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UNITED NATIONS CONFERENCE ON NEW AND
RENEWABLE SOURCES OF
ENERGY

NEW AND RENEWABLE SOURCES OF ENERGY IN ITALY

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. Administrative structure for dealing with new and renewable sources of energy

Italy's energy policy is formulated, directed and co-ordinated by the Ministry of Industry. The technical body responsible is the "General Directorate of Energy Sources."

The Ministry of Industry prepares the National Energy Plan (NEP) which defines both long-term and immediate energy objectives.

This machinery is used to develop proposals considered necessary to promote the use of new and renewable sources of energy (NRSE).

The executive bodies responsible for achieving the energy objectives laid down are the competent public agencies (enti pubblici). Each of these, within its own field, is also responsible for planning activities for the use of NRSE with a view to developing local energy resources and reducing as far as possible Italy's dependence on foreign supplies.

The main public agencies dealing with energy are:

- ENI (Ente Nazionale Idrocarburi - National Hydrocarbons Agency) whose priority task is to ensure Italy's supply of energy resources;
- ENEL (Ente Nazionale Energia Elettrica - National Electric Energy Agency) which ensures the national supply of electric energy;
- CNEN (Comitato Nazionale per l'Energia Nucleare - National Committee for Nuclear Energy) which deals with research, development, experimentation and promotion in the field of nuclear technologies, NRSE and energy conservation.

Scientific research, including matters related to NRSE, is the task of the Minister for the Co-ordination of Scientific and Technological Research, who prepares the National Energy Research Plan (NERP).

The first programme in the energy sector, and in particular in that of NRSE, was promoted and co-ordinated by the National Research Council (NRC). Under this programme, in which Italian industries and universities participate, some forty contracts have been awarded for the application of solar energy in the civil and agricultural sectors and for the production of process heat.

In 1979 the Ministry of Foreign Affairs, the Ministry of Industry and the major Italian industries established the International School for Solar Energy and Other Renewable Sources of Energy (ISSE), which provides high-level training for Italian and foreign workers.

2. National consumption of energy

In 1979 the consumption of energy in Italy was 149.05 million tons of oil equivalent (mtoe) or 2.63 toe per capita. This figure is fairly close to average consumption in the other industrialized countries.

This consumption of primary energy is broken down as follows: (1) oil 68.8 per cent; (2) natural gas 15.5 per cent; (3) coal 7.7 per cent; (4) water and geothermal 8,3 per cent; (5) nuclear 0.4 per cent.

A special feature of Italy's energy situation is its dependence on foreign sources for primary energy supplies (83.2 per cent). Oil is largely responsible for this dependence. It represents 68.8 per cent of primary energy supplies.

In 1979 final consumption of energy amounted to 108.1 mtoe, broken down as follows: industry 35.9 per cent, civil sector 28.1 per cent, transport 24.9 per cent, agriculture and fisheries 2.3 per cent and non-energy uses 8.8 per cent.

Final uses of energy were: 24 per cent in the form of oil, 12 per cent in the form of electric energy and the rest for the production of heat (23 per cent

high temperature, 8 per cent medium temperature and 33 per cent low temperature).

In view of its favourable hydrogeological situation, Italy will make substantial use of water and geothermal sources. At the moment these sources meet 27 per cent of national electricity demand.

The use of other renewable sources (solar, wind, biomass, etc.) has gone beyond the experimental stage. Many advances have been made but the contribution of these sources to the satisfaction of national demand for energy will be marginal over the short and medium term.

Objectives and policies for 1990

Although calling for an increased supply of between 3 and 3.5 per cent a year, the National Energy Plan for 1990 aims at holding back total demand to 200 mtoe. This will be achieved by an active policy of conservation designed to gradually reduce the coefficient of consumption elasticity to 0,7 At the same time Italy will reduce the share of oil in the consumption of primary energy. For the moment, it will be frozen at the present import figure of 100 mtoe. Coal, nuclear energy, gas and NRSE will be developed to the full and priority given to national energy resources.

To ensure the security and continuity of supplies, the objectives are to diversify sources as regards type and area of production and to build up sufficient strategic reserves.

In addition to this supply policy, Italy is already making technological choices which will help its industries to improve the quality of their products and to sell them on the international market.

