Advancion®
Energy Storage
Building the Clean, Unbreakable Grid
Advancion is a fourth generation complete energy storage solution, developed from the experience gained in nearly a decade of grid service.
Advancion® leverages more than 30 years of experience serving utility customers.

Representing nearly a decade of commercial energy storage development and operations, Advancion delivers the most proven, safe and reliable, and best performing battery-based energy storage solution in the industry.

Advancion is built for the long-term owner-operator, leveraging the knowledge and deep experience gained from managing power assets globally, and practical use of battery based storage for grid services. Started in 2006 with a vision for a better way to serve the needs of the electric grid, Advancion was developed at a time when no complete storage solutions were available. AES Energy Storage worked with leading component suppliers to create a storage solution to meet its vision. Now, ten years later, we offer the 4th generation of this proven platform.

We have combined everything we have learned about designing, developing, and operating energy storage into one complete platform: AES Advancion.
Solving the Energy Equation

Utilities, system operators, generators, and large load centers need new energy technology that is flexible, available, and clean. The convergence of global electrification, decarbonization, and decentralization of power generation is creating a need to redesign and modernize the energy grid. Choosing traditional forms of energy to provide new capacity results in an underutilized and inefficient energy infrastructure.

Battery-based energy storage addresses this need in a way that is distinct from other generation technologies. It provides unmatched operational flexibility, enabling the most efficient use of transmission resources and generating plants, lowering cost and emissions, while supporting the ongoing addition of renewable power sources. Storing and redistributing energy, these adaptive technologies strengthen and modernize the energy grid.

This new modern architecture is the key to building a clean and unbreakable energy grid. Battery storage fortifies current infrastructure while preparing for the future of power consumption: a resilient network that operates seamlessly in the face of weather events or accidents, no matter where you are or when you need it, providing clean, abundant energy.

BUILDING THE BALANCE

Advancion brings flexibility to the power grid by providing a range of services that support the modernization of the grid. A resource that is always available, it can balance electricity demand and supply, integrate renewable sources of energy, and respond immediately to peak power demands. Its scalable nature allows systems to be built to meet the need of any network.

1. ALWAYS ON
   Connected to the grid and ready to provide services at all times.

2. INCREASED RELIABILITY
   Providing critical grid balancing services.

3. RENEWABLE INTEGRATION
   Acting as load during times of over production and limiting ramp rates.

4. FLEXIBLE PEAKING CAPACITY
   Providing near instantaneous power when needed.

the benefits

OF ENERGY STORAGE

GRID EFFICIENCY
Allows other grid resources to operate at optimal output.

CLEAN ENERGY
Helps cut emissions by taking load off fossil-fuel generation.

TWICE THE RESOURCES
Providing generation and load, storage offers twice the flexibility of a peaker.

INCREASED RELIABILITY
Annual US cost of power outages is as much as $130 billion.

RENEWABLE INTEGRATION
Balances inherent variability from renewable sources of energy.
As a forerunner in the development of energy solutions, AES Advancion's nodal architecture represents the most advanced technology in the industry.

**Nodal Architecture**

Advancion delivers unmatched operational flexibility. Unique to the platform is its next-generation nodal architecture, providing compact, autonomous units of control. This architecture enables planned array augmentation, allowing sites to grow over time, incorporating the latest battery technology from multiple suppliers.

**Future Proof**

Built to take advantage of the current and future supply chain for energy storage, Advancion is designed to incorporate new technology over time.

**Scalable**

Advancion arrays are modular, making them scalable to hundreds of MW of capacity and allowing the architecture to grow with customers' unique needs, kilowatt by kilowatt.

**Simultaneous Operations**

Built for the distributed world, Advancion's nodal design provides unprecedented control, allowing for multiple services within the same array or across distributed arrays.

**Dependable**

Grid battery arrays use massively parallel architectures to provide industry-leading reliability and optimized serviceability of the array.

**Advancion® Control System**

A proprietary control system unlocks the full value of the nodal architecture, allowing for simultaneous operations across the array, reducing auxiliary power consumption, and optimizing battery performance and life.

**Optimized Design**

- **Node:** A compact, autonomous unit of control.
- **Array:** A collection of nodes.
- **Battery:** The energy storage component.

**Unprecedented Flexibility**

Batteries on the grid are always plugged in, so they are always on. They can act as both generation and load, providing multiple services that allow for more efficient use of transmission resources, generating assets, and large load centers. The patented Advancion Control System dispatches individual nodes in the array according to energy demand and node state.
PROVEN SUPPLY CHAIN

Advancion® Certification Program

Advancion’s certification program leverages relationships with the world’s leading equipment manufacturers to create standardization that allows for scalability and simple implementation.

ESTABLISHED FLEET

Designed by Industry Leaders

Designed by and for owner-operators, leveraging deep industry expertise to pinpoint and solve problems on the grid. The resulting platform is designed to be scalable and rapidly deployable, and serve the long term needs of operators.

