# Why Data Center may opt BESS over UPS?

*Data Centers has been reliance on UPS for power backup for many years. While UPS are reliable for short-term power outages, challenges faced by DCs nowadays extend beyond that. Deep power fluctuation, prolonged brownouts, cost saving needs, and carbon footprint reduction are issues beyond UPS capability. BESS on the other hand, have advanced features such as load shifting, peak shaving, grid smoothing, integration with renewables, and scalability that can help those issue.*

In the digital age, **data centers** serve as the critical infrastructure underpinning the global economy. These massive facilities house the servers, storage systems, and networking equipment that power countless online activities, from online transactions and social media interactions to cloud computing and artificial intelligence. Without data centers, the seamless flow of information that fuels innovation and commerce would grind to a halt. They are the silent engines that keep the digital world humming, enabling real-time communication, data exchange, and access to essential services. As our dependence on digital technologies continues to grow, the importance of data centers in fostering economic prosperity and societal progress will only become more pronounced.

The exponential growth of data generation and processing necessitates a corresponding expansion of data center infrastructure. However, these facilities are major consumers of electrical energy, often relying on traditional grid sources with inherent limitations. Fluctuations, outages, and dependence on fossil fuels pose significant challenges to data center operations and contribute to environmental concerns.

## Battery Energy Storage Systems (BESS)

BESS technology presents a paradigm shift in data center power management. By storing excess electrical energy during off-peak periods, BESS acts as a readily available backup power source, ensuring uninterrupted operation during grid outages. This enhances power security and system resiliency, crucial for business continuity and data integrity.

Furthermore, **BESS facilitates the integration of renewable energy** sources, such as solar and wind power, into data centers. These renewable sources, while environmentally friendly, are inherently intermittent. BESS mitigates this intermittency by smoothing out fluctuations in power output, guaranteeing a consistent and reliable flow of clean electricity to critical data center equipment.

Pic 1: Renewables in data center

## Power Conditioning Systems and BESS

PCS play a vital role in optimizing the benefits of BESS integration. These intelligent systems manage the flow of power between the grid, renewable sources, and BESS. PCS ensure a stable and balanced power supply by regulating voltage fluctuations, filtering electrical noise, and correcting minor power disturbances. This not only protects sensitive data center equipment but also optimizes the charging and discharging cycles of the BESS, extending its lifespan and maximizing its efficiency.

While both Battery Energy Storage Systems (BESS) and Uninterruptible Power Supplies (UPS) offer backup power, PCS+BESS boasts several advantages that make it a better choice for large-scale data center applications.

UPS systems excel at providing short-term power during outages, typically lasting from minutes to hours. However, BESS offers significantly **longer backup durations**, ranging from hours to even days. This extended runtime is crucial for data centers to ensure uninterrupted critical operations during extended grid outages.

BESS can also participate in **energy management** and **cost saving strategies** like peak shaving, reducing reliance on the grid during peak demand periods and lowering overall electricity costs. Overall, BESS provides a more comprehensive and future-proof solution for data center power management.

## Economic and Environmental Advantages

BESS offers compelling economic benefits for data centers. By enabling the utilization of off-peak electricity rates and reducing reliance on the grid during peak demand periods, BESS contributes to significant cost savings. Additionally, BESS facilitates the adoption of renewable energy sources, further reducing dependence on fossil fuels and lowering the overall carbon footprint.

## Conclusion

The integration of BESS with PCS represents a groundbreaking advancement in data center power management. This synergistic approach not only enhances power reliability and operational efficiency but also paves the way for a more sustainable future for data centers. By minimizing reliance on traditional grid sources and promoting the utilization of renewable energy, BESS empowers data centers to operate with greater environmental responsibility while ensuring uninterrupted service and cost optimization.

*References:*
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# Power Backup & Cost Saving