Role of new and renewable sources of energy in Italy

4.1 Background

According to the NEP forecasts, new and renewable sources of energy will

account for about 7 per cent of energy demand by 1990. By that time, allowing for increased consumption, 4 mtoe of oil will have been saved. Most of the contribution from NRSE will come from an expanded hydroelectric sector. Residual water resources are to be tapped and formerly abandoned hydraulic power stations reactivated. In view of the expected success of current exploration and that planned during this decade, geothermal sources should allow a subsequent saving of oil of about 1 mtoe. A similar saving should be achieved by the use of NRSE, especially solar energy.

4.2 Main technologies

4.2.1 Solar energy

Flat plate collectors

In Italy low-temperature solar technologies requiring flat plate collectors, are well advanced. Current research is now concerned with systemization and heat storage (day/night and interseasonal).

In final uses almost one fifth of national energy demand is absorbed by the production of low-temperature heat. Obviously, therefore, the spread of this technology can play a major role over the long term.

At the moment, the steadiest demand is for low-temperature heat for civil, agricultural and industrial purposes obtained from solar collectors rather than electric heaters. In 1979 some 60 firms produced a total of about 100,000 m^2 of flat plate collectors. Italian production is highly diversified: manufactures include regular plates, plates with selective surfaces and plates with absorbers made of steel, aluminium and copper.

With a view to eliminating undesirable uses of electric energy, ENEL is conducting an intensive promotional campaign for the replacement of electric heaters with solar heaters. Its programmes are aimed at the installation of

200,000 solar heaters in the next three years and 1 million by 1990.

The domestic market should expand considerably with the entry into force of Law No.655 which provides incentives of up to 30 per cent of the cost of solar installations.

The Government is studying closely the problem of the quality of the solar products marketed. Many centres are engaged in checking the conformity of products with the claims of producers and in providing certificates of reliability.

Concentrating collectors

Italian industry has also mastered the technology of parabolic and cylindrical/parabolic collectors. It has consolidated this experience with the operation of important pilot projects in Italy and abroad.

The limited use of these collectors is justified even though the medium-temperature heat produced absorbs a little less than 5 per cent of total demand in final uses.

Italian industry is taking part in the building of the Almeria plant, projected by IEA, which includes collectors covering a total area of 10,000 m^2 for the development of 500 KW of power.

Cylindrical/parabolic plants for the production of process heat have already been built in the textile, tanning, chemicals and food sectors. Two twin plants have been installed on the islands of Lampedusa and Pantelleria for the desalination of sea-water with multi-stage systems.

According to the National Energy Plan, in the next three years the national energy agencies (CNEN, ENEL, ENI) will carry out a $10 million programme for the

installation of 10,000 m^2 of collectors with different technologies of use and for the manufacture of components.

The agencies will be responsible for the compilation and dissemination of results.

Central-town plants

In this sector Italian industry has more than 20 years of experience and has achieved brilliant successes, which place it in the forefront of world development.

This experience has gone into the construction of the tower plant at S. Ilario near Genoa, the first of its kind in the world, built in the early 1960s on the initiative of Professor Giovanni Francia, under the sponsorship of the CNR and with the co-operation of Italian industry.

The experiments, conducted successfully, have enabled ANSALDO to acquire technical mastery of ground reflectors, solar tracking, the thermic cycle and the receptor or focal point. The first power station at S. Ilario was of 15 KW and consisted of 30 m^2 of reflectors activated by "Francia" tracking motors. Subsequently, Professor Francia designed the fourth plant of 90 KW with 135 m^2 of reflectors operated by 143 tracking motors.

The tower plant of Adrano (Sicily), generating 1MW sponsored by the European Economic Community and operated with Italian, French and German co-operation, has enabled ANSALDO to design a special boiler for which the prototype was the receiver for the present S. Ilario plant.

A unit with tower-mounted and ground reflectors has been built by ANSALDO of Genoa on behalf of the Institute of Technology of Georgia University (USA).

Italian industrial efforts in this sector are directed towards the export

of technology to the developing countries, where the lack of electricity grids justify the installation of such plants to satisfy the needs of self-contained and isolated communities.

Italian industry is participating in the EEC pilot project which will have a thermodynamic system at two temperature levels for industrial processes.

