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# Site Selection of Solar PV Plants Using the Renewable Energy Data Explorer

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# Survey question#1

What is **the most important factor** that will be used to select a site of solar PV projects?

- a) Solar potential
- b) Location of a site (near a road and grid access)
- c) Availability of grid capacity
- d) Information of land use
- e) All above

## Survey question#2

What is **a tool** that you prefer to use in site selection of solar PV projects

- a) Solar radiation map
- b) GIS tool
- c) Opened-access software
- d) Commercial software
- e) Web-based tool
- f) Publicly-available, no-cost, web-based, and GIS tool

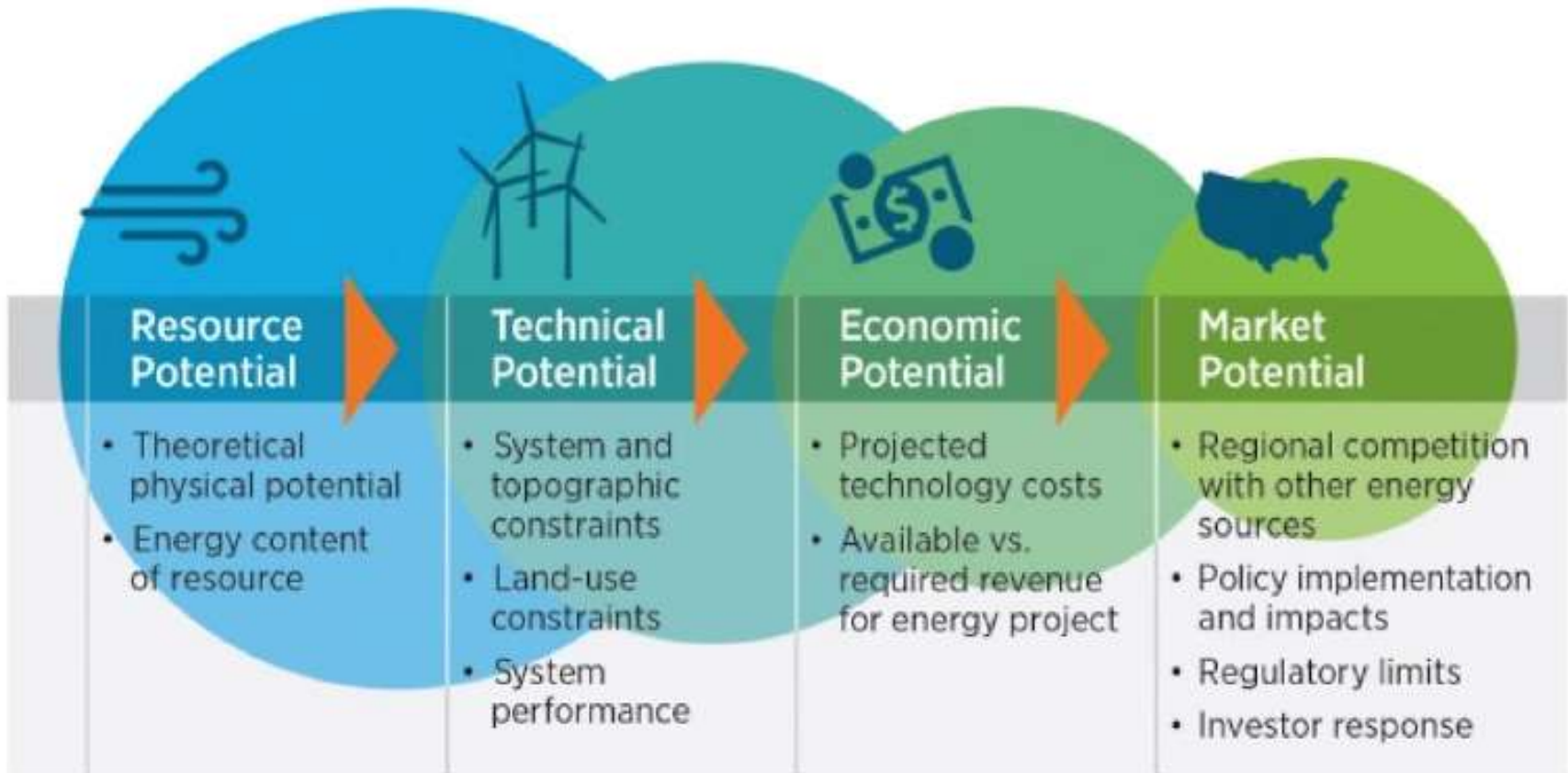
# Learning objectives

- To understand definitions of RE potential (theoretical, technical, and economical potential)
- To introduce the RE Data Explorer, and its applications for RE planning
- To increase understanding of how to use the RE Data Explorer for site selection for solar PV plants

