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*The Solar and Wind Energy
Resource Assessment (SWERA)
is a US\$ 9.3 million Project,
co-financed with US\$6.8 million
from the Global Environment
Facility (GEF) and more than 25
institutions around the world.*



SWERA maps are compiled using data from satellites and ground-based instruments such as those shown here.



In the Case of Renewable Energy, Knowledge IS Power

As energy planners seek cleaner energy solutions using renewable energy technologies, the availability of reliable, accurate, and accessible solar and wind energy information is critical and can significantly accelerate the deployment of these technologies.

Since beginning in 2001, the *Solar and Wind Energy Resource Assessment Project* (SWERA) has been developing a range of new information tools to stimulate renewable energy development, including detailed maps of wind and solar resources, and a new *Geospatial Toolkit* (see box page 2). The project covers major areas of 13 developing countries in South America, Central America, Africa and Asia. These countries need greatly expanded energy services to power sustainable development and SWERA offers them the technical and policy assistance to capture the potential that renewable energy can offer.

Informed Decisions, Good Policy and Investor Confidence

SWERA's aim is to support informed decision-making, develop energy policy based on science and technology, and increase investor confidence in renewable energy projects.

SWERA is also aimed at transforming the ability of developing countries to assess their technical, economic and environmental potential for large-scale investments in solar and wind energy projects. To achieve this aim, SWERA products can:

- Provide a definitive renewable energy resource base;
- Identify national and regional renewable energy opportunities;
- Match resource availability with community and industrial energy needs;
- Estimate the proportion of energy needs that could be met by renewable energy, particularly for regions or communities that lack modern energy services;
- Support project siting and sizing analysis; and
- Support effective allocation of financial resources for energy programs and pre-feasibility studies.

Solar and Wind Resource Products

SWERA is developing a range of solar and wind datasets and maps at varying scales. SWERA maps are compiled using satellite and terrestrial measurements, numerical models and empirical and analytical mapping methods.

Solar Resource Products

SWERA solar products include high, medium, and low-resolution spatial data and maps, including:

- High resolution (10 km) national solar;
- Medium resolution (40 km) regional solar maps; and
- Typical Meteorological Year (TMY) data sets for specific stations in each participating SWERA country.

SWERA is generating high resolution solar maps for all countries except China, where the map is restricted to the west of the country. Medium resolution solar maps are being produced for all of Latin America and the Caribbean, Africa, and South and East Asia including China, India, Nepal, Bhutan, Bangladesh, Myanmar, Sri Lanka and South East Asia.

Wind Resource Products

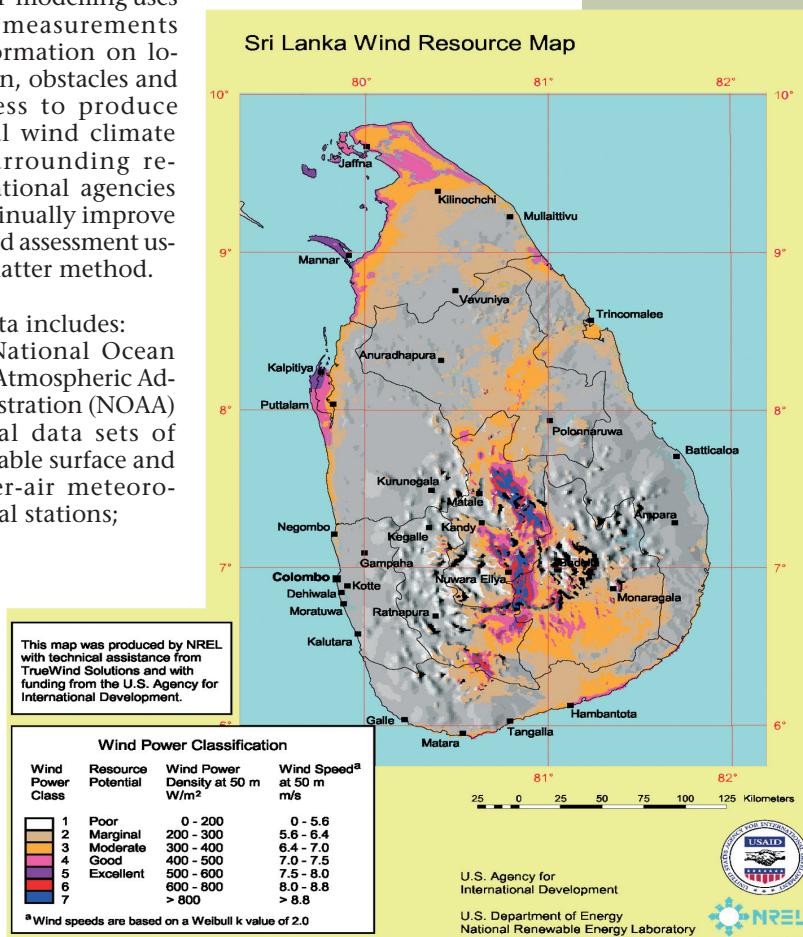
SWERA Wind Products include:

