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Evaluation report on UNESCO's Contribution to the World Solar Programme 1996 – 2005

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Executive Summary

Following the Evaluation Plan in the Programme and Budget for 2000-2001 approved by the General Conference at its 30th Session, the Director General established an evaluation of UNESCO's contribution to the World Solar Programme 1996-2005 (WSP) which was to be conducted by an external evaluation team.

A major task that the evaluation team performed was to assess UNESCO's contribution to the World Solar Programme. This evaluation covers activities that have been undertaken in the first five years of a planned ten-year World Solar Programme. The main activities assessed on the World Solar Programme are three solar demonstration villages and the Global Renewable Energy Education Training Programme (GREET). The recommendations suggested by the evaluation team provide guidelines and form a basis of a more focused future approach to a global renewable energy programme that would facilitate wider use of renewable energy resources and technologies for creating improved living conditions for poor people and promoting sustainable development on a global scale.

The objectives of the evaluation were to:

a) Examine the relevance of the work plan activities undertaken by UNESCO under the World Solar Programme to the objectives of the WSP and UNESCO's programme priorities

b) Establish the progress of activities undertaken by UNESCO under the World Solar Programme

c) Review programme outcomes and the processes for establishing those outcomes

d) Identify possibilities for strengthening of coordination of these activities with other UNESCO programmes, the rest of the UN system and other international partners

e) Examine how the key lessons from UNESCO's involvement in this Programme could be fed into the design of future UNESCO's activities in renewable energies

i) Summary of major findings

Given what has been observed from the implementation of projects under the World Solar Programme 1996-2005, the World Solar Programme did not attain all its objectives to become the major programme that was originally envisaged. The impact of the World Solar Programme has been limited due to a number of factors, the major one being the absence of an action plan. The action plan would have been beneficial for guiding implementation of the various activities.

Another issue that contributed to limited impact of the World Solar Programme was limited participation of other UN agencies and multilateral organisations as cooperating partners in the implementation of the Programme. The evaluation team contacted a number of multilateral agencies who showed an almost total lack of knowledge of the existence and objectives of the World Solar Programme. Although UNESCO top management did make efforts to ask for support from UN agencies in implementing the World Solar Programme, there was no consultation at the level of officials who were responsible for implementing various programmes in the UN agencies and UNESCO. As a result, UNESCO lost an opportunity to catalyse the UN system and mobilise other agencies to participate in the World Solar Programme. UNESCO with its limited resources could only play a catalytic role, collaboration with other agencies was, therefore, critical to the success of the World Solar Programme. The evaluation team held meetings with some representatives of UN and multilateral agencies and there were indications that with a properly defined programme of action, institutions would have been willing to collaborate with World Solar Programme on areas of common interest.

The concept of stand-alone power generation for local consumption through ‘solar village’ is one way of disseminating modern energy services to the rural poor. The solar village demonstration projects have a tremendous replicability value. However, affordability is an issue that seems to be a major limiting factor in wide dissemination of the solar technology due to the high cost of the technologies. Apart from donor funded activities, there is no evidence of wide spread dissemination of solar technology in the communities beyond the projects that had been funded by UNESCO under the World Solar Programme.

UNESCO’s role in the solar village demonstration projects is to be seen as that of ‘catalyzing’ dissemination of decentralized modern energy technologies. Sustainability of these projects in the medium and long term could be threatened by lack of participation by local stakeholders

such as government, private sector/industry, informal sector and community based organisations. These stakeholders were and are still critical to wide spread dissemination of renewable energy technologies.

ii) Major Lessons

A number of lessons can be learnt from implementation of the World Solar Programme. Collaboration with international, national and local agencies is essential as it provides opportunities for mobilizing financial and human resources that may be critical to the successful implementation of the programme.

Another important lesson learnt is that solar technology has potential for addressing poverty issues and some energy needs for rural populations and social institutions such as schools, hospitals and water pumping especially in the developing countries but is limited on meeting energy needs of the majority of the rural people. Major energy issues in the rural areas include energy for cooking and thermal applications in small and medium industries. A programme of the World Solar Programme magnitude should be flexible and have different approaches due to diversity of targeted countries. This will be more beneficial to the World Solar Programme and the community as priority energy needs will be targeted.

iii) Major Constraints

The implementation of the World Solar Programme faced a number of constraints. Some of the major constraints that affected proper implementation of the World Solar Programme included lack of coordination with other UN and multilateral agencies. Other constraints were insufficient budget allocation which affected monitoring of the projects and decentralization which impacted negatively on coordination of activities which were implemented.

iv) Summary Conclusions

Given what has been observed from the implementation of some of the projects, the World Solar Programme 1996-2005 was conceptually good and had potential for meeting some energy needs of the rural population. The following are main conclusions:

a) The absence of an action plan severely affected the implementation of the WSP.

b) WSP did manage to raise a level of awareness of benefits that solar technology can provide for the rural population. The solar village concept and GREET programme were found to be good approaches for introducing solar energy technology to the rural areas and building capacity of local human resources. Under the GREET Programme, the World Solar Programme contributed to enhancing capacity on the use and application of renewable energy through implementation of training activities, publication of learning / teaching material, conception and field implementation of Solar Training Platforms as a new educational tool.

c) Affordability of solar technology is a major limiting factor in the dissemination of the technology. As a result, the majority of households cannot afford to purchase solar systems for lighting and communications.

d) Sustainability in the medium and long term could limit the benefits of the good work done by UNESCO in implementing the solar village projects. It is not clear as to who is responsible for maintenance and paying for cost of replacement of batteries when they expire.

v) Summary Recommendations

The objectives of the World Solar programme are important and they all relate to substantive issues of increasing availability of sustainable energy, rural development, establishing or improving existing institutional frameworks, provision of adequate financing and increasing participation of local industry in renewable energy activities. The World Solar Programme was a promising idea and consideration should be given to how it can be restructured so that it continues to implement projects that address issues of poverty and contribute to sustainable development. To improve future implementation of the World Solar Programme, the following are recommended:

a) An action plan with clearly defined goals, objectives and activities should be developed that will guide implementation of the World Solar Programme.

b) Consideration should be given to establishing an international expert advisory group for providing guidance to UNESCO's contribution to the World Solar Programme. The advisory group should work within the framework of the existing United Nations Ad hoc Inter-Agency Task Force on Energy.

c) There is need to develop innovative macro and micro financing mechanisms for financing solar energy projects. Consideration should be given to the Energy Service Company (ESCO) approach.

d) Consideration should be given to establishing collaboration with national institutions, developing national capacity to manage demonstration projects and addressing issues of affordability and sustainability.

e) UNESCO should reinforce the implementation of the GREET Programme in the different regions and strengthen its African Chapter to enhance capacity building on the use and application of renewable energy of Member States.

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List of Acronyms and Abbreviations

ADEME	Agence de l'Environment et de la Maitrise de l'Energie
AfDB	African Development Bank
AsDB	Asian Development Bank
DTC	Development Technology Centre – University of Zimbabwe
ESCO	Energy Service Company
GEF	Global Environmental Facility
GREET	Global Renewable Energy Education and Training Programme
FAO	Food and Agricultural Organisation
IDB	Inter-American Development Bank
IOS	Internal Oversight Services
IPCC	Intergovernmental Panel on Climate Change
NGO	Non Governmental Organisation
OECD	Organisation of for Economic Cooperation and Development
OLADE	Organizacion Latinoamericana de Energia
PV	Photovoltaic
SADC	Southern African Development Community
SIRDC	Scientific and Industrial Research and Development Centre
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNIDO	United Nations Industrial Development Organisation
UNFCCC	United Nations Framework Convention on Climate Change
USIJI	United States Initiative on Joint Implementation
WB	World Bank
WSC	World Solar Commission
WSP	World Solar Programme 1996-2005
WSSP	World Solar Summit Process
ZOC	Zimbabwe Organizing Committee

1.0 INTRODUCTION

1.1 B BACKGROUND

The United Nations Conference on Environment and Development (UNCED) also known as the 'Earth Summit' held in Rio de Janeiro in 1992 adopted in Agenda 21 an international programme of action for global sustainable development into the 21st century. In March 1995, the United Nations Educational Scientific and Cultural Organisation (UNESCO) took an initiative with the support of a group of Heads of State and Government to establish the World Solar Commission (WSC). The World Solar Commission which had a secretariat provided by UNESCO was set up as an independent body. The purpose of the WSC is to provide a high level leadership aimed at encouraging the wider use of all forms of renewable energy to alleviate poverty and promote sustainable development.

