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SUBSTANTIVE PREPARATIONS FOR THE CONFERENCE

Report of the Ad Hoc Expert Group on Industrial Issues Including Utilization of Energy in Transportation and Allied Sectors

* A/35/43 (Part II), para. 67.

CONTENTS

INTRODUCTION

1. The Ad Hoc Group of Experts on Industrial Issues, Including Utilization of Energy in Transportation and Allied Sectors, for the United Nations Conference on New and Renewable Sources of Energy, met at Vienna, Austria, from 12 to 16 January 1981.

2. The Ad Hoc Group was composed of members (see the annex) appointed by the Secretary-General of the United Nations and chosen by him.

3. The terms of reference of the Ad Hoc Group were set up according to decision 2 (II) adopted by the Second Preparatory Committee at its second session (A/35/43 (Part II)). Special consideration was given to the proposed terms of reference for the Ad Hoc Group presented by India on behalf of States members of the Group of 77 which are members of the Committee (A/CONF.100/PC/L.6).

I. GLOBAL CONSIDERATIONS OF NEW AND RENEWABLE SOURCES OF ENERGY AND THEIR INDUSTRIAL IMPLICATIONS

4. Industry faces various problems with the use of new and renewable sources of energy. Those problems can be considered under two main headings - namely "Energy for industry" and "Industry for energy", which appear as two sides of a more general relationship. The "Energy for industry", concept refers to the fact that industry is a major downstream user of energy and treats energy as a variable element in industrial development strategies. The "Industry for energy" concept, on the other hand, corresponds to an upstream approach to energy and focuses on the changes in the industrial structures which are indicated in order to meet the energy targets. The two concepts play a basic part in the more general energy and development relationship.

5. The major question facing the Panel was which of the new and renewable sources of energy would play a significant role in industrial production. The answer depends mainly on the future energy requirements of the developing countries. The developing countries will have in 1980 an estimate joint GDP of the order of $2,200 billion. Their total energy consumption will be about 1,700 megatons of oil equivalent (Mtoe); 1/ that is, 34 million barrels of oil equivalent (Mboe) per day. Their industrial output will be on the order of 450 million dollars marginal value added (MVA).

6. For the year 2000, a projection consistent with the target set in the Lima Declaration and Plan of Action on Industrial Development and Co-operation 2/ would indicate a joint gross domestic product (GDP) of $9,000 billion (1980), assuming a growth rate of 7.3 per cent/yr, with a total energy consumption on the order of 6,500 megatons of oil equivalent, i.e., 130 Mboe/day (corresponding to a growth rate of 7 per cent/year of energy demand). Their industrial output expressed in MVA would be on the order of $2,300 billion (1980). Very roughly, it can be estimated that requirements for industrial energy 3/ plus energy needed for operation of transportation and allied sectors in developing countries, by 2000, will reach values on the order of 3,000 Mtoe/yr (or 60 Mboe/d). This will mean an increase in energy demand for industrial applications on the order of 2,200 Mtoe/yr (44 Mboe/d).

7. The above figures, rough estimates as they are, and "optimistic" as they may be are still of interest for purposes of broad, long-term analysis. Real figures cannot turn out to be lower than 2/3 (30 per cent below the values suggested) and, thus, the order of magnitude of the task is the same and could be summarized, as in table 1.

1/ Includes all developing countries and all forms of energy.

2/ See "Report of the Second UNIDO Conference" (ID/CONF.3/31), chap. IV, transmitted to the Economic and Social Council via a note by the Secretary-General (E/5696).

3/ "Industrial energy" means energy needed by the industrial sector.

Table 1. Estimate of new and renewable sources of energy for industry b/

	1980	Factors (Percentage)	2000
Developing countries			
GDP	2 200 a/	7.3 (4.1x)	9 200 a/
Industry	440 a/	8.6 (5.2x)	2 300 a/
(Share of industry/GDP)	20.1 per cent		25.4 per cent
Total energy (Mtoe)	1 700	7.0 (3.8x)	6 500
Energy for industry and transportation	800	7.0 (3.8x)	3 000
Share of industry and transportation	46 per cent	Share 46	46 per cent
Total energy covered by new and renewable sources (Mtoe)	800		3 000
For industry and transportation	345	Share 43	1 400
Share of various new and renewable sources (in total energy balance)			
Biomass (with fuel wood and charcoal)	620	2.0 (1.5x)	930
Hydropower	160	12.0 (9.6x)	1 540
Other	20	17.8 (26.5x)	530

Share of new and renewable sources in industry	Mtoe	GW installed capacity c/
Biomass (with fuel wood and charcoal)	430	344
Hydropower	710	570
Other	260	210

Developed countries			
GDP	9 200 a/	3.6	19 600 a/
Industry	2 800 a/	3.8	6 450 a/

Source: United Nations Industrial Development Organization.

a/ 1980 US dollars x 10^{12}.

b/ Figures are rough estimates. They correspond to certain scenarios and assumptions. They are consistent with the Lima target and with current models being used in UNIDO. Other scenarios and assumptions could be considered.

c/ Figures are given in oil equivalent and in installed hydropower capacity equivalent: 1 gigawatt installed capacity (1 GW I.C.) = 1.25 Mtoe.

