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NATIONAL RENEWABLE ENERGY LABORATORY

Analyzing Renewable Potential in NREL's Geospatial Toolkit



Asia LEDS Forum
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How much **renewable energy** is possible in **my country**?

Renewable Potential

Understanding **renewable energy potential** starts with resource assessments

Renewable resource assessments characterize **the fuel** available to power **renewable energy systems**

Solar and Wind Resource Assessments

Measurements

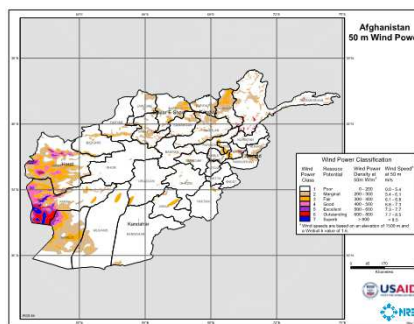
- Site assessment
- Highest quality
- Expensive
- Time consuming



Source: NREL Pix

Models

- Regional planning
- Less accurate
- Less time and money to complete
- Good spatial coverage

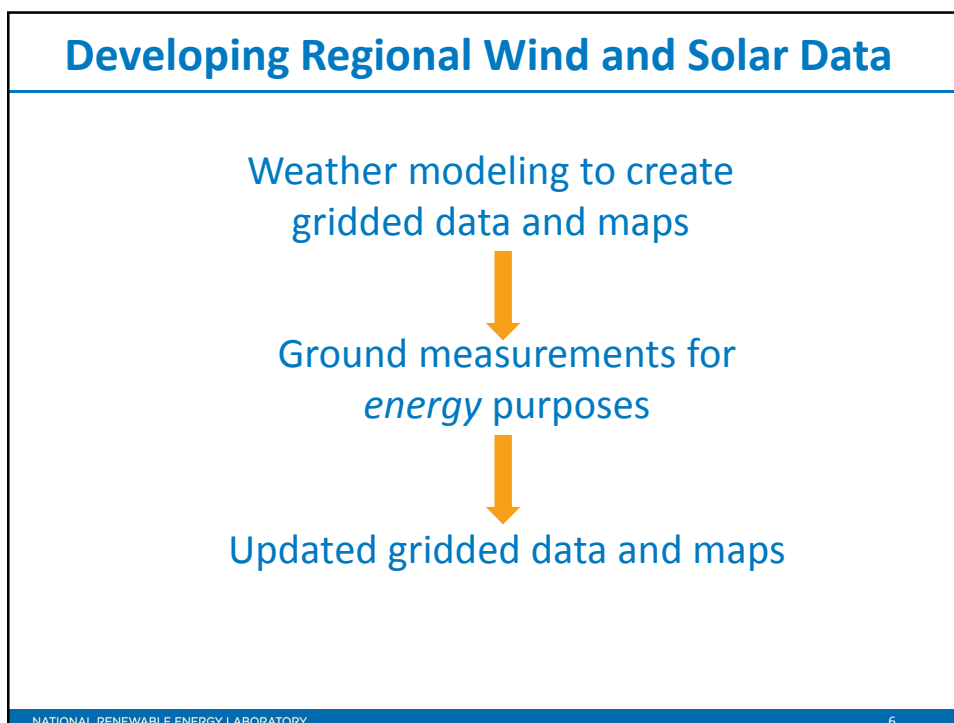


Applications of Resource Data

	Annual	Seasonal	Monthly	Daily	Hourly
Country	Policy				
Region		Planning			
km			Project Dev (sm)	Pre-feasibility	
meters				Project Dev (lg)	System Design

Regional Modeling

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What Regional Maps Tell Us

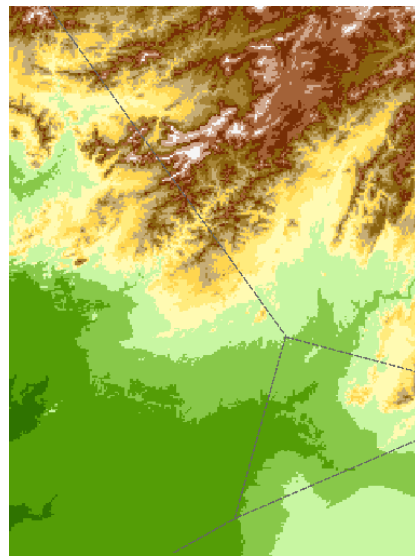
- Identify areas with best solar and wind resource
- Important because resource availability drives energy costs
- Example:
Class 3 wind site: 5.1 US cents per kWh
Class 6 wind site: 3.8 US cents per kWh
- But those are costs “inside the fence” ...

