

ADVANCION® APPLICATION STUDY

# Right-Sizing Transmission & Distribution Infrastructure

AES' Advancion platform is the leading battery-based energy storage alternative to traditional grid infrastructure investments. Its small land footprint allows easy siting in dense urban areas, and can be built in a fraction of the time of conventional transmission assets. With Advancion, utilities can improve the efficiency and reliability of their transmission and distribution networks.

**THE APPLICATION**

Transmission and distribution system planning.



Utilizing energy storage in infrastructure planning can reduce grid constraints and improve the efficiency of capital expenditures.

**THE CHALLENGE**

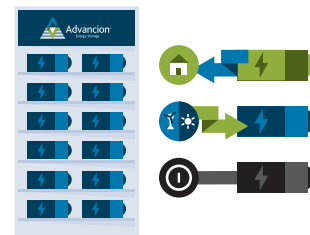
Investments in grid infrastructure are challenged by long lead times, unpredictability and permitting difficulties.



Energy storage can serve highly localized load centers and increase system reliability, ensuring that infrastructure investments are timely and meet the needs of a growing grid.

**THE SOLUTION**

AES Advancion 4 energy storage.



Advancion's nodal architecture is modular, scalable, and enables just-in-time deployment; it can be built to any size, from 1000 MW down to 100 kW, and positioned in the grid exactly as needed. Capacity can be augmented to match load growth over time.



### THE CHALLENGE IN TRANSMISSION PLANNING

Adding transmission capacity is challenging, as economic development patterns continue to be unpredictable, often making the projections used to place new transmission infrastructure inaccurate. This uncertainty is compounded by recent changes to the generation landscape. The expansion of solar and wind generation and the retirement of coal, oil, and nuclear plants, combine to create variations that create transmission challenges.

Investment in the electrical transmission system exceeds \$20 billion annually<sup>1</sup>. The bulk of this will be spent on planning and constructing traditional high-voltage AC lines, but the size of the market also provides room to apply emerging technologies to enhance grid utilization and efficiency.

When building transmission, the peak 10% of demand, taking up less than 1% of the operating hours of the year, determines the system size. This results in large expenditures and a utilization factor of just 55%<sup>2</sup>. Load factors such as these would be unsustainable in the airlines and communication industries.

### THE SOLUTION: AES ADVANCION ENERGY STORAGE

New investments should source the best available technology to address the needs of the energy grid. Extensive studies highlight the benefits of using battery-based energy storage in transmission applications<sup>3,4</sup>. Energy storage can right-size the grid and reduce the impact of peak demand; it has been proven in the field, with orders now exceeding 2 GW<sup>5</sup>.

AES' Advancion system is the leading battery-based energy storage alternative to traditional grid infrastructure investments. Its small land footprint can be easily placed in dense urban areas and can be built in a fraction of the time of traditional transmission assets. This presents a simple and efficient permitting process.

Advancion's nodal architecture is modular, scalable, and enables just-in-time deployment of resources; it can be built to a precise size and positioned in the grid exactly as needed. This unique architecture provides unprecedented levels of reliability through a massively parallel design. Capacity can be augmented at new or existing sites any time and expanded side-by-side with load growth. Transmission owners will derive significant benefits by considering energy storage, including a more efficient use of capital, targeted and real-time deployments to meet load growth, and increased grid stability.

### HIGHLY LOCALIZED ALTERNATIVE TO T&D INVESTMENTS

Advancion allows energy generated in off-peak periods to be saved for delivery at the daily peak. This can help avoid or defer the need for upgrades to existing transmission lines approaching their service limit. By looking at the demand profile of the line and nearby load centers, an optimal storage network can be determined to keep operations within the normal capacity of the transmission line. Placing a 10 MW Advancion array near a load center served by a fully loaded 50 MW transmission line reduces the load to 40 MW, extending its service life.

### PUSHING CAPACITY TO THE LIMIT

The loss of any single line can be a major strain to the grid. System operators must be prepared for N-1 type contingencies. In this scenario, a line malfunctions or is shut down, subtracting capacity from the grid (hence, N-1). To protect against this, the line is assigned a lower load, and full capacity is reserved only for use during system contingencies. In some corridors, major lines are significantly underutilized.

Energy storage helps transmission operators completely utilize existing network capacity. With Advancion providing the contingency resource<sup>6</sup>, line capacity can be used more effectively. Line losses are reduced delivering power over additional paths, or more power can be sent across the grid. Enhancing the use of transmission assets ensures that the return-on-investment for the overall grid is maximized.

