Smarter Than the Smart Grid?

How Telecom Providers Can Benefit From Backup Power Solutions That Turn Into Smart Energy Solutions

By Joe Blanchard

Today, hydrogen fuel cells are used in telecommunications, government communications, and security, as well as for backup power in grid-powered locations. Many may not know, however, that fuel cells are also used in remote and off-grid applications as one component to a hybrid power solution that can involve any of the following other power sources: solar arrays, wind turbines, batteries, and/or generators.

Believe it or not, there are currently more than 1,300 telecommunication sites using fuel cell power solutions in North America alone. While this represents a small percentage as far as total telecom sites, it is clear that fuel cells are a viable solution to the need for reliable power. But they can do more. Fuel cells can be used as part of a telecom operator's managed power strategy and, thus, improve its bottom line.

The benefits of using a managed fuel cell are difficult to see when examined individually with only a few kilowatts of power capacity at a single site. However, when the solution is aggregated across a network area, the value of the concept comes into focus. In simple terms, the fuel cell becomes a distributed solution that can support hundreds of kilowatts or even megawatts of power that is now under managed control by the telecommunications operator. When the operator can remotely start hundreds of systems to reduce its peak energy demand, the provider can positively impact its utility rates and receive credits from the electric utility or government agencies. In the end, the fuel cell becomes a viable tool in a telecommunications operator's overall energy management model as well as continuing to provide robust, long runtime, clean backup power.

Figure 3. Summary of U.S.-Based Financial Incentives for Renewable Energy[1]

Personal Tax	Corporate Tax	Sales Tax	Property Tax	Rebates	Grants	Loans
41	41	43	72	496	55	192

Figure 4. Summary of U.S.-Based Financial Incentives for Energy Efficiency[2]

Personal Tax	Corporate Tax	Sales Tax	Property Tax	Rebates	Grants	Loans
13	11	9	6	1103	55	209

Technology Overview

Before discussing how a fuel cell can help improve the bottom line, we first must understand exactly how it does what it does. A fuel cell is a device that converts the chemical energy of a fuel (hydrogen, natural gas, methane, methanol, etc.) and an oxidant (air or oxygen) directly into electricity.

While there are a number of fuel cell technologies available, the most common and practical technology for small- to medium-sized standby power is the proton exchange membrane, or PEM, fuel cell which generates electricity through an electrochemical reaction using hydrogen and oxygen. This process happens without combustion.

A fuel cell operates electrochemically through the use of an electrolyte, just like a battery, but it does not run down or require recharging. It is similar to a generator in that it operates as long as the fuel is supplied; but unlike an internal combustion generator, it is simple, quiet, and clean with few moving parts.

Based on technology available today, customer sites can be provisioned with fuel for hundreds of hours of run-time. Refueling allows the system to run continuously as long as needed during extended outages. Most fuel cells being used for backup power today range from hundreds of Watts to approximately 20 kilowatts. For sites with these relatively low power loads and outages lasting from hours to days, fuel cells can be the backup power source of choice.

