

High-Fidelity Solar Irradiance Data

Simple Access to State-of-the-Art Information Accelerates Southeast Asia's Clean Energy Economic Transformation

Democratizing Critical Data

Leaders and innovators around the world are working diligently to develop actionable, evidence-based pathways that accelerate economy-wide decarbonization. To support this, advanced energy technologies are being deployed at an unprecedented scale and are expanding global access to clean energy. Renewable energy resource data sets are foundational to climate-smart decision making, evidence-based policy planning, and clean energy investment mobilization. Democratizing data—making digital information accessible to technical and nontechnical users alike—is essential to

this mobilization. Providing public access to high-fidelity renewable resource data at decision-relevant timescales supports strategic renewable energy investments and can accelerate clean energy transitions at scale.

As a dynamic and fast-growing region, Southeast Asia is emerging as a key player striving to accelerate low-carbon development. The U.S. Agency for International Development (USAID) and the National Renewable Energy Laboratory (NREL) are supporting Southeast Asian nations through the [Advanced Energy Partnership for Asia](#)—a collaboration between USAID and the U.S. Department

of Energy's national laboratories—to accelerate renewable energy integration and increase access to clean, affordable, and reliable energy. In its first year, the Advanced Energy Partnership for Asia developed high spatial and temporal resolution solar resource data for the Southeast Asia region.

USAID and NREL are enabling public access to these critical solar resource data sets through the [Renewable Energy \(RE\) Data Explorer](#). RE Data Explorer is a centralized platform that democratizes critical data and empowers decision makers and energy sector users at all levels to participate in and drive clean energy transitions. Policymakers, technical planners, project developers, and investors can leverage this solar irradiance data to support solar energy market expansion and inform prospecting, target setting, renewable energy auctions, and other high-impact decisions to accelerate renewable energy deployment throughout Southeast Asia, as shown in Figure 1.

Box 1. High-Fidelity Solar Resource Data for Southeast Asia

NREL collaborated with the U.S. National Oceanic and Atmospheric Administration and the University of Wisconsin to develop high spatial and temporal resolution solar resource data for the entire Southeast Asia region, based on high-resolution cloud properties derived from imagery provided by the Japanese Meteorological Agency's Himawari weather satellite. For more information about the development of this data, visit: [Development and Validation of Southeast Asia Solar Resource Data](#).

Himawari satellite data enables enhanced spatiotemporal resolution and accuracy over ground-based renewable energy resource data sets.

- 2x2-kilometer (km) spatial resolution at 10-minute time intervals
- Aerial coverage of 33 countries
- 8.6 million data points at 2-km spatial resolution
- 350,000+ time steps across 10 years
- 26 million+ square km of land area covered
- 2,000+ user downloads in the first year

