



**UNITED NATIONS**  
**ECONOMIC AND SOCIAL COUNCIL**

---

Distr.  
GENERAL  
E/ESCWA/13/4/Add.26  
2 March 1986  
ORIGINAL: ENGLISH

**ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA**

Thirteenth session  
19-24 April 1986  
Baghdad

Item 6 (a) of the provisional agenda

**PROGRESS MADE IN THE IMPLEMENTATION OF THE WORK PROGRAMME**

**DISSEMINATION OF MATURE SOLAR AND WIND TECHNOLOGIES  
IN SELECTED ESCWA COUNTRIES  
WITH SPECIAL REFERENCE TO LEAST DEVELOPED COUNTRIES**

Note by the Secretariat

## A. BACKGROUND

In response to the Nairobi Programme of Action (NPA) adopted by the United Nations Conference on New and Renewable Sources of Energy held at Nairobi from 10 to 21 August 1981, ESCWA has embarked on a number of projects aimed at promoting regional co-operation for the transfer, adaptation and application of mature new and renewable energy technologies. The main objectives of such undertakings include:

- Analytical studies and evaluations with a view to identifying solar and wind technologies suitable for the ESCWA region. These activities, therefore, encompass comprehensive surveys, assessment of solar and wind technologies, their suitability for local applications and the terms of relevant commercial, technical and economic compatibility;

- Regional meetings to follow up on the findings of the above-mentioned studies and evaluations with the objective of recommending policy options and defining assistance needed. The overall output of such activities is to be reflected in a set of recommendations for the consideration of the concerned authorities in the ESCWA countries.

The present report has been prepared mainly to fulfil the first objective. It is basically aimed at formulating an appropriate regional plan of action for the promotion of solar and wind energy-related industries in the ESCWA region. The report is therefore intended to cover the following:

- Identification of mature solar and wind technologies suitable for application in the ESCWA region;

- Development of a system components inventory for suitable technology combinations;

- Assessment of local industrial infrastructures in the region and identification needed for enhancement, strengthening and adaptation;

- Assessment of the existing institutional capabilities and policy measures to support the development of industrial infrastructure;

- Survey of market potential for various solar and wind technologies in order to determine the required scale of industrial development.

## B. SOLAR AND WIND TECHNOLOGY OPTIONS FOR APPLICATION IN THE ESCWA REGION

Solar and wind technologies vary widely in nature, degree and maturity and suitability for specific applications. The economic advantages of these technologies depend, to a large extent, on climatic conditions, suitability of the available natural resources and diversity of uses. On the other hand, economic benefits differ according to the particularities of social conditions, discrepancies in the development of industrial infrastructure and the importance of a potential market in each country and in the region as a whole.

The criteria required for evaluation of "technology/application" options in the ESCWA region call for in-depth analysis of the following factors:

- Availability of solar and wind resources, which determines the areas where specific applications are most likely;
- Needs and priorities which would be in line with the objectives of the national development plans;
- Possibility of replication at the regional level and marketing opportunities;
- Relevant experience in the ESCWA region. Availability of related experience is a major factor in deciding on the technology/application in the region. The scope of experience includes design, analysis and operational activities;
- Availability of local capabilities for manufacturing system components which may not only provide the basic requirements of the industry, but also help to generate technological know-how and experience for improvement of designs and equipment;
- Availability of institutional capabilities for planning, development and training;
- Competitiveness with conventional alternatives and social acceptance.

A total of 40 solar, wind and combined technology/application options were evaluated. These options were scored in the light of the above-mentioned evaluation criteria. The subscores were estimated according to the relative effectiveness in realizing an economically widespread application. Scoring of options has been established in accordance with each criteria item and may be explained as follows:\*

- The ESCWA region enjoys very high solar isolation rates. As a result, availability of solar resources has been given "15" scores for solar collectors dealing with total radiation, while concentrating collectors have been given "12" scores. However wind resources have been given "8" scores owing to the fact that the ESCWA region is not, in general, a windy region and wind resources are only available in limited areas. However, more investigation is still needed to assess wind potential in several countries of the region;

- As the need for particular applications varies widely from one country to another, an average scoring has been given at the regional level;

- Scoring of technological status depends on the state of commercialization of the technology and/or its degree of maturity;

---

\* Details of scoring and its background and ranking of options are included in the main body of the study.