Photovoltaic conversion

Photovoltaic conversion offers the most encouraging prospects for the production of electricity, especially for small-scale use in self-contained and isolated localities. The present cost of photovoltaic systems still present their large-scale use in countries with highly integrated electricity grids, although today and even more in the future, photovoltaic installations may be technically and economically advantageous. Italian industries, especially those linked with State agencies, have prepared development programmes for the provision of complete systems for a variety of uses.

Under the new National Energy Plan, public buys will permit the installation of PV plants up to 1 MW year in 1983 and 10 MW in 1990.

It is expected that by the end of the 1980s the industry will achieve an annual production of 50 - 100 MW.

Besides there research activities, co-ordinated in the last few years by the National Research Council, Italy is developing a pilot programme which includes the installation of photovoltaic systems of various sizes. Recently, the National Electricity Agency and CNEN decided to plan and build in southern Italy, where the climate is similar to most Mediterranean countries, a generating

plant with a peak production of 1 MW. This project, known as DELPHOS, will be the biggest photovoltaic plant in the world.

In this field also Italian industry is working under a number of bilateral agreements between Governments. Programmes have been prepared for the implementation of projects in arid or isolated areas involving direct intervention or co-operation with local units.

4.2.2 Wind energy

Both the theory and practice of wind energy technology, which is still evolving, are relatively simple: raw materials are cheap; there is a maximum transformation of energy; and operating costs are low, being confined almost exclusively to labour.

According to our estimates, the cost of a KWH of power produced by small wind generators (80 per cent fixed costs) should be economically competitive in the next five years in rural areas not served by electricity grids.

In the research field, CNR and CNEN are preparing a complete wind map with exact indications of energy needs and the presence or absence of electricty grids. At the same time, industrial research and development is moving in three directions: wind installations with storage and hybrid installations combining wind with photovoltaic and biomass.

Among the most important developments we may cite:

- A wind-powered motor (CSN-0501) generating 4KW with a wind speed of 10.5 m/s, built by CESEN (FINMECCANICA);
- The building by ENEL-FIAT of 50KW prototypes with winds of 12.5 m/s.

4.2.3 Biomass

Technological processes for the use of biomass (disposal of urban wastes, direct combustion of agricultural residues, biogas, biomass, alcoholic fermentation, etc.), generally well-known, are being developed in Italy also, with a view to their improved application.

The problem of how to get rid of urban, industrial and agricultural wastes has existed for some time because of its impact on the environment. With the advent of the energy crisis, we have had to rethink this problem and search for appropriate solutions whereby we can recover these byproducts in order to produce energy. At the moment, as the latest progress shows, we have more or less acquired the necessary technologies. Strenuous efforts are now being made, in the research field, to reduce the costs of installation and increase the efficiency of biomass operations.

As regards the direct combustion of wood and lignocellulose residues in general, studies are being conducted of methods of rationalizing harvesting and storage operations, the efficiency of combustion and the possibility of automating the loading of furnaces.

As regards biogas (methane gas obtainable from the anaerobic digestion of animal wastes, urban sewage and other organic residues), Italy has launched a research and development programme which entails substantial financial investment.

Italy is also involved in the transformation of cellulose residues into ethyl alcohol.

Incidentally, a new interest is being shown in the first part of the process, the transformation of cellulose into sugar; the second phase may be tackled by the traditional technique of alcoholic fermentation.

In the biomass sector, Italy is conducting a series of studies designed to ascertain what "energy crops" are best adapted to the country's climatic and agricultural conditions, which are not very favourable.

Attention is also being given to the use of ethyl alcohol and methyl alcohol as fuel substitutes. A comprehensive programme of research and development has been organized with two main objectives. As regards ethyl alcohol, CNEN has reached an advanced stage in experiments for the transformation by hydrolysis of cellulose products discarded in agricultural operations (straw, clippings, maize stalks, etc.). As regards methyl alcohol, ENI has already programmed a pilot plant on an industrial scale for transformation from gas or coal (mainly of national origin).

4.2.4 Hydroelectric energy

Water is the most important energy source in Italy.

At the beginning of the 1960s this source was able to meet almost the total demand for electric energy in the country. It has gradually been superseded by oil to the point where in 1980 the production of hydroelectric power (48 billion kWh) met 26 per cent of this demand.

ENEL has carried out a pilot study of the remaining hydroelectric resources which are still technically harnessable, apart from their economic desirability.