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8. On the basis of the scenario summarized in table 1, the total energy from new and renewable sources of energy, for the industrial sector in developing countries in 2000, may reach values on the order of 1,400 Mtoe/yr (28 Mboe/D) or, for comparison, the equivalent about 1,200 gigawatt (GW) installed capacity (I.C.) hydropower (mechanical or electrical) or to about 5,130 kerawatt hour (Twh) in effective energy.

9. Accordingly, it is clear that it is necessary to consider the question of which of the new and renewable sources of energy can make significant contributions to the over-all demand indicated above. It is also apparent that, among them, hydropower and biomass are the ones likely to make the most significant contributions, both in quantitative and in qualitative terms. Other new and renewable sources of energy are highly "location-specific" or "purpose-specific", and cannot be expected to make contributions to the over-all industrial energy supply of developing countries in terms of quantity.

10. For different sectors, such as household, agriculture, industry and transport, there are a number of end uses for which new and renewable sources of energy can be usefully exploited with appropriate devices. Table 2 gives examples of some of the potential applications for different sectors, both for rural and urban areas.

11. Table 3 presents a concise and very tentative evaluation of new and renewable sources of energy for industrial application. It is no more than a tentative scenario in which the demand (about 1,400 Mtoe/yr, or 1,200 kW I.C.) of energy for industry (and allied sectors) would be met in the year 2000. This would require rates of growth at the highest levels encountered today (12 per cent per year, for hydropower, for example) and would not cover requirements for other uses. Such growth may require an extraordinary planning effort, specially since the resources are there and need only to be developed.

Table 2. Applications based on new and renewable sources of energy for different sectors (rural and urban)

Sector	Rural			Urban		
	End use	Source	Device	End use	Source	Device
Household	Cooking (heat)	Solar	Cooker	Water heating (domestic and public buildings)	Solar	Water heater
		Biogas	Gas burner			
	Lighting	Solar	Photovoltaic modules and incandescent/ fluorescent lamp	Space heating and cooling (domestic and public buildings)	Solar	Passive and active systems
		Biogas	Gas lamps			
	Water heating	Solar	Water heater			
	Drinking water (stationary mechanical work)	Solar	Photovoltaic pump, solar stills			
		Wind	Wind turbine			
		Biogas	Biogas engine			
		Producer gas	Producer gas engine			
Agriculture	Micro irrigation (stationary mechanical work)	Solar	Photovoltaic pump			
		Wind	Wind turbine			
		Biogas	Biogas engine			
		Producer gas	Producer gas engine			
	Ploughing (mobile mechanical work)	Methanol	Internal combustion engine			
		Ethanol	Internal combustion engine			
		Biogas	Biogas engine			
		Producer gas	Producer gas engine			
	Drying (heat)	Solar	Dryer			
	Refrigeration	Solar	Cold storage			

Table 2. Applications based on new and renewable sources of energy for different sectors (rural and urban) (continued)

Sector	Rural			Urban		
	End use	Source	Device	End use	Source	Device
Industry	Small-scale industries e.g. milling, grinding, threshing; (stationary mechanical work)	Wind Biogas Producer gas Solar	Wind generator Biogas engine Producer gas engine Photovoltaic and storage power packs	Water heating Hot air, low pressure steam	Solar	Water and air heaters
	Cottage industries (pottery, brick-making, smithy etc.) (heat)	Biogas Solar Wind	Furnace Photovoltaic and storage power packs Wind generator	Chemical industry	Biomass	Power alcohol as feedstock
Transport	Transport (mobile, mechanical work)	Methanol Ethanol Biogas Producer gas	Internal combustion engine Internal combustion engine Biogas engine Producer gas engine	Intercity transport (mobile, mechanical work)	Methanol Ethanol Biogas Producer gas	Internal combustion engine Internal combustion engine Biogas engine Producer gas engine
				Intercity transport	Methanol Ethanol Biogas Producer gas Electro-chemical storage	Internal combustion engine Internal combustion engine Biogas engine Producer gas engine Battery-powered vehicles
				Factory transport	Electro-chemical storage	Battery-powered vehicles

Table 3. Evaluation of relative significance of new and renewable sources of energy for industry a/