Lowest Total Cost of Ownership

Combining an industry leading supply chain, standardized system deployment, improved serviceability, higher availability, and a proprietary control system, Advancion provides the highest return for its customers.
Global Energy Innovators

Advancion is backed by a decade of research and multiple generations of product. The platform is available worldwide, installed directly by AES or through a network of leading partners.

OVER 3 MILLION MEGAWATT-HOURS DELIVERED SERVICE

The most comprehensive and advanced fleet of battery-based energy storage in the world.

FOURTH GENERATION TECHNOLOGY

Incorporating over 8 years of real-world commercial experience.
Setting the Standard

Advancion deployments have marked milestones in the industry. We work with our customers to develop power solutions that are dependable, cost-competitive, and smart in order to meet their needs and complement existing assets.

394 MW TOTAL

In operation, construction, or late stage development

15 LOCATIONS

In 7 DIFFERENT COUNTRIES

*In operation, construction, or late stage development.
Secure and Sustainable Solutions

Advancion allows customers to avoid complicated and costly environmental permitting, procurement is simple, and once implemented Advancion improves network efficiency across all energy assets.

FREQUENCY REGULATION

Providing critical grid balancing, Advancion provides frequency response in less than a second to stabilize an interconnection.

FREQUENCY REGULATION CASE STUDY | AES LAUREL MOUNTAIN

The AES Laurel Mountain Storage Array enables a 58 MW wind farm to be among the first wind generation facilities to supply critical grid stability services. It has consistently been selected for regulation service among competitively bid offerings in PJM, serving as a low cost, better performing, zero-emissions, renewable energy alternative to traditional power generation.

FLEXIBLE PEAKING CAPACITY

Locating Advancion in a critical load pocket, utilities can meet peak demand needs and receive twice the flexible range of a peaker plant to integrate renewable generation, while reducing system-wide emission.

FLEXIBLE PEAKING CAPACITY CASE STUDY | ALAMITOS POWER CENTER

Resulting from a three year process (2012 through 2014 — part of California’s Long Term Procurement Plan), that fully considered the value of storage for peaking capacity needs while accounting for changing system conditions, SCE’s unconstrained economic models identified 400-900 MW of grid-scale storage as the most optimal resource. No gas peakers were found to be economic.

CAPACITY RELEASE

By shifting reserve capacity to battery storage, generators sell more power from the same plant. System reliability is increased through generation and regulating that is online and can begin responding immediately.

CAPACITY RELEASE CASE STUDY | AES GENER POWER PLANT

The AES Angamos Storage Array integrates 20MW of energy storage with a 544MW thermal power plant to provide advanced reserve capacity. The storage enables AES Gener’s Angamos plant to increase power generation by 4% to serve an important mining region in the country.

COMMERCIAL AND INDUSTRIAL APPLICATIONS

Providing demand charge reduction and critical backup power to large facilities that create the products and services that are essential to our daily lives, Advancion is well suited for “behind the meter” applications. Advancion adds reliability for the end user and relieves utilities from costly upgrades required to support these large facilities.

C+I APPLICATION CASE STUDY | PANASONIC TECHNOPARK

Panasonic and AES will construct a 10 MW energy storage array at Panasonic’s Technopark manufacturing facility in Jhajjar, Haryana. This joint project is the first large-scale battery-based energy storage project in India. The storage will provide daily reliability and back-up to the manufacturing facility, while demonstrating grid stability and renewable integration services in the region.
Advancion® Technical Specifications

