

RE Data Explorer

Use of the Tool to Support Renewable Energy Project Development

The *Renewable Energy (RE) Data Explorer* is a user-friendly geospatial analysis tool for analyzing RE potential and informing decisions. Developed by the National Renewable Energy Laboratory (NREL) and supported by the U.S. Agency for International Development (USAID), RE Data Explorer performs visualization and analysis of RE potential that can be customized for different scenarios. RE Data Explorer can support prospecting, integrated planning, policymaking, and other decision-making activities to accelerate RE deployment. The broader *RE Explorer* website provides guidance and information to link the RE Data Explorer geospatial analysis tool to key decision areas. This document provides information on how the RE Data Explorer can support

private sector utility-scale RE project development. Box 1 provides information on the scale of projects that RE Data Explorer, and its underlying data, can inform.

Figure 1 depicts the high-level stages of utility-scale RE project development and identifies where the RE Data Explorer can inform and add value to these stages. The following sections elaborate on these stages, provide guidance on use of RE Data Explorer, and describe real-world examples of how project developers are using the tool to deploy RE.

Prospecting

The RE Data Explorer is highly applicable to the prospecting phase of solar and wind project development. In this phase, developers typically undertake three high-level, desk-based analyses focused on understanding:

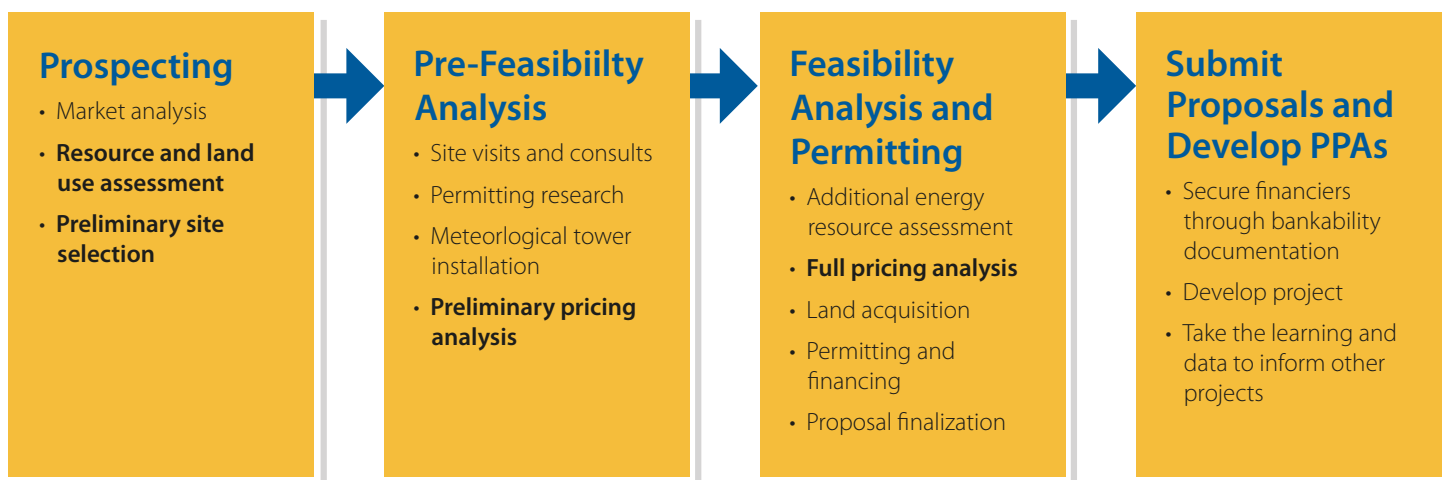
1. the market driver,
2. RE resource potential,
3. land-use constraints.

Box 1. What scale of RE projects can the RE Data Explorer inform?

RE Data Explorer analysis and data can be used to support projects from the utility-scale to the distributed generation-scale. This document details the specific stages of utility-scale project development that can be supported using RE Data Explorer.

In 2020, the PVWatts application will be integrated with RE Data Explorer to allow for more granular analysis of distributed generation projects including solar photovoltaic (PV) and energy value calculations for specific structures or areas. These calculations can support identification of distributed PV deployment opportunities and bolster industry players such as solar installers.

Figure 1. High-level stages of RE project development and intersections where RE Data Explorer can inform the process (in bold).



