EC-LEDS Enhancing Capacity for Low Emission Development Strategies

Introduction to the Geospatial Toolkit

Geospatial Toolkit Consultation

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What is a Geospatial Toolkit?

- Stand-alone computer application
- Data viewer & analysis tool
- Combines renewable resource information with other data
- Explores data visually and with targeted geospatial analysis functionality
- Each GsT is country or region-specific





Geospatial Toolkit Background

- Originally created to facilitate interaction with regionally mapped wind and solar resource assessments
- Evolved to include more technologies, queries, and data layers
- **Re-designed using open** source components to enable free/wider distribution



2005 – Sri Lanka UNEP Solar and Wind Energy Resource Assessment (SWERA) Project









Geospatial Toolkit Functionality

- High-level visual exploration through pre-defined country data packages
- Targeted/guided geospatial analysis to visualize potential development issues and quantify energy potential
- Interact with renewable energy tools such as HOMER
- Platform is adaptable functionality depends on data availability
- Users can add other data layers for visualization













Types of questions the Geospatial Toolkit can help with

- High-level, prospecting questions
- What resource areas are close to load centers, transmission lines, and/or roads?
- What are the site's characteristics? Is the site in or near a protected area? What is the land currently used for, and terrain around the area?
- How much land area has good-quality resource, close to infrastructure, and in suitable development areas?



Good answers depend on good data!













Data in the Geospatial Toolkit

- Renewable resource data
 - Gridded solar and wind resource data
 - Biomass, geothermal, hydro, and conventional resources can also be added
- Base data
 - Elevation and slope
 - Land use/land cover
 - Protected areas
 - Political boundaries
 - Cities/towns
 - Rivers and lakes

- Infrastructure data
 - Transmission lines
 - $\circ~$ Roads and railroads
 - Power plants
- Other data of interest (examples)
 - Meteorological stations
 - Rural development priorities (schools, clinics, etc)

For many layers, global data sources may be used, but those sources may be dated or lack detail



Philippines GsT – Interface



Philippines GsT—Wind Resource Data



Philippines GsT—Administrative Boundary Overlays



Philippines GsT—Infrastructure Overlays





Philippines GsT—Land Use Overlays



Philippines GsT—Solar Resource (Tilt)



Solar resource: kWh/m²/day

Spatial resolution: 30km

Source: NREL (2007)

GsT Analysis Functionality: Leyte Province

What kinds of questions can the GsT help explore?

- High-level, prospecting questions
- Where are the most appropriate areas to site utility-scale solar and wind facilities based on:
 - Resource quality?
 - Proximity to load centers, transmission lines, and/or roads?
 - Site suitability? (e.g., terrain, protection status, current landuse?)
- Which sites may offer the best possibilities for investment in long-term measurement stations?



Good answers depend on good data!



Query Constraints:

• (Unconstrained)

Outputs:

Nameplate Capacity (MW):	27,586
Total Land Area (km ²):	5,517
DC Generation (MWh/yr):	3,808,031

Resource Category (W/m ² at 65m)	Area (km²)
Wind class: 0 to 100	4,292
Wind class: 100 to 200	795
Wind class: 200 to 300	185
Wind class: 300 to 400	116
Wind class: 400 to 500	77
Wind class: 500 to 600	30
Wind class: 600 to 800	18
Wind class: 800+	4



Query Constraints:

- Minimum Wind Resource: 300 W/m² at 65m
- Exclude protected areas

Outputs:

Nameplate Capacity (MW):	1,213
Total Land Area (km ²):	243
DC Generation (MWh/yr):	3,770,853

Resource Category (W/m ² at 65m)	Area (km²)
Wind class: 300 to 400	114
Wind class: 400 to 500	77
Wind class: 500 to 600	30
Wind class: 600 to 800	18
Wind class: 800+	4



Query Constraints:

- Minimum Wind Resource: 300 W/m² at 65m
- Exclude protected areas
- Transmission line buffer: 5 km

Outputs:

Nameplate Capacity (MW):	728
Total Land Area (km²):	146
DC Generation (MWh/yr):	2,256,036

Resource Category (W/m ² at 65m)	Area (km²)
Wind class: 300 to 400	69
Wind class: 400 to 500	47
Wind class: 500 to 600	19
Wind class: 600 to 800	8
Wind class: 800+	3



Query Constraints:

- Minimum Wind Resource: 300 W/m² at 65m
- Exclude protected areas
- Transmission line buffer: 5 km
- Road buffer: 5 km

Outputs:

Technical Potential

Nameplate Capacity (MW):	422
Total Land Area (km²):	84
DC Generation (MWh/yr):	1,278,764

Resource Category (W/m ² at 65m)	Area (km²)
Wind class: 300 to 400	50
Wind class: 400 to 500	22
Wind class: 500 to 600	7
Wind class: 600 to 800	4
Wind class: 800+	2

Also possible to constrain analysis by **land use** (e.g., excluding forests and wetlands) and **slope**

Embedded HOMER Tool for Off-Grid Analysis



HOMER Tool		
Input Output		
Analysis		
HOMER System Optimization R	tesults	
System Type	Levelized Cost of Energy (\$ / kW	/h)
Wind/PV/Battery	\$0.357	Details
Wind/Gen/Batt	\$0.419	Details
Wind/PV/Gen/Batt	\$0.424	Details
PV/Gen/Batt	\$0.696	Details
Wind/PV/Gen	\$0.794	Details
Wind/Gen	\$0.798	Details
		Open HOMER File
		Close

The HOMER tool:

- Inputs monthly and annual solar and wind resource data and assumptions about offgrid energy demand
- Provides preliminary, high-level analysis of off-grid hybrid systems for a particular location
- Ranks top six systems based on levelized cost of energy

Leyte Province Solar Resource: Example Query



Query Constraints:

• (Unconstrained)

Outputs:

Nameplate Capacity (MW):	266,950
Total Land Area (km ²):	5,561
DC Generation (MWh/yr):	503,006,668

Resource Category (kWh/m ² /day)	Area (km²)
Tilt Solar: 4.5 to 5.0	974
Tilt Solar: 5.0 to 5.5	4,587

Leyte Province Solar Resource: Example Query



Query Constraints:

- Exclude protected areas
- Transmission line buffer: 5 km
- Road buffer: 5 km

Outputs:

49
62
83
;

Resource category (Rwin/in / day)	
Tilt Solar: 4.5 to 5.0	594
Tilt Solar: 5.0 to 5.5	2,768

Leyte Province Solar Resource: Example Query



Query Constraints:

- Exclude protected areas
- Transmission line buffer: 5 km
- Road buffer: 5 km
- Maximum slope: 1%

Outputs:

Resource Category (kWh/m²/day)	Area (km²)
DC Generation (MWh/yr):	85,348,251
Total Land Area (km ²):	947
Nameplate Capacity (MW):	45,458

Filt Solar: 4.5 to 5.0	201
Tilt Solar: 5.0 to 5.5	 746

Thank you for your time!

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Additional Resources:

- NREL GsTs: <u>http://www.nrel.gov/international/geospatial_toolkits.html</u>
- OpenEI GsT resources: <u>http://en.openei.org/wiki/Geospatial_Toolkit</u>

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