BUSINESSCASE

IRENA
International Renewable Energy Agency

THE PHILIPPINES:

SOLAR, WIND AND BIOENERGY RESOURCE ASSESSMENT

INTRODUCTION

The Global Atlas for Renewable Energy (Global Atlas) is the outcome of an international effort involving 67 countries. It is coordinated by the International Renewable Energy Agency (IRENA), based in Abu Dhabi, United Arab Emirates, and is a contribution to the Sustainable Energy for All (SE4ALL) initiative of the United Nations Secretary-General.

The Global Atlas builds on a strong international partnership involving national institutes, energy agencies, international organisations and private companies, which share data and expertise with the aim of promoting renewable energy. It started with mapping solar and wind data and will progressively expand to include other resources by 2015: bioenergy, geothermal hydropower and marine energy.

The vision of the Global Atlas initiative is to bridge the gap between countries that have access to the necessary data and expertise for assessing renewable energy potential, and those countries lacking such elements. The Global Atlas provides access to the datasets and methods needed for a first screening of areas of opportunity, where further assessments can then be targeted.

For solar and wind potential, a first version of the platform was released during IRENA's third Assembly in January 2013. This includes an online Geographic Information System (GIS) to manipulate relevant solar and wind data and provide an estimate of the technical potential in each case. Over time, the platform should include dedicated tools to perform calculations of energy production in areas of interest.

The GIS can draw on a large data catalogue, which contains references to over 1,000 data layers contributed by partner governments, institutes and private companies – showing solar and wind patterns, infrastructure, population density and other information to assess technical potential. The Atlas is a powerful instrument for countries preparing to prospect their solar and wind resources.

In the case of bioenergy, the Global Atlas aims to offer a central repository giving access to existing GIS datasets, tools and case studies for bioenergy assessments worldwide. The bioenergy component of the open-access platform, therefore, should serve as a catalyst for planning and policy strategies for sustainable bioenergy production and use.

Beyond the creation of a global repository, the initiative aims at stimulating investments in resource estimation activities. This document provides an overview of opportunities for further assessments of wind, solar and bioenergy resources in the Philippines.

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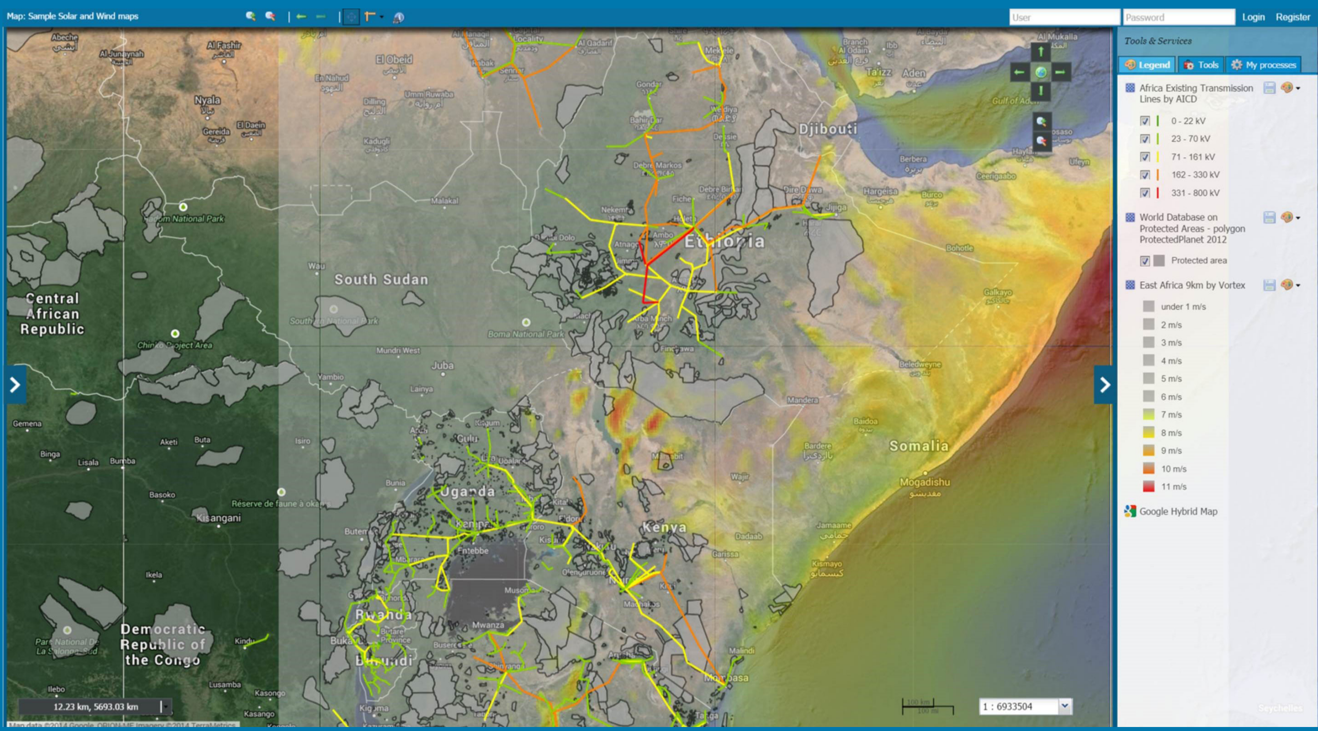

