# Report firms up land-use requirements of solar: 1,000 homes would require 32 acres

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The Energy Department's National Renewable Energy Laboratory (NREL) has published a report on the land use requirements of solar power plants based on actual land-use practices from existing solar facilities.

"Having real data from a majority of the solar plants in the United States will help people make proper comparisons and informed decisions," lead author Sean Ong said. The report, "Land-use Requirements for Solar Power Plants in the United States,"PDF was written with NREL colleagues Clinton Campbell, Robert Margolis, Paul Denholm and Garvin Heath.

Ong gathered data from 72% of the solar power plants installed or under construction in the United States. Among the findings:

- A large fixed tilt photovoltaic (PV) plant that generates 1 gigawatt-hour per year requires, on average, 2.8 acres for the solar panels. This means that a solar power plant that provides all of the electricity for 1,000 homes would require 32 acres of land.
- Small single-axis PV systems require on average 2.9 acres per annual gigawatt-hour – or 3.8 acres when considering all unused area that falls inside the project boundary.
- Concentrating solar power plants require on average 2.7 acres for solar collectors and other equipment per annual gigawatt-hour; 3.5 acres for all land enclosed within the project boundary.

By the third quarter of 2012, the United States had deployed more than 2.1 gigawatts of utility-scale solar generation capacity. Another 4.6 gigawatts was under construction. There has been a long-running debate over the comparative land needs for various forms of energy, old and new. But that's not the purpose of the new report, Ong and Denholm emphasized.

"The numbers aren't good news or bad news," Denholm said. "It's just that there was not an understanding of actual land-use requirements before this work. However, we were happy to find out that many of the solar land use ranges and estimates used in the literature are very close to actual solar land use requirements that we found."

These land-use estimates can also be compared with other energy-production land uses. For example, a study by Vasilis Fthenakis and Hung Chul Kim of Columbia University (2009) found that, on a life-cycle electricity-output basis—including direct and indirect land transformation—utility-scale PV in the U.S. Southwest requires less land than the average U.S. power plant using surface-mined coal.

A previous NREL report, "Land-use Requirements and the Per-capita Solar Footprint for Photovoltaic Generation in the United States," had estimated that if solar energy was to meet 100% of all electricity demand in the United States, it would take up 0.6% of the total area in the United States.

This time, the data come not from estimates or

calculations, but from compiling land use numbers from actual solar power plants. Every solar energy site analyzed in the study is listed in a detailed appendix.

"All these land use numbers are being thrown around, but there has been nothing concrete," Ong said. "Now people will actually have numbers to cite when they conduct analyses and publish reports."

NREL previously had released a report on land-use needs for wind power. Doing the same other generation resources including coal, natural gas and nuclear—estimating land use via huge sample sizes—would help inform decisions, Denholm said.

The report provides fundamental data that can be used to understand the impacts and benefits of solar. "Modelers and analysts, people looking 10 or 20 years into the future can use this report to evaluate the impacts solar energy may have," Denholm said.

**More information:**
www.nrel.gov/docs/fy13osti/56290.pdf

Provided by National Renewable Energy Laboratory