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NEW AND RENEWABLE SOURCES OF ENERGY IN ROMANIA

Romania's National Paper
for

THE UNITED NATIONS CONFERENCE
ON NEW AND RENEWABLE SOURCES OF ENERGY
Nairobi, Kenya, august 1981

FOREWORD

The present paper reflects the concept of and state of the art in the current Programme of Research, Development, Demonstration and Utilisation of the New and Renewable Sources of energy, initiated in 1972 at the request of the President of Romania NICOLAE CEAUȘESCU, along with the prospects of the new energies in the country's energy economy, indicated by the "Energy Research and Development Master-Programme for 1981-1990 and the Guidelines until the Year 2000", adopted in 1979.

Observing the suggestions of the Preparatory Committee of the U. N. Conference, the paper presents some of the major technologies in commercial use, in development or under study within a series of operative projects co-ordinated by the National Council for Science and Technology under the guidance of Dr. ELENA CEAUȘESCU, Prime Vice-Prime Minister of the Government, the President of the Council: Some of the factors influencing the process of implementation of alternative energy technologies in the established energy system of the country, as well as some of the solutions to problems encountered are reviewed, and suggestions are made concerning possible ways and means of international co-operation to foster the utilisation of the new energies, seen in the context of the strive towards a new world economic order.

One attempts to substantiate the conviction that the new and renewable sources of energy make up a complemental, though necessary and important component of the national regional and world efforts of adjusting in a balanced and effective way the energy economies to meeting better basic needs, improving life quality and environment, and that such a development can be achieved by merging countries' endogenous efforts into a wide and equitable international co-operation, which can and must stand for a sound model of co-operation in all other fields among all nations.

INTRODUCTION AND BACKGROUND

Romania, a socialist developing country which had to fight over the last thirty years the drawbacks of an inherited underdevelopment had and will further have to make important efforts in view of speeding up its multilateral development, to fill the gap that still keeps it off the economic performance of the industrialized nations. The implementation of this objective implies foremost a maximal mustering of the domestic natural, labour and financial resources, an adequate and efficient accumulation, establishing an industrial and occupational infrastructure to meet the needs of a balanced expansion of all segments of the economy throughout the country, thus generating the potential for a significant participation in the international division of labour.

With this long lasting outlook and especially over the past 15 years of intense economic growth challenged nowadays by the many abnormal occurences in the world economy, the nation attached a particular importance to elaborating, adjusting and applying of a coherent national energy policy. Supported by a substantial investment effort, this policy was basically featured by the following trends:

(i) Growth of energy production, to support the overall economic growth:

year 1950 = 1 — Table 1

	Year			
	1960	1970	1977	1979
. Overall output of				
- electric and thermal energy	4.3	23.0	42.0	46.9
- fuel	2.7	5.3	7.7	8.1

(ii) Strive to an adequate correlation between the growth of the industrial production and the electric energy production acting as a prevailing common factor in the energy supply of the economic and social activity:

Table 2

	Period				
	1955-1960	1960-1965	1965-1970	1971-1975	1976-1980
. Annual average growth rate of:					
1) overall industrial output (%)	11.0	13.7	12.2	12.9	9.5
2) electric energy output (%)	12.0	17.3	15.3	8.9	4.7
. Elasticity of electric energy production (2/1)	1.09	1.29	1.25	0.69	0.49

(iii) Efforts to keep control over and moderate the growth of primary and electric energy consumption as related to the growth of the national income, via enhancing the economic efficiency of the energy use:

Table 3

	Annual average growth rates		Annual growth index				
	1961-1970	1971-1973	1974 vs. 1973	1975 vs. 1974	1976 vs. 1975	1977 vs. 1976	1978 vs. 1977
1. National income (%)	8.4	11.2	12.0	10.0	11.0	9.0	8.0
2. Overal energy consumption (%)	9.5	6.3	0.34	8.28	7.43	2.36	-0.89

	Annual average growth rates		Annual growth index				
	1961-1970	1971-1873	1974 vs. 1973	1975 vs. 1974	1976 vs. 1975	1977 vs. 1976	1978 vs. 1977
3. Electric energy consumption (%)	16.2	10.0	8.30	11.06	11.71	5.57	5.86
4. Elasticity of overall energy consumption as against the national income (2/1)	1.13	0.56	0,03	0,83	0.67	0.26	-0.11
5. Elasticity of electric energy consumption as against the national income (3/1)	1.93	0.89	0.69	1.10	1.06	0.62	0.73

(iv) Efforts to diminish the specific primary energy consumption in industry following its technical improvement:

Table 4

	Specific average consumption of primary energy (t. e. c/ million lei worth overall industrial production)	
	1975	1980
Total industry	84.4	66.4
. Metallurgy	160.0	137.5
. Chemical industry	200.7	177.7
. Wood and building materials	133.1	115.7
. Machine building	16.8	12.4
. Light industries	25.1	21.4

Although during the last 15 years major concerns have been directed towards energy conservation, the growth of energy demand appearing from the rapid development of the basic industries and transports, advancements in agriculture, deployment of services and higher living standards, have resulted in a relatively high energy consumption per inhabitant:

Table 5

Year	1961	1973	1975	1977	1979
Primary energy consumption, in kg. e. c. /inhabitant	1384	3493	3803	3934	4118
Electric energy consumption, in kWh/inhabitant	466	1882	2013	2386	2943

Today Romania's energy pattern displays a number of features of relevance for the issue discussed in this paper.

Thus, owing to the relative readiness of the domestic resources of hydrocarbons - the most straightforward way of energy supply according to the routine prevailing in the world in the '50 s and '60 s, the primary energy balance of the country has been gradually forced into a critical dependence upon these particular source. - as far as almost 40 %.

Another striking feature regards the industry's clear predominance in the national energy consumption.

Table 6

	Sectors' share in the overall consumption of primary energy (%)	
	1975	1980
A. Industry	52.0	56.5
B. Agriculture (food industry included)	3.4	2.9
C. Transports and telecommunications	4.7	3.9
D. Household and public	11.9	9.6

The industry, which contributes at present by 57 per cent to the national income, absorbs more than 56 per cent of the primary energy of the country. This is, at least in part, due to the fact that, in establishing its industrial infrastructure during the last 30 years starting from scratches, Romania had inevitably to develop primarily its basic, high energy - consuming sectors.

At last, one has to notice the existence of a national electric power grid widely deployed, centrally dispatched and interconnected with the neighbouring countries' systems - an outcome of first evidence of a centrally planned energy policy. An unceasing supply with primary resources and an ever safer operation of this system, is of essence for Romania' s economy and social life.

These circumstances call for recognizing that Romania will further appeal to conventional primary resources such as coal, hydropower, oil and natural gas - to sustain and develop its established economy, industry and energy system.

On the other hand, by interpreting the same premises in the overall context of the nation' s development strategy one can consistently derive the necessity to undertake particular efforts to widen the ranks of energy raw materials ., to diversify the energy sources.

This must is stressed by the constraint to balance better between the energy demand of industries and the economy in general and the present scarcity of conventional high-grade energy resources of the country. The permanent strive to assimilate in the economic production any newly discovered raw material and energy resource, even of low grade by common standards of economic acceptability reflects the constant preoccupation to approach better the capability of a self-sustained energy, technological and economic development.

Romania' s lasting reputation of an oil producer and exporter is fading away since the country became to import substantial amounts of crude (half of the demand), which sharpened the concern to value better this raw material.

The efforts of turning to account any available resource, from farm and city wastes and low-grade lignites up to natural gas and oil, complemented by the strive to save high quality resources proved, however, so far insufficient to hinder the negative effects of the energy crisis. At present, Romania is given a full-size experience of the impediments resulting from the present energy constraints.

Romania, a socialist developing country, considers the energy crisis as a consequence of the persistence in the world of an inadequate economic order.

The high energy - consuming pattern of industrialized societies, the conduct of quick fixes and immediate profit usually resulting in "oil mono-culture", neglecting alternatives and poor management of energy, the inequities in the world trade of energy and processed goods, along with the world splitting apart between the rich and the poor, the persistence and sharpening of underdevelopment obviously demonstrate the unfitness of the present status and call for changing it by a new, more equitable international economic order.

In approaching the energy issue top priority should be given to the demands of those the most frustrated - the developing countries starving for oil as well as for other major energy resources.

It goes without saying that in our contemporary interdependent world, for any solution to the energy problem to prove valid requires a background of wide and many-sided

international communication and co-operation, such that information, resources, labour and technology should intensely co-work to the general benefit. It is, therefore, important to value all opportunities to enlarge the mutual knowledge of the energy problems in every country and region as a pre-requisite to develop sustainable solutions.

I. ENERGY FOR DEVELOPMENT - AN ENERGY RESEARCH AND DEVELOPMENT MASTER-PROGRAMME FOR 1981-1990 AND THE GUIDELINES UNTIL 2000

In the ninth decade Romania has committed itself to further an intense and many-sided development, re-assessed rationally to fit the present status of the economy and society and also to cope with the constraints resulting from the apparent deterioration of the world economy. Table 7 presents some indices relevant for this evolution.

Table 7

	1980 as against 1975 (%)	1985 as against 1980 (%)	Average annual growth rates (%)	
			1976 - 1980	1981 - 1985
. Social product	147 - 154	133,5 - 137,5	8 - 9	6,0 - 6,6
. Gross industrial production	154 - 161	147,0 - 154,0	9 -10	8,0 - 9,0
. Net industrial production[x)]		154,0 - 161,0		9,0 -10,0
. Gross agricultural production(annual average for the five year period)	125 - 134	124,5 - 127,5	4,6 - 6,0	4,5 - 5,0
. Overall investment in economy (in five years)	165 - 172	130,0 - 135,0	10,5 - 11,4	5,4 - 6,2

x) Adopted as a decisive index in evaluating the economic results beginning with 1980

The next five years (1981-1985) open up a new stage in Romania's development concept: the nation has decided for a strategy of consolidating the economy, based upon the necessity of a substantial increase of the economic efficiency of production. Accordingly, most investments are re-directed from expansion primarily to technology and production pattern substitutions aiming at updating the processes, diminishing production costs, especially specific raw and other materials, fuel and electricity consumption, increasing labour productivity, the quality and competitivity of products, having in view medium - and long-term changes in the production pattern in favour of high-value products requiring minimal material and energy costs.

The practical guidelines of the country's advancement in the next two decades are set forth in the Directives of the Twelfth Congress of the Romanian Communist Party. On certain essential lines of action, the Congress approved, for the first time in the country's political practice, a number of master-programmes for 1981-1990 and the guidelines until the year 2000, in the field of scientific research, technological development and implementation of the technical advancement, towards a balanced development of the counties, in improving the people's living standard and in the field of energy.

