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Abstract

This paper is a discription of the Indonesian energy situation pursuant to the decision on national papers by the Preparatory Committee for the United Nations Conference on New and Renewable Sources of Energy. The information contained here has been drawn from different reports and studies on the development of New and Renewable Sources of Energy as well as from data on the formulation of Indonesia's national energy policy. Also included is a proposal to assist in establishing a pattern of priorities suscribed to by participating countries in this field. For this purpose 3 matrixes are annexed to this paper and it is hoped that by thus measuring the relative degrees of urgency and priorities attached by governments to the various components of New and Renewable Sources of Energy the proposal may contribute towards a sound global policy framework.

C O N T E N T S

I. INTRODUCTION

1. Indonesia has witnessed a rapid growth rate of energy consumption over the last several years. This trend is understandable of course in terms of the economy's initial relatively low energy base.

Indonesia fortuitously has been endowed with copious hydrocarbon energy reserves whose current production level enables it to be a net exporter. Moreover oil and natural gas are Indonesia's most important sources of export earnings and these are important for achieving its development goals. At the same time, given the current energy surplus and the Indonesian economic situation, it may be advantageous to subsidize alternative energy sources for domestic needs. However with the advent of new and renewable sources of energy, if indeed they materialize, they could possibly play an important role in meeting the inevitable increase in domestic demand for energy and thus release such subsidy funds for other development purposes.

2. The transformation of domestic energy consumption is taking place for several reasons. It is both a function of the rise in population and the degree of national economic activity. What has been insufficiently recognized, however, is that it is difficult to keep energy development apace with the growth rates of these two variables. Furthermore there are constraints on energy development at the rural level including such factors as inefficiencies of scale,

the lack of financial resources and the reluctance to invest in new facilities.[1/]

3. A pervasive and major source of energy at the rural level is that of firewood.[2/] However, changes from its traditional cycle of production rate and functional use could have severe environmental impact not the least being that of soil erosion and degradation.

4. While gaps in understanding the role of energy in rural areas still persist, energy has become an integral part of rural development. Thus it is imperative that local resources, such as the availability of skills, leadership, financial resources and marketing systems etc., be developed and mobilized for energy production.

1/ Kadir, A and Arismunandar, A., Energy problems of the Developing Countries with Special Reference to the Firewood. Dilemma in Indonesia. Eleventh World Energy Conference, Munich, September 8 - 12, 1980.

2/ S. Hadi c.s., Utilization of firewood dillema and agricultural wastes in Indonesia: Progress report presented to the National Committee World Energy Conference Workshop on Energy Resources for Oil Substitution, Jakarta, April 24 - 25, 1979. Also see,

H. Soesastro, Energy and rural development in Indonesia. Paper presented before the Research Implementation Workshop on Energy and Rural Development, Chiang Mai, February 5 - 14, 1980.

II. ENERGY PROFILE

Oil, Natural Gas, Coal:

5. Indonesia has appreciable amounts of hydrocarbon energy sources including oil, natural gas and coal. For instance, recoverable deposites of oil are estimated at approximately 50 billion barrels whereas production levels reached 570 million barrels in 1980.

6. Natural gas deposit are estimated at about 30 trillion cubicfeet with a production level in 1980 of about 1048 million cubicfeet. However 27% of this is still being flared.

7. As for coal, possible reserves in Sumatra are calculated to be about 15 billion tons with proven reserves up to 600 million tons. Coal reserves have also been found in Kalimantan but its quality has not yet been assessed. Pre-war production of coal reached a total of 2,000,000 tons while current production is about 300,000 tons a year. If this annual figure is increased, production costs can be reduced to about US$ 30/ton at the pitmouth.

Firewood

8. Like in many developing countries firewood has been and still is a major and extensive source of domestic energy. This is especially true for rural areas for cooking and heating purposes.