Each of these analyses help inform developers on the feasibility of potential sites for project development and further evaluation. Essentially, sites with high market potential, significant RE resources, and absence of or minimal land-use constraints may be further evaluated by project developers. Market analysis includes identifying potential RE buyers such as utilities or corporations,

understanding the policy environment (e.g., national targets for RE), assessing electricity wholesale market prices, and assessing transmission availability now and in the future (e.g., transmission expansion within an Integrated Resource Plan and so on). The next two analyses, RE resource and land use assessments, can be undertaken using the RE Data Explorer. Box 2 provides an overview of data collection processes

and types of RE data that can support this process. Within RE Data Explorer, users can visualize solar and wind potential throughout a country or in various regions. Users can also overlay land use data, such as protected areas, agricultural areas, waterbodies, and so on, or exclude these areas within the technical potential tool. Figure 2 presents these analyses within RE Data Explorer.

Box 2. How is wind and solar data collected, developed, and validated?

Project developers can procure data from private companies and/or collect data from open sources such as RE Data Explorer. Often, project developers assemble several data sets to compare and use within various analysis tools as they assess the financial viability of projects. Key types of data and validation methods that can inform project development are described below.

Modeled data are RE resource data developed with modeling methodologies. For example, atmospheric scientists use a variety of methods to estimate solar irradiance, including empirical, semi-empirical, and, more recently, physics-based methods. For wind resource data, atmospheric scientists use numeric weather models (e.g., Weather Research and Forecasting [WRF] model) and downscaled reanalysis data.

Measured data are point-specific RE data gathered by trained personnel or meteorological measuring equipment (such as meteorological towers). If data from multiple points are available across a region, these data can provide a reasonable understanding of the solar or wind resource for a region. These data can also be used for site-specific project assessments. Project developers may choose to work with institutions already collecting these data, such as airports (for wind data). Measured data can also be used in models, such as WRF described above.

Validations of data are typically performed at the time RE resource data are created. Validation refers to comparing modeled data to “ground truth” data to quantify how closely the model matches reality. Validation can take many forms—for example, from a meteorological standpoint, comparing diurnal (daily) and annual cycles of wind speed; or from a power standpoint, comparing power output ramps and frequency distributions. Validation can play an important role in analysis application, sometimes warranting the use or purchase of another data set if the validation metrics indicate systematic biases.

What is the difference between annual average and time series data?

Annual average data	Time series data
<ul style="list-style-type: none"> • Generally large coverage area • Relatively easy to produce based on limited data locations • Lower fidelity than time series data • Not suitable for detailed project planning. 	<ul style="list-style-type: none"> • Modeled using multichannel measurements from geostationary satellites • Allows ability to estimate the amount of solar and wind energy that has been historically available at a given time and location <ul style="list-style-type: none"> – High temporal fidelity produces significantly increased degree of accuracy.

Text drawn from: Renewable Energy Data, Analysis, and Decisions: A Guide for Practitioners. <https://www.nrel.gov/docs/fy18osti/68913.pdf>.

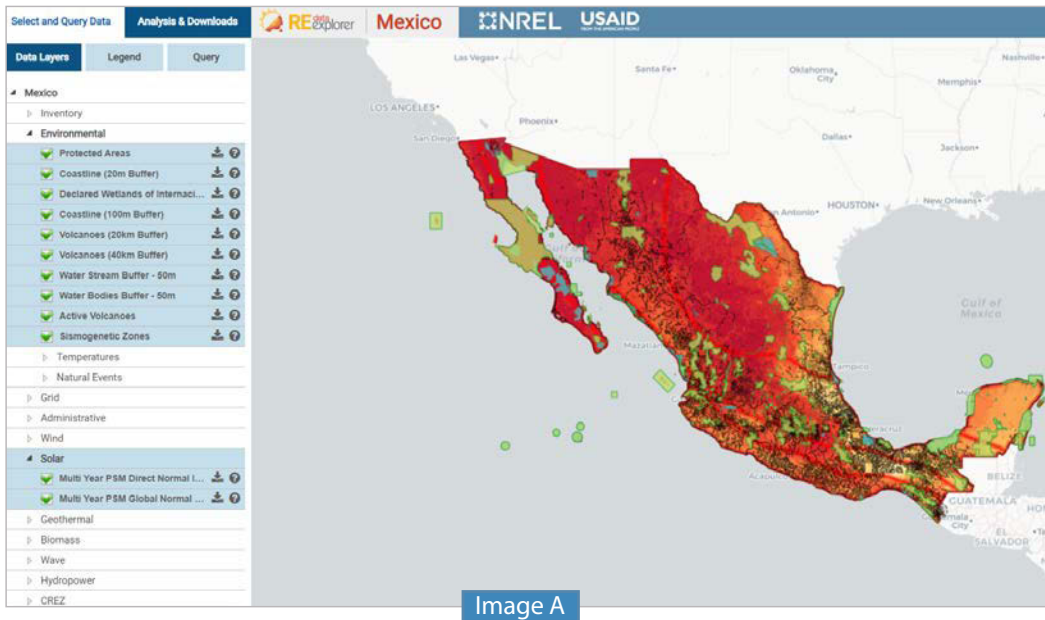


Figure 2. Visualization of solar resource and land use data layers and technical potential assessment for Mexico in RE Data Explorer.

