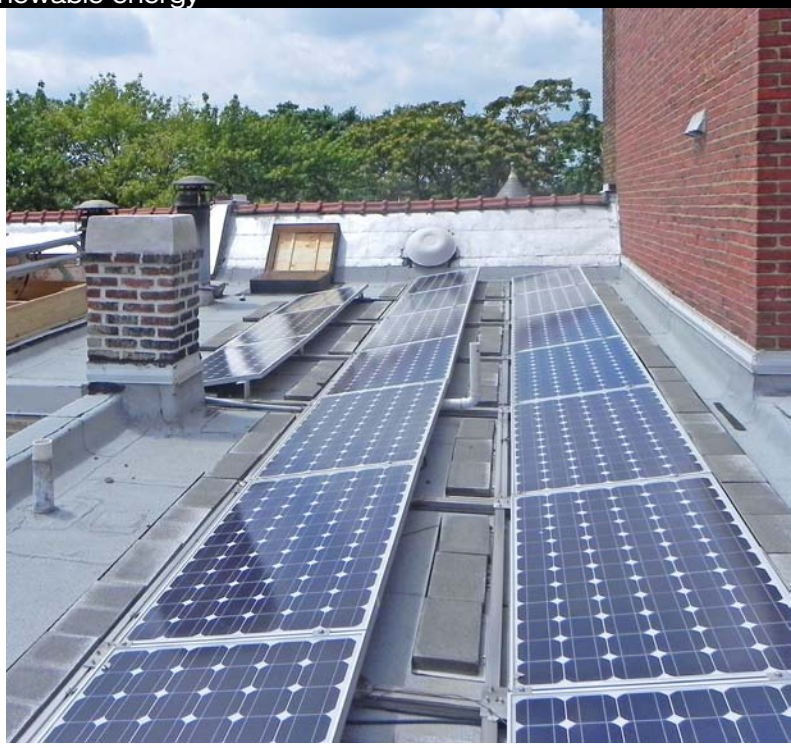
PV Challenges
in the Nation's Capitol



Courtesy Andy Kerr (3)

Urban solar installations often come with their siting challenges, as did this Capitol Hill townhouse in Washington, DC. First, its historic district designation meant that the array could not be visible from across the street. Second, the townhouse's age (86 years) meant that a lot more weight on the roof could cause more problems. With only 742 square feet of roof space—plus a chimney and plumbing vent penetrating the roof—the solar access was extremely limited, and some of that space would be needed for a future SHW system. A neighbor's tree also caused morning shading on the eastern roof. Finally, a rubber membrane roof meant no roof penetrations.

Ironically, the best solution for each issue yielded poor solutions for the other issues. Creative compromise was needed to find an optimal solution.

To hide the array from view, it would need to be low profile. That was good, since an array with a steeper tilt would mean more wind loading, necessitating heavier ballast to keep the array firmly in place without roof penetrations. A low tilt would be subject to less wind loading, and require less ballast, thus minimizing additional weight on the roof.

A couple of 90° elbows and two short pieces of plastic vent pipe were used to reroute the vent. If the design choice had been parallel-to-roof modules, placed end-to-end and side-to-side, the only option would have been to leave out a module to accommodate the vent.

The goal was to offset as much of my electricity use as possible. While the greatest number of modules could be fit on the roof in a parallel-to-roof array, its energy production would have be 86% of the maximum attainable with an array at an "optimal" tilt (33°). A compromise—tilting the modules at 10°, with three rows of modules carefully placed to avoid shading each other—would yield about 94% of "optimal" production.

Enphase microinverters, which pair one inverter per module, were used to reduce array performance losses due to shading from the chimney and neighboring tree. Shading from the chimney will be resolved by its removal after a direct-vented, high-efficiency gas furnace is installed. Because of chimney shade, two modules are producing less than their neighbors. By using microinverters, only the individual module's performance—not an entire string's output—is affected.

Enphase's Web-based Envoy monitoring system shows early-morning shading (black modules) from the chimney. When the chimney is removed, the shaded modules' production will return to normal.

Overview

Project name: Serrulata

System type: Batteryless grid-tied PV

Installer: Astrum Solar

Date Commissioned: May 1, 2009

Location: Washington, DC

Latitude: 38.89°N

Resource: Solar, 4.7 peak sun-hours

System capacity: 3.0 kW STC

Average annual production: 3,609 kWh

Average annual utility bill offset: 71%

Equipment Specs

Number of modules: 17

PV manufacturer & model: Suntech STP175S-24

Module rating: 175 W STC

Inverters: 17 Enphase Energy M190 microinverters

Inverter rated output: 190 W per inverter

Array installation: Roof

Roofing material: Rubber membrane

Array azimuth: 180°

Tilt: 10°

At the time, the District of Columbia was offering a very enticing rebate of $3 per installed watt. Solar renewable energy credits were also of at the high end of their fluctuating market price, equipment prices had dropped, and installation rates were competitive. Combining these factors with the 30% federal income tax credit, the combination of government and market incentives would result in a simple payback on this PV system of 1.3 years.

Further adding to the overall efficiency is a new furnace that uses less electricity and its new blower, which will make the air-conditioning more efficient. Adding better-insulated, new windows (which will also open easier to facilitate natural cooling) will also reduce electrical loads, allowing the home to get closer to—and maybe achieve—net-zero electrical energy.

—Andy Kerr

More steeply tilted modules would have required more concrete block ballast, putting an unwanted load on the roof.