The results of this study show that water power will contribute about 7.5 billion kWh per year. The study makes provision for some 60 small generating stations, most of which should be in operation by 1990.

Special mention should be made of pumping stations, a sector in which Italy has achieved a first-rank position in the European Economic Community.

As is well known, these stations do not actually increase the energy supply but help to regulate it by controlling the changing pattern of consumption over the days, weeks and seasons.

Pumping stations already built, or in the building or planning stage, will account for a total power supply of more than 7,000 MW. They are situated along the Alpine range near the Italian frontier, close to the primary European grid. This will enable Italy to exchange substantial amounts of electricity with other interlinked European countries. It will be able to export "power services" and also to balance the loads of these countries by importing electric energy from them.

4.2.5 Geothermal energy

After water power, geothermal energy is a fairly important source of renewable energy in Italy.

In this sector Italy can claim a unique experience because it was in Italy, at Larderello, that geothermal energy was used for the first time, at the beginning of this century, to produce electricity.

At the moment Italian geothermal sources at Larderello, Travale and Monte Amiata constitute an installed power of 240 MW. They account for an annual production of 2,7 billion KwH or about one third of world geothermal production and 1.4 per cent of Italian demand.

Italy's remaining geothermal resources (according to ENEL estimates) should yield an installed power of about 2000 MW and a potential of 900 billion kWh in 50 years (the period during which this resource is expected to become exhausted).

Low-temperature geothermal resources offer a much more reliable supply. They yield geothermal fluids at temperatures below 130° C. Obviously, their development depends on an adequate demand for heat near the geothermal sources.

Systems based on "hot dry rocks" are interesting from the point of view of

technical development. But their industrial use is still far off and depends on the acquisition of suitable technology and the solution of numerous problems.

Also of technological interest are Italy's "magmatic" systems. Their industrial application is also a long way off. In the Italian geological situation they are related to the "dry hot rocks" systems.

The operational programmes of ENEL and ENI, which are conducted as joint ventures in the geothermal sector, are expected to result in a gradual increase in the production of geothermal electric energy between the limits cited above. By 1990 the recovery of geothermal fluids for heating purposes will yield some 200,000 mtoe.

The two agencies are also involved in the development of new methods of exploration and operation and in the improvement of technological and scientific knowhow in all sectors of geothermal energy.

4.3 Main sectors of utilization

As we have seen, Italian industry absorbs about 45 per cent of total energy demand. In recent years, however, the rate of increase of industrial consumption has slackened as a result of a decline in the use of energy by heavy industry. This decline has followed a more careful policy aimed at the greatest possible reduction of waste and the improvement of the efficiency of productive processes.

As regards the applications of NRSE in the industrial sector, the pilot projects launched by certain public agencies have stimulated demand for the production of low-temperature process heat through the use of technologies such as "solar ponds", flat collectors and parabolic collectors.

By 1990 the use of solar energy for the production of low-temperature process heat will yield an annual saving of about 0.5 mtoe. Numerous pilot

projects are planned during the next three years with a view to tackling and solving such problems as maintenance, integration with other sources, loading diagrams and storage.

Altogether 45 pilot projects will be carried out in the various industrial sectors. They will cost about US$ 5 million, including partial financing of the investments.

4.3.2. Civil

The civil sector consumes about 30 per cent of Italy's energy demand. Heating of premises absorbs about 74 per cent; the production of hot water for hygienic and sanitary purposes 10 per cent; electricity requirements (lighting, domestic use) 10 per cent; and cooking 6 per cent.

The production of hot water for sanitary purposes offers the broadest scope for the use of solar energy. As already seen, ENEL, in co-operation with Italian industry, is preparing a plan for the installation of about 200,000 heaters in the next three years and 1 million by 1990.

A project for the distribution of methane gas in southern Italy is in the development phase. Under this project ENI is to work out a three-year plan of action designed to provide, besides the methane gas, a gas/solar system for the production of hot water for sanitary purposes.

Additional savings of oil in the building sector may be achieved through the use of geothermal fluids and of space heating with waste heat recovery and joint production of electricity and heat.

As regards new buildings, and especially public buildings such as hospitals and schools, full use will be made of thermal insulation systems and passive solar installations which will reduce energy demand by 40 per cent.