Source and order of magnitude of potential e/	Possible industrial uses	Approximate cost for electrical or mechanical purposes c/	Heating purposes (kWh) b/
Large hydro (500-640 GW I.C.)	General urban and rural industries. Large energy-based industrial estates. Aluminium smelters. Urban transportation. Railroad electrification.	0.020-0.030	Same d/
Mini hydro (50 GW I.C.)	Small and/or rural industrial estates. Isolated medium- and large-scale industries.	0.050-0.150	Same
Biomass (including fuel wood, saw mill dust, charcoal and agro-wastes (300 to 400 GW I.C., or 360-480 Mtoe/year	Already used widely for small- and medium-scale industries as fuel wood. Charcoal-based iron and steel industries. Fuel alcohol automobiles. Rural industries. (Great potential for further development and application, in volume and diversity.)		
Oil shale and tar sands (1.2 Mboe/d by 2000? Or about 50 GW I.C.)	Great potential but highly dependent on technological development. In principle, could be used competitively with petroleum but particularly important for transportation (as fuel), resource-based industrial estates, feedstocks for petrochemical industry.	0.070-0.100 (about same as petroleum based)	0.03-0.050
Geothermal (20 GW I.C.) (?)	Small- to medium-sized industrial estates. Isolated industrial plants.	0.030-0.100	0.020-0.050
Wind (5 GW I.C.) (?)	(Unstable, discontinuous.) Very small-scale or "cottage" industries. Small agro-industries.	0.030-0.100	-
Other (5 GW I.C.) (?)	Very small-scale industries, small agro-industrial installations. Special use.		
Total 930-1,170 GW I.C. Or about 1,160-1,460 Mtoe. Of which: Biomass = 430 Mtoe or 345 GW I.C. Hydro = 710 Mtoe or 570 GW I.C. Other = 260 Mtoe or 210 GW I.C.			

a/ Reference is made to table 19, p. 43 of the World Bank report, "Energy in developing countries" (August 1980).

b/ Effective energy delivered to mechanical or electrical systems or for heating purposes. At 30 per cent and 60 per cent conversion efficiencies, respectively for fuel to effective energy.

c/ United States dollars in 1980.

d/ Efficiency of conversion kWh to heat assumed to be 100 per cent.

e/ Estimated contribution in terms of power (kW) for actual use in industry (year 2000).

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II. NATIONAL ASSESSMENT OF NEW AND RENEWABLE SOURCES OF ENERGY AND THEIR INDUSTRIAL IMPLICATIONS

12. The fourfold increase in energy consumption by developing countries in the coming 20 years needs to be confronted by a more energy specific policy. The change involved in the industrial sector requires the set-up of an energy conservation and energy-saving policy. Energy being more costly and more needed, careful attention must be paid to all improper uses which are wasteful both in terms of resources and finance. On the ohter hand, the dramatic increase in energy from new and renewable sources will need a strong collective (national or international) support in infrastructure.

13. The total energy demand for developing countries in 1980 is assumed to have reached 1.7 Gtoe. Of that total, an estimated 0.8 gigaton of oil equivalent (G to e) - that is to say, about 50 per cent - has been covered by new and renewable sources of energy. Although accurate forecasts of energy demand for the year 2000 are not easy to make, it is assumed that if there is no major economic change in between, the total energy demand of the developing countries in the year 2000 could reach 6.5 Gtoe. On this amount 3 Gtoe could be supplied by new and renewable sources roughly in the order of magnitude of 50 per cent of the total. Those assumptions correspond to an increase of about four times. That forecast is in line with the Lima targets which aim at having the developing countries contributing to 25 per cent of the world industrial production.

14. The increasing scarcity of conventional resources and the resulting price evolution of energy do not allow for the growth of industrialization by developing countries unless a strong effort is made to introduce new energy sources and increased efficiency of energy use.

15. The price development has, on the other hand, created new opportunities for development of the energy supply structure, since it had made indigenous sources of energy more valuable and potentially competitive.

16. Industrial development will thus reflect a remarkable change in activities concerning prospecting and utilization of indigenous conventional fuels (oil, gas and coal) as well as new and renewable sources of energy.

17. Of the total of 14 new and renewable sources of energy studied by the Conference, a few can already yeild substantial amounts of commercial energy. They are, by decreasing order of importance, large hydropower, small hydropower and biomass. However, other types of new and renewable sources may be more adequate for certain specific industrial uses or locations.

18. The above-mentioned classification is based on world-wide considerations, and there is need for a concrete approach at the country level, applying to the selection of new and renewable sources six principal criteria:

(a) Type of source - that is which new and renewable sources have to be developed in priority in relation to the industrialization programme in order to bring the concerned energy source into commercial production;

(b) Natural endowment - taking into account the fact that the natural resources are not evenly shared by countries. Allowing to geographical location, climatic conditions or geological features, the potential for new and renewable sources of energy can vary considerably. The volume of natural resources in a country will be a decisive parameter for the industrial and energy decision makers;

(c) Type of industry - how each new and renewable source of energy may contribute differently to the development of the various types of industry (sectors and scale). Sectoral analysis has to be taken into account so that the industrial strategy will be precise and in order to work out the total energy balance scheme, leading to an optimal use of new and renewable sources of energy;

(d) Phasing and timing - the time when the different new and renewable sources of energy can play their parts in the process of industrialization. A distinction must be made between the long and the short term, and ways and means have to be defined to cover the transitory period when conventional energies will remain dominant. For instance, being given a set of new energy opportunities, it might be worth using developing resources which do not have a large potential but which are readily available and can feed the industry in the first phase of its development. Meanwhile long-term action can be taken in order to bring larger new and renewable sources of energy into production, but within a time-frame which matches the emergence of larger industrial needs for energy;

(e) Technologies - a number of which have been developed to harness new and renewable sources of energy. Most of the time they have been engineered in developed countries and are designed to suit the precise local industrial environment. Therefore the technologies are not necessarily suitable, as such, for developing countries. Moreover some unsophisticated technologies, disregarded in developed countries, can be much more valuable in an environment where it is difficult to ensure the maintenance of high technologies. More generally, an effort has to be made to select the more convenient technologies for new and renewable sources of energy, taking into account local conditions for resource and industry.