- Over 12 scores may be given to the relevant experience wherever significant progress has been achieved in the field of industrial development. The above figure may decrease to 10 when only demonstration activities are in operation. A lower figure is given when activities are confined to R&D (research and development);

- Institutional capabilities are scored according to the availability of these capabilities starting from R&D to development and commercialization with particular emphasis on the status of the industrial infrastructure;

- Scoring of economic and social considerations varies from one country to another following the respective economic development and the established social norms of the society.

High priority technologies for application in the ESCWA region may be categorized as follows:

(1) Mature technologies for industrialization (1986-1990);

- Flat-plate collectors, for temperature below 80°C, using either water or air as heating fluids;

- Greenhouse solar facilities for agricultural applications either for drying or protected agriculture techniques;

- Solar stills with capacities up to 10 m<sup>3</sup>/day for remote and isolated areas;

- Wind mechanical pumping.

(2) Mature technologies for industrialization in the mid-term (1990-1995):

- Photovoltaic technologies for electrical power generation for household applications in remote areas and for water pumping;

- Moderate temperature solar thermal collectors such as evacuated-tube and parabolic troughs.

### C. INDUSTRIAL INFRASTRUCTURE FOR SOLAR AND WIND TECHNOLOGIES IN THE ESCWA REGION

Several ESCWA member countries have already established industries for manufacturing solar and wind equipment. However, these industries are limited in most cases to the manufacturing of components of solar water heating systems. Besides, there is no co-ordination with the other industries which can complement the solar and wind industries whether within the country or at the regional level. The development of an appropriate industrial infrastructure at the regional or subregional level requires the following:

- Identification of the requirements for the promotion of the proposed options including institutional infrastructure, market evaluations and determination of industrial products to meet the needs of the widespread application of each option;

- Comprehensive assessment of the regional capabilities related to the proposed solar and wind options for application in the ESCWA region. Such an assessment would include the full spectrum of expertise needed for the promotion of the application of these options starting with R&D up to the industrialization and commercialization;

- Evaluation of the complementary requirements of the existing infrastructure to enhance its capabilities and hence strengthen its role in promoting the development of the solar and wind technologies.

As this report is primarily devoted to the investigation of the industrial infrastructure, its scope is specifically limited to the following:

(a) Development of an inventory of solar and wind system components;

(b) Investigation of the existing local solar and wind industries in the region, and identification of the complementary requirements.

1. Inventory of solar and wind system components:

Solar and wind systems incorporate various conventional elements such as storage, piping and controls which are essential for the functioning of the system. In view of this fact, the development of solar and wind industries should involve an interaction and integrating process with other manufacturing industries and suppliers. The development of an inventory of solar and wind system components would provide the required support to identify the type of complementary industry, and to help to investigate its potential in the region and the export prospects.

"Technology/application" options recommended for use in the ESCWA region may be summarized as follows:

(a) Low temperature solar water heating systems. A solar water heating system whether a small individual unit or a collective one comprises five main subsystems, namely: solar collector field, storage and heat exchangers, circulation and controls, piping networks and back-up system if used.

The investigation of manufacturing possibilities requires a breakdown of each subsystem to its basic components and analysis of its characteristics and properties of materials used.

- Solar collector field. A solar collector field comprises a number of interconnected solar flat-plate collectors to meet a particular heating load. The components are flat-plate collectors, pipes, support structures and expansion tanks in case of using a closed loop system. The type of heating fluid is of prime importance for the selection of collector field components;

- Storage system and heat exchanger. Solar hot water storage systems are mainly sensible heat storage vessels where water is heated directly from the solar collectors in an open loop system or via heat exchangers in a closed loop system.

Often, heating fluid should not pass directly through the collector field; thus, many solar heating applications require heat exchangers.

- Circulation and control. Centrifugal pumps and positive pumps are used in solar water heating systems as circulating pumps in collector loop and recirculating pumps in the hot water distribution network. Various devices are used for mechanical and electrical controls. Valves are often used as gate, non-return, safety, three-way and balancing valves as well as automatic air vents and differential thermostats are used to control the electrical back-up system and the operation of recirculation pumps.

- Piping networks. Two basic piping networks are used in a solar heating system: collector loop piping and hot water distribution. The simplest and probably the most extensively used type of collector field layouts is the direct return piping. Piping material should be compatible with the collector materials and should not react to the heat transfer fluid or corrode under working conditions.

Insulation materials are needed for collectors, storage tanks and pipes. These materials should be chosen in accordance with the requirements mandated by working conditions

The type of solar water heating system, environmental conditions and operating conditions determine the type of heating fluid to be used.