Giving expression to Romania's energy policy in the next two decades, worked out under the direct guidance of the President of Romania, Nicolae Ceauşescu, the "Energy Research and Development Master-Programme for 1981-1990 and Guidelines until the year 2000" assigns the basic tasks in the field of geological research to increase the national energy potential, develop the energy production - including the utilization of the new and

renewable sources of energy - improve the electric energy system management and operation to cut-back on energy consumptions and utilize energy at a higher economic efficiency. The Programme also settles the role and the responsabilities of the governmental bodies and economic-social units in the development and appropriate husbandry of the energy flow and outlines Romania's principles of action in the international co-operation in the field of energy.

"The Energy Research and Development Master-Programme - reads the document - starts from the necessity that in the next decade Romania should achieve self-reliance in fuel and energy". Towards this goal a number of lines of action are established.

Diversification - a rational alternative

The programme stipulates as "central targets- the thorough exploration of all areas over the territory to discover new coal, oil, natural gas, radioactive material beds and to speed up the use of the energy of the sun, wind, geothermal waters and biomass".

As a consequence the inventory of Romania's primary energy resources is likely to undergo, in the medium and long-term, significant shifts to more substantial reserves, but, in general, more expensive and not free of problems.

Leading challengers will be coal and bituminous shales, whose share in the electric energy output will have to increase from 40 per cent in 1980 to more than 55 per cent in 1985. To this end, it has been decided that all new thermoelectric power stations should be designed to operate on coal and bituminous shales, all while providing conditions for the present hydrocarbon-fuelled stations to shift to solid fuel too.

Coal mining should substantially expand up to 85 to 88.3 million tons by 1985. The lignite production mainly intended for energy utilization, is to achieve 75 million tons by 1985 - which is more than three times the 1978 level - a production mainly contributed by open-cut minings. In the next five years, the use of bituminous shales as solid fuels will become a fact by commissioning of two large thermoelectric power stations, supplied from an annual production of 15 to 16.5 million tons of shales. R and D is summoned to find economical solutions of exploration, improve the exploitation methods and coal preparation technologies.

Hydropower - a renewable source of energy of a traditional status in Romania, will be intensively developed in the next twenty years mainly by building large hydro-power stations over the Danube River and important reservoirs on the in-land rivers, but also by the implementation of an intensive programme of micro-hydropower stations. Starting from the present level of exploitation - 30 per cent of the national hydro-power potential - the hydroelectric sector is to achieve 45 per cent by 1985 and 65 per cent by 1990, so that by the year 2000 the entire economic hydro-power potential of the country be exploited.

Romania is committed to a programme of erecting a number of nuclear power plants, sized according to its effective needs and possibilities. It is envisaged the achievement of an installed capacity of 660 MWe by 1985, about 4,000 MWe by 1990 and about 10,000 MWe by the year 2000.

Giving a comprehensive extension to the concept of primary energy resources diversification the Master-Programme lays a particular stress on an ever larger utilization of the new sources of energy.

According to the meaning adopted in Romania "new" or "non-conventional" energies are those:

(i) renewable through natural mechanisms: geothermal; direct solar; wind and waves; biomass;

(ii) renewable through economic and social mechanisms: industrial waste heat, refuses from farming, animal husbandry, food industry, communities (biogas and incineration), oil residues;

(iii) ignored so far owing to technical and economic reasons: coal deposits off the balance sheet, loaded in areas of rough hydro-geological conditions; bituminous sands and shales; natural reserves of lean mixtures of methane in carbon dioxide etc.

The status of "new" energy technologies is assigned to the techniques associated to the exploitation of the above-mentioned reserves as well as to a number of other high-efficiency technologies, already demonstrated - such as fluidized-bed combustion, in process of demonstration - such as coal gasification and liquefaction, advanced electrochemical storage methods, or in prospect - such as MHD; cryogenic generation, storage and transportation of electric energy, a.s.o.

Unlike the convention adopted in view of the U. N. Conference, in Romania hydroelectric power is considered "conventional" in general. Admittedly the micro-hydropower is a "new" technology, strongly encouraged at present. All the while, the raw and auxiliary material policy tends to exclude the wood from energy utilizations, intending almost any type of wood or wood scraps to processing into valuable products.

In most of the mentioned areas of the new energies and technologies, identified as such by Romanian standards, fundamental and applied research is in progress at different levels of committment - from monitoring research, demonstration projects or commercial applications of proven solutions, since the maintenance of a wide range of interests and trained capability is taken as a necessary pre-requisite of rallying in due time to any new technological breackthrough which hopefully may occur in the field of energy, any time in the near future.

Expressing at present the Romanian option for a wide energy pluralism, the new and renewable sources of energy will probably be near expectations towards the end of the century (table 8).

Table 8

%

	1970	1975	1980	1985	1990
Energy output, of which:	100,0	100,0	100,0	100,0	100,0
- hydro-electric	8,0	16,2	17,6	20,0	24,0
- nuclear-electric	-	-	-	-	17-18
- on coal and fuel shales	27,7	27,8	40,0	55,0	44,0
- on hydrocarbons	61,6	27,8	39,7	20,0	5-4
- on recovered energy resources solar and other new sources of energy	2,7	2,7	2,8	5,0	10,0

According to the Master-Programme, "in the last decade of the century, electric energy production from coal and bituminous shales will stay roughly constant, while that supplied by hydro and nuclear-power plants is due to increase; there should be a more marked growth of production from solar and other new sources of energy as well as by recovered energy which have to account for at least 20 per cent of the total output by the year 2000".

Meanwhile, by 1985...1990 the new sources of energy are expected to contribute their share especially in the low temperature heat market (below 200°C) which will keep up the level of 23-25% per cent of the total primary energy consumption of the country. In time, research and development are expected to develop the technical and economic solutions required to approach higher temperature applications, particularly by recycling large amounts of waste heat resulting from the high energy-consuming industries, by producing synthetic fuels and, possibly, by some top solar technologies.

All along this transition to a pluralistic and self-sustained energy economy the improvement of the electric power system management and operation is of essence.

Among the guidelines are: expansion of co-generation of heat and electricity by adequate siting of the future industrial and urban consumers and faster development of the existing major district heating networks; more appropiate siting of thermal power stations; simplification of the electrical networks and shortening the energy transportation distances etc.

The diversification of primary resources introduces to the consumers low-grade, low-energy density, and high-cost energy resources as well as the practice of energy recovery - both requiring important efforts of technological substitution.

Conservation - a general imperative

Cut back on consumption and most efficient utilization of all raw and other materials and energy is a particularly important demand in Romania's development programmes.

A basic target is to achieve best world figures for energy consumption per national income unit. Throughout the decade 1981-1990, an at least 40 per cent lower index averaging energy consumption per 1,000 lei worth industrial output is to be achieved and by the year 2000, the index is to be at least 2.6 times smaller than in 1980. Accordingly, a greater stress should be laid upon low-fuel and energy-consuming industries, while in the processing industries raw materials and energy will have to be better utilized.

Some of the chief lines on which action is to be taken are: up-dating the technologies and rationalization of flow-sheets, restricting the use of energy intensive materials and rise of efficiency of the energy conversion from primary to end-use forms, so as to maximize economic effects with as low as possible primary energy consumption.

Of a great practical importance, with immediate and substantial effects are the measures of recovery of energy, heat and combustible resources resulting from technological processes.

A particular concern is, by now, to lower end-use energy consumption by a rigorous reappraisal of the nature of demand and allocation of energy in the strictly necessary amount, form and quality. This operation, where technology substitution, investments and the authority of norms and rules are closely co-operating and which results both in the clear cut-back on energy consumption and in the substitution of higher quality, depletable resources for other low-grade ones, is one of the main connections through which the new and renewable sources of energy are involved in the Romanian energy conservation policy.

Thus diversification and conservation, acting as common factors of the raw and other materials and energy policy, both addressing in a medium and long-term the new and renewable energy sources, help re-assessing the role of hydrocarbons in the country's economy of resources.

The part of oil and natural gas

Oil and gas production will be limited to maintain geological reserves at an adequate level. To this end, oil extraction level will be set to 12.5 million tons per year by 1985, while the natural gas extraction level will be 26.5 . 10^9, cubic meters per year. By in-situ combustion, steam or carbon dioxide injection and other thermal, chemical or biological methods under research and testing, the oil recovery factor from Romanian beds will have to rise from 31.5 per cent in 1979 to 37 per cent in 1986 and to about 40 per cent in the fall of the century.

In all consuming sectors special attention is paid to continually restricting the use of oil and gas for burning purposes. Likewise, research is to be intensified to develop new types of fuels, synthetic included, for transportation equipment.

One can conclude that the Romanian concept on the research, development and implementation of the new and renewable sources of energy should be understood as part of the efforts to diversify primary energy resources, to utilize better and conserve energy and fuel, to release the hydrocarbons from the energy uses, aiming at providing in the shortest possible time an energy pattern compatible with a status of potential energy self-reliance.

This line will develop, at a national level and under more convincing economic performance the incipient but encourageing experience gained over the last seven years in the use of new and renewable sources of energy.

Based on a RD and D programme initiated in 1972, a trial inventory of first-generation technical solutions has been established, to support deployment of applications for the first years of the interval 1981-1985. To guide the implementation process and avoid wasting of time and means, sets of standard technical solutions have been made available for

use in different commercial projects and economic or administrative steps were taken to stir up their promotion.

By the end of 1980 more than 100 consumers in industry, farming, services and household put to work the prescribed solutions, using solar heat, geothermal waters and biogas to ease their hydrocarbon demand.

For 1981-1985, the National Council for Science and Technology has proceeded to a radical reappraisal of the activities in the promotion of the new energies, based on the stipulations of the Energy Master-Programme, drawing up a series of operative projects of research, development, demonstration and utilization of non-conventional sources of energy".

II. TECHNOLOGIES OF UTILIZATION OF THE NEW AND RENEWABLE SOURCES OF ENERGY

II. 1. Establishing of the Technology Inventory - from Feasibility Studies to Standard Solutions

In Romania, the ensuring of the new energy technologies displays distinctive features consistent with the centralized planning system. Thus,

. a decision at the political level is at the origin of the technic and economic actions towards a massive and rapid implementation in the energy economy of the new energies.

. the whole of the activities of research - development - demonstration - equipment production - investment and development of aplications meant to ensure the implementation of the decisions forms the object of a series of programmes, financed by a sliding mechanism, where the state budget subsidy, almost exclusive during the first stages, is gradually diminished, as the beneficiaries take over commercially the development and deployment tasks;

the executive authority to implement solutions is released only by the National Plan of Economic and Social Development , worked out on a yearly and five years basis, ratified by the Parliament - the Great National Assembly-by the Low of the Plan.

