



ACP Science  
and Technology II Programme

Energy access and efficiency

Renewable energy

# Promoting sustainable energy access through the use of geospatial technologies in West Africa



Wind resource map

## GRANT

EUR 927,204.47

## PROJECT IMPLEMENTATION PERIOD

March 2014 - July 2016

## CONSORTIUM

- ECOWAS Regional Centre for Renewable Energy and Energy Efficiency (ECREEE), Cape Verde
- The Energy Center, Kwame Nkrumah University of Science and Technology, Ghana
- Directorate of Energy, Cape Verde
- NOVELTIS S.A.S, France
- University of Geneva, Switzerland

## PROJECT CONTACT

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## PROJECT WEBSITE

<http://www.ecowrex.org/acp-eu>

## SUMMARY OF RESULTS

The map framework of the web-based geographic information system (GIS) platform ECOWREX (ECOWAS Observatory for Renewable Energy and Energy Efficiency, a regional energy data hub) has been transformed into a complete spatial data infrastructure (SDI), compliant with international standards, including:

- new and enhanced datasets on solar and wind power potential with improved temporal and spatial resolutions;
- energy access maps and the most cost-effective technologies for increasing access to non-electrified communities using the improved energy access planning tool IntiGIS 2.0;
- maps of spatial distribution of power consumption and green power production potential.

ECOWREX – publicly accessible – provides policymakers in ECOWAS member states, project developers, investors and other stakeholders, with tailored information for evidence-based decision making, management and planning strategies. The standardisation and interoperability of spatial data on the platform enables end-users to easily explore, share and download data on renewable energy resources (solar, wind...) and energy access in West Africa.

## BACKGROUND

In the ECOWAS (Economic Community of West African States) region, only 19% of the rural population has access to electricity. At least 60% of the ECOWAS electricity generation capacity runs on expensive diesel or heavy fuel and imposes significant pressure on national budgets, private households and the private sector. Despite vast renewable energy resources, the electricity systems are facing tremendous challenges as the gap between predicted demand, existing supply capacities and limited capital to invest continues to grow. The regional electricity demand for 2030 is projected to increase to 250 TWh with 7% rural, 48% urban and 45% industrial demand. The total grid-connected installed energy capacity in West Africa reached 10 gigawatts (GW) in 2010 and 39 megawatts (MW) in 2014 (excluding hydropower). The overall renewable energy-installed capacity is expected to reach 14.5 GW in 2020 and over 30 GW in 2030.

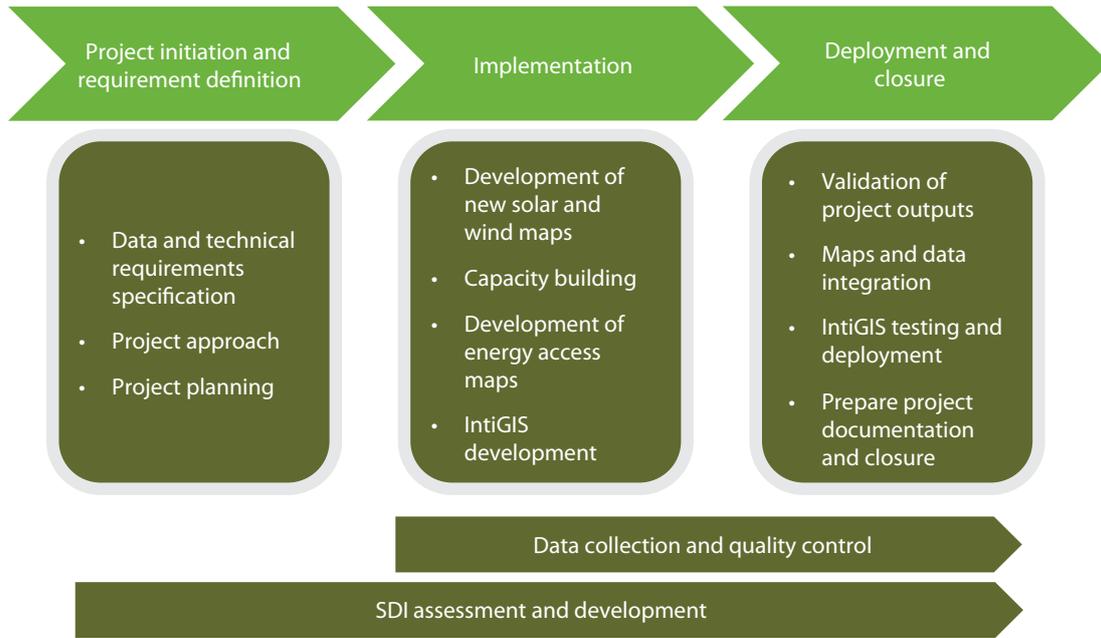
The lack of reliable and updated information on the energy systems poses a major constraint for development in the West African energy sector. Different systems and maps exist with various models (to depict size, terrain, points, lines...) and data sources, but information on energy resources and their potential is not readily available.