# Contents

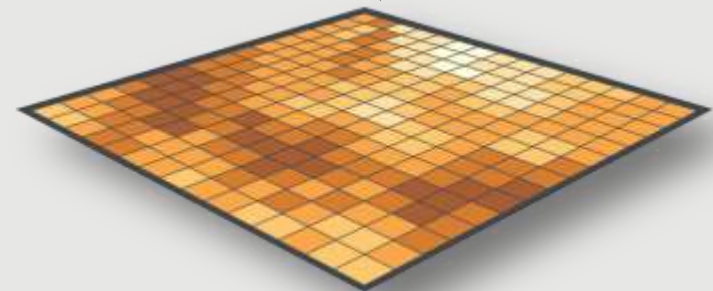
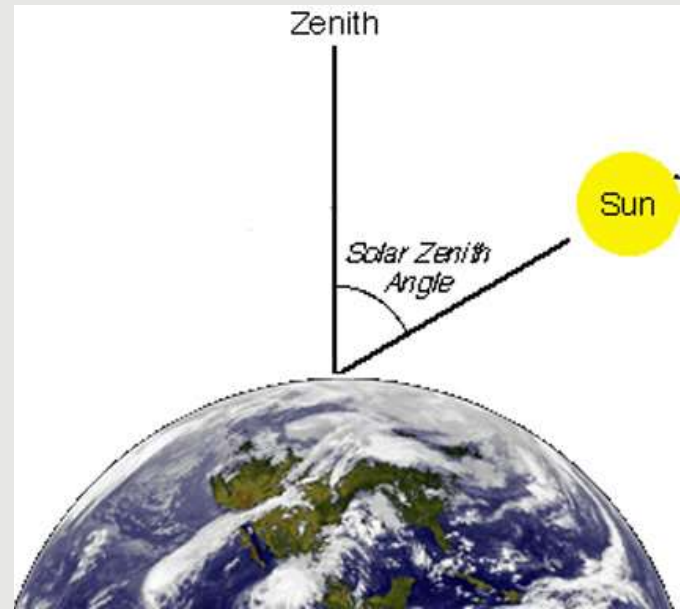
- Understanding definitions of RE potential and RE analysis
- A link of RE analysis and data requirements
- What is the RE Data Explorer?
- Key features of the RE Data Explorer in Vietnam
- Exploring the RE Data Explorer
- Exercise on selecting the best location for solar PV

# Definitions of RE potential



# Resource potential

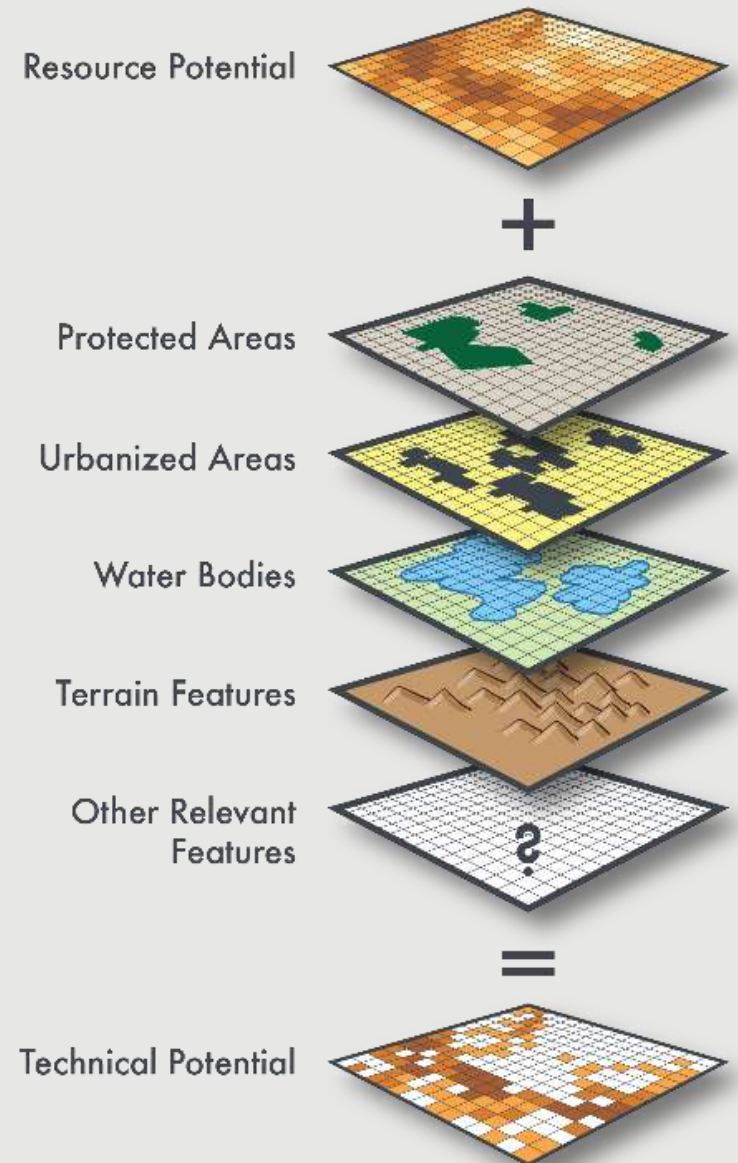
- Theoretical-physical potential
- Amount of energy physically available such as the amount of light energy striking a location