Figure 1: An opportunity area identified through meso-scale wind analysis. The information cannot be used to assess precise potential, but can initiate the dialogue that spurs further prospection. This map offers a snapshot over Kenya, overlaid with wind resources, power grids and protected areas.

BUSINESS CASE FOR MAPPING RENEWABLE ENERGY RESOURCES

Why is a business case needed?

Countries intending to deploy renewable energy technologies face several important questions. The transition to larger shares of renewable energy in the energy mix implies thinking differently about the way energy is produced and consumed in a country, and in some cases about energy relationships with neighbouring countries (IRENA, 2013).

This reflects the transition process from traditional, centralised, grid-connected infrastructure towards decentralised applications using appropriate technologies for each location. Planning for such a shift involves many considerations beyond basic resource availability. Since investments must be planned in advance, they require an understanding of the share of the renewable energy resource that can be harvested in a sustainable manner, the portion of the energy mix that can be supplied from those resources, probable energy costs, and the technologies best adapted to local conditions. All this information is used to assess the volume of investments that are required, including support schemes, human capacity and related infrastructure. Investors also prefer to have a long-term commitment on market volumes, as well as a sufficiently long-term perspective to create a supply chain.

Since renewable energy resources vary by location and – for some types – over time, carrying out a strategic analysis requires reliable renewable energy resource maps. The precision of resource estimates, moreover, directly translates into a risk factor in the decision-making process and the decision to move on a national strategy.

Estimating a resource requires large upfront investments in measurement campaigns and ground validation, along with extensive consultations and a high level of technical skills to provide “bankable” information that supports project design. A detailed resource mapping exercise across any sizable territory is a multi-million dollar exercise, entailing a cost barrier for many countries.