(f) Energy quality for end uses - Energy is obtained from the different new and renewable sources of energy through technical processes, the technical and economical feasibility of which depends on the characteristics of the source. Depending on the source and on the process, different thermodynamic levels are reached for the energy. It is very important that those levels be matched to the real requirements of the industrial final user. There is no need to use electricity for low-heat drying when solar or low-level geothermal energy is available.

19. As a basic requirement, prior to final long-term decision in new and renewable sources of energy industrial issues, it is necessary to have an assessment of the existing and potential new and renewable sources of energy of the country following the above-mentioned criteria. On the basis of such assessment, national programmes and projects would be identified with the appropriate priorities, taking into consideration all other aspects related to the specific cases of the country.

20. Energy and industry must be considered not as separate issues but as part of a broader energy/industry complex. There should be no reference to one of the two without spelling out the cross relation with the other, and all decisions on new and renewable sources of energy should be taken in view of the energy/industry system.

III. ENERGY FOR INDUSTRY

21. A number of issues are raised for industry regarding both the short-term and long-term prospects for energy sources and their availability. The successful resolution of those issues will require some changes in perspectives about the energy/industry relationship on the part of Governments, particularly the planners of industrial development, and changes in attitudes towards energy forms and their use by the administrators and engineers of industrial enterprises.

22. Industry requires energy inputs for three principal purposes: for power - electrical or mechanical; for heat - of different intensity levels; and for transport. Industries have been used to obtaining electricity mainly from central grids, although some factories have generated part or all of their electrical requirements, either because they are remote from a central grid or because the processes or materials used allow them to generate electricity efficiently. In most cases, fossil fuels have provided the most convenient source of heat energy. The convenience and flexibility of delivery by motor vehicle has led many industries to place great reliance on that means of goods transport. And the cost of energy relative to other factors of production has led to unnecessary consumption because of inefficiencies in energy utilization.

23. The "energy emergency" in the near and medium term has generated moves in many industries towards improving efficiency of energy use and reduction of energy waste. Those measures should be more rigorously organized and actively promoted and encouraged on a continuing basis at the level of government as well as of industrial enterprise, to conserve available energy for real needs.

24. In the long term, the characteristics of energy sources will change, as new sources emerge to replace or supplement the fossil fuels. It is important globally, as well as to each country, that as large a proportion of the new sources as possible also be renewable sources.

25. Energy is vital for industry, and industrial growth is crucial to the continued development of most developing countries. Industrial growth cannot take place at the pace envisioned by developing countries to the year 2000 unless the pattern of energy sources alters very substantially to make greater utilization of existing non-petroleum sources in the near and medium term, and unless the exploitation and development of new and renewable sources of energy increases very rapidly. The development and utilization of such sources is of greater importance to developing countries, not just because they possess the greater unexploited resource potential of the most important new sources - hydro, biomass and solar - but also because industrial growth is more crucial to their welfare than it is to the developed countries.

26. Table 4 presents selected examples of use of new and renewable sources of energy in specific industrial sectors, through use of new or conventional processes, leading to new or standard products. The examples given illustrate the diversity of problems and opportunities which may be encountered and the need for specific consideration case by case.

A. Large-scale hydropower

27. The new and renewable source with the greatest potential for utilization in the next two decades is hydropower, both large and small scale. It will be used almost entirely for the production of electricity, much of which will be for industrial needs. Although hydro-electric power is generated in situ, the electrical power generated by large-scale hydro-electric plants may be utilized by energy-intensive industries near the site, or redirected to other users through centralized distribution systems. In some cases massive hydro-electric potential in a developing country may be remote from consumption centres, in which case careful consideration needs to be given by the Government to the optimum long-term utilization of such electrical energy. While establishment of highly energy-intensive industrial plants to use the generated electricity is often a real alternative in such cases, careful study should be given, particularly where the energy-intensive product is to be largely exported, that such a step will be in the interests of the developing country in the long term and that it will receive an equitable share of the benefits accruing from the utilization of the energy resource over the entire life of the project.

28. The same considerations are applicable to the utilization of other new and renewable sources for production of large blocks of electricity.

B. Small- and medium-sized electrical plants

29. Other new and renewable sources of energy are suited for the generation of electricity, which may be utilized by nearby industries and surrounding communities. Any surplus power might be fed to electric grids, if economically possible. Small-scale hydro, small geothermal sites, biomass steam-electric plants fall into that category.

30. The generation of electricity on a small or medium scale with new and renewable sources of energy may be undertaken by the industrial enterprise itself or by an entity dedicated to utilization of the new and renewable sources of energy. In either case, it should be ensured that the new and renewable sources of energy be utilized in the optimum manner, with due regard to preserving environmental quality, and to serve the present and future needs of the adjacent communities as well as of industries. The exploitation of forest wood fuels, for example, should be accompanied by a reforestation programme, and a portion of the cut wood may be sold as fuelwood and/or converted to charcoal to serve cooking and heating requirements of rural households in the region.