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Other Considerations

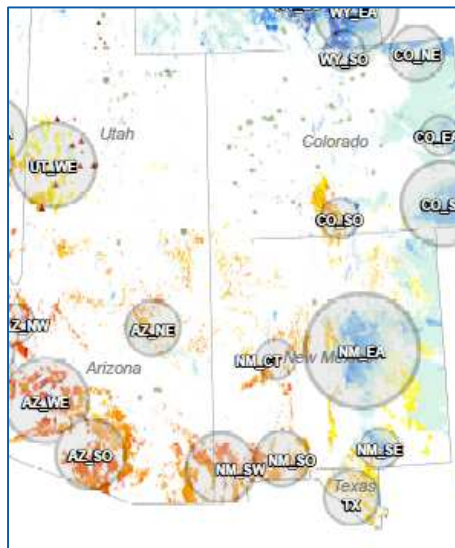
- Distance to loads, roads, and transmission, terrain slope
- Protected areas such as heritage sites, migratory bird routes, sensitive habitat
- Competing demands for land



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Using GIS Analysis and RE Resource Data



Needs:

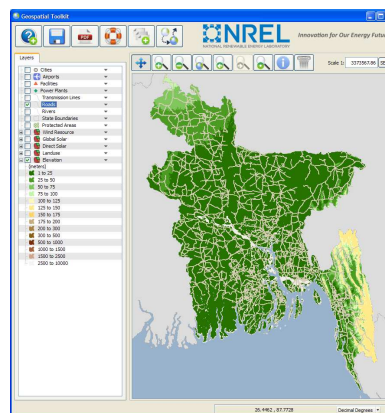
- GIS software
- GIS data (resource data, infrastructure, geographic)
- Expertise

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Geospatial Toolkit (GsT)

- Each GsT is country or region-specific
- Stand-alone computer application
- Integrates data with GIS capabilities
- Combines resource with other data
- Data viewer & analysis tool



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Combining Resource & Other Data

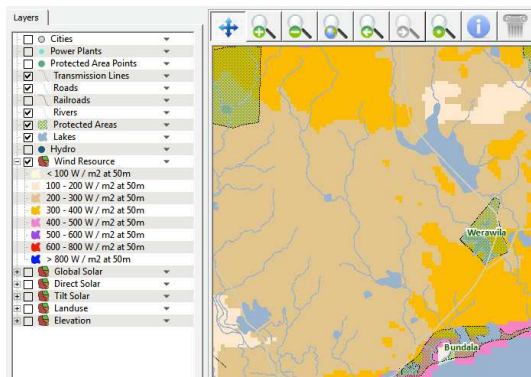
- **For sites, can answer:**
 - How far is resource from load centers, transmission lines, and roads?
 - Is site a protected area? Can we build on it? What is the land currently used for? Is site too steep to build on?
- **For countries, can answer:**
 - How much land area has good-quality resource, close to infrastructure, and in suitable development areas?

Data needs

- **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

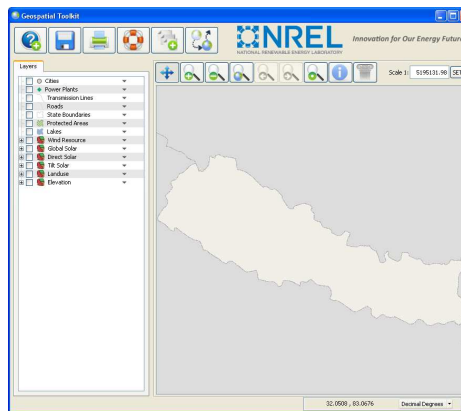
Infrastructure data

- Transmission lines
- Roads and railroads
- Power plants



Geospatial Toolkit – Demonstration

- Displaying data
- Tool functions
- Analysis options



Estimating Potential from Query Results

Query Info	
Summary	Statistics
	2,874.34 sq km (Wind class: 300 to 400)
	1,247.9 sq km (Wind class: 400 to 500)
	465.44 sq km (Wind class: 500 to 600)
	481.86 sq km (Wind class: 600 to 800)
	469.66 sq km (Wind class: 800 to 10000)

Wind Power [W/m ²]	Capacity Factor [%]	Total Area [km ²]	Potential Installed Capacity [MW]*	Potential Generation [GWh]
300-400	32	2,874	14,370	40,282
400-500	36	1,248	6,240	19,678
500-600	42	465	2,325	8,554
600+	45	952	4,760	18,764
		5,539	27,695	87,279

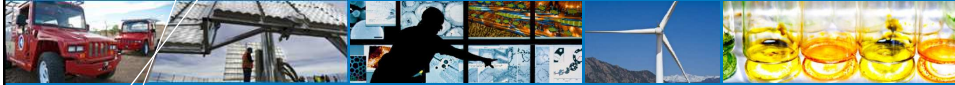
Note: Technical Potential ≠ Economic Potential *Assumes 5 MW per km²

Uses for the GsT

- **Identifying sites for long-term measurement stations**
- **Informing development of policies, such as renewable energy targets and incentives**
- **Screening for potential development sites to be further explored by developers**

GsTs for Asia

- **Afghanistan, Bangladesh, Bhutan, China (Hebei), India, Nepal, Pakistan and Sri Lanka**
- **USAID EC-LEDS program supporting development of new GsTs for some Asian countries**
- **Please fill out questionnaire to help us understand country data availability and needs to support this**



Resources:

- **NREL GsTs:**
http://www.nrel.gov/international/geospatial_toolkits.html
- **US Technical Potential Estimates and Methodology:**
<http://www.nrel.gov/docs/fy12osti/51946.pdf>