**Resource Potential**

# Technical potential

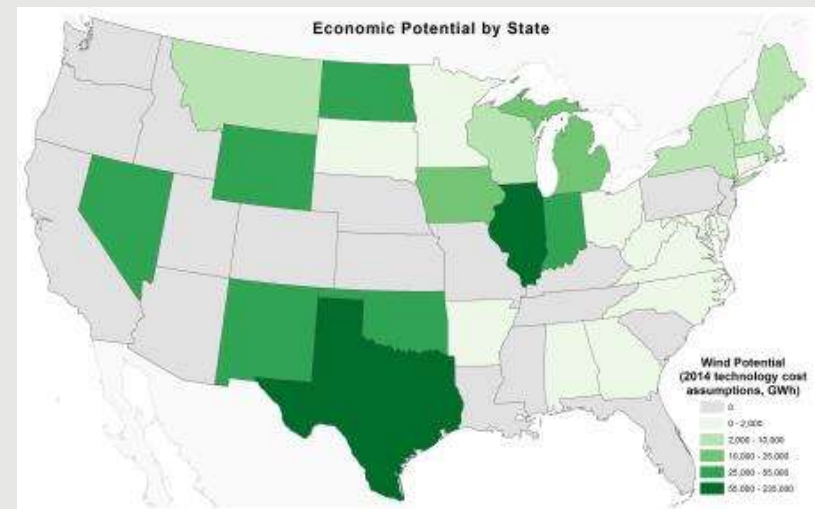
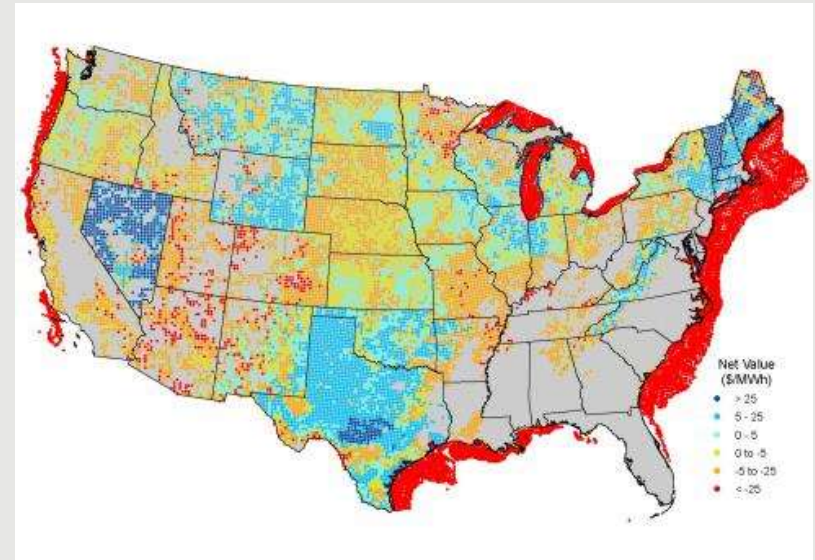
- Subset of resource potential
- Represents achievable energy capacity and generation of a specify RE technology by considering geographic constraints such as:
  - topographic limitations
  - environmental or other land-use restrictions
- Does not consider technology costs





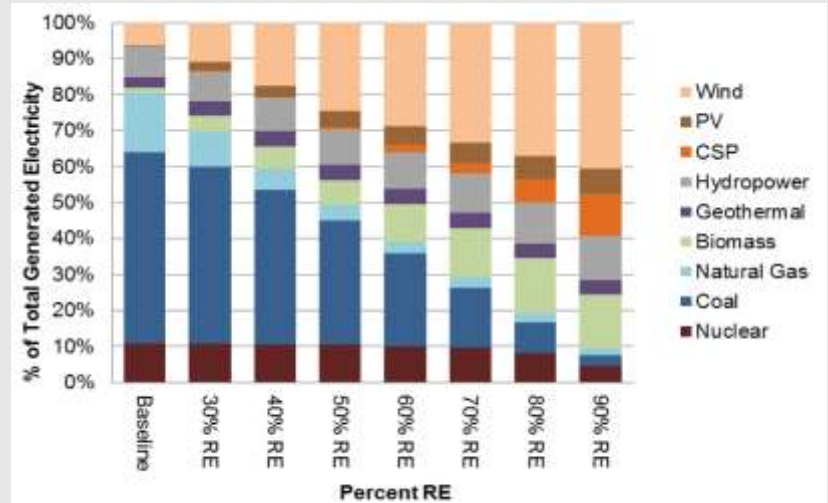
# Economic potential

- Subset of technical potential
- Cost to generate electricity from a particular RE technology is below the revenue available in terms of displaced energy and displaced capacity
- Provides insights to decision makers on the type, quantity, and location of RE resources
- Does not consider market dynamics, customer demand, or most policy drivers that may drive RE generation

