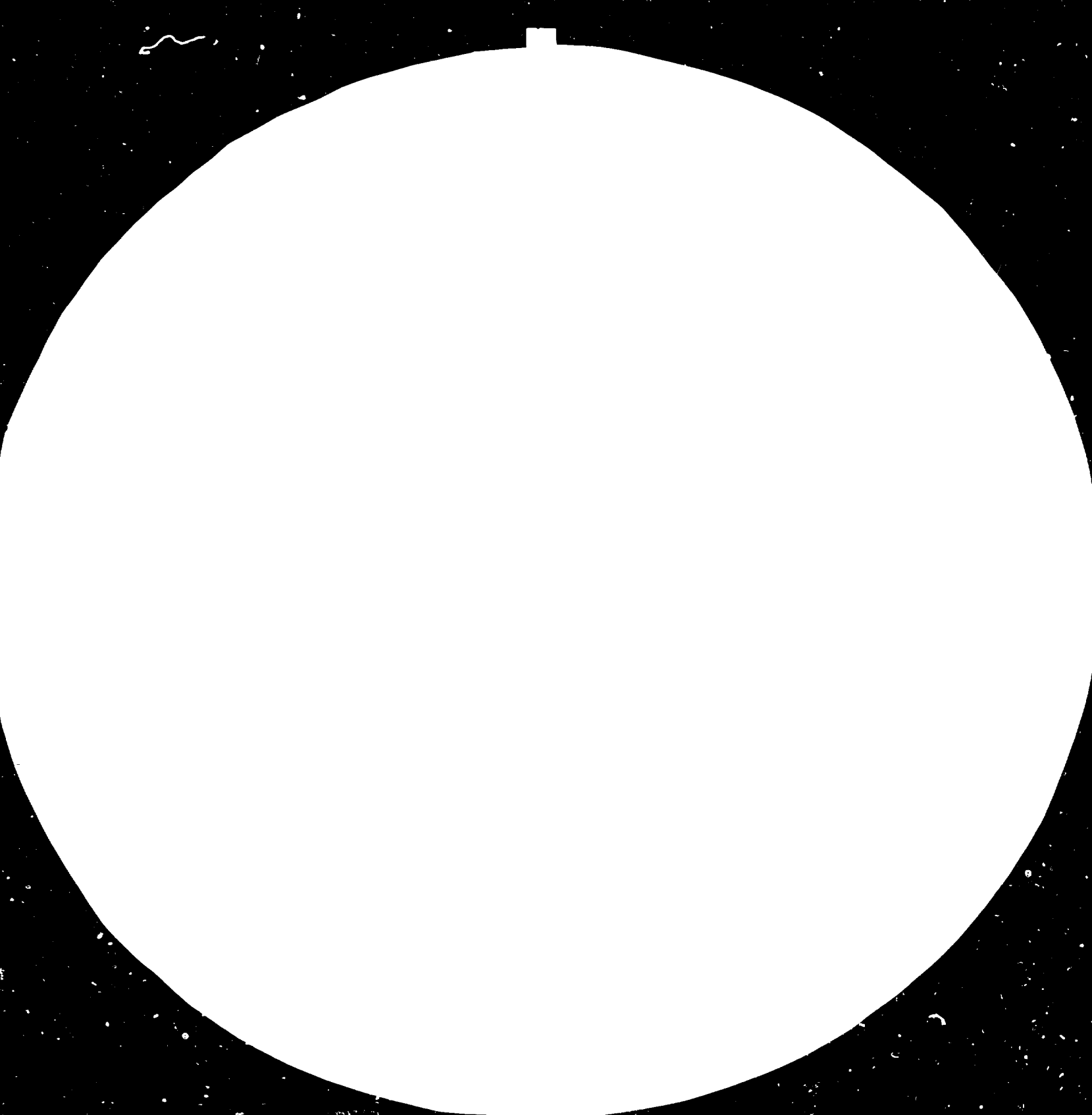
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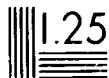




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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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

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

REPORT (Meeting on Energy and
industrialization).

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ENGLISH

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

Energy and industrialization
Oslo, Norway, 29 August - 2 September 1983

Report

Corrigendum

Page 40, entry 8

For Austria read Australia

Page 41, entry 17

The fourth line should read Federal Ministry of Industry

CONTENTS

<u>Chapter</u>		<u>Paragraphs</u>	<u>Page</u>
I.	Introduction	1 - 11	1
II.	General considerations on industrialization and energy in the developing countries	12 - 31	5
III.	Energy development for industrialization	32 - 77	11
IV.	Industrial energy management	78 - 99	24
V.	Recommendations for action by UNIDO	100 - 111	33
VI.	Closure of the meeting	112 - 115	37

Annexes

1.	Agenda of the meeting	38
2.	List of participants	39
3.	List of documentation	46
4.	Terms of reference and composition of working groups	49

CHAPTER I. INTRODUCTION

1. The High-Level Expert Group Meeting Preparatory to the Fourth General Conference of UNIDO on Energy and Industrialization was held at Oslo, Norway, from 29 August to 2 September 1983. It was organized by UNIDO in co-operation with the Government of Norway. The Meeting was attended by 34 experts from 27 countries including the host country. A number of observers from international organizations also participated. The list of participants is contained in annex 2. A list of documents presented to the Meeting is provided in annex 3.

2. The objectives of the Meeting, which was the last of a series of preparatory meetings for the Fourth General Conference of UNIDO (UNIDO IV), were to review both aspects of energy for industry and industry for energy. In particular the Meeting was to consider how industry could provide the capital goods and other products necessary for energy generation, transmission and distribution and how energy inputs could be maximized for industrial development purposes, paying attention to such aspects as energy policy and energy management and conservation.

Opening of the Meeting

3. During the opening session of the Meeting, a statement of the Executive Director of UNIDO, Dr. Abd-El Rahman Khane, was delivered on his behalf by his Special Adviser on Energy, Mr. E. Epreman. The Executive Director drew attention to the fact that, in considering options and actions for the eighties and nineties, the developing countries could not but take into account the constraints and opportunities in energy and industrialization as key elements of future development. The current Meeting had a significant context, since the developing countries were in a stage of decision-making concerning their transition from their current dependence on imported energy to an increased use of indigenous services and improved energy management.

4. Due to the massive investments required for the exploration and exploitation of oil and gas resources, increased attention was being given to the need for developing countries to develop new and renewable sources of energy. In that respect, hydropower and biomass seemed to offer the primary options for developing countries, not only from the technological point of view, but also because either

type of energy development was suitable for both centralized, large-scale facilities and decentralized types of operations, and could be pursued within the framework of the economic and social policies of a given country. Parallel to long-term energy development programmes, the developing countries needed short-term relief from the financial drain of imported energy. Industrial energy management should consider not only savings on energy consumed in industry by introducing simple changes which do not require any large expenditures but also investments in new plant and equipment, the cost of which is recovered through continuing annual savings in energy use. The Executive Director expressed the belief that, within the broad framework of a number of meetings already held within the United Nations system in the field of energy and industrialization, the current Meeting provided an excellent opportunity to establish a pragmatic and action-oriented programme in that field for the benefit of the developing countries.

5. In her opening address to the Meeting, the Norwegian Minister for Development Co-operation, Her Excellency Ms. Reidun Brusletten, referred to the need for a rapid increase of the energy supply in developing countries and, in that respect, the importance of developed countries making available in an appropriate form all suitable energy technologies, particularly those related to the development of new and renewable forms of energy. Potential hydrological and biomass energy resources in particular had not been put to use in developing countries where they were large and widely available. She emphasized the need for a wider distribution in the use of energy which would increase the welfare of the people, particularly in the rural areas where more readily available energy might substantially increase food production. In this context, UNIDO, she said, had an important role to play in providing advice and aid to the small industries and to industry in rural areas. She pointed out that the differences in the economic situation of most developing countries must be taken into consideration when offering advice on appropriate energy policies. In concluding, she expressed the hope that the Meeting could result in constructive initiatives for action by UNIDO and other organizations concerned.