The historical background and the chronology of the launching of the World Solar Summit Process, the establishment of the World Solar Commission and the approval of the World Solar Programme 1996-2005 can be traced back as follows: In July 1993, UNESCO organized a high-level Expert Meeting entitled "The Sun in the Service of Mankind" which dealt with all forms of renewable energy. According to UNESCO, the term 'solar' is generic and includes all renewable energies: solar thermal, solar photovoltaic, wind, biomass, tidal, ocean, micro hydro, geothermal and so on. This meeting recommended, inter alia, that UNESCO initiates a process leading to the holding of a World Solar Summit at the highest political level, i.e. Heads of State or Government (Annex C1). As a follow up to the meeting, the World Solar Summit Process (WSSP) was initiated. UNESCO took the initiative in 1994, following the UNCED, to conduct a "World Solar Summit Process." During the first two years of this Process, a World Solar Commission composed of a group of Heads of State or Government was established under the initiative of the Director-General of UNESCO. A World Solar Summit was organized by UNESCO between 16-17 September, 1996 in Harare, Zimbabwe during which an outline prepared with active participation of UNESCO for global renewable energy initiative known as the "World Solar Programme 1996-2005" (WSP) was approved. At the World Solar Summit a total of 104 countries were officially represented, including 12

organizations of the United Nations system and 10 regional international organisations including the European Union, the European Commission and the Organization of African Unity.

The WSP was conceived as a follow up to the recommendations of the UNCED. Following the World Solar Summit, the World Solar Commission in close collaboration with UNESCO and other partners during the nine months following the Harare Summit prepared a draft document entitled " World Solar Programme 1996-2005". WSP was considered and approved by the World Solar Commission in June 1997 in New York at its second session organised on the occasion of the 19th Special Session of the UN General Assembly (UNCED+5) in collaboration with the relevant units of UN and UNESCO secretariat. The WSC tended to dominate the WSP and restricted the majority of its activities to African states.

The master document of the World Solar Programme 1996-2005 contains a list of nearly 500 national priority projects identified by Member States, an outline of regional projects and five projects of global importance. These global projects range from education, information, rural electrification, water treatment to renewable energy policy. The national priority projects tended to form an ad hoc wish list of projects hastily submitted without adequate pre-planning in terms of reference to national energy strategies. UNESCO has co-financed 39 projects in the sum of US$ 1.7 million. Some of the projects have been implemented by Member States through direct bilateral cooperation programmes and other donors including UN agencies such as UNDP (Annex A1).

1.2 OBJECTIVES OF THE EVALUATION

The purpose of this evaluation was to:

- examine the relevance of the activities undertaken by UNESCO under the World Solar Programme to the objectives of the WSP and UNESCO's programme priorities;

- establish the progress of activities undertaken by UNESCO under the World Solar Programme;

- review programme outcomes and the processes for establishing that outcomes have been secured

- identify possibilities for strengthening of coordination of these activities with other UNESCO programmes, the rest of the UN system and other international partners;

- examine how the key lessons from UNESCO's involvement in this Programme could be fed into the design of future UNESCO’s activities in renewable energies.

1.3 TERMS OF REFERENCE

The Terms of Reference for this evaluation are as follows:

- Clarity and achievability of objectives and expected outcomes; relationship between the objectives, the outputs, the activities, and the inputs;

- Extent of attaining the initial objectives; practical utility and impact of results on identified target groups in terms of contributing to environmental, economic, and social sustainability (including gender equality) and alleviation of poverty;

- Extent to which financial and human resources were wisely used;

- Capacity to mobilize extra budgetary financing;

- Extent of financial viability, replicability and sustainability of the Programme’s practical results;

- Effectiveness of inter-sectoral approach within UNESCO;

- Areas of comparative advantage and added value vis-à-vis other international partners, UN agencies and NGOs, such as, for example, UNDP, UNEP, FAO, the

European Union, the International Solar Energy Society, the World Energy Council, ICSU, etc.;

- Contribution of UNESCO to the WSP seen as part of the UN action for sustainable development;

- Efficiency and effectiveness of decentralization;

- Constraints and opportunities.

The document containing the Terms of Reference is given in Annex A2

1.4 METHODOLOGY OF EVALUATION

The evaluation was conducted in the following order:

a) Discussions with officials at UNESCO Headquarters in Paris, France

The evaluation team visited UNESCO Headquarters in Paris during the period 21-26 October 2001 and held discussions with

- senior and staff members of UNESCO Science Sector.
- officials from other Sectors and Internal Oversight Service (IOS).
- persons who are not UNESCO officials including members of delegations of Member States to the 31st Session of UNESCO General Conference**.**

b) **Documents**

The evaluation team studied a number of documents that the Science Sector had submitted with respect to activities of the WSP. The evaluation team also visited the UNESCO website to search for material and documents that were relevant to the World Solar Programme.

c) **Interaction with International Organizations**

The evaluation team visited, communicated by electronic mail and telephone with representatives of international organisations with a view to assess the level and efficiency of cross-agency co-operation in implementing the WSP. The evaluation team visited the following international agencies:

- Inter-American Developmental Bank (IDB), Washington DC, USA
- The World Bank (WB), Washington DC, USA
- United Nations Development Programme (UNDP), New York, USA
- Global Environmental Facility (GEF), New York, USA

The evaluation team communicated by electronic mail and telephone with the following agencies:

- African Development Bank (AfDB)
- Asian Development Bank (AsDB)
- Food and Agricultural Organisation (FAO)
- United Nations Industrial and Development Organisation (UNIDO)
- Economical and Social Commission for Asia and the Pacific (ESCAP) Office in Bangkok

d) Field Visits

The evaluation team visited several project sites in Africa and Honduras to gain first hand knowledge of the inputs, outcomes, constraints and experiences of specific projects funded by UNESCO under the WSP. Africa had more field visits than any other region because the WSP projects concentrated more in Africa. The criteria for choosing the countries is given below:

i) Honduras (Central America)

This country was chosen because the UNESCO solar village implemented in that country is unique in that in addition to providing electricity for lighting to

classrooms, refrigeration of vaccines at the health centre and other social facilities, the solar system is used to provide electricity for school computers. The school children are now able to learn how to use different computer software and have access to the internet making it possible for the children to have access to the World Wide Web.

ii) Kenya

This country was chosen because the UNESCO Regional Science Office is in Nairobi, Kenya. All major activities in Africa are coordinated and implemented from there. This Office implemented a number of WSP projects in Eastern and Northern Africa.

iii) Zimbabwe

This country was chosen because of the role it played in organising the World Solar Summit activities as well as providing the Chairman of the World Solar Commission. The evaluation found it necessary to meet with officials in this country with a view to get more information on WSP and how it related to the World Solar Commission. In addition, the UNESCO Harare Office was the first to launch the African Chapter of the Global Renewable Energy Education and Training Program (GREET) as a model for the SADC region. The model is to be duplicated later on for other countries. Through WSP efforts were put in defining and implementing of a concept of solar training platform for English speaking Africa (Summer Schools) at SIRDC. So far two summer schools and two training of trainers sessions have been held for SADC countries. The UNESCO Harare Office produced learning and teaching materials for primary schools (Kawi Series) and training manuals for solar water pumping and biogas. These activities were vital to the evaluation.

iv) Madagascar

Being an island state, the evaluation team thought that this country could provide unique experiences in rural energy availability.

v) South Africa

The UNESCO Office in Pretoria was responsible for activities in 14 SADC countries. The Office was effective in 7 countries. SADC is an important sub-regional organisation and the experiences of UNESCO Pretoria Office regarding the implementation of WSP projects in the region were considered vital to the evaluation.

vi) Thailand

Thailand was chosen as a representative country of the region with a view to determine how electrification can be used as a means of alleviating poverty in Asia.

In addition to meeting UNESCO Field Officers in these countries, discussions were held with some representatives of Governments, NGOs, private sector and beneficiaries of the WSP projects.

e) Input from UNESCO Field Offices

The evaluation team received written comments regarding the implementation of WSP from the following UNESCO Field Offices:

- Indonesia
- Uruguay
- Beijing

Contact with UNESCO Field Offices was made by electronic mail and telephone.

f) Brain-storming

The evaluation team met in New Delhi, India to prepare a draft report. The evaluation team held a series of brainstorming sessions before work started to compile the draft evaluation report

1.5 METHODOLOGICAL CONSTRAINTS

a) Delay in contacting relevant authorities

UNESCO Science Sector sent letters informing various governments and agencies about the WSP evaluation very late. This is despite the fact that the Evaluation Team left a detailed work plan which included dates of the field visits with the Science Sector in Paris. As a result the evaluation team was unable to meet some government representatives due to short notice. In the majority of cases, the evaluation team had to contact the UNESCO Field Offices by itself.

b) Lack of access to people with critical information

Zimbabwe

The evaluator held discussions with senior officials from the Zimbabwe Organizing Committee (ZOC) of the World Solar Commission and senior officials from the Scientific and Industrial Research and Development Centre (SIRDC). The evaluator also met and held discussions with representatives of Development Technology Centre – University of Zimbabwe, private sector and NGOs. Although the Acting Director of Energy accompanied the evaluator on two field visits, no official was available from the Ministry of Energy and the UNESCO National Commission for Zimbabwe for discussions with the evaluator. As a result, the evaluator was unable to get vital information pertaining to the implementation of World Solar Cooking Project that was financed under the WSP.

