Restricted
Technical Report
PP/1979-80/2/4.3/09

MALTA

Participation in the activities
of Member States in the field
of technological and engineering
research, education and training

Renewable Sources of Energy

by
M. Claverie

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MALTA

RENEWABLE SOURCES OF ENERGY

by M. Claverie

Report prepared for the Government of Malta by the United Nations Educational, Scientific and Cultural Organization (Unesco)

U N E S C O

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FMR/SC/TER/81/126(Claverie)
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CONTENTS

INTRODUCTION

1. At the request of the Government of the Republic of Malta, the Director-General of Unesco, under the 1979-1980 Programme of Participation in the Activities of Member States, instructed the Consultant, Dr M. Claverie, to undertake a mission to Malta "to assist the national authorities in developing an institutional infrastructure for scientific and technological research and training in the field of renewable sources of energy".

2. From 26 October to 1 November 1980, the Consultant carried out a fact-finding mission and from 26 November to 1 December 1980, this was followed up by discussions with the Maltese authorities of the proposals included in the preliminary report.

3. The Consultant wishes to express his sincere appreciation of the excellence of the arrangements made by Mr Luis J. Saliba, Chairman of the Research Committee of Malta, who was responsible for the organization of the mission. He wishes to record, also, his gratitude to Mr Joe Mifsud, Head of the Department of Mechanical Engineering (University of Malta) and to Mr L. Ciantar, Director of ENEMALTA for their invaluable assistance and co-operation. The Annex lists the names of persons consulted.

Objectives of a national Maltese programme on renewable sources of energy

4. The Republic of Malta depends exclusively on imported oil for its energy supply. The Government has a great interest, therefore, in the development of new local sources of energy. The solution of the problem encounters certain difficulties. The Malta energy requirements are those of an industrialized country: per capita electricity consumption is above the world average due to the availability of electricity in every household, the needs of industry and wide use of cars and appliances. For these reasons, the simplified ways of using solar energy or biomass energy, proposed for developing countries, are not suitable for Malta. Moreover, the natural resources of Malta are limited by the size of the island. While the sun and wind resources appear plentiful, in practice, the area of the conversion devices will limit, in many cases, the available power and energy. Production of biomass is limited and farm land should be reserved for food production.

5. Utilization of renewable sources of energy in Malta will require, therefore, the use of efficient and powerful equipment, which are not yet available on the market. It should be understood also that a long-term effort of development and experimentation is still necessary before practical use of renewable energy resources can be envisaged and that only a small part (5 to 20 per cent) of Malta's energy needs could possibly be satisfied from these resources before the end of this century. However, as fossil fuels become scarcer and scarcer and subject to political and economic pressures, the development of new energy sources is essential and has been undertaken by most industrialized countries. It should be added that replacement by Malta of oil imports by import of renewable energy equipment is not the solution. As the development of Malta is also associated with the development of national industry, there is strong interest for promoting new products related to the energy field suitable for manufacture by Maltese industry. The objectives of a national Maltese programme on renewable sources of energy could be to gather information on energy requirements, production, transformation and utilization in Malta to help the government to elaborate energy policies; to train national expertise in this field to advise the Government on policy and to evaluate foreign proposals;to design equipment or systems, allowing utilization of renewable energy sources, optimized for

Maltese conditions, suitable for production by local industry with maximum local added value, and to develop and manufacture renewable energy equipment in Malta for national use and for export.

Maltese institutions participating in the national renewable energy programme

These institutions are:

(i) Energy of Malta Corporation (ENEMALTA)

6. The National Energy Management Corporation is implementing a programme of experimentation in equipment in Malta in co-operation with European countries: the Federal Republic of Germany for wind energy; Austria for heating and cooling of houses, and sea-water desalination by reverse osmosis and photocells. An Austrian-Maltese solar research centre is being developed at present.