C. Heat requirements

31. The emergence of commercial processes and equipment for efficient utilization of new and renewable sources of energy provides new sources of heat energy for industrial plants, which may require modifications of industrial facilities. Energ from those sources (e.g., biomass, geothermal, solar heat) will be of lower intensi

or quality compared with that derived from fossil fuels. Hence heat energy from new and renewable sources of energy may not be used in direct substitution of fossil fuels unless appropriate adaptations are made in the layout process and/or equipment by the industrial enterprises. Dual fuels may also be used in the same heating/combustion process.

32. Energy plans and programmes for industry should thus include measures to induce the use of the lowest quality energy source consistent with the nature of the energy requirement. Incentives may be considered in order to assist the industries to modify present facilities for efficient energy utilization. It is anticipated that the lower quality and/or more difficult handling and storage characteristics of the new and renewable sources of energy would be adequately reflected in its price per thermal unit to provide the profit incentives for industry to effect the necessary modifications in processes and equipment for extensive use of new and renewable sources of energy. At the same time, energy planners should consider mechanisms which ensure that once the new and renewable sources of energy for heat are widely used, prices for them relative to other energy sources will be kept stable enough so as not to overturn the economics of the investments made by industries for its utilization.

33. The strategies for greater utilization of new and renewable sources of energy by industry, especially for heating purposes, should give due consideration to the permanent replacement by industries in as many applications as possible of non-renewable energy sources by renewable sources. The experiences of existing industries in carrying out the required modifications towards that end will greatly influence the design and engineering of new plants to incorporate such modifications.

D. Transport and industrial location

34. Oil shales, tar sands and biomass conversion present promising opportunities for the production of liquid fuels for road transport vehicles, and the produced gas may be usable as fuel as an internal combustion engines in some applications. Brazil is already carrying out a national programme for the production of ethyl alcohol from sugar cane, its use in motor vehicles, and the manufacture of engines using ethyl alcohol as the sole fuel.

35. In spite of those developments, and considering the greater availability and lessening cost of using electrical energy in the future compared to liquid transport fuels, industry should give more attention to greater use of rail transport for its products. Rail transport should be electrified, particularly in high travel-density sections.

36. In many developing countries, public passenger transport, particularly in urban areas, relies very heavily on buses, which use liquid fuels. Serious attention should be given to installing and expanding electrical railway systems in the planning of cities and urban transport systems.

37. The modification of transport systems to carry more industrial goods and a greater proportion of urban personnel traffic will not be successfully implemented unless it is accompanied by more careful planning of the residential areas which the industrial workers would leave to go to their place of work, and by industrial measures to modify packaging, shipping and warehousing patterns better accommodated to rail transport. Consideration might be given, for instance, to containerized long-haul shipments by rail and break-bulk operations in storage warehouses from whence lorry shipments to individual industrial users or distributors would be made, analogous to sea-freight systems.

Table 4. Selected typical examples of interactions between industry and new and renewable sources of energy

Sector	Source of energy	Process	Product	Remarks
Iron and steel pig product (reduction)	Forests, wood	Charcoal pig a/	Standard/conventional	Small-scale and large low-investment local resources
Aluminium smelting	Hydro (large/macro)	Standard/conventional	Standard/conventional	
Organic chemicals and fuels	Biomass (sugar cane)	"Direct" Indirect (via molasse) alcohol prod.	Standard/conventional (alcohol and bagasse as fuel)	
Alcohol cars	Biomass (sugar cane)	Standard/conventional	100 per cent fuel alc. cars	
Energy-based industrial estates or areas	Hydro (large-scale to small-scale)	Standard/conventional (agro ind. small scale ind. manufact. ind. centre or complex)	Standard/conventional	
Ceramic industry: brick, tile, crockery, porcelain etc.	Wood (fuel)	Standard/conventional	Standard/conventional	
Food and agricultural product-drying	Solar (direct thermal)	Special ovens, kilns installations	Dried grains, meat, fish	
Salt	Solar	Evaporating basins/ ponds	Standard/conventional	
Heating, refrigeration equipment, household appliances etc.	Solar (thermodynamic)		Water heaters etc.	
Manufacturing industries (light/medium)	Geothermal	Standard/conventional	Standard/conventional	
Organic chemicals Methanol	Wood	Special and fermentation hydrolysis	Standard/conventional (methanol)	
Hydrocarbon production	Shale oil and tar sands	Special distillation Special extraction	Standard/conventional	
Small-scale or agro industry or rural industry	Wind (electromechanical)	Standard/conventional	Standard/conventional	
Agro-industry Small industry Rural industry	Peat	Standard/conventional	Standard/conventional	
Very small-scale industry (Special cases)	Solar (photo-electronic)	Standard/conventional	Standard/conventional	
Glass (special) silicon and high temperature ceramics	Solar (thermal optical reflectors etc.)	Specially designed process and equipment	Standard/conventional	
	Agro-wastes Saw mill dust	General heating or electrical generation	Standard/conventional	

1/ Different from the high furnace process.

