

Fuel Cells and Solar

Interest in renewable power generation, and solar power in particular, is growing quickly in the United States in both the residential and utility markets. Unfortunately, when the sun is not shining, in inclement weather or at night, solar can be a limited power resource. Fuel cells are the perfect partner, able to generate supplemental power if solar resources are low during the day, or by providing electricity at night.

A synergy between the two technologies is further emphasized when using solar electrolysis to generate 100% renewable hydrogen that can be used for onsite fuel cell power generation or fuel cell electric vehicle (FCEV) fueling.

Fuel Cells and Solar Benefits

An increasing number of customers with critical power needs, ambitious sustainability goals, or both, are pursuing co-located renewable energy systems to harden grid independence in the U.S. Facilities such as data centers, hospitals, telecommunications / switching sites and grocery stores are just a few of the market sectors pairing solar and fuel cells together to reduce emissions and ensure constant, reliable power, capable of operating independent of the electric grid.

Fuel cells generate electricity using an electrochemical reaction, not combustion, and when fueled by hydrogen, produce no polluting emissions, only water and heat as by-products.

Fuel cells improve the overall efficiency of solar PV technology by a substantial margin and mitigate the variability of the sun's energy. When paired with solar systems, fuel cells can provide a stable, base-load supply of electricity on cloudy or rainy days, at night, or in fall and winter months. During the day, solar panels can provide electricity to a facility while also splitting water into hydrogen, which can be used as energy storage medium for later use in a fuel cell. As an added benefit, this combination can become a sustainable closed-loop system as a fuel cell produces water as a by-product.

Fuel cells also have a much smaller footprint than solar, and the two technologies are often partnered in areas where space is too limited to site enough solar arrays to satisfy large-scale power needs.

In transportation applications, FCEVs are beginning to enter the market in Japan, Europe and Southern California, with automakers committed to increasing production in the next few years. To fuel these vehicles, efforts to create a hydrogen infrastructure are underway. California requires that 33% of the hydrogen for FCEVs must come from renewably-generated sources. There are several existing stations around the world that use solar electrolysis-generated hydrogen, with more planned in the coming years.



Fuel cell co-located with solar to power railroad safety signaling equipment in Florida

Examples of Solar/Fuel Cell Installations

Alameda County Santa Rita Jail – This California jail, a 1 million square foot facility that operates 24/7, has operated a 1-MW fuel cell power plant for almost 10 years to generate 50% of the facility’s power, using the fuel cell’s byproduct heat for the jail’s hot water systems. The county reports that the fuel cell, combined with the facility’s rooftop solar power array and energy efficiency upgrades, is reducing power purchases by up to 80% during peak-demand summer months and avoids 3,200 tons of annual greenhouse gas (GHG) emissions. The county anticipates gross savings of \$21.6 million over 25 years.

Apple – In Maiden, North Carolina, Apple operates a 10 MW fuel cell installation running off of biogas coupled with a 20 MW solar farm to provide 100% renewable energy for its iCloud data center facility. Apple installed another 20 MW solar panel farm, about 15 miles away from the data center, where the power generated goes into the nearby power grid, offsetting power Apple uses back at its data center.

Hartford Life – In 2009, the company installed a 300-kW fuel cell and a 202-kW rooftop PV array at its building in Windsor, Connecticut. The fuel cell helps offset 24/7 base-load power while the solar PV system provides power at daytime “peak” hours when grid electricity is most expensive.

Safeway – At its Santa Cruz, California, store, remodeled in 2010, Safeway receives 100% of its power from two 100-kW fuel cells and 896 solar PV panels installed on the roof. The fuel cell system provides between 60-70% of the store’s daily electricity needs while the solar panels handle the remaining load.

United Illuminating (UI) – UI is installing a 2.8 MW fuel cell power plant in Bridgeport, Connecticut, that will also include 2.2 MW of solar to create a renewable energy park at a former landfill site. The fuel cells will take up ¼ of an acre of land while the solar array is using more than 8 acres.

Solar/Hydrogen Fueling Stations

AC Transit – In Emeryville, California, Alameda-Contra Costa (AC) Transit opened a state-of-the-art fueling facility in 2012 that dispenses hydrogen generated from both natural gas and from water via a solar-powered electrolyzer. The station fuels AC Transit’s 12 fuel cell buses and is also open to the public to fuel FCEVs.



AC Transit’s solar-boosted hydrogen station

Honda – In 2010, Honda began operation of its second-generation solar hydrogen station prototype at the Los Angeles Center of Honda R&D Americas, Inc. in California. The unit, which would fit in the user’s garage, produces enough hydrogen (0.5kg) via an 8-hour overnight fill for daily commuting (10,000 miles per year) for a FCEV. During daytime peak power times, the Solar Hydrogen Station could export renewable electricity to the grid, providing a cost benefit to the customer, while remaining energy neutral. Honda also has a solar hydrogen station operating in Saitama, Japan.

More to come – In May 2014, the California Energy Commission announced \$46.6 million to fund 28 new hydrogen refueling stations, including six 100% renewable stations that will include solar electrolysis. The new stations are expected to be operational by the end of 2015.