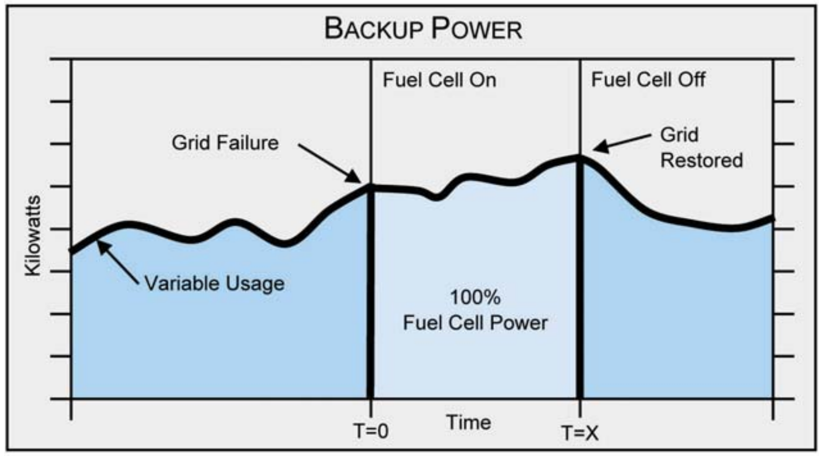


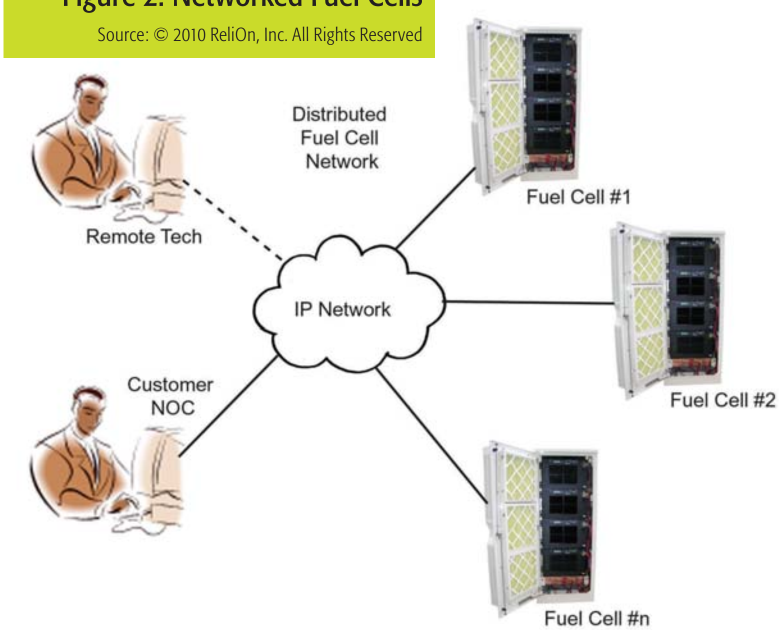
Figure 1. Backup Power Model

From Random Sites to Scaled Programs

Though it has taken time, telecommunications operators are beginning to transition from trials and limited deployments to scaled rollouts in North America, Asia, and Europe. Several operators have transitioned to programs deploying hundreds of fuel cells. As a backup system, it is seen as an insurance policy to reduce losses due to power outages.

"…smart energy programs are highly dependent upon government regulations and incentives."

Figure 2. Networked Fuel Cells



Industry Support	Bonds	Performance-Based Incentives
38	3	66

Industry Support	Bonds	Performance-Based Incentives
-	3	15

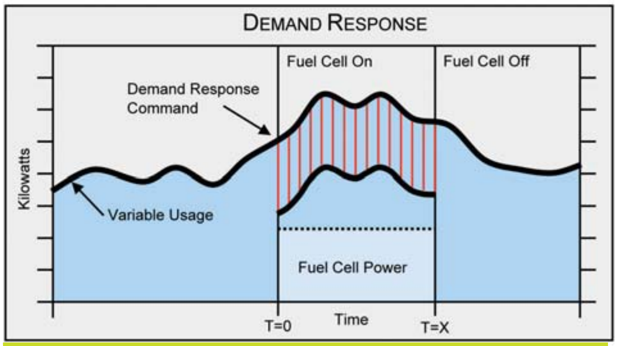


Figure 5. Demand Response Model

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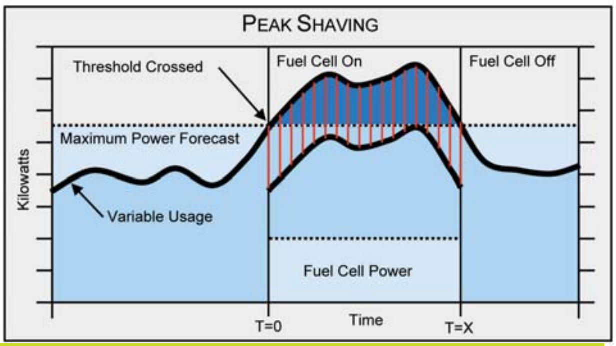

Figure 6. Peak Shaving Model

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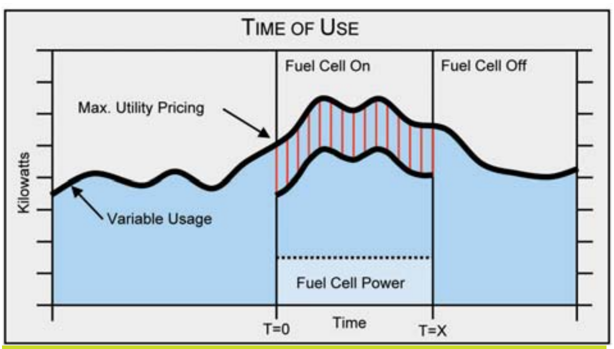

Figure 7. Time of Use Model

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In a backup model, the fuel cell and associated bridge energy storage support the entire load for the duration of the outage as is shown in Figure 1. During normal operation however, the generation and storage assets are in a standby state waiting for the next power disturbance. In other words, they are back to being an insurance policy.

Beyond the Backup

If backup power at a site is a foregone conclusion to ensure continuity of service during a power outage, then the capital investment has already been justified. A telecommunications operator can move beyond "just backup" power when they begin to look at their power assets as dynamic generation and storage tools. These are tools that utility grid operators want to take advantage of to balance, offset or avoid grid-related power issues. The telecommunications operator can benefit from utility programs around demand response, peak shaving, time of use pricing and "selling" back their commitment and/or results of their participation.

A smart energy solution in telecom must be able to be managed via traditional operations methods. In the models presented in this article, the operations center should be able to control and manage multiple power systems at any given time using direct commands or preset scripts. When using small power systems like fuel cells at cell sites there is a need to be able to manage potentially hundreds of devices to roll-up to a power level that makes a difference on the grid. Five (5) or 10 sites at 7kW won't interest the utility, and really does nothing for the telecommunications operator's energy consumption. On the other hand, a network of 250 sites at 7kW now becomes quite significant at 1.75MW.

