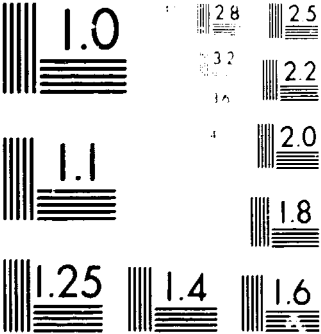
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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

DRAFT

BACKGROUND PAPER *

for

UNCNRSE

EXPERT GROUP MEETING ON INDUSTRIAL ISSUES AND UTILIZATION IN TRANSPORTATION AND OTHER ALLIED SECTORS

(Vienna, 12 - 16 January 1981)

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UNCNRSE - E.G.M. "INDUSTRIAL ISSUES"[1/]
DRAFT BACKGROUND PAPER

PART A - REVIEW OF CURRENT SITUATION

I. INTRODUCTION AND BACKGROUND

1. Scope of Work of the E.G.M.

When considering their energy-related problems and opportunities, there is basically only one fundamental and broad issue facing Dg.C. in their industrialization efforts towards the target and objectives set in Lima and New Delhi, namely:

- To develop and/or ensure the supply of the energy required to establish and operate the industries, and related transportation and other allied systems, needed for their accelerated economic and social development and viable in terms of local conditions resources and capabilities.

The above broad and comprehensive issue can and must be disaggregated, broken down, translated and/or refined in successive groups, stages or levels of subordinate or subsidiary goals, objectives and issues. The choice of variables, criteria and priorities for disaggregation may lead to different sets or groups of sub-issues and/or intermediate goals.

The General Assembly, through its Resolution 33/148 of 20 December 1978 followed by Resolution 34/190 of 18/12/1979, chose to start the disaggregation of the energy-related problems and opportunities faced by Dd . and Dg.C. with the consideration of the potential of new and renewable sources of energy (N.R.S.E.). This choice is fully justified and appropriate in the present energy conjuncture and is of special relevance to Dg.C., where new/different or characteristic patterns of resources, needs, capabilities and goals require a new approach to the planning of economic and social development, with special attention to the use of new and renewable resources (raw materials,commodities, fuels and other energy sources, etc.).

Besides previous and other decisions regarding the preparatory work for UNCNRSE, the Preparatory Committee, in its Second Session,

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1/ E.G.M. - Abbreviation stands for "Ad-Hoc Expert Group Meeting on Industrial Issues and Utilization in Transportation and other allied Sectors. Draft prepared by UNIDO upon request of Conference Secretariat received 17 November 1980.

finalized the disaggregation of the broad issue mentioned above and decided that special attention should be addressed to the examination of the potential and impact of utilization of NRSE in industry, including transportation and allied sectors, through an Ad Hoc Expert Group Meeting.

Accordingly, and in harmony with the terms of reference approved by the Conference Secretariat on 15 November 1980, the main objectives of this E.G.M. 1/ can be expressed as follows:

a) To review and analyse the present situation and the potential for development and application of NRSE in industry.2/ In particular, to examine: the impact of such utilization on the structure and operations of industrial production systems; the requirements for equipment and services that the development of the NRSE sector itself is likely to impose on the industrial sector of Dg.C.; and, finally, the requirements relating to the means and facilities for the intensive and successful utilization of NRSE in industry, in terms of manpower, technology and finance.

b) On the basis of the review and analysis above, to identify, as far as possible, the specific opportunities, problems and constraints relating to the utilization of NRSE in industry (including transportation and allied sectors), as well as the appropriate measures or action indicated to overcome the problems and constraints brought to light and to allow full use of their potential and of the opportunities they offer for industrialization in terms consistent and commensurate with the Lima target. Measures at national, regional and global levels should be suggested.

In the work to be carried out by the E.G.M. in accordance with the guidelines indicated by the Preparatory Committee, the participants should take into account the relevant conclusions and recommendations of the Panels of Experts which dealt with specific energy sources. The consideration of other selected relevant documentation is also assumed and/or indicated.

1/ Abbreviation stands for the "Ad Hoc Expert Group Meeting".
2/ When reference is made to industry, in this paper, one should understand "industry, transportation and allied sectors", unless the context indicates otherwise.

2. Concise review of certain basic features of the present energy situation.

2.1. The broad perspective

If one considers the broad perspective of world development since 1945 it is clear that three extraordinary scientific technological/industrial efforts took place:

a) The atomic/nuclear effort which led to the availability of a new kind of energy;

b) The semi-conductor research effort which led to the development of transistors and computers and to a continuing "electronic revolution";

c) The space exploration effort which led to service satellites for communications, earth resources exploration, etc..

It is clear that we are now in the midst of another and fourth vast international effort which will lead to a much needed readjustment in depth in the pattern of supply, management and use of energy.