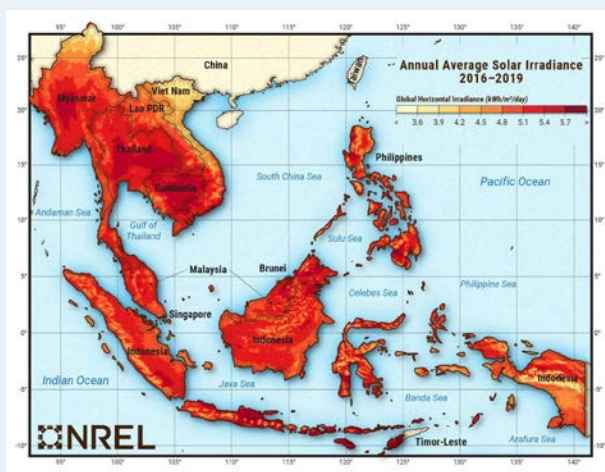


Illustration by Billy Roberts, NREL

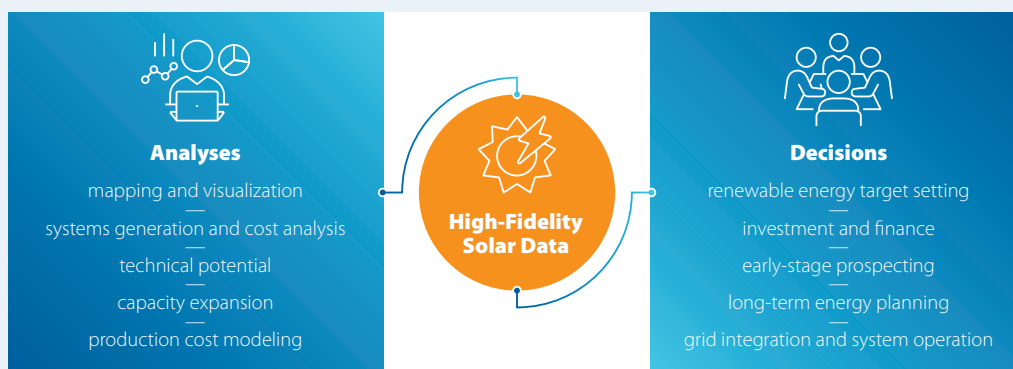


Figure 1. High-quality, reliable data are at the core of critical decisions to enable energy transitions. *Image by Christopher Schwing, NREL*


Box 2. RE Data Explorer Informs High-Impact Decisions

RE Data Explorer is a user-friendly geospatial web-based application and high-quality data repository to support renewable energy analysis and inform high-impact decisions around the globe. Developed by NREL and supported by USAID, RE Data Explorer performs customizable visualization and analysis of renewable energy potential for different scenarios and allows users to download global data to feed into other key analyses. Here are some of the many unique qualities that set RE Data Explorer apart as an unparalleled tool to support renewable energy development throughout Southeast Asia and around the world:

- Provides **best-in-class data from around the world**, including time series data for certain countries, extensive administrative layers, and data sets from key partners such as the Danish Technical University, Energy Sector Management Assistance Program, Japanese Meteorological Agency, World Bank, and World Resources Institute.
- Offers **intuitive and user-driven analysis capabilities** to inform renewable energy high-impact development and deployment decisions, including prospecting, integrated planning, and policymaking.
- Contains a **breadth of renewable energy resources and technologies** available for analysis, including solar and wind and, for certain countries, geothermal, biomass, and ocean wave.
- Integration with many **complementary tools and models**, such as the System Advisor Model (SAM).
- Creates **links between data, analysis, and decisions** through curated knowledge products, training resources, and an “Ask an Expert” service to provide **customized support**.
- Offers the flexibility of adding **functionalities and analysis capabilities** to respond to the changing needs of countries.
- Provides the opportunity to work with the RE Data Explorer team to **add localized data**.

On-the-Ground Impact

The following examples highlight how policymakers, project implementers, and academic researchers are leveraging the RE Data Explorer solar resource data developed for Southeast Asia to directly inform renewable energy planning, investment, and deployment decisions across the region.

 **Enabling Grid-Scale Renewable Energy Integration:** Supporting long-term power system planning and renewable energy transformation in Vietnam.

Vietnam set a national goal to achieve 27% solar and wind capacity by 2030 and 42% by 2045. To reach this goal, the Ministry of Industry and Trade anticipates that Vietnam will install 19–20 Gigawatts

(GW) of solar capacity and 18–19 GW of wind capacity by 2030. NREL worked in partnership with USAID’s Vietnam Low-Emissions Energy Program (V-LEEP) and the Hawaii Natural Energy Institute to support variable renewable energy (VRE) integration and power sector planning in Vietnam through 2050.

Several years of high-quality renewable resource data are a critical input to power sector planning and operational models in high-VRE grids. In Vietnam, the high-resolution solar irradiance data hosted in RE Data Explorer were used to build representative regional and provincial solar generation profiles that, along with wind generation data, fed into capacity expansion planning and production cost models. These technical analyses enable power system planners and operators, regulators, policymakers, and renewable

energy developers in Vietnam to anticipate probable development sites, identify the type and size of solar and wind generation capacity needed to meet renewable energy targets at least cost, and understand the operational impacts and costs of renewable energy production on the Vietnamese grid. Taken together, capacity expansion and production cost models, supported by rich renewable energy resource data, enable the advanced grid planning that is needed to accelerate Vietnam’s transition toward a high-VRE future.