To help mitigate this problem, in 2012 ECREEE developed the web-based information platform ECOWREX to provide decision makers, project developers, investors, researchers and the general public, with tailored information about the energy sector. Among the flagship products of the platform is a GIS framework. The framework helps visually analyse the energy resources in combination with other human activities (grid network, protected lands, roads...), and plan where and when specific energy technologies (solar, wind, water...) can be deployed. However, the platform failed to meet some international standards defined by the Open Geospatial Consortium (OGC) and International Organization for Standardization (ISO) to optimise geospatial data discovery and access. The platform also lacked high-quality resource maps (solar and wind maps) and other relevant data on energy access, necessary to support development in the energy sector.

The project focused on geospatial technology for the energy sector in West Africa and related energy resource management capacities. It improved ECOWREX by developing new resource maps, enhancing existing potential renewable energy maps, and incorporating new technologies compliant with international standards to aid data interoperability, extraction, sharing and transfer of knowledge.



# METHODOLOGY



During the **analytical stage**, the stakeholders' (planners, project developers, data managers ...) needs, technical assumptions (technological component performance, operation and maintenance, efficiency ...) and data requirements (energy resources, relevant infrastructure and their sources) were identified. Clear guidelines of these requirements, as well as standards for data format and metadata, were developed to support the data collection process. This was a very crucial stage as data exists in different formats, domains and types, and as such, a standard template for capturing and manipulating the data was required.

The **data collection process** started with a regional workshop of key experts from the energy research and planning departments in the ECOWAS member states. They were trained on data and metadata collection using guidelines based on Open Geospatial Consortium (OGC) standards. This was followed by field visits to the member states to provide support and collect the data required for the project. At the same time, the ECOWREX map framework was assessed to ascertain the technical and users' requirements needed for its restructuring into a Spatial Data Infrastructure (SDI).

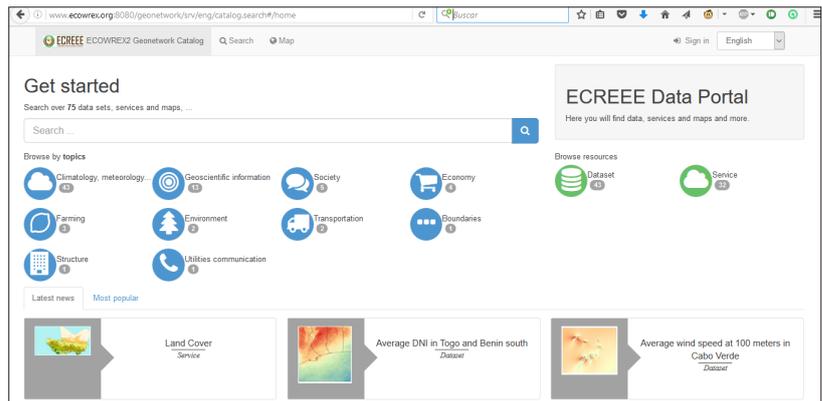
In the **development phase**, new resource (solar and wind) maps were produced, including a critical assessment of existing maps, comparison with *in situ* measurement stations in member states and production of hourly data for solar and wind sites, thereby increasing the temporal and spatial resolution.