South Africa

The evaluator held discussions with UNESCO Science and Technology Advisor who was responsible for implementation of WSP in SADC countries. The evaluator also met the Acting Secretary General of the UNESCO National Commission in South Africa. The Advisor contacted the Office of the Deputy Minister responsible for Energy to arrange an appointment for the evaluator to meet the Deputy Minister and senior energy officials. The Office of the Deputy Minister could not grant the appointment because the request was made late. As a result, there was no discussion with government officials.

c) Lack of access to vital documentation

Honduras

Documents for the solar village demonstration project were not available at the time of the field visit

Madagascar

Documents for the solar village demonstration project were not available at time of the field visit

Zimbabwe

According to comments received by the evaluation team from UNESCO Science Sector, documents related to the implementation of World Solar Cooking Project are now available at the UNESCO Harare Office. But these documents were not available to the evaluator at the time of the field visit; hence they were not reviewed.

d) Inadequate field visits

Field visits and evaluation were constrained by UNESCO timetable for report submission and budget limitations.

2.0 HISTORY, OBJECTIVES AND UNESCO'S INVOLVEMENT IN THE WSP

2.1 HISTORY OF WORLD SOLAR PROGRAMME 1996-2005

A high level expert meeting "The Sun in the Service of Mankind" (the summit of world expertise in the field of renewable energy), was successfully prepared by Engineering and Technology Division of the Science Sector of UNESCO and convened at UNESCO Headquarters, 5-9 July 1993 – exactly twenty years after the World Congress, "The Sun in the Service of Mankind", also held at UNESCO in 1973. Some 346 top experts from 53 countries prepared 66 in-depth critical written assessments of solar energy and related fields including "Solar Energy and Health", "Solar Energy, A Strategy in Support of Environment and Development" and "Financing Solar Energy Development". These reports were debated in 35 specialized round tables. At its seventh Plenary sessions the Meeting discussed and approved: "Conclusions and Recommendations of the High-level Expert Meeting for the World Solar Summit" and "Resolution Addressed to the Founding Sponsors of the World Solar Summit Process" together with the series of specific recommendations adopted at the Round Tables.

UNESCO, the European Commission, the International Energy Agency, EUROSOLAR, the International Solar Energy Society and the French Agency for Environment and Energy Management were the founding members and joint sponsors of the meeting. In addition to these organizations, some thirty cooperating agencies and institutions, including the United Nations Environment Programme, the United States Department of Energy, the E7 Network of Expertise for the Global Environment, the Friedrich-Ebert Foundation (Germany), the World Health Organization, and the United Nations University participated in the High-level Expert Meeting. The UNESCO Engineering and Technology Division of the Science Sector served as the Secretariat for the meeting.

The High-level Expert Meeting, "The Sun in the Service of Mankind", suggested undertaking a three-year campaign 1994-1996 entitled "World Solar Summit Process" (WSSP) leading to the organization of a World Solar Summit. The World Solar Summit Process 1994-1996 has been a concrete response to the recommendations of the Earth Summit concerning energy and the decisions of the 27th and 28th Sessions of the

UNESCO General Conference. This communication process and highly focused campaign had the following objectives:

- Enhance understanding of the role that renewable sources of energy could play in the preservation of the environment, in the provision of energy services - particularly for rural and remote areas - and in contributing towards a solution to unemployment

- Favour the access, transfer and sharing of knowledge on renewable energies by establishing a global information networking system using state-of-the-art communications technology

- Promote and harmonize cooperation in education, training and research, as well as in the transfer of research disclosures to industry at the regional, interregional and international levels

- Demonstrate how wide use of renewable energy is a cost-effective and rapid way for many developing countries to reduce energy costs, save foreign exchange and stretch the energy supply base without heavy investment

- Urge non-governmental organizations to enter into partnership with, and make their knowledge and experience available to global and regional intergovernmental bodies, as well as to establish innovative programmes for the promotion of the use of renewable energies

- Reinforce local industrial capacities

- Identify and define selected strategic projects of global importance for inclusion in the World Solar Programme 1996 - 2005, consisting of a major developmental initiative, which will trigger a wider use of renewable energy sources and create open competitive and sustainable markets for renewable energy technologies, equipment and goods

- Strengthen the commitment from the international community, especially multilateral and bilateral donors as well as the national commitment from each participating country

- Reinforce the involvement of the international community and, in particular, that of the multilateral and bilateral sponsors, as well as the national implication of each country

- Create small-scale financing and delivery mechanisms

- Prepare and convene a World Solar Summit at the highest governmental level

- Launch the World Solar Programme 1996-2005 during the World Solar Summit. This important worldwide initiative in favour of development included the carrying out of 300 top priority and carefully selected projects in the field of renewable energy and several projects of an exceptional quality and of a considerable universal value.

The European Commission and the International Energy Agency played a decisive role in this major initiative. An Action Plan for Renewable Energy Sources in Europe was prepared in 1994 that provided a most timely and useful framework for the European energy sector, and gave a useful example for development of similar Action Plans in other parts of the world, as foreseen in the World Solar Summit Process.

The master document of World Solar Programme 1996-2005 approved by the World Solar Commission at United Nations Headquarters in New York in June 1997 outlined an ambitious programme of national, regional and global projects ranging from education and information through rural electrification, water supply and treatment using renewable energies to renewable energy policy and planning issues. Resolutions of the General Assembly of the United Nations in the period 1998-2000 further endorsed the aims of the World Solar Programme within the framework of sustainable development and in promoting the special interests of UNESCO in education and training activities in the field of Renewable Energy (Annex B2). This thrust has since been transformed to a Global Renewable Energy Education and Training Programme (GREET). Attention has been given to developing and promoting the model concept of the Solar Village in Africa and Central America.

UNESCO in this instance provided seed funding to develop the model and encourage others to invest in similar developments.

An initiative was undertaken to provide educational materials for teaching renewable energy technologies at University and school level as outlined in Chapter Three of this report. Measures to implement an international renewable energy information and communication system (EIRCS) have so far not taken effect and may have been overtaken by other renewable energy information systems now in place such as WIRE (ISES), RERIC (AIT, Thailand), and others. A way forward now may be to network and hotlink the various sites available on the web rather than to create yet another renewable energy database. On the same lines with the proliferation of renewable energy research centres now seems to be an opportune time to take a leading role in networking national and regional centres into a global network**.**

2.2 UNESCO'S INVOLVEMENT IN THE WORLD SOLAR PROGRAMME 1996-2005

The Resolutions of UNESCO General Conference and Decisions of the UNESCO Executive Board define UNESCO's involvement in the WSP. The twenty-ninth Session of UNESCO General Conference held in Paris, 21 October to 12 November 1997 adopted the report of Commission III at the 26th plenary meeting, on 11 November 1997 as a special resolution on the subject (Annex C2). The Approved 28 C/5, 29 C/5 and 30 C/5 all include provisions for UNESCO's involvement in the WSP, set goals, objectives and define the means to achieve them. These documents also define in general terms the managerial structure. The Resolutions of the General Conference permit the Director-General to:

(a) Undertake further consultations with the World Solar Commission, Member States and interested partner organizations with a view to defining the steps, ways and means of transforming the World Solar Programme into an interdisciplinary undertaking in the framework of document 30 C/5;

(b) Mobilize extra budgetary resources and technical assistance for the effective implementation of the World Solar Programme;

(c) Continue to sensitize all Member States and international financial institutions, both public and private, to the strategic importance of this Programme for achieving world developmental needs.

The full text of all Resolutions and Decisions defining UNESCO's involvement in the WSP are given in the Annex C2.

The evaluation team also took into consideration the mandate given to UNESCO's for involvement in the World Solar Programme 1996-2005 by the UN General Assembly by several Specific Resolutions given in Annex B1 and B2. Essential elements related to UNESCO are quoted below:

"Invites the Secretary-General of the United Nations, in consultation with the United Nations Educational, Scientific and Cultural Organization and in close cooperation with the United Nations Environment Programme and other relevant organizations:

(a) To undertake concrete actino in order to esnure that the World Solar Programme 1996-2005 is fully integrated into and brought into the mainstream of the efforts of the United Nations system to attain the objective of sustainable development;

(b) To bring the World Solar Programme 1996-2005 to the attention of relevant funding and technical assistance sources and to encourage them to consider contributing to its effective implementation;

(c) To continue to sensitize and generate a greater degree of awareness in all Member States and international, regional and national institutions, both public and private, to the strategic importance of the World Solar Programme 1996-2005 for ensuring sustainable development;

(d) To submit to the Genral Assembly at its fifty-fourth session, under item entitled "Environment and sustainable development" , a report entitled "World Solar Programme 1996-2005" concerning measures taken by the different entities of the United Nations system in accordance with the provisions of the present resolution."

and

"Takes note of the decision of the General Conference of the United Nations Educational, Scientific and Cultural Organization regarding the strategic importance of the Global Renewable Energy Education and Training Programme 1996-2005 in attaining the objective of sustainable development, and encourages the Director-General of the United Nations Educational, Scientific and Cultural Organization to make efforts to promote public awareness in all Member States in this regard, with the support of international, regional and national institutions, both public and private;