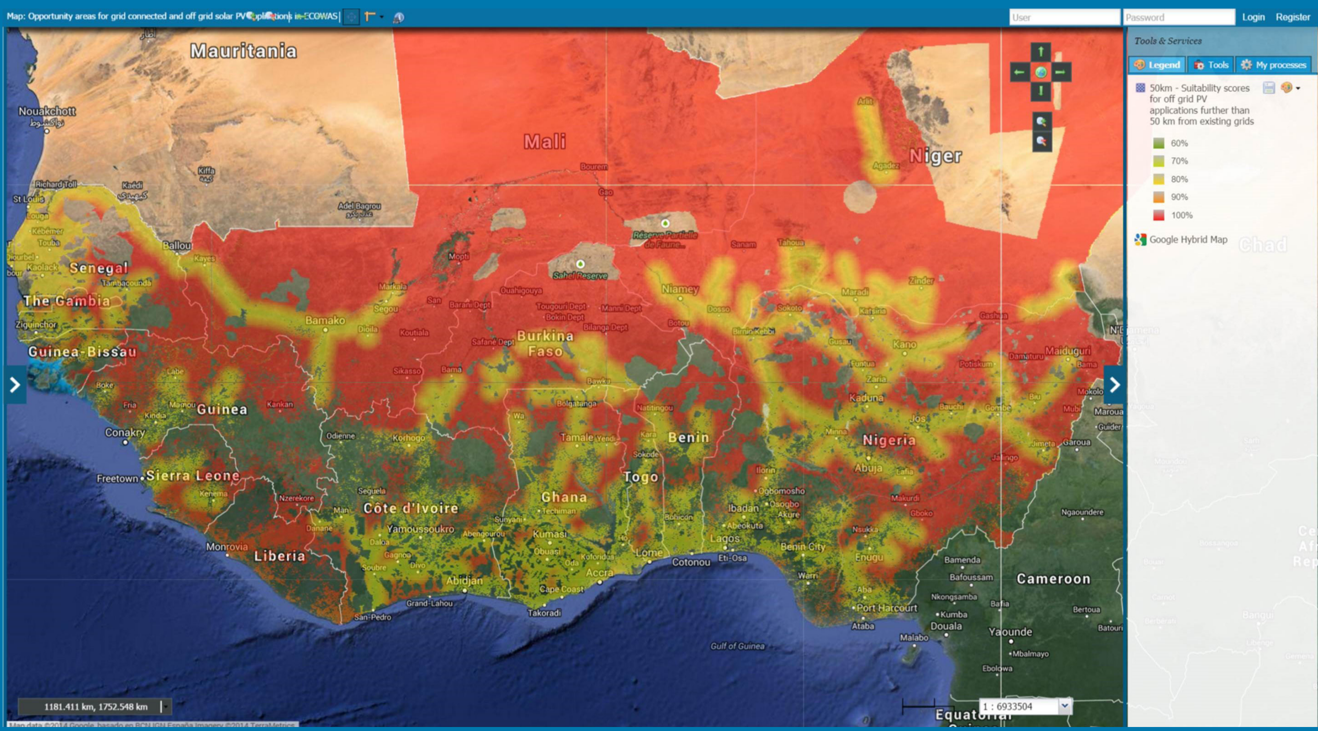

Figure 2: Suitability analysis for off-grid solar photovoltaic (PV) development in West Africa. Land colour distinctions indicate overall suitability scores, taking into account resource availability, population density, power grids, topography, land cover and protected areas.

For countries needing assistance, donor agencies and international programs can finance measurement campaigns. The Global Environment Facility (GEF), the Energy Sector Management Assistance Programme (ESMAP), the Solar and Wind Resource Assessment Programme (SWERA) and the South Pacific Regional Environment Programme (SPREP), but also multilateral development banks (Kreditanstalt für Wiederaufbau (KfW), Asian Development Bank), donor organisations (USAid, German International Cooperation (GIZ), AusAid, NZAid), and bilateral structures (UAE-Pacific Fund) have financed measurement campaigns in several countries. IRENA hopes to compile the resulting information and make it accessible through the Global Atlas.

Initially, the rationale of such grant-based mechanisms was mainly the promotion of renewable energy solutions in countries where those technologies had yet to take root. The situation has changed over the last decade, and nowadays at least 144 countries have renewable energy targets and 138 countries have renewable energy support policies in place (the Renewable Energy Policy Network for the 21st Century (REN21), 2014). This surge of interest in renewable energy creates a large demand for resource mapping and ground validation.

IRENA, through several initiatives (e.g., the Africa Clean Energy Corridor, the Renewables Readiness Assessments, and the Global Renewable Energy Islands Network), has identified high demand for expertise and funding for resource mapping campaigns – more extensive than the international community is in a position to fully support.

