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PREPARATIONS AT THE REGIONAL LEVEL

Reports of regional preparatory meetings

Addendum

Report submitted by the Economic and Social Commission for Asia and the Pacific (ESCAP)*

* Report has been reproduced as received.

I. OBJECTIVES OF THE MEETING

1. The objectives of the Meeting were: (a) to review the research, development and demonstration (R, D and D) for each source of new and renewable energy achieved by individual ESCAP member countries and their future plans; (b) to identify the problems encountered by countries; and (c) to suggest actions suitable to be taken at the national, subregional, regional and interregional levels with a view to accelerating the development and use of new and renewable sources of energy. The outcome of the Meeting is to be submitted to the United Nations Conference on New and Renewable Sources of Energy, to be held at Nairobi in August 1981.

II. ORGANIZATION OF THE MEETING

2. The Regional Preparatory Meeting for the United Nations Conference on New and Renewable Sources of Energy was held at Bangkok, from 10 to 15 December 1980.

Attendance

3. Representatives of the following countries or areas attended the Meeting: Afghanistan, Australia, Bangladesh, China, Fiji, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Samoa, Singapore, Sri Lanka, Switzerland, Thailand and United Kingdom of Great Britain and Northern Ireland. The following United Nations organizations and specialized agencies were represented: secretariat of the United Nations Conference on New and Renewable Sources of Energy, United Nations Department of International Economic and Social Affairs, United Nations Development Programme, United Nations Conference on Trade and Development, United Nations Industrial Development Organization, United Nations Environment Programme (UNEP), United Nations Centre for Human Settlements, International Labour Organisation, Food and Agriculture Organization of the United Nations and United Nations Educational, Scientific and Cultural Organization.

Opening of the Meeting

4. A message from the Executive Secretary was read by the Officer-in-Charge of ESCAP. In his message, the Executive Secretary referred to various activities undertaken by ESCAP in the field of non-conventional energy since 1975, which included two Workshops on Biogas Technology and Utilization, the Expert Working Group on the Use of Solar and Wind Energy, the Workshop on Biogas and Other Rural Energy Resources, held particularly for Pacific island countries, the Rowing Seminar on Rural Energy Development, the Expert Group Meeting on Biogas Development, the Seminar-cum-Workshop on the Exchange of Experiences and Technology Transfer on Mini Hydroelectric Generation Units, the Data Workshop on Non-conventional Energy Sources in Developing Countries, the Intergovernmental Meeting on Agro-industries, with Emphasis on Production of Energy and New Resources, the Seminar on Geothermal Energy and the Symposium on Solar Science and Technology as well as the ESCAP/FAO/UNEP Expert Group Meeting on Fuelwood and

Charcoal to be held in January 1981. He suggested that, in its deliberations, the Meeting should take note of the conclusions and recommendations of those meetings.

5. The Executive Secretary pointed out that rural areas in developing countries by and large had limited supplies of conventional energy and that if a relatively small amount of energy from new sources of energy could be made available economically to meet certain rural needs, there could be significant improvements in productivity and in turn the quality of life. However, he suggested that, in keeping with the interest of the global Conference, the current Meeting should consider the production and use of new and renewable energy in both rural and urban areas and for all economic sectors, including the industrial, transport, commercial, services and domestic sectors.

6. In conclusion, the Executive Secretary expressed the hope that the outcome of the Meeting, which would reflect the over-all views and strategies of the ESCAP region, would be an important input into the global Conference.

7. A message from the Secretary-General of the United Nations Conference on New and Renewable Sources of Energy was read out by the Principal Technical Adviser of the Conference, who was the personal representative of the Secretary-General at the Meeting.

8. In his message, the Secretary-General referred to the objectives and scope of the Conference as well as the preparatory process as defined by the General Assembly in resolutions which it had adopted at its thirty-third and thirty-fourth sessions.

9. He outlined the status of preparations for the Conference, which included the work of eight technical panels, six ad hoc expert groups on policy issues, synthesis groups for final reviews of the substantive and policy issues, national and regional papers, public information services and the involvement of intergovernmental and non-governmental organizations. He said that the technical panels had each met twice and had almost completed their work. Other preparations were in progress. The status of preparations at the national and regional levels and of those of the United Nations system and non-governmental organizations was also mentioned.

Election of officers

10. The Meeting elected Mr. Pravit Ruyabhorn (Thailand) as Chairman, Mr. M. Sohail Quereshi (Pakistan) as Vice-Chairman and Mr. Thong-Ngee Goh (Singapore) as Rapporteur. Mr. Ken Newcombe (Papua New Guinea) was elected Chairman of the Drafting Committee.

Adoption of the agenda

11. The following agenda was adopted:

1. Opening of the Meeting

2. Election of officers

3. Adoption of the agenda

4. Role, potential and current research and development of each type of new and renewable source of energy

   (a) Role and potential

   (b) Objectives and progress of current research and development, including per unit costs in the production and use of energy in various sectors such as the domestic sector, industries, agriculture and transport

   (c) Development of the supply and use of energy in rural areas, including agriculture

5. Plans for future research and development of each type of new and renewable source of energy within the context of over-all national economic development plans, and with due regard to social and environment implications

   (a) Objectives and magnitude of plans

   (b) Social and environmental implications

6. Role of integrated energy systems

7. Problems in undertaking current and future research and development throughout the countries, and particularly in rural areas

   (a) Assessment of potentials of energy resources

   (b) Manpower resources and education and training requirements

   (c) Finance

   (d) Management

   (e) Institutional arrangements and co-ordination among national organizations concerned

   (f) Lack of technology

   (g) Insufficient technology transfer and information exchange

   (h) Lack of co-operation among countries in research and development

8. Suggested actions

   (a) National level

   (b) Subregional level

   (c) Regional level

   (d) Interregional level

9. Adoption of the report

Conduct of the Meeting

12. As solar energy and wind energy were subjects of common interest to all participants, matters related to those two sources of energy were discussed in plenary. Subsequently, with due regard to the short time available and the difference in the interests of participants in the remaining sources of new and renewable energy, the Meeting was divided into two groups. Group I considered matters related to biomass and biogas and Group II discussed matters related to hydroelectricity, geothermal energy, oil shale, tar sands and ocean energy. Both groups submitted their reports to the Meeting for its consideration and for incorporation in the Meeting's report. The plenary also considered issues commonly related to several energy sources, i.e., agenda item 5 (b), agenda item 6 and the whole of agenda item 8.

