

**SWERA - SOLAR AND WIND ENERGY RESOURCE ASSESSMENT – REGIONAL
AGENCY FOR LATIN AMERICA.**

Enio Bueno Pereira, Fernando R. Martins, Silvia V. Pereira
INPE-CPTEC Rodovia Presidente Dutra, Km 40, SP-RJ
12630-000, Cachoeira Paulista, SP, Brazil Phone: +55 12 3186-8581
eniobp@cptec.inpe.br

Sergio Colle, Samuel L. Abreu
LABSOLAR-UFSC
Campus Universitário Trindade - CEP 88040-900
Florianópolis - Santa Catarina – Brazil Phone: +55 48 331-9379
colle@emc.ufsc.br

Alfredo Curbelo Alonso
Agencia de Ciencia y Tecnologia
Calle 20 esq. 18-a Miramar, Ciudad de la Habana, Cuba
geprop@geprop.cu

Tom Hamlin
UNE-DTIE
Tour Mirabeau 39-43, quai André Citroën
75739 Paris Cedex 15 – France Phone: +33 1 4437-1472
tom.hamlin@unep.fr

Marta Ximénez de Rivera
Ministry of Energy and Mines
14 calle 3-51, zona 10, Edificio Murano Center, Nivel 13, Of. 1302
Phone: 3665994 337-0034
mtdelangel@guate.net.gt

Abstract

SWERA – Solar and Wind Energy Resource Assessment is a project financed by UNEP, with co-financing by GEF, in the area of renewable energies, and more specifically solar and wind energy. The project includes the efforts of several countries, but is primarily directed to developing countries. The project will bring together high quality information on solar and wind energy resources into consistent GIS analysis tools. The project is aimed at the public and private sectors involved in the development of the energy market and it shall enable policy makers to assess the technical, economic and environmental potential for large-scale investments in technologies that enable the exploitation of the two increasingly important sources of renewable energy. The Latin America Regional Agency has as its main duty to link between the SWERA team and the national partners in order to facilitate the development of the project in Latin America.

Justification

The availability of reliable, easily useable data for energy resources is essential for governments and enterprises of countries to identify their potential for generating solar and wind energy and to make decisions based on such knowledge. For many developing countries, such reliable and sufficiently detailed data of simple use are non-existent. This lack of data is the primary obstacle for investments of the public and private sectors in applications of renewable energy sources in most of the developing world, including renewable energy projects supported by the GEF. SWERA has as its goal to remove such obstacles.

The barrier removal opportunity for the project was identified through the experiences of some developing countries in considering the requirements for incorporating large-scale use of solar and wind energy systems in national energy development planning. Developing such resources responds to their commitments and interests as parties to the United Nations Framework Convention on Climate Change (UNFCCC), and to many countries national interests (and energy development plans) in diversification of their energy mix, expanding domestic energy production, and diminishing the environmental burdens of energy supply.

Objective

The general purpose of the project is to promote the inclusion of alternative renewable solar and wind energy sources into the energy matrixes of developing countries thereby promoting the reshaping of policies aimed at integrating development with energy requirements in such emerging economies (Pereira, 2000). It shall also develop the local ability to ensure the continuity of usage of such information and the tools developed for it. An important component of the project development is the assessment of investment opportunities. This assessment is carried out using information on the most appropriated technology available in the market for every specific case, and the results are expressed as pre-feasibility technical-economical analysis for the most likely feasible cases. The main objectives are:

To reduce uncertainties associated with investment and development decisions for solar and wind projects. This in turn will decrease uncertainties in the design, cost, and performance of solar and wind systems, and should increase investor confidence, and confidence of key stakeholders, such as government agencies responsible for facilitating clean energy development.

To increase awareness by key stakeholders and decision makers of the solar and wind resources and the relevance of the resource information to the development and deployment of various solar and wind technologies, (existence of potential resource, inclusion of solar and wind energy technologies in energy planning).

To provide a set of consistent, reliable, verifiable, and accessible global data sets for international and in-country investors and other stakeholders.