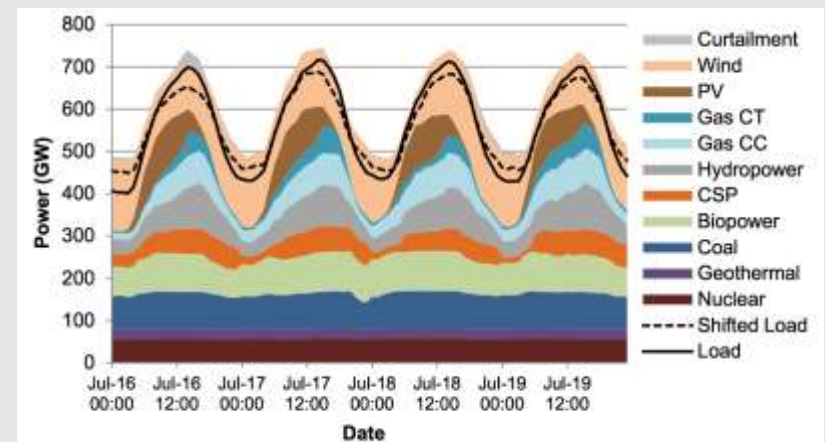


# Market potential

- Capacity and generation achievable through the market deployment of a particular RE technology based on the impacts of factors such as:
  - policies
  - incentives
  - regulations
  - investor response
  - economic competition with other generation sources



(b) Generation mix in 2050 for the exploratory scenarios



(a) Summer peak load in 2050

Source: Renewable Energy Futures (2012)