III. ROLE, POTENTIAL AND CURRENT RESEARCH AND DEVELOPMENT OF EACH TYPE OF NEW AND RENEWABLE SOURCE OF ENERGY

A. SOLAR AND WIND ENERGY

13. The Meeting was of the opinion that the majority of developing countries had not made quantitative estimates of the potential of solar and wind energy. It would take some time to undertake such surveys, for which some forms of assistance would be needed. The current and planned activities relating to research, development, demonstration, diffusion and commercialization in each country, and the applications which were being pursued, reflected the role foreseen for those sources of energy. The real problem in identifying the role was related to the cost-effectiveness and the implementation of technologies, particularly in the rural areas. The support that Governments should provide, by way of incentives or other forms of assistance, in order to achieve commercialization on the one hand and social acceptance on the other was considered to be of crucial importance.

14. It was pointed out that, while it was generally accepted that solar energy would have an important role in the future, that needed to be re-emphasized in view of the increasing cost of energy and uncertainty of supply. The Meeting agreed that the role of solar and wind energy was prominent for rural areas, as

many remote villages lacked an adequate supply of conventional forms of energy, including electricity supply. The cost of rural electrification also tended to be prohibitive, mainly owing to the remote location of villages and low load density. The Meeting stressed, however, that each country had to define the role in a manner most appropriate to its own conditions. Some countries such as Bangladesh, China, India and Pakistan possessed very large areas that received more than 2,200 hours of sunshine annually. However, it was pointed out that solar energy should be considered in complement with other viable sources of energy, as certain limitations in solar energy utilization existed, particularly with regard to energy storage.

15. The Meeting noted that the current status of research and development in the region covered practically all potential application areas, such as drying, distillation, cooking, water pumping, water heating, space heating, refrigeration, thermodynamic conversion and photovoltaic conversion. Major national programmes were being undertaken in Australia, China, Japan, India, Pakistan, the Philippines, the Republic of Korea and Thailand. Japan had commercialized solar water heaters with more than 2 million units and had established a production capacity of 200,000 units per month. Nearly 5,000 heating and cooling systems with high-performance collectors had been in existence by March 1980 and the number would have increased to 16,000 by the end of 1980. At that time, the retail price of solar collectors for water heaters would range from $US 100 per square metre, and the cost of the solar heating, cooling and hot water supply systems would be nearly two to two and a half times that of oil-based conventional systems. Accounts of solar water heating installations in China and India were also given. Pakistan was commissioning its first solar village in April 1981 with a 5 kW system to meet the village (50 houses, 400 population) needs of electricity for domestic use, community educational TV systems and water pumping for human and cattle needs and for controlled irrigation. By June 1982, Pakistan would be establishing a 100 kW system in seven villages at a cost of $US 3.8 million with financial assistance. Several countries stressed the need for further research and development and an increased level of funding, particularly in certain priority areas such as solar drying, cooking, cooling, refrigeration and pumping. A significant amount of work on wind energy covering R, D and D was being pursued in many countries.

16. Problems in undertaking current and future research and development throughout the countries of the region were related largely to inadequate information, expertise and financial resources. Insufficient information, particularly relating to performance under actual conditions of use, tended to produce duplication of efforts which needed to be avoided to optimize the utilization of available resources. Inadequate micro-level data posed a major problem in designing appropriate solar energy systems. Competent scientists were needed for laboratory research, but personnel for development work, demonstration and diffusion were also considered essential. The main thrust of future efforts should be towards gaining acceptance by the users and reducing the cost of devices. In some countries, the emphasis would have to be more on transfer of technology than on extensive R and D and that might entail training of personnel, visiting opportunities and financing. The pursuit of R and D should be not only for the sake of technology development but also for applications in accordance with the needs of end users.

B. BIOGAS

17. Biogas had a growing role to play in the member countries. It had been used to: (a) provide fuel for domestic use mainly in cooking and lighting and in some cases for running internal combustion engines; (b) produce fertilizer for use on land; and (c) improve hygienic, environmental and social conditions in villages. Biogas had been produced in both rural and urban areas. In the rural areas, animal, human and plant wastes were all used as input materials for the digesters. While animal and human wastes had been used separately as feedstock for digesters, plant wastes had always been mixed with one or both of them. In the urban areas, large digesters had been constructed using nightsoil and industrial wastes. That had contributed to solving some environmental problems of urban areas.

18. The objectives of biogas development were as follows: (a) to replace and supplement the use of kerosene in lighting and cooking and firewood in cooking; (b) to increase self-reliance by using domestic sources; (c) to provide a better socio-economic environment in rural areas, thus decreasing rural migration to urban areas; (d) to develop community-size biogas plants in order to provide enough energy for water pumping; and (e) to maintain the fertilizer and humus value of organic waste.

19. Most of the countries had plans for R, D and D to achieve optimal and most economical production of biogas on a macro base. More specificially, the following subjects were of common interest and relevant to many countries as far as plans for research and development were concerned: (a) field research and development on the optimization of the factors governing the fermentation process (temperature, C/N ratio, pH, solid content etc.); (b) R, D and D of microbiological, thermal and mechanical methods to improve digester productivity; (c) reduction of construction costs through the use of new techniques and cheaper materials; (d) simplicity in design and operation for socio-economic acceptability; (e) R, D and D on biogas production in urban areas from sewage and organic refuse and as part of industrial waste treatment systems; and (f) development and demonstration of biogas production from agricultural wastes like straw, rice husk and leaves.

20. It was felt that subregional, regional and interregional co-operation was needed in the following fields: (a) technical assistance; (b) exchange of experts to participate in projects in other countries; and (c) financial assistance from international financing agencies to provide the foreign exchange cost of raw materials and other equipment, if needed, and to pay for transfer of a technology package.