One of the corollaries of this way of working is that the new energies technologies, are listed under an inventory of an as clear a possible account, which, at the same time, is permanently open in order to acquire newly established technologies. To match this strive to rigor to the actual nature and problems of the new energies utilization (site sensitivity of design, costs and efficiency and the like) it was agreed that the accepted commercial technologies inventory should comprise "standard solutions" and/or "master-designs".

These are effective blue-prints of some degree of detail concerning the flow-charts, recommended furniture, the construction and assembly works, comprising also calculation guides of the efficiency elements, operation and maintenance directions, manuals, norms and standards,. rules concerning the protection of labour and of the environment, other assessment criteria.

The standard solutions and master-designs are compulsory for the designers of the commercial applications as far as the general norms controlling the specific consumption of materials, the range - type - dimensions of certain equipments and components, the volume of the due construction works and of other elements which should be observed in order to avoid excessive proliferation of hardware and mal-directed investments.

At the same time, the standard solutions and master-designs leave the execution designer a large room of maneuvre in order to adapt the background charts to the local utilities, to use local materials, rearrange the functional blocks and conceive appropriate logistics, thus observing, as far as possible, the inherent variety of the consumer requirements and stimulating the intervention in the process of the local economies.

II. 2 Technical solutions in Effect for the Utilization of the New and Renewable Sources of Energy - A Sampling

The data here presented refer to the standard solutions and master-designs already accepted or in process of approval.

For each of the described techniques there is at least one demonstration project or a commercial application in operation or under construction.

The adopted schemes are basically simple to help their acceptance by the many potential beneficiaries, also making possible the use of local materials and manufacturing facilities.

II. 2.1. Techniques for Hydropower Utilization

Among the technical options featuring the Romanian approach to hydropower one can mention the following :

- In the water management schemes, stress is laid upon the formation of important reservoirs in order to regulate the mountain flows, by erecting high dams and diverting flows of the neighbouring rivers in the main reservoir by secondary adductions. In some cases the tribute of the secondary flows proved to be 2-3 times richer than the flow of the main river. In order to concentrate the potential in stations rated at great powers, the waterfall is helped by long headraces and by locating the power station underground. Thus for instance, the main line of the adduction stretches over 13.25 km at the Argeş power station and over 20.2 km at the Lotru station. The secondary adductions amount to 29 km at Argeş and to 152.5 km at Lotru.

On the middle and low courses of the rivers which benefit by the regulation of flows via large reservoirs upstream, one builds chains of power stations of medium and small steps of water fall, sized to standard flows and falls in order to limit the variety of hydroaggregates. Thus on the Bistriţa river, downstream to the Bicaz power station, a chain of 12 stations (244 MW) has been erected, by utilizing only 4 types of hydroaggregates; on the Argeş river, the downstream chain of 14 stations (175 MW) uses 3 types, and the Middle-Olt chain, of 11 stations set in operation in 1980 (442 MW), utilizes for 10 power stations a single type of turbine with an adjustable r.p.m. according to the fall. Mention should be made of the fact that all the stations erected during the last 15 years have been equipped by the national industry either with groups of domestic conception or in cooperation with other countries for groups of a certain complexity, such as with Kaplan turbine of 178 MW, a runner diameter of 9,5 m for Iron Gates I (U.S.S.R.), the groups with Pelton turbine for the Lotru power-station, of 170 MW, for a 800 m. fall (France), the bulb turbines for the Iron Gates II, of 27 MW (U.S.S.R.).

- As concerns the micro-hydropower, as a first approach there were selected locations, displaying concentrated falls due to existent hydrotechnic works (dams for agriculture, water supplies, fish-farming, pressure breaks on adductions etc.) as well as zones of rapids or steep slopes on some secondary rivers which are not included in the main management charts etc.

The general scheme of a micro-hydropower station is given in figure 1.

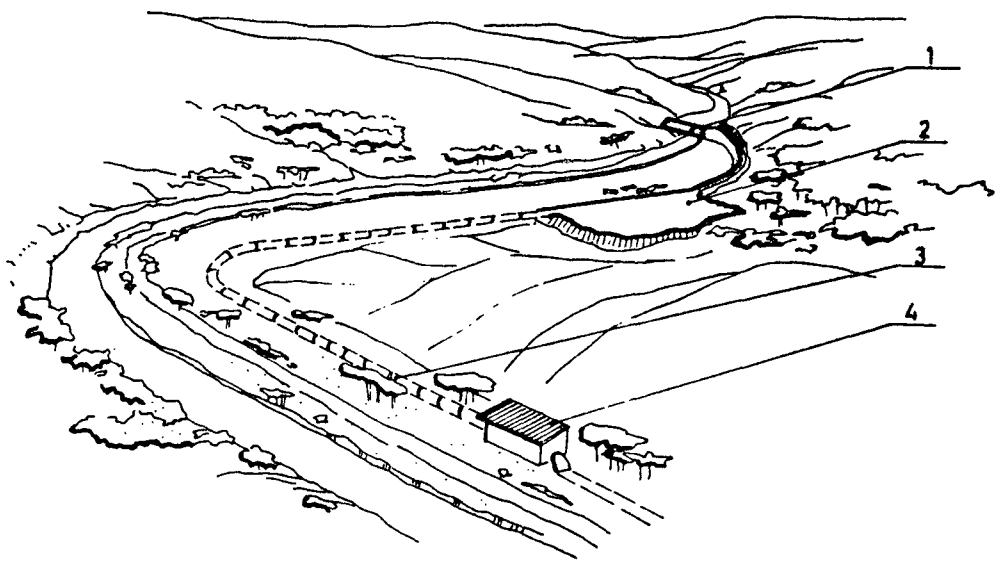


Fig.1.General Scheme of a Micro–Hydropower Station
1.Intake work;2.Compensating reservoir;3.Headrace;4.Power station

.The concept of a microhydropower-station differs from the one of a large station; it comprises standard designs for the power-station and guidelines for the other components of the facility such as intake, adduction, pools etc. So far this technical approach proved simple, robust and safe. These micro-hydropower stations can be built without requiring a special technical endowment, with labour of an average qualification and by using mainly local materials (stone, wood, clay, earth etc.) and a few ducts made of prefabricated concrete and cement.

After screening several hundreds of sites, a restricted range of turbine and hydraulic generator type-dimensions has been established, whose characteristics are shown in Table 9.

Table 9

Range of turbines for Micro-Hydropower Stations

Type of turbine[x)]	Rotor diameter (mm)	Fall (m)	Flow (m^3/s)	Power (kW)
FO 90/390	390	20-125	0,1 -0,35	10-260
FO 90/570	570	20-125	0,15-0,75	15-700
FO 125/640	640	20-125	0,30-2,00	50-1,500
FO 190/720	720	20-125	0,70-3,00	100-2,000
FO 230/720	720	20-90	1,70-5,00	250-2,000
EOS 0,5	500	2-12	0,40-1,80	5-100
EOS 0,7	700	2-18	0,70-3,70	10-500
EOS 0,9	900	2-10	1,20-5,50	15-750
EOS 0,1	1 100	2-18	2-9	30-1,300
EOS 1,5	1 500	3-25	3,5 -15	75 2,000

x) Francis turbine ; E -propeller- type turbine ; 0 - horizontal

II. 2. 2. Techniques for Direct Solar Energy Utilization

The Central Institute for Research, Design and Guidance of Constructions along with the institutes of technology design of the beneficiary branches, have authorized a series of standard solutions and master-designs, to guide the applications of the direct solar energy, among which one may note :

In household: :

. Solar hot water for apartment buildings (ground floor + 4; 2,000 m^2 flat collectors)

. Solar-passive space heating and solar hot water for apartment buildings in rural areas (ground floor + 1,63 m^2 passive + 16 m^2 flat collections)

. City hot water stations.

In public, sports, recreation and touristic facilities

. Hot water for groups of hotels (accomodation for 1,200 persons; 1,200 m^2 flat collections)

. Hot water in spa facilities (accomodation for 60 persons; 600 liters/day)

. Hot water for restaurants and motels (2 000 liters/day)

. Hot water for student campuses (62,400 liters/day).

. Solar back-up of hot water boilers for administrative buildings and schools (44 m^2 flat collectors)

In industry, building sites, animal husbandry

- Hot water on building sites (8,000 liters/day)

. Hot water for bread factories (6,000 liters/day)

. Hot water for car repair and maintenance shops (8,000 liters/day)

. Hot water for industrial enterprises (20,000 liters/day).

. Hot water for baby-beef farms (10,000 ; 15,000 ; 20,000 liters/day).

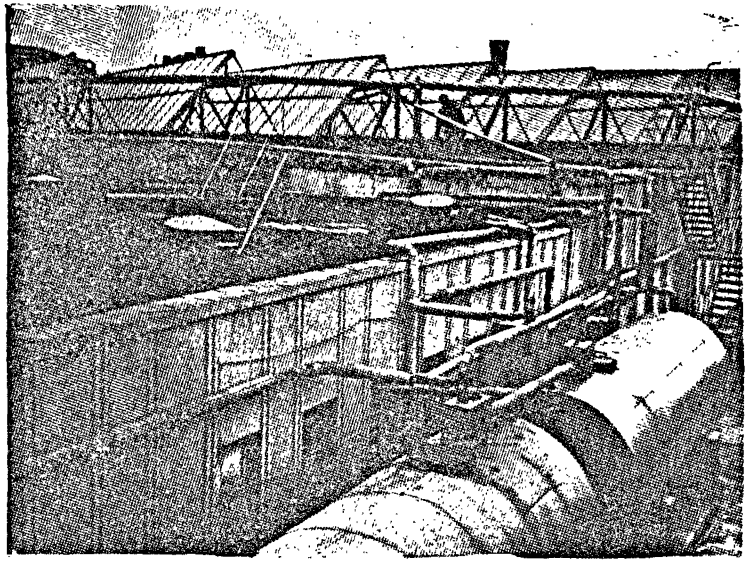
. Solar ice-making unit (100 kg/day)

. Solar timber drying unit (200 m^2 flat collectors)