Election of officers

6. The Meeting elected the following officers: Mr. Vidkunn Hveding as Chairman; Mr. M. K. Sambamurti, Mr. Abdel Raouf Radwan and Mr. Y. Zhao as Vice-Chairmen; and Mr. J. de Lima Aveloli as Rapporteur.

Adoption of the agenda

7. The Meeting adopted its agenda which is contained in annex 1.

8. Mr. G. S. Gouri, Chairman of the Task Force on the Fourth General Conference of UNIDO, explained that the function of the General Conferences of UNIDO was to review major problems and policy issues affecting the world industry situation and to recommend action to be taken in this respect by Governments and international organizations, including UNIDO. The Fourth General Conference, he said, would be meeting at a time when the world economy and the industrial community found themselves at a crossroads. The current economic crisis had mostly affected the process of industrialization and UNIDO IV would thus be concentrating on the ways and means to rekindle the process of industrialization with the aim of revitalizing the entire process of development. A new approach to industrialization was called for, which was the main consideration of the five preparatory meetings to UNIDO IV being held in 1983 in the critical areas of technological development, human resources development, energy for industrialization, industrial co-operation among developing countries and strategies and policies for industrial development. The current Meeting was the last of the series. The five areas being interrelated, the recommendations of the previous meetings were of relevance to the forthcoming discussions and the reports had therefore been made available to the participants. The recommendations emanating from the current Meeting, Mr. Gouri added, would no doubt be given the priority they deserved in the deliberations of UNIDO IV.

9. Representatives of the UNIDO secretariat gave an overview of the type of documentation submitted to the Meeting and the main issues raised in each document.

10. In his introductory statement, the Chairman, Mr. V. Hveding, underlined the complex links between energy and industrialization. The urgency of the energy problem had emerged at a moment when the developing countries were facing many other problems and challenges in their process of industrialization which, it should be remembered, were different from those that the developed countries had faced in the early days of industrialization. While it would not be possible to produce a common prescription for all developing countries, the Meeting would provide an exchange of experience and ideas which could be useful to Governments in the identification of problems and search for solutions. With this in mind,

the discussions, he said, should aim at policy-oriented and action-oriented results.

11. The Meeting agreed to proceed in the Plenary with agenda item 4 - General considerations on industrialization and energy in the developing countries. The deliberations on this item are contained in Chapter II of the present report. In order to deal more adequately with agenda items 5, 6, 7 and 8, two Working Groups were established: one dealing with energy development for industrialization, and the other dealing with industrial energy management. The reports of the Working Groups were adopted by the Plenary and constitute the basis for Chapters III and IV.

CHAPTER II. GENERAL CONSIDERATIONS ON INDUSTRIALIZATION
AND ENERGY IN THE DEVELOPING COUNTRIES

12. The Meeting noted with appreciation the background documentation prepared by the UNIDO secretariat as well as by participants on the subject of energy and industrialization. It was felt that the documentation provided a good basis for an in-depth discussion of the substantive items on the agenda.

13. The Meeting noted that considerable literature was available on the overall subject of energy. Also many meetings had been organized to discuss various dimensions of the energy problem. In this connection reference was made to the recent resolution on development of the energy resources of developing countries adopted by the General Assembly at its thirty-seventh session (General Assembly resolution 37/251) and also to the activities of the various United Nations organizations as well as by other international organizations to promote energy resource development in the developing countries.

14. The role of energy as one of the important inputs for the acceleration of the process of industrial development emerged in the context of the Lima Declaration and Plan of Action which set a target of at least a 25 per cent share of developing countries in world industrial production. The achievement of such a target by the year 2000 would require a threefold increase over present yearly consumption (about 1,700 million tons of oil equivalent). However, the major problem facing most developing countries was that they had to import vast quantities of conventional fuels for industrial and non-industrial purposes. The envisaged switch to use new and renewable sources had not taken place to the extent envisaged. The Meeting examined the present energy problems facing the developing countries, particularly in the context of the impact of the world economic crisis on the industrialization of the developing countries, and the national strategies and policies needed to ensure the required supply of energy, taking account of the critical time dimension.

15. The Meeting recognized the diversity of developing countries in terms of stages of development and resource endowment. While acknowledging the relevance of these differences when considering specific energy/industrial

issues for individual countries, the Meeting decided to concentrate on priority issues common to most developing countries. Therefore references to developing countries in the following paragraphs should be seen in that context.

16. The Meeting noted that the present international economic situation, characterized by stagnant growth, recessionary conditions and protectionist tendencies in developed countries and the consequent worsening of terms of trade, balance-of-payments and debt burden of developing countries, had seriously affected the industrial growth prospects of the third world. In particular, high energy costs had been a major constraint for the industrialization of developing countries. The seriousness of this situation became more obvious when contrasted with a period of rapid industrialization of the advanced countries which took place under the framework of cheap and abundant energy and low interest rates.

17. High energy costs had curtailed foreign exchange availability which in turn restricted capital formation and intermediate imports upon which the rate of industrial growth depends. The need to finance the development of indigenous resources of energy in the face of a critical energy shortfall competed with the financing requirements of equally important industrial development programmes. The lack of adequate technological capacity and the acute shortage of skilled manpower in developing countries posed additional problems for the development of the energy sector.

18. The meeting noted that escalation of energy prices during the last decade had been a major obstacle to industrial development.

The cost of energy input of developing countries was over 50 per cent of the value of their exports, and rising, largely as a result of a slump in commodity prices, and a slackening of demand for manufactured goods. The apparent downward adjustment of oil prices was perhaps illusory, at least in the short-term. While medium-term prospects for energy price trends were less unfavourable, the cost of energy imports to developing countries remained a very difficult problem. Also the temporary price decline which had occurred, had seriously affected the development of technological research on energy substitution in the developed countries.

19. The basic problem therefore was how to sustain the process of industrialization in developing countries in relation to energy supplies, the development of which required substantial outlay of resources, import of equipment and technological services. The prices of these had outpaced the prices of traditional commodity exports which in 1982 had reached their lowest level in fifty years. Some recovery was in progress but not enough to compensate imports of technology and equipment.

20. This situation called for a re-assessment of industrial policies and strategies as well as the corresponding energy policies. As industry was the major single market for energy, accounting directly for 30 to 50 per cent of total consumption, developments in industry closely affected the energy sector as developments in the energy sector in turn affected industry. The size and structure of the industry sector determined the amount and to some extent the type of energy needed. Similarly the availability and cost of energy supplies had a major influence.

21. In considering the twin subject of energy and industrialization the Meeting took note of three essential aspects of the energy/industry interaction, namely "energy for industry", "industry for energy", and "industrial energy management".

22. The concept of "energy for industry" refers to the development of industrialization patterns appropriate to and consistent with the local patterns of energy availability. It includes development or adaptation of energy-efficient and/or energy-appropriate processes and products. It also includes non-conventional processes and products and the fuller use of comparative advantages, such as the use of abundant and cheap hydropower for production of aluminium.

23. The Meeting noted that there was a strong correlation between the pattern of energy availability including the type, quality, location, cost, etc., and the corresponding industrial pattern that could be established such as the sector, size, location, export potential, processes, etc. Among the options available to the developing countries were, of course, the exploration and development of indigenous fossil fuels such as oil, gas and coal. In addition, increased attention was being focused on new and renewable sources of energy. They included, of course, wind, solar energy and geothermal.

24. "Industry for energy" is concerned with industry as a supplier of inputs and services to the energy sector. It has to do with the development of the capital goods industry and of the industrial engineering services required for the development of energy sources in general and of new and renewable sources of energy, in particular. The activities include production of equipment and special materials for projects in the energy sector such as petroleum exploration, coal mining, hydropower stations, transmission lines, etc. Another critical contribution of industry to energy development is the area of processing of primary fuels or special raw materials for production of secondary or special fuels such as petroleum derivatives, petrochemicals, coal, charcoal, etc. All these activities imply the development of a full scientific, technological and industrial capacity in the developing countries to handle research, design and engineering in order to develop or to service the large spectrum of capital goods needed by the energy sector.

25. "Industrial energy management" is concerned with the creation of the capability to plan effectively energy production and use from the national level to the plant level in order to ensure maximum self-reliance and efficiency of the local industry in so far as the energy input is concerned.