# Link to RE analysis and data requirements

Data Level

RE resource data

Non-RE resource data

Public infrastructure

Demand and consumption

Power plant and grid data

Environmental data, e.g., protected and land use areas

Administrative and other

Analysis level

Technical potential

Levelized cost

Grid integration studies

Economic potential

Production-cost modeling

Market potential

RE zones

Potential of DPV

Application level

Set/revise RE targets

Reconsider merit order

Revenue impacts studies on DPV

Develop High RE scenario

Solar auction pilot project

Revise PDP

FIT/auction designing

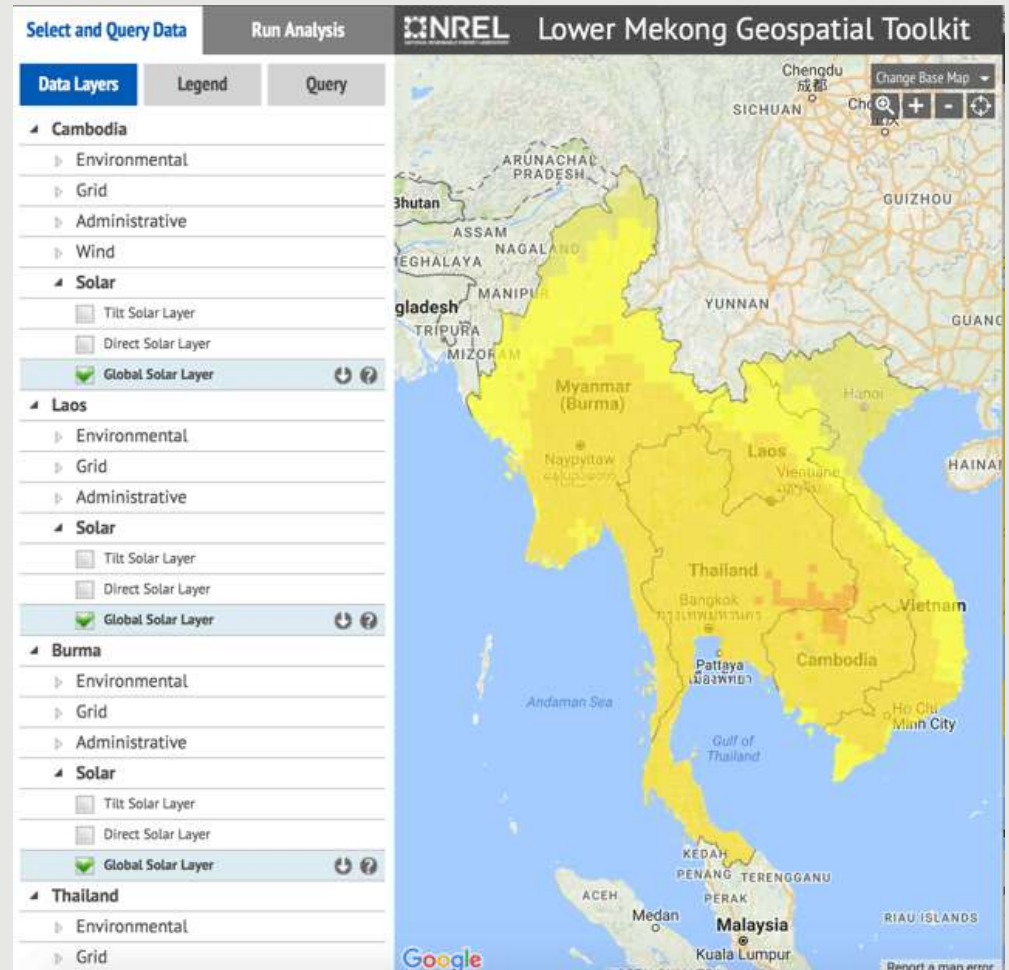
Grid codes

Higher RE target setting

Enabling RE policies

# What is the RE Data Explorer?

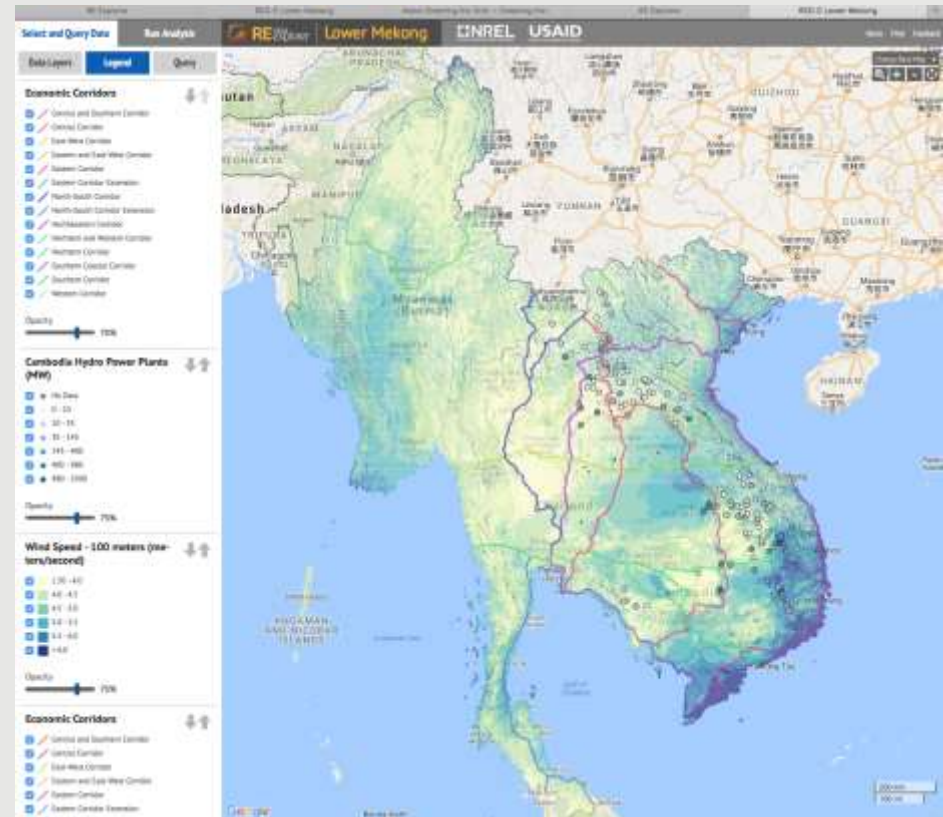
- No-cost, web-based decision-making tool:
  - Combines RE resource information with other base and infrastructure data
  - Explores data visually and with targeted quantitative geospatial analysis functionality
  - Complex spatial analysis techniques in easy-to-use interface targeted at non-specialists
- Currently available for Lower Mekong Region (5 countries), Afghanistan, Bangladesh, Ghana, India, Kazakhstan, Kenya, Mexico, Nepal, Pakistan, Indonesia, and Philippines.
- **Will expand to be ASEAN RE Data Explorer**