While currently we do not have comprehensive or accurate data on either the consumption or the production of timber for firewood, nevertheless it is estimated that firewood supply is about equal to the firewood consumption, which contributes about 50% of the total energy consumption and 80% of the needs of the rural areas.

Other

9. Many other conventional and unconventional sources of energy have been investigated and some are even in use, but to-date they represent only marginal significance to the nation's overall energy usage. These include hydropower, which has an estimated hydroelectricity potential of 31,000 MW with widespread possibilities for further small-scale electrical generation, and geothermal energy, biomass and biogas energy, solar, wind, ocean and even nuclear energy.

Infrastructure development and rural electrification

10. Rural electrification is proceeding at a rate of approximately 600 villages per year though at present only 7% of the 61,000 villages have been serviced supplying about 3,5 million people. Steps are now being taken to expand the electrification scheme on three broad fronts. These include the expansion of the existing grid, the promotion of a microhydro development scheme and the installation of diesel generators in remote areas as an interim measure. Major constraints, however,

including the lack of adequate funding and the availability of skilled manpower, hamper its implementation.

11. Management of the rural electrification programme has been given to one of the community institutions at the village level as is prescribed by the philosophy of rural development. This philosophy requires that people participate in rural development at all stages of planning, implementation and evaluation. For instance law No. 5, 1979 stipulates that, to promote and develop the "gotong royong" or mutual help spirit of the villagers, it is necessary to strengthen coordination activities by means of village institutions including village social committees, neighbourhood associations and citizens wards. Furthermore at the Kecamatan, or group of villages level, management participation has also been established. Plans formulated at these grassroots levels are then submitted to higher levels of government for clearance. Government support for both managerial and technical training has been provided and models for the promotion of cooperatives and the State Electricity Corporation have been developed for future implementation. 3/

3/ Speech by H.E. the Junior Minister for Cooperatives before the Workshop on Energy in Rural Areas, Jakarta, September 2, 1980.

Energy Consumption:

12. Two major trends are detectable in the domestic consumption of energy in Indonesia. Firstly, its growth rate has rapidly changed from an average of 10% p.a. during the first 5 year plan (1968-1974) to 15% p.a. during the second 5 year plan (1974-1979) with consumption per capita growth-rate rising from 0.47 BOE to 1.17 BOE over the last decade (1969-1979). The second trend is that oil, though still the dominant source of energy in Indonesia's commercial energy mix, has a decreasing role and stands at about 80% to-day. Natural gas and even coal are increasing their proportion in the domestic commercial energy composition. For example domestic consumption of coal increased 46% to 190.426 tons in 1980 over the previous year while exports consisting of anthracite and steam-coal reached 100.465 tons.

13. The share of commercial energy consumption is about equally distributed among the three major sectors of the economy and has not shown any considerably variation in recent years. However if we include non-commercial energy consumption, which is mainly used in the household sector, this sector would have the largest share.

14. Energy in the form of electricity has expanded over the past decade, showing an increase in installation capacity of 1621 MW which represents an average increase

of 24% a year. Nevertheless the per capita installation capacity is only about 16 Watts and covers only 7% of the population. The increase in public electricity supply over the last 2 years has reached an average of 3 Watts per capita per year.

15. Preliminary assessments of non-commercial energy consumption is relatively large and, although this is declining, it still contributes up to 50% of total energy consumption. More precise data on non-commercial energy is in the process of being collected. Current data relates mainly to firewood which is the main source of fuel in rural areas. One of the main measures to offset this pervasive use of firewood is the introduction and distribution of kerosene, though this apparantly was only possible given a substantial subsidy and its importance is still limited outside of urban centres. 4/ The demand for firewood continues to increase at a rate of around 3% to 4% per annum, which is larger than the population growth rate. Its total consumption was estimated at about 39 millions tons in 1980.