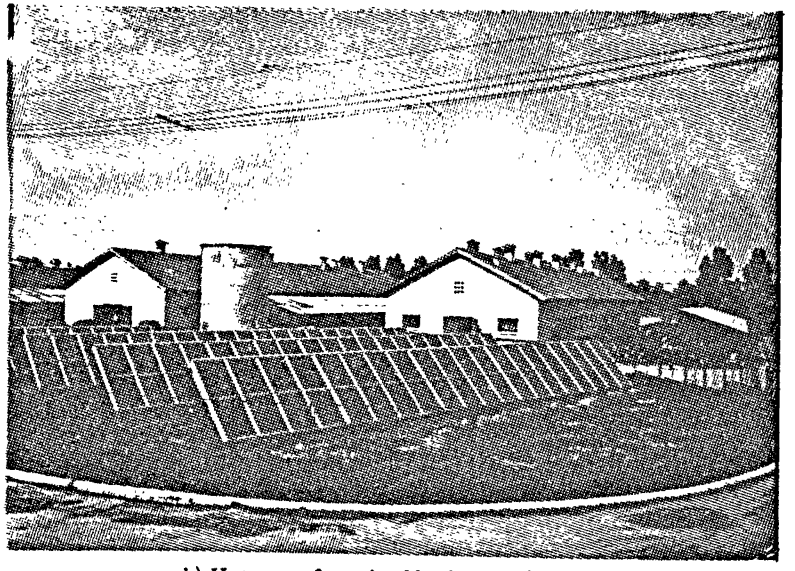
. Solar applications in the cellulose and paper industry

. Solar applications to casting sand drying

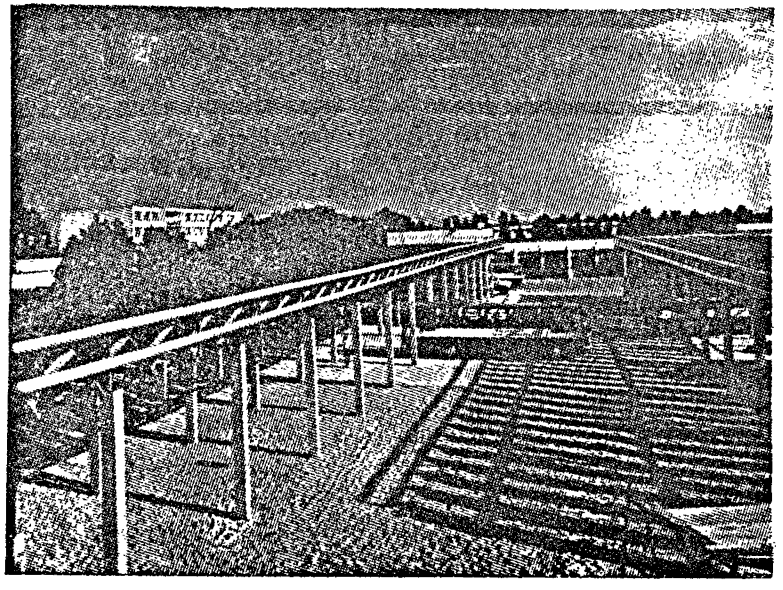
. Solar intensive drying of ceramic products (600 m^2 collectors; 5,000 m^3 hot air/h)



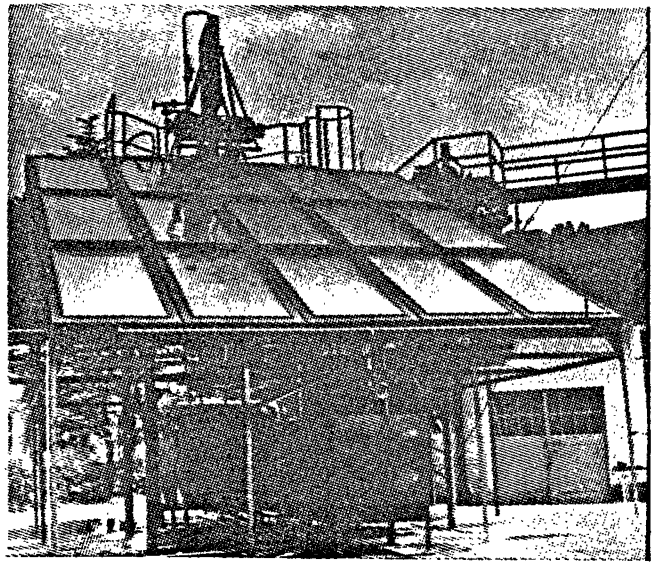
a) Timber drying in a factory



b) Hot water for animal husbandry farms



c) Hot water for hotels



d) Ice making

Photo 1. Solar Energy Applications

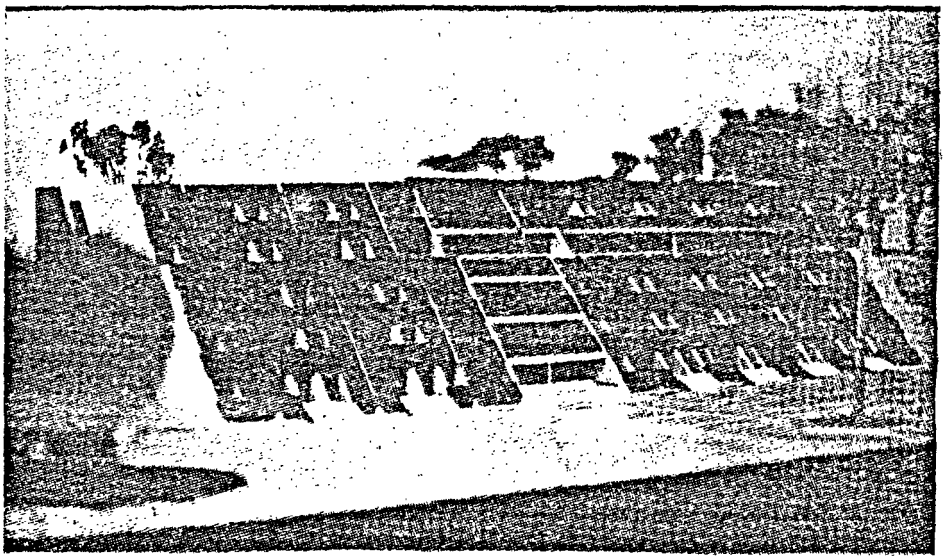


Photo 2. A Model of a Solar Hotel, Active + Passive System

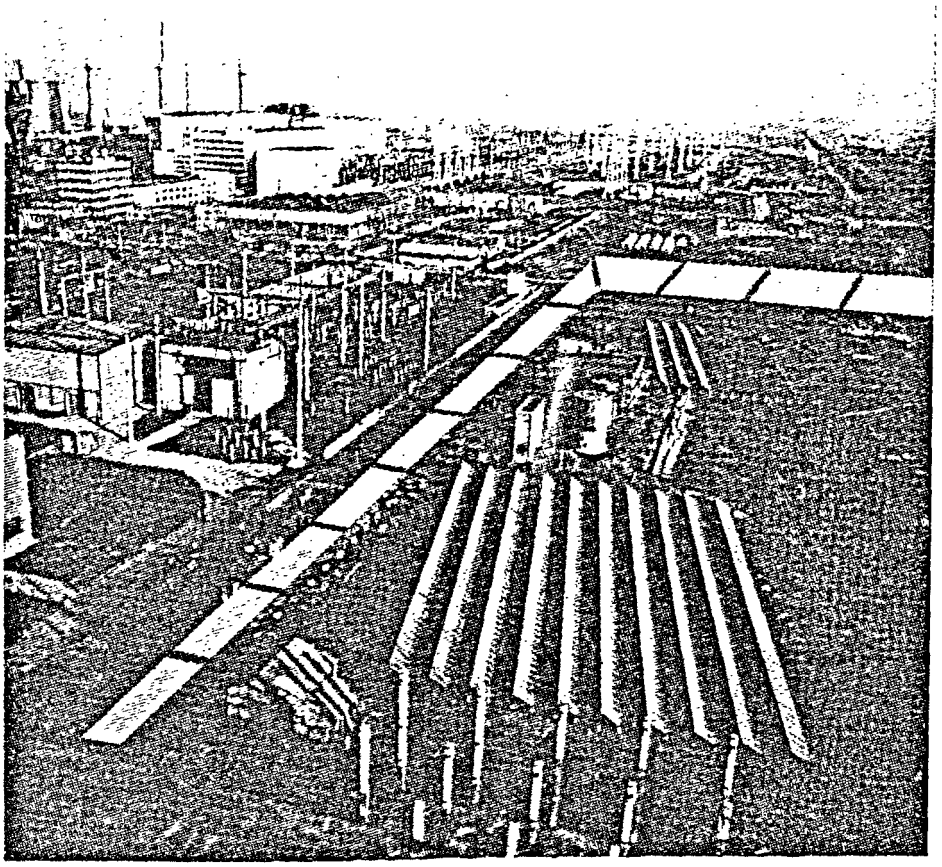


Photo 3. The Site of an Experimental Solar Power Plant of 30 kWe,
in an early state of erection (right bottom corner)

- Solar cereals drying (17 tons/h)
- Solar heaters of ponds for biological cultures (60 m^2 flat collectors)
- Solar casein dehidrating units (200 m^2 flat collectors; 600 kg/day)
- Solar heat units in the food processing industry (salami factories etc, 1 000 m^2 flat collectors)
- Solar hot air unit for flour pastes drying (360 m^2 flat collectors; 4.5 tons/day)
- Vegetable and fruits dehydration units (108 m collectors)
- Hot water for industrial buildings
- Space heating in many-floored industrial buildings, via collector walls (3,600 m^3 hot air/h)
- Solutions to assembling solar flat collectors on terraced - roofs of industrial buildings.
- Solar - maintained heat regime of biogas generators
- Bitumen solar pre-heating unit (120-600 tons/day)
- Hot water for social facilities of industrial buildings (15-25-40-60-80 thousand liters/day,
- Turbogenerator group for thermodynamic conversion of low temperature heat into electric power, to fit solar, geothermal or waste heat sources (30 KWe)

Part of these solutions are in commercial operations to 40 consumers.

II. 2. 3. Techniques for Wind Power Utilization

The Institute for Scientific and Technical Creativity in Bucharest, in cooperation with the University in Braşov, have selected so far 15 types of wind machines of the type with vertical rapid axis, with vertical slow axis and with rapid and slow horizontal axis, presented in table 10.