Available online at <https://maps.nrel.gov/gst-lower-mekong>

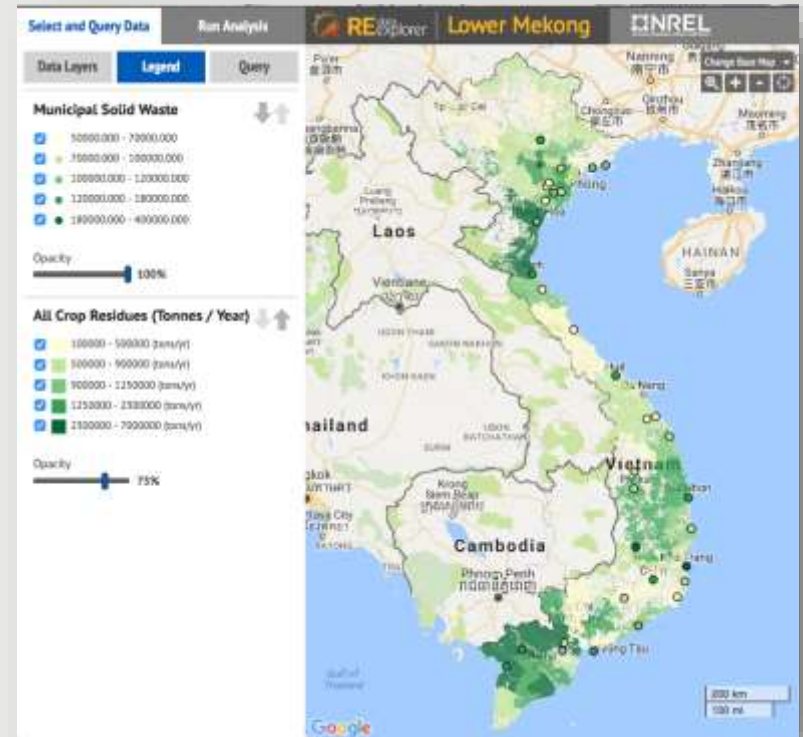
# Features of RE Data Explorer

- **Renewable resource data**
  - Gridded solar & wind resource data
  - Biomass, geothermal, hydro, & conventional resources can be added
- **Base data**
  - Elevation/slope/land use/land cover
  - Protected areas/political boundaries
  - Cities/towns/rivers/lakes
- **Infrastructure data**
  - Transmission lines
  - Roads and railroads
  - Power plants
- **Other data of interest, for example,**
  - Meteorological stations
  - Rural development priorities (schools, electrification, etc.)



# Key features of RE Data Explorer for Vietnam

- High resolution solar data from World Bank and wind data from the Danish Technical University
- Biomass resource data
- Numerous local datasets, including for electrification and poverty
- Dynamic technical potential tool for solar and wind



**Coming soon!** (Through USAID's Clean Power Asia and V-LEEP programs)

- Finer resolution wind dynamic technical potential
- Additional data layers from local sources

# Exploring the RE Data Explorer

- Match your partners (2-3 persons per a group; will help to reduce internet congestion while using the tools)
- Go to [www.re-explorer.org](http://www.re-explorer.org)
- Click on Lower Mekong

# Exercise 1: Explore data through visualization

1. Turn off any active layers
2. Ensure checkbox is selected for “Global solar”
3. Under “Environment” turn on “Protected areas” layer. Use the layer ordering and opacity features in the legend to explore this data visually.
  - Note: Elevation layer may also be useful to identify high-slope areas
4. Under “Grid” turn on power plants; explore this information visually
  - Note: Relative position of utility-scale (e.g., 4.5kWh/sq.m./day)
5. From the visualization, where are the best areas for solar PV projects?  
Which provinces?



Data Layers

Legend

Query

Protected Areas

- Protected Area

Transparency

Power Plants

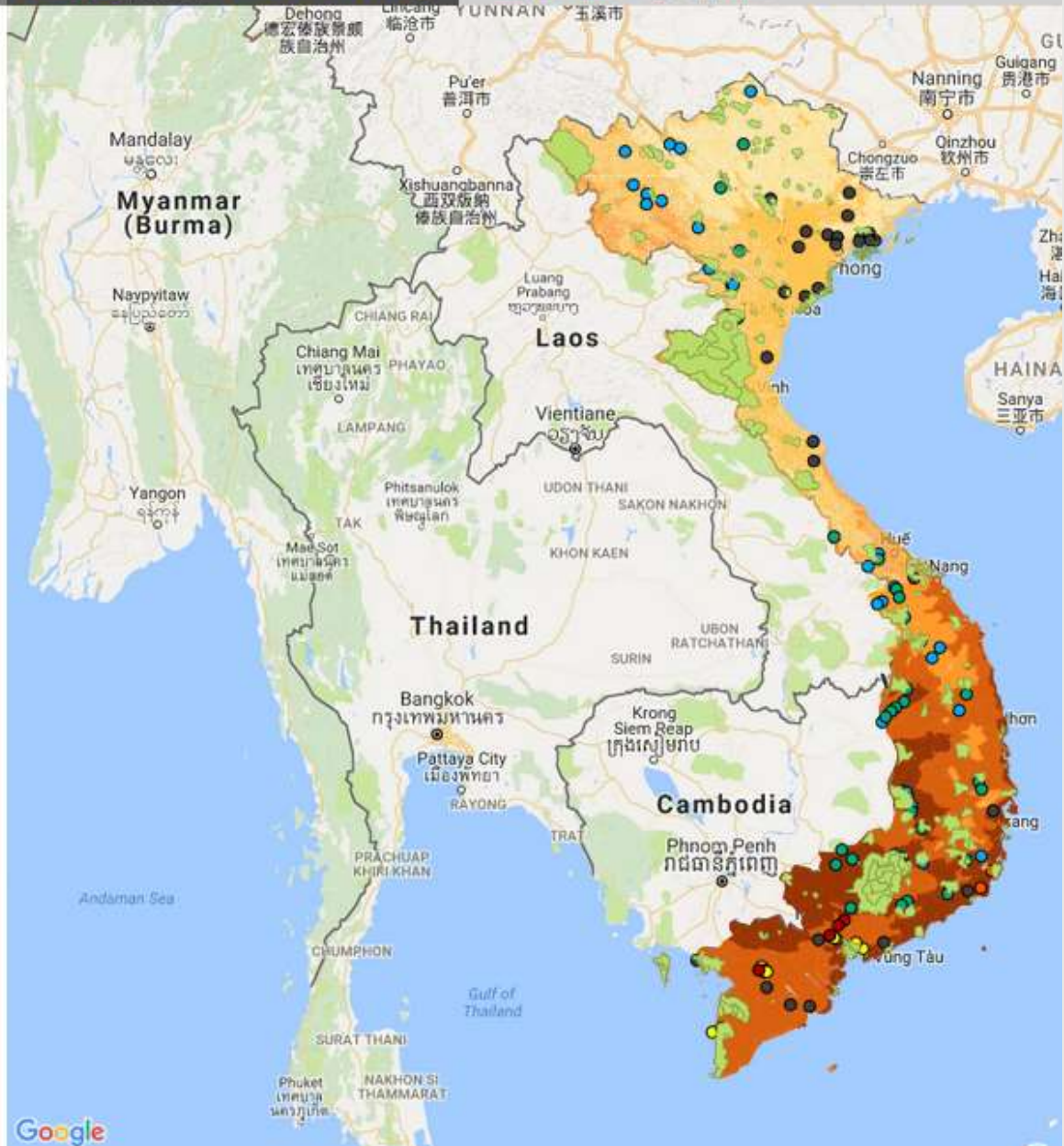
- Coal Plant up to 2025
- Existing Coal Plant
- Existing Gas Plant
- Existing Hydropower
- Existing Oil Plant
- Gas Plant up to 2025
- Hydropower up to 2025
- Nuclear Plant

