City of Worcester, Massachusetts

SUSTAINABILITY PROFILE

Harvesting Sun's Energy at North High School

Location: 150 Harrington Way, Worcester North High School

Solar Array's Capacity: 30.2 kW DC

PV System Specifications and Other Interesting Facts:

- ✓ **Maximum rated capacity:** 30.2 kW DC
- ✓ **Owned By:** City of Worcester
- ✓ **Date in service:** 7/12/2011
- ✓ **Number of modules:** 144
- ✓ **PV surface area:** 3,856 SF
- ✓ **Attachment:** Ballasted system, not attached
- ✓ **PV panel rated efficiency:** 8%
- ✓ **Azimuth:** 180°
- ✓ **Inclination:** 0°
- ✓ **Project cost:** $300,000
- ✓ **Funding Source:** Renewable Energy Grant, $300,000
- ✓ **PV panel manufacturer:** Solyndra
- ✓ **Inverter manufacturer :** Solectria
- ✓ **Service Provider**: SouthPoint, LLC

Worcester North High School is home to Worcester Public Schools' first solar array - a 30.2 kW direct current (DC) photovoltaic (PV) system atop the reflective, white PVC Sarnafil roof of its gym. The system was installed when the school was built in 2011, which replaced the old school building constructed in 1972.

The solar installation produces an average of 28,635 kWh per year (see chart below), which translates to about $3,500 in annual utility cost savings. The cost of this installation was covered by a generous $300,000 Renewable Energy Grant from the state.

Operation and Maintenance: WPS's Facilities Department is responsible for the general system maintenance.

Upcoming Solar Project: A second 77 kW DC PV system will be installed at North High, as part of the City's Energy Savings Performance Contract, in the fall of 2015 costing approximately $234,000. It will be ~ 9,900 SF in size and is estimated to produce 81,210 kWh/year. More information will be provided following installation and analysis of initial production data.

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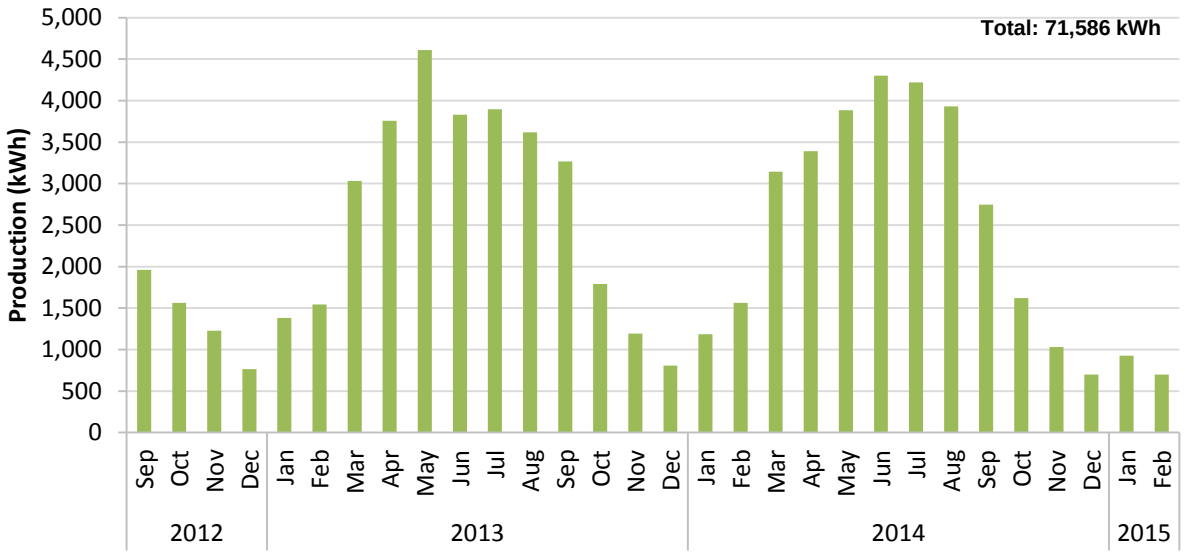
North High's PV system – the first among Worcester Public School - currently produces 1.6% of the school's electricity, a small but still meaningful contribution. Together with the second system, North High's solar arrays are estimated to produce ~6% of its electricity needs.