In this connexion, dispassionate and fair analysis will show that the "oil shock" of 1973 brought with it a worldwide awareness of the need for a re-adjustment of the world energy production-consumption pattern which will take at least a decade and which will have profound and long lasting impact on the industrial structure and on industrial processes, products and services.

2.2. Assumptions regarding energy sources.

In so far as energy sources are concerned, the following general assumptions, relating to the use of energy for industrial development in the period 1980-2000, seem relevant:

a) Energy derived from fossil fuels, in particular petroleum, will continue to be an important factor in this development process. Given present consumption patterns, however, world demand will, in the next decades, outstrip known and assumed petroleum resources, necessitating the launching of large-scale prospecting for, and exploitation of, other resources, especially in non-oil-exporting developing countries;

b) Natural gas resources offer great potential in the developing countries, but call for extensive exploration and infrastructural development;

c) Steps will have to be taken - in terms of infrastructure, technology and investment (both in mining and industry) - to permit the increased utilization of coal in the developing countries, not only for the generation of power but also for the production of synthetic fuels and chemical feedstocks;

d) By virtue of its enormous potential (some 1,500 - 2,000 MkW), hydro-electric power constitutes one of the main energy options of the developing countries;

c) Energy derived from biomass is a basic feature of the energy spectrum in most developing countries and will take on increasing importance in terms of volume, value and "quality".

f) Nuclear energy is an important option to those developing countries which dispose of the necessary resources, infrastructure and technologies;

g) Other renewable resources, such as solar, geothermal, wind and ocean energy, will play an important, although quantitatively secondary role, as they are only suited to specific areas or applications.

2.3. Other general "consideranda"

There are some aspects and concepts which for their relevance should be kept in mind in work of the type envisaged in the E.G.M.. They are concisely reviewed below:

a) The Lima target already carried with it, implicitly, an "energy target", and programmes for expansion of the energy sector of Dg.C.[1/] and, particularly, of NRSE, should be consistent and commensurate with that target.

b) In the analysis of the energy/industry interaction it is necessary to distinguish clearly the major from the minor or subsidiary sources of energy for industry. The five main or "macro" sources which will form the basis of the energy sector of the Dg.C. community,

1/ Dg.C. = Developing Countries, Dd.C. = Developed Countries taken as a whole, if they are to reach the Lima target are: fossil hydrocarbons;coal; nuclear power; hydropower and biomass, the latter two being NRSE. Other sources will be highly "location- and purpose-specific".

c) One must distinguish clearly the long-term energy requirements from the short-term"energy emergency". The first has been a long standing problem, for Dg.C.. The second is a transient situation requiring adjustments which may lead to a more balanced energy supply pattern, with a larger share of NRSE. in industrial applications.

d) It is necessary to consider and distinguish clearly the global industrial energy requirements of the Dg.C. as a whole from the individual situations of regions, countries or specific industrial sectors.

2.4. UNIDO's activities in energy-related aspects of industrialization.

UNIDO has been active, since its inception, in projects and activities involving consideration of conventional and non-conventional energy inputs and related equipment. The IIIrd General Conference of UNIDO, in New Delhi, in February 1980, assigned special importance to energy-related activities, relevant to industrial development. Accordingly, and as a further step towards designing a UNIDO energy-related programme, the Executive Director decided the creation, in April 1980, of a Special Advisory Group on Energy.[1/] The Group's main task is one of co-ordination, information and promotion.

On the basis of experience accumulated and of work carried out so far it is by now clear that the attention of planners and managers, in Government and in industry, should largely focus on three cogent aspects of the energy/industry "interface":

a) The "energy for industry" aspect, which relates to the patterns of industrial development (sectors, processes and products) arising from characteristic patterns of energy availability, specially from new and renewable sources.

b) The "industry for energy" aspect, which relates to the development of a full capability for design and production of the equipment needed by the energy sector, specially for the development and utilization of NRSE

1/ Reference: UNIDO/EX/B.165 dated 23 April 1980.

utilization of NRSE.

c) The "energy management" aspect, which includes studies and action relating to national energy planning and industrial energy management. This includes specialized activities and measures such as substitution, "conservation", optimization, etc., as well as planning and action in areas such as education and training, etc.. It also includes, of course, energy management of specific industrial systems or units, on the one hand, and of infrastructural sectors such as transportation, on the other.

II. BASIC ISSUES

The review of the current situation, as reflected in various Reports of previous preparatory work for the Conference and in the voluminous energy/ industry related studies and publications, leads directly to four basic questions or issues to be considered by the participants of the E.G.M.:

a) Which NRSE have now or may have in the future a significant potential for use in industrial production ? (Issue No. 1)

b) Which sectors, sub-sectors, branches or types of industries can be effectively developed on the basis of NRSE ? (Issue No. 2)

c) What types of capital goods industries and industrial engineering services will be required to meet the needs of the NRSE sector ? (Issue No. 3)

d) What can be done, in terms of "energy management" 1/ to expand the application and to increase the efficiency and effectiveness 2/ of use of NRSE in industrial systems, plants, processes and products ? (Issue No. 4)

In the following paragraphs these issues are examined in more detail.