IV. INDUSTRY FOR ENERGY

38. Industries in developing countries, with only a few exceptions, regard energy, particularly sources of heat energy, as a commodity. They have been used to fossil fuels as their source of heat energy. Those fossil fuels are extracted from deposits laid down in geological time and are a depleting resource, whose real value can only increase as the deposits are depleted over time. They are already of high energy quality at source and, prior to purchase by industry, undergo refining in the case of petroleum, and blending cum beneficiation in the case of coal, in order to bring the specifications of the fuels as delivered within desired limits.

39. The energy intensity level as well as other characteristics of new and renewable sources of energy for heat that will be available to industry will not be of as high levels of energy intensity or as predictable specifications as the fossil fuel products. Industry in each country must at the sectoral level and/or at the level of the enterprise intervene and participate in the upgrading, refining, or transformation to more conveniently usable forms of certain new and renewable sources of energy for use by industry as heat. Industry also will have to undertake research and development, equipment and process design and pilot-plant experimentation before manufacturing equipment and facilities for utilizing new and renewable sources of energy or converting them to suitable products for industrial transport, commercial and residential use.

A. The reorientation of industry for new and renewable sources of energy

40. Each country will be more interested in those new and renewable sources of energy for which it has important natural endowments. In biomass conversion, particularly, the forms of biomass will depend on the particular soil or climatic conditions in a given country. Rapid development of such new and renewable sources of energy for energy production is unlikely unless the countries endowed with them take an active interest and even participation in that development where those sources are adapted for industrial use, or for industrial upgrading/transformation. Especially when production of the requisite capital goods in the country seems feasible, industry must be encouraged to participate actively in the process of developing the new and renewable sources of energy.

41. Such a reorientation of industry for new and renewable sources of energy and of energy planners for more effective co-ordination of the energy/industry relationship requires specific programmes for the modification of perspectives, realignment of attitudes about the energy/industry relationship and sharpening of perceptions on the consequent problems and opportunities in the two sectors. Special professional skills involving several traditional scientific disciplines (e.g., energy engineers) may also need to be developed in academic institutions or by special training courses to implement and reinforce this reorientation.

B. Processess and equipment

42. It is useful to consider industrial participation in development of the new and renewable sources of energy described in two main groups of activities:

(a) For the production/transformation of the new and renewable sources of energy, particularly for heat energy and for transport;

(b) For the utilization of the new and renewable sources of energy by industrial enterprises, transport, commerce and households (particularly rural).

43. The regeneration, reproduction and more efficient allocation and preparation of biomass for energy utilization presents another field for participation of industry, especially in developing countries.

44. In this connexion consideration should be given by international agricultural agencies to development and propagation of new varieties of agricultural crops and tree species with high potential energy content, intrinsically or through biomass conversion (agriculture for industry).

C. Industrial opportunities in new and renewable sources of energy

45. Table 4 illustrates the variety of roles that particular industries may play in the development and manufacture of equipment for wider use of specific new and renewable sources of energy. It should be noted that the equipment required falls in a wide range of size, sophistication and complexity. Thus opportunities exist for manufacture of equipment for new and renewable sources of energy and for appropriate transformation, in both developed countries and in many developing countries, even those with relatively non-advanced industrial infrastructures.

46. It would be of value to industry in each country to receive assessments from time to time of the state of development of technology for utilization of the new and renewable sources of energy with which the country is well endowed, and estimates of the date when processes and equipment designs for commercial utilization will become available. This would enable industry to consider those opportunities in planning future activities.

47. Special consideration should also be given, within the scope of long-term planning, to the promotion of less energy-intensive types of industries.

V. MANAGEMENT

48. Implementation of national strategies in developing and using new and renewable sources of energy, as discussed in chapter I, will require the formulation of specific programmes, projects and policies. Appropriate action would also be required in relevant sectors such as education, training, research and development, information flow, financing and others. In the following paragraphs a selected number of topics have been chosen to amplify the measures required, from the planning and management points of view.

49. The formulation of energy strategies will involve policy issues covering areas such as education and training, finance, information flows, research and development and transfer of technology, and covering important sectors such as agriculture, commerce, domestic (rural, and high- and low-income urban), industry and transport. The policy issues cannot effectively be considered in isolation, and their interdependence must be acknowledged in the course of formulating national energy plans. In considering the industry and transport sectors, for example, attention to the policy aspects outlined below must be given special attention.

A. Detailed planning of national energy requirements

50. National energy assessments will involve:

(a) Analysing present energy use patterns in all important sectors including domestic (rural and urban), agricultural, commercial, industrial and transportation;

(b) Projecting future energy-use requirements of socio-economic development goals and identifying energy related constraints;

(c) Identifying and assessing potential sources of energy which can be used to satisfy present and future energy requirements, including both conventional and new and renewable sources of energy;

(d) Critically examining the relative economic and capital requirements and resource constraints of the different energy supply options.

51. National energy planning will involve the formulation of strategies for satisfying present and future energy needs, using both conventional and new and renewable sources of energy and defining the resource implications of each strategy.

