BATTERY COUNCIL INTERNATIONAL

ESSENTIAL ENERGY EVERYDAY

INFORMATION BRIEF

Micro-Grids:
Battery Energy Storage Systems Provide a Successful Transition to Renewable Energy

As the race to net-zero carbon emissions continues to move forward around the world, the need for energy storage to overcome the intermittent nature of renewable energy production will become an integral component of the overall energy distribution system. This will not only require a shift towards a decentralized grid, where energy is distributed from multiple sources, but will also require continued development and implementation of a “SMART GRID” infrastructure.

The scope of this information brief is to highlight:

- A growing need for energy storage.
- How Battery Energy Storage Systems (BESS) specifically will play a critical role in this transition.

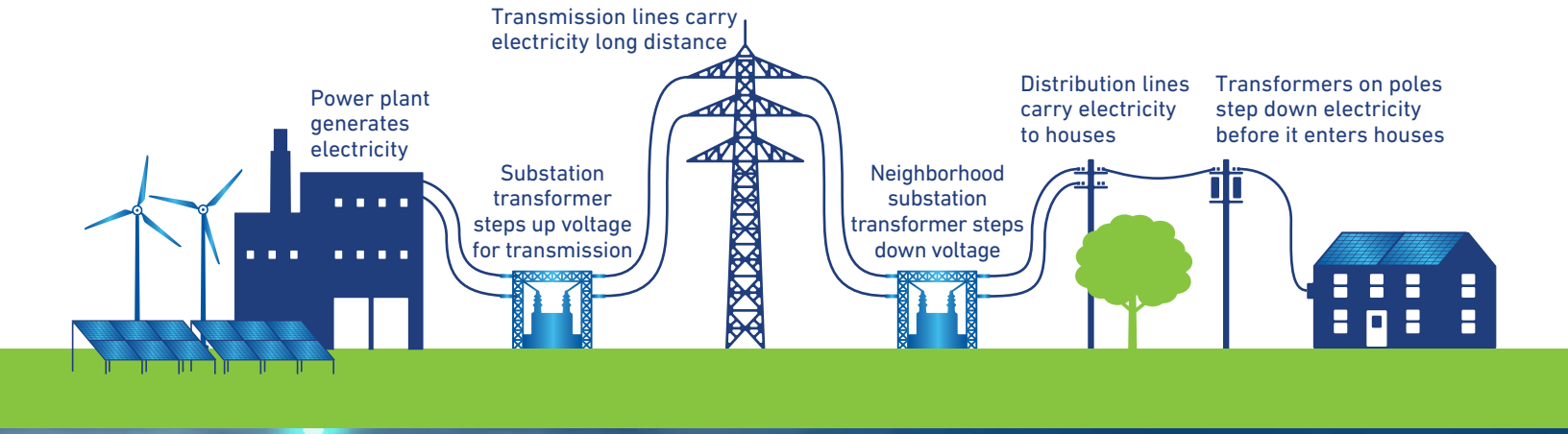
These small energy storage sources that are deployed on an as needed basis are often called micro grids, as they have the ability to supply power to the surrounding area for a specified amount of time.

The U.S. battery energy storage system market is expected to grow at a compound annual growth rate of 30.5% from 2024 to 2030.

Power Generation of the Past

Historically, electricity has been generated at a relatively small number of large power plants and was then distributed throughout the coverage area via high voltage transmission lines. Power substations were used to convert this high voltage electricity into a lower voltage suitable for distribution to the end user.

Although using a centralized energy production model has many complications associated with it, one of the primary challenges is that it takes a significant amount of time for large power plants (especially coal and nuclear) to ramp up and ramp down power production. Some plants take up to half of a day to reach full operation. The increased production of power from renewable sources has amplified this issue as power production is not consistent throughout the day or even from day to day.