Table 10

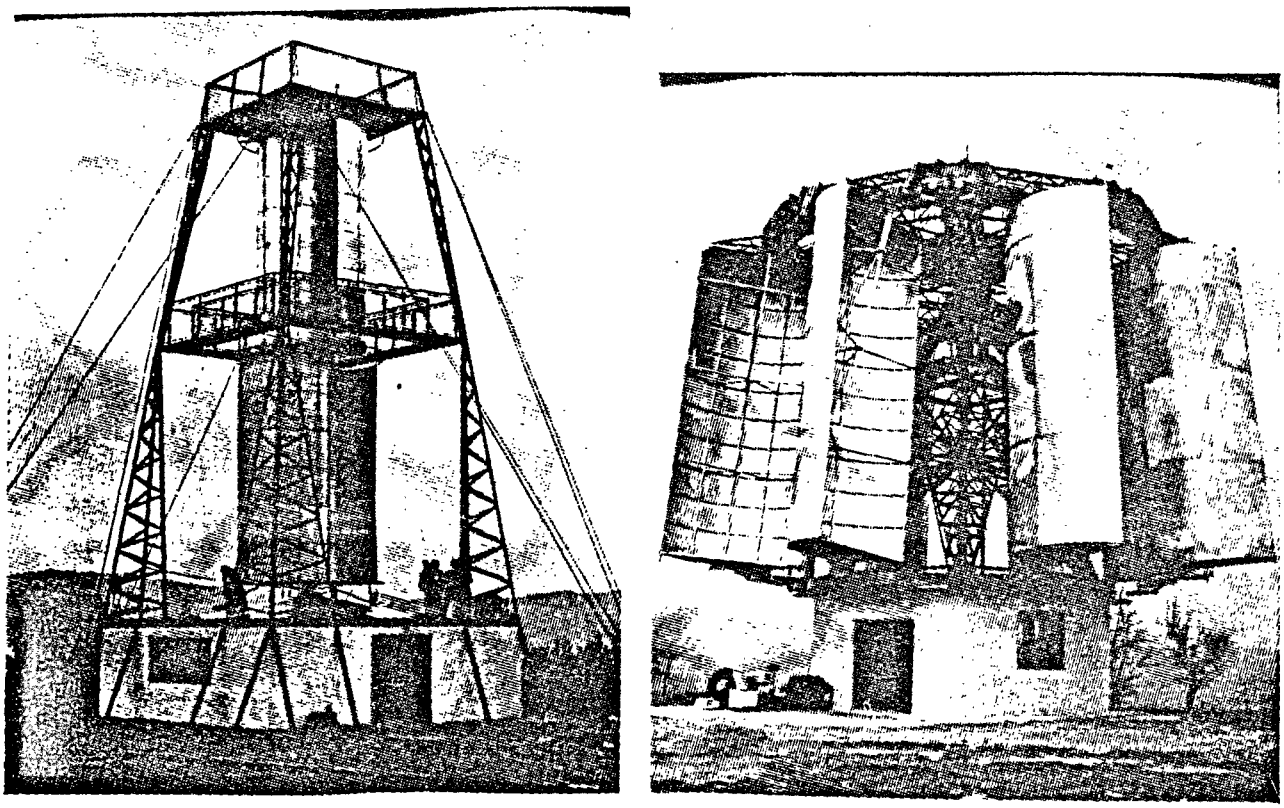
Selected Wind Machines in Romania

Type of machine	Mark	Power at a wind speed of 10 m/sec. kW	Delivering: Electric power d.c.	Electric power a.c.	Pumped water	Compressed air
Rapid vertical axis (Darrieus or Giromill with fix or variable incidence angle)	TEP	1	x	-	x	-
	TEV2	2	x	-	x	-
	TEV6	6	x	x	x	-
	TEV20	20	-	x	x	x
	TEV50	50	-	x	x	-
	TEV100	100	-	x	-	-
	TEV500	500	-	x	-	-
	TEV1000	1,000	-	x	-	-
Slow vertical axis with variable geometry	TEGV10	10	-	x	x	-
	TEGV30	30	-	x	-	-
	TEGV100	100	-	x	-	-
	TEGV300	300	-	x	-	-
Slow and rapid horizontal axis	TEO 10	10	-	x	x	-
	TEO 50	50	-	x	-	-
	TEO 100	100	-	x	-	-

So far their use was limited only to demonstration projects, the production of equipments being scheduled beginning with 1981.

II. 2. 4. Techniques for Biogas Production

The specialized institutes of design in agriculture, food industry and animal husbandry have considered, up to now, 3 types of technologies for production of biogas out of refuses from the respective fields of activity, namely :



a) Savonius Rotor

b) Variable pitch-turbine

Photo 4. Demonstration Projects

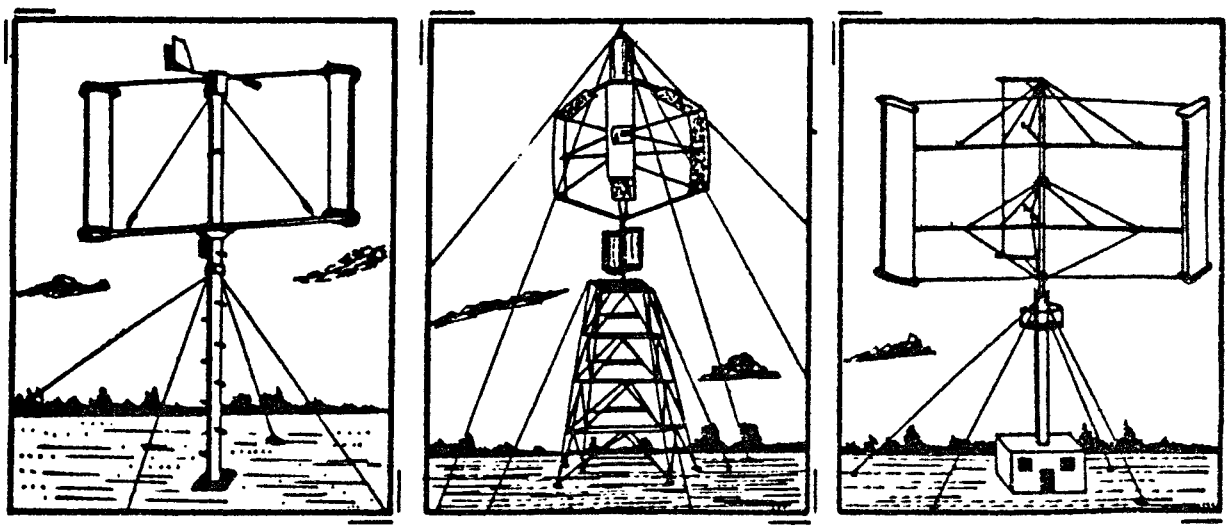


Fig.2. Other Types of Vertical Axis Machines, under Experiment and Evaluation in Romania

(i) intensive anaerobic fermentation in mesophilic regime ((35 + 2)°C) in industrial, controlled fermentors supplied continuously or by batches with sludges resulted from urban or by residual waters decantation or with animal refuses at high concentrations (5-8% dry substance)

(ii) anaerobic fermentation in a natural regime, with simple installations of small and medium size in rural areas for private households or collectivites ;

(iii) contact anacrobic fermentation in mesophilic regime, in industrial, controlled fermentors continuously supplied with industrial residual waters.

The standard solutions have been applied so far to 15 utilities.

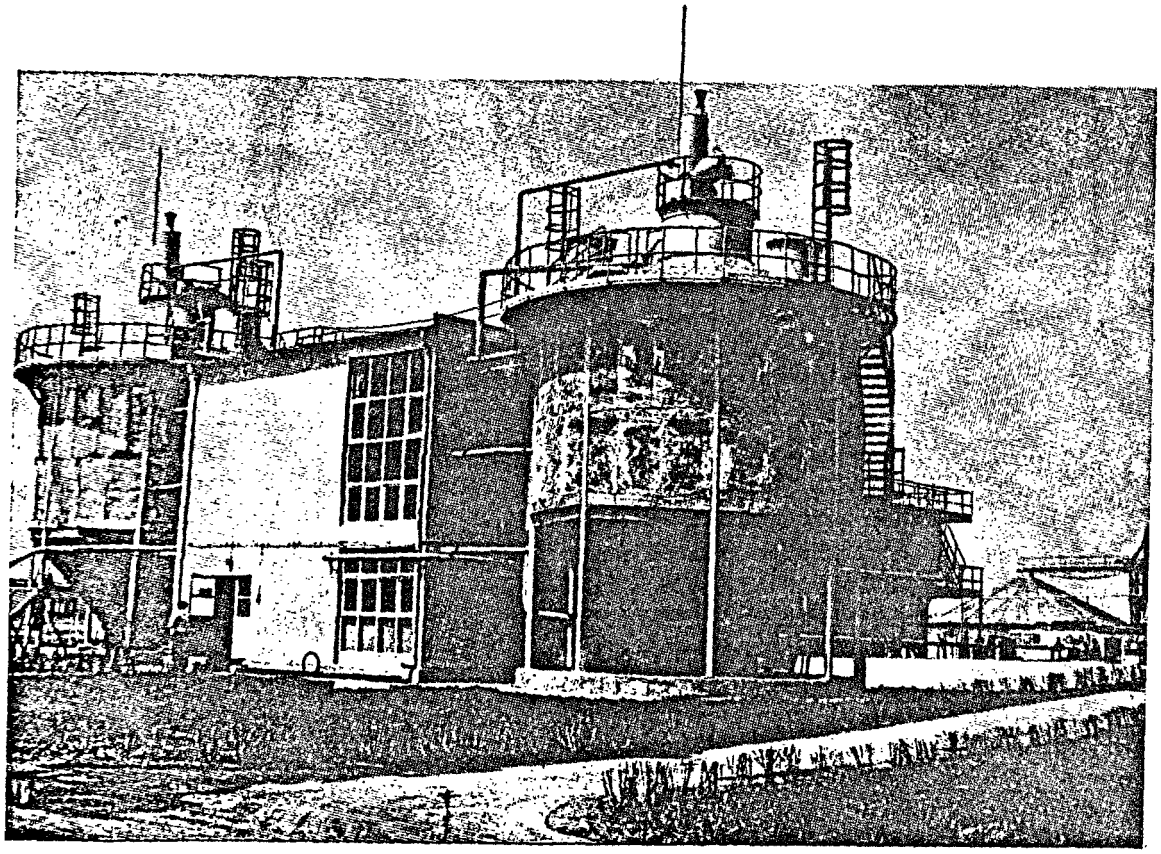


Photo 5. View from an Experimental Biogas Plant, in an Animal Husbandry Farm

II. 2.5. Techniques of Urban Solid Wastes Utilization with Energy Ends

Based on the experience acquired on a pilot for urban domestic solid wastes burning of 5,000 t year, the energy institutes of the machine building industry have developed an industrial utility project of a modular incineration plant, to be applied near residential areas of 150-200,000 inhabitants where the optimal technical-economic conditions are gathered.

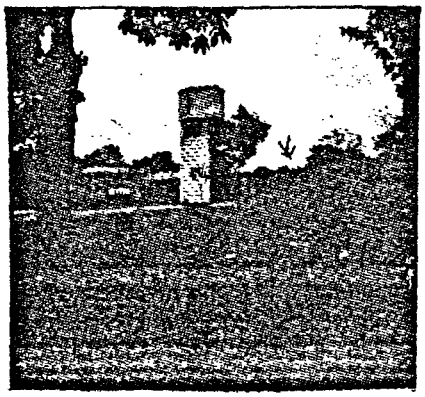
The first industrial facility will be comissioned this year at Iaşi, to process 72,000 tons of solid wastes a year.