21. To achieve the above task, in addition to making available existing sources and techniques, it was recommended that: (a) countries take initiatives to exchange technical information on biogas production on bilateral, subregional, regional and interregional bases; (b) funds be created within each country to finance renewable energy development; and (c) international organizations such as the United Nations, IBRD and EEC establish funds for R, D and D of biogas and other renewable sources of energy depending on the priority given by each respective country to a particular renewable source of energy.

C. OCEAN ENERGY

22. The potential of ocean energy in the region was considerable, but its role should be viewed in the context of individual countries' situations. Energy derived from sea waves could be of interest to all countries having a coastline, while thermal energy from the ocean would be of value to those countries having thermal gradients of more than 20°C close to the shore. On a global scale, current estimates of total potential of wave energy were approximately 0.9×10^{17} watts but the utilizable upper limit was 10^{12}-10^{13} watts; the corresponding estimated potential in the case of ocean thermal energy ranged from 10^{15} watts and 10^{13} watts respectively. In the ESCAP region, work relating to wave energy and ocean thermal energy was being pursued on a significant scale by Japan. The Japan Marine Science and Technology Centre had initiated work in 1976 on an experimental wave energy device measuring 80 m long, 12 m wide and 3.5 to 7.5 m high, with a peak power generation capacity of 200 kW. That unit had been undergoing experimentation in the Japan Sea since 1977. Japan had also initiated in 1979 a major experimental project on 100 kW ocean thermal energy conversion (OTEC) in Nauru under an agreement with the Government of Nauru. The United States of America was planning to install 40 MWe OTEC systems in Guam, the Northern Marianas and Hawaii, while France was planning a 3-15 MWe system in Tahiti, all within the next five years. Work on tidal power was being pursued by China, India (feasibility studies) and the Republic of Korea.

23. While island countries had an interest in ocean energy for future exploitation, the majority of them, with the exception of Japan, had no concrete plans to pursue the technology. Feasibility studies and analysis of techno-economic and environmental aspects were considered to be the first steps towards possible utilization of ocean energy. At the same time, it was realized that cost data on ocean energy were very difficult to obtain and that they were subject to great uncertainties, necessitating greater information flow. However, in view of its vast potential as a resource, it was felt desirable to pursue appropriate investigations and experimentation with the co-operation of interested countries and international organizations.

D. BIOMASS

24. In almost all developing countries of the region, the biomass fuels of the non-commercial sector made up a substantial proportion of total energy consumption, commonly in the range of 40-75 per cent. Fuelwood was the predominant biomass energy source, although cow dung made up a high proportion of the non-commercial energy forms in Afghanistan, Bangladesh, China (Tibet), India, Nepal and Pakistan. Other sources of biomass for combustion at the domestic and industrial levels were charcoal, cereal straw and husks, bagasse, sawdust and miscellaneous weeds and shrubs. The main role of those fuels was to provide energy for household cooking and, in colder areas, heating. The potential of continued and stabilized use of fuelwood in particular, and of cereal cellulose and wood residues, was to provide a long-term source of domestic energy and to reduce dependence on kerosene for cooking and lighting.

25. China and the Philippines were currently producing ethanol for fuel purposes, whereas several countries had potable and chemical feedstock ethanol distilleries.

26. Fiji, Japan, Pakistan, Papua New Guinea and Thailand had specific plans for near-term commercial production of alcohol fuel for blending with gasolene or direct combustion. Molasses, sugar-cane juice, cassava and sweet potatoes were the feedstocks to be utilized. Indonesia, the Republic of Korea and Sri Lanka had medium-term plans for alcohol fuels industries of varying scales: Sri Lanka from sugar-cane and Indonesia and the Republic of Korea from potatoes. Plant oils such as palm oil were recognized as having potential but were not the subject of large-scale R, D and D in any country.

27. The selection and trial of short-rotation fuelwood species were under way in Afghanistan, Bangladesh, China, India, Indonesia, Nepal, Pakistan, Papua New Guinea, the Philippines, Sri Lanka and Thailand, and in some cases that had led to extensive plantations. The common objective was to provide a stable and renewable source of fuelwood for cooking and major primary industries.

28. Gasification or pyrolysis of wood, charcoal or briquetted cereal and wood wastes was being examined in China, Fiji, Indonesia, Papua New Guinea, the Philippines, the Republic of Korea, Samoa, Sri Lanka and Thailand. The common objective was to make more energy-efficient use of those materials and to make rural industries more energy-self-sufficient.

29. Fuel-efficient stoves and charcoal production systems were major regional objectives. The introduction of cheap stove and extension programmes was reported in Bangladesh, Fiji, India, Nepal, Papua New Guinea, the Philippines and Sri Lanka. The common objective was the extension of the fuelwood resource and improved economics of operation.

30. Charcoal was being examined in Fiji, Nepal and Papua New Guinea as a relatively new fuel for domestic sectors, both as a means of displacing kerosene and to replace fuelwood which had to be brought from great distances. The potential of refuse-derived fuels was noted.

31. It was widely felt that there was both experience and knowledge of energy resource assessment. That was clearly a first step towards new and renewable energy development and could be the subject of workshops and forums on principles, methodologies and case studies in respect of the general need and the approach to particular energy resources assessment.

32. Manpower resources, education and training and management had to do with the availability of trained and skilful people and their effective deployment. Those human resources were not adequate and there was a potential for their development in respect of biomass energy production.

33. Regional co-ordination of training to promote particular skills and to identify needs and deficiencies was proposed. That was related to the question of regular interaction and co-operation.

34. Lack of technology reflected both a lack of finance and insufficient knowledge of the available technology and methods of energy management. The latter could be improved through regional or subregional interaction, such as through the establishment of energy centres.

35. It was suggested that finance should be provided for energy projects and extension, monitoring and assessment work at the regional or subregional level at the same time.