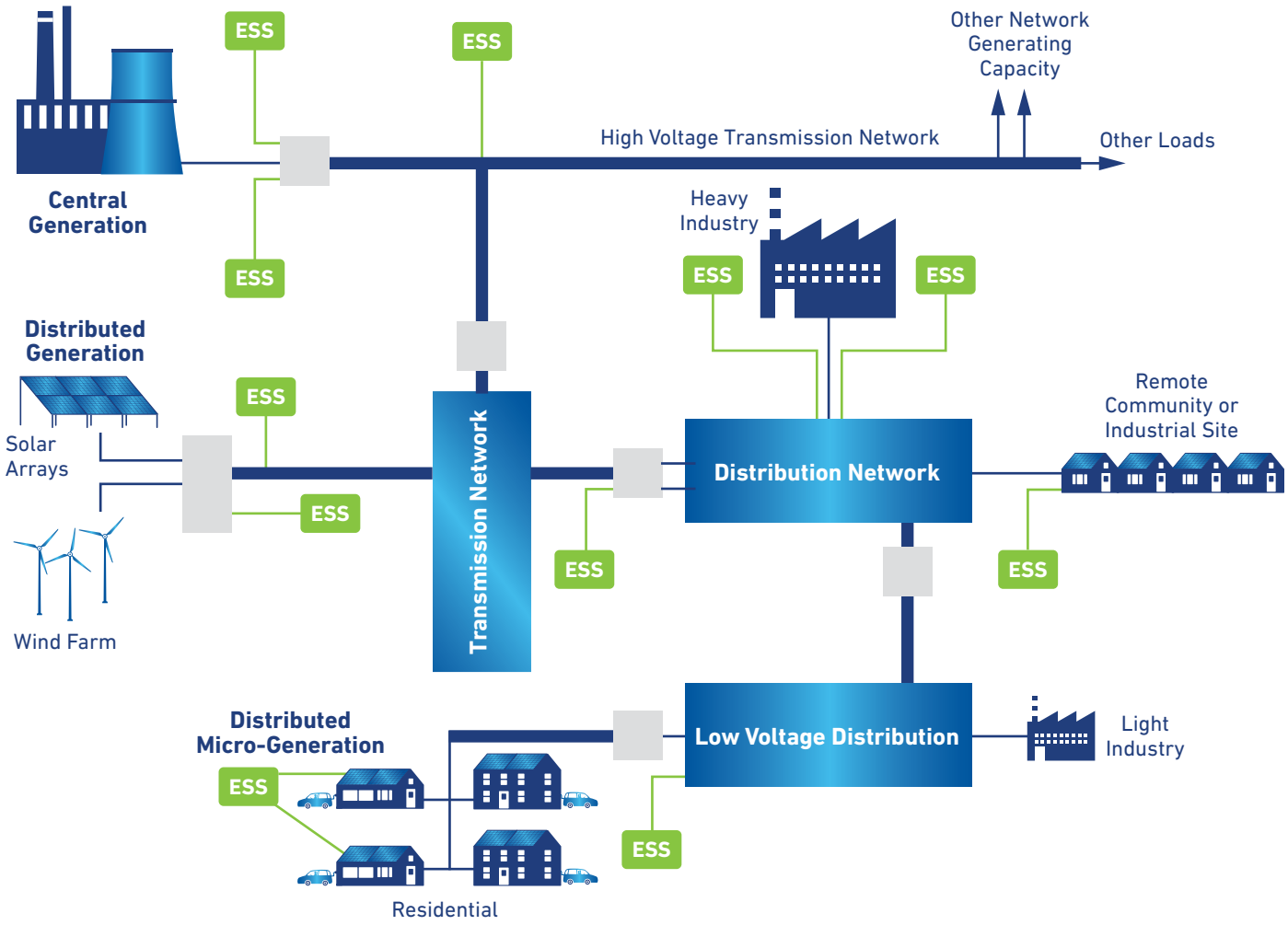


Grid of the Future

In order for the grid of the future to become a reality, we must adapt the way our energy network is designed, with energy sources being widely distributed and closer to point of use versus the past configuration of only large power plants coupled with high power transmission lines. This is often referred to as Distributed Energy Resources, or DER. From rooftop solar, residential energy storage, behind-the-meter energy storage, and grid-scale renewable wind and solar coupled with energy storage, we will continue to see changing sources of energy that will feed into the grid as demand in different areas ebbs and flows.

