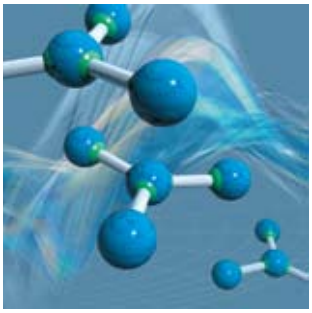


Increasing Reliability through Hybridization

By Sandra Saathoff, *ReliOn*

We've all heard the old adage about hybrid vigor, whether it be in plants or pets. The same is true for power solutions. Every technology has its strong points and its weak points. Combining multiple product types can result in a stronger overall solution. In general, there are two reasons to consider a hybrid solution for communication sites: to harden a critical site, so that it is more reliable in variable conditions and to address an off-grid scenario where communications is critical.

There are a number of technologies offered today that make providing clean, hardened power solutions easier than it used to be. Solar, wind and fuel cell power solutions offer strengths that, when combined, become a strong solution for a number of applications, providing a clean, highly reliable alternative to long term diesel generator use. These solutions can be used either to harden a grid-connected site or to power an off-grid site. Federal and State funding opportunities lessen the initial cost burden and the solution can actually save money on maintenance costs.

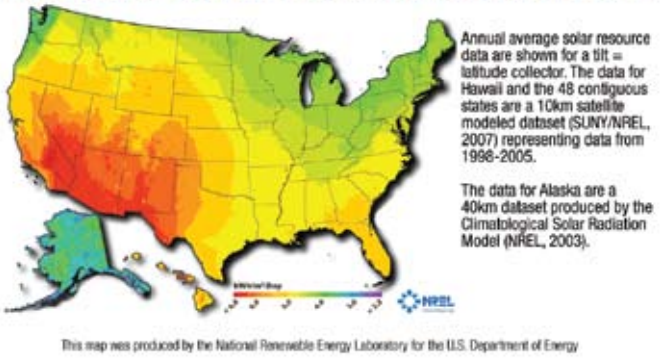
In order to discuss the hybrids, it is important to understand each component: solar, wind, and fuel cells. Batteries continue to play an important role as well.

Solar

The amount of power generated by a photovoltaic system at a particular site depends on how much of the sun's energy reaches it. A map of the United States provided by The National Renewable Energy Laboratory (NREL) shows solar resource areas, color coded by amount of potential power production. (see chart A)

As a stand-alone system, photovoltaics will not provide continuous power solutions because when the sun does not shine, the system does not produce energy. Therefore, solar must be combined with an energy storage or another energy production technology allowing it to ride through periods of low solar activity. Used with other power solutions, solar offers the benefits of renewable energy…clean power with no emissions and no ongoing fueling costs.

(A) Photovoltaic Solar Resource of the United States

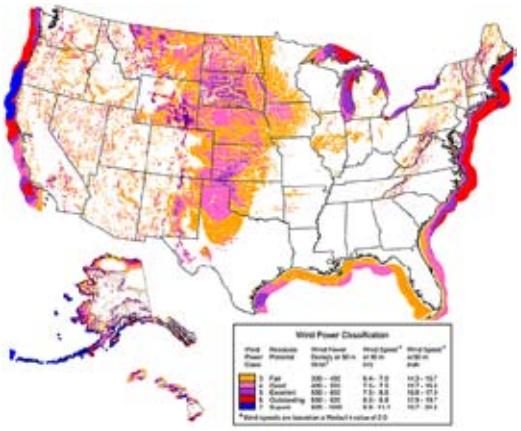


This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy

Wind

Small wind turbines, those rated below 100 kilowatts, can be a viable power solutions for telecommunications networks in areas where the wind blows consistently and with enough speed wind to provide power solutions for the site, but not overwhelm the equipment. The U.S. Department of Energy provides a map of the United States showing general areas that can be good for wind. (see chart B)

(B) Areas with Potential for Wind Power



As long as the wind blows, the site will continue to run, without running out of fuel. Like with a solar power solution, wind turbines need to be combined with an energy storage technology or an additional energy production system, allowing them to ride through periods with no wind.

Fuel Cells

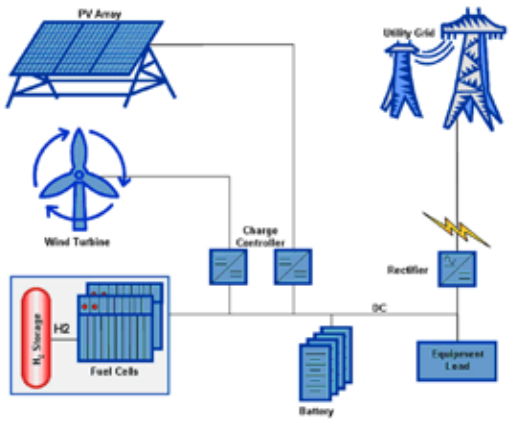
Proton Exchange Membrane (PEM) fuel cells generate electricity through an electrochemical reaction using hydrogen and oxygen. They generate energy without producing harmful emission by-products – the only by-products are water and heat – and without combustion, fuel cells are a quiet, highly reliable alternative for a backup power solution. Like with a generator, runtime for a fuel cell is determined by the amount of fuel storage capacity at a site. Based on technology available today, sites can be provisioned with fuel for hundreds of hours of runtime. Refueling allows the system to run continuously as long as needed for extended outages.

Most fuel cells for backup power solutions available today range from hundreds of Watts to about 20 kilowatts. For sites with relatively low power loads and outages lasting from hours to days, fuel cells can be the power solution of choice.