52. In developing comprehensive national energy plans, it will be important for countries to pay attention to long-term energy planning and management. This would involve devising strategies for overcoming possible social barriers and for taking due account of environmental impact, in addition to providing the finances needed for fulfilling identified education and training, research and development and demonstration programmes.

B. Regional and international co-operation

53. Technical and other forms of co-operation between developing countries and between developed and developing countries will play an important role in the utilization and creation of the industrial capacity of individual countries for harnessing and utilizing the new and renewable sources of energy as well as for providing the energy needs of the industrial and transportation sectors. It will thus be important for countries to exchange basic data concerning energy resources, energy data and technology know-how to facilitate the formulation and financing of joint industrial programmes and projects. It is imperative then that countries effectively manage such joint programmes, technically and contractually, to ensure their effective and mutually advantageous execution. Such joint programmes may, for instance, be aimed at the development of new technology for a number of industries that are now major consumers of energy, e.g., vertical axis cement kilns, bacteriological fermentation of biomass for production of methane and alcohol, etc.

54. It is also apparent that many of the technologies in the area of new and renewable sources of energy are not yet ready for immediate use for the purpose of meeting the energy needs of the industrial and transport sectors. Immediate action will be needed, then, to develop a programme of incentives and other managerial measures aimed at cutting down the waste of conventional energy in those sectors and for better utilizing the energy content of both industrial wastes (e.g., ligno-cellulose materials) and waste energy. Demonstration programmes will be needed not only for convincing decision makers but also for potential users of the system and enterprises that are involved in commercialization and marketing of the technologies and products.

C. Decentralized systems

55. A desirable characteristic of many of the new and renewable sources of energy will be their potential to produce power in a decentralized fashion. It will be necessary to develop new managerial techniques to ensure the satisfactory operation and maintenance of such decentralized units.

D. Adaptation and transfer of technology

56. Technology transfer merits special mention. A variety of the technologies capable of generating large-scale power from hydropower, biomass conversion, geothermal, ocean, wind, solar, oil shale and tar sands are now available or will be developed in the industrially advanced countries (developing and developed). Many of them will not involve patentable technologies but rather proprietary positions, based on know-how, experience and manufacturing capacity. The purchasing, importing and harnessing of such technologies will have to be faced by many developing ccuntries, and such countries will have to strengthen their position by tracking developments under way or planned. On the other hand, many of the technologies capable of use in the decentralized mode, will involve end uses that are country-specific, and countries will have to examine the engineering

of the whole system. Such technologies are unlikely to be developed wholly in the industrially advanced countries, and individual countries will have to develop the capacity for design, engineering, long- and short-term testing, demonstration, commercialization, marketing and manufacture of such technologies and products. Examples of such technologies are small-scale solar thermal, solar photovoltaic, wind-pumping, wind electricity generation, hydro-power, and biogas digestors.

57. In the case of both types of technologies described above, it is essential that developing countries keep in mind that they often possess a better renewable energy resource base (e.g., higher solar insolation rates) or offer better prospects for decentralized power generation. A variety of enterprises from developed countries will wish to collaborate with counterparts in developing countries to develop such technologies and products. Consequently, developing countries should pay close attention, whenever undertaking such joint ventures, during negotiations, to the costs, risks and benefits from such participation.

E. Action in the fields of education, training and information

58. The planning, development and management of new and renewable sources of energy, together with their associated industrial issues, requires special efforts in the fields of education, training and information. Those efforts would naturally be a part of the general requirements of training and information for energy and for industrialization as a whole. Yet specifically, the formation of "energy engineers", for example, appears to be a clear requirement, as is the training for "industrial extension and promotion of small decentralized industries", which are likely to grow on the basis of new and renewable sources of energy. The increasing interest in establishing data banks and information systems in all sectors should be supplemented by special "industrial and technological information and advisory services" specifically tailored to the requirements of industry and allied energy problems. The pioneering efforts of UNIDO, in that respect, are very commendable. In general, in their development efforts, the developing countries should give more attention and allocate relatively more resources to "soft-ware", i.e., training, information, management and skill formation and upgrading, as compared to "hard-ware" equipment and installations.

F. Institutional arrangements

59. Both at the national and international levels, a number of initiatives have been taken of an institutional nature to assist the developing countries in identifying and developing their energy sources, including new and renewable sources of energy. They include design engineering and industrial extension centres, technology transfer service corporations, technology improvement funds, cost-sharing programmes, government procurement systems and private company transfer systems. Corresponding institutions are required at the national level, so as to ascertain national requirements and assure the best use of external assistance in conformity with national policies.

VI. RECOMMENDATIONS

60. The Panel recommended strengthening and deepening international assistance to Governments of developing countries for their national energy assessments, giving due attention to new and renewable sources of energy. Most developing countries will require technical assistance in order to conduct national energy assessments, which are a prerequisite for their formation of national energy strategies, plans and programmes. In view of the great potential for commercial utilization of new and renewable sources of energy in many developing countries, the technical assistance activities should include:

(a) Provision of information on possibilities in new and renewable sources of energy for the developing country;

(b) Evaluation of the country's potential in new and renewable sources of energy;

(c) Advice on the probable timing of technological developments which will enable realization of the potential for specific new and renewable sources of energy;

(d) Appreciation of the implications of new and renewable sources of energy on industrial structure and development plans.