Below is a diagram showing how the grid is quickly changing to encompass a DER model as multiple sources of energy production combined with energy storage work together to deploy energy on an as-needed basis in each geographic area. While central electricity generation still exists, various energy storage technologies are utilized to meet the needs of residential, commercial and heavy industry. This demonstrates that it will probably not be one single technology that will make a carbon neutral transition possible, but many available sources of energy and storage coming together to form an active network of power distribution.

Grid Energy Storage Systems (ESS) and Applications



Battery Energy Storage Micro Grid

Although there are many types of energy storage available on the market today, BESS solutions are rapidly growing in number and forecasted to represent 81% of new installed energy storage between 2023 and 2027. A BESS is made up of one or more battery modules connected to an electronic controller which dictates whether power is being added or removed from the batteries. This controller can range from a small inverter in residential solar installation to a large bi-directional power conversion system used on larger container-sized applications. When energy storage is coupled with an inverter in a way that it can supply a home, business or community with its energy needs without the help of the grid, this is known as a micro grid.

A BESS provides many benefits over other types of energy storage:

- Scalable from 5KWh residential to megawatt hour Installations for grid scale storage
- Capable of high power output
- Well suited for 4 to 12 hours of backup power when a grid goes down
- Integrates seamlessly with solar and wind technologies to provide a consistent flow of power throughout the day and night
- Coupled with smart grid technology, a BESS can act as an energy buffer to supply power during high peak demand periods to reduce charges from utility demand rates
- Smart Grid technology allows deployment of power in milliseconds instead of hours

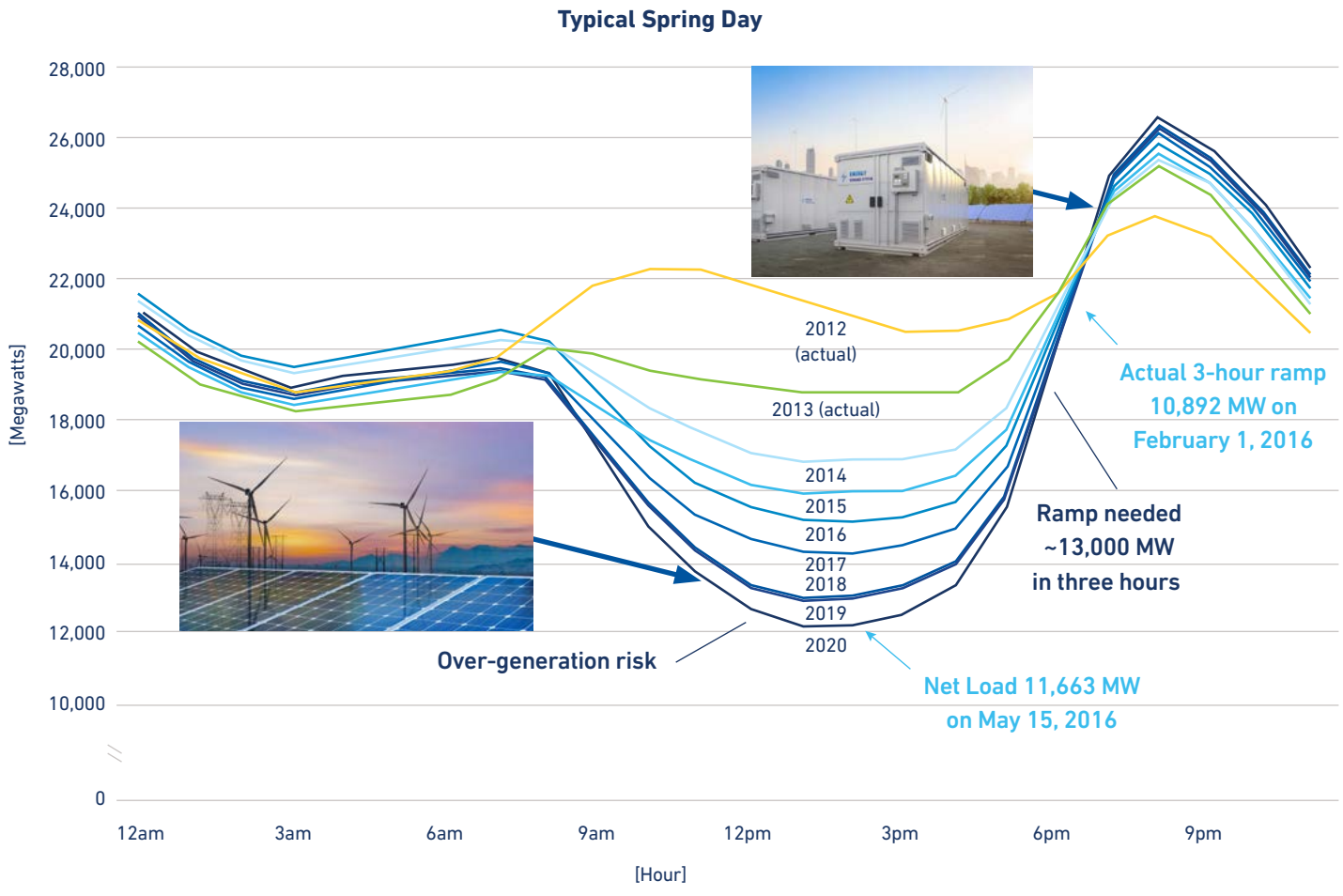
An employee opens the doors on the Flex manufactured battery enclosure, 1MW, 1 MWh rating, using lithium ion batteries from LG, at the Battery Energy Storage System, owned and operated by NREL for grid integration research at the National Wind Technology Center (NWTC). Photo courtesy of U.S. Department of Energy.