- Noting also that the Global Renewable Energy Education and Training Programme 1996-2005 constitutes one of the major programmes of universal value of the World Solar Programme 1996-2005

- Requests the Secretary-General, in consultation with the United Nations Educational, Scientific and Cultural Organization and in cooperation with the United Nations Environment Programme and other relevant organizations, to submit to the General Assembly at its fifty-sixth session a report on concrete action being taken for the promotion of new and renewable sources of energy, including the effective implementation of, and mobilization of resources for, the World Solar Programme 1996-2005, including promotion for mobilization of resources"

2.3 AIMS AND OBJECTIVES OF WORLD SOLAR PROGRAMME 1996-2005

The main aim of the World Solar Programme 1996-2005 as approved by the Word Solar Commission is to encourage the wider use of all forms of renewable energy to alleviate poverty and promote sustainable development. WSP has the purpose of sensitizing governments, intergovernmental organizations, non-governmental organizations, financial institutions academia and private institutions on the need to support the development and utilization of renewable energy for sustainable development. The stated objectives of WSP are:

<u>Objective 1.1</u>

To promote at the international and national level a sustainable energy path that will ensure that energy can fulfill its potential role as a key instrument for sustainable human development.

Objective 1.2

To accelerate rural development through the use of renewable energies, in order to improve the quality of life of the people, notably through better health, education, socio-economic development and local productivity.

Objective 2.1

To establish effective institutional frameworks and improve existing ones that will accelerate and facilitate continued technological advancement and the effective dissemination and utilization of renewable energy.

Objective 3.1

To achieve a substantial increase in the use of renewable energies particularly for electric power general generation, as a major contribution to sustainable development.

Objective 3.2

To provide adequate financing for the development and application of renewable energy through the mobilization of additional resources at the international and national level.

Objective 3.3

To progressively secure an increasing participation of industry and the private sector in the development and deployment of renewable energy technology.

The World Solar Programme 1996-2005 contains a concept and three distinct categories of projects:

i) Global projects of universal value

- Global Renewable Energy Education and Training;
- International Renewable Energy Information and Communication System;
- Renewable Energy for Rural Electrification;
- Renewable Energy for Water Desalination and Treatment, and
- Industrial Policy, market Penetration and Technology Transfer for Renewable Energy

ii) Regional priority projects

iii) High priority national projects, (nearly 500)

3.0 RESULTS OF EVALUATION

3.1 MANAGEMENT OF THE WORLD SOLAR PROGRAMME 1996-2005

The Director-General established within the Natural Science Sector the World Solar Programme 1996-2005 (DG/Note 96/7 dated 26 January 1996). According to the D/Gs Note, the Director of SC would head the WSP under the supervision of the Assistant Director General Science Sector (ADG/SC). A team of staff members dealing with research, development, higher education and training linked to the use of renewable energy was entrusted with the implementation of WSP. The overall coordination of WSP was entrusted to the Deputy Director General who was to chair an Inter-sectoral Solar Task Force composed of ADGs of programme sectors.

UNESCO Science Sector did not have staff who were solely responsible for implementation of a major demonstration programme such as the WSP. Programme Specialists who were responsible for other programmes implemented the WSP. A Task Manager should have been recruited whose sole responsibility would have been WSP. The responsibility of the Task Manager would have been to ensure that an action plan and project documents were developed, collaboration was established with other agencies and programme was monitored.

Decentralization did affect the Programme in that some of the activities in the UNESCO Field Offices were not reported to UNESCO Headquarters. For instance, there were no documents at UNESCO Headquarters for a major project like the Honduran Solar Village Project.

UNESCO Science Sector did not work out a specific action plan for implementation of specific activities within the mandate of the WSP objectives. In the absence of an action plan, implementation of activities tends to be ad hoc and lack focus. An action plan would not only have facilitated focused action but would have enabled proper resource planning and mobilization. The action plan would have been a reference point for evaluating the activities implemented under the WSP. Further, the action plan would have served as a foundation for successive action plans.

UNESCO implemented projects under WSP through requests made by Member States. Requests were submitted to UNESCO through project proposals outlining priority areas and the financial needs. UNESCO would then assess the proposal and if it was accepted and funds were available, disbursements were made to successful Member States.

3.2 FINANCING OF WSP

The UNESCO Executive Board made a decision that an appeal be launched to international financial institutions, UNDP and other agencies for implementation of the World Solar Programme (Annex C3). However, lack of an action plan led to low level of financial resources available for the World Solar Programme. Annex A3 shows regular budget for World Solar Programme activities for both UNESCO Headquarters and Field Offices.

UNESCO was able to mobilize extra budgetary resources. The total funds mobilized by UNESCO from extra budgetary resources as given by the Science Sector shows that US$1.7million was received by UNESCO as extra budgetary money for WSP activities. This money was allocated to high priority national projects. It was explained that this figure may be below the reality since it did not include, amongst other**,** extra budgetary funds mobilised by UNESCO Field Offices. Attention was also drawn to the fact that there were other extra budgetary resources mobilized for WSP activities which, although not channeled through UNESCO, did contribute to WSP activities on bilateral basis or between countries and other institutions. It is worth mentioning here that for the Global Renewable Energy Education and Training (GREET) Programme, Extra Budgetary Resources of the order of US $348,000 were mobilized for activities implementation from January, 1998 to December, 2001 i.e. over a 4 year period with in-kind contribution of donors. The contributions were as follows:

a) Ministry of Foreign Affairs of France provided an amount of US $ 110 000 for the realisation and installation of the Solar Training Platform as well as the organisation by French experts of a training of trainers session in Zimbabwe.

b) ICAEN organised for the Summer Schools (1996, 1997 and 1998) technical and field visits in Spain, that would have cost to UNESCO approximately US $ 123, 000.

c) Similarly, CDER organised for the Summer Schools (1999 and 2000) technical and field visits in Morocco, that would have cost to UNESCO approximately US $ 55, 000.

d) Under the joint UNESCO/ISESCO agreement, ISESCO through direct support given to participants from ISESCO Member States has allocated over the last three years almost US$ 60,000 to the training activities implemented under GREET Programme.

In the area of High Priority National Projects, initially, around 500 such projects were proposed by Member States. The UNESCO Executive Board made a decision that WSP became a joint endeavour of the entire UN System paying particular attention to Africa (Annex 4). WSP's main focus was, therefore, Africa where 39 projects requiring an investment of over US $38 million were identified by Member States as shown in Annex A1. UNESCO allocated US$1.7 million for projects in Africa during the last three biennium and since 1996.

A few rich Member States donated funds that were used to finance renewable energy projects. Another source of funding was the Multi-disciplinary Participation Programme where Member States could draw US$40,000 over a period of two years. Funding details of these activities were not available.

3.3 ACHIEVABILITY OF OBJECTIVES AND EXPECTED RESULTS AND OUTPUTS

The difficulty associated with this evaluation was that there were no project documents or action plans describing the objectives or purpose, duration of the projects, outputs or results of the various activities that were to be implemented under the WSP except for the GREET Programme. The depth of analysis was limited by the ambiguity and generality of the WSP aims and objectives and lack of credible data pertaining to technical and financial aspects of the projects and programmes implemented under the WSP. The objectives of WSP are not very clear and specific. As a result the evaluation team found it difficult to measure the various outputs and outcomes of WSP activities. Moreover, linking the objectives of the activities implemented under the WSP with the results or outcomes became unattainable.

The success of the outcomes of WSP were measured in terms of the qualitative assessments and discussions held with Programme Specialists who were responsible for implementation of the projects, government officials, NGOs and beneficiaries.

The outputs of the World Solar Programme 1996-2005 are:

- Solar village demonstration projects
- Global Renewable Energy Education Training Programme
- Publications Programme
- Raised awareness of solar energy at the political and policy planning level especially in Africa where the needs are enormous.

All the above activities contribute to achieving objectives of the WSP which can be summarized as follows:

- Promotion of sustainable energy path for human development especially in the rural sector
- Enhancement of the dissemination and utilization of renewable energy sources
- Facilitation of adequate financing and resource provision at the national and international levels

Annex A1 provides a summary of activities which are being implemented.

3.3.1 Solar Village Programme

A solar demonstration village is defined as electrification of households, community facilities like water pumping, schools, churches and health centres in remote areas which are far from the national electricity grid. This definition can also include electrification of rural police posts, administrative buildings and street lighting.

The objective of a solar village demonstration is to raise awareness among the people within the local community on the use and application of solar energy technologies with a view to promote the use of such technologies.

UNESCO's major contribution is to be seen in giving the concept of a 'Solar Village' to the international community with around 2 billion people worldwide having no access to modern energy services. The concept of stand-alone power for local consumption through the wider acceptance of the 'Solar Village' idea could prove to be the ultimate solution to some of the energy needs of the majority of world's population living in poverty. Solar photovoltaic systems can be used to meet some of the energy needs like illumination and low power applications such as water pumping, vaccine refrigeration, radio and television.