For another 5 facilities, the investment documentations are in course.

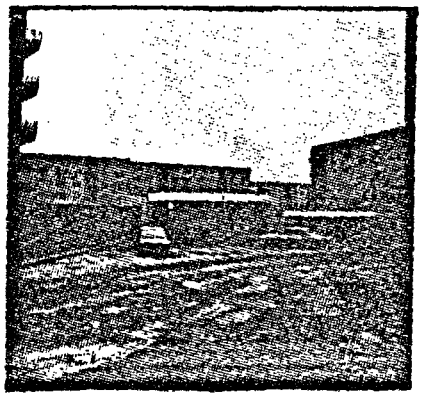
II. 2.6. Techniques of Geothermal Waters Utilization

The Central Institute of Research, Design and Guidance in Constructions along with design institutes agreed on series of standard solutions and master-designs of geothermal waters utilization, among which one can mention:

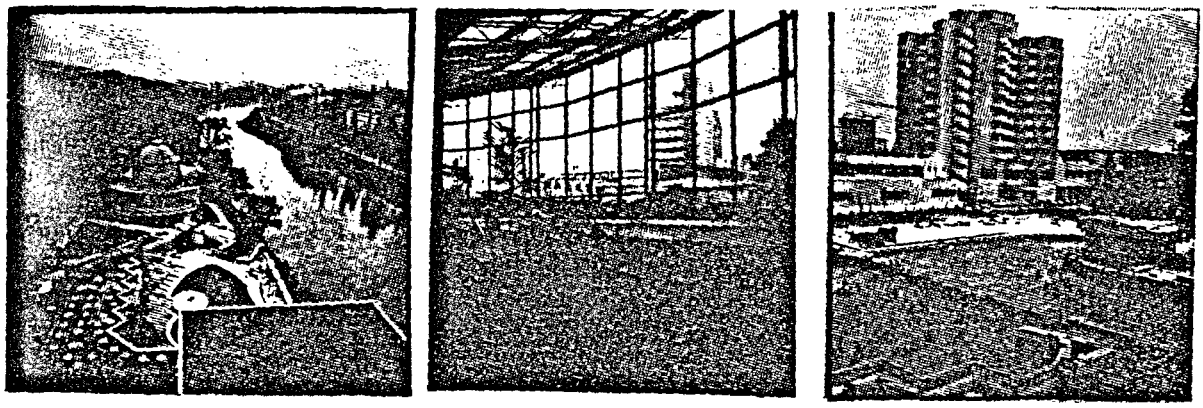
. Hot water preparation by direct or indirect utilization of geothermal waters (45...60°C) ;



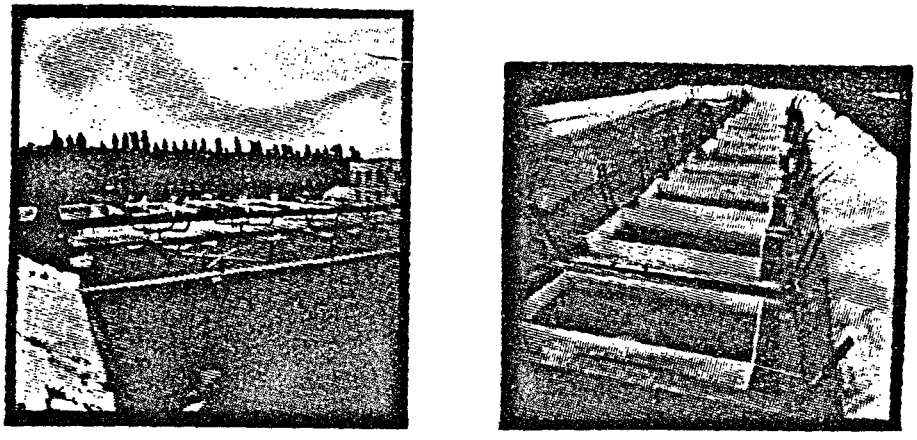
a) A Hydrogeothermal Wellhead in a City Area



b) Hot Water and District Heating (in front of the building – the heat plant)



c) Greenhouses and Spa and Touristic Facilities



d) Fish farming

Photo 6. . A Typical Sequence of Utilization of Geothermal Water

. Hot water preparation by heat recovery from waste geothermal waters with a heat pump (30°C waste water);

. Hot water preparation with heat from mesothermal waters, with a heat pump (30-40°C)

. Hot water preparation and space heating, with geothermal waters of high temperature (80°C)

- Hot water preparation and space heating with geothermal waters at medium temperature with hot water boilers peak source (50-80°C).

. Hot water preparation and space heating with mesothermal waters with a heat pump and hot water boilers peak-source (30-50°C).

. Hot water preparation and space heating with geothermal water at medium and high temperatures with hot water boiler peak source (60°C).

. Hot water preparation with geothermal waters at temperatures ranging from 50-70°C without additional source.

. Hot water preparation with a heat pump using geothermal waters at temperatures ranging from 25 to 50° C.

. Hot water preparation with heat pump by recovering the heat from waste geothermal waters in the temperature range of 25-35°C.

. Hot water preparation and space heating, using geothermal waters in the temperature range of 90...100°C without additional heat source.

. Hot water preparation and space heating - using geothermal waters in the temperature range of 50-90°C with hot water boilers - as additional source

. Hot water preparation and space heating - using geothermal waters in the temperature range of 35 - 60°C with - heat pump and hot water boilers as additional sources.

. Hot water preparation and space heating using geothermal waters in the temperature range of 70-90°C with hot water boilers as additional source.

- Greenhouse of a block type for higher temperature water
- Greenhouse of a tunnel type for lower temperature waters.

Some of these solutions have been already used in 65 utilities.

II. 2.7. Technologies of Waste Heat Utilization - Heat Pumps

The Central Institute of Research, Design and Guidance in Constructions together with the Central Institute for Energy Research in Bucharest have developed so far 4 standard solutions of heat pump implementation to recover waste heat from industries or hydrogeothermal applications :

. Waste heat recovery from the industrial process waters, using heat pumps of 0.1 G. cal/h or 0.6 G. cal/h respectively.

Waste heat recovery from the released geothermal waters using heat pumps of 0.1 Gcal/h or 0,6 Gcal./h respectively.

Three applications have been registered so far, and another 10 utilities are preparing appropriate investment documentations.

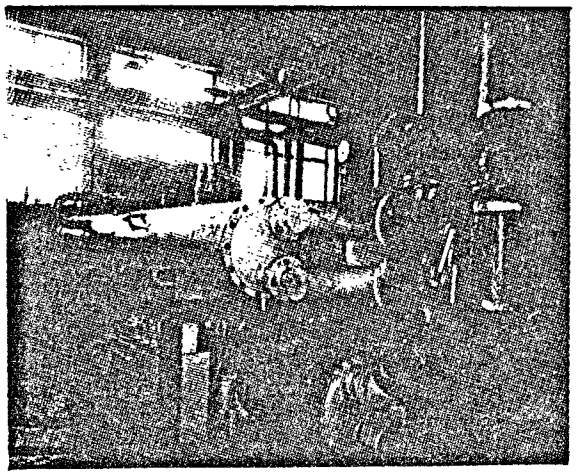


Photo 7. Experimental heat pump

I. 2. 8. Other prospective projects

In compliance with the Energy Master-Programme, in addition to the resources reviewed in the preceding sections, the Romanian operative projects promote a series of other initiatives in the field of unconventional energy sources and technologies, for which RD and D is entertained at various levels of committment.

Oil: hydrocarbons from heavy distillates and petroleum residues

Recycling naphta vacuum distillation residues requires development of integrated flow-charts to balance demands of fuels, carburants and raw materials for chemical processing, starting from the said residues.

Pilot research developed several lines of turning to account petroleum residues. The residue processing yields petrochemical raw materials made of olefine and aromatic hydrocarbons, hydrogen and methane ; ingredients for the metal-working industry as well as high - purity sulphur (over 99%), fuels and carburants are obtained as by products.

Coal: fluidized-bed combustion and conversion to synthetic fuels.

The projects aims at a more efficient utilization of the energy potential from the organic mass of lignites having a high content in non-combustible ballast (water and ash). The fluidized-bed combustion technologies takes as reference a lignite of about 1,200 kcal/kg, shredded at 0-5 mm.

Starting from the present pilot units, R and D will boost the installation of over 1,500 reactors producing up to 10-100 Gcal/hour, and 50-100 ton steam/hour.

Moreover, gasification and liquefaction technologies suitable for indigenous coal are developed. Starting from the present pilot design, building and operations, in the next five years about 50 gasifiers at normal pressure are to be built and installed for small users, substituting for a hydrocarbon consumption of 200,000 t.e.c/year . Also, at present, option studies are undertaken for an appropriate process to gasify under pressure indigenous low-grade coals.

Field experiments in course are to test underground gasification processes of some coal resources unaccounted for, owing to prohibitive mining costs. In the event of overcoming the difficulties and gaining experience in the layer fracturing and underground combustion control techniques, this technology could have an impact on the gas supply of some industrial users in selected areas, after 1985.

Unconventional methane : carbon dioxide deposits poorly mixed with methane, as a source of alcohols and hydrocarbons

Appropriate processes are to be developed to convert natural lean mixtures of methane in carbon dioxide into methanol, and, hopefully, for obtaining methane by biological conversion of carbon dioxide. To use the methanol, internal combustion engines have been designed and tested mainly on gasohol-type mixtures. Field tests are currently conducted on the vehicles of several institutions.

Turning to account poor resources : synthetic fuels from tar sands and bituminous shales

Preliminary research showed that certain varieties of indigenous bituminous shales, apart from those meant for direct burning in specially designed thermal power plants can yield shale oil. This brought also in view some possibilities to process in the same purpose tar sands.

The selected processes yield from these poor raw materials gaseous, liquid and solid fractions which can be converted into petrochemical products, fuels and carburants.

Biomass, as a direct source of fuel alcohols and hydrocarbons

Complementally to the conversion of waste biomass into biogas and fertilizers, research is conducted to develop appropriate processes to produce alcohols out of fresh agricultural and forest biomass, of a prevailing cellulosic starch structure or containing direct fermentable sugars.

Back-up research aims at selecting high energy value forest biomass (poplar, willow etc.) fit for superintensive crops, with as short as possible productive cycles; farming of water biomass of energy interest ; thermochemical and enzymatic processes for conversion of fresh biomass with a prevailing cellulosic structure; higher utilization of sulphite residual solutions from cellulose production and other.

Other research :

the hydrogen — Application of R and D on hydrogen, started in 1975, is sought after 1985...1990.