1) Issue No. 1 - "NRSE for industry".

The answer to the question proposed in II.a above requires a preliminary consideration of the following aspects:

a) The energy requirements for the industrialization of Dg.C.

b) The rôle of NRSE as contributors to the industrial energy supply, with tentative evaluation of the relative industrial significance of the various NRSE.

1/ Overall planning and control of energy use in quantitative and qualitative terms. It includes energy auditing, optimization, conservation, substitution, etc., at macro- or micro-level.

2/ "Efficiency" is meant here in terms of "output" compared to "input". "Effectiveness", in terms of "actual results" or "effect" in relation to a "problem".

In considering this issue, the focus of attention will be placed in the industrial energy requirements of Dg.C., since it is in these countries that requirements will expand at the faster rate and where NRSE are likely to contribute most towards the overall and/or industrial energy supply.

1.1. Tentative quantification of energy requirements in the period 1980-2000.

Developing countries will have in 1980 an estimated joint GDP of the order of 2200 billion dollars. Their total energy consumption will be about 1700 megatons of oil equivalent,[1/] i.e. 34 Mb oil equivalent/day (Their industrial output will be of the order of 450 billion dollars (MVA).

For the year 2000, a projection consistent with the Lima target would indicate a joint GDP of 9000 billion dollars (of 1980), assuming a growth rate of 7.3 %/yr, with a total energy consumption of the order of 6500 megatons of oil equivalent, i.e. 130 MB oil equivalent/day (corresponding to a growth rate of 7 %/yr of energy demand). Their industrial output expressed in MVA would be of the order of 2300 billion dollars (of 1980). Very rougly, it can be estimated that requirements for industrial energy [2/] plus energy needed for operation of transportation systems in Dg.C., by 2000, will reach values of the order of 3000 M.toe/yr (or 60 Mboe/d). This will mean an increase in energy demand for industrial (and allied) applications of the order of 2200 M.toe/yr (50 Mboe/d).

The above figures, rough estimates as they are, and "optimistic" as they may be, are still of interest for purposes of broad, long term analyses. Real figures cannot turn out to be lower than 2/3 (30 % below the values suggested and, thus, the order of magnitude of the task is the the same and could be summarized as in Table II. 1.1.

1/ Includes all Dg.C. and all forms of energy. Inter alia: "Centrally planned Asia"; "non-commercial energy".

2/ "Industrial energy" is meant here as "energy needed by the industrial sector".

TABLE II.1.1. ESTIMATE OF NRSE FOR INDUSTRY [1/] [2/] [3/]

G.US$_{80}$	1980	Factors	2000
Dg.Countries	2200	7.3% (4.1x)	9200
GDP (G.US$_{80}$)	2200	7.3% (4.1x)	9200
Industry (G.US$_{80}$)	440	8.6% (5.2x)	2300
(Share Ind/GDP)	20.1%		25.4%
Tot.Energy (Mtoe)	1700	7.0% (3.8x)	6500
Energy for Industry and transportation (Mtoe)	800	7.0% (3.8x)	3000
Share of industry and transportation	46%	Share 46% [4/]	46%
Total energy covered by NRSE (Mtoe)	800		3000
NRSE for industry and transportation	345	Share 43% [4/]	1400
Share of various NRSE (in total energy balance) (Mtoe)			
- Biomass (with fuel-wood and charcoal)	660	3.0% (1.8x)	1200
- Hydropower [5/]	120	12.0% (9.6x)	1200
- Other [6/]	20	18.5% (30x)	600
Share of NRSE in industry: (Mtoe)			
- Biomass (with fuel-wood and charcoal)			430
- Hydropower			710
- Other			260
Dd.Countries			
GDP (G.US$_{80}$)	9200	3.6%	19.600
Industry (G.US$_{80}$)	2800	3.8%	6.450

1/ UNIDO draft background paper and additional estimates

2/ Figures are rough estimates and should all be rounded. The figures proposed 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.

3/ To convert the figures in Mtoe into the equivalent installed hydropower capacity, divide by 1.25 (since 1 M.kW I.C. year = approx. 1.25 Mtoe)

4/ Share is higher if "non-commercial" energy is not considered

5/ Estimates for 1980 changed, after the Expert Group Meeting on "Industrial Issues" (Vienna, January 1981)

6/ All other NRSE.