Energy Policy

16. The core of Indonesia's energy policy is to guarantee that domestic energy supplies are available to

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4/ T. Soerjadi c.s., Rural Development Policy in Indonesia and the role of energy in its implementation. Paper presented before the Research Implementation Workshop on Energy and Rural Development, Chiang Mai (Thailand), February 5 - 14, 1980.

meet domestic demand both quantitatively, qualitatively and at affordable prices. This policy has the objective not only of improving the welfare of the Indonesian people but of also providing the necessary support for rapid socio-economic growth.

17. Energy Policy formulation is based on one of the founding principles of the state, namely that land, water and natural resources are state owned and should be used for the optimal welfare of the population. Given these principles the following policy measures are recommended:

a) the formulation of a comprehensive and integrated energy policy based on the development and utilization of these resources, taking into account both domestic and export growth in demand, and development of a long term strategic energy supply;

b) The conservation of oil based energy, the main energy source, and the development of non-oil energy resources, such as coal, hydropower, windpower, geothermal energy, nuclear energy, solar energy, etc;

c) The development of cheap energy supplies in rural areas which minimize damage to forestry, land and water;

d) The increased development and management of mineral resources, and in particular that of energy minerals, due to their role as foreign exhange earners for the financing of national development;

e) The establishment of a national energy policy which

is fully supportive of national development;

f) The increased development of electric power both in rural and urban areas for the purpose of improving the welfare of the society in general and for triggering economic activities in particular.

18. Furthermore in order to facilitate the achievement of these objectives the following policy measure is to be taken, namely the economization and more efficient use of oil resources so as to maximize its value both indirectly for earning foreign exchange or directly as a fuel for national development. This step can be strengthened by the use of available oil substitutes, which due to their site-specific nature and/or their low heat quality, cannot be economically exported.

19. Measures to accomplish this can be summarized as follows:

- intensification of survey and exploration of energy resources especially in new areas and the creation of incentives to attract private investment;
- diversivication to minimize the dependence on oil for domestic use by the development of substitutes;
- conservation, by issuing regulations and conducting a conservation campaign to promote more efficient use and saving of energy;

- indexation, of certain energy sources for their optimum utilization.

Necessary infrastructure development, such as training, information, investment, R & D., laws and regulations and techno-structure should also be undertaken.

Implementation:

20. Efforts to establish long-rage planning of energy have been taken. These are based on both an estimate of long-range domestic energy consumption and on assumptions of a economic growth-rate of between 5.5 and 6.5% GDP up to the year 2000, population growth of about 2% and an energy elasticity of approximately 1.6% during the planning period.

Given these assumptions estimates for commercial energy demand should reach 934 million BOE by the end of the period.

21. At present rates of oil production, total demand would not be covered by domestic production by the end of Repelita V (1994). 5/ Consequently the role of oil in the Indonesian energy mix would decline, while the contribution of natural gas, coal, geothermal and hydropower would increased.

5/ The Fifth Development Plan (Pelita V)

22. At the rural level long term development programmes have been consistently formulated and implemented for the purpose of gradually transforming the traditional village into a modern one. Implementation of rural electrification and the development of energy supplies, including locally available new and renewable sources of energy, are an integral part of these programmes. Implementation of this strategy is to take place over a 30 year time span starting with the beginning of the Second Development Plan (1974-1979).

23. Major energy programmes for the 1980/81 period are being financed by the National Development Fund. These includes:

a. Mining development, (research on processing technology for minerals, oil and gas).
b. Geological development (mapping, exploration and drilling, for inventary building.
c. Electricity development (erection of various power plants, transmission and distribution networks).
d. The development of gas and other energy resources (gas distribution networks and surveys on non-conventional energy resources).
e. Training and development of physical infrastructure.

In the same budget period foreign sources of financing equivalent to Rp. 269 billion will be available

for the electricity sector and Rp. 17 billion for rural electrification.