- Medium resolution (5 km) wind maps produced in cooperation with the Danish National Research Laboratory (Risø) for Kenya, Ethiopia and Bangladesh;
- High resolution (1 km) wind maps produced in cooperation with US National Renewable Energy Laboratory (NREL) for Sri Lanka, Honduras, El Salvador, Cuba, Nicaragua, Guatemala, Ghana and portions of China; and
- Wind atlases and applications using the Wind Atlas, Analysis and Applications Program (WASP) model from ground measurements by national agencies.

The high-resolution wind maps are designed for regional wind mapping and do not depend on high-quality surface wind observations, although such observations are helpful. The WASP modelling uses ground measurements and information on local terrain, obstacles and roughness to produce a general wind climate for a surrounding region. National agencies can continually improve their wind assessment using this latter method.

Wind data includes:

- US National Ocean and Atmospheric Administration (NOAA) global data sets of available surface and upper-air meteorological stations;



SWERA provides Reliable, Accurate and Easily Accessible Data

Global Archive

Through a data collection and analysis network of international and national agencies, SWERA is creating a global archive of solar and wind energy resources in the form of data sets. The solar and wind energy information is available on CDROM, and incorporated into a user-friendly website.

Geospatial Toolkit

The SWERA *Geospatial Toolkit* allows wind and solar maps to be combined with electrical distribution grids and other information to provide high quality information that supports energy planning and policy development, while lowering the risk for renewable energy project developers and reducing project lead times. The Toolkit allows decision makers to select and display solar and wind resource data, along with other relevant geospatial data, by assimilating resource data, worldwide Geographical Information Systems (GIS) datasets and country-specific data.

The Toolkit is simple and easy to use, with no GIS expertise or software required. The Toolkit can:

- Help developers and planners understand the resources and the renewable energy potential for a country;
- Provide a basic renewable energy analysis, e.g. choosing optimal candidate sites for RE applications; and
- Support energy planning functions.

Although it is not intended for detailed site analyses, the Toolkit does provide:

- Support for analysis of environmental impacts;
- Standard, stand-alone functions and queries to evaluate different development scenarios;
- Displays with layers of data that allows the user to see how these interact for their country; and
- Calculations of the amount of solar/wind resource that occurs within specific distances of key features such as transmission corridors or roadways.

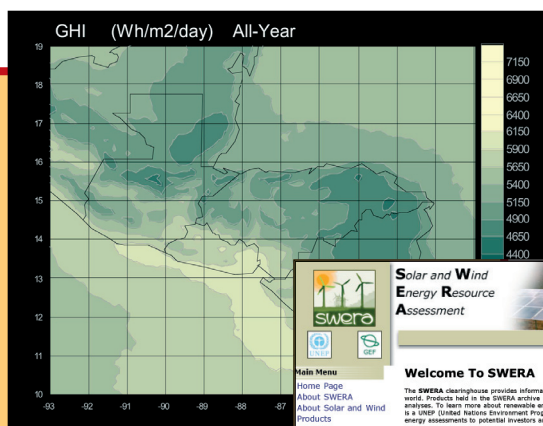
The Toolkit is written for the Windows platform using ESRI's Map Objects software and can be downloaded from the SWERA website at www.swera.unep.net

SWERA Website

<http://swera.unep.net>

The SWERA website is a comprehensive database of SWERA products and information, featuring:

- Multi-Language Pages in English, Spanish, Portuguese;
- Interactive Maps;
- Country Information;
- Product Query that allows SWERA and general website users to browse the products in the archive; and
- An archive of data, tools and documents that can be viewed by anyone.



High resolution solar maps, such as this one of Central America, are part of SWERA's Global Archive that can be easily accessed through the SWERA website.