E. GEOTHERMAL ENERGY

36. Geothermal energy had already been used in some countries of the region both for electricity generation and as a direct source of low- and medium-grade heat. Electricity should be considered as one of many possible uses of geothermal energy. Non-electrical applications in the ESCAP region included water and space heating, air conditioning, cooking, crop drying and process heat in industry. Some minerals were also being extracted from geothermal fluids.

37. Future programmes for geothermal energy included thorough investigation of potential geothermal resources, exploration techniques, development of potentially rich geothermal reservoirs and hot dry rocks, environmental impact study, resource management, scaling effect and increasing the power efficiencies of generating plants.

38. The main problems were the high capital costs needed for survey and exploration work and the lack of expertise and know-how in some developing countries. In addition, many countries in the region did not have suitable personnel trained in that field and suffered from a lack of co-ordination of the activities of individuals as well as institutions.

39. With respect to suggested actions, the following recommendations were made: (a) establishment of a regional research and training centre; (b) provision of adequate funds by international financing organizations and donor countries for exploratory and production drilling; (c) co-ordination among institutional and individual activities; and (d) issuance of more publications and periodicals in that field.

F. HYDROELECTRICITY

40. The contribution of small-scale hydro potential to a country's total energy needs was generally small. Nevertheless, such resources could and did play a significant role in the development of rural areas in some developing countries.

41. Currently, the supply of electricity to rural areas of many developing countries was fed from national grids. A combination of technical, financial and administrative difficulties led to long delays in providing electricity and poor quality of supply, in terms of both power cuts and low voltage conditions. Overgrown branches and falling trees were often the main cause of rural supply breakdowns.

42. For remote areas, both the cost of transmission lines and percentage loss of power in transmission might render the scheme ineffective. Small-scale hydro could therefore be a local source of power in rural areas.

43. Introduction of light industries in rural areas where small-scale hydro plants were installed might prove advantageous in view of the following factors: (a) it would stabilize the demand curve since day-time demand in the rural areas was generally low; and (b) it could create more job opportunities to the people in the rural areas, thus reducing migration of population to urban centres.

44. Many manufacturers from such countries as China, India, Japan, Nepal, Pakistan, Papua New Guinea, the Philippines, Thailand and the United Kingdom had carried out research and development of turbines and generators for small-scale hydro plants.

45. It was suggested that the possibility of utilizing water head from irrigation canals for generation of electricity should be examined. Investigations of the integrated use of renewable energy and water resources were worth exploring.

46. It was noted that the international hydrological programme of UNESCO proposed studies on water balances, floods, low flow and other such aspects of water resources. Apart from the assessment of large hydropower resources, those studies would provide useful water resources data for the design and assessment of mini-hydro potential. Topographical maps, which were normally available in each country, could be used to identify possible sites readily.

47. It was pointed out that training local technicians in equipment maintenance was an essential part of the implementation of mini-hydropower projects. It was noted that capital cost per kW installed was generally high and that developing countries required financial assistance for mini-hydro development.

G. OIL SHALE AND TAR SANDS

48. It was noted that oil shale had been slowly developed in many countries for several decades when the price of regular oil had been much lower than that of oil extracted from shale. But after the oil crisis, many countries, especially the developed countries, had made greater efforts to exploit that forgotten energy resource. In the near future, the development of oil shale was expected to be economically viable in comparison with the increasing oil price and would play a significant role in liquid fuel supply.

49. Oil shale could be utilized either by direct burning as solid fuel or by extraction for oil. Currently, shale with an oil yield higher than 10 per cent could be economically exploited for oil. The problems of undertaking research and development depended on both technical and financial aspects. Except for China, the current development of oil shale was only at the research stage with many problems to be overcome such as mining, extraction methods and disposal of spent shale. In China, oil shale production had begun in 1930 and was currently at a scale of 300,000 tons per year. Production was likely to increase

in future. The development of oil shale required enormous financial support to developing countries for reserve assessment and research and development, the results of which would be beneficial to the world as a whole.

IV. PLANS FOR FUTURE RESEARCH AND DEVELOPMENT

50. A study made by consultants for a power master plan for Afghanistan showed that rural electrification would be developed in two ways: (a) connexion of larger rural centres to the developing system and (b) installation of individual generation plants for the isolated systems. Afghanistan had potential for thermal power generation from gas and coal and hydropower. However, power for scattered rural population was needed from biogas, biomass or other sources. While the potential of hydropower had been identified, research on biogas, biomass etc. was lacking. Manpower and education were insufficient and assistance was required for financing, management, promotion of technology in relation to the current problems and future research and development for new and renewable sources of energy. Afghanistan needed considerable assistance in setting up research, planning and design organizations.

51. New and renewable sources of energy had been given high priority in the second five-year plan (1980-1985) of Bangladesh. In the earlier plans, no serious consideration had been given to traditional energy, which supplied about 70 per cent of the total energy need. In formulating the plan, the Government had noted that extreme dependence on traditional energy resources of botanical origin had already caused serious depletion of natural resources like forest and homestead wood lots and that technologies were currently available or were fast improving for the efficient use of the age-old traditional energy.

52. Since the global energy crisis would remain and Bangladesh was endowed with only modest commercial energy resources, emphasis had been given to research, development, demonstration and promotion of biogas plants, application of solar energy with technologies which might be assimilated by the rural people, development of efficient cookers for the rural people and plantation of fast-growing trees in the rural areas.

53. Fiscal and monetary incentives would be given to promote new and renewable energy use. A provision of 200 million taka had been made for the development of new and renewable energy during the plan period.

54. A plan for future research and development in China was briefly described as follows:

Biogas energy: (a) increasing the gas production rate from 0.1 to 0.15-0.2 m^3/m^3 of digester volume; (b) increasing the heat efficiency of biogas burners, stoves and lamps from 0.4 to 0.6; and (c) increasing the rate of killing germs and parasite eggs.