UNESCO has promoted the development of Solar Villages. Several of them have been installed in Africa and one of them in Honduras, Central America. The evaluators visited solar villages in Honduras, Madagascar and Zimbabwe.

Solar Village in Central America

Honduras

The Solar Village project in Honduras was implemented in a village which has about 800 inhabitants in an isolated region, to the south of the capital Tegucigalpa. The solar systems generate electricity for the following:

- Illumination of classrooms in the school
- Computers with software like Word and Excel, educational software like Click, among others
- Connection to the internet
- Television (TV) and video cassette recorder (VCR)
- Health care post with refrigerator for vaccine preservation and computer for storage of health records of the community
- Illumination of church and priest's house
- Public lighting

The estimated cost of the project was US$200,000 with in kind contribution by the Governor of Choluteca. The solar systems have been in operation since 1999. This project is important to the development of the community in the area because it has exposed school

children to new educational technologies, information access and also to communicate with other people through the Internet.

One of the limitations of the program in the beginning was the limited participation of the local community members. However, the children have contributed to developing in the adults a positive attitude towards new technologies. This is evidenced by the formation of two bakery and tailoring micro-enterprises. These micro-enterprises were formed as a result of exposure of the community to opportunities that were seen via the Internet and television. Such exposure was not available before due to the remoteness of the area and lack of modern energy services such as electricity generated by solar photo-voltaics.

As a consequence of this demonstration project implemented by UNESCO there has been other development of Solar Villages in Honduras with contributions from OAS, GEF and other national and international organizations. The biggest impact of this demonstration project will be the development of the Hondurean Program of Solar Villages that has received a credit from the Inter-American Development Bank (IDB) for US$8.5 million to develop over a hundred solar villages.

Observations

The evaluator observed during the field visit that the battery bank was constructed outside a building which is not the normal practice. This will result in shortening the life span of the batteries. Further, fatal accidents can occur due to high dc voltages. This matter must be corrected quickly as people's lives especially children may be at great risk.

Relevance to WSP Objectives

This project has helped to fulfil Objective 1.2 of WSP of improving the quality of life through a better way storing vaccines, improvement in education through the use of computers and internet and contribution to local productivity through the creation of micro enterprises. Further, this project can be replicated in other areas and the government of Honduras has used this project to mobilize financial resources for developing more solar villages. This aspect is a fulfilment of Objective 3.2 of WSP.

Solar Villages in Africa

About 48 solar village demonstration projects mainly financed by donor agencies and/or countries have been implemented in 24 African countries under the WSP.

Madagascar

A solar village demonstration project was implemented in a remote area of Ampasina Maningory which is about 500 kilometres from the capital city Antananarivo. Ampasina Maningory is far and is not connected to national electricity grid. UNESCO funded the solar village project with a total sum of US$58,000 with in-kind contribution of the Madagascar government (payment of customs duty on solar equipment, installation costs and transport). The solar systems have been operational since 2001 and generate electricity for:

- Illumination of two primary schools
- Illumination and vaccine refrigeration for a small rural hospital
- Illumination of a local government office block
- Six street lamps

The installations of above solar systems were done by engineers and technicians from the Department of Energy. Further, the funds provided by UNESCO will cover additional installation of four street lamps and one battery charging station and training of three local technicians who will be responsible for the maintenance of the systems. So far only one local person has been trained in basic maintenance of solar systems.

Relevance to WSP Objectives

This project has helped in raising of awareness on the use and application of solar technology. There are opportunities for the private sector in developing a renewable energy technology market. Following implementation of solar village demonstration projects, the mayor of Ampasina Maningory, Her Worship Ms Fenerive Atsinanana, bought a solar

lighting system at a cost of approximately US$600 for providing light to her house and restaurant business. The business operators that cannot afford solar systems due to high costs have bought car batteries and solar dc lamps which they use to provide light at night for their businesses. The car batteries are taken to a commercial centre which is about 15 kilometres for charging at least once very fortnight. This is the first step towards the creation of a local market for solar technology. This would fulfil Objective 3.3 of WSP.

The project has brought social benefits to the area. The street lighting has reduced the rate of crime in the area where they are installed. The illumination of the hospital using solar lighting has provided better environment for the patients compared to kerosene lamps that were used before and were a health hazard due to smoke and fire risks. Further, availability of refrigeration has improved storage of vaccines. Illumination of schools has made it possible for children to study at night. According to a headmaster of one of the schools, there was a marked improvement in the results of the examinations. He attributed this to the fact that children were able to study at night and prepare for their examinations adequately. All these activities fulfil Objective 1.2 of the WSP

Zimbambwe

Solar Village Project

The solar village project was implemented in Kawanzaruwa village which is situated about 110 kilometres from Harare. Kawanzaruwa village is far from the national electricity grid. The project was completed in 1998 and was wholly financed by the Chinese Government as contribution to WSP after the World Solar Summit held in Zimbabwe.

The objective of this project was to solve some of the energy problems in the rural areas by means of solar home systems and solar systems for community and business applications. The other objective was to demonstrate the application of clean energy technologies with a view to promote commercial and industrial cooperation in the field of solar energy technology between Peoples Republic of China and the Government of the Republic of Zimbabwe.

In this project 110 houses each received a solar PV panel, accessories and a black and white television set. The solar systems were used to provide power for 4 light bulbs and a black and white television set. In addition, a solar water pump was installed for providing potable water to the community, a bar and a grocery shop each received solar systems for lighting. At the time of the field visit, the pump for the water had broken down. There was no evidence of the community buying their own solar systems for other applications.

Relevance to WSP Objectives

This project provided better illumination for the households compared to kerosene lamps that had been used before. There was an improvement in the health of the people as respiratory diseases due to smoke from lamps were eliminated. The television sets were a means through which entertainment, news and current affairs were accessed by the community. Solar village electrification has also contributed to raising awareness on HIV/AIDS through public media such as television. One of the beneficiaries interviewed during the field visit spoke of the benefit that he derived from watching programmes on HIV/AIDS on television. He explained that he knew very little about HIV/AIDS before the electrification project. The people of this area also benefited clean potable water for domestic use. The two businesses were able to operate at night thereby extending their business hours and earn more money. Although this project did not address energy issues for cooking, the solar water pumping helped women in accessing clean water easily without having to walk long distances to fetch water. All these benefits meet Objectives 1.2 and 3.1 of the WSP.

World Solar Cooking Project

This project was funded by UNESCO to promote the World Solar Cooking Project and Zimbabwe Organising Committee (ZOC) project generation activities. The evaluator found it difficult to make a proper assessment of implementation of the project as people who were responsible for this project and relevant project documents were not available. However, the evaluator accompanied by two trainers, responsible for training women in how to use solar cookers, visited Epworth a township in Harare where solar cookers were disseminated. The evaluator was informed by the women who bought the solar cookers that this technology was popular.

A Project Officer from the Development Technology Centre (DTC), University of Zimbabwe who was involved in dissemination of solar cookers funded under WSP explained that the design of solar panel cooker was based on the solar cooking box developed by Solar Cooker International (USA). The technology was adapted locally in Zimbabwe by Manpack Plastic of Zimbabwe. The Department of Energy contracted Manpack Plastic to produce solar cookers which the Department of Energy later sold at a cost of US$3 each. According to information obtained from the DTC, the number of solar cookers donated and sold by the Department of Energy were 5000 and 3030 respectively. These solar cookers were disseminated to women through a group of trainers that trained women on how to use the cookers. There was no evidence of any attempts to introduce other solar cooking technologies such as parabolic and box cookers.

Affordability

The concept of stand-alone power for local consumption through 'solar village' idea is one way of disseminating modern energy services to the rural poor. The solar demonstration projects have a tremendous replicability value. However, the cost of solar technologies is beyond the reach of many rural households. Innovative approaches for funding of these technologies are required for increased dissemination.

One approach could be the Energy Service Company (ESCO) which has been successful in Zambia and Zimbabwe. In the ESCO approach, government in collaboration with donors give solar energy equipment on lease to local companies whose owners have undergone basic training in main aspects of solar business. The ESCOs are established in rural areas and lease the solar systems to rural households and businesses and collect a monthly fee which is usually affordable to some people. The ESCOs are responsible for installation and maintenance of the solar systems. In this way the issue of affordability can be addressed.

Sustainability

UNESCO's role in the solar village demonstration projects is to be seen as that of 'catalyzing' dissemination of decentralized modern energy technologies. Other agencies should augment UNESCO's effort in this regard. Sustainability of these projects in the

medium and long term is a major concern. Although a number of people have been trained in basic maintenance of solar systems in some countries under WSP, there is no evidence of beneficiaries or their governments having made commitments to maintain solar systems and replace batteries when their life expires.

