United Nations
Environment
Programme

Distribution
RESTRICTED

UNEP/IG.5/INF.10
22 November 1976

ENGLISH
Original: FRENCH

Intergovernmental Meeting of Mediterranean
Coastal States on the "Blue Plan"
Split, Yugoslavia
31 January - 4 February 1977

THE PROSPECTS FOR SOLAR ENERGY IN THE MEDITERRANEAN REGION

Note prepared by the Centre International de Recherches sur l'Environnement et le Développement (CIRED).

GE.76-11663

CONTENTS

I. INTRODUCTION

1. At the Intergovernmental Meeting on the Protection of the Mediterranean which was held at Barcelona under the auspices of the United Nations Environment Programme from 28 January to 4 February 1975, the suggestion was made that the various forms of pollution assailing the Mediterranean region could be effectively controlled by integrated planning of the region's development and rational management of its resources Solar energy is one of the resources which the region could command in abundance.

2. The Mediterranean region is indeed a privileged one for harnessing solar energy, in virtue of its climate and still more, perhaps, in virtue of the very varied economic characteristics and energy situation of the countries concerned. Before considering the main lines of international co-operation to speed up the utilization of solar energy, it will be useful to note some scientific and technical data bearing on its development.

II. PHYSICAL DATA RELEVANT TO THE PROBLEM

3. Being situated between the thirtieth and forty-fifth parallels of latitude, the Mediterranean and its coastal regions have a very favourable annual pattern of insolatic In the first place the insolation is very intense, reaching 800 kJ/cm^2 2/ in the desert areas and not falling below 450 kJ/cm^2 in the north of the basin. However, an even more important factor as regards the working of a solar "lode" is that the insolation is relatively constant throughout the year. To take an example, the mean solar energy received by a south-facing wall in the south of France is of the order of 3.6 kWh/m^2/day in July and 2.5 kWh/m^2/day in January, whereas in the north of France the range is much wider, the amounts received being 3 and 0.9 kWh/m^2/day respectively. The consistency is even greater on the African and Middle Eastern shores.

4. Another argument in favour of harnessing solar energy in this region is the existence of large desert and semi-desert areas around the Mediterranean basin; such thinly populated areas are especially suitable for the installation of solar collectors.

III. THE MERITS OF SOLAR ENERGY

5. The arguments in favour of the sun as one of the future main sources of energy are of three kinds:

5.1. Solar energy is renewable: The realization, at the time of the energy crisis, that hydrocarbon resources were relatively limited 3/ started a debate on whether needs could be met by using flows of renewable energy rather than stocks which, if only in the long term are exhaustible. Solar energy is the standard example of these potential new sources of energy in that, on the time-scale of earth, it is inexhaustible.

1/ In this connexion see document UNEP/WG.2/2: Integrated Planning of the Development and Management of Resources of the Mediterranean Basin, January 1975, 10 pag

2/ kJ = kilojoule.

3/ Quite apart from the advantages of ceasing to use as fuel carbonaceous raw materials containing rich compounds which are more suitable for uses with a high added value, for instance in chemistry.

5.2. Solar energy is "clean": Solar energy has no significant ecological impact and in particular, unlike conventional thermal energy and nuclear power, does not change the heat balance of the earth.

5.3. Solar energy is well distributed: Energy from other non-fossil sources (hydraulic, wind, tidal energy, etc.) is unlikely to play more than a supplementary role, except in a few countries. Consequently solar energy is the only possible solution for countries which are poor in fossil energy but which do not wish to be totally dependent either on oil or on the atom for their supplies.

6. On the other hand, the main argument against solar energy is that its very low concentration necessitates the use of large collecting surfaces that are difficult to reconcile with the needs of big modern industrial centres. However, this disadvantage may be overcome by research into diversified ways of harnessing solar energy (see part IV below) and of meeting requirements. It may then be possible to harness solar energy in a highly decentralized pattern which is better suited to the requirements of large, sparsely populated countries in that it saves them the time and money needed to install transport infrastructures.

7. It is important to emphasize, therefore, that the sun should not be regarded merely as a source of energy for the distant future and hence as the prerogative of rich countries, in contrast to the developing countries which cannot afford to postpone the satisfaction of their urgent needs.

8. In short, although solar energy, in the conventional form of power supplies dominated by electricity, cannot as yet claim to be a replacement for conventional thermal power and nuclear power, it can nevertheless be used, either immediately or in the medium term, to meet a significant range of needs and can thus help to speed up development.

IV. CHIEF WAYS OF HARNESSING SOLAR ENERGY

9. The place occupied by electricity in the energy models of the developed countries is apt to focus attention exclusively on the use of solar energy to generate electric power. In reality, although this is one of the main ways of harnessing solar energy, it appears that for technological reasons it will be able to play a significant part only in the long term. Although some of them are still in the realm of pioneering research, there are ways of using solar energy that could be applied in the relatively near future and that would make it more feasible to build up, step by step, pluralist energy models in which solar energy would play a central role. The following should be mentioned:

9.1. Applications of solar energy which do not entail producing an energy carrier. These are often called direct uses. This set of applications includes:

9.1.1. Air-conditioning in housing: an item which accounts, according to the country, for 20 to 30 per cent of energy requirements. It is estimated that solar energy could cover between 50 and 70 per cent of this sector, a proportion which could be increased by reorienting architecture towards the development of an integrated habitat that would turn local sociological, technological and ecological conditions to advantage. The provision of household hot water (solar water heaters) can also be placed under this heading;

9.1.2. Agricultural applications: solar pumps, greenhouses and driers; 4/

9.1.3. Water desalination;

9.1.4. Solar furnaces: an advanced technology whose industrial application may eventually be important in metallurgy and also in the production of hydrogen (see below).

