Buckeye Power Sales
Reliable Power Professionals Since 1947

Since the turn of the century, innovative advances in battery technology coupled to economies of scale and improvements in manufacturing processes, much of it driven by the increase in electric driven vehicles, have resulted in price declines in lithium-ion batteries. As such, it is now feasible to consider a Battery Energy Storage System (BESS) as the back-up power to the utility system. Even renewable energy systems rely on a BESS to supplement energy needs when wind and solar do not meet an application's power requirements. A purely battery standby system to the utility grid can also be adapted to serve as the main source of power during the day when electrical tariffs are at their highest. This information discusses utilizing BESS, not only to provide standby power when the utility drops off line, but also how BESS can be adapted to be recharged by the utility during low tariff periods and supply system load when the utility tariff is higher.

## 1.0 UTILITY SYSTEM TWO-TIER ELECTRICAL RATES:

A two-tier tariff rate from utility companies is frequently available. However, before adopting a BESS system for the purpose of recharging during the low tariff period, it's important to verify the utility supplying the load does have varying tariff rates:

**1.1 WHY UTILITIES OFFER DIFFERENT RATES –** As the load on the utility expands, they have a responsibility to meet demand. However, demand can vary seasonally, such as air conditioning in the summer; it can also vary due to the characteristics of the connected load. Some manufacturing processes incorporate equipment with high electrical demand, such as large electric motors or electrical furnaces. A utility will provide incentives for high demand users to power up their high demand connected loads when the average user demand is at its lowest. A utility then, can meet demand without increasing capacity.