Cost-effective mapping and assessment strategies

Over the last decade, the private sector has developed strong expertise in mapping renewable energy resources. Within the framework of the Global Atlas initiative, several private companies (3Tier, Geomodel, Meteotest, Noveltis, Sander&Partner, Vortex) are making available datasets of higher spatial resolution than any previously in the public domain.[1] Those datasets represent a sample of larger, more detailed datasets, often available from partners for a fee.

[1] *The information displayed by the Global Atlas is distributed through web-mapping services. This allows users to view the information and query the values, but downloads are blocked as needed in order to preserve intellectual property.*

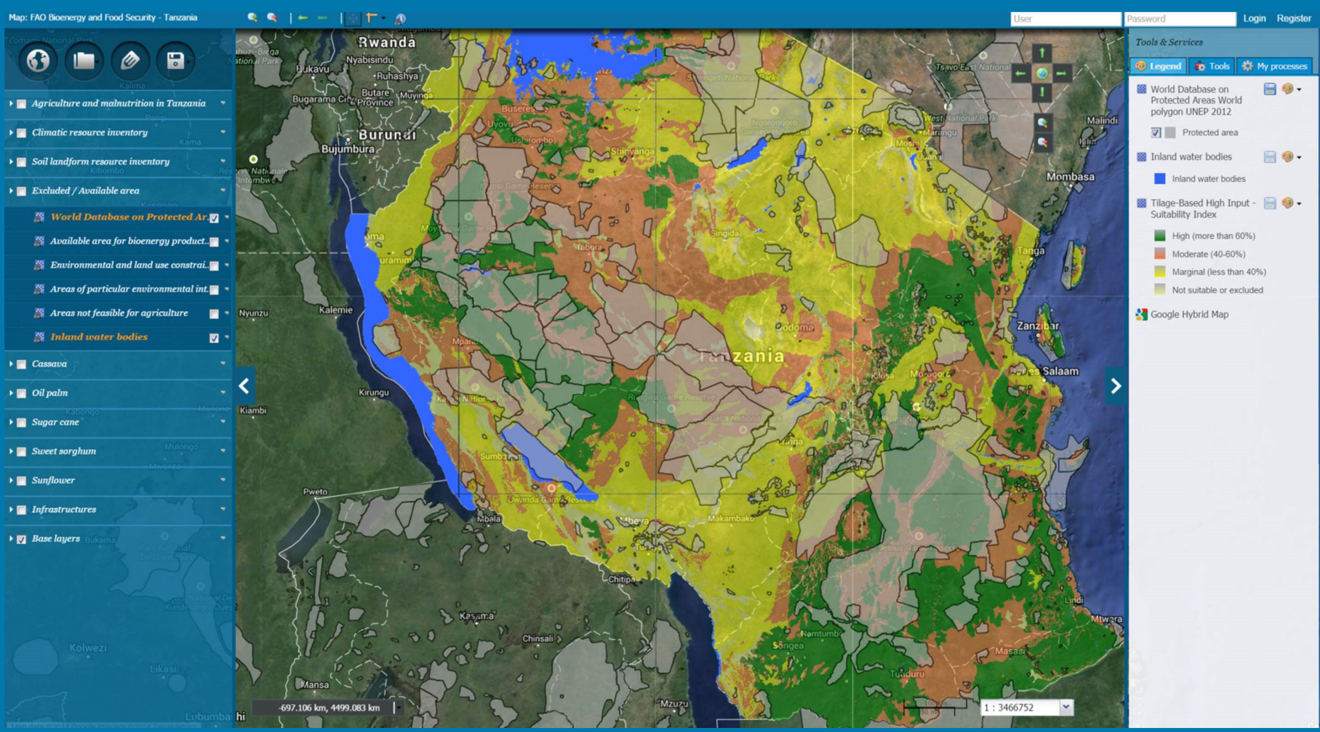

Figure 3: A land suitability map for sunflower cultivation for bioenergy in Tanzania, overlaid with protected areas, off-limits for cultivation.

Through the Global Atlas, maps of 3-5 kilometre (km) resolution for wind and solar resources are available for the entire globe, against the 10-50 km maps previously in common use. Datasets are all properly documented and are validated globally against large data samples. The Atlas datasets, though not suitable for project development, can be of sufficient quality to highlight areas of opportunity for further prospection (IRENA, 2014a).