Solar energy: (a) solar thermal utilization: (i) solar collectors - improving thermal performance of collectors, vacuum glass tube collectors and

spectrum selective coatings; (ii) solar cookers' cost reduction and reflective materials; (iii) passive and active solar house testing; and (iv) experimental research for sea-water distillation; (b) solar thermal power generation: experimental research on the hot water-intermedium method and tower solar power stations; (c) photovoltaic power generation: reduction of the cost of silicon solar cells; research on cadmium sulphide (Cd S) and galleum arsenide (Ga S) solar cells.

Wind energy: (a) testing of a 40 kW wind generator set; (b) vertical axis wind turbine; and (c) variable speed and constant frequency generator.

Geothermal energy: (a) hot water application in agriculture and industry; and (b) power generation - 1,000 kW generator set and larger set.

Oil shale: improving the processing furnace in order to enlarge processing volume.

Integrated energy system for rural areas.

55. With positive indication of energy price increases in the future, Fiji had no alternative but to burden itself with paying for expensive oil imports while acquiring funds for the development of alternate energy sources. Both options (and also the option of inaction) were expensive. It was hoped that those decisions on energy would have a great impact on Fiji in the future.

56. The specific objectives were as follows:

(a) Formulation of an improved sectoral data base and a dynamic national energy accounting system;

(b) Reduction of the volume of imported energy per unit of GDP;

(c) Evaluation of the suitability of existing petroleum legislation to Fiji's needs;

(d) Increased level of investigation of and where appropriate investment in indigenous energy resources for transport, electricity generation and household use;

(e) Improved standard of cooking, lighting and other rural household energy needs;

(f) Preparation of a package of fiscal and price measures to manage energy demand.

57. Eleven project areas were proposed in the current development plan with a total expenditure of $46.1 million at 1980 prices, the largest single one being alcohol fuel development, costing $21.2 million, envisaged to replace 20 per cent of all petrol imports by late 1983.

58. Owing to the economic or "laissez-faire" structure of commerce and industry in Hong Kong, there was no comprehensive programme of R and D in the field of solar energy applications. R and D were almost entirely confined to the University of Hong Kong, with some activity at the Chinese University of Hong Kong (photovoltaics) and at Hong Kong Polytechnic (testing a hot water collector with plane and "involute" reflecting surfaces).

University of Hong Kong

Department of Electrical Engineering: Development of low-cost photoelectric cells

Department of Mechanical Engineering: The broad objective was the development of cost-effective heating and cooling systems. Topics under investigation:

(1) Development of selective surface treatments (ε - emittance and α - absorptance measurement)

(2) Development of flat plate collectors, CPC and evacuated glass tube types

(3) Modelling and design of heating and cooling systems using the f-chart method and TRNSYS programme respectively

(4) Optimization of flow networks

(5) Development of small DC-powered circulators using photovoltaic panels

(6) Simple tracking devices for photovoltaic panels and others, where space was at a premium

(7) Updating the local weather profile using hourly data obtained from the Royal Observatory, Hong Kong

(8) Application of photovoltaics to powering advertising displays

(9) Development of liquid piston pumps at minimal cost

(10) Discontinuous absorption refrigeration, using an NH_3 H_2O solution

(11) Monitoring a small LiBr + H_2O cooling system

(12) Consideration of non-glass covers such as polycarbonate sheet and Tedlar alm in place of glass (hazardous in typhoons)

TIME SCALE: 2-3 years from 1 January 1981

STAFF: two with technician support (university)

EQUIPMENT BUDGET: $US 20,000 (university funds)

Geothermal energy: Continuation of the reconnaissance geotechnical studies and completion of the survey of geothermal resources.

Tidal power: Studies and investigations conducted for establishing the techno-economic feasibility of a tidal station (of 600 MW) in one location were to be completed.

Hydropower: Increase of hydropower capacity from 11,300 MW to 16,000 MW in five years.

Energy storage: Development of systems suitable for solar thermoelectric and total energy systems.

59. The future plans for research and development in India are as follows:

Solar energy:

(1) Sealing up the technologies already developed to the level of pilot plants and field-level demonstration experiments.

(2) Development of low-cost solar grade silicon material and low-cost techniques of fabrication of photovoltaic systems to bring down cost per peak watt of electricity.

(3) Development of modules for application such as pumping of water, community lighting, educational radio and TV sets, and communications in remote areas.

(4) Solar thermal devices - a major national demonstration-cum-field trial programme based on such systems.

(5) Setting up a prototype and product development centre including field trial and demonstration in rural areas.

(6) Preparation and publication of a solar radiation data handbook for solar energy users.

Biomass: Projects for identification of fast-growing species, methods of increasing photosynthesis efficiency and development of cost-effective processes for utilizing biodegradable materials to produce gaseous and liquid fuels.

Biogas: A major thrust was being given to the development of community-size biogas plants. Pilot community projects were being launched to evaluate sociological problems in introducing such plants in rural areas.

Wind energy: Field demonstration programmes would continue to increase reliability, cost-effectiveness and experience for large-scale utilization.

60. The objectives of energy R, D and D activities in Indonesia could be grouped in three categories, in keeping with the requirements for attaining national goals. The first was aimed at improving the energy supply, which could be achieved through decreasing the dependence on oil and providing new, indigenous energy resources.

61. The second concerned the whole range of transfer of technology and skills development. The introduction of rural development programmes and the necessary supporting activities, such as energy surveys, popularization, village co-operatives courses and other infrastructure development belonged to the second category.

62. The third category concerned improvement in the management cycle, which consisted of policy formulation, planning and programming, financing and fund raising, pollution control and conservation, technology assessment and monitoring, and supporting and downstream activities.

63. Priorities for the next five years in the field of renewable energy sources were biomass, solar energy and biogas. Major national projects, apart from the development of fossil fuels, were hydro and micro hydro schemes and geothermal development.

64. Japan had drawn up a comprehensive energy R and D programme, the Basic Programme of Research and Development of Energy in 1978, which comprised R and D of all kinds of energy sources, including new and renewable sources of energy.