1.2. Tentative broad evaluation of the potential of NRSE for industrial use.

On the basis of the scenario summarized in Table II.1.1. the total energy demand from NRSE, for the industrial sector of Dg.C. in 2000, may reach values of the order of 1400 M.toe/yr (or 28Mboe/d) or, for comparisons, the equivalent of about 1200 M.kW., I.C. hydropower 1/ (mechanical or electrical) or to about 5130 G. kWh in effective energy.

Accordingly, it is clear that it is necessary to consider the question of which of NRSE can make significant contributions to the overall 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 as in qualitative terms. Other NRSE are highly "location-" or "purpose-specific", and besides cannot be expected to make contributions to the overall industrial energy supply of Dg.C., in terms of quantity.

Table II.1.2. presents a concise and very tentative evaluation of NRSE for industrial application. It is no more than a tentative scenario in which the demand (about 1400 Mtoe/yr or 1200 kW I.C.) of NRSE for industry (and allied sectors) would be met in the year 2000. Yet, this would require rates of growth at the highest levels encountered today (12 % per year, for hydropower, for example) and would not cover NRSE requirements for other uses. It is a major question to be considered carefully whether this scenario is acceptable; whether it can be implemented; and if not, which are the alternatives for maximum use of NRSE in industry.

1/ M.toe/yr = Million tons oil equivalent per year
M.kW I.C.= Million kW installed capacity. = approx. 1.25 M.toe/yr
Assuming 0.3 efficiency of conversion of thermal to mechanical or to electric energy and).5 utilization factor of installed hydroelectric capacity.

TABLE II.1.2. - EVALUATION OF RELATIVE SIGNIFICANCE OF NRSE FOR INDUSTRY 1/

	NRSE AND ORDER OF MAGNITUDE OF POTENTIAL 5/	POSSIBLE INDUSTRIAL USES	APPROX.COST US¢ ELECTR. OR MECH. PURPOSES 3/	kWh HEATING PURPOSES 2/
1.	Large hydro (500 - 640 M.kW I.C.)	General urban and rural industries. Large energy-based industrial estates. Aluminium smelters. Urban transportation Railroad electrification.	0.020-0.030	same 4/
2.	Mini-hydro (50 M.kW I.C.	Small and/or rural industrial estates. Isolated medium and large scale industries.	0.050-0.150	same
3.	Biomass (including fuel wood, saw mill dust, charcoal, and agro-wastes. (300 to 400 M.kW. I.C., or 360 - 480 M.toe/ year	Already used widely for small and medium scale industries as fuelwood. Charcoal based iron and steel industries. Fuel alcohol automobiles. Rural industries. (Great potential for further development and application, in volume and diversity).		
4.	Oilshale and tar sands (1,2 Mboe/d by 2000? Or about 50 M.kW 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 petrochemicals industry.	0.070-0.100 (about same as petroleum based	0.03--0.050

1/ Reference is made to Table 19, page 43 of Wld.Bk. Report "Energy in Developing Countries" - August 1980

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

3/ US dollars of 1980.

4/ Efficiency of conversion kWh to heat assumed at 100 %.

5/ Estimated (rough) contribution in terms of power (kW) for actual use in industry (2000). (The unit used is the equivalent installed hydropower capacity, in M.kW).

(cont'd.)

	NRSE AND ORDER OF MAGNITUDE OF POTENTIAL 5/	POSSIBLE INDUSTRIAL USES	APPROX.COST U$ ELECTR.OR MECH. PURPOSES 3/	kWh HEATING PURPOSES 2/
5.	Geothermal (20M. kW. I.C.) (?)	Small to medium sized industrial estates. Isolated industrial plants	0.030-0.100	0.020-0.050
6.	Wind (5M. kW. I.C.) (?)	(unstable, discontinuous) Very small scale or "cottage" industries. Small agro-industries.	0.030-0.100	-----
7.	Other NRSE (5 M.kW I.C.) (?)	Very small scale industries, small agro-industrial installations. Special use.		

2. ISSUE NO. 2 - "ENERGY FOR INDUSTRY"

This issue has to do with the "energy for industry" aspect, i.e., the correlation between the pattern of energy availability (type, quantity, location, timing, cost, environmental impact) on the one hand and the industrial pattern (sectors, factors, size, processes, products, location, export potential, environmental impact, etc.) which can be established, on the other hand. Close analysis of the energy availability pattern will be required for any specific country, region or location, before planning, construction and operation of industrial units. Process, products and materials input and output will have to be selected or developed (after research and pilot plant work) to fit particular energy patterns, especially those in which NRSE play an important role. This will require an unprecedented technological, industrial and financial effort by Dg.C. and Dd.C.