Advancion Arrays are modular and scalable configurations of Advancion Core and scale to thousands of MWs controlled by a patent-pending hardware and software control aggregation platform.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
<th>Note</th>
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<tbody>
<tr>
<td><strong>POWER</strong></td>
<td>100 kW to 2 MW per Core; from 1 to 1024 Cores per Array</td>
<td></td>
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<tr>
<td><strong>FLEXIBLE RANGE</strong></td>
<td>2x Interconnected Nameplate Power</td>
<td></td>
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<tr>
<td><strong>VOLTAGE</strong></td>
<td>420 VAC (Isolation transformer to selectable voltage)</td>
<td></td>
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<tr>
<td><strong>REACTIVE POWER</strong></td>
<td>Adjustable based on application, up to 0.85 leading to 0.85 lagging (reactive capability available over full real power range)</td>
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<tr>
<td><strong>RAMP CAPABILITY</strong></td>
<td>Max capacity change in &lt; 1 second</td>
<td></td>
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<tr>
<td><strong>DURATION</strong></td>
<td>30 min; 1 hr; 2 hrs; 4 hrs</td>
<td></td>
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<tr>
<td><strong>ROUND TRIP EFFICIENCY</strong></td>
<td>&gt;85% &gt;88% &gt;89% &gt;90%</td>
<td></td>
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<tr>
<td><strong>EQUIVALENT AVAILABILITY FACTOR</strong></td>
<td>&gt;970%</td>
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<tr>
<td><strong>OPERATING TEMPERATURE</strong></td>
<td>-20°C to 50°C</td>
<td></td>
</tr>
<tr>
<td><strong>ALTITUDE</strong></td>
<td>De-rated over 5,000 ft</td>
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<tr>
<td><strong>SEISMIC RATING</strong></td>
<td>Available ratings up to Zone 4</td>
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<tr>
<td><strong>RIDE-THROUGH</strong></td>
<td>Low/high voltage ride-through</td>
<td></td>
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<tr>
<td><strong>STANDARDS COMPLIANCE</strong></td>
<td>Meets or exceeds industry standards, including IEEE519, NEC, UL1741, UL1642, UL1973</td>
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<td><strong>CONTROL &amp; MONITORING</strong></td>
<td>Advancion Control includes HMI, SCADA, Data Historian, Application Agents, and Patented Performance Algorithms</td>
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</tr>
<tr>
<td><strong>EXTERNAL CONTROL INTERFACE</strong></td>
<td>SCADA and EMS integration available via DNP3 or comparable</td>
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<tr>
<td><strong>BATTERY CHEMISTRY</strong></td>
<td>Advanced lithium ion sealed cells or similar</td>
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### POWER FLEXIBLE RANGE

- **VOLTAGE**: 420 VAC (Isolation transformer to selectable voltage)
- **REACTIVE POWER**: Adjustable based on application, up to 0.85 leading to 0.85 lagging (reactive capability available over full real power range)
- **RAMP CAPABILITY**: Max capacity change in < 1 second
- **DURATION**: 30 min; 1 hr; 2 hrs; 4 hrs
- **ROUND TRIP EFFICIENCY**: >85% >88% >89% >90%
- **EQUIVALENT AVAILABILITY FACTOR**: >970%
- **OPERATING TEMPERATURE**: -20°C to 50°C
- **ALTITUDE**: De-rated over 5,000 ft
- **SEISMIC RATING**: Available ratings up to Zone 4
- **RIDE-THROUGH**: Low/high voltage ride-through, Low/high frequency ride-through (settable thresholds)

### STANDARDS COMPLIANCE

Meets or exceeds industry standards, including IEEE519, NEC, UL1741, UL1642, UL1973

### CONTROL & MONITORING

Advancion Control includes HMI, SCADA, Data Historian, Application Agents, and Patented Performance Algorithms

### EXTERNAL CONTROL INTERFACE

SCADA and EMS integration available via DNP3 or comparable

### BATTERY CHEMISTRY

Advanced lithium ion sealed cells or similar

### REACTIVE POWER CAPABILITY

- **P, Q Capability Curve (p.u.)**
- **V, I base** based on system sizing
- **V, I max** = 420 VAC
- **I, Q max**
- **Capability varies based on desired overrate duration**
- **150% of rated MW capacity available for overrate durations of 60 seconds or less**

### OVERRATE CAPABILITY

Overrate Level Available for A Given Overrate Duration

### OPERATION MODES AND APPLICATION SERVICES

The Advancion Array Control System has 3 main Modes of Operation: Automatic Resource Control (ARC), Autonomous Dispatch, and Manual Dispatch. Each Array also has multiple, unique, and fully customizable Application Services definable at the Array or Core-group (Unit) level.

### ADVANCION CONTROL SYSTEM MAIN OPERATING MODES AND CORRESPONDING APPLICATION SERVICES

<table>
<thead>
<tr>
<th>APPLICATION SERVICES</th>
<th>OPERATING MODES</th>
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<tbody>
<tr>
<td>Real and Reactive Power Dispatch</td>
<td>•</td>
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<tr>
<td>Primary Frequency Control (Droop/Response)</td>
<td>•</td>
</tr>
<tr>
<td>Secondary Frequency Control (Automatic Generation Control)</td>
<td>•</td>
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<tr>
<td>Contingency Response</td>
<td>•</td>
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<tr>
<td>Spinning Reserves</td>
<td>•</td>
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<tr>
<td>Automatic Voltage Regulation (Voltage-Droop)</td>
<td>•</td>
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<tr>
<td>Constant Power Factor</td>
<td>•</td>
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<tr>
<td>Renewable Ramp Limiting</td>
<td>•</td>
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<tr>
<td>Black Start</td>
<td>•</td>
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<tr>
<td>Isochronous Operation</td>
<td>•</td>
</tr>
<tr>
<td>Transmission &amp; Distribution Deferral</td>
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</tbody>
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1 Similar to Automatic Generation Control via Modbus TCP or DNP 3
2 Via the Advancion HMI on a workstation or touch interface