The Global Atlas, therefore, has raised the standard for spatial resolution in public data. This, in turn, permits a new approach for financing resource mapping activities at national level:

» For wind and solar projects, average annual and monthly irradiance and wind speed values can be used at an early stage of evaluation to determine the overall feasibility of a particular site and to select the appropriate technology to be installed.

» For bioenergy production, land suitability and availability maps can be used as a starting point to identify 'Go' and 'No-Go' areas. In addition, other spatial-explicit datasets can support assessments of socio-economic and environmental impact in correlation with expected land-use changes.

The current accuracy of modelled and simulated data, combined with maps showing distance to the grid, population density, topography, land cover and protected areas, allows reliable identification of 'hotspots' for renewable energy development (IRENA, 2014b; IRENA, 2014c). The resulting maps (Figures 1, 2 and 3), while not confirming the amount of energy that can be extracted at each location, allow reliable preliminary identification of priority zones where detailed assessments can follow. The preliminary analysis based on Atlas data, moreover, helps to initiate dialogue with the local authorities, refine parameters, and converge towards a first rough project plan. In turn, this information can be of sufficient quality to attract the interest of the private sector in further prospection, or to mobilise funding from the international community.

Such an approach, while less comprehensive than systematic resource mapping of an entire country, offers a time- and cost-effective alternative that allows for further refinement. Initial projects could be expected to create mounting interest, encouraging further resource prospection. In contrast to traditional approaches, the objective is not to be comprehensive, but to start an iterative resource-discovery process.

Initial resource analysis and opportunities for donors

IRENA, along with compiling a large number of resource mapping studies[2], sees large amounts of information available, often only locally, in most countries. Different assessments may exist that were financially supported either nationally or by third parties. In some instances, past activities may not be known by the authorities; complementary activities conducted by different entities may never be correlated. In some instances, IRENA has identified resource measurement campaigns to attract or secure project financing, while a parallel project develops high-detail maps of the country. Yet one project's measurements will not necessarily be used to validate the other's maps.

Before new resource mapping activities are initiated, a first step is to identify ongoing and past activities. The next step is to identify hotspot areas with promising resources, where data can be improved or re-used. Efforts can then be focused on such areas, with the aim of accelerating the development of projects.

The outcome of analysing past studies and available data is a short action plan, which identifies opportunities for government and donors to focus investments on specific resource mapping activities in targeted zones.

IRENA is well positioned to assist its Member States with such analysis whenever needed. The next step, following IRENA's analysis, involves performing detailed, site-specific resource assessments for a selected number of locations.

Rationale for this study

The Philippines is a densely populated country with growing energy needs. In partnership with IRENA, the government will be conducting the consultations for a Renewables Readiness Assessment (RRA).

The purpose of the RRA process is to review existing efforts and identify gaps in resource mapping in the country. In the case of the Philippines, the RRA aims to motivate complementary validation studies for solar and wind resources at specific locations.

A discussion would follow with energy authorities, planners and rural electrification agencies, in order to present the business case for further resource mapping in Philippines. This would also help to reconcile the study outcomes with known challenges and move towards a consensus on mapping identified hotspots.

IRENA does not intend either to raise or to manage funds for resource mapping, but to highlight opportunities and support the momentum for further assessments, in the interest of promoting accelerated renewable energy development.

RESOURCE MAPPING IN THE PHILIPPINES

Wind potential

In 1999, the National Renewable Energy Laboratory (NREL) released the Wind Energy Resource Atlas of the Philippines (Figure 4), which details a national-scale wind-resource analysis and mapping results for the country. The study claims that the country has 11,055 km^2 of windy land estimated to have good-to-excellent wind resource potential. Wind speeds at these sites range from 6.4 metres per second (m/s) to 10.1 m/s, with wind-power-density values of 300–1,250 Watts per square metre (W/m^2).