24. Other major projects in the fields of oil and gas include:

a. the construction of a hydrocracker with a processing capacity of 85.000 billion barrels LSWR a day;

b. the expansion of 2 refineries with an additional capacity of 100,000 barrels a day each;

c. the constuction of a new refinery;

d. the expansion of LNG facilities with 4 additional trains;

e. natural gas utilization projects (as petrochemical feedstocks).

25. The development of the Bukit Asam Coal mine, to produce 3 million tons of coal a year including its infrastructure development, which is to supply a steam power plant for electric generation, is the main project in coal.

Hydropower and geothermal energy development are also targeted for electrical power generation.

Pelita III (3rd Development Plan) reflects these energy policy targets. For instance, the role of oil is to decrease from 84% to 80%, while the aggragate role of the other energy sources are to increase. The use of non-commercial sources of energy will continue to be

considerable, but their relative contribution to the total energy mix declines as their availability decreases and its relative inconvenience increases.

On the other hand, energy elasticity is expected to be 1.8 during Pelita III and not less than 1.5 for the balance of this century.

III. THE ROLE AND POTENTIAL OF NEW AND RENEWABLE SOURCES OF ENERGY

Hydropower

26. Hydropower is already playing a role in electricity generation in Indonesia and its potential for further development is being evaluated. Hydropotential available for electricity generation has been estimated at 31.000MW, and the possibilities for small-scale or microhydro programmes look promising with some already underway.

The potential for large scale hydropower plants is restricted by the capital cost per KW which is relative high compared to other forms of electricity generation. The development of such plants necessitate technical requirements such as surveys, studies and design of power plants, long range irrigation plans and soil investigation etc. Other essential inputs include human and financial resources.

Microhydro schemes

27. Though faced with many of the same constraints as those encountered by larger plants the microhydro programme

has made progress with 27 plants completed and a further 8 plants proposed for the current 5 year Development Plan. Major constraints include both the lack of funds and the availability of skilled manpower. Moreover the very isolation of these areas, compounded by the lack of adequate infrastructure and human resources, contributes to the difficulty of preparing accurate planning. In planning such microhydro projects, factors of rainfall intensity, the nature of the catchment area and its elevation, among others, necessitate accurate data. Feasibility studies are available for 5,610 villages covering 2.5 million consumers. However this only forms part of the whole programme.

28. Nevertheless microhydro power plants could be economical and environmentally viable sources of rural electrification, particularly in remote regions from the main power centres. The development of local industries and technical skills could contribute towards the reduction of cost, and indigenous manufacturing programmes for the production of water turbines are designed for the standardization and simplification of units. Transfer of technology is considered necessary in order to stimulate more progress in the programme. In the past choice of sites was limited to low head schemes which further increased the cost. The greatest part of the cost is for the procurement of equipment including the generating

unit,which alone accounts for up to 40% of the cost of generation.

An indirect benefit of hydropower development is its positive contribution towards water resource management in general, and in particular, in the areas of irrigation and water table maintainance, the control of soil erosion and the promotion of the "greening" scheme.

Geothermal Energy

29. The potential of geothermal energy has been deductively assessed at between 8000 and 10,000 MW. The island of Java itself has a potential of around 5500 MW. In the past 6 years, experience has shown that a success ratio of 0.55 has been reached for exploration holes and 0.67 for production holes. Probable reserves in 6 development regions have been estimated to be 3150 MW with proven reserves of 1500 MW.

30. Although the potential of geothermal energy is large and suitable for a dispersed system of energy supply, its present development is directed only towards large-scale applications of 15 MW capacity and larger. Preriminary steps have been taken to investigate the use of this source of energy for purposes other than electricity generation, such as fumigation of the planting base for mushrooms, and crop drying. More precise figures for technically and economically recoverable geothermal reserves and their possible application are not yet

available and still need to be assessed. This also includes possible influences on the environment, especially in densely populated areas.

Solar:

31. Solar energy has traditionally been extensively used in the form of direct radiation. More recently photovoltaic cells for the generation of electricity are being tested.