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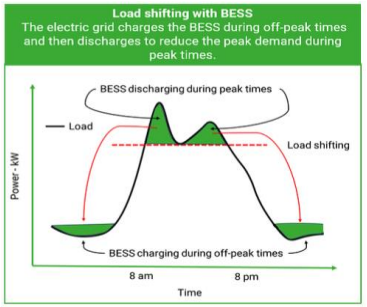
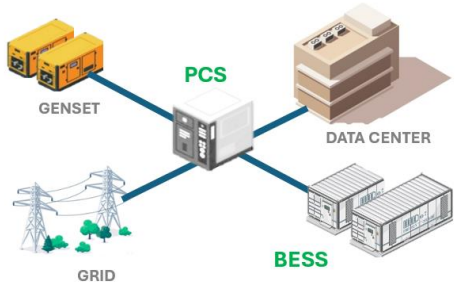
- ✓ **Critical Infrastructure Protection:** Facilities reliant on uninterrupted power, such as hospitals, data centers, process control room, and communication networks, can significantly benefit from BESS backup. During an outage, BESS ensures the continued operation of vital equipment, minimizing service interruptions and potential safety risks.
- ✓ **Instant Black Start Capability:** In the event of a widespread blackout, traditional power plants require extra time to restart. BESS can serve as a crucial backup source, providing the initial power needed to jumpstart essential generators and begin the process of restoring system power.
- ✓ **Rapid Response to Fluctuations:** BESS can react rapidly to real-time fluctuations from the grid. Advanced control systems allow BESS to charge and discharge strategically, ironing out the wrinkles in power supply and effectively smoothing out the overall power curve. This real-time response capability helps to maintain a stable power, mitigating voltage sags/swells and dips.
- ✓ **Frequency Regulation:** Maintaining a constant grid frequency is essential for the proper functioning of critical equipment. BESS can act as a fast-acting frequency regulator by absorbing or injecting energy as needed. This helps to maintain the grid frequency within a narrow range, preventing cascading outages that could cripple entire regions.

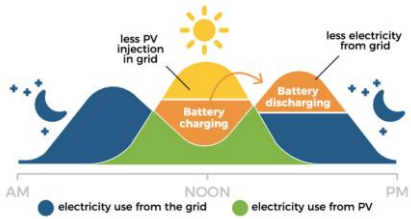
## Load Shifting Saving

Battery Energy Storage Systems (BESS) enables load shifting. This strategy leverages the ability of BESS to store electrical energy during off-peak hours, when demand and electricity prices are typically lower. The stored energy can then be discharged during peak hours, when demand and electricity prices are at their highest.

With capability to shifting energy consumption patterns in this way, BESS empowers business to **reduce their overall electricity costs** and contribute to efficient operation.



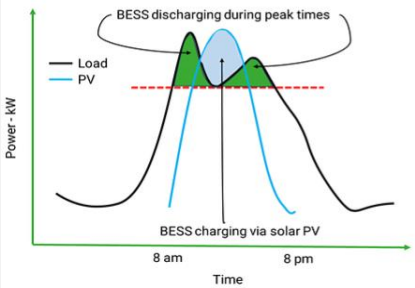




## Peak Shaving cost reduction

Battery Energy Storage Systems (BESS) can be implemented for peak shaving. By strategically employing this approach, business & utilities can avoid **unnecessary expensive investments** by sizing down generation capacity to meet realistic average demand, instead of following peak demand.

BESS also reduces the need for traditional power plants to **constantly ramp up and down** to meet fluctuating demand. This not only minimizes wear and tear on the power generation plants but also improves their overall efficiency, leading to potential cost savings and reduced greenhouse gas emissions.

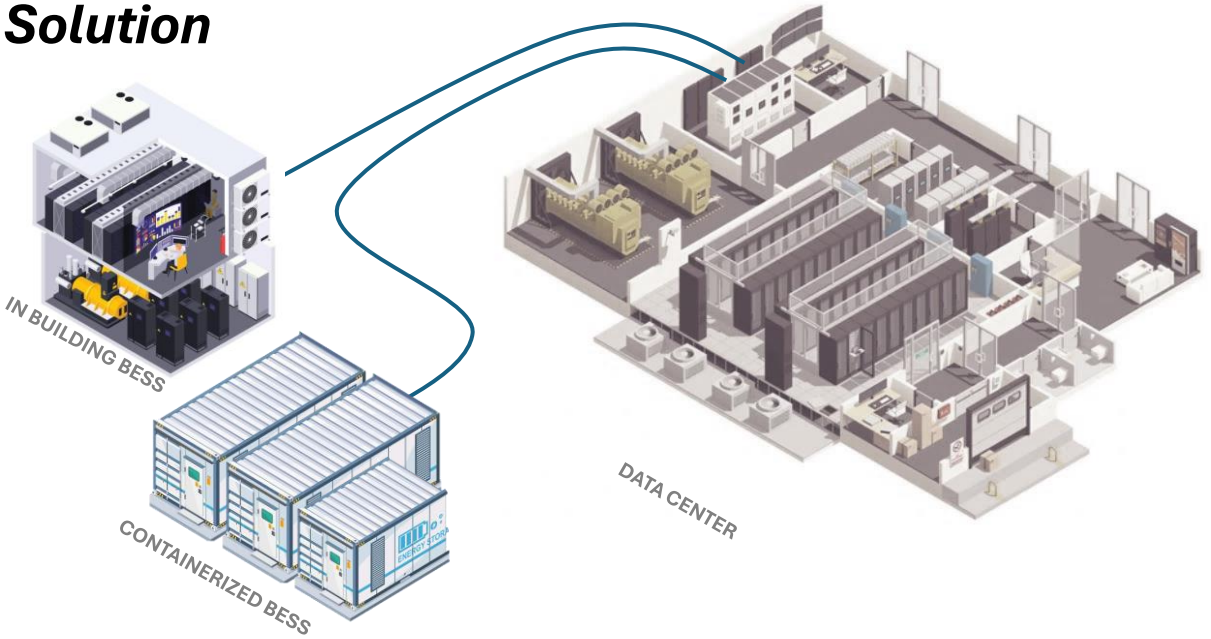
This way, **CAPEX and OPEX investment can be optimized**.




