We have seen an accelerating rate of change in the electric power industry over the past 10 years. Several factors have driven this transformation. First, natural gas has become abundant and inexpensive in the United States; second, renewables have become, in many cases, the lowest cost (although intermittent) energy source; and, finally, energy storage using lithium-ion batteries has allowed greater integration of renewable energy and significant avoidance of some transmission and distribution costs. All of these, combined with advances in the implementation of digitalization, will allow electric companies to provide the greener and even more resilient electricity that our customers are demanding.

The fundamental challenge with renewables is that they provide intermittent energy: the sun doesn’t always shine and the wind doesn’t always blow. Even when these resources are available, clouds and gusts of wind affect the amount of power they deliver. Customers demand reliability: electric companies must deliver power whenever their customers want it, 24 hours a day, 7 days a week, throughout the year. Furthermore, there are significant costs associated with integrating renewables and ensuring they reach the major load centers. In a carbon-constrained environment, outside of energy efficiency efforts, only nuclear and hydropower can provide 24/7 carbon-free capacity, but the timing and costs associated with both make significant additional buildout difficult.

This is where lithium-ion-based energy storage comes in: the technology is here today to provide multiple services from one location, with zero emissions, much faster construction times, and with fewer permitting requirements than either renewable or thermal generation.

In December 2018, AES made history by bringing the world’s largest operational solar-plus-storage system online. Designed for the Kaua‘i Island Utility Cooperative (KIUC), the project will deliver roughly 11 percent of the island’s power, bringing the state of Hawaii one step closer to achieving its goal of being powered by 100 percent renewable energy by 2045.
At AES, we have been building and operating lithium-ion-based, grid-scale energy storage systems for more than a decade. In 2007, we did an initial survey of advances in battery technology for electric vehicles. We saw an application and an opportunity to use similar technology to improve the flexibility and efficiency of energy grids and to enable greater penetration of renewable sources. That insight led to a technical pilot with our subsidiary Indianapolis Power & Light, which connected the world’s first lithium-ion battery system to the energy grid to power customers. We continued to grow our platform, and, in 2018, we formed a joint venture with Siemens, called Fluence, to make our technology and applications available to customers and electric companies around the world.

The need to store energy has never been more critical. Integrating renewable power with battery-based storage not only increases energy grid stability and enhances distribution networks, it increases the value of renewable energy. It forms what we call ‘firm renewables.’

Today, through Fluence or on our own, we have more than 1,125 megawatts (MW) of energy storage systems in operation or under construction in 19 countries around the globe. Fluence has been rated the best integrator of energy storage systems three times running by Navigant Consulting and is the current global market leader. In 2016, AES was awarded the EEI International Edison Award for energy storage, and, in 2019, we won the U.S. Edison Award for our Lāwa‘i Solar and Energy Storage Project.

A NEW MARKET: FIRM RENEWABLES

The need to store energy has never been more critical. Integrating renewable power with battery-based storage not only increases energy grid stability and enhances distribution networks, it increases the value of renewable energy. It forms what we call “firm renewables.” The combination of renewables and energy storage creates predictable blocks of power that can be bid into the energy market just as traditional methods of generation are.

Typically, batteries charge when there is a surplus of energy—often during the day when sunshine is abundant or at night when the wind is blowing—and release that energy when customers need it most, including during peak hours after dark when solar panels no longer are producing power or when turbines stop rotating. This lowers the average cost of electricity to customers and allows greater penetration of renewables on the energy grid.

HELPING HAWAII PURSUE 100 PERCENT RENEWABLE ENERGY

Hawaii was the first state to set a 100 percent renewable goal by 2045. The island of Kaua‘i also has stipulated that 70 percent of its energy be supplied by renewable sources by 2030. As part of this journey, together with Kaua‘i Island Utility Cooperative (KIUC), we inaugurated the largest operational solar-plus-storage project in the world—located in the town of Lāwa‘i on Kaua‘i’s south shore.

