

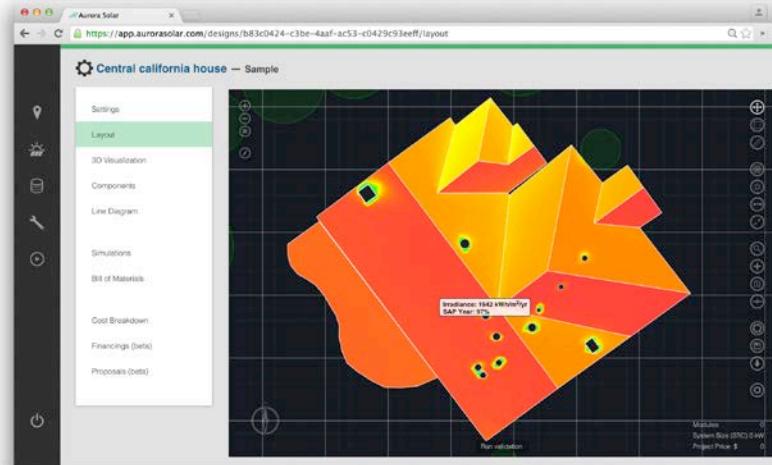


## Fast Facts

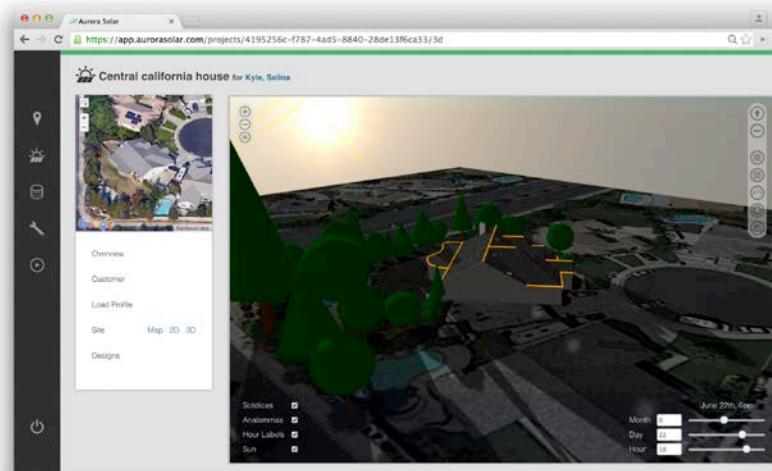
- DOE's SunShot Incubator program provides early-stage assistance to help startup companies cross technological barriers to commercialization while encouraging private-sector investment.
- As part of the Incubator program, Aurora leverages its patent-pending algorithms to produce a high-resolution remote shading analysis for any rooftop, globally.
- Aurora and NREL conducted a blind study to determine the accuracy of Aurora's remote shading algorithms. Aurora's results were found to be equivalent, with tolerance intervals of  $\pm 3.00$  (for locations with LIDAR data) and  $\pm 4.93$  (for locations without LIDAR).

## Evaluation of the Aurora Application Shade Measurement Accuracy

Aurora ([www.aurorasolar.com](http://www.aurorasolar.com)) is an integrated, Web-based application that helps solar installers perform sales, engineering design, and financial analysis. One of Aurora's key features is its high-resolution remote shading analysis, shown in Figure 1. To generate a shading report, solar practitioners use a satellite image in Aurora's interface to define the



**Figure 1.**  
A sample house with a heat map of irradiance and solar access values



**Figure 2.**  
Simulating the sun's path over a 3D model

structure of the building for which they are designing a photovoltaic (PV) system. Aurora then applies a proprietary algorithm alongside user input to construct a 3D model from the 2D building structure, and simulates the sun's path over the resulting 3D model, as shown in Figure 2. The result is a heat map that visualizes the irradiance value and provides solar access values (SAVs) for any point on the building's surface.