Impact of Renewables on Energy Demand

The diagram below, often referred to as a duck curve, illustrates how the influx of renewable energy in California has impacted power production. In 2012, power demand was relatively level throughout the day with slight fluctuations in the morning and evening hours. The increased use of intermittent renewable energy over the past decade has changed the level load throughout the day to a scenario in which demand can fluctuate significantly. When the sun rises and the millions of installed solar panels begin to produce power, the demand from the utilities sharply drops until it reaches a low at around 1 p.m. Due to the required time for electric plants to ramp power production down, there is a risk of too much power being produced during this time.

Between 5 and 7 p.m., the sun begins to set and energy from solar sources quickly tapers off to zero production. This tapering of power production happens at the same time that millions of people are returning home and demand naturally spikes. As can be seen on the illustration, demand more than doubles from the 1 p.m. low to the 8 p.m. high.

One way to smooth out demand and improve conditions for the grid-scale generation plants is by adding BESS micro grids throughout the usage area. As solar power ramps up throughout the day, utilities can maintain a more constant power output by funneling any excess power produced to charge the large scale BESS. This stored energy can then be used in the evening hours to supply power during the high demand times, while again allowing the utilities to maintain a consistent output.



Applications for Micro Grids

Grid-scale BESS installations are not the only application for microgrids. Universities, hospitals and large manufacturing plants require reliable electricity on a 24/7 basis to successfully provide their important services. In addition, these institutions are typically the largest consumers of electricity in their communities.

Utilizing a BESS micro grid can provide these institutions with:

- The ability to provide backup power for critical loads when the grid is down.
- Helping to reduce the financial impact of time of use rates and peak demand charges imposed by the utility for high power usage.

Additionally, during peak demand events when the utilities are experiencing above average energy demand and are not able to meet production needs, these companies can dispatch power from their micro grid to power their own loads and reduce the strain that they are putting on the grid.

Conclusion

In order to stabilize the grid and make a successful transition to renewable energy, all available energy storage technologies will be needed to help provide sufficient power when the sun does not shine and when the wind does not blow. BESS is a well proven and currently available technology that will continue to support this need and provide energy to consumers and utilities when needed.

BATTERY COUNCIL INTERNATIONAL Recently celebrating its 100th anniversary, BCI was formed in 1924 and joins together battery manufacturers and recyclers, marketers and retailers, suppliers of raw materials and equipment, and battery distributors from across North America and around the world. BCI members are committed to responsible manufacturing and recycling processes, and serve as a unified voice for environmental, health and safety stewardship.

Learn more at BatteryCouncil.org

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