To increase capacity for making solar and wind energy plans on the local, provincial, national, and regional levels. The availability of the solar and wind resource data and training in the use of the tools to make use of the data will facilitate better planning for solar and/or wind energy development. In some countries, large-area high-resolution wind and solar resource mapping is expected to reveal far larger commercial wind and solar project development potential than currently thought possible. In order to demonstrate the outputs of SWERA, nationally executed assessments of the potential for solar and wind development will be performed.

Background and Context

The human development is strongly related with the per capita consumption of energy and, as a consequence of improvement of the life quality in the developing countries, it is expected a annual growth of the energy demand of 4% in those countries, i.e. a duplication in the next 17 years. (Goldemberg, 1998). The relationship between energy and environment has been object of many researches and, sometimes, it is possible to establish a cause/effect relation that produces damage to the environment. The increase in energy demand, the reduction of the supply of conventional fuels caused by political crises in producing areas, and the growing concern with the preservation of the environment lead to the necessity of a sound survey for alternative energy resources. Solar energy is a renewable source of energy with minor environmental impact and it is becoming technically and economically feasible (Pereira and Colle, 1997). Reliable assessment of solar energy is essential for in-country energy policy and planning mostly in developing countries.

Furthermore, an effort to reducing and reversing the growth of global emission of gases causing the greenhouse effect will, among other things, require the large-scale development of technology in using sustainable renewable energy sources (Climate Change, 1999). The Global Environment Facility (GEF) is committed to render full support to projects aimed at such technologies worldwide.

In the upcoming decades, large-scale applications of wind-electric and solar-electric technologies may grow by hundreds of thousands of megawatts. A study promoted jointly by EWEA (European Wind Energy Association) and the Greenpeace, demonstrates how by 2020, 1,231 GW of wind power can be installed, creating 1.79 million jobs, with an electricity cost reduction of 40% and with a cumulative saving of 10,921 million tonnes of CO₂ (<http://www.ewea.org/03publications/WindForce12.htm>). The vast majority of it is projected for Europe and the United States, in spite of a great and growing potential in other parts of the world.

Technology applications of photovoltaic energy generation shall continue to grow in a strong way (>30%/year), with greater market penetration when costs for installed systems will drop below the US\$ 4-6.00 / Watt mark (<http://www.solarbuzz.com/StatsCosts.htm>). This is expected to happen probably within the next decade. Thermo-solar generating plants may reach a large-scale commercially viable production as a result of the initiatives of IFC /World Bank /GEF.

KfW (<http://www.kfw.de/EN/Inhalt.jsp>), together with UNEP /DTIE, have explored the potential of a decentralized photovoltaic grid-connected generating plants in co-generation with hydroelectric generating plants in developing countries around the world. This may lead to a fast growth in applications for photovoltaic energy. Taking into consideration that information about the renewable resources is not always readily available in many countries; the evaluation of such resources in the marketplace must be reoriented in order to accelerate the opportunities for investing in this sector.

Investments in large-scale applications of these technologies in developing countries are inhibited by the barrier of deficiency of adequate resource data on wind and solar energy, and the lack of tools to evaluate these data for energy planning.

Some of the considerations that must be addressed are:

- A critical parameter in the costing of solar and wind energy development is the proximity of possible generation locations to load centers and electricity grid stations.