North High School's PV System: Electricity Production by Month

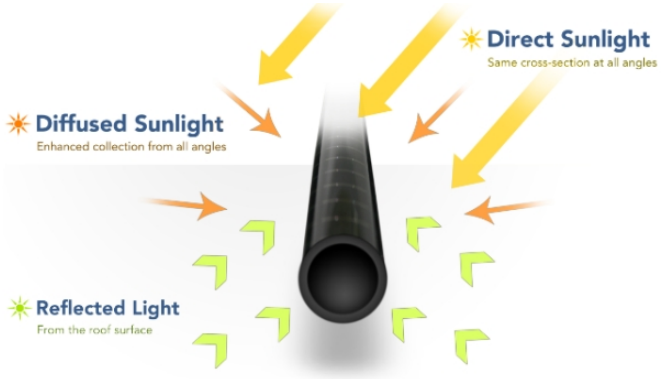


Source: Massachusetts Clean Energy Center's Production Tracking System database

Cylindrical Photovoltaic System and Solyndra. Unlike typical rectangular solar panels, North High's first PV system was made of a series of solar *cylinders*, which are placed about a foot off the surface of the flat roof and spaced several inches apart from each other. Their unique shape allows for direct sunlight collection from all angles (see diagram below). Traditional flat solar panels (except for the ones designed to move with the sun) only produce peak output during a short portion of the day when the sun's rays hit the panels perpendicularly, but the curved surface of cylindrical modules can collect direct sunlight throughout the day as the sun moves across the sky. Even the bottom of the modules can collect light that is reflected off the white-coated surface of the roof.

The modules are lined with a form of non-silicon thin film called CIGS, a semiconductor material composed of copper, indium, gallium, and selenium. Although CIGS and other thin-film solar cells have not yet reached the efficiency of silicon, the material's flexibility and cost gave competitive advantage over silicon at the time of installation.

How Cylindrical Solar Modules Work



Source: EDN Network[1]

[1] Don Scansen, "Solyndra: Its Technology and Why it Failed," *EDN Network*, November 21, 2011, http://www.edn.com/design/power-management/4368710/Solyndra-Its-technology-and-why-it-failed.

North High's PV system was manufactured by a California-based company called Solyndra, which was awarded a $535 million guaranteed loan from the federal government in 2008 but filed for bankruptcy in 2011. The thin-film technology that Solyndra utilized was significantly cheaper than silicon at the time of Solyndra's establishment, and silicon's price was not expected to decrease anytime soon, as predicted by the Department of Energy (DoE). In the next two years, however, solar-grade silicon's price shot down 89%, in large part due to China entering the market, thus affecting Solyndra's competitiveness. Solyndra's complex and expensive manufacturing process also appears to be a major factor in the company's termination.[2,3]

While Solyndra's competitiveness decreased, this was largely because silicon solar technology has become much more affordable, which is a positive change for solar industry as a whole. As *Scientific American* points out, "The falling price of highly refined sand may have doomed Solyndra, but it may also help fulfill the promise of solar power."[4]

[2] David Biello, "How Solyndra's Failure Promises a Brighter Future for Solar Power," *Scientific American*, October 12, 2011, http://www.scientificamerican.com/article/cylindrical-solar-cells-give-new-meaning-to-sunroof/.

[3] Matthew Feinstein, "Setting the Record Straight on Solyndra," *Lux Populi*, September 23, 2011, http://blog.luxresearchinc.com/blog/2011/09/setting-the-record-straight-on-solyndra/

[4] David Biello.