Hydrogen production in electrochemical and photo-electrochemical systems, coal electrochemical gasification, fermentation processes and water photolysis via micro-organisms are attempted.

In hydrogen storage, where interesting tests on metal-hydrides were conducted, research is directed towards development of low-cost hydrides of an increased storage capacity and sorption rates. Hydrogen engines and catalytic burners have also run experimentaly in Romania.

MHD topping of steam cycles — Monitoring research have been conducted in the field of magnetohydrodynamic (MHD) generators since 1967. A first near-zero power MHD generator, hinted in 1970 to the domestic feasibility in this field. As a next step, an experimental unit was set up by own efforts, provided with all sub-assemblies requested, with a MHD generator of 1 MWt, operating by combustion-obtained plasma.

Advanced electrochemical sources — In relation to the emerging problems of storage of energy produced by the new and renewable sources, with their rather random yields and low energy densities and flows, as well as for meeting some current needs of commercial electrical engineering, a deeper involvement was sought to develop improved and advanced electrochemical sources. Three lines were followed : performance increase by technological improvements of the current production of cells and accumulators (lead-acid accumulators, alkaline cells etc.) R and D fo some novel electrochemical sources (primary elements in the Zn/Ag_2O system, Ni-Zn, Na-S, $Zn-Cl_2$ accumulators, Li/copper, lithium chlorides, iron sulphide, metal-air systems, hydrogen-oxygen and hydrazine - hydrogen peroxide fuel cells, photoelectrochemical systems etc.) ; electrochemical methods and techniques to reduce energy consumption in industry (electro-active cathodes for natrium chloride electrolysis through the diaphragm process, ion exchanger membranes for electrochemical conversion, electrolysis and electrosynthesis, coupling of hydrogen cathodic generation to anodic electrosynthesis processes etc.)

Fundamental research in physics, chemistry, biology and interdisciplinary fields — Basic resarch programmes were due to room some more pertinent energy topics. In physics, research were directed towards heavy and super-heavy ions, study of some direct conversion processes of the energy of nuclear fission fragments, production of photovoltaic materials et al.; in chemistry, a special attention is given to photochemistry, electrochemistry and physical chemistry, carbochemistry, hydrogen, chemistry of fermentation etc. in biology, biophysics and biochemistry, the photosynthesis mechanisms and muscle contraction are studied and the role of water in living systems is emphasized etc. Physics, mathematics and engineering support interesting research in gravitation.

When seen from the stand point of their intrinsic complexity and difficulty, such dearing endeavours of a country of limited resources are of a marginal impact. The real benefit of these activities is, however, the building up and maintenance of an endogenous capability to join eventually the efforts and breackthroughs of the world research, providing grounds for committing decisions in the fields of achievement proved to be efficient in the future.

III. PROBLEMS AND SOLUTIONS IN THE IMPLEMENTATION OF THE NEW AND RENEWABLE SOURCES OF ENERGY

III. 1. A survey of the interest and commitment factors in the Development of the New Sources of Energy in Romania

Among the motive forces of the new energies implementation, of prevailing significance are:

a) The need to release oil and natural gas from energy utilisations

In spite of the marginal impact, in the nearly forseen horizon, of the new forms of energy on the large scale energetics, they already operate as a paradigm of conserving the premium resources, of a necessary and accepted energy austerity, and of the committment to attempting a more pluraliistic and safer energy order.

b) The availability of a segment of the consumption sector for low-temperature heat (below 200°C)

Numbers of potential consumers are drawn in the process of implementing the new energies by State suport to introduce adequate alternative technologies and, in the same time, by measures to limit the allocations of premium fuels towards those wich, as a rule, may satisfy their energy demand by means of low-temperature heat and lower shaft power.

c) A self-reliant development policy, as far as resources and efforts

A constant element of the Romanian developing policy, this conduct is expressed in the unceasing strive to utilize all the country's resources, regardless their useful content, even in severe conditions reaching at economic efficiency.

d) Large public adhesion to the convictions and decisions on the new energies at the political level

The convictions and decision at the political level towards a vigorous promotion of complemental ways and means of energy supply are encouragingly answered at, by numerous initiatives to employ new forms of energy not only in the professional media, but also by spontaneous commitment of communities and citizens.

The present technical and economical pattern of the country, with its specific energy requirements as well as the paramount request to save energy, metal building materials etc. require a certain effort of adjustment to the alternative energy technologies, wich have to consider, inter alia, the following:

- The constrast between the unit power installed in the national electric power system and those which can be achieved from new and renewable sources of energy, still sharpened by the contrast between the centralized, as against the disperse nature of the two systems.
- The relative limited share of the new energies in the energy supply of an ever more industrialized economy, requiring high quality power.
- The high cost of the substitution investments.
- The high initial material cost of the deployment programmes, connected with the innitial crash supply of energy and energy-intensive materials.
- The economic risk to invest massively financial means and materials in deploying first generation technologies.

Finally, additional efforts are required, to provide a suitable manufacturing capacity for necessary equipments and materials.

III. 2. The Partners of the Programmes: A Co-operation Matrix for a Rational and Efficient Promotion of the New Energies

The above mentioned trends express themselves through the concrete and permanent action of the system, of its competent institutions.

The table 11 hints to the interaction and mutual influences amoung different sectors in the process of developing and implementing the new sources of energy in Romania:

At the political level a strong emphasis is put on a permanent enlargement of the country's energy basis and for its best utilization.

At the tactic level:

- The R and D departments are elaborating, testing, demonstrating and homologating processes and hardware to using the new sources of energy, delivered as standard solutions and master-designs.

Table 11

Partners of the Programmes on New Energies

←, ↑ - motives and constraints

Strategic (political) level:		Tactic level				Operative level
		RD and D, homologation and standard solutions	Planning investments in deployment	Assessment of demand and control of energy and fuel consumption	Establishment and monitoring of prices	Energy consumers: investors in and beneficiaries of the new energies
Logistic level	Technical-material supply	↑	↑	←↑		↑
	Financing from state budget and from the departments' funds of development	←				↑
	Investment financing		←	←	←	↑
	Application design capacities	←	←	←	←	←
	Equipment manufacturing capacities	←	←		←	←
	Construction-assembly capacities	←	←		←	←
	Institutions, laws and regulations	←	←	←	←	←

The nature of the proposed solutions is strongly influenced by the logistic constraint of material savings particularly refering to the energy-intensive ones. The solutions should also take into account the design, equipment manufacturing and construction-assemblying capacity, which should be periodically cheked up and adjusted appropriately.

– Planning the investment in commercial applications of the new energies is where the constraints of material savings and the inherent limits to the capacity of design, equipment manufacturing and construction - assembly are taken into consideration analitically and solved properly.

– The department in charge with assessing demand and controlling consumption of electric power and fuels has a stimulating part in the promotion of the new sources of ener-

gy. It has to investigate systematically the possibilities of meeting the energy demands from recoverable or other nonconventional resources to any available or potential consumer.

– The investment financing, equipment design and manufacturing and construction - assembly activities are subject to the normative influence exerted by the state function to establish and monitore the prices all over the economy.

At the operative level, the energy consumers addressing the new energies as both investors and beneficiaries are due to balance motivations and constraints, observe the requirements of material and financial savings, and solve their problems of fitting or retrofitting their energy consumption to new energies on sound grounds.

Logistic forces are also the institutional system co-ordinated in the field by the Co-ordinating Council of Energy Development and Functioning of the National Grid, and the legal framework, adopting laws and other pertinent regulations.

III. 3. Rational Development and Management of the Energy Resources, including the New Sources of Energy - a National Objective

Following the Energy Master-Programme, energy plans are worked out at the economic unit and territorial levels, aiming mainly at meeting local demands with local resources and emphasing the new and renewable energies and strict energy savings.

Stress is laid upon the improvement of the activities carried out by ministries and synthesis bodies. Explicit tasks are set for:

– The Coordinating Council of Energy Development and Functioning of the National Grid, asked, inter alia, "to play a major role in the promotion of new solutions and technologies which ensure lower consumption and the utilization with increased economic efficiency of electric energy an fuels" and also "to act directly for... the faster introduction into the economic flow of the new sources of energy."

– The State Planning Committee, which "must see to the adequate incorporation of the provisions of the Programme and of the means to fulfil them in the Single national economic and social development plan, while working firmly for their translation into life, for the capitalization of the planned resources and the observance of the planned energy consumption norms, for the improvement of the country's energy balance and the updating in optimum conditions of the national economic structure, which should ensure the faster advance of the highly efficient processing industries and the limitation of energy-consuming products to a strictly necessary amount".

– The Ministry of Technical-Material Supply and Control of Fixed Assets Administration, which is assigned the task to control the ground of the energy consumption norms on the basis of the latest results in science and technology, the strict observance of the norms set, "strongly fighting indiscipline and waste, and channelling the activity of all economic and social units toward the national husbanding and saving of energy".

The National Council for Science and Technology, whose prevailing role results from the conviction that "the implementation of the provision set by the Programme also means highly complex and responsible tasks to research and technological engineering which are called upon to elaborate the theoretical and practical principles and the technical solutions necessary to supply the energy demanded by our country's accelerated economic and social development". In this respect the Council, "alongside the central research institutes, should mobilize all scientific forces to the solution of the complex problems posed by the discovery and capitalization of the new sources of energy, the modernization of technologies and production patterns, the cutting down of consumption and the saving of fuel and electric energy energy. The research and technological design institutes co-ordinated by the Council "should take into account the necessity that everything they develop - technical solutions and new products - be characterized by low consumptions of energy, of hydrocarbons in particular, be based on the larger use of new sources and ensure a high economic efficiency of enery consumption".

Specific tasks are also set for the Ministry of Mining, Oil and Geology, the Ministry of Electric Energy and the Ministry of the Machine Building Industry, which has to ensure, inter alia, "the introduction and manufacture of (...) equipment for the capitalization of the new sources of energy".

The economic ministries, centrals and enterprises should "act for the strict rationalization and steady lowering of energy consumption in all fabrication processes, for the rapid generalization of advanced methods of economizing on energy". In designing new capacities it is necessary to ensure "the introduction of uptodate, energy efficient technologies, inclusive of those based on the new sources of energy".

In support of the country's endogenous efforts the Ministry of Foreign Trade and International Economic Co-operation is asked "to pay special attention to developing the co-operation ventures with other countries in the energy domain, according to the guidelines set in the Programme".

The Master-Programme is persistently seeing to the involvement and mustering of all decision-making and executive factors, of all social and professional categories, each community and citizen in the re-shaping and improvement of the energy system of the country, recognizing a political dimension of the energy problem - of being a paramount national issue.