- The terrain topology and features have a great influence on the microclimate. They cause relatively small areas of land to show great variations in regards to wind and solar energy resources. On the other hand, changes in the microclimate have a yet unknown influence of manmade changes in the environment such as deforestation, large hydropower reservoirs lakes, air pollution, etc.
- In the case of solar energy, very few climactic stations carry out real solar measurements with pyranometers. Thus, solar information has to be deduced from human observations of cloud coverage or simple instruments that only record the total number of sunshine hours in a day. The global solar data available are of low resolution and must be improved substantially to include important microclimate effects.
- As for winds, measurements are frequently blocked by obstacles in their vicinity, such as buildings and trees, resulting in readings of poor representation. In addition, in many countries, areas with excellent wind resources have not had any measurements giving the impression that the total available wind resources are much lower than in actuality. Many current wind maps, are in low resolution, and considered inadequate for evaluating the available energy in most parts of the world. For example: the world map of wind resources, prepared by the Northwest Pacific National Laboratory (USA) in the early 1980's, has low resolution, 100 x 100 km, and prevents it from being used to identify those regions which probably would have wind data of commercial value, also known as wind fields.
- UNEP operates a Global Resource Information Database - GRID, responsible for collecting, filing and providing access to environmental information in general. This information covers a vast range of environmental subjects originating from various sources. The surveys of solar and wind energy data contained in GRID are not adequate at all. As information of this type is widely used, like in studies of evaporation rates of surface moisture, to make such information available is consistent with the long-term goals of GRID. This sector in conjunction with the DTIE/UNEP, with its efforts focused on renewable sources of energy and support services to the industry, will provide a sustained information service on solar and wind energy resources.
- Without reliable information about existing resources, potential investors tend to avoid the risk of activities dealing with the development of solar and wind energy projects. Investors, risk capital enterprises, and independent energy producers are not aware of viable renewable options.
- The project will influence investment decisions by promoting alternative business scenarios in addition to those taken up by energy entrepreneurs themselves, working directly with banks and project development managers to overcome information barriers for financing. Through estimates focused on solar and wind energy technologies, the project will increase the familiarity of investors in investments in Electric Energy and Reliability Evaluation Tests (EE/RET). Once these barriers due to the lack of knowledge and perception will have been removed it is unlikely that they will return.
- Information on the potential of solar and wind energy may also influence national policy and planning for the sector. Although long term average costs of solar or wind may be higher than for hydropower, diversification of energy supply will become

more important as climate change impacts cause droughts and endanger the availability of hydro resources.

- Security of supply could justify increased buying tariffs for independent power producers. The reliability of the solar and wind energy resources over time, and phase relationship of these resources relative to other fluctuating resources, can therefore be important.
- Without accessible, high quality information solar and wind energy development opportunities for enhancing energy supply diversity and security will be missed. The lack of adequate information is blocking the efforts of developing countries to utilize renewable sources of energy. Whenever the information will become available, important new development programs may be started while existing programs may be enlarged.

Participants

There are thirteen countries involved in the pilot phase of the project. These countries were divided into 3 great regional groups: Africa, Latin America and Asia. In Latin America there are seven countries participating in the leading phase of the project: Brazil, Cuba, El Salvador, Guatemala, Honduras, Nicaragua and Belize.

Results

The development of SWERA in Latin America is now at the stage of assembly of national information and data processing. The cross validation of solar models are now completed and, in some cases, a draft version of the high-resolution solar assessment has just been released for internal evaluation (Central America and Cuba). Regional data files containing model input data in GIS format necessary for the implementation of charts of national and regional solar and wind energy resources are being assembled and processed. An operational website for the Latin America Regional Agency is available at: http://www.dge.inpe.br/swera/EN/en_swera_home.html where the reader can have an almost real time update on the development status of SWERA.

References

Climate Change – a threat to global development: Acting now to safeguard the future. Bonn:Economica Verl; Karlsruhe: Muller. 1992.

Goldemberg, J. *Energy, environment, and development.* São Paulo: EDUSP, 1998. (In Portuguese)

Pereira, E. B., and Colle, S. The Energy from the Sun. *Revista Ciência Hoje*, **22**, 130, 25-35, 1997. (In Portuguese)

Pereira, E.B. *SWERA Report of the Latin America Regional Workshop.* June5 to 8, 2000 São José dos Campos - SP – Brazil, INPE press, 145 pp, 2000.

Nomenclature

DTIE – Division of Technology, Industry, and Economics

EE/RET – Electric Energy and Reliability Evaluation Tests

GEF – Global Environment Facility

GIS – Geographic Information System

GRID – Global Resource Information Database

IFC – International Finance Corporation

UNEP – United Nation Environmental Programme

UNFCCC – United Nations Framework Convention on Climate Change

GIS - Geographic Information System