Batteries

Even in a clean power solution, batteries continue to have an important role. Batteries have been the traditional choice for short duration backup power support, as these devices tend to be relatively inexpensive in terms of an initial cost of capital. Due to their requirements of frequent replacement, particularly in outside plant applications, batteries generally result in a higher lifecycle cost. Batteries provide a bridge between other power solutions and a place to store excess energy produced for later use. They are quiet, scalable, and have relatively reliable performance.

Diagram A

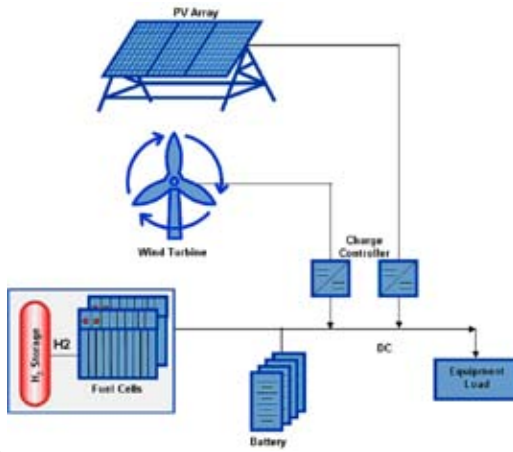


Site Hardening

Many sites normally operate from AC grid power, and are equipped with VRLA batteries to support the site in case of AC power failure. These sites can benefit from a fuel cell connected in parallel with the batteries. For outages that exceed the capacity of the batteries, the fuel cell serves to carry the site load when the batteries drop below a specified voltage, whether due to loss of AC power or in the event of a rectifier failure. The fuel cell minimizes the deep level of discharge on a battery string and allows the site to operate on a backup power solution for much longer than on batteries alone.

The addition of a wind or photovoltaic (PV) sub-system takes advantage of "free" power from the wind/sun. Combining the various backup power solutions allows an operator to quickly recover and provide services to support the truly critical equipment during an outage event. It also allows time to assess damages and implement the longer range reconstruction to restore the entire network. Sizing of the system depends on whether it is sized to cover the entire site load, or also charge the batteries. This solution can provide sufficient backup for most short outages, conserving the fuel cell for longer outages. Once the wind/PV/battery system is depleted, the fuel cell operates to carry the site load. Because it is fueled, the fuel cell delivers power as long as fuel is present, and unlike a battery, additional fuel can be delivered and deployed while the fuel cell is operating, theoretically providing unlimited clean power generating capability. (see diagram A)

Diagram B



Off-grid

The cost of extending the grid can be daunting. Some estimate it at $1,000,000 per mile or more. (Comparing Pipes & Wires: A capital cost analysis of energy transmission via natural gas pipelines and overhead electric wire lines, Bonneville Power Administration and Northwest Gas Association). In many cases, it makes better business sense to employ a hybrid

power solution at locations significantly off the main grid highway. (see diagram B)

Example

In the deserts of Arizona, there are a number of off-grid surveillance sites that are being powered by a hybrid power solution consisting of solar panels and batteries, with fuel cells providing the backup power solution. The fuel cells operate if a period of extended darkness limits the photovoltaic output, or if there is a problem with the solar array in general. The fuel cell systems are supplied with additional fuel storage, increasing the length of time the system is able to operate between site visits.

The goal of this power solution's configuration was to maximize the power of the sun in providing energy to the site, while maintaining the battery string at a healthy level of operation so that it had the ability to cover much of the time not powered by the solar array. At issue was reliability of generators, which would occasionally fail to start or would cease to operate shortly after startup, leading to costly, manpower intensive maintenance off normal work hours. The introduction of the fuel cell power solution as a replacement for generators at these sites dropped the maintenance costs significantly, lowered fuel consumption and eliminated false sensor alarms caused by vibration of the generators, while increasing the reliability of the sites. A side benefit was the ability of the fuel cell data logs to provide information about how the power solution as a whole was working, which resulted in adjustments to the solar panels, thus increasing their ability to provide power for longer durations.

Financing Options

In order to assist the market, the U.S. Congress passed an expansion and extension to the 2005 fuel cell tax credits to be available for purchases of fuel cells, solar and wind power solutions beginning January 2009 and going through December 2016. For fuel cells, these credits amount to $3,000 per kilowatt or 30% of the system cost, whichever is less, and entitle the taxpayer to subtract the amount of the credit (dollar-for-dollar) from its total federal tax liability. For solar and wind, this credit is 30% of the cost of the system. As part of the ARRA, a grant option was put into place in order that those companies who do not have a tax liability may be able to participate in the program. Information may be found at www.ustreas.gov/recovery/1603.shtml.

In addition to the federal program, there are a multitude of State incentive programs in place for solar, wind and fuel cell solutions. Policies continue to be added and changed. A good source for current incentive information is the Database of State Incentives for Renewable Energy website, www.dsireusa.org/summarytables/finre.cfm.

Conclusion

Design of a power solution must take into consideration the characteristics of each individual site. Where AC grid power is available, it may be beneficial to harden the site by providing a hybrid power solution in order to cover anticipated extended outages. Where no grid power is available, a hybrid power solution provides clean energy on a continuous basis. Either way, fuel cell/solar/wind hybrids are a viable method for meeting the needs of communications, security, and a multitude of other equipment sites. IPSOI

“The introduction of the fuel cell power solution as a replacement for generators at these sites dropped the maintenance costs significantly, lowered fuel consumption and eliminated false sensor alarms caused by vibration of the generators, while increasing the reliability of the sites.”