It is important to recognize, at the start of an analysis of the co-relation mentioned above that the pattern of energy availability in Dg.C. is new and/or characteristic, specially with regard to NRSE. In fact, it is in the Dg.C. that one can find, today:

a) some of the most original and significant departures from use of conventional and/or non-renewable energy resources. For example: biogas; 100% fuel-alcohol cars; large scale charcoal based iron and steel production.

b) the largest degree of dependence on NRSE, possibly approaching 50% for the whole Dg.C. community, in their overall energy balances.

c) some of the most attractive opportunities for technological development and for investment in NRSE-based industries. For example: the hydropower potential of Dg.C. is probably in the range of 1500-2000 M.kW 1/ and most of this potential can be harnessed to produce electricity at a fraction (1/5 to 1/2) of the cost of that obtained from thermal power stations based on fossil hydrocarbons at international prices.

Table II.2.1. presents some selected typical examples of NRSE industry interaction.

1/ These figures (rough estimates) are much higher than those mentioned in the Wld.Bk.Report ("Energy in the Dg.C.") because it is felt that the latter do not reflect the latest information and the full potential of Dg.C.. For example: Brazil's potential is over 200MkW, not 90 MkW.

Table II.2.1. includes selected examples of industrial manufacturing sectors (Column I) which may appropriately use some of the NRSE (Column II) through either standard or special processes (Column III) leading to the manufacture of products, conventional or new (Column IV).

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16 January 1981

TABLE II.2.1.

SELECTED TYPICAL EXAMPLES OF NRSE/INDUSTRY INTERACTION

Sector/Factor Prod.System/Service	NRSE	PROCESS	PRODUCT
I + S Pig production (Reduct.)	Forests, Wood	Charcoal pig 1/	St. 2/
Al. smeltg.	Hydro (large/macro)	St.	St.
Organic chemicals and fuels	Biomass: Sugar-cane	"Direct" Indirect(via molasse) alcohol prod.	St. (alcohol and bagasse as fuel)
Alcohol cars	Biomass: sugar cane	St	100% fuel alc. cars
En.based ind.estates or areas	Hydro (large scale to scmall scale	St.(agro ind.small scale ind. manufact.ind. centre or complex	St.
Ceramic inds.: brick, tile, crockery porcelain, etc.	Wood (fuel)	St	St.
Food + agric. prod. drying	Solar (direct thermal)	Special ovens, kilns installations	Dried, grains meat, fish
Salt	"	Evaporating basins/ ponds	St.
Heating + refrigeration equipment + household appliances, etc.	Solar (thermodynamic)		Water, heaters, etc.
Manufact.industr. (light/medium)	Geothermal	St.	St.

1/ NB: it is the process which is different. *Pig iron produced is about same as from coke.*
2/ St: Standard/conventional

Sector/Factor Prod.System/Service	NRSE
Org.chems. Methanol	Wood
Hydrocarbon production	Shale + tar sands
Small scale or agro ind. or rural ind.	Wind (electromechanical)
Agro ind. Small ind. Rural ind.	Peat
Very small scale inds. (Special cases)	Solar (photo-electronic)
Glass (special) silicon and high temp. ceramics	Solar (thermal optical reflectors etc.)
	Agro-wastes Saw-mill dust

PROCESS	PRODUCT
Special and fermentation hydrolisis	St. (methanol)
a) Special distillation b) Special extraction	St.
St.	St.
St.	St.
St.	St.
Specially designed process and equipm.	St.
General heating/or electr. generat.	St.

Accordingly, and notwithstanding the fact that conventional and/or non-renewable sources of energy will still play the main rôle in the industrial development of Dg.C., it is apparent that this development will lead to, or maintain, a markedly different industrial pattern in Dg.C.. This new or characteristic industrial pattern, will be conditioned, in general, by a new or different pattern of social development, resources, needs, goals and capabilities, also, in particular, by a different pattern of energy availability and use in which:

a) NRSE will play a major role, possibly contributing with up to 50% of total energy;

b) New and/or non-conventional processes and products will be based on NRSE (examples already mentioned);

c) Increased share (possibly a major share) of Dg.C. in certain energy intensive industries (sub-sectors) in which the use of NRSE is particularly attractive (Ex.: the aluminium industry based on low cost electricity), creating new export opportunities.

If the above considerations are correct (or acceptable as a basis for analysis) an enumeration of features characterizing the "new industrial pattern" related to use of NRSE, in Dg.C., might include:

a) A high degree of reliance in electricity originating from hydropower, "macro" and "mini" (Ex.: over 90 %, in Brazil ; thousands of mini-hydropower installations in China).

b) A diversified, non-conventional spectrum of subsidiary electricity generating installations for use in industry, specially in the case of: agro-industries; rural industries; industrial units located in remote areas. Such spectrum to include NRSE such as: fuelwood; agricultural wastes (e.g.: bagasse, saw mill dust, straws etc.); bio-gas; geothermal energy; solar energy; wind energy; hydro-carbons from shale and tar sands.