Figure 2 shows a networked collection of fuel cells that are managed from the Network Operations Center (NOC) or by a third party services company. When there is a need to generate power, the command can be issued via the network to start generation, stop generation, and gather statistics about the production of energy.

Incentives for Smart Energy Programs

As has been previously described, smart energy programs are highly dependent upon government regulations and incentives. The data in Figures 3 and 4 show a summary of incentive programs in the U.S. for renewable and energy efficiency. At the federal level, fuel cells qualify for an Investment Tax Credit that is equal to the lesser of $3,000/kW or 30% of the cost basis. In addition, some states have tax incentives and further capital offsets when using certified renewable-generated hydrogen.

It is highly recommended that the operator consult with their tax advisors and government officials to see what programs are available and if they must be taken singularly or can be compounded. In all investigated cases, the government programs were 100% complementary to the utility programs.

Energy Management Tactics

In terms of understanding HOW energy management programs work, below are 3 tactics providers can use to improve their bottom line by employing smart energy programs.

Tactic A: Demand-Reponse. Demand Response (DR) is typically a program where customers plan for a certain amount of power to be switched on/off within specified lead times (response). This allows the utility to have some predictable control on the demand on the grid. For example, if the utility has customers with the capability to turn off load within 24 hours or 8 hours or even 30 minutes, then the utility can manage the grid and make decisions to balance between DR actions and deploying peaking generating assets or having to spot buy energy from a neighboring utility.

The DR programs compensate the utility customer (in this case the telecommunications operator) by the number of kilowatts or megawatts committed to the program, the speed of response (e.g., a 24-hour response would not get as much compensation as a 1-hour response time) and the commitment on the duration or frequency of DR events. Annual base compensation can be in the range of $40-80/kW committed. These rules are government- and utility-specific so they must be reviewed accordingly.

Figure 5 shows a DR model representing a point in time when the utility issues a DR call and the telecommunications operator controls the fuel cell to produce power, reducing net kilowatts of load on the grid by the corresponding power produced by the fuel cell.

Because the fuel cells can respond quickly, even across a large network, this model uses a 30-minute response commitment. In programs based on commitments and response time, if commitments are not met then there is a downside to the operator in the form of penalties and/or fees.

Tactic B: Peak Shaving. Peak shaving is a power threshold-based program. If a telecommunications operator has forecasted their consumption and manages their energy billing with the utility based on usage and forecasting, there is typically a large penalty if they cross their forecasted threshold. In some cases, cost per kW-hr can be 10-20X normal rates. The key to implementing programs for peak shaving is that the total cost of local generation to reduce the peak must be better than the higher price of grid power.

Figure 6 shows a Peak Shaving model that has an established threshold that triggers the fuel cell to generate power and "shave the peak" and therefore eliminate the customer from having to pay the high cost to the utility. When the total usage is below the threshold, then the fuel cells turn off and all power is again provided by the utility.

A peak shaving program is simpler than a DR program to implement since it is up to the telecommunications operator to establish their forecast model with the utility, and then just manage by deploying generating assets or even storage to not exceed their forecast. To manage this model, the operator must be able to see their aggregated power consumption dynamically.

Tactic C: Time of Use. Time of Use (TOU) programs are quite similar to peak shaving, but the triggers are based on time and not power thresholds. Utility operators know their statistical seasonal and daily demands and establish programs to incent customers to use less energy during the critical times of year/day. Though the pricing differences are not as dramatic as a peak shaving model, off-peak to on-peak rates can still vary from about 3-8X.

Figure 7 shows a TOU model with a time-based trigger to start the fuel cell, which then produces power for a predetermined time. These programs are not typically as high value to the telecom operator, but they are the easiest and most predictable to implement. The regular use of the fuel cell for a certain number of hours per day over a certain number of weeks can easily be programmed at the operations center.

Smart Moves for the Future

Smart energy programs come in many variations and are growing in popularity due to ongoing electrical grid issues. Worldwide electrical demand continues to increase, resulting in capacity shortages and strain on grid infrastructure. Failures and instability are inevitable without corrections. Smart energy and demand side programs are a step toward correction.

Today's fuel cells offer viable solutions to support the necessity of backup power and the smart energy solutions. The telecommunications operator has a choice: they can buy a robust backup power solution and get a smart energy solution, or they can buy a smart energy solution and get a backup power solution as a side benefit.

Endnotes:

1.Database of State Incentives for Renewables & Efficiency (DSIRE) is a comprehensive source of information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency. Established in 1995 and funded by the U.S. Department of Energy, DSIRE is an ongoing project of the N.C. Solar Center and the Interstate Renewable Energy Council. http://www.dsireusa.org. 2. IBID.

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