The GIS-based technique produces high-resolution (1 km^2) maps of the annual average wind resource. Along with wind resource distribution, the maps highlight seasonal and diurnal variability and other salient wind characteristics.

[2] *All references are available at:* www.irena.org/potential_studies/index.aspx

Philippines most favorable wind resource areas

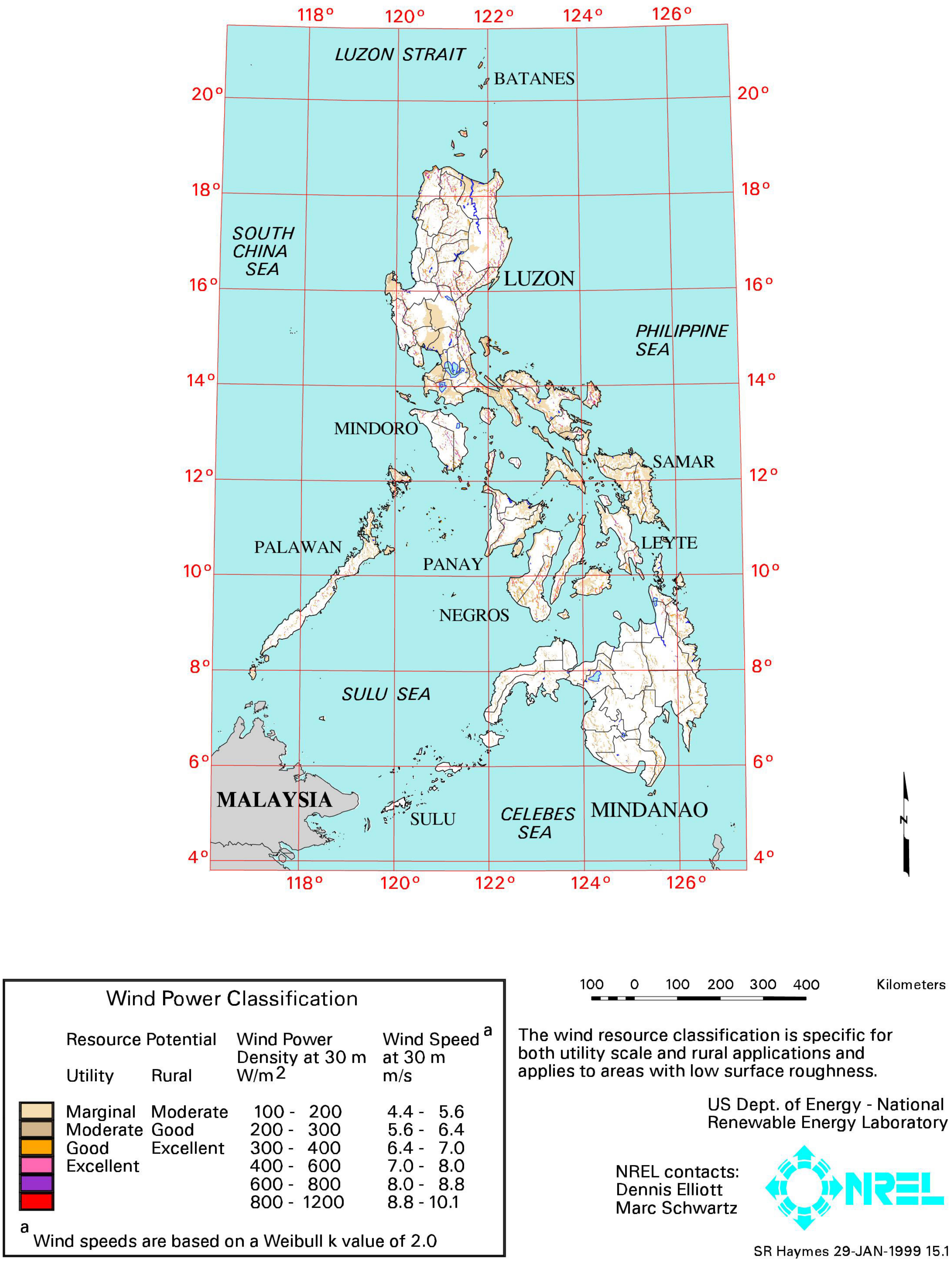

Figure 4: A map from the *Wind Energy Resource Atlas of the Philippines* (NREL, 1999)

The wind mapping results show many areas of good-to-excellent wind availability throughout much of the Philippines, particularly in the northern and central regions. The atlas was instrumental in identifying 14 new sites, where wind measurement systems were subsequently installed. NREL is currently validating the Philippines wind atlas maps with ground measurements.