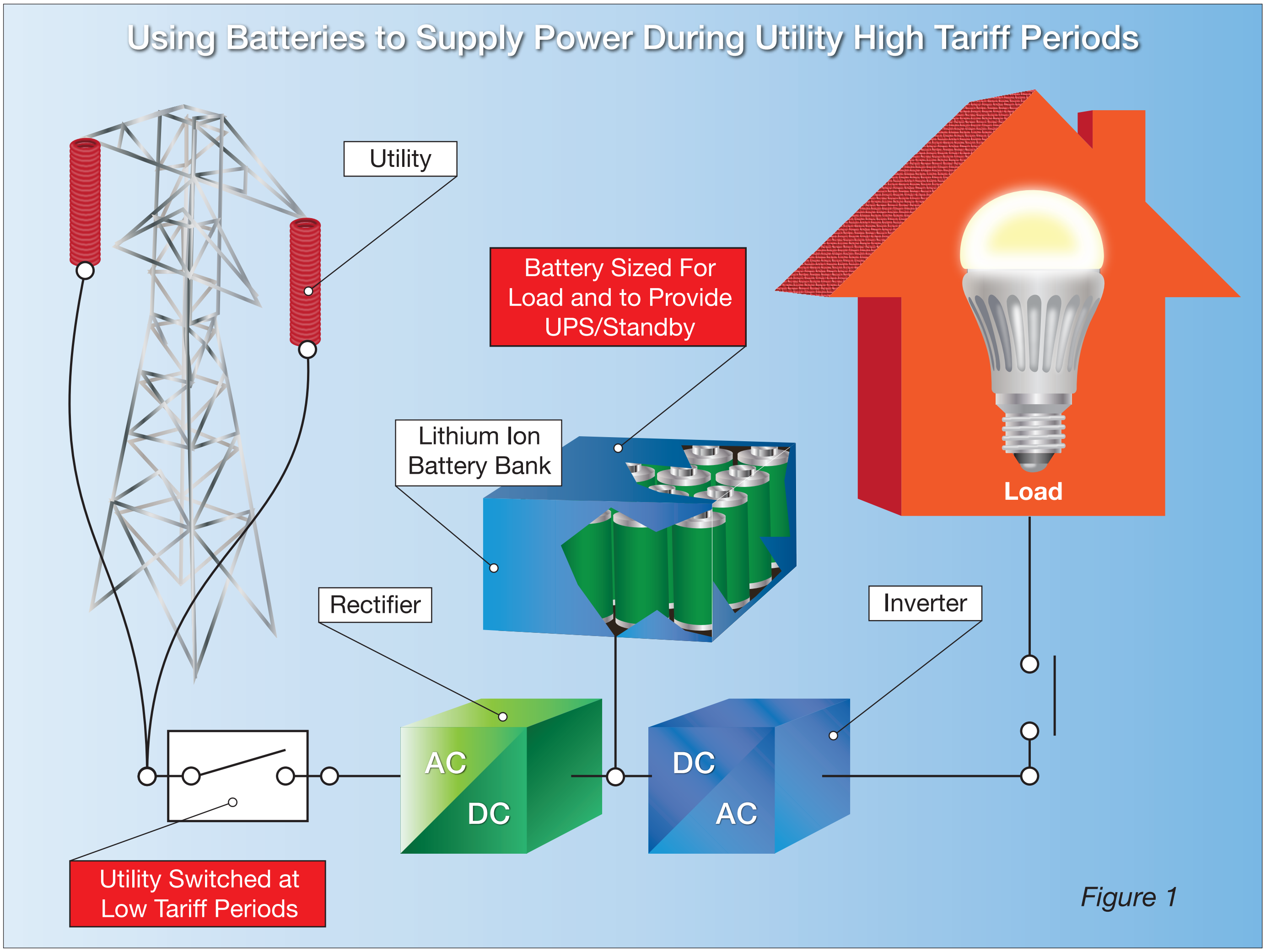


*Figure 1*

**1.0 UTILITY SYSTEM TWO-TIER ELECTRICAL RATES:** *(Continued from page 1.)*

**1.2 VARIABLE RENEWABLE ENERGY (VRE) –** The pressure on utilities to reduce carbon emissions has resulted in them adopting renewable components to generate power, primarily wind, and solar. A component of wind and solar systems are batteries to provide stored energy during periods of reduced wind and available solar energy. There is an incentive for the utility to offer users of BESS the option to recharge during low demand periods.

## 2.0 GRID-SCALE BATTERY STORAGE:

Battery storage systems provide power system managers and utility companies with the ability to store energy for future use. BESS has the options to utilize many types of battery chemistry, but as stated, the dominant technology is lithium-ion. The appropriate level of grid-scale battery storage depends on the characteristics of the system, including but not limited to:

- The applications existing and planned mix of generator systems
- How flexible the existing system is to the adoption of BESS
- Factors that could affect interconnection with adjacent systems
- Load characteristics of electrical demand, including hourly, daily, and seasonal
- Application of future VRE supply

## 3.0 ALTERNATIVES TO GRID-SCALE BATTERY STORAGE:

In many systems, BESS may not be the preferred option, such as:

- The utility in the area does not offer lower tariffs to produce economic benefits
- Other standby systems may be more applicable
- More feasible for Utility to increase generator capacity

## 4.0 KEY CHARACTERISTICS OF BESS TO CONSIDER:

When determining the BESS to apply to an application, the system design will consider:

**4.1 RATED POWER CAPACITY –** The total discharge capability of the batteries, kW, and the maximum rate of discharge required by the system from a battery in a fully charged state.

**4.2 ENERGY CAPACITY –** How much stored energy required to meet connected load.

**4.3 STORAGE DURATION –** What is the load on the battery for a given period to ensure adequate storage capacity.

**4.4 LIFE-CYCLE –** When will the battery have to be replaced when the charge and discharge rates are projected.

**4.5 SELF-DISCHARGE –** When not connected batteries self discharge, the level has to be calculated to ensure capacity.

**4.6 STATE OF CHARGE –** The state of charge will dictate the batteries ability to provide power to the connected load when required.

**4.7 ROUND-TRIP EFFICIENCY –** This refers to the energy used to charge the battery to the energy the battery provides to the load when discharged. This is measured as a percentage ratio of the energy charged to the battery and the energy discharged from the battery. This will be taken into account when sizing the battery.

## 5.0 THE ADVANTAGES OF BESS:

Having determined that BESS is applicable for the load to be powered, there are many advantages to using batteries between the utility input and the system load. These advantages are:

**5.1 THE ABILITY TO CONSUME UTILITY POWER AT LOWER TARIFF RATES –** As in indicted in figure 1, with the battery bank placed between the utility and the load it can be arranged via a timer/contactor where the utility is only connected to the system during the period the utility is supplying power at a lower tariff rate. Most lower rates are during the night time hours. During the lower rate period, the utility would charge the battery and power the system load.

The utility will have several hours to charge the battery to a capacity that will manage the day time load for which the utility company would charge a higher rate. The battery would have to be sized to manage the day time load plus back-up power should the utility be taken off line. Calculations would be made based on utility performance and any critical loads.

**5.2 BACK-UP POWER TO THE UTILITY –** In addition to using the utility only on a lower tariff basis, the battery is sized to provide standby power should the utility go offline. The system designer (your local authorized distributor) will size the battery to manage the load for high tariff periods and anticipated periods of outage.

**5.3 UNINTERRUPTED POWER SYSTEM (UPS) –** Engine driven standby systems transfer power via a set of contactors from the utility to the standby generator. There is a period of no power as the generator system runs up to speed. With critical power systems, a UPS is connected to ensure no interruption in power while the generator runs up to speed.

With a BESS the system already has an in-built UPS system. As most loads are AC and batteries are DC, the Utility charges the batteries via a rectifier (see figure 1) the output from the batteries is then passed through an inverter to convert DC to AC power to supply the system load.

When the Utility goes off-line, the power is instantly drawn from the batteries. The load never experiences a drop in supply.

**5.4 PEAK POWER DEMAND –** Use additional battery capacity to serve intermittent loads that greatly increase normal utility power requirements. This reduces costs by reducing potential power capacity from the utility supplier.

***To fulfill our commitment to be the leading supplier in the power generation industry, the Buckeye Power Sales team ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our Information Sheets are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.***


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