The project will help eliminate the island’s dependence on oil to run its peaker plants and will remove the associated financial burden that has strained its economy.

The project supports three vital scenarios in power distribution characteristic of energy storage:

1. It allows for solar generation to supply the energy grid while charging the battery system.
2. It dispatches power stored in the battery system to the energy grid during peak demand periods.
At the AES-operated Laurel Mountain wind facility, 61 1.6-MW turbines generate 100 MW of wind power, connected to 16 MW, 4 MWh of battery storage—enough capacity to supply energy to 24,000 people.
In Chile, AES is constructing a battery project as part of its 750 MW Alto Maipo hydropower plant near Santiago. It will deliver 10 MW, 50 MWh of energy storage as part of the initial phase, with plans to scale up to 250 MW, 1,250 MWh.

3. It can dispatch solar and battery power simultaneously to answer spikes in demand, in addition to supporting the energy grid through provision of ancillary services like voltage and frequency support.

While there are many examples of systems that are co-located but not tied together, the Lāwaiʻi Solar and Energy Storage Project fully integrates all systems. It consists of a 20 MW, 100 megawatt-hour (MWh) energy storage system, combined with 28 MW of solar generation, and is one of the world’s first solar-powered peaking plants, providing evening and morning renewable energy from the sun to customers via the energy grid.

In total, the new system will help Kauaʻi exceed 60 percent renewables in the next five years and will remove the annual cost and environmental impact of 3.5 million gallons of oil.

Our other work in Hawaii includes construction of an additional facility combining 19.3 MW of solar and 14 MW, 70 MWh of battery energy storage for KIUC. This solar-plus-storage project is located on leased land from the U.S. Department of Defense within the Pacific Missile Range Facility—Barking Sands Naval Base.

The Hawaiian Electric Company also has commissioned AES for two of its seven planned solar-plus-storage projects in Hawaii, representing the largest addition of renewable energy in the state’s history.

**ACROSS THE PACIFIC, A FIRST FOR INDIA**

We see the potential for energy storage to revolutionize the energy grid around the world—for example, in India, where it can help the country fulfill its vision for 225 gigawatts (GW) of renewables by 2022. Battery-based energy storage enables...
electricity to be stored and then delivered within milliseconds, reducing the reliability issues that often plague the country and enabling more energy to be captured and delivered on demand.

That’s why, together with Mitsubishi, we launched an energy storage solution that is serving more than 2 million customers in the Delhi region. The 10 MW, 10 MWh Delhi Battery-based Energy Storage System for Tata Power-DDL is the first grid-scale battery-based energy storage solution in India—and the largest in South Asia.

This project is paving the way for wider adoption across India. Energy storage has the potential to benefit India’s commercial and industrial sectors by powering can’t-fail manufacturing operations and enabling better onsite generation. In remote areas that lack access to electricity today, energy storage can be paired with renewable generation to provide safe, affordable power. Transmission and distribution network operators also can use energy storage to reduce congestion on the region’s transmission system and limit the cost of system imbalance charges.

In general, fast-ramping energy storage, like the Delhi system, can be built in a matter of months to provide critical flexibility where needed on India’s energy grid. In comparison, older technologies, such as pumped hydropower energy storage, can take years to build and are highly dependent on geographic conditions.

**Hydropower Without a Dam in Chile**

Another example of energy storage bypassing the expense and headache of traditional infrastructure is in the case of “virtual dams.” In Chile, AES is constructing a battery project as part of its 750 MW Alto Maipo hydropower plant near Santiago—making it the first power plant of its kind. It will deliver 10 MW, 50 MWh of energy storage as part of the initial phase, with plans to scale up to 250 MW, 1,250 MWh once the hydropower facility comes online after 2020. This innovation will allow hydropower to be captured without constructing a physical dam or using a water reservoir.