The next stage will be to mobilise activities in specific hotspot areas, with the view to accelerating the development of projects. NREL and the Philippine Department of Energy (DOE) are updating the maps with data from the 14 sites and other project developers in the Philippines. Based on the updated maps, a revised spatial analysis could help to identify new sites for project development and implementation.

Assessment of existing NREL wind map analysis

The original NREL map was based on wind data from meteorological stations at 10 m height. These 10 m measurements are extrapolated to higher altitudes, and the resulting values are also interpolated horizontally between measurement points, using models and information on the topography. This rough-cut approach provides a good first estimate of wind speeds, but it needs to be validated using local measurements.

Validation matters for several reasons:

Topographic information is acquired at 1 km^2 resolution. In complex terrain, however significant variations can occur within a 1 km^2 area, creating large variations in the wind potential that cannot be captured without closer analysis.

The Philippines is an island nation, with strong interactions between land and sea elements, which most assessment models have difficulty capturing.

Finally, the extrapolation from 10 m to higher altitudes involves representing surface roughness, which carries large uncertainties. With current maps, wind estimates for areas with high surface roughness need to be adjusted accordingly.

Updated atlas maps with a ground measurement database factored in, however, will provide accurate, high-quality resource mapping as a solid starting point for wind energy planning in Philippines.

Solar potential

Solar resource assessments for the Philippines have usually relied on ground-based measurements of total hours of sunshine per day. NREL's updated assessment combines existing ground-mounted data with the output of NREL's Climatological Solar Radiation (CSR) model. This collates satellite- and surface-derived cloud-cover data, collected at 40 km spatial resolution, with monthly averages of the estimated daily total for Global Horizontal Irradiation. The NREL study shows the country's annual average potential to be 5.1 $kWh/m^2/day$.[3]

Bioenergy potential

Biomass resource assessments are essential in evaluating bioenergy potential, as well as social, environmental, and economic effects associated with resource production, distribution and use.

According to the survey of biomass resource assessments prepared in 2008 by NREL, most of the Asia-Pacific Economic Cooperation (APEC) countries have assessed their biomass resources economy-wide. Several have completed biomass assessments by state/province, while some have done so at a more localised level, by county or district. Additionally, all APEC members possess the prerequisites for biomass resource assessments: scientific knowledge, tools and data. Not all of them, however, have used their full capabilities. Only a few of the existing assesements reflect advanced capabilities, such as geospatial analysis and simulation modelling.

[3] *www.doe.gov.ph/renewable-energy-res/biomass-solar-wind-and-ocean*

In the Philippines, biomass resources, particularly agricultural and forestry residues, represent an opportunity for many areas of the country to produce sustainable bioenergy both for commercial uses and for urban and rural communities. However, agricultural and forestry residues are currently underutilised or in some cases wasted.

Ongoing work by the Food and Agriculture Organization of the United Nations (FAO) is helping to identify opportunities for the intensification of agricultural feedstock production for bioenergy purposes. Such intensification could significantly increase the supply of feedstock for biofuels, without competing with existing crop and land uses (e.g., food and export) (FAO, 2014).

The EC-ASEAN[4] Combined Generation Programme (1991-2004) estimated the volume of residues from rice, coconut, palm oil, sugar and wood industries at 16 million tons per year. If converted into usable energy, the bagasse, coconut husks and shells from agricultural production could account for at least 12% of total national energy supply. The World Bank's Energy Sector Management Assistance Program estimated that residues from sugar, rice and coconut could represent untapped power capacities equivalent to 90 megawatts (MW), 40 MW, and 20 MW, respectively.