Energy access maps for non-electrified communities were produced. Based on the adapted IntiGIS model (a GIS model for rural electrification with renewable energies), the most cost-effective technologies (e.g., home solar and wind systems; diesel, hybrid wind or photovoltaic (PV)-diesel mini-grids) for improving energy access in these communities were then identified. The IntiGIS software takes into consideration the Levelized Electricity Cost (LEC) for the various technologies, including: photovoltaic, diesel and wind energy home systems; central diesel mini-grids; and hybrid mini-grid systems (both wind-diesel and PV-diesel). The LEC is considered in combination with other parameters such as grid extension cost, operation and maintenance cost, diesel consumption, investment cost and other relevant spatial datasets. A combined map of power

consumption and green power potential was also produced.

After **assessing** the ECOWREX map framework, the restructuring of ECOWREX into a complete Spatial Data Infrastructure (SDI) was carried out. After completion, all the data and maps produced were integrated into the new ECOWREX platform.

Finally, a **project validation** meeting and training workshop on the use of ECOWREX, was conducted for experts from the data management and planning departments of the energy ministries in the member states. Throughout the project, constant dissemination of information on the project results and benefits were carried out, including e-newsletters and communication kits for distribution at events and other media channels.



ECREEE GeoNetwork Portal.

# RESULTS

## → Outputs

### Technical

- ECOWREX SDI fully compliant with OGC standards, based on Open Source software: [www.ecowrex.org](http://www.ecowrex.org)
- 60 new geospatial datasets: [www.ecowrex.org/mapView](http://www.ecowrex.org/mapView)
- ECOWREX metadata catalogue (Geonetwork v.3): [www.ecowrex.org:8080/geonetwork](http://www.ecowrex.org:8080/geonetwork)
- Beta version for the software of the energy access planning tool 'IntiGIS 2.0'.
- The most cost-effective technologies for increasing access to some non-electrified communities in the region calculated.
- Enhanced solar and wind maps with improved temporal and spatial resolutions.
- Maps of energy access based on the IntiGIS model.
- Maps of power consumption and green power production potential.

### Capacity building

- 2 regional workshops on standardisation of energy data and metadata collection and validation of project outputs.
- 80 national energy experts (71 male, 9 female) trained to use GIS and ECOWREX platform for energy planning:

- ECOWAS member states – the Energy Ministries, Rural Electrification Agencies, Energy Information Systems (SIE), Water Resources Directorates;
- Other ECOWAS institutions - ECOWAS Regional Electricity Regulatory Authority (ERERA) and West African Power Pool (WAPP).

### Documents

- 9 reports describing the methodology for the evaluation and improvement of the solar and wind resources on ECOWREX geospatial data section (<http://www.ecowrex.org/page/maps>):
  - Solar comparative analysis
  - Wind comparative analysis
  - Wind critical analysis
  - Solar critical analysis
  - Solar resource study
  - Wind resource study
  - Wind Power Density at 60 meter high – Togo
  - Wind Power Density at 60 meter high – Senegal
  - Wind Power Density at 60 meter high – Sierra Leone

- 1 policy brief on the strategy for improving data collection and management for energy planning in the region.

### Visibility

- 2 videos about ECOWREX and the project.
- Communication press kit: USB sticks (50), mouse pads (50), t-shirts (100), booklets (50) and pens (100).
- 2 press conferences.
- 2 news articles in West African journals.
- 2 TV news broadcasts.
- 4 electronic newsletters sent to ECOWREX stakeholders.
- 2 project banners.
- 200 ECOWREX flyers.