- Wind data from surface meteorological stations;
- Global ocean satellite wind data; and
- Wind data from other sources, including data provided from country/regional partners.

Preliminary Results

SWERA solar and wind assessments have been completed for a number of regions, often with surprising results.

Latin America

In Nicaragua, SWERA assessments of wind resources demonstrated a much greater potential than the 200 megawatts (MW) estimated in the 1980s. The results prompted the Nicaraguan National Assembly to pass the *Decree on Promotion of Wind Energy of Nicaragua 2004* that gives wind generated electricity "first dispatch", meaning it has the first priority over other options when fed into electricity grids. The US Trade and Development Agency and Inter-American Development Bank have subsequently launched wind energy feasibility studies in Nicaragua, and wind investment projects are now advancing with 40 MW planned in two projects and two exploration licenses granted.

SWERA information is also stimulating a range of cooperative efforts in Nicaragua between groups such as the World Bank and GEF for projects focused on rural electrification. Six thousand (6000) solar PV systems, for example, are being installed in the World Bank and InterAmerican Development Bank rural electrification programs.

In Guatemala, wind estimates before SWERA were mostly unknown, but are now estimated at 7000 megawatts, based on SWERA products. The Guatemala Ministry of Energy has established, with support from SWERA, the Centre for Renewable Energy and Investment within the Ministry to carry out validation studies and identify sites for wind energy development.

Since beginning in 2004, the SWERA effort in Honduras has substantially raised interest in wind and solar energy. For the first time, wind energy has been included for energy planning in the country's central zone. SWERA has helped to identify potential sites and complement developer data, giving confidence to policy makers and project develop-

An International Partnership

SWERA is truly an international partnership. Partner Institutions include:

- The Energy Resources Institute TERI (India)
- National Renewable Energy Laboratory (USA)
- Risoe National Laboratory (Denmark)
- State University of New York/Albany (USA)
- UNEP Global Resource Information Database GRID/Sioux Falls, South Dakota (USA)
- National Institute for Space Research - INPE (Brazil)
- German Technical Cooperation Agency GTZ
- German Aerospace Center DLR
- Brazilian Wind Energy Centre CBEE
- Universidade Federal de Santa Catarina (Brazil)
- Chinese Renewable Energy Industry Association
- University of Dhaka (Bangladesh)
- Centre for Energy Studies and AEPC (Nepal)
- National Engineering Research and Development Centre (Sri Lanka)
- Ministry of Mines and Energy (Ghana)
- Intermediate Technology Development Group East Africa (Kenya)
- Ethiopian Rural Energy Development Centre
- Energia y Minas (Guatemala)
- Ministerio del Energia (Nicaragua)
- Ministra de Recursos Naturales y Ambiente (Honduras)
- University of Central America (El Salvador)
- Agencia de Ciencia y Tecnologia (Cuba)
- Natural Resources Canada - RETScreen
- Renewable Energy in the Americas (OAS)
- National Aeronautics and Space Administration (USA)

ers. When superimposed with electrification data, particularly for rural areas, SWERA assessments indicate a potential boom for wind and solar projects, including major rural electrification programs in eastern Honduras using solar technologies.

Africa

In Africa, SWERA is active in Kenya, Ethiopia and Ghana, with solar and wind maps being prepared for each country. A geospatial toolkit will integrate the solar and wind data with GIS data to support an overall solar and wind energy resource assessment for each country.