26. The Meeting emphasized the need to integrate national energy planning with national industrial planning. There was also energy planning at the plant level, including considerations of energy conservation and substitution, energy-efficient processes and equipment optimization and operating schedules and similar activities. In addition, there were the supporting functions for energy management including scientific and technological development, training and education, adequate financial support to promote and sustain the energy/industry development and the legislative, fiscal and promotional framework to provide incentives and mechanisms for expansion and improvement of energy production and consumption.

27. Attention was given to strategies and policies dealing with centralization and decentralization of industrial production in the context of energy availability and its costs. It was noted that countries had the prerogative to devise their own strategies and policies of industrial development. Both had merits and demerits in terms of economies of scale, efficiency, adequate distribution of production and employment and income levels, etc.

There was also the question of industry moving to the sources of energy and vice versa. These were certainly advantages in small-scale decentralized production as investments were small and within the financial means of the developing countries. Also there was considerable scope in establishing a whole range of energy industries and services, for instance for tapping micro- and mini-hydro resources. Moreover, energy inputs for corresponding transport of goods and services would not be sizeable.

28. In considering the overall requirements of energy inputs for industry, the Meeting gave special attention to energy development and energy management including conservation. In this connection reference was made to technological skill and industrial production capacity dimensions inherent in both areas. While it was difficult to assign relative priorities in terms of allocation of resources, it was generally realized that energy management, particularly conservation, was important in the short run, as energy savings of up to 30 per cent were possible with modest investments. On the other hand, for the longer term energy development was basic to sustain the pace of development in general and every effort needed to be made to exploit available energy sources. Since this would undoubtedly require large investments and under the present economic conditions be beyond the capabilities of many countries, regional and co-operative approaches of interested countries were envisaged. For instance, reference was made to the "Regional Dam" as the power needs of one country were small as compared to what would be available and the financial burden would be heavy if one country alone had to pay for it. Therefore, the thrust of future action in energy resource development might perhaps have to originate as a joint action on the part of several countries. Such action through a regional organization could benefit all participating countries in terms of training, information, planning and advisory services.

29. The Meeting recognized that financing was one of the most serious constraints faced by developing countries in the development of their energy programmes for industrialization. The Meeting therefore stressed the urgent need to mobilize the financial resources required for energy development, especially for large-scale, regional co-operative schemes. In this context, the importance of financing technical assistance for pre-investment activities was also underlined.

30. Lastly, but not least important, it was essential that the social and environmental impact be taken into consideration in designing a programme for industrial energy development and management. For instance, the most critical problem facing the firewood programme was its reforestation requirements and its possible adverse effects on the environment in the way of expanding deforestation, soil erosion, devegetation, etc. In fact, the real danger of environmental degradation caused by extensive deforestation had already reached a critical state in many parts of the developing countries and the task of arresting this drift toward environmental disasters had been hampered by acute shortages of capital for reforestation programmes and the rapidly rising prices of kerosene and other fuels which accelerate further firewood consumption.

31. In all these matters the role of UNIDO, as a catalyst, promoter and disseminator of information was mentioned. It was noted, however, that the bulk of the effort for energy development and management as well as that for obtaining financing had to rest with the developing countries themselves. The important role of the industrialized countries in assisting the developing countries in that respect was also recognized. UNIDO could help by creating awareness with regard to new technologies as well as assistance in the choice of most energy efficient equipment required in the industrialization programmes of developing countries. UNIDO could also assist in identifying the energy potential of a region to develop and foster multinational action.

CHAPTER III. ENERGY DEVELOPMENT FOR INDUSTRIALIZATION

32. The terms of reference and composition of Working Group No. 1 are contained in annex 4. Pursuant to its terms of reference and on the basis of the documentation provided, the Working Group held three sessions, as a result of which the following policy measures, international support measures and recommendations for specific action emerged.

33. The Meeting addressed the issues being faced by developing countries in the application of energy resources to industrial development. For each major energy resource and technology option, significant barriers to their effective use were examined and actions recommended at the national, regional and international levels that would be most useful in overcoming such barriers.

34. The importance of national industrial energy planning was stressed. It was recognized that energy is a prerequisite to trigger and sustain the industrialization process and energy development could be used as a strategy for balanced regional growth within a country. In the last ten years energy has become a much more important element in industrial strategy. Whether viewed as a constraint or as an opportunity to be exploited, the cost and availability of energy resources must be an explicit consideration in national industrial development planning. Clearly, strategies for energy resource development vary from country to country. In the Meeting attempts were made to draw out those elements that were common to many countries.

A. Energy resources and technologies

35. In addition to the energy resource opportunities outlined below, the Meeting recognized that there were other energy resources such as geothermal wind and tidal energy which must be considered by developing countries in evolving their specific energy development planning. The Meeting decided not to discuss these sources of energy since they were considered to be site-specific and therefore of limited application.

(a) Oil

36. Outside the current oil-producing countries, the developing countries have seen very little exploration for oil despite their geological potential. Indeed, in the last eight years, the number of exploratory wells drilled in the oil-importing developing countries has remained relatively constant (except for an increase around 1976) and has declined as a percentage of the world total to a meagre 3.1 per cent in 1980. There are several reasons for this situation. One is that for the international oil companies there are other areas with greater prospects for major finds with lower risks. Many oil deposits in importing countries might be large compared to the countries' needs but small in terms of world markets.

37. The Meeting agreed that developing countries need to initiate more active programmes for exploration and development. For this purpose they need assistance in a wide variety of areas:

- Training in all aspects of exploration and development;
- Administration and management, including negotiating and contracting for oil exploration and production;
- Programme development, including the compilation of data, project preparation, strategy development and promotion of oil development;
- Institutional development in the areas of exploration, production drilling and productivity improvement in drilling, reservoir engineering, refinery technology and other related activities.

38. These activities particularly need to be attuned to the development of small oil deposits. Ultimately, the objective is to provide financing for and the national competence to manage and carry out active programmes of exploration and development. These activities could be enhanced through regional co-operation as well as co-operation between private and public enterprises engaged in oil exploration and development.

(b) Coal

39. Coal and other solid fossil fuels such as lignite and peat represent a major resource opportunity in many developing countries. Several countries, India being a prime example, are attempting to reverse a recent historical process of substituting oil for coal. Others have significant resources - often in small deposits - which have never been developed. Especially where coal is an indigenous resource it will probably remain significantly cheaper than oil. At any event, for countries which are highly dependent on petroleum, the introduction of indigenous coal represents a strategic diversification of supply. In this connection the Meeting noted that coal transportation was a limiting factor in the use of domestic coal resources. Technologies appropriate to developing countries for the exploitation of small and low grade resources are also inadequate or not available.

40. The development of a national coal industry is highly complex. A first requirement is adequate data on the extent and quality of national coal resources. The formulation of a coal development strategy involves consideration of a co-ordinated programme of investment in resource extraction (or facilities for importing coal), transport, and coal-fired power plants or industrial equipment.

41. International organizations and other agencies can provide important assistance to developing countries, at their request, in their coal development through programmes in the following areas:

- Strategic planning: as implied above, the development of a national coal plan requires technological expertise in a number of specialized areas as well as a systematic analytical approach;
- Training and institutional development: countries with previously untapped coal resources will require assistance in manpower and institution development;
- Extraction technology: there is a significant job to be done in identifying, adopting and possibly developing technology for the extraction of low quality coal in small deposits at low capacity cost;
- Utilization technology: countries require greater access to more focused information on coal utilization technologies. A shift to coal utilization can be facilitated by the use of technologies such as coal-oil slurries or coal-water mixtures that can be used in slightly modified oil-burning facilities.

42. The Meeting noted that the United Nations Economic Commission for Europe had accumulated considerable information which could be used in developing national coal programmes.

(c) Natural Gas

43. Natural gas reserves exist in many developing countries, including 30 which at present import oil. In many oil-producing countries, associated gas is flared and represents a "free" resource. While the natural gas liquids including liquified petroleum gas (LPG) are readily used, the use of natural gas is currently limited by the high cost of transport and distribution infrastructure. Recent World Bank studies have indicated that the cost of domestically produced natural gas is cheaper than previously thought.