For more information about how RE Data Explorer solar and wind resource data were used to support power sector planning in Vietnam, visit: [Development of Renewable Energy Data for Facilitating the Clean Energy Transition in Vietnam](#).



Expanding Energy Access:

Accelerating distributed photovoltaic (DPV) deployment in remote communities.

Technology startup *Okra Solar* leverages RE Data Explorer’s high-resolution solar irradiance data to optimize solar microgrid design and accelerate DPV deployment in remote communities around the world. Okra Solar partners with local utilities and renewable energy developers to provide clean, affordable, and reliable electricity access to off-grid communities through innovative “mesh-grid” technology and smart distribution system controls. Since its founding in 2016, Okra Solar’s team of engineers and software developers has installed 160 kW of DPV in 30 microgrid communities, reaching approximately 700 households in Cambodia, the Philippines, Indonesia, Haiti, Rwanda, and Nigeria. Okra Solar uses solar irradiance data provided by RE Data Explorer, in conjunction with NREL’s SAM, to perform preliminary techno-economic analysis and optimize standalone solar home system design and integrated microgrid configuration. High-resolution solar irradiance data allow Okra Solar and local renewable energy developers to compare cost-savings metrics generated by mesh-grid technology applications over traditional microgrid system designs.

Flexible and publicly available renewable energy resource data are enabling innovative end-users like Okra Solar to transform energy system design, accelerate

“We have helped provide 24/7 100% renewable electricity access to more than 3,000 people. RE Data Explorer, in conjunction with the System Advisor Model, has been very helpful with solar insolation modeling for our unique technology.”

*Oscar Aitchison,
Okra Solar*



Okra Solar uses RE Data Explorer’s solar irradiance data for Southeast Asia to optimize solar microgrid design in rural Cambodia. *Image courtesy of Okra Solar.*

smart investment decisions in renewable energy, and achieve their mission to expand global access to clean, affordable, and reliable electricity.



Training the Next Generation of Energy Experts in Southeast Asia:

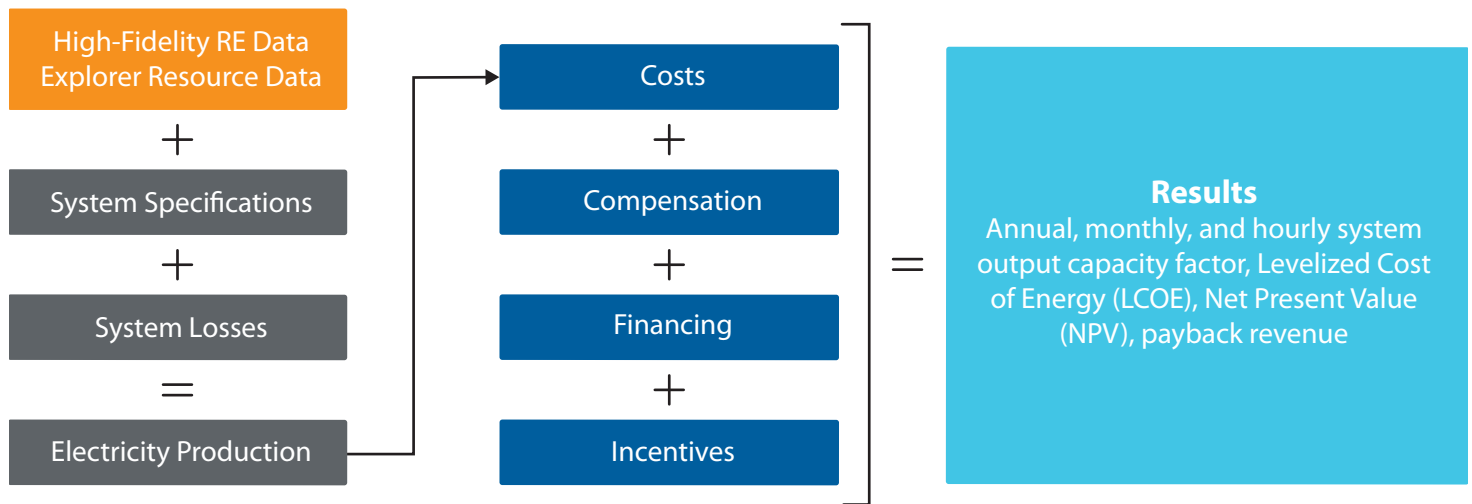
Creating opportunities for applied student learning and academic research.