Image A shows specific RE Data Explorer data layers for Mexico, including solar direct and global normal irradiance as well as land use layers presented in the layer tree on the left.

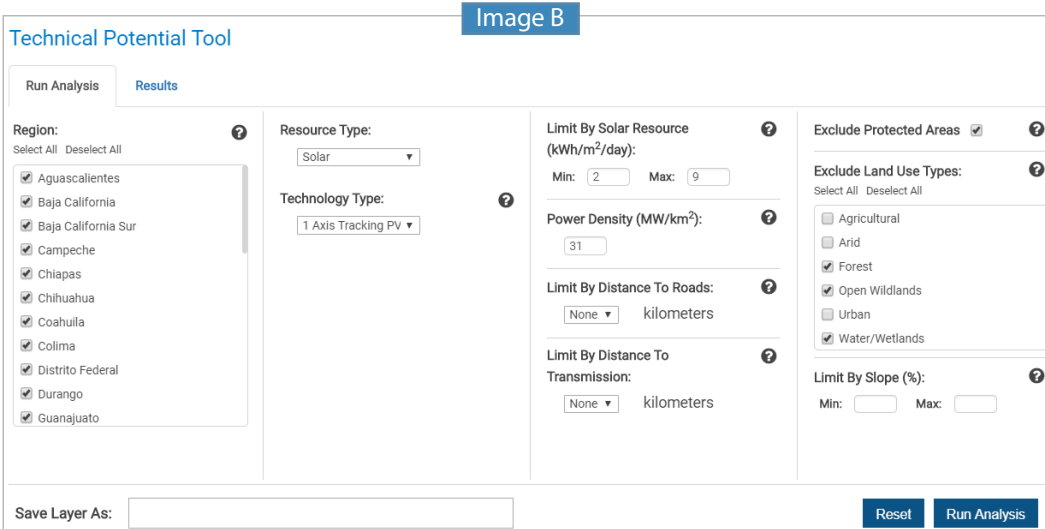
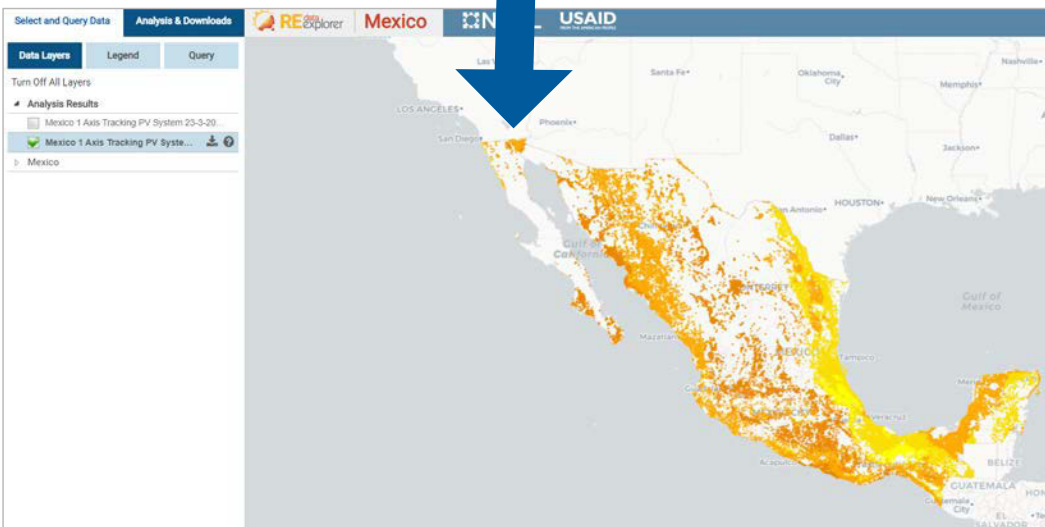


Image B presents the technical potential tool in RE Data Explorer and user input areas that can be tailored and modified for specific scenarios, as well as the visualization that is produced as an output of the technical potential analysis.



Based on a prospecting assessment, project developers can identify sites for pre-feasibility analysis, covered in the next section. Boxes 3 and 4 provide real-world examples of the use of RE Data Explorer to inform solar project prospecting in Mexico.