65. Before 1978, Japan had been executing many R and D programmes in the field of new and renewable energy sources, such as the Sunshine Project of MITI and the Green-energy Programme of MAFF. The basic programme was therefore not compulsory but gave general guidelines which oriented R and D in that field to the R and D objectives consistent with the over-all national economic development plans. According to that basic programme, new and renewable sources of energy would provide an energy supply equal to 11 per cent of the total domestic energy demand in 1990. The basic programme had been endorsed by the Cabinet and would be given special consideration in the budget.

66. In Malaysia, plans had been made to undertake a comprehensive nationwide survey to determine the potential of new and renewable energy sources.

67. The tariff rate had been increased for electricity use greater than normal consumption. That was designed to reflect the true situation of energy resources and to compel consumers to resort to new and renewable sources of energy.

68. Reasonable amounts of funds had been allocated to higher institutions and universities to pursue research on new and renewable sources of energy.

69. Training of manpower had been programmed to carry out a nationwide survey on the use of energy, the problems encountered and possible solutions. The Government had engaged foreign experts to channel the training programmes in the right path.

70. As to electricity production, the examination of nuclear options as a source of electricity production continued.

71. Pakistan's future plan for R, D and D included establishing energy centres in selected energy-deficit villages in the country.

(a) The biogas compact system had been designed by the Directorate General of Energy Resources and had been publicly demonstrated in June 1980. The system provided electricity and fuel for cooking along with improved manure. By 1983, 160 villages would be provided with the indigenous system.

(b) Solar energy system: Pakistan would be energizing seven energy centres with solar photovoltaic by 100 kW and solar thermal by 30 kW.

(c) Energy bank approach: Four energy centres should have a combination of photovoltaic and biogas from an agricultural waste and photovoltaic system combined with a wind generator at two of the four energy centres under the approach.

(d) Ten-year plan on renewable energy R, D and D.

72. The fundamental objective of Papua New Guinea was the economic production of renewable energy sources compatible with the development goals of the nation. To fulfil that objective, there must be a dynamic understanding of patterns of energy use, costs and the availability of alternatives considering all relevant constraints.

73. That gave rise to broad sectoral programmes, revised on an annual basis. For example, in the transport sector the current goal was 30 per cent replacement of motor spirits by alcohol fuels by 1990, in the industrial sector, 80 per cent replacement of diesel and fuel oil for heat and steam running (outside of the mining industry) by 1990 and for electricity greater than 90 per cent of grid-supplied electricity from hydropower and other renewable sources by 1995.

74. The financial outlays for that programme would exceed $US 600,000 in the decade with hydropower development taking about three quarters of the total capital requirement.

75. The energy programme in the Philippines was aimed at reducing dependence on oil, bringing demand down to appropriate levels and diversifying the country's sources of energy towards renewable, preferably indigenous types.

76. Total commercial energy was projected to rise from 97.8 million barrels in 1981 to 133.7 million barrels in 1985. To reduce dependence on oil, the current 88 per cent share of oil in the energy requirements must be reduced to 55 per cent by 1985.

77. The growth of energy demand was forecast to continue at a healthy rate of 8 per cent a year during the planning period because of the strong demand for electricity and coal by upcoming heavy industries. Otherwise, the traditional

oil consuming transportation market in the Philippines would be exhibiting near-stagnant growth rates. Hydroelectric and geothermal energy would supplement power generation, while the use of coal as an industrial fuel enhanced the country's independence from oil.

78. The Philippines was continuously undertaking R and D of non-conventional energy resources such as solar water heating, biogas, alcohol, dendrothermal, marsh gas and agricultural waste, which offered great potential for contributing to the national commercial energy mix. Substantial reduction in the problems related to rural-to-urban migration, substandard living conditions and widespread low levels of income was among the ancillary benefits that the Philippines foresaw could be derived from those non-conventional energy resources.

79. The Republic of Korea's rapidly expanding energy requirements had been met by imported oil. The attainment and maintenance of a high level of industrialization as well as the economic well-being of the people were essentially dependent on adequate availability of energy. The country was handicapped in that its national resources could not possibly meet its energy needs. Consequently, not only must the energy supply be provided by imports, but the most skilful planning and management must be provided. The Government would place greater emphasis on new and renewable energy technology developments.

80. The available amounts of resources of solar, wind, biogas, tidal power and hydropower were 16,425, 1.12, 54, 18.7 and 7.65 TW/year respectively. The expected completion date of the various renewable energy research projects was by 1984. The Government had a training programme for its staff and also had an invitation programme for foreign experts.

81. Samoa's objective was to develop indigenous new and renewable sources of energy to reduce dependence on imported oil and subsequently save valuable foreign exchange. Samoa had given priority to the development of hydropower resources, and investigations and research were continuing to locate further possible sites. Such investigations included the collection of hydrological data, river flow measurement, geological investigations and site selection for optimum gain. Research was being undertaken on the use of wood and coconut wastes in steam-power generation with a view to installing a 5 MW electricity generating plant within the following few years. With the above development, power generation would be independent of oil in the mid-1980s. Research was being undertaken on wood and charcoal stoves, charcoal production, gasification units and the use of coconut oil in diesel engines.

82. Singapore, a city-State of about 600 sq km, stressed energy conservation rather than exploration of alternative energy resources. However, work on solar energy (for water heating and refrigeration) had been carried out at the Faculty of Engineering, National University of Singapore, for some time. Singapore would likely be the focal point for research on solar refrigeration in the ASEAN region, and the bulk of the research was expected to be conducted at the University, in co-operation with related government departments or agencies.

83. More than 60 per cent of the commercial energy requirements of Sri Lanka were met from imported fossil fuels, which represented an expenditure of more than 40 per cent of the country's foreign earnings. Increasing costs in the development of hydropower resources also frustrated hopes for hydropower development. Firewood represented more than 60 per cent of the total energy consumption of the country. Over 80 per cent of the rural population used firewood for cooking and kerosene for lighting. Sri Lanka's present economic activity as seen from the growth rate of GDP was increasing at a rate of around 7 per cent (1979), and correspondingly a high rate of growth was noted in the energy sectors. Electricity use was growing at around 10 per cent per annum, with similar rates noted in other energy sectors. Supply of firewood was diminishing, owing to the opening up of forest areas for agriculture and village expansion. In that context, recognition had been given to the need to accord the highest priority to the speedy development of indigenous sources of energy and especially new and renewable sources, with the prime objective of maintaining sound economic activity while reducing the dependence on imported fuels.