Average insolation per year is estimated at about 1800 KWH/M2 which is over and above the limits of application. Estimates of throughput average 75 BOE at current population size, a 5% conversion rate and 7% of land use. Direct solar energy and photovoltaic cells have a role in:

- crop drying with and without the addition of hot air storage,
- solar water heaters and stills,
- solar cookers, and
- photovoltaic water pumps and refrigerators.

Also the adoption of solar mirrors for household application have been proposed and tested for their economic feasibility. Other efforts have been tried to estimate the potential of photovoltaic cells to generate electricity for very special purposes such as communication between remote stations and villages.

32. It is still too early to make any reliable prediction regarding the general feasibility of solar energy for widespread use. Such information will only be available when solar technologies acquire greater maturity and diffusion in the market. Also socio-economic studies to assess the general acceptance of these projects by the public have still to be evaluated.[6/] It is also unlikely that solar energy potential could be fully exploited in densely populated areas, such as Java, where land availability per capita is very limited.

Biomass

33. As a tropical country, the potential for biomass energy supply in Indonesia has been recognized for a long time. Precise data on the economics of biomass energy supply are not yet available. Efforts have been made to demonstrate the potential for energy production as well as for other purposes. Further evaluation has still to be made for activities such as:

- fast-growing plantations for the dual purpose of regenerating degraded land areas and of fuel wood supply,

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6/ F. Harahap c.s., Possibilities of Unconventional Energy Resources Utilization in Rural Areas. Paper presented to the Workshop Unconventional Energy Resources Development. Jakarta, January, 22-29, 1980 (in Indonesia).

- firewood plantations with the multiple objectives of reforestation and "greening" for soil erosion control, creating buffer areas surrounding commodity plantations, supply of firewood and food, etc.

These efforts can be enhanced by the development of plant specifies which make optimal use of the land, and which would also be commercially and environmentally acceptable.

34. Firewood plantations were started in 1975 and since then some promising production figures have been obtained. On suitable soils Caliandra production ranged from 70 to 120 m2/ha/year. Retarded growth has been observed in certain areas, the causes of which are still being investigated. Other species are also being tried out, although on a more modest scale. 7/

7/ T. Soerjadi c.s. op. cit. Also see,

H.H. Sitompul c.s., The Potential of energy farming system of renewable resources for the tropics. Paper prepared for VIIth G.A., World Federation of Engineering Organizations, Jakarta, November 11-18, 1979;

Harun Alrasjid, Fuelwood species for dwelling forest. Paper presented for the Workshop on Energy Survey in Rural Areas. Jakarta, September 1 - 10, 1980 (Indonesian);

Gamser, M.S., The Forest Resource and Rural Energy Development World.

35. Two extensive programmes are underway, which would among other things, renew the energy source of biomass and in particular that of firewood. These are the reforestation programme, which is the establishment of new forests on government or public forest land, and secondly the greening programme, which is the encouragement of planting perennial species on private and community property.

36. The annual target is designed to establish 300,000 ha of new forest and to "green" 70,000 ha of critical private land. This accelerated effort created major problems in its implementation. The success rate was intially very limited at about 50% for reforestation and 30% for greening. The greening programme is essentially aimed at increasing the vegetative cover of critical land areas to combat erosion and flooding. Free distribution of 15 to 20 firewood species, which are fast growing perennials with profitable by-products, to the community has been started. Efforts have also been made to use 10 to 12% of the Greening Programme budget for firewood plantation. Up to 1980, 65810 ha of land have been planted with fast growing trees. The next step is to create 100,000 ha of firewood plantations each year, which should yield more than 10 tons/ha/year after 2 years.