(ii) The University of Malta

7. Apart from some projects undertaken by students for their theses in the final B.Sc. (Engineering) year, there is no systematic research in the field of renewable energy. Professor Joe Mifsud, Head of the Mechanical Engineering Department, Professor C.J. Camilleri, Head of Mathematics and Science Department, Professor Kaldarar, Head of the Civil Engineering and Architecture Department, have all expressed a strong interest in developing teaching and research activities in this field. However, they have also pointed out the following difficulties: as the university receives only first-degree students, there are no senior research students preparing doctoral theses and research work is therefore restricted to that undertaken by faculty members. The lecturing load is heavy (standard periods of lecturing seem higher than in French universities, where usually they are about 50 per cent of those of the University of Malta) and it is very difficult to ensure continuity in research work undertaken at first-degree level. Moreover, no specific mission of research in the field of renewable energy sources has been given to the university.

(iii) Research Committee

8. The Research Committee, chaired by Dr L. Saliba, is responsible for recommending priority fields of research according to the needs of the Republic of Malta. Professor Mifsud and Professor Kaldarar are members. ENEMALTA is not represented.

(iv) Committee for Non-Conventional Energy Sources

9. This Committee, chaired by Mr L. Ciantar, Head of Electricity, ENEMALTA Corporation, advises the Minister responsible for energy on policy matters relating to the renewable sources of energy. Dr L. Saliba, Chairman of the Research Committee, is a member.

Proposals for organization

10. At the government level, development of renewable energy resources in Malta is the responsibility of the Ministry of Development and Energy. The advisory and co-ordinating body is the Committee for Non-Conventional Energy Sources. It is desirable to strengthen the representation of the University of Malta in this Committee. The Committee for Non-Conventional Energy Sources is responsible for drawing up objectives for the renewable energy research programme. The Research Committee has the responsibility of determining from these objectives the detailed renewable energy research programme.

11. The University of Malta should effect liaison with the National Energy Management Corporation (ENEMALTA) to ensure the execution of this programme. For this purpose, a functional structure should be devised. For instance, a renewable energy project leader (reporting to Research and Renewable Energy Resources Committees); several principal investigators each in charge of one research project.

12. It is also necessary to recognize that applied research requires time and money. For effective results from a worthwhile research programme, support should be provided in the form of visiting foreign scientists (perhaps with assistance from international organizations); co-ordination of the individual research work of faculty members; the research work of senior students, preparing Ph.D theses in foreign universities, and undertaking field work in Malta; allocation of a higher proportion of time of faculty members to applied research; assigning to the University of Malta a few permanent technicians for the building and operation of the main experiments.

13. The development of a specialized documentation centre on renewable energy resources managed by a permanent staff is advisable. This documentation centre could be housed at the University Library and available not only to faculty members but also to engineers from Maltese industry. The availability of an electronic computer facility is absolutely necessary to enable useful work on thermal analysis of building and energy systems, or on solar and wind systems performance prediction to be conducted. The university computer is of limited size and has a very high utilization load for computer teaching. Its improvement should be considered as a first priority.

14. Due to its limited resources, the University of Malta cannot expect to make a major contribution either to the science or the technology of the sources of renewable energy. However, the university may usefully contribute to Malta's development in the following directions:

to keep abreast of research and development in the field conducted throughout the world, and to make a critical assessment of the progress of technology;

to evaluate potentialities of new energy systems in Malta under local conditions, such as sun and wind resources, land and water restrictions, living habits of the population and present and future costs of energy (this includes an assessment and inventory of local conditions and resources in Malta);

to develop an independent expertise on the design of systems proposed by foreign or Maltese companies or organizations;

to participate in the testing of new systems procured by ENEMALTA or other government agencies, and in the activities of the newly-established Austrian-Maltese solar research centre; and

to conduct experimental work, either on specific components (for instance building components using local material), or on equipment built by Maltese industry, or to better understand new technology (for instance tests on reverse osmosis membranes). After a few years of experience in this field, the University of Malta could reach a degree of expertise enabling it to design, with ENEMALTA's technical facilities assistance, equipment which could be transferred to Maltese industry for development and manufacture.

Proposals for an applied research and development programme

15. The following proposals have been discussed with ENEMALTA and with the University of Malta and provide a general framework for an applied research and development programme on renewable energy resources in the country.

(i) Energy utilization in Malta

16. The conventional analysis of the energy situation of a country is concerned generally with the consumption of energy, classified by nature (electricity, fuel, natural gas, etc.).