84. The current investment on R and D efforts was moderate and additional and increased funding was expected. The Government and some private organizations were currently actively engaged in that work. Their efforts were centred on the development of biogas for rural cooking, lighting and irrigational water pumping, solar energy for industrial and agricultural water heating, electricity generation, wind energy for integrated farming and study of ocean thermal energy possibilities, prime movers for mini hydro facilities etc. and on conservation and the improvement of efficiency aspects. Most of those efforts were ongoing and definite time-frames could not be defined. Current capital investment on R and D efforts with regard to new and renewable energy forms was estimated to be around SRs 18 million annually.

85. The objective of Thailand's plan for development of new and renewable sources of energy was to help the country to decrease the demand for oil consumption from 75 per cent of the aggregate energy demand to 45 per cent by 1989 with the use of 34 per cent from natural gas and lignite energy resources and 21 per cent from new and renewable energy resources. Out of the new and renewable sources of energy identified, emphasis would be given to the following sources: hydropower, charcoal and fuelwood, biomass, wind energy, solar energy, geothermal power, oil shale, draught animals and ocean energy.

86. The total expenditure of Thailand in pre-investment investigation and feasibility studies for the development of conventional energy resources and resource assessment, need identification, research and development, demonstration, promotion and popularization activities for the development of non-conventional energy sources according to the plan was estimated to be $US 300-400 million within the next 10 years.

V. SOCIAL AND ECONOMIC IMPLICATIONS

87. A number of countries gave examples of instances where social and cultural factors had inhibited the exploitation of new and renewable sources of energy.

However, the Meeting recognized that economics played the most important role in the social acceptance of new and renewable sources of energy. In the initial stages of the introduction of energy programmes, adequate financial incentives should be given; otherwise, poor people in the villages would not benefit sufficiently and it would be difficult to obtain their co-operation for the successful implementation of such programmes. Examples where cost had been a barrier included solar and wind energy systems as well as biogas, which was in relatively more wind widespread use. It was stated that one of the problems in the promotion of biogas technology was that not many families owned enough cattle to produce sufficient dung for a family-size plant. As against that, the promotion of community-size plants had to deal with even more difficult social problems concerning the collection of dung, distribution of gas and maintenance and management of the plants. Another problem that had considerable implications was that any new system fit for introduction in villages had to face the reality that at present most villagers did not have to pay for the fuelwood collected to meet their dominant energy need, namely, cooking. Another problem was that the pattern of availability of certain sources might not coincide with the demand pattern; for example, wind energy patterns in certain locations might not match the cropping pattern. It was emphasized that the integration of various sources might alleviate such problems to some extent. It was also pointed out that most renewable energy technologies needed strong extension services for their success. China's success in the field of biogas was attributed largely to the smooth co-operation among organizations concerned at the government, provincial and commune levels as well as the co-ordination among those levels. In some countries there was strong opposition to the collection and use of human waste in biogas plants. Evaluation of cultural and social responses was a prerequisite for popularization and implementation of programmes relating to new and renewable energy, so that problems arising from social and cultural inhibitions could be minimized.

88. The representative of Sri Lanka gave some information on the rural energy centre established in his country with the assistance of UNEP. Other countries evinced interest but cautioned that such projects should be carefully planned, to take into account the pattern of energy consumption and the need to match the sources in a manner appropriate to the end uses. Some expressed the view that the problem of integrated energy systems should not be viewed in terms of energy sources alone but should be considered within the over-all context of food and material systems.

VI. PROBLEMS, NEEDS AND SUGGESTED ACTIONS SUITABLE TO BE TAKEN AT THE NATIONAL, SUBREGIONAL, REGIONAL, INTERREGIONAL AND GLOBAL LEVELS

A. PROBLEMS AND NEEDS

89. The Meeting discussed the problems and needs concerning the assessment, development and utilization of different new and renewable sources of energy with a view to recommending appropriate measures for actions at the national, subregional, regional, interregional and global levels. The Meeting identified the major problems faced by many countries in the region and recognized the need for:

(a) Information and data on the availability of various resources of new and renewable energy, their potential for conversion into energy and current patterns of energy consumption, particularly in the rural sector;

(b) National energy policies and plans and the need to evolve such plans and policies identifying the role of new and renewable sources of energy;

(c) Information on the status of available technologies and the need of developing countries for improved access to such information;

(d) Information on the current status and future needs of scientific and technical research and development work in the area of new and renewable sources of energy;

(e) Co-ordination and monitoring, at the national level, of research, development and demonstration programmes, and the need to arrange for such co-ordination;

(f) Developing the capacity of developing countries to assess, select, adapt and improve foreign technologies and negotiate their purchase when necessary on favourable terms;

(g) Developing the capacity to generate appropriate indigenous technologies and suitable institutions for that purpose;

(h) Establishing satisfactory linkages between R, D and D institutions and manufacturing organizations for undertaking design, engineering, development, testing and evaluation of prototypes and pilot plants;

(i) Formulating internationally agreed test codes to evaluate the performance of devices and systems employed in the utilization of new and renewable sources of energy;

(j) Establishing satisfactory systems for delivering technologies in socially and culturally acceptable forms to the users and developing suitable extension services and capacity to undertake the management, repair and maintenance of devices and equipment;

(k) Providing facilities for popularizing potentially viable new and renewable technologies, including widespread demonstration and measures to promote the development of markets;

(l) Research and actions aimed at minimizing problems created by social and cultural inhibitions that retarded the adoption of new and renewable technologies;

(m) Research and development to reduce the high capital cost associated with many new and renewable energy technologies;

(n) Promoting opportunities, through suitable measures, for commercial organizations in developing countries to invest financial resources for development of new and renewable sources of energy;

(o) Arranging the underwriting of the high financial risk associated with the development of new and renewable energy technologies as a result of, for example, the high capital costs incurred in the context of rapidly changing and sometimes unproven technology;

(p) Making long-term projections based on energy supply scenarios in the absence of assessments, on a global basis, which might affect future development of technologies, and the implications of such developments in developing countries in particular;

(q) Fostering co-operation among developing countries for the assessment, development and utilization of energy from new and renewable sources.

