Energy Storage
July 2019

What is "energy storage?"
Energy storage is the capture of energy produced at one time for use at a later time.

Why is "energy storage" important?
Energy storage plays an important role in creating a more flexible and reliable electric grid. For example, CPS Energy can store energy that is produced by its plants at night, when there is less demand for energy, and release the stored energy during the day, when there is higher demand.

The energy industry has witnessed innovation and many new technologies for over 100 years, yet one factor has remained the same during all that time – electricity must be produced at the moment it is needed. Not before, not after. This fundamental aspect of the electrical system drives the need for a vast array of electricity-generating facilities, multiple, redundant transmission pathways to deliver the energy to customers; analysis and planning for future needs; and sophisticated control systems to manage it all.

The storage of energy – produced at one time and deployed at another time – has been possible for many years but only on a small scale or in specific locations. Now, for the first time ever, technology is beginning to enable large scale storage at any location. This trend will have far-reaching consequences for the electrical grid and power markets in general.

What are the different types of "energy storage?"
Pumped Hydro. For many decades, power companies in the United States and abroad have utilized pumped hydroelectric technology as a form of energy storage. During times of low power prices, water is pumped from a low elevation to a high elevation (typically a reservoir on the top of a hill). Later, when demand grows and prices are higher, this water is channeled back downhill, though turbines, to produce electricity. There are dozens of these installations worldwide, but few new facilities have been built in recent years because of permitting complications, land issues, and costs. The availability of the fuel supply for these turbines, water, can also present challenges during drought conditions.

Compressed Air Energy Storage (CAES). Another approach to storing energy is to compress air into underground caverns at very high pressure, then release the pressure, channeling the air through a combustion turbine to produce power. Only a handful of these installations have been developed or built. The costs of the compressed energy, plus fuel costs in the combustion turbine, limit the economics of such a system to markets where there is a very large spread between high and low prices on a regular basis. Also, the combustion turbine emits nitrogen oxide and carbon dioxide so is therefore not considered an environmentally friendly option.

Batteries. The area of largest growth in energy storage is batteries. Lithium ion and a whole array of additional chemistries are being applied and developed to create huge battery systems. These options have the benefits of zero emissions, very quick discharge, steadily decreasing costs, and, in some cases, tax advantages if paired with renewable energy.

How is CPS Energy using "battery energy" technology?

Price Responsiveness – The fundamental characteristics of batteries naturally lend themselves to energy markets. In energy markets, the primary commodity is power delivery. The market creates a price signal so when the demand for power goes up or down, prices follow in the same direction. Batteries are able to follow these price signals naturally and will charge up when prices are low and discharge when prices are high. This ability to charge and discharge based on price signals facilitates solar shifting.

Solar Shifting – Solar shifting refers to capturing the energy from the sun when the sun is shining and using that energy when the sun is not shining. When the sun is at its brightest and solar panels are making the most power, typically mid-day, the demand for power on the grid that day is still growing. This leads to less solar power being available when the grid needs it the most – typically later in the afternoon. Batteries can solve this problem by storing energy until it is needed. In a well-designed market, prices facilitate this mechanism by being really low during the solar peak (signaling the panels

that it is time to charge up) and rising during the demand peak (signaling that it is time to deliver the stored energy to the grid).

System Reliability – Battery control system technology is so advanced that the storage systems are able to charge or discharge, and change between the two, very quickly. This adaptability is important for system reliability. When the Electric Reliability Council of Texas (ERCOT) – the entity that manages the flow of electric power on the Texas grid for more than 25 million customers – is operating the grid, it focuses on keeping the system as stable as possible. It balances supply and demand and organizes the market so that there are some power plants that can easily increase or decrease their output. Batteries can adjust quickly by acting as a shock absorber and keeping the grid reliable. Batteries can also adjust much more quickly than a power plant. This feature increases their value in terms of reliability. The faster energy can be moved, the better balanced ERCOT can keep the system.

What are the advantages of "battery energy" technology?

1. Batteries have no mechanical parts, so they respond as fast as electricity can move through the wires and control systems. Being able to supply energy very quickly means that batteries can respond to grid changes in a fraction of a second as opposed to conventional generators.

2. Batteries are also relatively easy to site. The footprint of a battery is relatively minimal, and today's systems are completely self-contained. There is also no need for cooling water, which allows for batteries to be put into places where a power plant cannot fit.

3. Since batteries can be more easily inserted into the system, they can provide backup power to consumers and businesses in a way that does not increase carbon emissions.

4. When paired with renewable energy sources like solar or wind, batteries can help to reduce the need for new peak generation capacity. They simply charge when there is a surplus of solar or wind energy and discharge when there is a high demand for power.

5. There are zero emissions from a battery. It charges from the grid or renewable power source and discharges to the grid or directly to the consumer with zero emissions.

What are the disadvantages of "battery energy" technology?

1. Since the technology is still new, the costs for batteries are still high. Also, there are no federal subsidies associated with battery storage.

2. The battery chemicals have a defined life span. Based on use, they can wear out and lose the ability to hold a charge. This degradation must be considered when planning for a battery project.

3. Since a battery is storing energy via chemical reactions, heat is a natural byproduct of the energy conversion. As energy is stored and delivered, the battery heats up and can pose a fire hazard. The battery control systems monitor temperatures, and the enclosures are temperature controlled. Numerous safety systems must be in place to prevent and extinguish fires.

4. There are environmental concerns and challenges with the materials in batteries, as well as with their disposal.

5. Additional training and safety precautions are necessary for utility crews and first responders who may encounter batteries in the field.

What are the future applications of "battery energy" technology?

As the grid matures and continues its transformation to a more renewable and cleaner system, batteries are expected to enable the transition. Batteries will flex their usefulness when the grid is strained. They also have the potential to smooth out renewable energy – that is, to reduce intermittencies, increase efficiency, and keep the state of charge in the battery consistent– for the entire energy system.

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What is the bottom line?
Storage is a new technology that is largely seen as an enabler of cleaner power. There are many technical advantages that come with batteries and they provide an enormous value to the grid, but with any new technology the costs currently outweigh the benefits. This trend is changing, however, and as costs come down there will be increased deployment of storage on the grid.

What do we want you to know?
CPS Energy is committed to delivering safe, reliable, and affordable energy to its customers using energy storage to create a more flexible and reliable grid system.