17. As solar energy is produced close to the final user, prospective utilization of solar energy requires an analysis of the use of energy classified by final use: low, medium or high temperature, mobile mechanical power, fixed mechanical power, specific electricity, etc. It is also of interest, in order to study energy substitution, to determine how these final needs are satisfied by existing sources of energy.

18. At present, this information is not available in Malta. Consumption of energy is obviously known by the Maltese Government as ENEMALTA has the monopoly of importing, producing and selling energy, but the final use of the energy products by the customers is not known. As this problem is very similar to a market study, requiring surveys of samples of individual users or businesses, it is the Consultant's view that the University Business Management Department could play a useful role in collecting relevant data. A joint team of ENEMALTA and the university could define the aims of the survey and analyse the data.

(ii) Solar radiation data, collection and handling

19. Systematic measurements of solar radiation data have been made in the past at Luqa airport and at Qrendi base. These measurements relate to sunshine duration at Luqa since 1947. Global diffused, and net balance solar radiation (on a horizontal plane) and other meteorological data, have been taken at Qrendi base from 1958 to 1968. Sunshine duration data are readily available from the Meteorological Office, and some processed data (monthly average) from Qrendi are in the hands of the university staff. However, detailed data from Qrendi are not available in Malta and should be acquired from the Bracknell Research Establishment in the United Kingdom. The university owns and operates a pyrannometer and a actinometer, but not for systematic collection of data. As the availability of solar radiation data is a prerequisite for the study, priority should be given to design and testing of solar equipment or systems.

Securing the existing data

20. Happily the existing data may be very useful: daily sunshine duration for a long period may give a good idea of the extremes of solar radiation in Malta; four years of global data collection are generally considered sufficient to give a good description of statistical behaviour of solar radiation.

21. However, it is absolutely necessary that the university obtain the set of data as measured, without any processing, as processing has to be made according to the application foreseen.

22. The Consultant recommends that the university create a solar radiation measurement data base, using the university computer, an enhanced university computer, or another computer available in Malta.

Processing the data

23. Two levels of processing for solar radiation data may be considered.

First level: to process the data to obtain flux and energy reaching solar collectors or walls of houses.

From sunshine duration, global radiation, and astronomical data, compute the direct radiation flux, the energy received by a tilted flat surface (for collector applications), and the energies received by vertical walls facing south, east and west (for architecture applications).

Second level: to process the data to determine how solar energy is available in time, to allow design of storage system, or energy storage failure risk.

For that purpose, it is necessary to conduct statistical analysis of data to obtain information on time dependency of radiation. This analysis may be made on instantaneous flux or on integrated energy.

Example:

probability of successive days without sunshine;

probability of sun flux above given value;

probability of daily energy above given value;

probability of daily energy above given value if the previous day is under another given value.

24. From these results it is often possible to design simple mathematical models (Markovian series) of the solar radiation as a random function of time.

Gathering new data

25. If it is considered that solar energy may play a role in Malta in the future, it seems absolutely necessary to recommence the gathering of radiation data.

26. As routine measurements are involved, according to strict procedure it seems preferable that this task be given to the Maltese Meteorological Office rather than to the university. The minimum requirement is for global radiation with continuous recording or ten-minute period sampling and daily integration.

27. An additional requirement would be the measurement of direct radiation using pyroheliometer, but this instrument is more expensive and more delicate to operate.

28. Measurements may also be included in the functions of the Austrian-Maltese solar research centre and of the German wind energy project.

(iii) Solar and wind systems performance prediction

29. Due to the random availability of solar and wind energy, performance prediction of solar systems is not an easy task. As it is dependent on local conditions, it cannot be derived exclusively from foreign experiment or evaluation.

30. The following points need to be considered:

processing of solar radiation or wind data in appropriate form;

analytic modelling of the system (conversion efficiencies, temperature and flux effect, inertia, losses, etc.);

computation of actual energy supplied to the system user.