3.3.2 Workshops, Training and Publications

The UNESCO Executive Board made a decision that UNESCO participates actively with regard to implementation of Agenda 21 by acting effectively as an Inter-Agency Task Manager for Agenda 21, Chapter 35 on science for sustainable development and Chapter 36 on education, awareness and training (Annex 5). UNESCO launched the Global Renewable Energy Education Training Programme (GREET) to be implemented under the WSP with particular emphasis on education and training programmes in the field of new and renewable sources of energy (Annexes B2 and C6).

Workshops

UNESCO organized an impressive series of workshops and training programmes in conjunction with other organisations both in Europe and in developing countries predominantly in Africa. The workshops were supported by international and national agencies with large number of participants from different countries. Further, in attendance at these workshops were good speakers and well-known scientists with good documentation and material provided to the participants. These workshops concentrated on the training of decisions makers and engineers involved in the design of renewable energy projects. It was beyond the scope of this evaluation to measure the outcomes of these workshops since the organizers and participants could do this before leaving the workshops.

Publications

UNESCO entered into an arrangement with John Wiley and Sons Publishers of the UK to publish books on renewable energy for training of engineers and students at post- graduate level. The books were to contribute to the body of knowledge on renewable energy to the scientific and engineering community.

Under the leadership and the mobilization of resources of different nature, UNESCO has produced an important series of publications covering:

- Energy Engineering learning package for engineers and scientists
- Book series on Renewable Energy
- Books on specific technologies
- Training Manuals on different technologies
- Series on the Maintenance of Renewable Energy Systems

The Wiley-UNESCO series cover a wide range of areas in energy and power engineering. This package was organised by UNESCO and "established to train engineers to meet the challenges of today and tomorrow in this exciting field of energy engineering" (quote from the back cover). "This modular course will appeal to advanced undergraduates and post graduate students, as well as practising power engineers in industry" (quote from back cover).

The series cover a wide range of the energy problems, new technologies in terms of application from small to larger scale and application in decentralized and centralized energy generation. The book 'Solar Electricity' had an excellent acceptance, being published a second revised edition that includes new topics such as diesel hybrid systems, applications such as rural electrification, interconnection of photovoltaic systems to grids, besides including case studies, self-assessment questions and answers. The editor and contributing authors are well-recognized experts in the fields they cover in single chapters. The book is considered very good. The number of books sold speaks by itself: two editions and over 2350 copies since first edition in 1995.

Different books in a series, not necessarily complementary, have covered different sector-interests and different needs. All the titles are important for developing countries as they address some of the developmental needs. The series can be considered an excellent contribution of the authors and editors through UNESCO to the scientific and technical knowledge of energy engineers.

Publications under the GREET Programme

The continued commitment by UNESCO to facilitate high-level publications for education and training in solar energy is very critical to the strengthening of the WSP. Two books were published in 1993, the first volume on the Physics and Technology of Photo-voltaics and the second on Socio-Economical Aspects of Photovoltaics. Prof. B. Equer edited both volumes. The two books represented an important contribution to the knowledge of the photovoltaic technology and the problems associated with their development from the socio-economical point of view. These two volumes were published as a result of the annual UNESCO summer school organised for French speaking participants under the title "Solar Electricity for Rural and Remote Areas"

shows the number of books sold (for few titles) since publication. The series can be considered an excellent contribution of the authors and editors through UNESCO to the scientific and technical knowledge of energy engineers.

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Figure 1. Books sold since publication (for few titles)

Figure 1: Number of books sold

Other publications include ‘Maintenance on Renewable Energy Systems’ and ‘Water Desalination Technology,’ both were published in 1995. Within the framework of the popularisation activities of the World Solar Programme 1996-2005, a prestigious book was published by UNESCO under editorial guidance of a distinguished Indian scholar Madanjeet Singh entitled “The Timeless Energy of the Sun” in eleven language editions and has widely been distributed around the world.

More recently, under the GREET Program, the following have been published:

- UNESCO / Kawi Series on Renewable Energy, published in 1999 by UNESCO and the African Publishers’ Network, a set comprises a series of six primary school books addressing different topics on renewable energy. All the contributors are from the African region. The UNESCO / Kawi series on renewable energy constitute a very good and almost unique example of collaboration between two sectors of UNESCO - Science and Education.

- Training Manuals on solar PV for Water Pumping and Biogas Technology, published in 2001 addressing basic needs of renewable energies in the developing countries based on local experience.

The evaluation team gave a limited sample of the publications to university based lecturing staff in Australia and Columbia to assess their quality. The books were found to be of good standard.

Training Tools under the GREET Programme

A new concept of Renewable Energy Training Platform has been designed and implemented within the GREET Programme. This concept of Training Platform constitutes an adapted training tool and simulator for spreading renewable energy knowledge for decentralised electrification. The platform implemented at SIRDC, in Zimbabwe covers the following main area of renewable energies:

i) solar photovoltaic
ii) mini hydro
iii) mini grid.

The platform can be used for conducting weeklong seminars and training programmes at national and sub regional levels in the SADC region.

The concept of Renewable Energy Training Platform for training was a very good and innovative concept. Its implementation contributed to enhanced local capacity building and expertise in renewable energy use and applications. Further, more training activities using the Training Platforms tools will contribute to sustainability of projects that had been implemented.

The model of Renewable Energy Training Platform so far implemented shall be developed and extended to other countries and regions.

3.4 COORDINATION OF THE WORLD SOLAR PROGRAMME

3.4.1 Within UNESCO

As shown in the background history of World Solar Programme the concept originated from the Science Sector within UNESCO and the resulting programme was driven essentially from that sector. There appears to have been little or no coordination across other sectors that have the potential to deal with socio-economic aspects of energy development in rural economies although UNESCO is uniquely placed to deal with such inter-disciplinary factors.

In the educational programme associated with World Solar Programme no effective contact appears to have been made with the Sector of Education, who handle the UNESCO Chair's programme and the UNITWIN programme. Useful coordination of the energy chairs, now 14 in number and including 11 specifically related to renewable energy, could have provided a useful input and stimulus to the World Solar Programme.

Feedback from field visits associated with the evaluation process has indicated a disturbing and significant lack of knowledge of World Solar Programme at some UNESCO Field Offices and National Commissions. However, this is not true in general, UNESCO Regional Offices appeared to be well informed about the programme. As a result, some government institutions responsible for energy, scientific and technological communities within many individual countries are still unaware of the many opportunities for cooperation within the World Solar Programme.

3.4.2 Outside UNESCO

<u>The World Solar Commission</u>

The World Solar Commission successfully organised the World Solar Summit in Harare, Zimbabwe in September, 1996. The World Solar Commission provides high level leadership and guidance to the development and implementation of the World Solar Programme 1996-2005. This relationship contained in the Harare Declaration which calls "on all nations to join in the development and implementation of the World Solar Programme 1996-2005." The World Solar Programme 1996-2005 was approved by the World Solar Commission at its second session held on 23 June, 1997 within the framework

of the \specal Session of the UN General Assembly. The World Solar Commission also participates in business and investment meetings and regional initiatives such as the African Solar Council with a view to enhance implementation of the World Solar Programme.

UN agencies and programmes

The Director-General of UNESCO wrote to the UN Secretary-General and to the Executive Heads of the concerned agencies and programmes of the UN System, transmitting the Harare Declaration on Solar Energy and Sustainable Development and the outline of the World Solar Programme 1996-2005, and inviting them to actively participate in the design and development of the World Solar Programme 1996-2005. The Director-General also reported on the World Solar Summit and its follow-up to the meeting of the Administrative Committee on Coordination, held at United Nations Headquarters on 26 October 1996. Further, the Director General wrote a joint letter with UNDP Administrator requesting full cooperation of UNDP country offices in the implementation of the WSP.

Following a meeting of members of the World Solar Commission regarding Inter-Agency Task Force on Energy, a meeting of representatives of the UN organizations and programmes was held in December 1996 at UNESCO Headquarters. These meetings were followed in January, March and May 1997 by preparatory meetings attended by representatives of all parties involved, in order to review periodically the progress made in the preparation of the World Solar Programme 1996-2005.

On 16 October 1998 the General Assembly of the United Nations adopted in plenary session Resolution A/RES/53/7 (Annex B1) on the World Solar Programme 1996-2005, endorsing it as a contribution to the overall sustainable development agenda and inviting all Member States of the United Nations as well as the competent UN System organizations to contribute to the Programme's successful implementation.

There is a basic relationship between sustainable development and access to sustainable energy resources and it is clear that poverty is strongly linked to the lack of energy. The ninth session of the Commission on Sustainable Development held in New York April 2001 had sustainable energy as one of its main topics. It was necessary for UNESCO to collaborate with other UN agencies which had the mandate of sustainable development and addressing

poverty and energy issues. UNESCO has a clear mandate on the scientific, educational and cultural fronts and energy resource utilization impacts heavily particularly on the developing countries. Collaboration would have provided mechanisms for partnership in ensuring that there was sustainability of WSP initiatives as other agencies would augment the efforts.