### ADDITIONAL BENEFITS

Advancion can provide efficient four quadrant operation with variable power factors. This provides additional flexibility for operators to meet the reactive power needs of the grid for voltage control. Advancion can ramp from full load to full generation in seconds in response to grid events, providing highly accurate response that will enable higher level of grid stability.

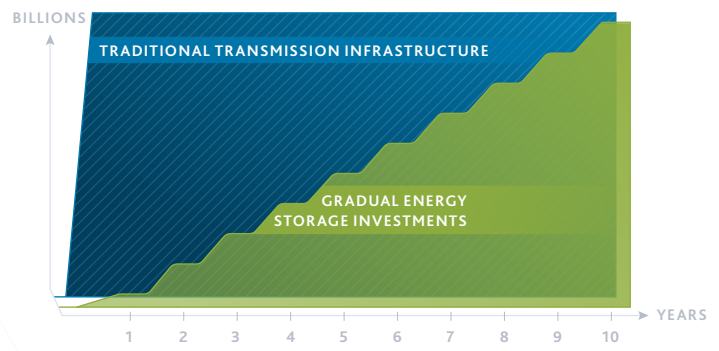
### STAYING AHEAD OF THE DEMAND CURVE

Traditional transmission lines are a one-size-fits-all solution—a new line must be built from fixed conductor sizes, often significantly larger than required—with considerable investments in planning, routing, and construction. Capacity must be built far ahead of demand, as development can take 5 years or more.

Energy Storage provides the opportunity for transmission network operators to deploy systems in as little as 6 months. This changes the dynamic of infrastructure investments, creating the ability to deploy capital in a lock-step fashion. (See Fig. 1)

With Advancion, grid operators can leverage the declining costs of batteries to create a more cost-effective solution for grid needs. Advancion's nodal architecture allows for gradual capacity expansion both at new and existing sites, incorporating the latest developments in battery technology over time, making the solution 100% future-proof.

Fig. 1: INVESTMENTS IN ENERGY STORAGE



<sup>1</sup><http://www.eei.org/ourissues/ElectricityTransmission/Pages/default.aspx>

<sup>2</sup><https://epicenergyblog.com/2015/07/14/half-empty-planes-utilization-rates-for-californias-electric-grid-part-ii/>

<sup>3</sup><http://www.sandia.gov/ess/publication/doespri-electricity-storage-handbook> (Chapters 1.3, 1.4)

<sup>4</sup>"Energy Storage for Relief of Transmission Congestion", IEEE Transactions on Smart Grid, Vol. 5, No. 2, March 2014

<sup>5</sup><http://tdworld.com/generation-renewables/grid-connected-energy-storage-projects-pipeline-hit-2gw>

<sup>6</sup><http://energystorage.org/energy-storage/case-studies/aes-energy-storage-angamos-battery-energy-storage-system-bess>

ADVANCION® CASE STUDY

# AES Alamos Energy Storage

Energy Storage is the most cost-effective solution for peaking applications, favored over gas peaking plants, considering long-term economics and the full range of benefits gained from grid balancing capabilities delivered by Advancion.

## LOCATION

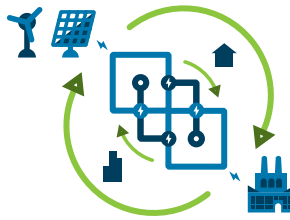
Long Beach, California



In the densely populated Los Angeles area with limited locations to site much needed electrical infrastructure, repurposing of existing sites is critical.

## THE NEED

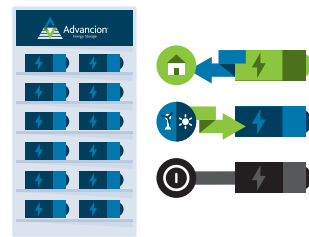
Environmentally responsible and highly flexible resources in preferred locations.



California's environmental objectives and rapidly changing net load profile require clean, fast ramping peak power solutions to reduce greenhouse gas emissions and maximize the utilization of renewable energy.

## THE SOLUTION

AES Advancion 4 energy storage.



The 100 MW lithium-ion energy storage facility will serve as a peaking plant that will provide both the ability to charge during off-peak periods and discharge for up to four hours in combination with providing much needed grid stabilizing services.