31. The university could develop the methodology for the conduct of performance prediction on thermal and photovoltaic systems. Methodology could be verified on simple systems (hot-water heaters, single photocells panel coupled with a battery, etc.) built and tested by students as final-year projects. After qualification, the methodology could be used, at first, to evaluate foreign or Maltese proposals received by ENEMALTA, then to optimize the design of solar equipment to be used in Malta.

(iv) Solar water-heaters

32. Solar water-heaters as industrial products are no longer a subject for research. However, study of a water-heater may provide the opportunity to develop and test a solar system performance prediction methodology. Also, the university, at the request of a Maltese company producing solar heaters, could agree to study specific problems relating to their product, preferably with the participation of a student working half-time for the company.

33. The Architecture Department has also proposed to include a study of the integration of solar water-heaters in the project of public buildings they are at present studying for the Maltese administration.

(v) Solar energy in architecture

34. The climate of Malta is warm throughout most of the year so the heating season is very limited and heating is by electricity or paraffin-heaters. Therefore, active solar space-heating systems (e.g. using collectors and thermal fluids) could not be sufficiently amortized and such systems are not economically acceptable. However, heating by electricity, despite discouraging rates, is causing a peak load of electricity demand in January or February. For electricity alone, a cold day (maximum temperature 10° C and minimum temperature 5° C) brings an additional peak demand of 15 megawatts, topping a general winter demand increase. The total electricity demand for heating seems to be close to 25 per cent of the electricity demand in Malta. However, the coldest days are no more than ten or fifteen during the year, so the impact is more on the requirement for a peak load generating capacity than on the actual fuel consumption to produce electricity.

35. In existing dwellings, the first required action is probably to promote energy conservation, thanks to thermal insulation, tighter windows and doors, controlled ventilation, etc. Most of these measures would also improve protection against heat from sunshine during the summer.

36. The university Architecture Department could usefully study reasonable energy conservation measures suitable for existing Maltese houses. For new buildings or houses (4,000 new family dwellings are built each year), the Consultant recommends, in addition to the energy conservation measures cited above, the study of passive solar houses, suited to traditional Maltese building techniques. Passive solar houses include architectural design and special components allowing and enhancing the input of solar heat during the winter and limiting it during the summer. Special building features of passive solar houses are greenhouse balconies, Trombe walls, double-glazing, etc.

37. The study of such solar houses requires the co-operation of architect and thermal engineer using solar radiation and meteorological data, and thermal analytical studies. Elaborate computer codes have been designed for that purpose, but simplified models compatible with desk-top computers or abacus may also prove effective. The behaviour of components, particularly if original Maltese components are proposed, may be studied on a small scale using test cells. Test cells are small isolated buildings: for instance cubes with a 2 m side which bear the component to be studied on their southern faces, the other faces and the roof being as well insulated as possible. Inside ambient conditions (air temperature, wall temperatures, etc.) are recorded continuously. According to the experimentation to be conducted, controlled ventilation and electric heating may be used. Outside conditions (solar radiation, temperature, etc.) have also to be recorded. Using this kind of test set-up would allow the study of the thermal properties of Maltese building components (limestone double wall, for instance). After a reasonable time devoted to architectural design and evaluation components, a demonstration house could be built with the participation of the university, of ENEMALTA and of the Maltese agency responsible for housing.

(vi) Solar refrigeration and cooling

38. Refrigeration or cooling from solar energy is a very promising method as the need for cooling grows with solar radiation. However, present equipment built in several countries (Austria, Federal Republic of Germany, France, United States of America) is still quite complicated and expensive, and is far from being competitive in Malta, where electricity is available everywhere. ENEMALTA is implementing a co-operation programme with Austria for the experimentation in Malta of two houses, equipped with solar cooling equipment (one with flat collectors, one with concentrating collectors). The university could participate in the testing of this equipment and in a general evaluation of this concept. However, although the thermodynamic study of refrigeration systems is not very difficult, the technology of their construction is important and is mastered only by a few companies in the world. So the university, even with the support of Maltese industry, cannot be expected to design, within the next few years, solar refrigeration systems, competitive with electricity-driven commercial units.