Despite all these initiatives, the World Solar Programme 1996-2005 did not collaborate with the majority of UN agencies with strong interest in renewable energy technologies as directed by the UNESCO Executive Board (Annex C7). These include inter-alia UNIDO, UNEP, UNDP and FAO who have strong programmes dealing with industry development, renewable energy, environmental control, development programmes, food production, preservation and storage in developing countries.

Discussions with two representatives of UNDP and GEF revealed that UNESCO staff responsible for implementation of the WSP had never consulted their counterparts in UN agencies who were implementing similar programmes on renewable energy. There was no action plan presented to other UN agencies identifying common strategies for addressing renewable energy issues. In the absence of a proper defined programme of action, UN agencies found it difficult to cooperate. However, there were indications that with a properly defined programme of action, UN agencies were willing to collaborate with WSP on areas of common interest.

Contacts with the African Development Bank, the Asian Development Bank, the Inter-America Development Bank and World Bank also indicated an almost total lack of knowledge of the existence and objectives of World Solar Programme.

Effective cooperation appears to have been established early on with OECD although this had not been extended in recent years to cooperation with IEA / OECD. There had been effective cooperation with other European Agencies in the European Union such as ADEME in France and ICAEN in Spain amongst others. It is to be mentioned that the European Commission was one of the major partners in, and has contributed to, the implementation of a number of UNESCO's activities within the WSP including the organisation of the World Solar Summit and other educational and advocacy activities. In its energy strategy for 2010, the European Commission refers to the WSP as a programme partner for international cooperation

3.4 OUTCOMES AND IMPACT OF UNESCO'S CONTRIBUTION TO WSP

3.5.1 Raising Awareness

The World Solar Programme 1996-2005 has greatly contributed to raising awareness on potential and opportunities for utilization of renewable energy at various levels of society.

Some of the projects implemented by the WSP have created awareness at political and government levels. For example, the Honduran government used the solar village demonstration project to source funding for more solar village projects. According to information obtained during field visits, the electrification of a rural police post under the Solar Village demonstration project in Malawi has made police authorities aware of the benefits of solar lighting and to this effect, authorities in Malawi Police have requested their government to provide funds that will enable all rural police posts to be electrified.

Electrification of schools has provided a linkage between education and energy. Children have become aware of benefits of solar energy applications. In case of Honduras, the project has contributed to broaden children's knowledge through exposure to new educational technologies using computers, access to information and communication via the internet

Through these projects, rural business operators have become aware of opportunities to extend their business operating hours at night by using solar energy for lighting. Further, the Honduran project has contributed to raising awareness of the people in the community about the opportunities in micro-enterprises through television and via internet.

Solar village electrification has also contributed to raising awareness on HIV/AIDS through public media such as television. Some people in Kawanzaruwa Village in Zimbabwe have benefited in learning more about HIV/AIDS through television programmes.

The GREET programme contributed to raising awareness of participants regarding the potential applications of renewable energy. Some participants have used the training and materials produced by the GREET Programme to teach in their universities. The training and materials have been useful to people who are responsible for planning, policy and implementation of energy programmes in various countries.

So far 300 participants have attended the French Speaking Summer Schools from 50 Member States including 10 least developed countries. Two English Speaking Summer Schools have been held attracting participants from 9 countries from Southern Africa.

3.5.2 Capacity Building

WSP contributed to the organisation of summer schools, training of trainers sessions and implementation of the Solar Training Platform through which managers, engineers, technicians and trainers have been educated and trained in the design, application and maintenance of renewable energy technologies through the GREET Programme. The publications produced under the GREET programme have been useful in teaching renewable energy courses in universities and have also proved to be useful reference material for the scientific community.

The solar village project in Madagascar has a component for training of local technicians in basic maintenance skills. One technician has been trained and three more will be trained this year. In the Kawanzaruwa solar village project in Zimbabwe, a few local people were trained in basic maintenance of photovoltaic systems. These activities have contributed to building and enhancing capacity in renewable energy in the various countries.

The innovative concept of Renewable Energy Training Platform will be duplicated and implemented in other countries and regions to develop and enhance local capacity building on the use and maintenance of renewable energy systems. This will therefore improve the implementation of renewable energy projects and contribute to their sustainability.

3.5.3 Creation of business opportunities

UNESCO is sensitizing its Member States and international financing institutions, both public and private, to the strategic importance of the World Solar Programme 1996-2005 and the use of renewable energies. Under the aegis of the World Solar Commission and with encouragement from UNESCO, leading national governmental institutions, and in close partnership with the European Commission and UN Specialized Agencies and Programmes, the following meetings on business and investment opportunities, to enhance

the implementation of the World Solar Programme 1996-2005, have been successfully held:

- African Solar Forum, Bamako, Mali, 25-28 March 1998;
- Business and Investment for the World Solar Programme 1996-2005, Tbilisi, Georgia, 23-24 July 1998;
- Business and Investment Seminar for Renewable Energy in Latin America, Quito, Ecuador, 14-16 September 1998;
- Business and Investment Forum for Renewable Energy in Africa, Harare, Zimbabwe, 29-31 March 1999;
- Island Solar Summit-Sustainable Energies, Santa Cruz de Tenerife, Canary Islands, Spain, 6-8 May 1999;
- Business and Investment for Renewable Energy in Russia, Moscow, Russian Federation, 31 May-6 June 1999;
- Pan-European Forum on Business and Investment for Renewable Energy, Sofia, 1-3 December 1999;
- Business and Investment Forum for Renewable Energy and Energy Efficiency in Asia and the Pacific 2000, 4-7September 2000; and
- Business and Investment Forum for Renewable Energy Sources in the Arab Region, 12-15 November 2000**.**

In Zimbabwe, activities under the WSP have managed to sensitize many people in various sectors of national economy by bringing together academic institutions, industry, financial institutions through the business fora to explore various opportunities in renewable energy technologies. This interaction is an important outcome of the WSP. Further, due to high level of awareness of solar technologies, there has been an increase in the use of solar lighting systems in homes and schools as well as solar PVs for water pumping. These activities are in line with WSP objective of progressively securing an increasing participation of industry and the private sector in the development and deployment of renewable energy technology.

Through activities implemented under WSP, Zimbabwe had secured support from the Italian Government for electrifying 250 rural schools, 250 rural health centres and 10

libraries using solar systems. Plans for implementation of this project were underway and the Zimbabwe Solar Energy industry would be a beneficiary of this project through local contracts to be awarded.

3.5.4 Production of renewable energy education material

UNESCO has produced under the GREET Programme a major series of renewable energy books that have been well received all over the world by academic institution. In addition solar and bio-gas maintenance manuals have been developed. Further through the GREET Programme, a series of books for use in primary schools have been developed for incorporation into the school curriculum for English speaking countries in Africa. These outputs have contributed to enhancing knowledge on renewable energy systems.

The materials have been distributed to participants during the summers schools. In addition, the Kawi Series have been distributed to Ministries of Education in 14 SADC countries.

3.5.5 Creation of socio-economic opportunities

There is evidence of creation of small scale rural industries motivated by provision of renewable energy. In Zimbabwe, training materials produced under the GREET Programme were used to construct a biogas digester in the Musami Biogas Project for a farmer to use in his poultry business. This project is situated 100 km from Harare. The biogas generates methane gas that is used to provide light that illuminates the poultry houses to enable chickens eat throughout the night.

Technical know how was provided by staff from the Department of Energy who also supervised construction of the digester at no cost. The Department of Energy donated some pockets of cement on condition that the farmer allowed 5 brick layers to be trained on digester construction. The builders were expected to be hired by anybody that was interested in biogas technology. In this way the technology would be disseminated to many rural areas of Zimbabwe. This will help to achieve one of WSP’s objective to promote a national level of sustainable path that will ensure renewable energy plays a key role in human development.

The UNESCO solar village electrification project under WSP in Kenya has contributed to some children of nomadic tribes attending school at night. During the day children are engaged in chores such as taking animals for grazing and drinking water.

The UNESCO solar village electrification projects under WSP in Namibia and Niger have contributed to the introduction of adult literacy programmes. In Namibia, the school that has been provided with solar lighting system, has introduced adult education classes at night. In Niger, community buildings that were electrified by solar energy are used to provide educational lessons to adults in the evenings. This was not possible before the solar electrification was done.

The solar water pumping project in Ghana funded by WSP has helped to alleviate some of the problems that women face in fetching water for domestic requirements. Domestic chores such as collection of firewood and water are in the domain of women. This project has contributed to solving some of the gender biases in Africa in that women will save time spent on walking long distances to fetch water. This time could be spent on income generating activities.

In the case of Ghana, it was reported that the solar village project was catalytic to introduction of local initiatives such as solar charging stations in some rural areas. This is in line with the WSP objective of achieving a substantial increase in the use of renewable energy particularly for electric power generation as a major contribution to sustainable development.