44. Natural gas development and use for industry also requires national strategic planning. Some countries (India is an example) limit the use of natural gas to fertilizer and petrochemical feedstock, with power production being only a temporary use. If natural gas is to be a major industrial fuel it will affect the location and the kind of industrial development. The value of natural gas resources in developing countries would increase substantially if they could be applied to the transport sector. There are methods of using compressed gas or gas converted to methanol which are of great potential importance to several developing countries.

45. The Meeting identified the following areas where international assistance could enhance the exploitation of natural gas for industry:

- Technical assistance in developing national strategies for natural gas development and use;
- Small-scale extraction. A review is required of technical approaches to small-scale natural gas use. This could result in an information document and training tool;
- A programme to evaluate and support research, development and demonstration of technologies to use natural gas in the transport sector.

(d) The Development of Hydropower

46. The exploitation of hydropower is an old and mature technology and has a considerable role to play in providing electricity for industrial

and economic development in the developing countries. The Meeting noted that only 9 per cent of the hydroelectric power potential in the developing countries had been exploited. Traditionally in many developing countries the application of this technology has been on a large scale, developed with external assistance and operated by national electricity authorities. With the widespread adoption of small and mini-hydropower, opportunities become available for locally administered construction and operation.

47. The Meeting noted that the major portion of the future hydroelectric power was expected to be supplied from large-scale projects. At the same time, the Meeting recognized the primary role of small and mini-hydropower in providing electrical energy to local distribution grids, in a decentralized rural scheme or even as part of a larger regional network. However, its promise lies in its use in rural areas where no grid is available and the major options are diesel generation or small hydro. In such remote areas, small hydropower is highly competitive with diesel because of escalating fuel prices, and uncertain supply.

48. The Meeting identified the following activities for the consideration of Governments:

Hydropower potential assessments

49. Assessments of hydropower potential can be carried out on a national or regional basis. These assessments will provide a basis for decision-makers to determine which basins would provide favourable conditions for hydropower development. New techniques have been developed whereby these assessments can be carried out rapidly using remote sensing data, geographical information systems and microcomputers. It is recommended that international agencies develop methodologies for assessment using these new systems. These hardware/software systems should then be made available to countries wishing to initiate a small hydro programme. UNIDO's work in this area was noted and it was requested to expand its programme to meet the increasing demand in this area.

Prefeasibility and feasibility studies

50. Until recently there has been little dissemination and exchange of information on suitable approaches to feasibility investigations and economic analysis specifically for small hydropower projects. Clearly,

local circumstances may dictate how a study is organized, which factors are examined and the type of economic analysis used. One of the principal considerations, however, is that the study should provide an objective view of the situation and meet the guidelines for donor funding. There is a certain lack of knowledge as to what constitutes a feasibility study and what international financial institutions and donor organizations seek in their review of a project. It was proposed that model methodologies be developed for carrying out both feasibility and reconnaissance studies. Consultations should take place with financial institutions and donor organizations on the form and substance of such studies. A manual and computer software package (similar to UNIDO's industrial project appraisal hardware/software efforts) should be developed and made available to Governments and private corporations.

Local manufacture of electromechanical equipment

51. Clearly, local manufacture of equipment could save scarce foreign exchange. If an extensive programme of small hydropower is undertaken, the establishment of a local or regional manufacturing facility could be justified. Countries which already have established such an industry include China, India and Indonesia, all having vast hydrologic, and skilled human resources.

52. The Meeting noted that the manufacture of micro-hydro equipment - less than 100 kW in capacity - can be carried out in most developing countries. However, mini-hydro equipment - a few hundred kW in capacity - requires a much larger manufacturing infrastructure. It becomes a question of system scale and the power market. The Meeting recommended that a study be undertaken to determine the relevant prerequisite to the establishment of an electromechanical industry. Such a study would provide advice to decision-makers as to what factors must exist in order to establish a profitable new industry. Secondly, manuals should be prepared by UNIDO on how to establish a manufacturing facility and how to manufacture the equipment required. The manufacturing issue was recognized as complex and therefore it was recommended that a workshop dealing primarily with that question be held.

Financing

53. Traditionally, in many developing countries, funds for generation, transmission and distribution of electricity have come through large international loans. In today's financial environment, continued commitments to such large-scale energy schemes were considered doubtful. More creative financing mechanisms must be developed. These may include increased participation by local banks and rural organizations so that not only the benefits are shared, but also the risks. Clearly, if a local manufacturing operation was to be started, development funds could be made available. The mechanism for such arrangements could be a joint venture, a subsidiary company or other form of co-operation.

54. Another means of financing, that would involve less risk, is to arrange it in such a way that amortization is indexed in accordance with the ability of the users to service the debt. By this method capital charges would increase toward the end of the depreciation period when it is hoped that the community would be more prosperous and have the ability to pay. The relevant United Nations organizations should investigate alternatives for financing hydropower schemes and establish a consultative capacity to provide advice to Governments.

(e) Biomass

55. Biomass, mostly in the form of fuelwood, provides the major source of energy in the developing countries. In general this energy form is used for household or very small-scale commercial applications. The direct burning of fuelwood and the inefficient production and utilization of charcoal has led to a serious problem of deforestation in many parts of the world. New initiatives in the field of conserving biomass energy and increasing its supply have to be undertaken. At the same time biomass represents, at least in the medium term, an important potential for increasing the indigenous energy supplies for industrial applications in developing countries. In Brazil ethanol is produced in very large quantities from biomass (sugar-cane and manioc). Other sugar- and starch-rich countries have or intend to follow the same path. But feedstocks of sugar or grains limit the relevance of this form of biomass conversion to those countries which have surplus crops. In most instances equipment required for most biomass conversion technologies is not very complex. Therefore much of the equipment could be fabricated locally in developing countries.

56. Biomass in its different forms has many competing uses. It is therefore essential that the food, animal feed, raw material and energy potential of biomass is balanced in an integrated systems approach taking account of the particular needs and resources of developing countries. This requires, as a first step, an assessment of the biomass availability on a national and/or regional basis and an analysis of the possible end-uses and their value. As far as possible, the aim is to find complementary uses and, therefore, approaches which utilize waste products from agriculture and forestry are to be preferred.

57. There are a wide range of biomass conversion technologies both thermochemical and biochemical. Developments are taking place in all of them and it is essential that UNIDO in co-operation with other United Nations organizations monitor and assess these technological advances for the benefit of developing countries. In some cases the technical advances are a matter of improved efficiency and reduced cost but others may provide major new opportunities. There is a need to get this updated information to the appropriate institutions in developing countries.

58. Research and development relating to biomass energy is being carried out in many countries. It is recommended therefore that a network composed of researchers working in the field, especially those in developing countries, be established. There is also a need for a focused technological information exchange on a regional and international basis linked with similar national mechanisms for information dissemination direct to industrial users.

59. The development of commercial processes for converting cellulose and hemicellulose to ethanol should be vigorously pursued as this would provide a much wider range of feedstock possibilities including forest and crop wastes. It was noted that this type of research and development could be undertaken by the International Centre for Genetic Engineering and Biotechnology which is being proposed by UNIDO.

60. Another important area of development is the production of methanol from biomass. There is a need to demonstrate the commercial applicability and economic viability of the various processes. This would involve national and regional activities for the conversion of agricultural and

forestry waste products such as palm-oil plant waste to methane. An important aspect for the developing countries of producing both methanol and ethanol from biomass is that, apart from the energy potential, it also provides an indigenous route to petrochemicals without the need for indigenous petroleum resources.

61. Another notable area of development is the production of substitutes for diesel oil such as vegetable oils. Much research and development work, however, needs to be carried out to commercialize the processes. A more active transfer and development of biomass technology and the strengthening of local design and construction capability in the developing countries is needed. It is suggested that UNIDO could play a major role in the activity through workshops and the provision of manuals.