37. These measures should prove helpful in alleviating

both the pressures created by an increasing consumption rate and the loss of critical vegetative coverage on hillsides and mountain slopes. However population pressures too, especially in Java, have enchroached on the forests. On the hillsides for instance clearances are made for the cultivation of such food stuffs as cassava and other root crops, and not just for firewood. In such cases the Greening Programme does not apply.[8/]

38. Waste could also be an important source of biomass energy given the extent of wood and farm production. Timber logs alone for export are estimated at about 30 million cubic meters per year, of which 40% is counted as waste. Agricultural waste is also extensive since the majority of the population is engaged in farming. Twenty five million tons per year are derived from rice husks alone. Also 70 to 100 m3/ha wood is produced annually from the clearance of wooded land in the implementation of the national transmigration programme. Other wastes such as those from sawmills and plywood factories which produce roughly 30 million m3 wood residue each year could possibly be utilized as an energy source. A scheme, including the necessary incentives, to convert such waste into energy has already been proposed and in some cases, such as for drying purposes has been applied.

8/ Malcolm Gillis, Projections of Energy Demand for Indonesia: An Assessment. Harvard Discussion Paper, 1980.

Biogas

39. A family-size digester for the production of biogas has been developed and demonstrated since 1978, and an attempt has been made to integrate it into the rural development programme. The unit is used, not only to provide energy but also, to perform other activities, such as the transformation of residues into fertilizer, cultivation of algae for feeding cattle, breeding of fish, and making use of surplus water for irrigating home garden.

40. A major constraint hampering its widespread acceptance is a psychological one, that is the use of animal and household wastes for cooking. However local leaders suggest that this barrier may be overcome at least in the long term. According to studies a reduction in cost should be accomplished by the utilization of varoius locally available construction materials. 9/

Another pertinent question is whether this technology would only benefit the relatively well to do people and what, if any, effect would it have on the village as a whole.

9/ R. Razak, Some Experiences in Biogas Applicator in Indonesia. Paper presented before the Research Implementation Workshop on Energy and Rural Development, Chiang Mai, February 5-14, 1980. See also,

F. Harahap c.s., Possibilities of unconventional energy resources utilization in rural areas. Paper presented to the Workshop on Unconventional Energy Resources Development, Jakarta, January 28-29, 1980 (in Indonesia).

Wind:

41. Wind power is widely used for the traditional mode of sea transportation. Currently, several locations, based on available data, show promise for land-based generators, having wind speeds of more than 20km/hr and an intensity of more than 1500kWh/m2/hr.[10/]

Small-scale applications in rural areas, such as for water-pumping and food processing may be feasible, once appropriate data on the availability of wind velocity etc., is collected. Existing data mostly from the meteorological stations of airports, is not suitable for such decision making.

Some multiblade windmills, which have been installed with foreign aid for water pumping purposes, have not been successful. Improper preparation and maintenance may have contributed to the problem of these mills. The main constraints are probably neither technical nor engineering, but rather the lack of capabilities and skills for the preparation of proper feasibility studies and the lack of promotion for local population acceptance. Proper feasibility studies serve to make more understandable difficult variables such as the socio-economic interaction of technology and people.[11/]

10/ H. Djojodihardjo, Some observation on the prospects of wind energy utilization in Indonesia. Paper presented for the VIIth G.A. of the World Federation of Engineering Organization. Jakarta, November 16-17, 1979.

11/ F. Harahap c.s. op. cit.

Other

42. Other potential sources of energy include ocean power both tidal and thermal differentials. Also included are peat production, methanol and uranium processing. Energy potential of many tidal basins could be exploited and ocean thermal differentials, in areas of Sumatra, Java and Easter Islands, with steep shore gradients reaching depths of over 500 m, have good possibilities as sources of energy. Preliminary investigations indicate that, if appropriate and inexpensive technology is developed to harness these topographical and hydrographical conditions, several isolated coastal regions could be greatly benefited. 12/

43. With regard to peatland exploitation preliminary reports 13/ estimate that 10 million hectares of such land with an organic content of approximately 30% are available, though their prospects are not yet evaluated.

12/ Proceedings of a Workshop on Unconventional Energy Resources Development, Jakarta, January 28-29, 1980 (in Indonesia).