Transparency

Global Solar (kWh/sq.m./day)

- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

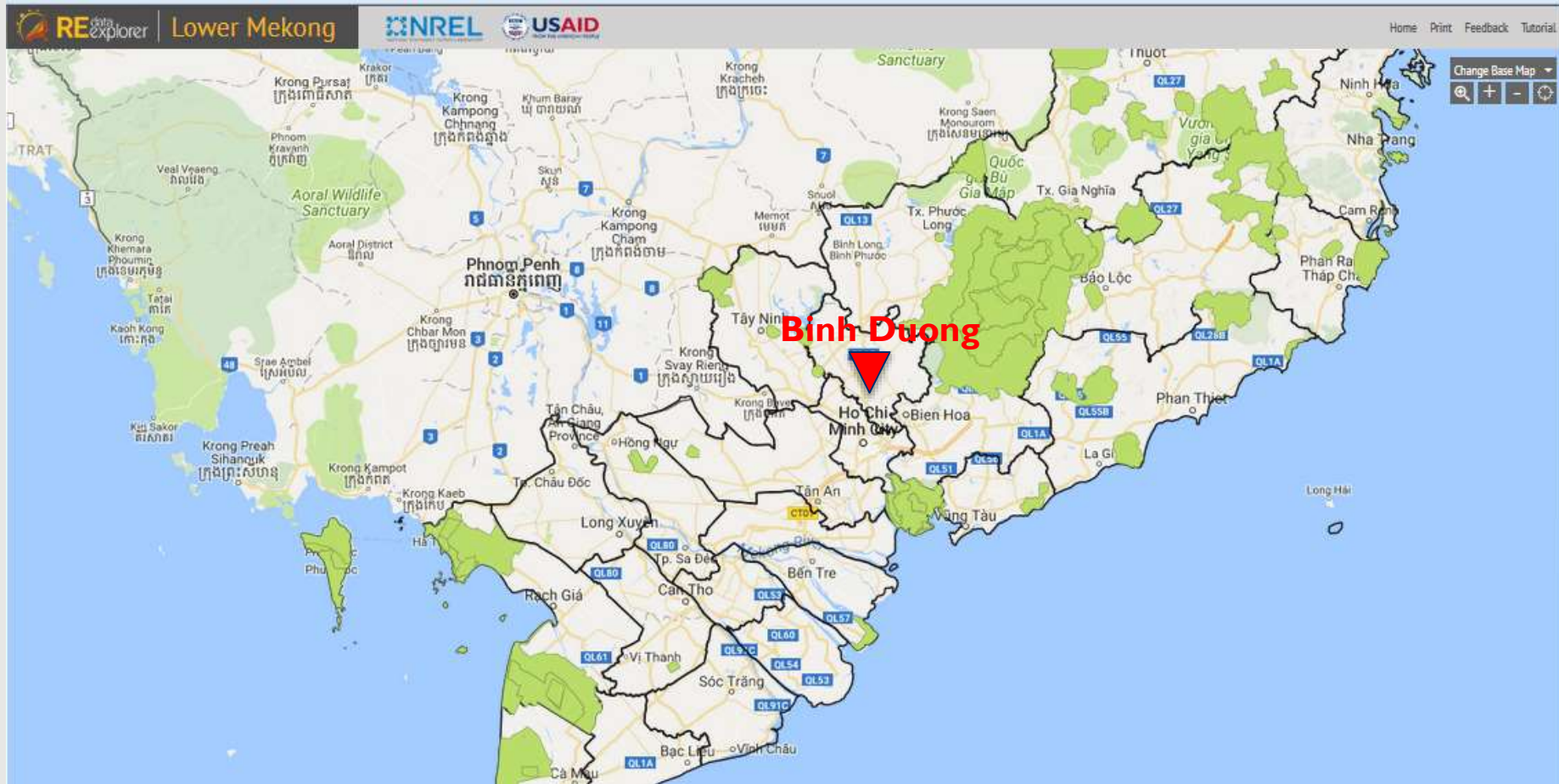
Transparency



## Exercise 2: Estimate technical potential

1. Click the *Run Analysis* or *Analysis and Downloads* tab in the upper left-hand corner and select *Technical Potential*.
2. In the *Inputs* tab, make the following selections to explore utility-scale solar PV potential:
  - **Country:** select “Binh Duong province”
  - **Technology:** choose “Fixed Tilt PV System”
  - **Region:** select 1 or more provinces of interest (select all to analyze national potential)
  - **Limit by Solar Resource (kWh/m<sup>2</sup>/day):** minimum 4.5 (can set maximum value, e.g., 12.0)
  - **Power density (MW/km<sup>2</sup>):** incorporate local assumptions, or use the default given
  - **Limit by Distance to Roads and Transmission:** None
  - **Exclude protected Areas:** check the box
  - **Exclude Land Use Types:** select any urban and water body categories
  - **Limit by Slope (%):** limit to slopes under 20%
3. Create a unique name for your analysis results (e.g., my\_PV\_analysis)
4. Select *Run Analysis*. If no results are returned, check and/or modify your inputs and execute the query again.


# Location of solar PV potential estimation



# Results from running analysis

## Technical Potential Tool

Run Analysis Results

Layer: Only Binh Duong 

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### Cumulative Results

AC Generation:	137 million MWh/yr
Total Land Area:	2,647 km <sup>2</sup>
Nameplate Capacity:	95,279 MW
<b>Land Area by Resource Class</b>	
4.5- 5 kWh/m <sup>2</sup> /day:	317 km <sup>2</sup>
5- 5.5 kWh/m <sup>2</sup> /day:	2,330 km <sup>2</sup>

### Regional/State Results

#### Binh Duong

AC Generation:	137 million MWh/yr
Total Land Area:	2,647 km <sup>2</sup>
Nameplate Capacity:	95,279 MW
<b>Land Area by Resource Class</b>	
4.5- 5 kWh/m <sup>2</sup> /day:	317 km <sup>2</sup>
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# Data can be downloaded in various formats

The screenshot displays the REexplorer web application interface. The top navigation bar includes "Select and Query Data", "Run Analysis", and logos for NREL and USAID. The main map area shows the Lower Mekong region, with a yellow-shaded area representing the data layer selected. A dialog box titled "Only Binh Duong" is open, displaying the text "Download map layer data in the following geospatial data formats:" and four buttons: "CSV", "Shapefile", "KML", and "GeoJSON".

