Alternative Energy Issues and Concerns for Extreme Weather Conditions

Solutions to Keeping Mission Critical Applications Charged

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While it seems intuitive that alternative power solutions would love the bright sunny day what happens when you add in extreme heat and cold to the equation. Adding to the mix of the initiative and solutions is the fact that there are weather extremes both hot and cold that affect how alternative energy power generation and storage are affected.

Alternative Energy Application Trends

At the Presidents 2008 State of the Union address the issues concerning the U.S. dependency on Oil and the issues of climate change were brought to the front of the agenda of the Administration. While, sustainable energy is not a new concept with solar power production starting in the late 1970's. The movement to renewable energy and the "green initiatives" have provided more incentives to individuals and organizations to begin to investigate use of alternative power in their mission critical applications.

These new **green initiatives are on the increase** and will have a great impact on the overall development of alternative fueled solutions in the near future.

While one of the challenges with alternative energy is cost, the other is a matter of **climatic conditions** which **cause power generation and storage to become a major factor in design**.

Before we start into the body of the paper we wanted to define some of the terms we are using.

Power Generation: Depending on what part of the world the systems will be deployed in, power generation is usually made up of solar and wind generating systems that charge batteries which in turn, power the devices. Solar panels need to be cleaned in very dusty (sandy) regions every once in a while and you have to knock the snow off when they are covered up for periods of time. Wind generators need to have exposure to the wind. They don't require maintenance, other than to check that they have all their blades intact.

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Our experience and test define the **ratio of power generation to usage is between 1.5 and 2 times the amps consumed**. Meaning, 100 amp hours requires 150 watts to 200 watts of power input. Ideally, you need to have to have enough power generation to recharge the batteries based on the storage and rate of consumption.

Power Storage: To determine how many amp hours are required to run the systems on battery alone and that meet the requirements of the systems we use the following procedures and formulas. We start by accurately measuring the power consumption, identify "spikes" in turn-on routines, and measuring actual run rates under "normal" operating conditions. We then identify the **Amp hour ratings on the batteries** determine how long a battery will run a 1amp load (12vDC). A 100 amp hour rated battery will run one amp for 100 hours. Amp hours are determined at 65 degrees (F) with fresh batteries. Rarely do we have fresh batteries and rarely is it 65 degrees. We use 75% of the available amp hours for our calculations. Therefore, for a battery bank that has a 100 amp hour rating a 2 amp draw at 12vDC (24 watts) will run for just over 3 days on the battery bank without any charge. If you wire the batteries so they operate at 24vDC, you loose one half the amp hours. A 100 amp hour battery bank at 12vDC will provide 50 amp hours at 24vDC.

Power Consumption: This is where we can have the biggest effect on the success of the installation. We work with the customers to define the "minimum mission critical security profile" with regard to power. Using the customer's threat assessment we work together to define the sensor management, communications, and overall security profile - from a power efficiency standpoint. We define power budgets for consumption, power storage requirements for sustainability and power generation for recharging the batteries. We outline the power management and monitoring requirements and then define the possible maintenance requirements for hitting the uptime and sustainability requirements in the field as defined by the situation and the customer.

The Challenges of Weather Conditions

There are a lot of resources that show areas of most promise for use with alternative fuels. These areas have been mapped to show average conditions to base decisions on the most likely type and source of alternative energy to be most successfully deployed in the area. During these extreme swings in temperature for long periods of times more of the individual components making up the power generation and storage solution will come to affect the overall performance slowly degrading over time. This is not to say that a brief rise or dip in temperature will shut down an alternative energy platform. Most systems are designed with some temperature range in mind. It is when the conditions are prevalent enough that output will be affected.

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Figure 1 depicts the areas of the United States most suitable for solar power solutions. Figure 2 show the breakout of wind conditions and their suitability for sustained renewable energy. Figure 3 shows the temperature averages for the United States. As you can see from the figures the most suitable places for alternative fuels are also the places that have the most extreme climate conditions. It's almost formulaic; the areas most likely to provide sustainable wind conditions are among the colder areas both on the coast and in the northern portions of the U.S. Conversely, places most likely to provide sustainable solar conditions are hottest. The highest annual solar radiation occurs in locations found bordering on the Southern and Western portions of the country.