(f) Solar Energy

62. Two routes are being pursued to harness solar energy for various applications; one to absorb solar heat energy through a system of collectors and use it either directly or by conversion into mechanical energy, and the other to produce electricity directly through solar photovoltaic cells. The technology of solar thermal systems with simple and advanced flat plate collectors is well developed and the present state of the art permits its application in industries requiring low and medium temperature heat. It could also be used for preheating and weather conditioning. Solar crop drying is also a well established technology with wide applicability. The other route, photovoltaic technology, is also well developed and eminently suitable for small-scale application. The costs of production of solar cells using presently known techniques, however, are high and also the techniques of storing electricity economically have not been developed. As such, solar cells presently find economic application only in remote areas. New and cheaper techniques of making solar cells are being developed and the indications are that these might bring the costs of solar cells within the realm of economic feasibility in less remote areas in the foreseeable future.

63. One of the basic problems at present preventing the widespread adoption of solar thermal systems in developing countries is lack of available information on their possible application in industries and lack

of know-how for designing and manufacturing the systems for specific applications.

64. The first step to be taken by a country is to gather the basic solar insolation data that are required to evaluate the economic feasibility of solar applications. An evaluation of various possible applications of solar energy should then be made to establish a national programme. An important consideration will be the degree to which solar equipment can be manufactured within the country.

65. The Meeting proposed two activities that could be usefully undertaken by UNIDO in the area of solar energy:

- assistance to countries in evaluating the potential for solar industrial process heat and, if warranted, applying the technology including, where the scale is sufficient, the creation of a local manufacturing and assembly operation;
- encouragement and support of research on techniques to manufacture solar photovoltaic materials in developing countries.

(g) Nuclear Power

66. The Meeting noted that nuclear power is another option for the generation of electricity which can be considered by developing countries. Several developing countries have nuclear power plants in operation and a few more have embarked on nuclear power programmes. It is expected that by the end of the current century, 20 developing countries will have nuclear power plants.

67. Introduction of nuclear power in developing countries has been inhibited by several factors viz.:

- lack of necessary infrastructure facilities;
- non-availability of small- and medium-size power plants which would fit into the existing power systems;
- large capital outlays required;
- long gestation periods involved;
- lack of highly trained and skilled personnel to operate and maintain power plants;
- safety considerations which require a high level of quality control and assurance.

68. Experience indicates that developing countries generally need arrangements for the supply of equipment and material; and also long-term assured programmes for the development of trained manpower and domestic participating industry; research co-operation and financing. Global co-operation and regional and international arrangements and exchange of information are needed to further the peaceful use of nuclear energy. Given the special features of nuclear power, individual Governments will have to take their own decision regarding the pursuance of this option after considering its potential in the context of their overall energy strategy and socio-economic development.

B. General conclusions and recommendations

69. There are a number of issues that are common to the various resource/technology combinations that warrant identification. These common threads also provide emphasis to combinations of recommended international initiatives and lead to several suggestions for major programmes covering several technologies.

(a) Capital goods for the energy sector

70. An important objective of energy resource development is to maximize the domestic component of the total cost of the service eventually provided. Countries will want to manufacture as much as possible of the equipment required to exploit each of the technology resource combinations discussed above. Renewable resource technologies, in particular, tend to be capital intensive. There is no benefit in replacing imported oil by energy forms which require imported capital goods.

71. There is a natural progression that countries can follow to establish an energy capital goods industry. The first step, and perhaps the one warranting maximum attention is the development of a repair and maintenance capacity for energy equipment. Establishment of maintenance facilities and provision of adequate spare parts would improve the utilization of existing equipment. Also effective maintenance programmes will prolong the life of capital equipment and lower capital investment per unit output.

72. A next stage in the development of a manufacturing capability for energy capital equipment is to establish some kind of joint activity (licence, joint venture, etc.) with a manufacturer in a developed country. The final step is often hindered by the small size of the local market. This can be overcome by taking a regional approach to the co-ordinated manufacture of various kinds of energy equipment.

73. These issues clearly suggest the need for a major programme for UNIDO and other international agencies. In this regard the Meeting endorsed the suggestion of the High-level Expert Group Meeting Preparatory to the Fourth General Conference of UNIDO on the Accelerated Development of Human Resources for Industrial Development, held by UNIDO at Yaoundé, United Republic of Cameroon, 30 May- 3 June 1983, that a programme be established to develop local capabilities in industrial maintenance, perhaps through multipurpose industrial maintenance institutes.

74. Countries also need assistance in identifying and, perhaps, in contracting with partners in developed countries for the local manufacture of energy equipment. Assistance is required also in designing, financing and constructing local manufacturing facilities. UNIDO could also play an important role in drafting and negotiating regional manufacturing agreements.

(b) Dissemination of information

75. Developing countries often maintain that one of their critical needs in the area of energy for industry is detailed information on technologies - including costs, performance specifications, experience in applications and manufactures - despite the large number of information transfer programmes carried out by various agencies including UNIDO. The Meeting recommended that UNIDO, in co-operation with the relevant international organizations, review the needs for information exchange in this area and the effectiveness of current programmes in order to make whatever changes are necessary to create an effective information network. This network should also facilitate the exchange of experience of energy/industry applications between developing countries, and develop the energy equipment market between these countries. One important feature of such a network would be the multiple access points to the information.

(c) Strategic planning

76. Reference was made earlier to the need for strategic planning at the national level for industrial energy development. However, planning can be overdone and should never stand in the way of progress, but rather should facilitate progress and productive investment. UNIDO and other United Nations agencies could provide technical assistance to countries in planning energy resource systems. All planning assistance should aim at establishing an integrated national planning capability on a continuous basis.

(d) Social and environmental considerations

77. The effects of energy systems on human health and well-being can be significant. As countries choose between industrial energy systems and consider the development of large-scale systems, for instance for the development of coal, it is important that environmental considerations become an integral part of a process. There are too many cases in the industrialized countries, where environmental effects are considered too late and hinder development, for their example to be followed by developing countries. While the environmental and health standards, practices and criteria developed by industrialized countries might not always be appropriate for developing countries, they could be usefully adapted to their conditions. It would be useful for a combination of international agencies to support one or more pilot programmes in integrating social and environmental concerns into energy development strategies and programmes.

CHAPTER IV. INDUSTRIAL ENERGY MANAGEMENT

78. The terms of reference and composition of Working Group No. 2 are contained in annex 4. Pursuant to its terms of reference and on the basis of the documentation available to the Meeting, the Working Group held three sessions as a result of which the following policy measures, international support measures and recommendations for specific action emerged.

79. The Meeting recognized that energy was one of the most important inputs necessary for industrial development. Escalation in energy prices in the last decade called for major structural changes in industrial management, the output-mix and technological processes. Those changes could be brought about by the implementation of rational energy planning at regional, national and plant levels in existing industries as well as in new industries. Industrialized countries therefore developed considerable expertise in dealing with industrial energy management.

80. In the case of the developing countries, the following problems were noted. There are a number of small- and medium-scale industrial enterprises which use different technologies of production, produce different outputs and use local materials on which little research and development has been done. Some of the industries, such as food-processing, brick making and pottery, use non-commercial energy, the supply of which is becoming scarcer. The Meeting noted further that these difficulties were compounded with technical, economic and financial bottlenecks which, taken together, called for new policy actions and training requirements that could not be patterned entirely on the energy conservation model of developed countries. Technical difficulties related mainly to the lack of information, energy auditing capabilities and energy management expertise at both national and plant levels. The unavailability of suitable equipment and trained manpower to carry out simple housekeeping measures of energy conservation also lay at the root of the problem.

81. Economic and financial difficulties were due to the non-availability of capital at low interest rates and distorted pricing of energy and industrial outputs, making it difficult to commit large investments on an energy-saving programme.

A. Policy measures by developing countries

82. The Meeting noted the need for adopting the following policy measures with regard to industrial energy management.

(a) Industrial energy pricing

83. Appropriate industrial energy pricing policies must take into account firstly the absolute and relative price levels of the various energy sources commonly used by industry (fuel, oil, gas, coal, electricity) and secondly, where relevant, a rate structure (electricity and natural gas rate schedules) which will provide enterprises with adequate incentives for improving their energy efficiency both through conservation and fuel conversion measures. Although the pricing strategy will depend on country-specific parameters, there is ample evidence to suggest that domestic energy prices for industrial energy need to be brought in line with the long-term cost of additional supply of energy.