Aurora further facilitates the 3D model construction and irradiance/SAV calculations by incorporating LIDAR, Google Street View, and oblique imagery where available; however, these are not required to perform a shading analysis. Because Aurora uses a modeling-based approach, it can calculate irradiance values and SAVs for any location in the world.

## Verification of Remote Shading Accuracy

The National Renewable Energy Laboratory (NREL), in partnership with Aurora and supported by the U.S. Department of Energy's (DOE) SunShot Incubator program, independently verified the accuracy of Aurora's remote shading solar access percentage values on an annual basis for locations in Los Angeles, California, and in Denver, Colorado.

Estimates of annual SAVs were calculated using the Aurora application at 40 roof locations across four houses in the Los Angeles metro area, and at 41 roof locations across four houses in the Denver

**Table 1. Analysis of Annual Solar Access Value Estimates from Aurora Solar**

SAV Equivalence Interval	Los Angeles	Denver
+3	No	Yes
+5	Yes	Yes
±10	Yes	Yes

metro area. In total, 81 roof locations were assessed on houses with varying slopes, rooftop obstructions, surrounding trees, and other factors that affect rooftop SAVs. Aurora's estimated SAVs were compared with the averaged readings taken from two Solmetric SunEye devices at the physical roof locations.

Table 1 shows the results of the two one-sided statistical test (TOST) used to evaluate the differences in Aurora's readings and the SunEye readings. Readings between Aurora and the SunEye devices are considered to be statistically equivalent if the confidence intervals of their mean differences fall within a given interval.

Aurora used LIDAR data for the Denver locations, but did not have LIDAR for the Los Angeles metro area. The results of the analysis show that annual SAV measurements calculated by Aurora were statistically equivalent within ±5 SAVs

to those of on-site measurements made with SunEye devices in Los Angeles and Denver. At the Denver locations where LIDAR was available, Aurora's results were statistically equivalent within ±3 SAVs of SunEye's on-site measurements.

## Soft Costs Savings Potential

Aurora is an integrated platform that enables solar installers to perform detailed shading analysis, conduct sophisticated PV system design, and produce a sales proposal in less than 15 minutes. Aurora also generates engineering documents such as layout diagrams and single line drawings, saving solar installers time and money, and thus reducing soft costs for the industry.

The cost of analyzing site data and conducting an on-site assessment before a quote is given is estimated to constitute 55% of the customer acquisition and engineering design costs for residential solar PV installations.<sup>1</sup> Accordingly, NREL estimates that bid preparation software tied with integrated shading analysis can save \$0.17/W on a 5-kW system.<sup>2</sup> Although NREL has not independently certified Aurora's soft-cost savings, the estimated savings of this type of software application deployed at market scale is generally understood to reduce soft costs to a similar degree.

<sup>1</sup> Estimated soft costs: customer acquisition and engineering design, \$0.57/W; site visits, including system design, \$0.08/W, and permitting, inspection, and interconnection (PII) labor, \$0.10/W; sales, \$0.16/W. Sources: Litvak, Nicole, and Kann, Shayle. 2013. U.S. Residential Solar PV Customer Acquisition. Greentech Media, [greentechmedia.com/research/report/us-residential-solar-pv-customer-acquisition](http://greentechmedia.com/research/report/us-residential-solar-pv-customer-acquisition). U.S. DOE SunShot Incubator FOA. Table 1. [ere-exchange.energy.gov/FileContent.aspx?FileID=dd1a0f0e-d53b-45b7-914f-6853613f151e](http://ere-exchange.energy.gov/FileContent.aspx?FileID=dd1a0f0e-d53b-45b7-914f-6853613f151e).

<sup>2</sup> Ardan et al. 2013. Non-Hardware ("Soft") Cost-Reduction Roadmap for Residential and Small Commercial Solar Photovoltaics, 2013-2020. NREL/TP-7A40-59155. National Renewable Energy Laboratory, Golden, CO. [nrel.gov/docs/fy13osti/59155.pdf](http://nrel.gov/docs/fy13osti/59155.pdf).