According to FAOSTAT[5], sugarcane is the main crop produced in the Philippines in terms of volume, followed by rice and coconuts. Between 2000 and 2013, sugarcane production increased by 30%, rice production by 49%, and coconut production by 18%.

The Philippines produced in 2012 over 280,000 terajoules (TJ) of energy from primary solid biofuels and 150,000 tons of liquid biofuels (IEA, 2014), while several projects are being planned for the production of ethanol and biodiesel. In the year 2000, a biomass resource assessment study by the University of the Philippines (Biomass Atlas of the Philippines 2000) evaluated and mapped biomass residue resources at the economy-wide, regional, provincial and – in some cases – municipal levels. These include rice hull, bagasse and coconut residues, animal manure, forestry wastes, and urban refuse.

RESOURCE ASSESSMENT OPPORTUNITIES FOR PROJECTS IN THE PHILIPPINES

Wind

The Philippine DOE had awarded 41 wind power contracts under the 2008 renewable energy law (Republic Act No. 9513), to install 1,887 MW of total generating capacity. According to the DOE, 87 MW[6] of wind capacity has been installed and 900 MW is under construction.

NREL in association with the Philippine DOE is updating the country's wind atlas with ground measurement data. This includes collecting wind data from 14 wind masts in identified hotspots and private wind masts set up by project developers. The DOE will make the updated maps freely available. For wind energy, a detailed spatial planning analysis combining wind resource information with, for instance, topography, land occupation, population density, distance to the grid and site access could help to identify additional opportunity areas for prospection by the private sector.

Solar

Following the renewable energy law (Republic Act No. 9513), the DOE has more recently increased the national solar power capacity target to 500 MW, under an amendment in March 2015. The government has awarded 61 solar contracts, aiming for a total capacity of 1,014 MW. Most solar projects (approx. 700 MW) will be developed in the province of Luzon; the largest of these is a 100 MW solar PV project in Bataan. The DOE received two proposals for concentrated solar power (CSP) development and has expressed the need to install ground measurement equipment for CSP projects.

[4] European Commission and Association of South East Asian Nations
[5] The FAO Statistics Division
[6] Source: Department of energy, Philippines

According to the government, project development is underway for several key solar projects in an effort to meet the national target of 500 MW by March 2015. However, for a large-scale development of solar energy for the country, validated solar maps are needed, followed by an identification of sites and islands of major interest.

Bioenergy

As of April 2014, 65 biomass projects were awarded, and the total grid-connected installed capacity was 143 MW. Due to incremental improvements in agricultural production, as well as changes in crop yields and land cover in the Philippines over the last 10 years, a review of past resource assessments must be performed. This should highlight, in particular, current land utilisation for crops and the economic viability of bioenergy in different parts of the country.

The environmental and socio-economic sustainability of developing different bioenergy value chains should also be evaluated, taking account of specific local conditions.

Statistical and spatial-explicit evaluations of biomass resources should be reviewed periodically, in order to examine and update the amounts and geographic distribution of resources available or potentially available in a region.

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ACRONYMS

APEC	Asia-Pacific Economic Cooperation
AusAID	Australian Agency for International Development
BEFS RA	Bioenergy and Food Security Rapid Appraisal
CSP	Concentrated solar power
DOE	Philippine Department of Energy
ESMAP	Energy Sector Management Assistance Program
EC-ASEAN	European Commission and Association of South East Asian Nations
FAO	Food and Agriculture Organization
GEF	Global Environment Facility
GIZ	German International Cooperation
KFW	Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute)
NREL	National Renewable Energy Laboratory
NZAID	New Zealand Aid Programme
REN21	Renewable Energy Policy Network for the 21st Century
RRA	Renewable Readiness Assessment
SPREP	South Pacific Regional Environment Programme
SWERA	Solar and Wind Resource Assessment Programme
UAE	United Arab Emirates
USAID	United States Agency for International Development

About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

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