An undergraduate astronomy student at the Bandung Institute of Technology, Rachel Delvin, used the publicly available RE Data Explorer solar resource data to enhance her thesis research in 2020. Using machine learning techniques, she trained recurrent neural network models to predict solar irradiance for two Indonesian provinces—Jakarta and East Nusa Tenggara. Delvin initially planned to use data provided by public agencies in Indonesia to complete her research but opted to use the RE Data Explorer satellite data after identifying numerous anomalies in other ground-based meteorological data sets. Now a university graduate, Delvin plans to publish her findings and make her machine learning model publicly available on GitHub, an open-source code-hosting platform, to help support renewable energy projects and expand electricity access in Indonesia.

“I believe in a future where the knowledge, information, and data that can help us live more sustainably are made easily accessible to anyone and provided in an open-source format.”

*Rachel Delvin,
Bandung Institute of Technology*

RE Data Explorer is also supporting graduate-level research. A master’s degree student in chemical engineering at Xiamen University in Malaysia, Wong Weng Pin, is using RE Data Explorer’s Southeast Asia solar data and NREL’s SAM to research differential thermal energy storage material performance in concentrating solar power parabolic trough systems for his graduate thesis. Accessibility and streamlined integration between RE Data Explorer data and techno-economic modeling in SAM allowed Weng Pin to easily analyze and optimize for multiple performance metrics in thermal material selection.



NREL's System Advisor Model is a free techno-economic assessment tool that couples high-quality renewable energy resource data provided by RE Data Explorer with relevant economic inputs to model renewable energy system output and cost parameters. Learn more about using these tools together in a webinar hosted through the Asia EDGE Power System Learning Series: [RE Data Explorer Next Steps: Project Economics Using the System Advisor Model](#).

Looking Toward the Future: Scaling Impact

Southeast Asia has ambitious decarbonization goals, including a long-term goal by the Association of Southeast Asian Nations, to collectively achieve net-zero emissions in the latter half of the 21st century. To achieve this critical objective, Southeast Asia's energy sector requires high-quality, publicly available wind resource data to support power system modeling, renewable energy target-setting, integrated PV-wind planning, and prefeasibility assessments to support

regionwide net-zero transitions. USAID and NREL's Advanced Energy Partnership for Asia has developed a novel approach to accurately model wind resources across the Southeast Asia region that combines cutting-edge techniques in numerical weather prediction and machine learning. Expanding access to this high-fidelity spatiotemporal wind resource data is needed to scale renewable energy integration and accelerate Southeast Asia's transition toward a net-zero future. These data will be freely available to the public in mid-2023.

Get Started!

- Access the publicly available, high-resolution solar resource data for Southeast Asia on [RE Data Explorer](#).
- Explore resources and training about how to find, analyze, and use renewable energy data on the RE Data Explorer [Resources and Training page](#).
- Submit questions about RE Data Explorer or the solar irradiance data set developed for Southeast Asia: USAID.NREL@nrel.gov.

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www.re-explorer.org | www.nrel.gov/usa-id-partnership

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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 is supported by the U.S. Agency for International Development.

The USAID-NREL Advanced Energy Partnership for Asia helps partner countries address the technical challenges of transitioning to sustainable, secure, and market-driven energy sectors across Asia. More information can be found at: www.nrel.gov/usa-id-partnership.

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