IV. THE NEW AND RENEWABLE SOURCES OF ENERGY - AN EMERGING FIELD OF GENERAL INTEREST FOR THE INTERNATIONAL CO-OPERATION

As the President of Romania, Nicolae Ceauşescu stated "...Under the deepening of the world energy and oil crisis, we consider it necessary to achieve an active cooperation on an international level, with a view to discover and turn into account new energy sources as well as to put them at the disposal of all countries under advantageous conditions".

IV. 1. International Co-operation as a Key Factor of Promoting the New Energies

The implementation of the Programme of Energy Research and Development provides the prerequisites for an ever more intensive promotion of Romania's co-operation and collaboration with all the world states, with the international organizations interested in the equitable and efficient solution of the problems posed to mankind by its needs for energy and the rational utilization of this energy.

A prioritary importance is granted to the cooperation aiming at solving the problems regarding the enlargement and turning into account of the energy raw material basis and of the hydropower potential, acceleration of the nuclear power implementation, more rapid an efficient utilization of the new and renewable sources of energy, elaboration and implementation of modern technologies to save fuels and power in all fields of activity.

Romania will intensify its collaboration and co-operation with the socialist countries, the developing countries, the developed industrialized countries regardless their social system, on the grounds of the principles of observing the national sovereignty and independence, non-interference in the internal affairs and the mutual advantage.

Aware of the part and contribution the United Nations Organization and its specialized bodies and institutions can and must have in the development of international co-operation, including the energy field, Romania will participate actively in the implementation of joint research programmes sponsored by the United Nations Organization as well as in regional and/or any other appropriate cooperative actions, aimed at solving the energy problems.

IV. 2. New and Renewable Sources of Energy - A Field of Long-term Mutually Advantageous Co-operation between Developed and Developing Countries

The new and renewable sources of energy represent a novel emerging field, in rapid formation, of the international cooperation. The present experience in this field, though only a beginning, demonstrates convincingly the existence of encouraging possibilities for the development of an international co-operation in the benefit of all states.

The fact that, so far, a market for technologies and equipment of the new and renewable sources of energy has not yet been accomplished, even if it looks like an impediment, offers the possibility to act from the very beginning in order to form this market in tune with the requirements of the new international economic order, thus doing away with the traditional pattern which permit continuation of the monopoly practices on science and technology, the utilization of the latter as an instrument of control on the less developed countries.

A great importance would have, in this respect, agreeing upon appropriate steps and actions, which , starting from the necessity to satisfy the actual needs of all countries, and especially of the developing ones, should ensure broad and non-discriminating access to the technologies in the energy field, eliminations of all artificial barriers hindering an equitable trade of goods and know-how.

The developing countries should, at the same time, be backed by the international community in their efforts with a view to form and develop their own capacities and technologies to turn into account the new and renewable sources of energy, according to their national profile and pattern of interests.

The share of the developed countries possessing experience, technology and economic power in the development of the patrimony of energy technical solutions can and should be increased. The responsibility of the developed countries concerning solutions to the world energy problems is of essence. Even ignoring the historical roots of this responsibility, its present pragmatic motivations should be emphasized in connection to the universal desire of leaving the present energy crisis behind, which may come true by using ways and means to be largely found at the disposal of the developed countries: technology and capital . Mobilizing part of such means in the actual interest of the energy development of the developing countries serves obviously also the cause of the energy security of the developed countries.

On the other hand, the developing countries, the energy non-favoured countries should actively participate in the identification of the most adequate forms of international co-operation in the field of the new and renewable sources of energy, starting from an exact determination of their needs and resources.

These recommendations originate in the conviction that the field in formation, not yet eroded by noxious practices and biassing precedents, of the promotion by co-operation of the new sources of energy, can and should be a good example of all states - developed and developing - readiness and willingness to imagine and turn together into reality a new conduct of international economic, technical, scientific and political relationship, aiming ultimately to a gradual achievement of a new, viable, long-lasting energy order, to everyone's satisfaction.

Adoption of practical steps and action which should lead to these ends should represent the main concern of the UN Conference for New and Renewable Sources of Energy. When working out and adopting such steps, the following aspects should, inter alia, be considered:

- Recognizing the new and renewable sources of energy as one of the long-term, complemental , necessary components of the energy policies of all states, as an important driving force in the transition process towards a fair and better general energy order,

- Subscribing efforts to turn into account the new and renewable sources of energy to the general effort to ensure each nation enough energy to meet fully their needs rationally determined as far as quantities, forms and quality.

- Replacing the practice "market first, then co-operation" by the objective of creating a market in co-operation, which implies a systematic inferring of the technology inventory for the utilization of new sources of energy from the actual needs of the consumming entities; assuming by the affluent countries of natural responsibilities in developing performant , efficient technologies; formation of capital flows and qualified personnel; assistance to the developing countries; massive and early committment in the development of the new energy technologies of endogenous efforts and resources of raw and other materials, finances and personnel; eliminating the traditional constraints of commercial restrictions or/and political emargoes in the field of technology transfer; adoption of certain "technological styles" and energy policies capable of leading gradually and smoothly to those modifications and adjustments which shall prove desirable in the economies' profiles - and the associated energy consumptions-of the countries etc.

- Securing a climate favourable to the promotion of the new sources of energy by realistically and fairly balancing the raw material prices, including the energy, against those of the processed goods, including the technologies.

IV. 3. Suggested Action to the International Co-Operation in the Field of New and Renewable Sources of Energy. The Role of the United Nations

The establishment of a fair and steady energy order within the framework of the new international economic order is achievable, also being a political and moral necessity.

Despite the present difficulties and some worrying previsions entailed by direct extrapolation of the present trends in the energy field, one considers that there are good chances for the present state of energy crisis to be overthrown.

This presupposes a constructive approach by an international dialogue on the still debatable problems in the energy field, with a view to find solutions which should meet the immediate requirements as well as the medium and long term needs of all states and especially of the energy-poor developing countries.

Romania's view is that international co-operation in the energy field, including the new and renewable sources of energy, should concentrate, inter alia, on the followings aspects and should materialize in specific actions for :

a) Ensuring of an adequate correlation between the conventional sources and the new and renewable ones, which should enable, together with a rational utilization and conservation of the classic resources, an increase of the new energies' share, with a view to create in each country sound energy economies and an implicit protection of the environment.

This presupposes that the states possessing classic energy resources should continue to ensure an adequate supply to meet the rationally determined demand of the energy-poorer states which, in turn, should do their best to develop the utilization of some new energy sources. At the same time, the states possessing the technology for the new energies utilization should ensure to all interested countries fair access to them.

They also should help the countries which commit themselves to developing and implementing new sources of energy in the process of reassessing their energy requirements - to identifiy those demand areas which can be satisfied as soon as possible and with maximum economic efficiency by means of new and renewable sources of energy, together with a rational definition of those developmental requirements for which the high quality conventional energy resources - mainly oil - are still indispensable.

b) Development of technologies suitable to an efficient utilization of the new and renewable sources of energy.

In this respect, priority should be assigned to:

- a tight correlation between the emerging technologies of utilization of the new sources of energy and the range of specific energy requirements the most likely to be met by these sources; formation in close co-operation with regional and national bodies of sets of solutions, recommendable on a regional and/or national level, depending on local potential of renewable resources and on the demand profile these can satisfy in the first approach and with maximal efficiency;

- a most judicious correlation, in a conservative way, when designing techniques and applications, of the requirements of maximal performance, technological simplicity and accessibility, lowest material costs - especially of energy-intensive and scarce materials - and financial efforts; substantial utilization of the expertise of the regional bodies with a view to direct part of the effort of technology substitution towards the new and renewable sources of energy, as adequately as possible with respect to the beneficiaries' needs and actual possibilities; increasing, in this way too, of the competitivity of the new energy technologies;

- paying special attention to the development of energy technologies for an autonoms or quasi-autonomous supply of the areas lacking access to major power systems, including rural areas and small local industries;

- observing the necessity of providing a wide access for all interested countries, and especially for the developing ones, to the pertinent technologies, inter alia by avoiding excessive charging of technical solutions with elements susceptible of technological, economic or political embargoes;

- setting up fast mechanisms for the acceleration of technology transfer in the field of the new and renewable sources of energy towards all interested countries; utilization of the joint bilateral and/or multilateral projects of research, development, demonstration, equipment manufacturing, personnel training and commercial applications for the parties and/or third parties, as a viable scheme to shorten the technology transfer cycle;

- assistance by the industrialized countries of the developing ones to form their own capacities for development and assimilation of pertinent technologies, design, equipment manufacturing, to foster the utilization of the new energies in accordance with the national profiles of demand; the regional and national bodies should help elaboration of guide-books, manuals, case history collections and other documentation in order to avoid error re-making, achieve maximal labor and means savings in promoting the new energies.

c) Development of scientific and technological research for the utilization of the new and renewable sources of energy and the ensuring of a fair dissemination of results

One can envisage:

- foundation of subregional, regional and interregional research centres for resource survey and the development of the appropriate technologies of exploitation;
- forming of international research networks;
- establishment of continuous and efficient information flows and exchange of experience between the national research authorities;
- assistance to the developing countries in forming and developing domestic research capacities;
- establishment of joint research, development and demonstration projects by two or more countries.

d) Formation of personnel in the field of utilization of the new and renewable sources of energy, a field of particular importance, within wich special attention should be paid to:

- assisting the developing countries in forming domestic personnel training units;
- providing, by the developed countries of suitable training mechanisms for the personnel from the developing countries, considering the resources profiles of these countries;
- endowment of the training units in the developing countries with equipment, instruments, documentation as well as teaching personnel, when needed.

e) Ensuring of the financial resources necessary to the deployment of the new energy technologies, especially by increasing the funds alloted in this respect by the developed countries and by other countries.

f) Development of co-operation between the developing countries in the field of the utilization of the new and renewable sources of energy.

Romania's view is that the debates of the UN Conference for New and Renewable Sources of Energy should yield and ample Programme of action which should reflect these and similar suggestions and which, when implemented, should contribute efficiently and directly to the development of the international co-operation in the field of the new energies, with a view to meet optimally the rationally determined energy requirements of all states.

The Programme of action should assign an essential part to the United Nations Organization, materialized, inter alia, in:

- establishment of the necessary framework to debate and adopt operative action in compliance with countries' interests, to develop the utilization of the new and renewable sources of energy;
- mustering of increased financial resources for the purpose;
- elaboration of pertinent studies, programme and project proposals at a national, sub-regional, regional and international level;
- establishment of a suitable co-ordination of the activities in the field of the new energies entertained by different specialized institutions of the UN system;
- establishment of adequate mechanisms to monitor the and ensure implementation of actions agreed upon at the international level in the field of the new and renewable sources of energy.

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