61. It was also recommended that international financing institutions provide highly concessional financial assistance and risk capital to developing countries for pioneer experimentation and commercialization of specific new and renewable sources of energy in order to accelerate utilization by all developing countries.

62. The potential of new and renewable sources of energy in developing countries is probably greater than popularly believed. International financial assistance is needed to enable developing countries with important potential for specific new and renewable sources of energy to carry out - nationally, bilaterally or multilaterally - the experimentation and commercialization of the new and renewable sources of energy. Since the degree of financial risk in such projects is high, the financial assistance needs to be highly concessional and may include a substantial grant element. Technological information derived from projects largely funded by such financial assistance should be made freely available, without charge, if possible, to all developing countries possessing substantial resources of the specific new and renewable sources of energy, so that its widespread utilization may be accelerated.

63. A master plan was proposed for the development of hydro-electric resources in the developing countries.

64. A planning exercise should be conducted in order to develop the available potential in the common interest of the countries involved. That would permit the use of available financial resources and technological capacities to be used advantageously. Further, isolated projects face the risk of being turned down for

lack of markets owing to the remoteness of the location. Further, such integrated approaches to the problem could lead to the setting up of industrial complexes which would make the projects benefit from infrastructural investment shared by the totality of the industries involved in the complex. Such a procedure would allow the development of industrial capacities for construction of the hydro-stations and other necessary infrastructure and development requirements.

65. A similar approach may be appropriate in the case of other large-size projects using, for example, geothermal or oil shale.

66. It was recommended that an international task force should be set up to examine all apsects of development and production of usable fuels and other industrial products using bio-technology in general. Bio-technology is developing at a fast pace, is leading to increased applications in the energy industry, transport and other sectors. Fermentation alcohol is used as a fuel for transport and can be used as a chemical feedstock.

67. It was recommended that the United Nations system, especially UNIDO, should expand its services of industrial information and technology to small- and medium-size enterprises in the fields of new and renewable sources of energy and industry, since the development of new and renewable sources of energy in developing countries will need an appropriate supply of specific investment and industrial information for a large number of small and disposed users.

68. A suitable arrangement, possibly involving a competent agency such as UNIDO, would be made for monitoring the industrial aspects of new and renewable sources of energy related international activities. This would be necessary since industry-related issues on new and renewable sources of energy need joint action by a number of competent agencies - bilateral and multilateral - for the different aspects involved, such as formation, financing, information etc. The United Nations co-ordinating body could ensure a proper, timely co-ordination of the efforts, bring forward the implementation of industrial projects in new and renewable sources of energy, and achieve a higher efficiency in this crucial activity.

69. It was recommended that Governments establish an appropriate mechanism to co-ordinate national strategies and policies on energy-related issues and to supervise national energy assessment.

Annex

LIST OF PARTICIPANTS

I. H. ABDEL RAHMAN (Chairman)	Adviser to the Prime Minister of Egypt
Kemal Abdallah KHODJA	Consultant, Algeria
Fjalar KOMMONEN	Consultant, Finland
Vicente PATERNO	Member of Parliament, Philippines
Eugeniu PAVEL	Head of the Department of Research and Development, Technical Division Ministry of Power, Romania
Rajinder K. SURI (Rapporteur)	Project Manager (Non-Conventional Energy Sources) Bharat Heavy Electrical Limited, India

Observer

Jaoa PIMENTEL	OLADE - Latin American Organization for Energy

United Nations Industrial Development Organization (UNIDO)

Farlan CARRE	Deputy Executive Director
Luis CORREA DA SILVA	Special Assistant to the Executive Director
G. S. GOURI	Senior Technical Adviser, Technology Programme, Division for Industrial Studies
Mohamed ABDEL MONEIM	Senior Industrial Development Officer, Investment Co-operative Programme Branch, Division of Industrial Operations
Endre T. BALAZS	Acting Head, Mettalurgical Industries Section, Division of Industrial Operations

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Ronald HSIA	Head, Global ABD Conceptual Studies Branch, Division of Industrial Studies
George KOMMISSAROV	Industrial Development Officer, Industrial Energy Engineering Unit, Division of Industrial Operations
Irene LORENZO	Head, Training Branch, Division of Industrial Operations
Roch T. DE MAUTORT	Chief, Industrial Information Section, Division for Industrial Studies
H. W. TANAKA	Head, Development and Transfer of Technology Branch, Division for Industrial Studies
Han WUONG PACK	Industrial Development Officer, Development and Transfer of Technology Branch, Division for Industrial Studies

Secretariat of the United Nations Conference on New and Renewable Sources of Energy

Brahman SIVAPRAKASAPILLAI	Principal Technical Adviser, Special Representative of the Secretary-General of the Conference
Jean NAUWELAERS	Secretary of the Ad Hoc Group of Experts