c) A re-structuring of the world's aluminium industry (and other electricity intensive industries) to make full use of low cost kWh generated from hydropower. Such re-structuring has already started, and must be further encouraged.

d) Wide-spread use of charcoal for production of pig iron and steel, in independent, small to medium size installations (Ex.: 4.4 Mt of charcoal pig iron were produced in Brazil, in 1979). The "charcoal technology" allows viable installations from 10,000 to 500,000 tons/year for pig iron, and 50,000 to 1,000.000 t/yr for ingot steel. It must be complemented by intensive forestry management and re-foresting programmes.

e) A "revised model" for urban transportation systems, with increased use of public and private transportation based on use of: electricity from hydropower; vehicles moved by internal combustion engines using (fully or partially) non-conventional fuels (NRSE).

f) Development (or improvement) and production of automobiles, trucks, tractors, locomotives and small boats and ships using Diesel and Otto engines operating with: fuel-alcohol (from sugar cane, wood, etc.); vegetable oils; charcoal and wood-chip gas-generators; etc. (Example: in 1980 Brazil produced some 200.000 cars and trucks 1/ designed for 100 % ethanol use, the alcohol being produced from sugar cane).

g) Increased use of biomass "feed stock" for the organic chemicals industry (as alternative to petro-chemicals).

3. ISSUE NO. 3 - "INDUSTRY FOR ENERGY".

This issue has to do with the development of the capital goods industry and of the industrial engineering services necessary for development of NRSE in general (not only for the NRSE to be used in industry). In other words, it has to do with the development of a full technological and industrial capability, in Dg.C., to do research, design, produce and service a varied spectrum of capital goods and eingineering services, including:

1/ Of a total production of the order of 1 million automotive vehicles.

a) Engineering capability to plan and design installations and equipment relating to exploration and use of NRSE (the "soft ware" aspect);

b) The industrial production capability to deliver such "hardware" as:

- hydraulic turbines (Kaplan, Francis, Pelton, etc.); the corresponding generators (for A.C. or D.C.); the control and accessory equipment for hydropower stations and dams (electric and mechanical); transformers, switches and similar, for both the high voltage and low voltage transmission and distribution;
- biogas generators and ancillary equipment;
- forestry equipment, including planters; fertilizer and pesticide distributing mobile units; saws and logging equipment; wood chipping machinery; etc.;
- agricultural machinery for "energy-crops" (sugar-cane, sorghum; etc.); sugar-cane processing industry, including distilleries for fuel alcohol; alcohol transporting systems (tanktrucks, pipelines, etc.);
- charcoal and special fuel wood processing and transporting equipment;
- Shale and tar sand processing equipment, including drilling equipment; large scale open-pit mining equipment; distilleries and refineries; etc.;
- geothermal exploration equipment; heat and/or steam extraction equipment; special geothermal power generating equipment (for cleaning of natural steam and water, v.g.); etc;
- windmills and ancillary equipment;
- solar energy (electronic and thermal) equipment for a variety of solar energy capture and application technologies (from semi-conductor devices to crop drying equipment);

It can be rougly estimated that all such equipment for harnessing and application of NRSE (including up-streams and down-stream installations from primary site to plant gate, consumer door and service station) in Dg.C., in the period 1980-2000, will be worth no less than 1200 G.US_{80} 1/. Even if lower estimates are considered, it is still clear that development of NRSE will require an extraordinary effort, by Dg.C., to establish or expand their capital goods industry (even if one considers only the requirements of the NRSE sector).

The corresponding effort in terms of technology, trained manpower and finance will have unprecedented dimensions (These aspects are mentioned in Part III of this background document).

4. ISSUE NO. 4 - "ENERGY MANAGEMENT":

Good energy management has always been a problem in industrial operations and any well organized, medium or large scale industrial plant has, for decades, included an energy management unit of some sort. The problem has, however, become acute in recent years, with the scope and urgency of such programmes being increased to the point when it is receiving the closest attention both from industry and from Governments; and both at plant and national scales.

The pre-occupations with "energy management" now include, *inter alia*, such aspects as:

a) National energy planning, aimint at optimization of national energy supplies and consumption according to: national resources; priorities assigned to different consuming sectors (urban, industrial rural, commercial, etc.); problems relating to national finance, to the balance of payments and to foreign debt.

b) The optimization and improvement of plant energy balances, with special attention to: substitution for lower costs and/or for import substitution; efficiency of equipment, with close energy-auditing or monitoring; preventive maintenance for energy equipment and accessories; recovery of waste heat; diversification of sources (to ensure supply); optimization of operating schedules (to make maximum advantage of or to avoid "peak and trough" in demand and costs).