## CLIENT NEED

The power grid is one of the most complex and innovative systems ever designed. It has served us well for over 100 years, improving our lives and becoming the backbone of our society. The convergence of global electrification, decarbonization and decentralization is disrupting this model, creating the need for flexible and responsive technologies that meet the needs of our evolving grid.

Fast ramping, peak power has become a necessity in California, as the “duck curve” illustrates the daily, sharp increase in Net Load during high energy consumption periods. In the Los Angeles area, the retirement of large generation facilities created the need to procure replacement capacity flexible enough to meet the demands of a modern grid. With the additional unexpected shutdown of the San Onofre Nuclear Generating Station in 2012, the need for new capacity only increased.

Regional utility Southern California Edison (SCE) issued an all source RFP for replacement peaking capacity in the LA basin area. Transmission constraints created the additional challenge that systems be placed near the load centers they would serve<sup>1</sup>. Between 2013 and 2014, SCE evaluated over one thousand responses to its request. The responses included a wide variety of technologies, including large scale combined cycle, simple cycle gas turbines, demand response and energy storage. After extensive evaluation of each proposal on a long-term economic market model, SCE selected energy storage as a viable solution to meet its peak load needs.

## ENERGY STORAGE MEETS PEAK POWER NEEDS

SCE’s selection of AES Alamos Energy Storage in such a competitive environment is an affirmation of the long-run cost-efficiency of battery-based energy storage. SCE’s procurement of energy storage far outstripped the California Public Utilities Commission’s modest deployment timeline<sup>2,3</sup>, making it clear that the economic benefits are the driving factor for implementing grid storage.

Grid storage enhances overall flexibility, reliability, and capacity value. It reduces emissions by substituting for traditional peaking plants, and by improving the availability of renewable resources. It can be forward-deployed to cut transmission losses, while its load-shifting and instant availability serve to reduce out-of-merit generation, start-up costs for traditional peaking plants, and overall peak energy costs. For these reasons, advanced energy storage

technology is not just a possibility, but an exponentially growing reality in the electrical industry.

SCE’s economic models determined that between 400 and 900 MW of energy storage was the optimal resource for its grid; the Alamos deployment was sized at 100 MW and is the largest contracted lithium-ion based energy storage project to-date.

## THE SOLUTION: AES ADVANCION®

AES’ Advancion system is the leading battery based energy storage alternative to traditional peaking facilities, and is now being deployed at numerous sites worldwide. Advancion requires no fuel or water. Its small land footprint can be easily placed in dense urban areas and can be built in a fraction of the time of traditional generating facilities. This presents simple and efficient site permitting.

Advancion can be scaled to any desired peak power and duration, from 100s of KW to 100s of MW and beyond. The system is permanently connected to the grid, and is capable of responding to grid requirements at any time. It has advanced line regulation capabilities, dispatchable within seconds by market-responsive algorithms, to improve overall power quality at the point-of-interconnection. This allows regional power plants to operate closer to full capacity, rather than derating in order to provide these critical grid services.

AES Alamos is a 100 MW, lithium-ion energy storage facility that will serve as a peaking plant. The system can be charged at off-peak times and discharged during peak periods, up to 4 hours at maximum load. Its rapidly-controllable load and generation capabilities creates a resource with twice the flexibility of traditional generation, providing critical peaking capacity to the Los Angeles region.

## OUTLOOK

AES Alamos Energy Storage has been approved and is in an advanced stage of system integration, with a target operating date of 2020. The system will provide peaking demand and enhance grid stability through at least 2040.

The experience gained in planning this large-scale project has headlined lithium-ion energy storage as a solution for the Aliso Canyon energy deficit<sup>4</sup>, where seasonal undersupply of natural gas might otherwise cause rolling blackouts<sup>5</sup>. Even at scales of 150 MW or more, an Advancion Energy Storage System can be deployed in a matter of months, compared with years for traditional generating stations.

<sup>1</sup>CPUC D.12-03-014, Figure I-2

<sup>2</sup><http://www.greentechmedia.com/articles/read/california-sets-1.3gw-energy-storage-target-by-2020>

<sup>3</sup><http://www.powermag.com/sce-signs-contracts-for-record-amount-of-energy-storage/>

<sup>4</sup><http://www.latimes.com/business/la-fi-electricity-storage-20160526-snap-story.html>

<sup>5</sup><http://www.pe.com/articles/california-798996-gas-energy.html?page=1>