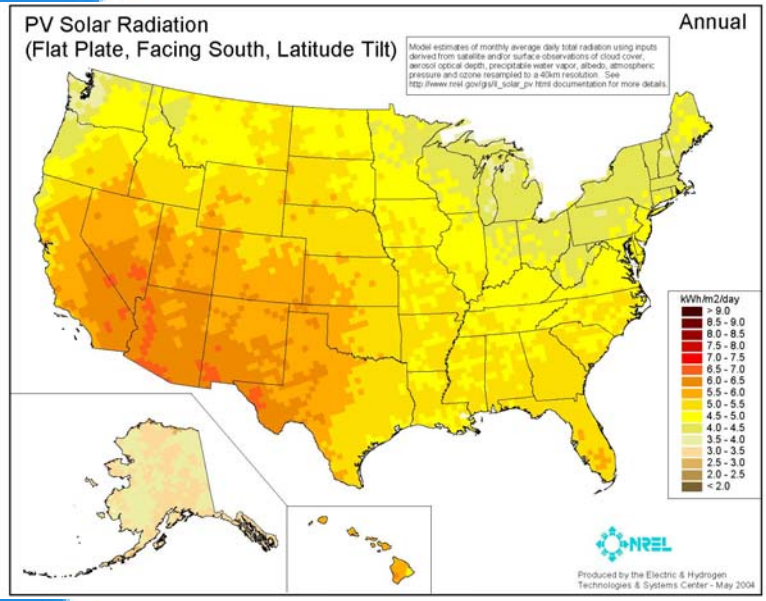

Figure 1: Average Annual Solar Conditions throughout the U.S. (image courtesy of NREL).

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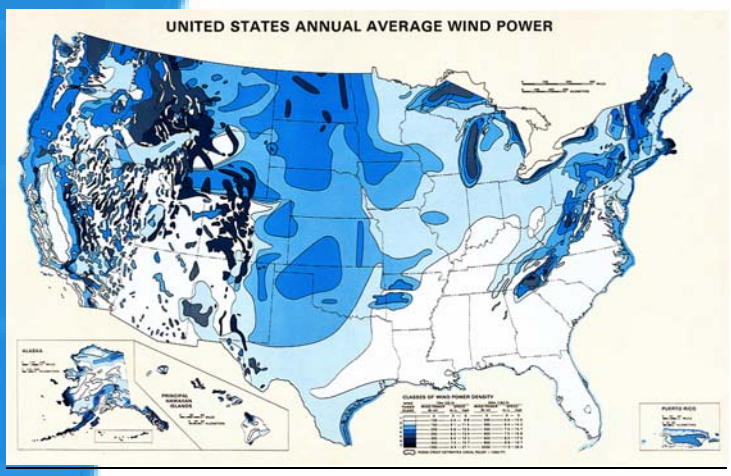

Figure 2: Average Annual Wind Conditions Throughout the U.S. (image courtesy of the Wind Energy Resource Atlas of the United States)

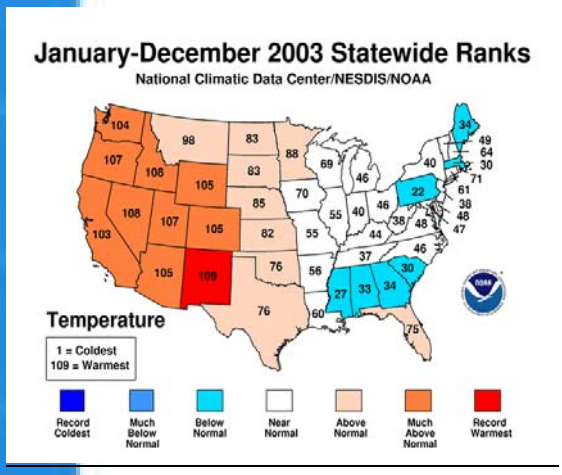

Figure 3: National Climate Data for the U.S. (image courtesy of NOAA)

Extreme cold

Cold weather presents a number of challenges that will be similar to hot weather but require different solutions to address the issues. The greatest challenges is low temperatures affect both power storage and generation. The storage cells that routinely get below 0 degree Celsius (32 degrees Fahrenheit) will have both diminished storage capacity and lower power output. Power cells that are exposes to cold conditions for a long enough period of time will start to degrade their ability to sufficiently charge to capacity until such time that they ultimately fail.

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Extreme heat

Heat causes another set of problems with rising temperatures degrading the lubricants of wind powered equipment and the storage capacity of the power cells. Heat is able to breakdown the reaction of the electrolyte being converted into power for storage. Once again, as performance in keeping the cells fully charged gradually lowers, the ability to keep the system running at optimal performance is decreased.

In understanding the challenges there are solutions that can maintain system performance and addressing design requirements for temperature conditions can affect performance without pushing the material costs of the solutions to high.

The Solution: Temperature Control Using Minimal Power

In developing sustainable platforms one must look at the weather conditions that the devices will operate in over time. By identifying the types of weather patterns in the area and see if augmenting the solar with wind, hydro, or even a power backup system that uses hydrogen – or even diesel as a last resort will keep the power storage at maximum capacity for the life of the design. In Arizona, the sun angle is greater than in Maine and the sun is available for longer hours, especially in the winter months.