(vii) Electricity from renewable sources of energy

39. Malta has a fully developed electrical network supplying electricity throughout the island. Present electricity production in Malta relies on oil-fired thermal power plants (127 MW, plus 60 MW being built). Conversion to coal has been decided for about 20 per cent of this production capacity. Also, a large electrical plant of a total capacity of 350 MW is planned for the future, burning either oil or coal.

40. As already indicated, the peak load for electricity is reached during the winter, as part of the electricity is used for heating of buildings. The utilization of electric air cooling has been discouraged by the cost of electricity

in the past few years and may be found only in a limited number of luxury hotels. Therefore there is no summer peak-load related to air cooling. These features of electricity in Malta, i.e. winter peak-load and developed network, do not allow a short-term use of solar energy for electricity production, as the closest applications relate to small isolated electricity users (Africa, India, South America) or complementary network supply during summer peak-load as planned in the United States. In a longer term perspective, the reduction of cost of solar electricity power plants, using either thermodynamic or photovoltaic conversion, may make them attractive as fuel-savers. So the University of Malta and ENEMALTA should keep themselves informed of the progress of this technology, but development in Malta does not seem a priority, unless electricity production is associated with a direct application to sea water desalination, for example.

41. Due to the availability of wind energy in Malta (particularly in February and March), utilization of this energy for electricity production seems more advisable than conversion to solar energy. But, as the total power which could be obtained from wind energy is limited by the size of the island, and as nuclear power is excluded, since it is not economic for power plants under 1,000 MW, the use of coal-fired thermal power plants seems the best way to produce electricity in Malta for the next fifteen years.

(viii) Wind energy

42. Among various types of renewable energy, wind energy seems the closest to economic competitivity for electricity production. Malta has an agreement with the Federal Republic of Germany for a demonstration programme with two phases: first, building and experimentation of five 10 kW aerogenerators, and, secondly, building and experimentation of a 550 kW aerogenerators farm (including two 250 kW units) associated with an hydroelectric storage having an output of 1,000 kW. However, some problems have to be resolved before large-scale wind energy projects may make a substantial contribution to Malta's production of electricity. These are reliability and durability of propellers which are still critical for large power units; impact on environment (noise and long-distance visibility) and availability of sites for hydroelectric storage. Unfortunately, the aerodynamic behaviour and the stress of the propellers create very difficult scientific and engineering problems, requiring a high degree of experience and much equipment. Therefore, it would not be reasonable to recommend the initiation of such studies at the university. However, the university may be involved in a site survey, taking into account such criteria as energy production, noise nuisance and storage possibilities. On this last point, it is not clear whether the wind measurements made in Luqa are valid for every site in Malta. A measurement programme conducted in geographically contrasted sites would be interesting to check the correlation of wind speeds among Malta sites, allowing the validation of Luqa measurements and the prediction of the energy output time dependency of a large wind energy system. The university should participate in the testing of the German aerogenerators project and in an independent performance evaluation of the German project and be involved in the evaluation of its performance under local conditions in Malta.

(ix) Solar desalination of sea water

43. Desalination of sea or brackish water using solar energy has attracted considerable interest in many countries as the need for fresh water generally coincides with sunshine abundance. The first equipment built used a single greenhouse effect without any recuperation of latent heat from condensation of the steam, therefore the efficiency of these solar stills and their production is very low. Consequently, despite their limited cost, the cost of fresh water remains very high; the installations are cumbersome and their maintenance is difficult. This solution is

suitable, therefore, only for remote desert areas. The adaptation of desalination systems (multi-stage, distillation systems, compression of vapour, reverse osmosis, etc.) already developed for use with other sources of energy should be considered in order to make them suitable for the utilization of solar energy. These systems operate either from thermal energy or mechanical energy.