Significant industrial capabilities for the application of solar water heating systems exist in a number of ESCWA member countries, particularly in Egypt, Jordan, Syria and potentially Iraq. Over 80 per cent of the system components can be manufactured in these countries with capacities which may meet the needs of the whole region. At present, controls and measuring equipment and circulating pumps are imported from outside the region. However, electronic industries in the region can contribute considerably to the development of these components. Such an orientation is already under consideration by the Egyptian General Organization for Industrialization. Activities aimed at locally producing imported equipment may be further boosted through a subregional programme involving the four countries mentioned above.

(b) Agriculture drying and greenhouses. These applications are very simple in both design and construction. The basic requirements for the industrial infrastructure consist of:

- Plastics industry for the production of the transparent covers appropriate for the climatic conditions in the region. This type of industry exists in a number of ESCWA member countries. It is to be noted that a joint venture between Egypt and Jordan is being considered for the development of a plastics industry;

- Piping networks which may be constructed by using local products. Ventilators used in some cases are locally produced in some ESCWA countries.

(c) Wind system for mechanical pumping. A wind energy pumping system comprises mainly:

- Wind turbine rotor. Capabilities to design, construct and install wind turbines for mechanical pumping have reached an advanced stage in the region, particularly in Egypt.

- Wind system towers. Capabilities required for constructing such towers are extensively available in several countries of the region.

- Storage. Water could be stored in large tanks, basins, etc. Mechanical energy could be stored in a flywheel in the form of rotational energy. Requirements for storage can be made available locally.

- Water mechanical pumps. Such pumps can be manufactured in some countries of the region.

(d) Moderate temperature solar collectors. It is expected that by 1990-1995, many ESCWA countries may opt for the use of moderate temperature solar thermal systems. The main additional components compared with the previously described flat-plate collectors are reflective surfaces and evacuated tubes. Industrial capabilities for these components already exist in Egypt, although manufacturing of evacuated tubes is limited to one company. On the other hand, more investigation of regional capabilities is needed before proceeding with the manufacturing of these type of collectors.

(e) Photovoltaic stand-alone applications. This system consists of PV modules, support structures, storage batteries, and power conditioning units. Industrial capabilities relevant to PV systems are still very limited in the region.

## 2. Existing industrial infrastructure in the ESCWA region.

Solar and wind components for selected "technology/application" options and the relevant industrial capabilities in the ESCWA region are described in a matrix included in the main body of the study. It can only be indicated here that the existing industrial infrastructure may meet about 80 per cent of the required components for the application of mature solar and wind technology which ranks as a high priority option in the region. There is, however, a need for a regional programme to co-ordinate the individual activities of ESCWA countries and undertake development projects at the regional level.

### D. PROSPECTS OF THE PROMOTION OF SOLAR AND WIND INDUSTRIES IN THE ESCWA REGION

Extensive efforts in planning, training, product testing and standardization, marketing and adoption of relevant regulations are required for promoting solar and wind industry in the region, especially in the least developed countries, where appropriate infrastructures are virtually non-existent. Special attention should be, therefore, given to the following:

1. Strengthening of institutions dealing with solar and wind technologies. Various activities aimed at promoting the use of solar and wind technologies are being undertaken in several countries of the region. In many

cases these activities are carried out in universities and departments within the competence of different ministries. However, specialized institutions have been set up in a number of ESCWA countries such as Egypt, Iraq, Jordan, Kuwait and Saudi Arabia and although substantial activities of these institutions are mainly directed towards R, D and D (research, design and development) projects, significant involvements in the implementation of projects for various applications of mature solar and wind technologies have been noted. These leading institutions can play an important role in disseminating mature solar and wind technologies throughout the region. However, close co-operation and co-ordination of activities are, in many cases, lacking not only at the regional level, but also at the national level. An integrated spectrum of activities starting with appropriate planning to product commercialization is, therefore, badly needed.

2. Special attention should be given to the particular economic and social conditions of the least developed countries. A regional programme of action should be adopted in favour of these countries. Such a programme is to include:

- Providing financial assistance to help the least developed countries to establish the required industrial infrastructure;
- Providing technical assistance for promoting the use of mature solar and wind technologies.
- Involving nationals from the least developed countries in R, D and D activities carried out in the more advanced countries of the region;
- Supporting training programmes and providing training facilities within and outside the least developed countries.