Pre-Feasibility Analysis

Pre-feasibility analysis can begin with visits to potential sites identified in the prospecting stage. In addition, developers can begin to research permitting requirements related to wildlife, sound, environmental impact, and other factors—these factors are closely linked to the context of the site and may vary widely. During site visits, meetings can be held with landowners and permitting representatives to learn more about potential drivers and barriers to development. At this stage, assuming site visit and preliminary permitting discussions are positive, a developer will usually lease a parcel or two of land and permit and erect meteorological towers to not only validate the strength of the wind resource (see Box 2) but also to begin the necessary data collection step required for financing. Additional met towers may also be added incrementally, over time. RE Explorer provides a repository for both modeled and measured RE data to help project developers compare and validate data. Box 5 highlights Bangladesh's wind meteorological data initiative to support private sector investment. In this stage project developers may also submit interconnection applications for grid integration and begin permitting processes.

An important element of this stage is the use of preliminary pricing tools to estimate how well the project might compete with current energy costs. To support this analysis, time series solar and/or wind resource data can be downloaded from the RE Data Explorer and used as an input to tools such as Open Wind, the System Advisor Model, or the *Clean Power Asia's Financial Model for Utility-scale Solar in Southeast Asia*¹, coupled with technology assumptions and preliminary cost data (e.g., from previous construction projects).

Box 3. Solar irradiance data informs project development in Mexico

A U.S.-based developer, Energy Development Partners, is using the RE Data Explorer and underlying solar irradiance data for Mexico to inform early stage prospecting and preliminary feasibility analyses for solar project sites throughout Mexico. RE Data Explorer was chosen to support this process due to its usability, high quality data, and ability to integrate data with other tools such as the System Advisor Model (SAM).

The Energy Development Partners team used the tool and data layers to visualize sites with high solar potential in an early prospecting stage, and then fed the weather and irradiance data from the RE Data Explorer into SAM to calculate performance indexes and capacity factors at different sites. With early prospecting analysis supported by the RE Data Explorer, over 100 megawatts of projects identified as viable or bankable are in the pipeline to be built in Mexico by Energy Development Partners.

Box 3 provides an example of RE Data Explorer solar time series data used for this purpose.

Finally, in this stage, developers can also undertake geotechnical studies to assess factors such as soil bearing capacity. The geotechnical study and other assessments may also feed into a preliminary layout for the project.

Each assessment in this stage can feed into “Go/No-Go” decisions based on the outcomes and anticipated feasibility of the project. At this point, the developer may also be reviewing specifications and guidance included in a Request for Proposals (RFP), which can also inform the decision to proceed based on these earlier stage assessments. If a “Go” decision is made, a preliminary proposal may be developed for an RFP and/or utility negotiation.

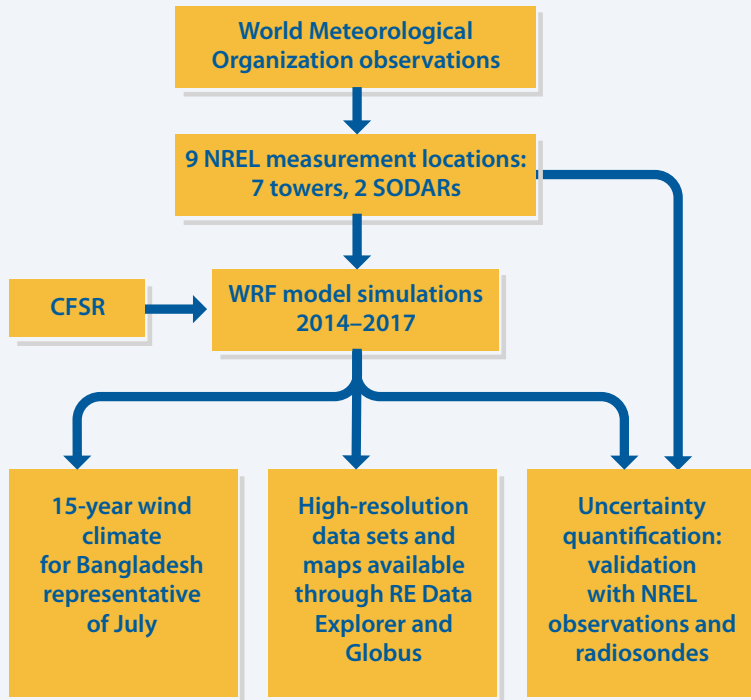
Box 4. RE Data Explorer as a training tool for project developers

The Centro de Capacitación Eléctrica y Energías Alternas (CCEEA) is a training center located in Mexico that provides courses for working energy sector professionals across Latin America to increase their skills and knowledge related to RE technologies. CCEEA has deeply integrated the RE Data Explorer into its PV training curriculum to help students identify and understand weather condition variables critical for PV system sizing. CCEEA's students go on to apply these skills to develop PV projects in the private sector. CCEEA has produced thousands of alumni to date and drives hundreds of monthly users to the RE Data Explorer tool.