44. The problem of production of fresh water in Malta may be considered at two levels:

<u>centralized production</u> in the same way as the four large units at present associated at the Malta main electricity generating plant. These units use a multi-stage distillation process, with condensation latent heat recovery. The ENEMALTA plants have a specific consumption of 5 kg of oil per cubic metre of fresh water, which is equivalent to 50 kWh of thermal energy per cubic metre. This very good performance is obtained thanks to the large size of each unit, allowing a large number of stages. Efficiency decreases as size decreases, so this process is not suitable for small units. In the case of centralized production by distillation, solar energy may be used as a fuel saver (oil or coal). A large solar collector is built close to the plant and, when the sun is shining, solar heat is fed to the process, reducing the consumption of fuel. However, in the multi-flash distillation process, most of the heat has to be supplied at between 90° and 100° C. This temperature is too high to allow a good conversion efficiency using standard flat collectors. A study made by a French consultant has shown that such a system associated with one of the large units operated by ENEMALTA, would lead to a very large collector field, which could not be amortized in a reasonable time. Therefore, to improve efficiency at this temperature, it seems necessary either to rely on a evacuated collector (collector insulated by vacuum) or on a concentrating collector (such as Winston collector, or a parabolic concentrator). The university may undertake, as proposed by one faculty member, a study of special concentrating devices to meet the necessary requirements (good thermal efficiency, low pumping power). However, developing such equipment up to its industrial production is an ambitious project, considering the university's limited resources;

<u>decentralized production</u>, to be implemented in hotels, tourist complexes or sea-side villages. It seems, at present, that the most suitable process to be used in small desalination plants (10 to 100 m^3/day of fresh water) is reverse osmosis. In this process, sea water is pumped under a high pressure into a tank, which has a wall made of a special membrane. The fresh water flows through this membrane. The energy theoretically required is quite small, but to avoid fouling the membrane, which is very expensive, concentration of sea water should be very limited. For this reason the sea water has to flow through the pressurized tank. To limit the pumping energy, a turbine is installed at the water output to recover part of this energy. The present state of technology requires a consumption of 12 kWh of mechanical energy per cubic metre of fresh water, if membrane area is minimized. In the case of utilization of solar energy, the total investment cost of solar generator and desalination unit should be optimized jointly and it may be preferable to increase the area of the membrane and to decrease the power of the generator. In this case, mechanical energy consumption may be limited to 7 kWh/m^3.

45. The equivalent consumption of thermal energy is 35 kWh/m^3 (60 kWh with limited area). It appears that reverse osmosis is efficient and is a very promising way for sea water desalination units of any size, as systems are modular. The required mechanical energy may be supplied from electricity delivered either by the electrical network (to be considered mainly if centralized production of electricity relies on coal, rather than on oil), or by a local solar electricity generator. For small units, the simplest way, but still the most expensive, is to use photocells.

46. Considering the difficulty of development of equipment associated with centralized production, and the wish of the Maltese Government to promote private investment in the field of desalination, it is obvious that the Maltese research programme should be oriented towards the decentralized production of fresh water. It seems that the multi-stage distillation process is not suitable for small units which could be studied and manufactured in Malta. So reverse osmosis, already proposed by ENEMALTA, seems the most interesting solution. However, it would be interesting for the University of Malta to make, at first, a comparison study of all the available processes (distillation, compression of vapour, reverse osmosis). As ENEMALTA plans to experiment, within the framework of its agreement with Austria, a reverse osmosis cell driven by a photovoltaic generator, the university should be associated with this experimentation. Problems to be studied relate to the process itself: production versus pressure, efficiency, membrane fouling, etc. and to solar operation: influence of the night-and-day cycle, interest of electricity storage. Due to the importance of desalination for Malta, it would be interesting to install, at the university laboratory, a small reverse osmosis cell with several purposes: to acquaint faculty and students with this new technology, and to allow testing of membranes, which are the most sensitive part of the reverse osmosis desalination units.

47. The experimentation of the photovoltaic generator associated with the Austrian desalination unit may also provide a good opportunity for the faculty members to become acquainted with the photovoltaic conversion of solar energy.

<u>Information and documentation</u>

48. It is very important for the Malta renewable sources of energy programme to obtain complete information on the results of research in other countries and on available industrial products. Several sources are possible; three are particularly appropriate:

(i) <u>The European Documentation Centre on Solar Energy</u> (Centre Européen de Documentation et d'Information en Energie Solaire - CEDIES)

49. This centre is at present being installed in France at the University of Perpignan, thanks to the support of Unesco and of the European Economic Community. The objective of the centre is to supply, in the future, documentation and information on solar energy to any interested person, in any country, in the quickest and most convenient way. In the starting phase, the centre could operate in a network fashion. Institutions or scientists willing to supply information to the centre will receive, in return, information coming from the other members of the network. To operate this organization, an international association of users (called also CEDIES) has been created. The address of the centre and of the association is Centre Universitaire de Perpignan, Groupe Génie Solaire, Avenue de Villeneuve, 66025 Perpignan Cedex France. The present chairman of the board of the association is Professor Michel Daguenet.