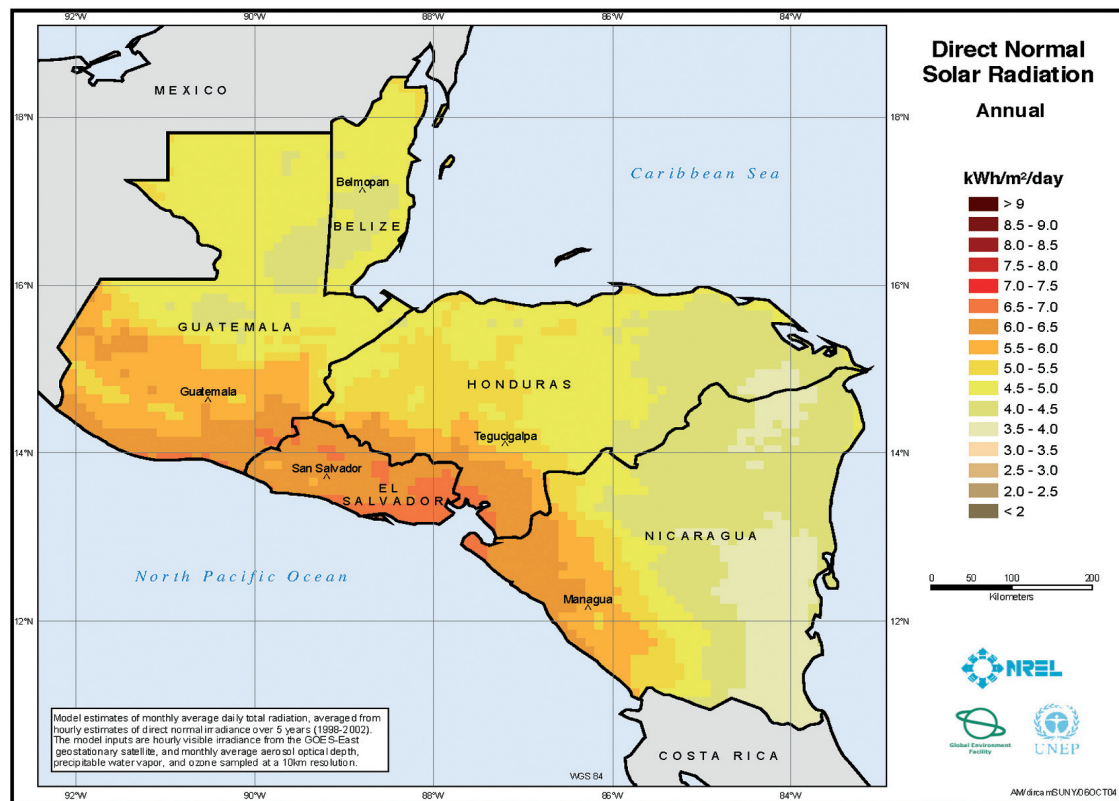
The SWERA partner in Ethiopia is the Ethiopian Rural Energy Development & Promotion Center and the National Meteorological Service Agency. In Kenya, SWERA is coordinated by the Intermediate Technology Development Group in cooperation with the Kenyan Ministry of Energy and the University of Nairobi. In Ghana, SWERA is handled by the Ministry of Mines and Energy and the Meteorological Services Department.

Initial assessments show more than 2,000 MW of wind energy potential in Ghana - mainly along the Togo border where measurements are being taken with support from the Netherlands and the Ghana Energy Commission.

Asia

SWERA is active in Sri Lanka, China, Bangladesh and Nepal. In China, SWERA has partnered with the Center for Renewable Energy Development and the China Renewable Energy Industry Association. Although SWERA provided the broad scale resource assessment in China, parallel efforts by UNDP have supported wind measurements while the World Bank has supported policy development. Together, these efforts have enabled China to proceed with a wind energy target of four gigawatts (GW) by 2010 and 20 GW by 2020. They have also set a PV target of one GW by 2020 and 270 million square metres of solar water heating panels by the same year. The broad renewable energy assessment – especially for wind – provided Chinese energy planners with the resource confidence that such a target could be implemented and met.

In Bangladesh, wind energy potential is not currently considered very significant, although coastal and island sites may have enough wind for smaller wind projects. The value and effectiveness of SWERA efforts to transfer technical skills were clearly demonstrated when SWERA partners, RERC Bangladesh, were able to show that the wind measurements being taken under a separate project were incorrectly placed.



Unlike Bangladesh, Sri Lanka has a significant amount of wind measurement data. SWERA's partners are the National Engineering Research and Development (NERD) Centre and the Ceylon Electricity Board. Using the Geospatial Toolkit, the SWERA assessment found Sri Lanka shows a wind electric potential of about 26,000 MW, excluding the offshore potential. This represents more than ten times the 1800 MW of the country's electrical installed capacity in 2002.

In Nepal, SWERA's partners are the Alternative Energy Promotion Centre and the Centre for Energy Studies. Due to the extreme nature of Nepal's topography, modelling is difficult. With funding from the Netherlands, SWERA is supporting a wind measurement programme with potential for water pumping, small home systems and grid power. The main target areas for the programme are dry areas of the country where hydroelectric power is not feasible.

The Future of SWERA

The SWERA project is now under evaluation and will be seeking support to service requests from renewable energy development programs in other developing countries. SWERA has clearly demonstrated that the modest amounts of funds needed to support renewable energy assessments can significantly change the way countries pursue their energy goals.

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