13/ Team Lembaga Penelitian Tanah, Laporan Survey dan Pemetaan Tanah Daerah Bunut-Kuala Kampar, Riau. Departemen Pekerjaan Umum dan Departemen Pertanian. LPT. No. 10/1975 (in Indonesia).

44. Methanol production from sweet potatoes has also been investigated and its feasibility studies completed. If this project proves feasible it could be integrated into the transmigration programme.[14/]

IV. PROSPECTS FOR INTERNATIONAL CO-OPERATION

Possbile objectives:

45. Objectives of international energy co-operation might be grouped into three categories, in line with requirements for attaining national goals.

The first category is aimed at improving the energy supply. The objectives here could be pursued, for the short and medium term, through the following measures:

a. by decreasing dependence on oil, in terms of the time required to replace imported oil-products with domestic energy.

b. by providing new indigenous energy resources.

These short-term and possibly medium-term goals cover not only technical, but also economic, commercial and international aspects.

46. The second category of objectives concern the whole range of technological transfers and skill development.

14/ W. Djojonegoro, the Prospect of Alcohol Fuels in Indonesia. Paper presented at the Symposium on Alcohol as Alternative Fuel. Jakarta, January 29, 1981.

Supporting activities to achieve these objectives include:

a. Joint R & D and technological application. These are measures designed to strengthened the production process capability in the energy field, by establishing laboratories, testing and standardization facilities.

b. Joint projects in the energy field, using such models as ASEAN industrial projects.

c. Information dissemination, the selection and channelling of relevant information to interested countries.

d. The increase of the quality and quantity of skilled manpower, through exchange of experts, joint training facilities, on-the-job training among participating institutions, etc.

e. Special arrangements, for instance through ASEAN, with technologically advanced countries to enhance effective transfers.

47. The third category of objectives focuses on improvements in the energy management cycle, which consists of:

a. Policy formulation; consultation and exchange of views which would be very helpful not only because of the complexity of the problem due to many uncertainties but also because it is a new field for most of the member countries.

b. Planning and programming; this has been one of the activities in ESCAP competence. In the sphere of the Colombo Plan Countries, this may prove very useful because of their existing common interests.

c. Financing: The lack of financing is one of the major stumbling block facing energy projects, due in part to doubts about their economic viability. Fund-raising may be possible by exploring possibilities within the country, through the exchange of respective country experiences and through channeling of foreign funds. Possibilities of institutionalizing these activities should also be explored.

d. Pollution control and conservation of the environment have already been initiated by most countries and these need to be put into a more solid framework.

e. Energy conservation and increasing the efficiency of energy use. There already exists a framework of such co-operation between ESCAP countries.

f. Technology assessment is an important input for energy policy and planning. Co-operation in this field would increase the efficiency of data gathering and their evaluation.

g. Supporting and downstream activities; exchanges on exploring new ways and methods to speed up the implementation of energy policies would be very

helpful. This would include linkages to the economic system, industry and employment.

Activity Matrix (see Annexes)

48. The following is a proposal for a schema, based upon the above objectives and activities, formed by three matrixes designed to identity the main possibilities for co-operation in the field of new and renewable sources of energy.

a. The first matrix is designed to discover the interests of various participating parties over a spectrum of objectives and activities (note: International Organizations here may include financial institutions, UN organization and governmental as well as non-governmental organizations) (Annex I)

b. The second matrix (Annex II) seeks to identity areas of interest of the various participating parties with respect to a list of new and renewable sources of energy.

c. The third matrix (Annex III) is designed to seek to identify various stages of activities of interest to the participating parties with respect of different new and renewable sources of energy.