50. (ii) <u>COMPLES</u> - Mediterranean Co-operation for Solar Energy, is an international association, set up in 1961, grouping members belonging to the world of science and engineering and dealing with solar energy and its application. COMPLES new groups nearly one thousand members (regular, benefactors or collective) working in about sixty countries, in thirteen of which a national section has been set up. The objective of COMPLES is to establish between its members scientific and technical relations in order to promote information exchanges on the practical applications of solar energy. It organizes annual international meetings to which invitations to

personalities concerned in heliotechnique development are widely extended. COMPLES publishes the Heliotechnique International Review, a bilingual (French/English) semestrial journal, with scientific and technical papers, a calendar of congresses and meetings and information on recently issued books on solar energy. COMPLES also gives encouragement and direction to organization of educational sessions for heliotechnicians. It is governed by an International Board set up from a Central Administrative Committee grouping elected members from various contributing countries. The present Chairman of the Board is Mr S. Ben Jemaa of Tunisia. The international headquarters is located in France: Chambre de Commerce et d'Industrie, Palais de la Bourse, La Canebière, 13001 Marseilles.

(iii) International Solar Energy Society

51. Address: P.O. Box 52, Parkville, Victoria, 3052 Australia. ISES is a worldwide international association grouping about 7,000 members, but mainly from the English-speaking countries. ISES publishes "Solar Energy", the most famous scientific journal related to solar energy utilization. ISES also organizes every eighteen months a Solar Energy Congress, which provides an opportunity to assess the status of development of solar energy technology in the world. The next ISES Congress will be held at Brighton (United Kingdom) in August 1981. The present Chairman of the Board of ISES is Mr W.C. Charters (Australia).

International support for the programme on renewable sources of energy

52. The Government of Malta has signed bilateral agreements for joint research programmes with Austria and the Federal Republic of Germany. It is advisable that international support from the United Nations agencies (Unesco and UNDP) be given to Malta to provide a good start to the research programme. This support might relate to the following activities: tour by the future "principal investigators" of the European laboratories engaged in renewable energy research, to gather practical ideas, which are difficult to obtain from the available literature; participation of faculty members in specialized conferences or summer schools at an advanced level; and fellowships (three to six months) for faculty members in the field of highest priority for Malta - desalination.

Conclusion

53. The development of utilization of renewable sources of energy in Malta, jointly with an energy conservation programme, appears quite feasible. The University of Malta and ENEMALTA, working together, may play a useful role in this development. Bilateral co-operation is a good way to initiate activities in this field. However, Malta should pursue the aim to create its own team of experts for technical management of projects. United Nations agencies should assist Malta to attain that objective.

LIST OF PERSONS ENCOUNTERED ON MISSION

Research Committee

Dr L. Saliba, Chairman of Research Committee

University of Malta

Dr D.H. Walwyn-James, Rector of the University of Malta
Professor Debono, Chairman of University Council
Professor C.J. Camilleri, Head, Department of Mathematics and Science
Professor Joe Mifsud, Head, Department of Mechanical Engineering
Professor K. Kaldarar, Head, Department of Civil Engineering and Architecture
Professor C.J. Farrugia, Head, Faculty of Education
Dr E. Scicluna, Acting Head, Department of Management Studies
Professor V. Karfic, Department of Architecture
Mr E. Scerri, Department of Mathematics and Science
Mr L. Pollacco
Mr G. Agius
Dr D.A. Havard, Department of Physics

ENEMALTA

Mr L. Ciantar, Head of Electricity, Chairman of the Committee for Non-Conventional Energy Sources

Malta Development Corporation

Dr Noel Z. Adami

Unesco Club

Mr A.V. Rutter, Chairman