**Select and Query Data** | **Run Analysis** | **REexplorer** | **Lower Mekong** | **NREL** | **USAID**

**Data Layers** | Legend | Query

- Analysis Results
  - Only Binh Duong
  - Cambodia
  - Laos
  - Burma
  - Thailand
  - Vietnam
    - Poverty & Electrification
    - Biomass
    - Environmental
      - Elevation
      - Land Use
      - Protected Areas
      - Rivers
    - Grid
      - Transmission Lines
      - Power Plants
      - Vietnam Hydro Power Plants
    - Administrative
      - Commune Boundaries
      - District Boundaries
      - Province Boundaries
      - Country Boundary

# Specify area by using region or custom shape query

Select and Query Data | Run Analysis | REexplorer | Lower Mekong | NREL | USAID

Data Layers | Legend | **Query**

**Point Query**  
Select a single point on the map and get data for that location.

**Region Query**   
Select an area on the map and get data for that area.

**Custom Shape Query**  
Draw a custom shape on the map and view data for that area.

**Attribute Query**  
Use this advanced feature to filter your query based on specific attributes.

EGST Analysis Result | Protected Areas | Transmission Lines | Province Boundaries

Region Name	Results Area (km2)	Nameplate Capacity (MW)	Technical Potential (MWh/yr)
Binh Duong	0.89	32.08	46,596.81

# Exercise 3: Best solar PV location between Tay Ninh and Binh Duong provinces

1. Use the same default figure from the previous example
2. In the *Inputs* tab, make the following selections to explore utility-scale solar PV potential:
  - **Country:** select your country of interest
  - **Technology:** choose “Fixed Tilt PV System”
  - **Region:** select one or more provinces of interest (select all provinces to analyze national potential)
  - **Limit by Solar Resource (kWh/m<sup>2</sup>/day):** minimum 4.5 (can set maximum value, e.g., 12.0)
  - **Power density (MW/km<sup>2</sup>):** incorporate local assumptions, or use the default given in the tool
  - **Limit by Distance to Roads and Transmission:** None
  - **Exclude protected Areas:** check the box
  - **Exclude Land Use Types:** select any urban and water body categories
  - **Limit by Slope (%):** limit to slopes under 20%
3. What criteria will you use to select the location?

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