NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Fast Facts

- DOE's SunShot Incubator program provides early-stage assistance to help start-up companies cross technological barriers to commercialization while encouraging private sector investment.
- As part of the SunShot Incubator program, Aurora leverages its software to calculate roof dimensions and slope for evaluations of solar potential.
- Aurora and NREL conducted a blind study to determine the accuracy of Aurora's remote measurement tools. Aurora's results were found to be within their stated accuracy bounds 98% of the time, with only 1 slope out of 60 total measurements exceeding the 1.5-feet or 5-degree threshold.

Validation of Aurora Solar's Remote Measurement Capabilities

As part of the U.S. Department of Energy (DOE) SunShot Incubator program, Aurora Solar has developed a web-based application that quickly and precisely calculates the solar potential of a roof. The results of this application will increase the ability of solar firms to accurately assess large numbers of potential solar installation sites and increase closing rates. As discussed in a fact sheet on the "Evaluation of the Aurora Application Shade Measurement Accuracy,"[1] the National Renewable Energy Laboratory (NREL) evaluated the accuracy of Aurora Solar's remote shading analysis. The resulting heat map that visualizes the irradiance and solar access values for any point of a roof based on Light Detection and Ranging (LIDAR) data, which is not universally available throughout the United States.

To further expand the geographic reach of their offering, Aurora Solar developed advanced measurement tools that utilizes Google Street View as a basis for remotely measuring roof slope, roof edge lengths, and other distances. These measurements are the inputs into a three-dimensional model, which is used to calculate the aforementioned irradiance and solar access values.

In this report, NREL summarizes the evaluated accuracy of Aurora's edge and slope measurements. Aurora's stated threshold is 1.5 feet for edge lengths and 5 degrees for slope measurements.

Verification of Remote Shading Accuracy

NREL, in partnership with Aurora and supported by DOE's SunShot Incubator technology-to-market initiative, independently verified the accuracy of Aurora's measurements on 15 unique roofs throughout Denver, Colorado.

Measurements of lengths and slopes were collected from among 15 roofs for a total of 60 measurements. A 200-foot surveyor's tape measure was used to measure all lengths, eliminating any need to calculate lengths as a sum of several shorter tape-measure lengths. A 4-foot digital level was used to evaluate roof slope. Measurements were taken with various roof conditions. The homes that were evaluated had a large range of characteristics: they were of different ages and had varying slopes, varied orientation to the road, and different

[1] *http://www.nrel.gov/docs/fy16osti/65558.pdf*

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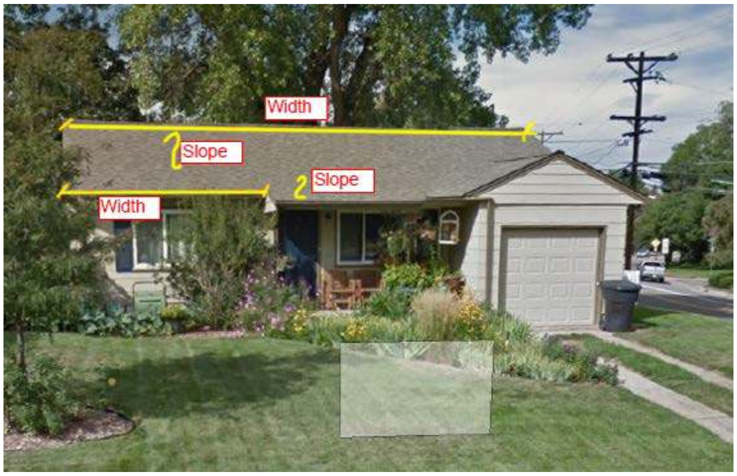

Figure 1: Sample Roof with Collected Measurements

Figure 2: Roof that resulted in inaccurate measurement

types of surrounding vegetation. Aurora's estimated measurements were compared to the measurements taken by NREL staff at each of the physical roof locations.

Table 1 summarizes the differences between Aurora's measurements and those from NREL. In all cases except one, as described below, measurements fell within the stated design parameters.

Process Evaluation & Considerations

Aurora's measurement tools , which utilize Google Street View, may serve to expand the roofs for which Aurora is able to complete a full shading analysis. The purpose of this evaluation is not to determine the overall success of the product, but rather to validate that the measurements calculated by Aurora match reality.

Note that given the use of Google Street View, this approach is limited to houses that were captured by a Google Street View photograph. Households that have chosen to remove their house from visibility, that are located on a private street, or that have not been photographed by Google Street View cannot be evaluated. In addition, in some situations foliage may prevent all necessary measurements from being collected, and the platform cannot capture measurements of roof structures facing away from the street.

For each roof, NREL staff accessed the roof in question and collected the relevant measurements.

Of all measurements collected and compared to Aurora's calculations, only one was noncompliant. The roof in which the maximum slope difference was 7.33 degrees, exceeding the 5-degree stated limit, was built in 1908 and had a measured main roof slope of 36.2 degrees. Aurora's software calculated the roof slope to be 43.53 degrees. The Aurora team evaluated this discrepancy and pinpointed the source of the error as poor site visibility from Google Street View.

Note, however, that this measurement was not the greatest percentage differ- ence in slope measurements. Other roofs had higher percentage differences in slope, but given the lower actual slope, the differences remained within the 5-degree threshold.

	Absolute Value Difference				Absolute Percentage Difference		
	Average	Max	Median	Units	Average	Max	Median
Slope:	1.54	7.33	0.95	degrees	8%	27%	4%
Distance:	0.52	1.50	0.50	feet	4%	22%	2%

Table 1. Evaluated Differences between Aurora's and NREL's On-site Measurements

	Value Count	Compliant	% Compliant
Slope	28	27	96%
Distance:	32	32	100%
	60	59	98%

Table 2. Compliance Evaluation between Aurora's and NREL's On-Site Measurements

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