### Publications

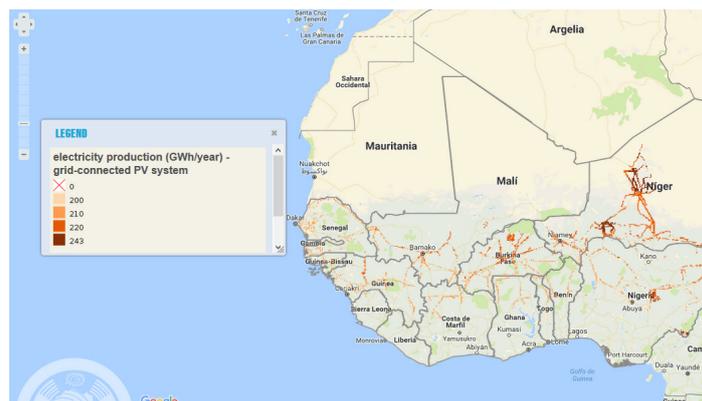
- Yushchenko A., de Bono A., Chatenoux B., Patel M.K., Ray N. GIS-based assessment of photovoltaic (PV) and concentrated solar power (CSP) generation potential in West Africa. [www.sciencedirect.com/science/article/pii/S1364032117309619](http://www.sciencedirect.com/science/article/pii/S1364032117309619)



Electricity demand in rural areas.



PV suitability in the region.



Electricity production of grid-connected PV system.

## Outcomes

- Strengthened knowledge of energy systems planners and developers and their increased use of geospatial technology (ECOWREX GIS framework) for data management and efficient energy planning in order to promote development in the energy sector in West Africa and to provide investors with reliable information.
- Policymakers have at their disposal the information needed for evidence-based decision making in the energy sector.
- The general public is aware of the energy resources and potential in West Africa.

## Impacts

### Usage

- With a publicly accessible ECOWREX platform, relevant knowledge and information is available to all stakeholders in the energy domain, acting as a catalyst for promoting sustainable energy development in the region, e.g., through transfer of GIS knowledge to support data management and planning in the energy sector.
- The ECOWREX Spatial Data Infrastructure will serve to disseminate information about other geospatial research and projects carried out in the region – including shapefiles, raster files, metadata files, maps, reports, etc. as these can easily be integrated into the platform.

### Policy implications

- The developed renewable energy resource potential will support energy sector policy formulation and targets.
- The policy brief on the data collection strategy is expected to be transformed into a regional policy for ECOWAS member states.

### Sustainability

- Institutional and financial sustainability: ECOWREX has become a major programme in ECREEE, through which it provides continued support to the ECOWAS member states and develops partnerships with financiers and data providers.
- Stakeholders' involvement will ensure that the platform is used effectively by the targeted audience and the data and applications developed are frequently updated and improved respectively.
- A continued skills development programme by ECREEE will adequately improve capacity in member states to use the platform, e.g., GIS expertise for the energy sector
- ECREEE is currently identifying experts from each member state to support the process of testing and improving the Inti-GIS 2.0 software.
- Visibility of the ECOWREX platform is promoted at regional events, online, in newsletters and through collaboration

with partners such as REN21, IRENA, SE4ALL, REEEP and Open Data Inception.

**Sustainability indicators** to measure the achievement of the project benefits:

- Number of new data points, spatial datasets and information available on ECOWREX.
- Number of registered users and downloads from ECOWREX.
- Number of functionalities added to ECOWREX.
- Number of open data platforms utilising ECOWREX data.
- Number of stakeholders trained to use ECOWREX.
- Number of stakeholders using ECOWREX for energy planning.
- Number of publications from ECOWREX data.
- Number of applications and tools available to support energy planning and the number of users.

## TESTIMONIALS



**Mr. Coffi Able, GIS Manager at the Directorate of Energy, Ministry of Energy of Benin, at the Regional Validation Workshop held in Dakar in July 2017**

“This project will help us a lot with the collection and processing of data in the energy sector, and thus better plan in our country. As such, we expect a lot from this ECOWREX platform that has just been presented. Recalling that data collection is a difficult process, now we have a platform that will help us process data and propose solutions to the authorities for better and quicker decision making, within the framework of the national energy planning process.”



**Mr. Mahama Kappiah, Executive Director at ECREEE, at the Regional Validation Workshop held in Dakar in July 2017**

“For us engineers, planners and policymakers in the energy sector, the problem has always been: how do we plan our systems? You cannot plan without information or without data. That data has never been readily available in our region, and in almost every country and sector there are gaps in the available data. These gaps and missing portions are caused by both a lack of collected data and inadequate accuracy levels of collected data. It is for this reason that the European Union decided to support ECREEE, to improve and update our ECOWREX data platform so that it can support member states in their planning processes and decision making.”

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