(b) Incentives

84. Despite the inherently attractive returns on energy savings investments, incentives have proven necessary to overcome the inertia preventing investments for energy conservation even where appropriate energy prices exist. In some industries due to their relatively modest impact on total production costs, many energy conservation investments receive a low priority within the enterprises' investment budget. Incentives include grants, soft loans, fiscal incentives and subsidies for the execution of audits. It must be ensured, however, that such subsidies should not become a permanent feature of the incentive schemes. It was suggested that UNIDO undertake a comparative study on the subject and raise the level of interest of the countries through meetings, publications, etc.

85. The leasing of equipment would allow enterprises to install energy conservation equipment, without affecting their balance sheet position, and would enable the rental payments to be made out of the savings generated by the conservation investment. Governments should provide the framework, including financial incentives, to promote the establishment of such leasing companies. For example, the energy bus, which is a mobile laboratory giving energy audits, could be leased to visit various plants to give on-the-spot diagnosis. Leasing equipment could also be obtained on a permanent basis by developing countries through bilateral or multilateral international assistance programmes.

(c) Regulatory aspects

86. While the regulatory framework must vary from situation to situation, energy consumption norms may be established for boilers, furnaces and other combustion units, and sometimes for industrial lighting, space heating and other items. Energy consumption standards of manufactured products are significantly more difficult to establish and administer. In this context, of particular interest to most developing countries are the appointments of energy managers and the conduct of energy audits in industrial establishments that exceed minimal energy consumption standards. To facilitate the implementation of energy conservation measures, the timely supply of equipment and instrumentation should be ensured.

(d) Decentralized industries

87. The informal or decentralized industries sector provides 15 to 60 per cent of value added in manufacturing industries in a number of developing countries. Often, it employs more persons than the formal sector. The informal sector is usually characterized by small-scale operations with low capital requirements (per operating unit and not always per unit of output); labour intensiveness; and operational and managerial flexibility within the constraints of the infrastructure existing in the developing countries. Decentralized industries often use indigenous raw materials and tend to reduce inequalities in income distribution. They are essential for the provision of the basic necessities of life such as food, clothing, housing. These needs

generate informal sector industries in the areas of food-processing, textiles, brick making, metalworking and simple chemicals such as soaps and dyes. Such informal sector industries have not received the attention they deserve in the efficient utilization of energy.

88. Decentralized industries are often dependent on substantial animate energy (human and animal labour) and non-commercial energy, the supply of which is becoming increasingly unreliable. Existing research and development efforts in energy conservation are mainly undertaken in the developed countries for centralized industries. Thus, research and development efforts are needed to address the specific energy conservation problems of decentralized industries. Given the specific characteristics of these industries, and the level of skills of the manpower, it may be desirable that developing countries organize a system of industrial extension services, whereby training and technical assistance can be provided. Co-operatives and manufacturers' associations could be used for this purpose. The Meeting requested UNIDO to initiate the necessary action to promote such a programme at the national level.

B. Recommendations for specific actions

(a) Energy audit and management programmes

89. Knowledge of how energy is used in industry is of fundamental importance when considering programmes to improve industrial energy management because they provide a basis for necessary action. Ideally, the programmes should be comprehensive and on a national, sector, and plant basis. However, there are clearly constraints on achieving this objective, as illustrated by the fact that few industrialized countries come close to this ideal. Nevertheless, undertaking energy audits of large and medium-sized energy-intensive facilities constitutes the core of any industrial energy savings programme. Energy audits are necessary to estimate the energy savings potential, to identify the individual energy savings measures required and estimate their investment costs and impact on operating costs. Depending on the energy consumption level of each facility, the complexity of the in-plant energy distribution and utilization systems, and the objectives, several types of audits can be designed:

- (i) In-depth audits require a detailed analysis of energy flows and balances within each industrial enterprise. They can last up to two months per plant, and are recommended for large steel, chemical, fertilizer, cement, refinery and paper plants;
- (ii) General audits, while also requiring the preparation of plant energy balances, are appropriate for facilities with a simpler energy use pattern (for example, a plant with two boilers and a steam distribution system). This type of auditing is sufficient for most medium-sized facilities in food, textile, bricks and similar industries. A general audit takes one to two weeks;
- (iii) Brief audits (also called plant surveys) do not require the calculation of energy balances. A brief audit aims at collecting essential data through basic energy accounting, for example, total fuel and electricity consumption by type for a given period of time (generally the previous year). During a brief audit, instrument reading and production figures are also collected to allow the computation of relevant ratios; this will indicate the relative plant performance as regards energy consumption. These audits take two to three days and are typically meant for small and medium-sized plants. When the audits have been completed, suitable action plans may be drawn up. These audits have to be repeated frequently.
- (iv) Simple plant inspections by trained personnel without formal mechanisms may often result in significant energy savings.

90. It is in this area of energy audit and management that there is scope for an early and significant return in the form of energy savings, with only modest financial outlays. This is particularly the case at the plant level where very simple audit and management techniques can bring quick and positive results.

91. A useful complement to an energy audit programme is the appointment and training of energy co-ordinators or energy management teams in the major energy-consuming enterprises to ensure follow-up on the energy audits and to facilitate energy management practices. This includes the designation

of a single person solely responsible for energy management. UNIDO was requested to design and undertake, as required, training programmes in that area in close co-operation with other concerned agencies.

(b) Institutional support

92. There is a need to establish an appropriate body or to strengthen existing energy institutions, especially those directly involved in energy supply, as well as to create a scientific technological milieu within which the energy professionals can operate. It is also considered most desirable to set up centres of excellence for energy planning; management including conservation; energy development; preparation of feasibility studies and reports to assist in securing financing, etc. These centres should emphasize the information, training and technical assistance aspects mentioned above and together with the existing institutions dealing with related subjects could provide the basis for an integrated approach to energy and industrial planning.

(c) Promotion, training and information exchange

93. Promotion and information campaigns have been found useful in many countries to create an awareness of the benefits of energy savings, not only among industrial managers, but also among employees and the general public. Such campaigns include brochures, pamphlets, general or subsector seminars, energy saving competitions and other devices. Training programmes in energy conservation or auditing can be addressed to different groups, such as energy auditors, energy managers of enterprises, boiler operators, maintenance engineers and other employees, with significant results. Such programmes should include in-plant training and should be a permanent feature of industrial operations.

C. International support measures

94. International support measures call for assistance from the industrialized countries to share their experiences and to provide financial and technical assistance in this endeavour through bilateral, multi-lateral and regional channels.

(a) Access to information on energy conservation

95. There is a need for the development of a wider and more efficient information network on industrial energy management matters so that experiences and developments elsewhere can be made available to any country seeking such information. It was noted that considerable work in this area was being carried out at the present time by different international agencies (including those within the United Nations system). The problem for many countries is both identifying such information and gaining access to it. By improving the co-ordination between existing agencies it should be possible for an organization such as UNIDO to direct an inquirer country to the relevant primary sources of information. UNIDO, and particularly its Industrial and Technological Information Bank (INTIB), has a particularly important role to play in this context as it would normally be the focal point of contact for developing countries seeking information on industrial energy matters. UNIDO was requested to give priority to this area in its industrial information programme.

(b) Regional centres

96. In most cases, developing countries of the same region have similar national development objectives, industrial infrastructure and socio-economic constraints. Therefore, national industrial energy management measures could be promoted by regional co-operation.

97. Within a geographic region there are countries at varying degrees of industrial development and with a variety of experiences in respect of industrial energy management. Because of their proximity they also face a number of common or related problems and opportunities. There is therefore considerable scope for countries within a region to come together to discuss industrial energy management issues. UNIDO should organize, as necessary, meetings at the regional and subregional level. The setting up of regional centres to exchange experience and information should help clarify issues such as: the potential for more effective use of energy in industry; the advantages to be gained from industrial energy management; and ways and means of overcoming constraints to achieving efficient industrial energy management. Additional functions of the regional centres would be to provide basic training in energy management

for decision-makers, managers and technicians concerned with energy use and management. Seminars, workshops and training programmes could be organized for specific industry groups by such regional centres. The work of the Latin American Energy Organization (CLADE) was noted and it was recommended that other regions, such as Africa and Asia, initiate action towards establishing similar institutions.