The wind on top of mountains or high spots in Maine is much greater than many places in the southern climates of the US. Wind would very effectively augment the solar and provide a much needed power source during the reduced sunlight of the cold winter months.

In Arizona we have to deal with overheating – in Maine we have to deal with the cold. Both situations require some use of power.

The biggest difference is that the power required during a heat wave in Arizona would come primarily during the hottest time of the day, and one can only assume that the sun would be generating a lot of excess power through the solar configuration. The cold in Maine comes during the coldest time – mostly at night when there is no sun to rely on.

The batteries have reduced efficiencies in extreme cold conditions as well as in the hottest conditions. Both situations cost power, but draining power off the installation during peak power performance times is much more advantageous than draining power went none is being generated and you're only draining the batteries.

We can insulate the battery boxes and use small heating "pads" to warm the box. Ideally, we could heat the box to 32+ (F) without using more than 50-75watts (of course it would take a bit more if the temperature drops into the -40 to -50 (F) degree range). This system is thermostatically controlled and only comes on when absolutely necessary.

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Batteries struggling from heat can be addressed a little different. We can protect the battery boxes from the direct sun – insulation, shade and reflective paint reduce the overall top temperatures by several degrees. Cooling - using slightly more power than necessary to heat - can be accomplished again with a thermostatically controlled Peltier heater. Sinking the battery boxes into the ground in a fixed installation can benefit both temperature extremes.

What to Look for in Alternative Energy Solutions

The secret to success using non-traditional power or renewable energy is to always be generating some amount of power. When there is sun you want to use a lot of solar. When there is wind, you use wind generators. When you have a little of each – you must use both.

There are three core elements Power Generation, Power Storage, Power Consumption.

It is most important to look at the factors that will most affect the success of these installations.

Reduce the power consumption to the "minimum mission critical communication profile". This means identify the most efficient devices to use in the application, and try to keep everything in one voltage, as well as limiting the power to non-mission related functions. LED lighting in the structure, monitoring and reporting systems in place, and industrial controllers that are capable of turning on/off devices, are distinct advantages.

Limit the need for heating and cooling. All devices used in the system must be environmentally ruggedized themselves. The batteries are the only things that should have an environmental cost in power

Use every bit of available natural power to run these systems. If there is wind available – use it. The sun will be very limited in the winter and must be considered less than ½ of what it is in the summer. We have to make up that power.

Have a backup generator, hydrogen fuel cell – or some other power source that can be turned on automatically or remotely to help provide a battery charge when everything else disappears.

Solar panels don't work with a foot of snow on them. An automatic "snow dump" could help – but augmenting with wind is more reliable.

Dropping the power requirement through the use of power efficient devices and designing the power system to be the most efficient possible WILL positively effect the success factor of the installation.

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The Critical Power Advantage

Critical Power Solutions International (CPSI) was founded in 2004 with a mission - to provide a self-powered sensor platform that could be rapidly deployed easily and fill the "gaps" in physical security perimeters.

After several attempts using non- traditional power sources and various tower based platforms, CPSI began delivering it's first solar, wind and fuel cell powered portable tower systems in 2006. The company's first patent pending trailer system was recently selected for use by the Department of Energy, Federal Bureau of Prisons for Emergency Response Teams, and is part of the multi-billion dollar Secure Border Initiative awarded to Boeing Corporation.

Each CPSI product is powered by hybrid, alternative technologies for continuous power in areas previously unreachable by traditional grid based systems.

Figure 4: One of our off-grid platforms providing monitoring and security for a regional airport.

CPSI's products allow for the deployment of a totally integrated security system virtually on-demand. Without the need for grid power, all product lines are implemented quickly. All our products are portable and are designed to be placed quickly and moved when necessary to provide the most rapid implementation available today.

Reliability and flexibility is a critical component of any security solution. We integrate all our systems with COTS (commercial-off-the-shelf) products that are tested and proven. Whether you require Thermal Imaging, Night Vision, Motion Tracking or Dynamic Alarming, this open platform allows us to easily upgrade and customize your solution. COTS-based integration allows our systems to keep pace with technological improvements and innovations.

Each product incorporates Ethernet switching and communications. Using a standard Ethernet platform and high level encrypted security options, wireless video and alarm signals can be transmitted to mobile and hardwired monitoring systems. Each tower can broadcast at regular intervals or upon query. The system also includes the ability to report

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on battery and system status, allowing security personnel to remotely turn devices on and off as needed.

Further Information

To find out how Critical Power Solutions can support your mission critical applications contact Mike Lee at mike.lee@cpsi-inc.com or John Mays at jmays@cpsi-inc.com.

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