UNESCO is coordinating the implementation of Kilwa Cultural Heritage project in Zanzibar. The project is jointly funded by Japanese and French cooperation. Once this project is implemented, it is expected that the project will contribute to the promotion of tourism in that area. This project will also contribute to the promotion and preservation of culture. These activities fall within the mandate of UNESCO.

3.5.6 Energy Policy Formulation

Following implementation of solar village demonstration projects in Malawi and Namibia, governments of these countries invited the UNESCO Science and Technology Advisor who was responsible for implementing the projects to participate in formulation of energy policies. This is line with decisions adopted by the UNESCO Executive Board at its 152th Session The Executive Board invited Member States to strengthen national activities and UNESCO's collaboration with national focal points. (Annex C2)

3.6 CONSTRAINTS TO THE IMPLEMENTATION OF WSP

The implementation of the WSP faced a number of constraints. The following major constraints to effective implementation of the WSP emerge from observations made and interviews conducted during field visits with different people:

3.6.1 Lack of coordination with other UN agencies

Lack of participation by other UN agencies limited the impact of WSP. UNESCO could only play a catalytic role and other agencies could address issues of mass dissemination of the technologies. Collaboration with other UN agencies such as UNDP and GEF was crtitical to the success of the Programme.

3.6.2 Insufficient budget allocation for monitoring projects

There was insufficient budget allocation for monitoring projects. Programme Specialists in the UNESCO Field Offices responsible for implementation of the projects informed the evaluators that money was not adequate for project monitoring. In most cases, they could only afford to undertake one field visit after the project was commissioned.

3.6.3 Delay in completion of projects

Some projects delayed in completion. Factors that contributed to this delay were beyond the control of UNESCO. For example, natural disasters in Mozambique delayed the project for one year. In Angola, due to lack of availability of a local company to install the solar system, the project was delayed resulting in increased project costs.

3.6.4 Lack of record keeping and project documents

Project documents were not made available in Honduras, Madagascar and Zimbabwe when the evaluators requested for them. The lack of record keeping made it difficult to assess the success of projects implemented.

3.6.5 Lack of local participation and coordination

It was observed that in Kenya, senior officials at the Department of Energy were not aware of the existence of solar village demonstration projects. This is despite the fact that there was evidence of UNESCO having extended invitations to the Department in the past for participation in WSP workshops and meetings. This problem cannot be attributed to UNESCO but to the internal national institutions. As a result institutional frameworks were not strengthened to the extent originally envisaged in the WSP.

3.6.6 Emphasis on Conferences

Some people interviewed on field visits were of the view that WSP had concentrated too much effort on high level conferences and workshops. These people felt that a stronger emphasis should be placed on projects that would help them solve local energy problems rather than on those which generate conference papers and internal reports. An alternative view often expressed by others however took cognisance of the importance of such events in raising political awareness of the importance of renewable energy technologies in the overall energy economy.

4.0 LESSONS LEARNT

The World Solar Programme 1996-2005 was launched as a major global developmental initiative that would make important contributions to poverty alleviation and the attainment of sustainable development. The implementation of several projects under WSP has helped to identify a number of issues from which lessons can be learnt to improve future implementation of the Programme.

The following are some of issues from which important lessons can be learnt:

a) An action plan is important for maintaining focus of activities in a programme. The plan should also make it easier for other agencies to collaborate in the implementation of the activities. The plan would also help in evaluating the activities that have been implemented. Further, project documents are important for proper implementation of the projects.

b) The impact of WSP has been limited due to non-participation by UN agencies. WSP is a global initiative and such would require collaboration with international agencies that have similar Programmes. This would help address issues of mobilization of funds and sustainability in the long term. Similarly, participation at national level is very critical for creating a sustainable path for these technologies. In this regard, governments, private sector/industry, informal sector and local communities need to create dialogue that will help identify innovative mechanisms for promoting dissemination of these technologies. Further, WSP could collaborate with Regional Councils on Renewable Energy.

c) Based on field visits undertaken, there is no evidence of adoption of the solar technology by the communities in the areas where the solar village projects were implemented except in Honduras and Madagascar where some solar energy activities have taken place after solar village electrification. Perhaps there is need to carry a needs assessment with a view to determine priority energy requirements of the people and design a strategy for meeting these needs. Member States could do this as a pre-requisite for funding. Major energy issues in rural areas that need urgent attention are cooking and thermal energy needs for business operation. It may be necessary therefore to consider inclusion of other forms of energy.

5.0 CONCLUSIONS

The conclusions cover the first five years of a planned ten-year World Solar Programme. Given what has been observed from the implementation of projects under the World Solar Programme, it can be concluded that WSP was conceptually good and has potential for meeting some energy needs of the rural poor especially electrification of community facilities. However, there are constraints when it comes to electrification of households.

Based on the findings and discussions in Chapter 3, the following conclusions emerge from the evaluation:

a) The absence of an action plan did affect the implementation of the WSP. By failing to secure cooperation of other UN agencies UNESCO lost an opportunity to catalyse the UN system. As a result it was difficult to attract donors to provide more funds for the Programme. Some of the problems experienced during implementation of projects were as a result of lack of project documents. Project documents provide all details about the project making it easier for implementation and evaluation.

b) WSP did manage to raise a level of awareness of benefits that solar technology can provide for the rural populations. The solar village concept and GREET programme developed were good approaches for introducing solar energy technology to the rural areas and building capacity of local human resources.

c) The cost of solar technology is a major limiting factor in the dissemination of the technology. As a result households cannot afford to purchase solar energy systems for lighting. There is no evidence of wide spread dissemination as a result of implementing solar village demonstration projects.

d) A problem that could limit the benefits of the good work done in the solar villages projects is sustainability in the medium and long term. It is not clear as to who is responsible for maintenance and paying for cost of replacement of batteries when they expire. Participation of all local stakeholders such as governments, private sector/industry, informal sector and community based organisations is critical for sustainabilty of the projects.

e) Within the GREET Programme, WSP has contributed to production of a series of educational and training materials, training activities, conception and field implementation of solar training platform for the development of renewable energy. Further, the materials and training tools will help the developing world in increasing awareness and addressing critical issues in the installation and maintenance of renewable energy systems.

f) Management of WSP was affected by lack of a Task Manager whose sole responsibility would have been the implementation of the WSP

g) Decentralization issues that affected the implementation of WSP are internal matters which UNESCO can resolve.

6.0 RECOMMENDATIONS

The objectives of WSP all related to important issues of increasing availability of sustainable energy, rural development, establishing or improving existing institutional frameworks, provision of adequate financing and increasing participation of industry in renewable energy activities. All these issues are very relevant in addressing sustainable development especially in developing countries. The World Solar Programme is a great idea and consideration should be given to how it can be restructured so that it continues to address issues of poverty and contribute to sustainable development. The following recommendations are intended to form a basis for a more focused future global renewable energy programme:

a) An action plan should be developed to guide the implementation of WSP. Initiatives on how to tackle collaboration, resource mobilization, affordability and sustainability should be important features of an action plan. The action plan should have clearly defined goals, objectives and activities.

b) The overall and specific aims and objectives of WSP and its individual programmes and projects should be clearly identified and defined.

c) Consideration should be given to establishing an international expert advisory group for providing guidance to UNESCO's contribution to the implementation of WSP. The group could include, inter alia, UN agencies, the African Development Bank, Asian Development Bank, Inter-American Development Bank and the World Bank. The group could provide WSP with advice on technical and financial matters. Terms of reference for the group should be drawn with reference to the existing United Nations Ad hoc Inter-Agency Task Force on Energy.

d) WSP should develop project documents that would guide implementation, monitoring and reporting of every project.

e) Consideration should be given to employing a Task Manager whose sole responsibility would be to manage the WSP.

f) There is need to develop innovative financing mechanisms for financing solar energy projects. Consideration should be given to the Energy Service Company (ESCO) delivery approach.

g) Consideration should be given to strengthening local institutional frameworks. WSP should establish collaboration with national institutions, developing national capacity to manage demonstration projects. Innovative financing mechanisms should be developed that can address affordability and sustainability issues.

h) UNESCO should ensure that countries show commitment and that communities participate in demonstration projects. This should be addressed through commitment by the recipient communities and their national governments.

i) As a technical agency whose role, inter alia, is to facilitate and catalyze diffussion of innovation in the various activities in science and technology, UNESCO should continue and reinforce the implementation of education and training activities on renewable energy. Special attention be given to training of trainers and emphasis in future programmes should focus on training technicians and artisans who will be involved in installation and maintenance of renewable energy systems. UNESCO Chairs could prove useful to any future solar programme and should be used to support the programme. Consideration should be given to:

- publishing material that is more directly oriented towards training on renewable energy increasing participation of technicians and scientists of the developing world as authors.

- disseminating and field implementing the Training Platform on Renewable Energy concept in the different countries and regions

- increasing participation of UNESCO Regional Offices

- UNESCO should reinforce the implementation of the GREET Programme in the different regions and strengthen its African Chapter to enhance capacity building on the use and application of renewable energy of Member States.