B. SUGGESTED ACTIONS

90. Actions at the national level

(a) A centralized energy planning or co-ordinating agency was a highly desirable component of energy administration for the development of new and renewable energy resources. It could ensure that duplication was minimized and the best use made of available human and financial resources.

(b) Comprehensive data could be collected on the patterns of energy use in the economy, including details of distribution, end use and costs. It would be useful if the data were periodically updated and maintained in a format which enabled the exchange of information among countries.

(c) Those basic data would be useful for developing scenarios of the growth in energy demand, sector by sector, matched in turn with the proposals for the energy mix to meet the demand as forecast. The various scenarios of supply and demand would then serve as one means of identifying the needs for imported skills and technology, R and D priorities, finance and forms of subregional, regional or interregional co-operation.

(d) Inventories could be made for each of the energy resources which had been identified as having significant national potential.

(e) Careful consideration should be given to the purely financial barriers to new and renewable energy development such as the first cost barriers common to solar energy technologies. Fiscal tools to alleviate those problems should include loan schemes, selective application of government guarantees, tax concessions for the commercial application of new and renewable energy conversion or end-use systems and other forms of economic incentives.

(f) National funds for energy R, D and D would facilitate the smooth transfer of renewable energy technologies into the unique context of each nation and the development of the new and renewable energy potentials of each nation.

(g) Energy extension services were important for the dissemination of energy forms and related technologies for which a firm economic and social advantage had been identified.

(h) Evaluation of the social and cultural context was a major element in the implementation of new and renewable energy technologies. Such information should complement the relevant micro-level economic and ecological data on energy flow and end use.

(i) Governments should seriously examine strategies for commercialization of the products of their own R, D and D and the transfer from elsewhere of successful technologies for the use of new and renewable energy.

(j) It was important to monitor on a continuing basis the implementation and operation of energy projects in order to learn from their successes and failures and to enable further development.

(k) It was necessary to develop local services and maintenance support systems for all of the new and renewable energy technologies chosen for widespread dissemination. Such support included skills training, local infrastructure for maintenance and servicing and adequate spare part back-up where supplies must come from outside the local region.

(l) Industrial and commercial establishments must be involved in the commercialization process right from the initial stages of R, D and D and in strengthening the manufacturing base for particular energy technologies at the local level.

(m) Demonstration projects of new and renewable energy technologies under different social and environmental conditions should be promoted to enable technical, economic and environmental assessments of technology and possible impact.

(n) Identification of manpower needs and skills required to undertake R, D and D in the area of new and renewable sources of energy and for manufacture of devices and systems and for training of personnel if necessary. In case of insufficient indigenous capability, the extent and nature of technical assistance from outside should be identified and obtained.

91. Actions at the subregional level

(a) Strong support was expressed for the establishment of mechanisms for subregional energy co-operation which might have the following functions:

(i) Enabling a systematic and comprehensive study of problems and conditions common to a subregion;

(ii) Exchanging information on the implementation and performance of new and renewable energy programmes of interest to a subregion;

(iii) Providing a basis for extension and training on the use of promising energy technologies;

(iv) Providing training on methodologies for energy analyses in each sector of energy consumption and for energy strategy formulation;

(v) Gathering and disseminating information on new energy sources and technologies of significance and identifying funding sources for regional demonstration projects;

(vi) Identifying and maintaining directories of human resources available within a subregion for new and renewable energy management and development.

(b) It was recognized that funds would be needed for those activities.

92. Actions at the regional level

(a) Information exchange between subregions was a major function of regional-level co-operation, in addition to the procurement and distribution of information from international bodies concerned with new and renewable energy management and development.

(b) Regional-level co-operation should extend to the organization of seminars, study tours, expert group meetings and demonstration projects. At that level, it was suggested that existing institutions be strengthened in order to expand their activities related to the provision of technical assistance for management, technology import, training and extension services.

(c) Regional co-operation should include the identification and full exploitation of opportunities for economic and technical co-operation among developing countries in the production of new and renewable sources of energy.

93. Action at the interregional level

(a) There was scope for greater interregional co-operation, for example, among countries having similar problems and conditions, such as land-locked countries and island countries of different regions.

(b) Development of certain sources of new and renewable energy such as geothermal energy and ocean energy available at specific locations in different regions could be pursued through interregional co-operation.

(c) Avenues should be opened for exchange of information on experiences in different regions.

94. Actions at the global level

(a) The Meeting recognized the unique opportunity provided by the United Nations Conference to give impetus to the development and utilization of new and

renewable energy sources. It urged all member countries to undertake comprehensive preparations and submit national inputs to ensure the maximum use of that opportunity.

(b) The Meeting likewise felt that sources of new and renewable energy already being used and those having great potential for use by the majority of the people in developing countries, such as biomass and solar energy, should be given maximum attention in order to attain full-scale development of such sources of energy.

(c) It was recognized that substantial financial resources would be desirable for the development of new and renewable sources of energy and that new funding mechanisms in that connexion would be one of the possibilities for consideration. That might entail devising mechanisms to underwrite financial risks both for undertaking projects involving large-scale expenditure and relatively unproven technology and for tooling up for the large-scale manufacture of, say, solar equipment in the context of rapidly changing technologies. The Meeting felt that such financial mechanisms must include the possibility of quickly accessing small grants as well as large for new and renewable energy development.

VII. GENERAL RECOMMENDATIONS

95. The Meeting recommended that its report be submitted to the Economic and Social Commission for Asia and the Pacific for its consideration and endorsement, prior to its submission to the Conference to be held at Nairobi.

VIII. ADOPTION OF THE REPORT

96. The report was adopted on 15 December 1980.