(c) Promoting industrial management projects

98. The experience of developing countries in seeking assistance for industrial management projects, and of those industrialized countries and international organizations which are equipped to provide such assistance, points to the need for projects to be precisely identified and proposals to be specific and carefully designed. In this sense "project" is taken to mean any practical activity designed to improve industrial energy management whether it be in the field of training, improved information flows, technology, production of capital equipment, energy audits, improved production processes, etc.

99. UNIDO also could play an important role in facilitating the implementation of industrial energy management programmes in developing countries inter alia by the following:

- Assisting Governments in energy pricing policies;
- Preparing, assembling and disseminating manuals for carrying out energy audits in different industries. Furthermore, information prepared by different international organizations, for use in energy conservation training, should be assembled by UNIDO, to make it available to developing countries;
- Setting up an effective information mechanism through which developing countries can draw upon the experiences of other countries, both successful and unsuccessful, in the field of energy development and conservation. In this regard, UNIDO's Industrial and Technological Information Bank (INTIB), could play an important role by providing a focal point for such information dissemination;
- Preparing packages of graphics, pamphlets and advertising materials that can be provided to developing countries for dissemination;
- Extending technical assistance to remove constraints encountered by developing countries in implementing energy management and conservation programmes, and help them in designing rational energy planning and assessment at the plant and national levels;

- Assisting developing countries to mobilize domestic and external resources needed to carry out rational energy management and conservation programmes, including organizing energy workshops and training seminars for specific sectors of industry, such as cement, textiles, chemicals;
- Assisting developing countries to obtain impartial advice on the energy implications of the choice of suitable technologies, prior to investing in new industries;
- Drawing upon the resources of relevant international agencies, non-governmental organizations including labour organizations and professional associations.

CHAPTER V. RECOMMENDATIONS FOR ACTION BY UNIDO

100. The Meeting noted that the developing countries are now in a stage of transition and decision-making regarding their industrial energy situation. The transition is from the past and current dependence on imported energy - which despite low per capita energy consumption, represents for many countries a heavy financial burden - to an energy future based on the increased use of indigenous sources and improved energy management. That transition requires a careful examination of policy options and their associated issues, and taking the necessary steps to pursue the chosen energy paths for the future. Each country must, of course, evolve its own industrial and energy policy and the role of UNIDO is to assist in those endeavours.

101. Despite the short time available, the Meeting endeavoured to indicate specific tasks and recommend some proposals for action. These are contained in the relevant sections of chapters III and IV. It should be noted that these proposals are by no means exhaustive but merely indicate the critical elements needed to tackle the difficult energy situation in the context of industrialization programmes. The present chapter contains some specific recommendations for action by UNIDO. In implementing these, UNIDO was requested to take account of work being undertaken in this field by other international organizations.

102. Concerning the need to strengthen the methodologies for developing and implementing energy/industry policies in developing countries, inasmuch as the most relevant experience exists within these countries, the Meeting recommended the use of mechanisms for sharing experience in the integration of development, industrial and energy policies. Workshops, seminars, and other modes should be considered by UNIDO and the developing countries. UNIDO's activities in this area should focus on the process of formulating energy/industry policies including the identification of the major options, the criteria and their relative importance in establishing priorities and selecting alternative paths; factors involved in gaining understanding and acceptance of new policies; and techniques for modifying policies in the face of significant changes in conditions.

103. The Meeting agreed that the developing countries would benefit significantly from further assistance in project preparation and in fulfilling the criteria used by international financial institutions to secure financing. It recommended that UNIDO extend its project feasibility service by establishing Project Feasibility Centres at several regional locations for project analysis, training and assistance in the preparation of project proposals for substantial capital investments from national and international financial institutions. The necessary methodology and computer programme already exist and are in use at UNIDO headquarters.

104. The Meeting further agreed that the developing countries should be given greater technical and other assistance in developing their capacity for the manufacture of capital goods and the provision of services to the energy sector as part of their self-reliance activities. It was recommended that UNIDO make use of its various types of activities to help assess and foster this area of development. These activities include: study of the necessary conditions for local manufacture of energy equipment; guidance in establishing a manufacturing plant; facilitating the transfer of the necessary technology; and encouraging joint-ventures in capital goods, with particular emphasis on the energy sector, through the Investment Promotion Service and System of Consultations of UNIDO.

105. Noting that the potential for hydroelectric power development is very high in many parts of Africa, but only 1.5 per cent of this potential has been developed, the Meeting recommended that UNIDO initiate a mini-hydro development programme in Africa similar to the very successful programme it has promoted in the Asian region. The recommended programme would consist of various elements including: the creation of a regional network of centres; the establishment of a research and training centre; the organization of workshops; the dissemination of manuals on the design, construction, operation, and maintenance of small hydro stations; and assistance in strengthening the local capacity for providing capital goods and services to the hydroelectric sector.

106. Concerning biomass energy resources, it was recognized that they are large and widely distributed and could become a significant industrial energy source in developing countries. Some of the technologies for extracting useful energy from agricultural wastes have been sufficiently well developed in the laboratory to be carried forward. The Meeting recommended that UNIDO selectively conduct demonstration projects on such processes to establish the necessary information regarding rates, yields, economics, and other factors needed as a basis for the design and analysis of an industrial-scale operation. These demonstration projects also should be used for training purposes by including individuals from neighbouring countries so that if the project is successful there would be a useful technology transfer effect in the region.

107. It was further recommended by the Meeting that UNIDO explore the means for stimulating the proper design of gasifiers to deal with the diverse feed materials available in the developing countries such as coconut shells, peanut shells, and rice husks. The lack of proper designs for use with various feedstocks is the main barrier to the development of gasifiers and their widespread use.

108. The Meeting considered that industrial energy conservation represented an opportunity to obtain short-term relief from the economic pressure of imported commercial energy and to make significant savings at a low cost. Industrial energy management including the efficient use of energy is an essential feature of the industrialization of the developing countries. Conservation is no longer seen as a matter of hardship and denial but rather as a means of producing more goods and services with a given amount of energy, thus contributing to economic growth. In many instances energy conservation can generate employment; for example, the increased use of thermal insulation in industrial equipment provides more work for insulation manufacturers.

109. The Meeting recommended that the developing countries, with the assistance of UNIDO, launch a comprehensive, integrated, result-oriented programme of industrial energy conservation to be implemented on a national and regional basis. Such a programme should be comprehensive in the sense that it would include those industrial sectors which account for the largest use of energy and would include most if not all of the countries of a given region. The programme should be integrated to bring together all the essential elements for an effective activity including: education and training of managers, engineers and workers; the preparation of manuals; the methodologies for performing energy audits and assessments; the use of workshops, seminars and plant visits; the creation of information centres; and linkages between organizations and institutions in the participating countries. The programme should be result-oriented so as to focus on achieving a significant improvement in industrial energy efficiency. In this regard it was suggested that the first phase of the programme should be aimed at energy savings with little or no capital investment coupled with a monitoring and reporting system to measure progress.

110. The Meeting further recommended that the developing countries should consider the concept of establishing their own corporate entity for industrial energy conservation. The entity would perform services for client industrial plant energy audits and make recommendations of two types: measures resulting in substantial savings that can be implemented immediately and longer-term measures involving investments associated with new processes and equipment. The services provided by the entity would include the training of designated plant personnel in conservation activities.

111. The Meeting recommended that additional resources be made available to UNIDO to enable it to carry out the above recommendations.

CHAPTER VI. CLOSURE OF THE MEETING

112. The draft report of the Meeting was presented by the Rapporteur, Mr. J. de Lima Acioli to the final plenary session on 2 September. A number of comments were made and amendments proposed and it was agreed that the Secretariat would be entrusted with the task of incorporating such comments and amendments, as appropriate, in the final report.

113. In his closing statement, the Chairman, Mr. Vidkunn Hveding, expressed his appreciation for having been entrusted with the presidency of the Meeting and thanked the participants for their co-operation and valuable contributions as well as the secretariat for the work accomplished.

