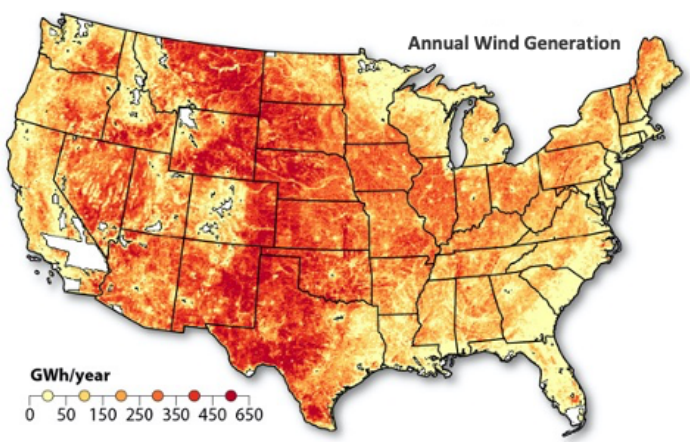
The Renewable Energy Potential (reV) Model: A Framework for Analyzing Geospatial Energy Data

The Renewable Energy Potential (reV) model is a platform for detailed assessment of renewable energy resources and their geospatial intersection with grid infrastructure and land use characteristics. The reV model currently supports photovoltaic (PV), concentrating solar power (CSP), and land-based and offshore wind generation technologies. Modules in the reV framework function at different spatial and temporal resolutions, allowing for assessment of resource potential, technical potential and supply curves at varying levels of detail.

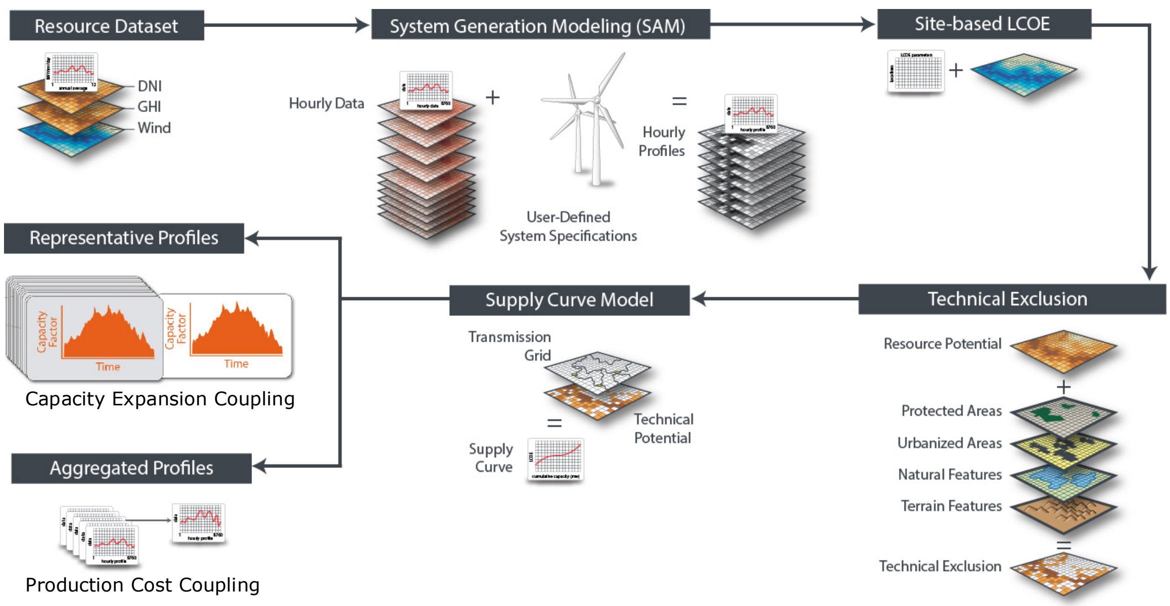
The platform runs on NREL's high performance computing (HPC) system and the AWS cloud, providing scalable and efficient performance from a single location all the way up to continental scales, for a single year or decades of time series resource data. Coupled with NREL's System Advisor Model (SAM), reV supports resource assessment from 5-minute to hourly temporal resolution and provides for analysis of long-term (i.e., year-on-year) variability of renewable energy generation. Technical potential is measured as a function of resource potential and limitations put on developable land area defined by the user. For example, the user can limit development by land ownership, terrain, land use/cover, and urban areas, as well as custom inputs. Technology, grid interconnection, and operation costs, based on the latest market data and future projections, are also embedded in the model. The supply curve module is a spatial sorting algorithm based on plant siting, distance to transmission infrastructure, and regional competition, which provides a geographically discrete estimate of levelized cost of energy (LCOE) and available capacity for specific renewable technologies.



Example of national scale estimate of annual wind generation potential for the U.S.

The development of the reV model has advanced the level of fidelity and complexity in national- and continental-scale modeling of wind and solar energy potential. The geospatial modeling platform has enabled researchers to dynamically examine renewable energy production and cost improvements, with high spatial and temporal fidelity, by modifying system and financial parameters, spatial exclusions, and transmission costs. Processing times for producing national renewable energy supply curves and assessments of technology performance impacts have also been dramatically reduced. While substantially improving our ability to understand how technological innovations and cost reductions could make renewable energy technologies more competitive and open new markets, the reV model has also illuminated new research directions to improve our underlying assumptions and increase the fidelity of broad- scale supply curve modeling.

The reV model automates the entire supply curve modeling pipeline as well as downstream model coupling, and thus facilitates reproducibility of studies and enables sensitivity analyses of model assumptions. Once the initial effort of preparing the input data is completed for a new geographic extent, multiple model runs based on different assumptions are as simple as updating a configuration file and rerunning the model. The model leverages distributed and parallel computing to efficiently process tens of terabytes of wind or solar resource data in a matter of minutes. The reV model currently provides broad coverage across North America and a growing number of countries across the globe to inform national and international scale analyses as well as regional infrastructure and deployment planning. Potential and intended users of the reV model outputs include utility planners, regional and national agencies, project and land developers, energy modelers, and researchers.



The principal modules of reV and model coupling to provide direct support for capacity expansion (e.g., ReEDS) and production cost modeling (e.g., PLEXOS).