The benefits compared to traditional reservoirs or pumped hydro are numerous: reduced environmental and human impact from construction, shorter time to install, and even quicker delivery of energy—from seconds to milliseconds. The project is expected to strengthen Chile’s national energy grid.

**Across the United States**

Across the United States mainland, electric companies also are using energy storage in a number of ways. In Arizona, with Arizona Public Service (APS), we’re harnessing the state’s abundant sunshine to provide critical summer peaking capacity. APS is Arizona’s largest and longest-serving electric company. Energy affordability and reliability for its customers are its top priorities.

APS is charting the course to a clean energy future in this state. Its battery storage projects add up to more than what the entire U.S. electric power industry installed in 2018, and the company is continuing to grow its position.

Our collaboration with APS will deliver a 100 MW, 400 MWh battery-based energy storage system. In addition to peaking...
capacity, the project, which AES will own and operate, will offer operational flexibility, resulting in the most efficient use of renewable energy. Costs and emissions will be lowered, while reliability will increase.

California also has set a goal of using 100 percent renewable energy by 2045. With that in mind, and as part of a larger modernization and replacement project, AES broke ground in June 2019 on a 100 MW, 400 MWh battery-based energy storage system at the Alamitos Energy Center in Long Beach.

This sustainable facility can be expanded and can provide up to 300 MW, 1,200 MWh of local capacity for flexible and reliable energy for Southern California customers. The AES Alamitos storage project essentially will serve as a peaker, while also maintaining energy grid reliability, reducing greenhouse gas and criteria air pollutant emissions, and improving the integration of intermittent renewable energy resources.

AES also operates in the PJM Interconnection, one of the largest electricity markets in the world, through its Laurel Mountain wind facility in West Virginia. Sixty-one 1.6 MW turbines generate 100 MW of wind power, with 16 MW, 4 MWh of energy storage—enough capacity to supply energy to 24,000 people.

**THE TIPPING POINT**

We’ve reached a point where energy storage is a more cost-effective and environmentally friendly alternative to traditional single-use infrastructure. It offers flexible capacity to meet peak demand, firm renewable generation, and is a transmission asset. With the incorporation of storage into a renewable energy project, we can harness an intermittent source of generation and convert it into safe, reliable, and higher-quality power.

The various projects and range of geographic locations highlighted here show clearly the importance and global potential of renewables-plus-storage. AES will continue to partner with leading companies, such as Fluence, on technological innovation to help us deliver on customers’ changing energy needs.

Our Kaua’i project is a template for a renewables strategy. We expect this type of solution to serve other solar-saturated markets where it is beneficial to time-shift
most of the energy generated to when customers need it. Instead of simply augmenting traditional generation, solar-plus-storage can replace it altogether.

With higher penetration of renewables in global power markets, soon we will see conditions similar to Hawaii’s in many other parts of the world, including remote energy grids on islands and peninsulas, in mining applications, and in deserts. Declining costs of solar and exemplary projects such as the Lāwaʻi Solar and Energy Storage Project will make similar systems the smartest choice to leverage abundant energy from renewables.

Increasingly, we will see energy storage addressing a broader range of applications, including as a source of transmission capacity. Energy storage can reduce congestion by injecting or absorbing power as needed, helping to avoid the need for line upgrades or for new lines to be built.

Through applied innovation, AES takes on our industry’s toughest challenges and creates the best solutions to move the marketplace to new levels of reliability, sustainability, and affordability. These solutions improve the way people work and live today. As we look to tomorrow, we will keep innovating with our visionary partners across the electric power industry to accelerate a greener energy future for everyone.

This June, AES broke ground on a 100 MW, 400 MWh battery-based energy storage system in Long Beach, CA. The facility will provide power at times of peak demand, and will also support grid modernization, increase the integration of renewable energy, and lower costs and greenhouse gas emissions.

**ANDRÉS GLUSKI**

is president and CEO of The AES Corporation