9.2. Electric power produced from solar energy by thermodynamic or photovoltaic methods. In the medium term these are likely to be developed for small power stations, particularly once a significant cut has been made in the cost of certain components such as photovoltaic cells. At large power stations, space will be a limiting factor until a major improvement can be made in the efficiency of conversion. In countries which have vast desert wastes, however, the development of such stations looks a more realistic proposition, especially since they could be used to produce hydrogen as an energy carrier.

9.3. Bioconversion of solar energy for the production of power or of industrial raw materials. The raw materials used may be urban refuse, agricultural and forest waste (straw, manure, etc.) or the products of "energy plantations" (plants with a high energy yield, such as algae). In addition to charcoal-burning and wood distillation, the raw materials thus harvested can be treated by pyrolysis, anaerobic fermentation, hydrogasification, or hydrogenation to produce alcohol (methanol or ethanol) or liquid or gaseous hydrocarbons.

9.4. Solar chemistry, which uses solar energy in a chemical reaction:

9.4.1. Photochemically: using the sun's rays without converting them into heat;

9.4.2. Heliothermically: using the sun as a source of calories; 5/

10. These two approaches are still in the pioneering research stage but have very promising long-term prospects in the following fields:

10.1. Photochemical synthesis for molecules requiring high-yield reactions (e.g. hexachlorocyclohexane) or low-yield reactions that result in products with a high added value, such as medicines; 6/

10.2. Production of hydrogen and motor spirit by photochemical or heliothermal processes;

4/ It should be noted that solar driers, by significantly reducing post-harvest losses, could play a major part in solving the food problems of some countries.

5/ Some applications of solar furnaces come under this heading.

6/ This method can now be envisaged even for products with a medium added value, as shown by the synthesis of caprolactam and nylon 12 by a team at the Marseilles University Institute of Technology.

10.3. A new chemistry of carbon and carbonates involving the recovery of carbon from CO_2 molecules and the processing of carbonaceous substances, both by heliothermy.

V. CONSIDERATIONS ON THE DEVELOPMENT OF SOLAR ENERGY

11. The various methods of harnessing solar energy which have been briefly outlined here vary widely in importance and in level of technological development. Some of them (solar electricity and solar chemistry) are for the medium or long term, while others can be put to use immediately.

12. Since there is a large measure of inertia in energy systems, preparations for the eventual switch to solar energy as one of the principal successors to oil should be begun now by introducing it in sectors where the necessary technology is available: water pumping, greenhouses, driers and household uses, followed by transport using bio-fuel and so forth.

13. There is a major field here for industrial and technical co-operation between the countries around the Mediterranean. In order to avoid the setbacks which might befall a purely technical approach to the development of solar energy, it would be well to give some thought to ways and means of fitting it into the urban and rural environment and into different social and economic systems, with due consideration for the necessary incentives. For every application it will be necessary to spell out, in addition to the technical characteristics, those relating to use, the production and maintenance of equipment, training and research requirements, and support policies.

14. The technologies which will be available only in the long term could form the subject of very close scientific and technical co-operation between the industrialized countries with advanced technologies and, paradoxically perhaps, the oil-producing countries. It is in the interest of the latter, as of other countries, to control from the outset, what may prove in 20 or 30 years' time to be a means of avoiding dependence on nuclear power. At the present time they have the financial resources to do this.

15. Steps should also be taken to interest the oil-poor countries in carrying out research on energy carriers which offer an alternative to electricity, such as methanol, bio-fuel and hydrogen. Indeed, their development is a prerequisite for the general adoption of solar energy use.

VI. SOME GUIDELINES FOR A CO-OPERATIVE PROGRAMME

16. Co-operation between the countries of the Mediterranean basin could be a factor in speeding up the development of solar energy. Such co-operation should take into account existing imbalances in scientific and technical potential and the need to avoid the harmful aspects of transfers of technology made in ignorance of the effects on the host environment. Such co-operation could take four main lines:

17. Pilot experiments in the immediate fields of application, to follow up the efforts already made by several States:

17.1. Agricultural applications, such as pumping, greenhouses, driers and desalination. Some priority could be given to the production of dried fish at a cost within the means of the low-income strata of the population. Under this heading, the experiments with integrated aquaculture-solar energy systems should be carried further;

17.2. The solar habitat in terms of architecture, town planning and solar techniques of heating, air conditioning and treatment of waste.

18. The construction of experimental units for technologies which cannot be fully developed in the short term, but which will be of decisive importance in the medium and long term:

18.1. Construction of thermodynamic concentrating power stations of medium capacity (10 MW and above);

18.2. Application and development of photovoltaic cells for low-power uses (telecommunications, portable and transportable equipment, devices which are difficult of access, and fixed and isolated installations).

19. The establishment of machinery for continuous scientific and technical co-operation

19.1. Identification of research teams and industries in the Mediterranean basin which could contribute to the development of solar energy;

19.2. Organization of a permanent supply of information on scientific development and on the lessons learnt from pilot projects;

19.3. Exchange of scientists and technicians, and assistance in setting up research centres in the developing countries of the Mediterranean region.

20. In addition, provision should be made for overall forecasting of interrelations between solar energy and society, with special reference to the implications for town and country planning and the location of industry.