## Onsite Power Generation

While renewable energy sources such as solar and wind power offer compelling possibility of **virtually free energy**, their inherent variability and intermittency can pose challenges for critical system. BESS can function as large-scale storage of surplus electricity generated during periods of peak production – sunny days for solar or high-wind hours and allows for the delayed utilization of this clean energy. This stored energy can then be released back when renewable generation
Consequently, BESS facilitating the integration of a **reliable, low cost**, renewable energy

# Data Center & Control Center Solution




## CONTAINERIZED SYSTEM

250 kWh – 1.2 MWh / block
7 /10 / 20 / 40 ft insulated container
Selectable operation option (from PCS module range)
Grid forming / assisting
Transformer / transformer-less
Forced air w/ filtration / liquid cooling
Pressurization system for harsh environment (optional)
SCADA/DER controlled
CAN/RS485/Ethernet

## POWER CONVERSION SYSTEM

**PWS1-500KTL**
**Bi-directional storage inverter**
**Offgrid & Interactive mode**
**30kW - 1.7MW Scalable blocks**
150-1500VDC
380/400VAC 3Ph+N
SCADA/DER controlled & EMS

## HYBRID INVERTERS

**PWG2-50/100K**
**Hybrid inverter**
**45kW - 1.7MW Scalable blocks**
250-830VDC MPPT Input
380/400VAC 3Ph+N Output
SCADA/DER controlled & EMS

## BATTERY RACK SYSTEM

**Indoor LV Rack System**
5 - 30 kWh / block
12 - 72 V DC mode
Natural / forced air
Rectifier / inverter / PCS (option)

**HV Rack System**
30 - 50 kWh / block
240 - 584 VDC
Forced air/natural cooling
Rectifier / Inverter / PCS (option)

**HV Integrated System**
200 - 450 kWh / block
240 - 584 VDC
Forced air / liquid cooling
Rectifier / Inverter / PCS (option)

## PCS + BESS

- ✓ **Power Backup & Quality**. Power Conditioning System (PCS) in a data center safeguards sensitive equipment from issues with the incoming electrical supply. Integration with Battery Energy Storage (BESS), allows greater enhancement, more resistance to even **deep power disturbance, brownout, or blackout**.
- ✓ **Cost saving**
  - ✓ **Load Shifting**. PCS can control BESS to store energy in cheaper low demand and use it during peak demand higher cost period. Saving Opex
  - ✓ **Peak shaving**. PCS + BESS can act as buffering for onsite genset and DRUPS. Allowing engineering to size them down for average demand calculation instead of peak demand. Saving Capex.
- ✓ **Integration with Onsite Renewable**. BESS & PCS can intelligently manage intermittency of onsite renewable generation e.g Solar PV or Wind, allowing low cost & green energy and improving carbon footprint.
- ✓ **Grid Stabilization Support**. Data Center power consumption, with its high demand and sometimes uneven may strain the grid. PCS & BESS can help to mage such condition in-bound and even out-bound if permittable by regulation.