¹ Clean Power Asia has also developed a Financial Model for Wind Farms in Southeast Asia, available here: <http://usaidcleanpowerasia.aseanenergy.org/resource/financial-model-for-wind-farms-in-southeast-asia/>.

Box 5. Bangladesh's Wind Meteorological Data Initiative

With funding from USAID and in partnership with the Government of Bangladesh, NREL led an assessment with in-country partners to quantify the wind resources in Bangladesh. Beginning in 2011, the Bangladesh Wind Resource Mapping Project included collecting multiyear wind measurements and validating a wind modeling effort for high-quality nationwide wind estimation at various hub heights. An overview of the approach is presented below.



Transporting the SODAR instrument used for collecting wind resource data via ox cart through a field to its platform near Rajshahi, Bangladesh. *Photo by Harness Energy.*

Data developed under the initiative supported:

- Assessment of Bangladesh wind resources
- Expedite prospecting by developers
- Wind energy development
- Grid integration studies
- Decision support for stakeholders
 - Private developers
 - Investors
 - Transmission planners
 - Policymakers
- Government agencies/advocacy groups

Acronyms

SODAR – SOund Detection and Ranging
 CFSR: Climate Forecast System Reanalysis
 WRF: Weather Research and Forecasting Model

Source: *Assessing the Wind Energy Potential in Bangladesh Enabling Wind Energy Development with Data Products.* <https://www.nrel.gov/docs/fy18osti/71077.pdf>.

Feasibility Analysis and Permitting

In the full feasibility analysis and permitting stage, developers are preparing detailed documentation and undertaking administrative processes to inform full project proposals and/or bilateral negotiations (e.g., with utilities for power purchase agreements). This may begin with a more detailed resource assessment informed by further installation of met towers for improved data collection and

analysis. In parallel, state, local, and national permitting processes will be underway and completed. All land acquisition activities will also be completed in this stage, including landowner discussions to support permitting and to finalize project layout, legal title activities, and legal review of leases. At this stage, town hall meetings usually begin to educate and inform communities on renewable power, associated impacts, and other considerations.

In this stage, the engineering and technical details of the project are also finalized including turbine layout iteration and optimization for maximum energy production. At this time proposals are received for civil and electrical engineering and construction. The details within these technical proposals will feed into more specific and finalized full pricing analyses to inform project costs to be put forward in the proposal or to inform negotiations. Financing partnerships are also finalized, and documents are prepared



Judith Gap Wind Energy Center, Judith Gap, Montana 135 MW, 90 GE 1.5 MW SLE turbines *Photo Credit: Mark Jacobson*

for development, construction, and operational loans. Finally, any additional interconnection and transmission studies required for the project are completed to inform the project proposal.

While the RE Data Explorer is not designed to support a full feasibility analysis, the previous stages and use of the RE Data Explorer can be highly beneficial in setting the stage for a robust feasibility assessment.

Submit Proposal and Develop Power Purchase Agreements

All of the analyses above will feed into a final proposal and/or bilateral contract negotiations with utilities or other stakeholders. In some cases, this will result in power purchase agreements or other contracts for grid integration. In other cases, the process will provide a valuable

learning experience and preliminary inputs (e.g., construction cost data) for project development in other locations.

In all cases, the RE Data Explorer and best-in-class, reputable data can support making the case for the bankability of projects, critical for this final stage.

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www.re-explorer.org | www.nrel.gov/usaaid-partnership

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This work was authored, in part, by the National Renewable Energy Laboratory (NREL), operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the United States Agency for International Development (USAID) under Contract No. IAG-17-2050. The views expressed in this report do not necessarily represent the views of the DOE or the U.S. Government, or any agency thereof, including USAID.

NREL/TP-6A20-76573 | May 2020
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Renewable Energy (RE) Explorer provides renewable energy data, geospatial analysis tools, and technical assistance to support data-driven renewable energy decision making. The RE Explorer was developed by the National Renewable Energy Laboratory and are supported by the U.S. Agency for International Development.

The USAID-NREL Partnership addresses critical challenges to scaling up advanced energy systems through global tools and technical assistance, including the Renewable Energy Data Explorer, Greening the Grid, the International Jobs and Economic Development Impacts tool, and the Resilient Energy Platform. More information can be found at: www.nrel.gov/usaaid-partnership.