1/ Total value of installed capacity, assuming about 1250 US_{80} per equivalent hydropower kW I.C. or 1000 US_{80} per toe. y; a total NRSE demand of 3000 Mtoe/yr in 2000 and some 40% of the investment in capital goods.

c) The optimization and improvement of energy related planning and use in urban areas, with special attention to requirements of industry, transportation and commerce; and with emphasis on new concepts regarding selection, relocation, restrictions and conditions governing the use of energy in those sectors.

d) It also includes consideration, planning, programme and action relating to the "means" required to achieve the above results (see Section III).

The above, true for all energy sources and uses, applies particularly to the use of NRSE in Dg.C., where good "energy management" and reliance on those sources require the greatest attention to the aspects mentioned in a, b and c above. The approach must be, at the same time, imaginative and pragmatic.

Undoubtedly, the questions raised above will oblige all planners, entrepreneurs, managers and operators (down to small scale, specific equipment or service) involved in industrial development to take into consideration of and to take action relating to good "energy management". This will make it an imperative to train or recycle such planners, managers and operators in the intricacies of energy selection for and application in industry. Computerized, automatic and close monitoring and control systems will become an imperative and will require, inter alia, the development of new skills and new services, for successful and competitive operation of industrial and transportation systems.

III. SUBSIDIARY ISSUES RELATING TO MEANS

In Part II of this document the issues relating to NRSE and arising directly at the energy/industry interface were considered. It is necessary and appropriate to consider also the "subsidiary issues" or issues relating to the means to remove obstacles and to make good use of opportunities encountered in the effort to achieve full and effective use of NRSE in industry.

a) Three main sub-issues were selected and are introduced concisely in the following paragraphs. They can be considered as sub-issues of Issue No. 4 ("Energy management") but are singled out for consideration, in view of their importance.

1. Subsidiary Issue No. 1 - Manpower needs and constraints.

One of the significant aspects of the energy problems now facing all countries (and industry in general) is the relative lack of familiarity of planners, managers and operating personnel at all levels with the peculiarities and intricacies of energy processing and utilization, specially regarding NRSE.

The problem arises from three circumstances:

a) The fact that until very recently energy was, so to speak, "taken for granted", as a generally available and low cost "utility" which only merited special attention in certain few highly energy-intensive sectors.

b) The fact that energy is a phenomenon and an input which is difficult to handle from any point of view: in physics, in technology, in industry, in economics and in national planning. The multiplicy of forms in which it apperas (photons, electrons, mass, molecular vibrations; light, electricity, heat, mechanical power, chemical energy; etc.) together with the diversity of sources, processes and products needed for extraction, conversion, transmission, distribution andutilization make energy science, technology and economics one of the most complex areas of human activity.

c) The goods and services production system of Dd.C. has been essentially based, specially in the recent past, on energy from conventional non-renewable resources. Familiarity with the potential and peculiarities of NRSE is practically non-existent. This is most conspicuously noticeable in the extent and nature of the treatment or attention devoted to NRSE in the technical and industrial literature, where even basic and essential facts are ignored.

Accordingly, one of the concrete problems now faced by Dd.C. and Dg.C. is the lack of "energy proficient" personnel, in terms of numbers and level of qualification. This lacuna is specially noticeable, inter alia, in the activities listed below and is particularly acute in the area of NRSE:

i) Energy planning and management at national level;
ii) Ditto, at plant level;
iii) R. and D. and technology of NRSE-related processes and products;
iv) Energy "processing" engineering (extraction, conversion, transmission and distribution);
v) Energy economics (financing, investment, operating costs, etc.);
vi) Industrial equipment operation, control and maintenance for optimum energy performance.

Consequently it seems essential and urgent that educational and training programmes and activities to cover the "demand" outlined above are immediately initiated and/or intensified. Manpower needs should be covered, inter alia, by: 1/

a) Energy engineers - there is urgent need for establishment of this specialized profession and for the corresponding University curriculae.

b) Energy technicians - ditto, with establishment of the appropriate curriculae, in technical and professional schools of intermediate level, for a diversity of specialized tasks.

c) Skilled operators and workers to produce, handle and operate specialized equipment (for example: a charcoal kiln; a biogas unit; maintenance of alcohol driven motors; etc.);

1/ The listing is illustrative and is certainly not complete. V.g.: "energy scientists" are essential, but it is assumed that this is one case in which, fortunately, highly skilled physicists are already available even in Dg.C.

d) Energy economists - specializing in the economics of energy selection, costing, etc.;

e) Energy planners at macro-level.

The above needs can and must be met through regular courses, specialized training and "re-cycling programmes". It is not easy to quantify such needs globally or by specialties. This will demand detailed and specific surveys and studies. It can be roughly estimated, however, that total immediate yearly demand would be no less than 10-20 specialists per 1 million of population, in Dg.C. 1/

2. Subsidiary issue No. 2 - Technological development and related institutions and services.

It will be practically impossible to handle successfully the expansion and use of alternative energy options, specially those related to NRSE, without the creation or strengthening of technological institutions and services qualified, proficient and active in the handling of energy-related industrial problems.