V. CONCLUSIONS AND RECOMMENDATIONS

49. Given the rich reserves of fossils fuels and in particular those of hydrocarbons in Indonesia it is

certain that these will continue to play an important and increasing role in supplying the growing domestic demand for energy. Further development of these resources is therefore planned for the purpose of reaching their optimal utilization in achieving national development objectives. The development of coal, though its technology is domestically available, is however limited by infrastructure constraints and the state's limited development capacity to enlarge it. For the foreseeable future therefore the development of hydrocarbons will continue to be a priority in Indonesia while new and renewable sources of energy will play a supportive role.

50. From the Indonesian perspective the most promising and feasible new and renewable sources of energy are those of geothermal and hydropower. Both are being developed in Indonesia and may contribute up to 5% and 16% respectively to the generation of electricity by the late 1990s. 15/ Biomass, as a source of energy, has been used traditionally but without proper management might cause serious environmental problems. Solar and wind energy potentials need further assessment and studies.

15/ See, Hasil-hasil Lokakarya Energy 1980. Komite Nasional Indonesia, World Energy Conference, April 17 - 18, 1980.

51. Thus due both to the uncertainties and the unproven records of many new and renewable sources of energy as substitutes for hydrocarbons for accelerating the development of the developing countries and also due to the substantial constraints of human, technological and financial resources confronting their development, it may well be premature to make a definite commitment to their development at this time. However, Indonesia intends to keep this question continuously under review.

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PROBLEMS AND POTENTIALS OF NEW AND RENEWABLE SOURCES OF ENERGY DEVELOPMENT IN INDONESIA

Prepared for submission

to the

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ACTIVITY MATRIX

Annex I

PARTICIPATION OF COUNTRIES IN VARIOUS ACTIVITIES

Objectives / Participating Party	Energy Supply							Transfer of Technology				Energy Management								
	Exploration	Exploitation	Transportation	Conversion	Distribution	Utilization	Final Use	R & D	Exchange of Experts	Information Dissemination	Training	Policy Formulation	Technology Assessment	Planning & Programming	Funding & Financing	Market Studies	Environmental Studies	Economic & Social Implications	Energy Conservation	Supporting & Downstream Activities
Participating Country (Colombo Plan Countries)																				
Third Countries																				
Groups of Countries																				
International Organization																				

Annex II

ACTIVITY MATRIX

PARTICIPATION OF COUNTRIES IN DEVELOPING VARIOUS ENERGY SOURCES

Energy Resources / Participating Party	Direct Use of Sun - heating, cooling	- drying	- goods, storage	Photovoltaic	Passive Systems	Ocean Energy - waves	- O T E C	Tidal Energy	Wind Energy	Biomass + physical - combustion	- pyrolysis	- briquetting	- carbonization	- heat systems	+ chemical - gasification	- liquefaction	- distillation	+ biological - fermentation	- digestion	- silviculture	- aquaculture	B i o g a s	Microhydro	Geothermal	C o a l
Participating country																									
Third country																									
Groups of countries																									
International Organizations																									

ACTIVITY MATRIX

Annex III

PRIORITIES AND SCHEDULE OF IMPLEMENTATION

Program \ Energy Resources	Direct solar - heating, cooling	- drying	- ponds, storage	Photovoltaic	Passive Systems	Ocean Energy - waves	- OTEC	Tidal Energy	Wind Energy	Biomass + physical - combustion	- pyrolysis	- briquetting	- carbonization	- heat systems	+ chemical - gasification	- liquefaction	- distillation	+ biological - fermentation	- digestion	- silviculture	- aquaculture	Biogas	Microhydro	Geothermal	Coal	Peat	Animal Draught Power
Energy Supply																											
Exploration																											
Exploitation																											
Transportation/Storage																											
Conversion																											
Distribution																											
Utilization																											
Final use																											
Transfer of Technology																											
R and D																											
Exchange of experts																											
Information Dissemination																											
Training																											
Energy Management																											
Policy formulation																											
Technology assessment																											
Planning + programming																											
Funding + financing																											
Market studies																											
Environmental studies																											
Economic + social implications																											
Energy conservation																											
Supporting + downstream activities																											