4.3.3 Agriculture

Energy consumption to meet the production requirements of the agricultural sector represents about 2 per cent of national energy demand. This consumption is closer to 10 per cent if we include the energy resources employed in activities related to the processing of agricultural commodities,in the production of technical aids such as fertilizers, chemicals and farm machinery and in the satisfaction of the domestic needs of the rural population.

In view of the probable growth of this sector, we may foresee a subsequent increase in energy demand, while the use of NRSE may to a certain extent accelerate this development. In particular we may expect more widespread mechanization because of the fragmentation of the system, for which the use of new sources of energy are especially favourable.

To attain these objectives, co-ordinated action is planned to stimulate the development of technologies adapted to the specific needs of the system.

The main initiatives are focused on the production of low-temperature heat for agricultural processes such as drying and storage; for greenhouse production, a sector in which Italy, with over 14,000 hectares of greenhouse crops, leads the world; and for the airconditioning of buildings.

In the agricultural sector, we are considering the possibility of using combined generating plants producing electric and mechanical energy for servicing the machinery and the heating installations needed for the above processes.

These combined plants will use renewable sources of solar origin (direct or indirect), wind power or biomass conversion of existing byproducts of vegetable or animal origin. It is calculated that the recovery of 50 per cent of potential capacity will save about 2 - 3 mtoe per annum.

The actions planned for 1980 - 83 concern essentially the adoption of public incentives (through the necessary legislative provisions) and the dissemination of the results of experiments designed to save energy and use renewable sources in agricultural and food-processing establishments.

In this three-year period integrated systems will be built in at least 50 such establishments scattered throughout the country.

The above description may serve as a fairly representative initial picture of how renewable sources may be used in the agricultural sector to replace, completely or partially, the traditional sources, with a view to meeting the needs of crop-raising and stock-breeding under different climatic conditions.

Programmes of co-operation

Italy's foreign policy in the NRSE sector has two main objectives.

The first is to co-operate actively with the industrially and technologically advanced countries so as to achieve a consistent saving of human and financial resources through the development of joint research and a broader exchange of experience in the implementation of industrial projects.

The first objective is being sought by means of the adoption of scientific and technical co-operation agreements between Italian and foreign agencies working in the same field. These joint programmes provide for the building of pilot plants with equal contributions of human and financial resources.

The second objective concerns the transfer of the new technologies to the developing countries.

It is recognized that the development of NRSE in many areas of the third world represents an important option for their economic progress. The transfer of technologies will depend therefore on the social and economic links established with existing infrastructures.

From this viewpoint, the building of pilot projects to meet real needs will bring immediate benefits in the form of energy supplies and will also involve the local administrations in the development of technological processes and in technical and economic co-operation which will take account of environmental considerations.

6. Legislative and financial action

Through the adoption of a series of State laws, Italy is providing incentives for the conservation of energy and for the use of NSE in all final user's sectors.

The National Energy Plan provides triennal programmes for the development of NRSE technologies and of industrial initiatives for the production and operation of plants, systems and components for the utilization fo these sources.

In particular, the production of electricity has been liberalized in cases where single plants generate less then 3,000 KW and combined plants less than 500 KW. The essential points of the law are concerned with the allocation of resources among the various sectors.

For the airconditioning of buildings and the production of hot water for sanitary purposes with the use of NRSE, 100 million lire have been allocated during 1981 - 82 as a capital contribution (30 per cent of the investment cost) under a regional distribution plan drawn up by the Interministerial Committee for Economic Programming.

For the limitation of primary energy consumption 120 billion lire have been allocated in the first biennium as a contribution to interest costs.

Authorization has also been given for the expenditure of 40 billion lire during the biennium 1981 - 1982 as a capital contribution (30 per cent of the investment cost) to local Autcrities or to autonomous electricity Enterprises which build distribution networks for heat recoverable in electricity-generating stations from exhaust fumes or the burning of waste.

In order to expand the use of NRSE, capital contributions up to 41 billion lire (30 per cent of expenditure) have been made in 1981 - 82 to undertakings which build pilot projects, prototypes or specific devices with low energy consumption.

Finally, in 1981 - 82 the expenditure of 50 billion lire has been authorized as a capital contribution for the extended use of hydroelectric plants using small-scale water concessions.

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