114. Mr. G. S. Gouri, Chairman of the Task Force for UNIDO IV, thanked the Government and the people of Norway for their invitation and hospitality and drew the attention of the Meeting to the generous contributions of the Government of Norway and its important role in international co-operation programmes for development.

115. The Meeting expressed its appreciation to the Government and people of Norway for the warm hospitality and excellent services provided.

Annex I

AGENDA

1. Opening of the meeting
2. Election of officers
3. Adoption of agenda
4. General considerations on industrialization and energy in the developing countries:
 - (a) Problems faced by developing countries
 - (b) Energy/industry interdependence
 - (c) Centralized/decentralized development policies
5. Energy development for industrialization
6. Energy management
7. Strengthening of industrial and technological capacities of developing countries in respect of capital goods and engineering services and other capacities for all aspects of production and utilization of energy
8. Policies and strategies in the field of energy for industrialization; recommendations for actions
9. Role of international co-operation including co-operation among developing countries
10. Adoption of the report of the meeting
11. Closure of the meeting

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LIST OF DOCUMENTS

1. Basic papers

	<u>Title</u>	<u>Language</u>
ID/WG.402/1	Energy and industrialization for development: Policy options, major issues and programme initiatives	E, F, S
ID/WG.402/2	Provisional agenda	E, F, S
ID/WG.402/3/Rev. 1	Provisional work programme	E, F, S

2. Background papers

ID/WG.402/4	Technical co-operation in energy among developing countries. Prepared by UNIDO secretariat	E
ID/WG.402/5	UNIDO's energy development and industrialization programme. Prepared by UNIDO secretariat	E
ID/WG.402/6	Industrial energy requirements and some policy implications for developing countries. Prepared by T. Balabanov, UNIDO consultant	E
ID/WG.402/7	The economics of, and potential for, energy conservation and substitution. Report of the fourth session of the Technical Energy Group of the ACC Task Force on Long-term Development Objectives	E
ID/WG.402/8	Nuclear energy for developing countries. Prepared by H. J. Laue, Director, Division of Nuclear Power, International Atomic Energy Agency	E
ID/WG.402/9	Energy consumption in the decentralized industrial sector. Prepared by J. Parikh, UNIDO consultant.	E

3. Other documents

ID/WG.402/10	Provisional list of participants	E
ID/WG.402/11	Provisional list of documents	E
ID/WG.384/6/Rev. 1	Implications of biomass energy technology for developing countries. Prepared by the UNIDO secretariat	E

Other documents (continued)

	<u>Title</u>	<u>Language</u>
ID/WG.389/6	Report of High-level Expert Group Meeting Preparatory to the Fourth General Conference of UNIDO, International Forum on Technological Advances and Development. Tbilisi, USSR, 12-16 April 1983	E
ID/WG.391/12	Report of High-level Expert Group Meeting Preparatory to the Fourth General Conference of UNIDO on Industrial Development Strategies and Policies for Developing Countries. Lima, Peru, 18-22 April 1983	E
ID/WG.394/8	Report of High-level Expert Group Meeting Preparatory to the Fourth General Conference of UNIDO on Accelerated Development of Human Resources for Industrial Development. Yaoundé, United Republic of Cameroon, 30 May - 3 June 1983	E
ID/WG.399/4	Report of High-level Expert Group Meeting Preparatory to the Fourth General Conference of UNIDO on Industrial Co-operation Among Developing Countries. Bangkok, Thailand, 18-22 July 1983	E
Conference Room Paper No. 1	UNDP views on industry-energy related issues. Prepared by the United Nations Development Programme	E
Conference Room Paper No. 2	How to assist in the initiation and strengthening of an electro-mechanical industry in developing countries, with emphasis on water power plant and electrification equipment. Prepared by A. Vinjar, UNIDO consultant	E
Conference Room Paper No. 3	Industrial experience from the petroleum activity in Norway. Prepared by the Norwegian Ministry of Petroleum and Energy	E
Conference Room Paper No. 4	The energy consumption in the manufacturing industries, and the strategies in order to comply with future energy consumption. Prepared by Ramon O. Argote, Technical Secretary, National Commission of Energy, Republic of Panama	E
Conference Room Paper No. 5	Energy resource development and utilization in Kuwait. Prepared by M. Kellow, Senior Scientist, Kuwait Scientific Research Institute	E

Other documents (continued)

	<u>Title</u>	<u>Language</u>
Conference Room Paper No. 6	Financing for initial stage developmert. Financing on different terms - not softer terms. Prepared by A. Vinjar, UNIDO consultant	E
Conference Room Paper No. 7	An outline of the work of the International Organization for Standardization (ISO) on energy and industrialization. Prepared by ISO.	E

TERMS OF REFERENCE AND
COMPOSITION OF WORKING GROUPS

WORKING GROUP NO. 1 - ENERGY DEVELOPMENT FOR INDUSTRIALIZATION

1. Terms of reference

Working Group No. 1 will, taking into account the discussions in the Plenary Sessions, cover the main issues under agenda items 5, 7, 8 and 9.

The Working Group will, in particular, be required to put forward practical recommendations for action at the national and international levels including the role of UNIDO within each of the following subject areas:

1. Actions for the development of indigenous sources of energy in oil-importing developing countries through technology and development of capital goods with regard to the following options:
 - (a) Fossil-fuel resources: oil, natural gas, coal and other hydrocarbon resources (ID/WG.402/1, ID/WG.402/9, CRP.1);
 - (b) Hydropower resources: special advantages of, and requirements for, the establishment of small-scale hydropower plants for industrial development (ID/WG.402/1, ID/WG.402/9, CRP.1);
 - (c) Biomass resources: the need for an integrated approach in matching biomass resources to industrial energy requirements (ID/WG.402/1, ID/WG.384/6/Rev. 1, ID/WG.389/6, ID/WG.402/9);
 - (d) Other energy opportunities such as geothermal, wind and nuclear energy (ID/WG.402/1, ID/WG.402/8, ID/WG.402/9).
2. Development and implementation of long-term energy/industry policies, in the light of the above, taking into consideration the interdependence of industrial development and the energy sector (ID/WG.402/1, ID/WG.391/12, ID/WG.402/4, CRP.1).

The background documentation for Working Group No. 1 will consist of: ID/WG.402/1, ID/WG.402/4, ID/WG.402/6, ID/WG.402/8, ID/WG.402/9, ID/WG.384/6/Rev. 1, ID/WG.389/6, ID/WG.391/12, ID/WG.399/4, CRP.1.

2. Composition

Working Group No. 1 - Energy Development for Industrialization

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Rapporteur: Mr. P. Palmedo

Mr. J. de Lima Acioli

Mr. A. Allertsen

Mr. R. O. Argote

Mr. J. Arnott

Ms. B. Chooi

Mr. I. Dalesios

Mr. N. Escalante-Barrett

Mr. J. Fritz

Mr. M. Juričić

Mr. S. Mbakop

Mr. T. Møgedal

Mr. M. Mpia Nsale

Mr. D. Rosales

Mr. A. Schwartz

Mr. I. Tampone

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WORKING GROUP NO. 2 - INDUSTRIAL ENERGY MANAGEMENT

1. Terms of reference

Working Group No. 2 will, taking into account the discussions in the Plenary Sessions, cover the main issues under agenda items 6, 7, 8 and 9.

The Working Group will, in particular, be required to put forward practical recommendations for action at the national and international levels including the role of UNIDO with regard to the following:

1. Industrial energy management at the national and plant levels, including programmes for scientific and technological activities, education and training, appropriate financial machinery, etc.
2. Industrial energy conservation and substitution; increased energy efficiency; changing product mix; provision of incentives; and in general removal of obstacles to conservation.
3. Policies and measures for energy management and conservation and the institutions and mechanisms required.

The background documentation for Working Group No. 2 will consist of: ID/WG.402/1, ID/WG.402/4, ID/WG.402/5, ID/WG.402/6, ID/WG.402/7, ID/WG.402/9, ID/WG.391/12, ID/WG.394/8, ID/WG.399/4, CRP.1.

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