## PCS MODULAR SYSTEM


**Bi-directional inverter 30kW/45 (summable)**
150-750V Charging
700-830V DC bus
400±15V AC

**Intelligent Transfer Switch 100kVA**
- 1ph 220/230VAC
- 3ph 380/400/480VAC

TN-C-S, TN-S, TT, TN-C Grid
SCADA/DER controlled & EMS

**PV charger module 45kW (summable)**
250-830V PV side
700-830V DC Bus
MPPT *3

**Static VAR Generator**
30 – 120 kVAr
400 – 690 V
50 / 60Hz (auto sensing)

**Active Harmonic Filter**
Capacity 5 - 300A
228 – 456 V
IEEE519

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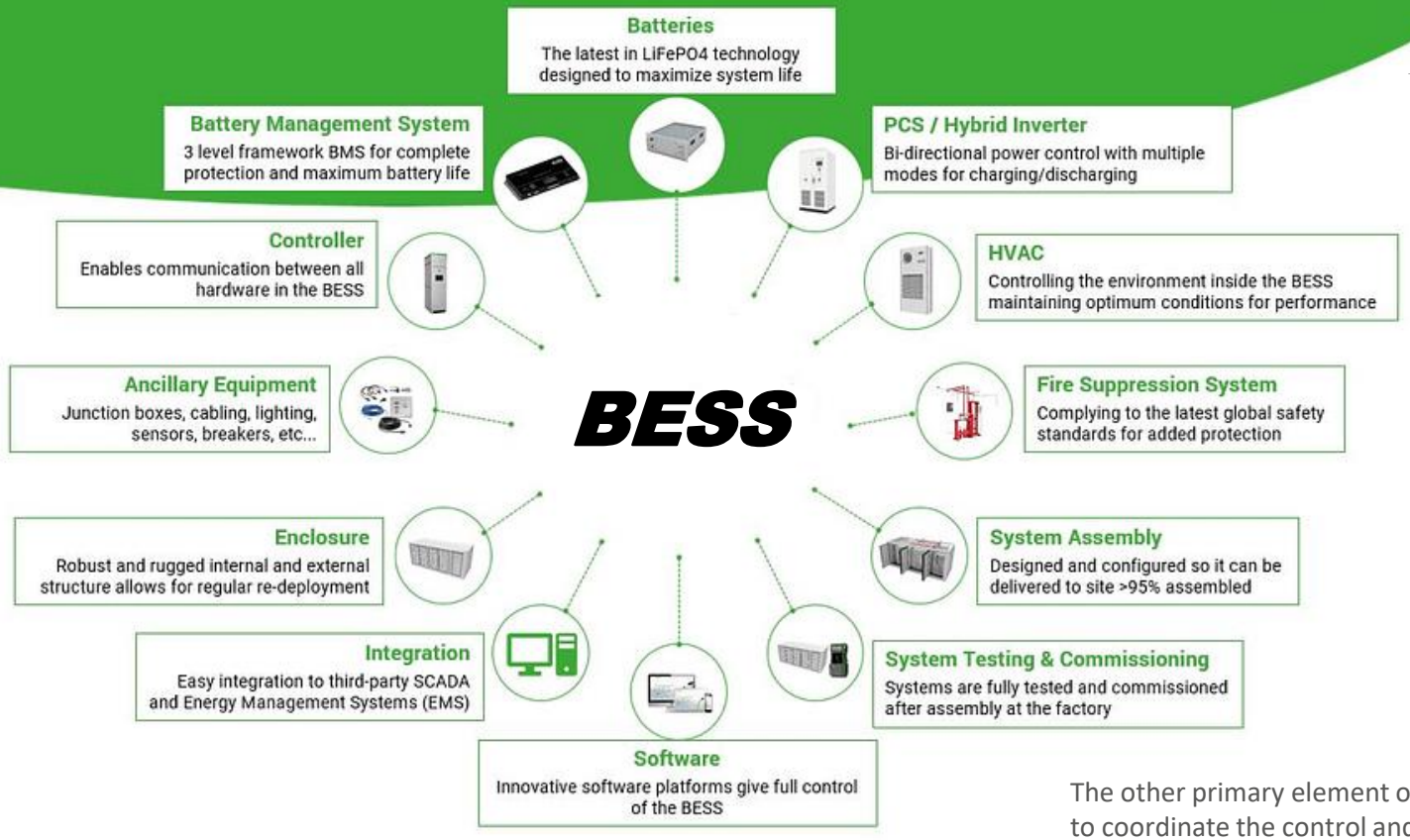


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A battery energy storage system captures energy from renewable and non-renewable sources and stores it in rechargeable batteries for later use

Power Conversion System (PCS) is the main device that converts power between the DC battery terminals and the AC line voltage and allows for power to flow both ways to charge and discharge the battery.

The other primary element of a BESS is an energy management system (EMS) to coordinate the control and operation of all components in the system.

| BESS vs UPS | Scale | Function | Target Application |
|---|---|---|---|
| **BESS** | Designed for **large-scale applications**, fraction of capacity is in hundreds of kW folds. | Offers a broader range of functionalities beyond just backup power. Their PCS can be used for **grid stability** (smoothing fluctuations, frequency regulation), **peak shaving** (reducing power generator size)**,** load shifting , and **energy management** (integrating renewable energy sources to grid | • Utility-scale power grids for grid stability and integration of renewable energy.<br>• Commercial and industrial facilities for peak shaving, load shifting (shifting energy consumption to off-peak hours), and backup power. |
| **UPS** | Primarily for **smaller-scale application**s, protecting individual electronic devices or critical subsystem. | Primarily focused on providing short-term backup power during outages. They bridge the gap between a power outage and the activation of a backup generator or the return of grid power. Usually **has no long-term** power generation function such as MPPT, Grid forming, and EMS. | • Individual computers and critical electronic equipment in homes and businesses.<br>• Data centers and server rooms to ensure uninterrupted operation during outages. |