Accordingly, it is apparent that a readjustment and strengthening of the Dg.C. capabilities, facililities, institutions and enterprises will be needed to cope with the technological and industrial problems relating to NRSE. These problems are functions of a large number of variables. The corresponding types of technological activities and services are also diversified to a large degree.

The questions arising from consideration of this sub-issue relate, then, and specially to:

a) Creation or strengthening of technological institutions or teams for R. and D.; testing and certification of fuels, components and equipment; design and operation of pilot plants (for processes) and/or prototypes;

b) Incentives and assistance for establishment (or strengthening) of organizations or enterprises (state or private sector) specialized in

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1/ This is indeed a very tentative estimate and is mentioned here to promote further consideration.

in industrial engineering services relating to the design, construction and operation of NRSE installations, including distribution to and inside industrial plants. Such engineering services would include such novel areas as: fuel alcohol distilleries and ancillary systems (bagasse use as fuel or for other purposes); conversion of industrial installations for substitution of conventional by NRSE; installation of energy saving equipment; etc.

c) Establishment or strengthening of specialized technological and industrial information services, including information on NRSE related patents.

3. Subsidiary issue No. 3 - Financial requirements for use of NRSE in industry. 1/

If the scenario sketched in Table II.1.1. is accepted as a basis for consideration of the magnitude of the scientific, technological, industrial, managerial and financial energy required for the use of NRSE by 2000, the following figures might be derived:

TABLE III.3.1. - ROUGH ESTIMATES RELATING TO MAGNITUDE OF FINANCING REQUIRED FOR USE OF NRSE IN INDUSTRY 2/

- Industrial energy demand by 2000	3000 Mtoe/yr
- Ditto, to be covered by NRSE	1400 "
- Industrial energy demand covered by NRSE, 1980 ..	400 "
- Additional NRSE industrial use, 1980-2000	1000 "
- Investment, 1980-2000, at 1000 US/toe/yr	1000 billion US_{80}
- Of which, in equipment and industrial services, approximately	..500 billion US_{80}
- Additional NRSE for all uses, 1980-2000 (see Table II.1.1.)	2200 Mtoe/yr
- Corresponding total investment in NRSE, 1980-2000	2200 billion US_{80}
- Of which, in equipment and industrial services, approximately.........................	1,1 $(10)^{12}$ US_{80}

1/ At the moment of writing of this document the results and final Report of the E.G.M. on Finance were not yet available.

2/ Assumptions: industry, transportation and allied sectors; all Dg.C.; all energy, including non-commercial; up-stream and down-stream investment; period 1980-2000.

The figures in Table III.3.1. correspond to only one of many possible scenarios. They are, however, consistent with the Lima target. In certain respects they are even conservative (e.g., in the investment assumed per coe/yr for up-stream and down-stream installations).

On the basis of the figures mentioned, and on the energy supply side the total additional investment in NRSE to supply industry alone would reach 1000 billion dollars of 1980 (US_{80}), for Dg.C., of which about 500 billion would correspond to equipment and industrial services. On the other hand, industry itself (of Dg.C. and/or Dd.C.) would have to supply a total of about 1100 billion of equipment to the overall NRSE sector of Dg.C..

Even if these figures are exaggerated or "optimistic" it is still clear that the financing effort relating to the use of NRSE in industry and the provision of capital goods to the NRSE sector (in general) of Dg.C. will require unprecedented volumes and facilities ("machinery") for finance.

PART B - ACTION NEEDED

In view of the questions raised and the analyses carried out by the participants of the E.G.M. in connexion with the issues suggested in Part A of this background document specific recommendations for action should be elaborated, with a view to overcome the constraints to and ensure maximum utilization of NRSE in industry and maximum contribution of industry to the development of NRSE for general use.

Such recommendations will have to consider various levels or modalities, relating to:

a) Action relating to the various stages of "energy processing", from exploration to final distribution;

b) Action appropriate to the various sectors of industry, according to NRSE relevance for their processes and products;

c) Action relating to the means for successful study, planning and development of NRSE use (technology, manpower, finance, national institutions);

d) Action aiming at regional and at international co-operation (in general);

e) Action by UN bodies;

f) Action by Governments, at national level.

With regard to item d) above, it would appear that the following aspects should receive special attention:

a) Joint projects requiring international co-operation (technological, financial, etc.) aiming at use of NRSE for industrial and transportation systems.

b) Technical assistance needed for the identification of site-specific and sector specific problems and opportunities in the use of NRSE for industry and transportation (including research, development, pilot and prototype testing).

c) Specific units or mechanisms to ensure and maximize international co-operation for the use of NRSE in industry and transportation.