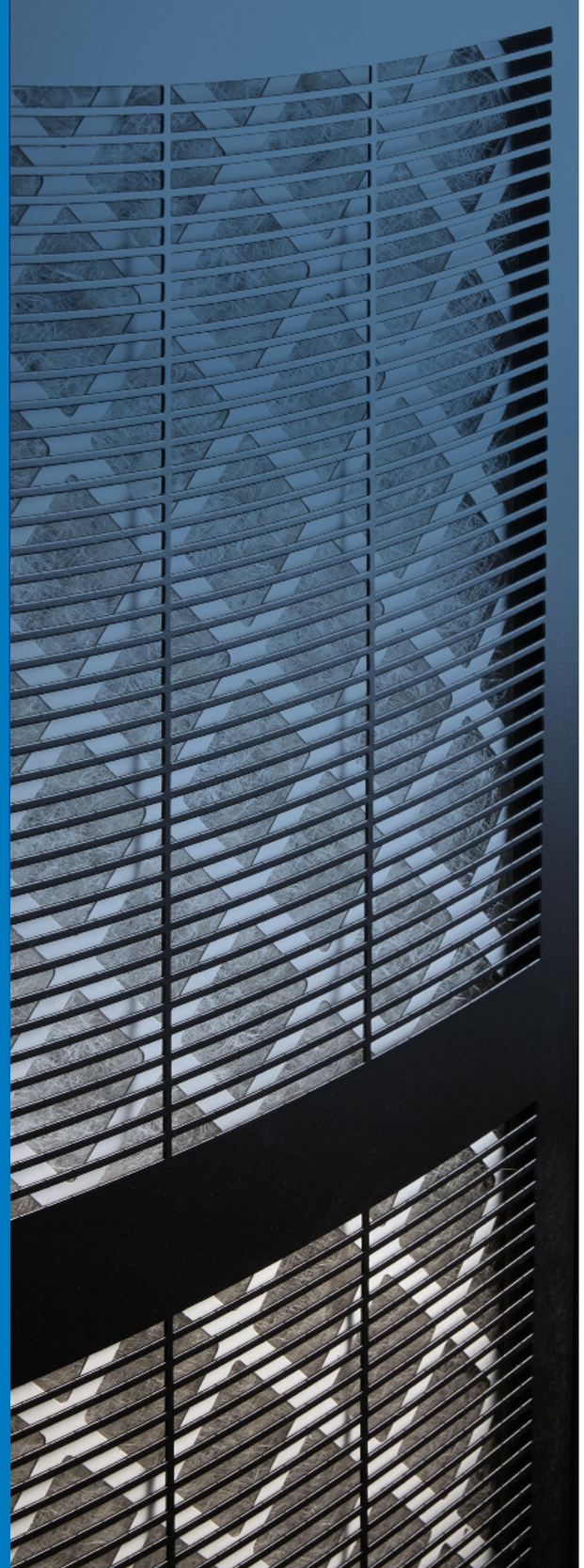
An Eaton Playbook on Li-ion batteries for UPS Applications

Transforming Data Centres With Lithium-ion Technology

Powering Business Worldwide

This playbook serves as an introduction to the use of Lithium-ion (Li-ion) batteries in UPS solutions. It is a guide to help data centre owners and operators understand and incorporate this emerging energy storage technology and offers insight into selecting the right UPS solution for any modern data centre.



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The impact of Li-ion batteries

- The battery is both the most critical and vulnerable part of any UPS solution because of its role in ensuring uptime and keeping IT infrastructure operational, even in a power outage.
- That's why selecting the right battery can make all the difference when it comes to ensuring reliable performance and simplifying maintenance.
- When selecting a UPS battery solution, you will need to assess your risk exposure, the needs of your system and your budget in order to make your decision.
- Thanks to their central role in powering electric vehicles, Li-ion battery technology has matured significantly, making them ideal for use as critical power back-up solutions.
- Their small size, lightweight and longer lifespan have also cemented their position as attractive alternatives to traditional valve-regulated lead acid (VRLA) batteries.
- As a testament to their global impact and game-changing potential, the three scientists that developed the modern Li-ion battery were awarded the 2019 Nobel Prize in Chemistry.

Today, Li-ion batteries can be found in a wide range of devices and systems:

Consumer electronics

Electric vehicles

Personal mobility devices

Portable power bank and charging devices

Not all batteries are made equal

Advancements in Li-ion battery technologies have yielded a multitude of improvements for the industry.

Weight

Weighs up to 40% to 60% less than legacy UPS battery technologies

Capacity

Charging capacity is also significantly higher than that of existing VRLA systems

Size

Approximately 40% smaller, taking up less space in the data centre

Lifespan

Li-ion batteries have a 10- to 15-year lifespan compared to lead-acid alternatives, which need to be replaced every 3 to 5 years

Reliability

Advanced manufacturing techniques and better battery design have decreased the risk of failure dramatically

Environmental impact

Because of their much longer lifespan, Li-ion batteries are less resource-intensive to produce and generate less waste

Always-on monitoring

Built-in Battery Management System (BMS) tracks performance, safety and charging to maximise battery longevity

Handling

Li-ion batteries also contain no toxic materials, unlike lead-acid batteries

Charging

Li-ion batteries can typically be recharged to 90% capacity in under 2 hours for rack-based systems

What are the advantages of Li-ion batteries in the data centre environment?

Smaller footprint

Li-ion UPS battery systems take up markedly less floor space (50-80%) and weigh less than a comparable lead-acid system. This offers dramatically higher power and energy density for the same space, simplifying design and planning requirements.

Better Performance

Li-ion batteries have a greater cycle life (the number of charge/discharge cycles) extending into the thousands, versus approximately 500 for VRLA batteries. Their high cycle-count and faster recharge times compared to their lead counterparts allow for their use in non-traditional UPS applications, such as grid sharing, peak shaving, and industrial or process control support.

Sustainability

While Li-ion batteries are still catching up to lead-acid batteries in terms of recycling capabilities, new technologies are being developed every day and the end-of-life market is still expected to grow. In the meantime, the majority of Li-ion batteries enjoy a second life as part of energy storage systems. From residential to larger grid-scale solutions, used Li-ion batteries can be used as energy storage to reduce stress on the grid and decrease the demand during peaks, ultimately encouraging the adoption of renewables.

Falling costs

Li-ion batteries are not only cheaper to run but are becoming available at a more accessible price point. Overall, a Li-ion battery system provides lower TCO through life cycle Capex costs, and Opex savings via a longer replacement interval, and its ability to operate at higher ambient temperatures. In recent years, the average market prices of Li-ion batteries have also declined drastically, from $1,100/kWh in 2010 to $156/kWh in 2019 – approximately 87% in real terms.

What makes Li-ion batteries safe?

Battery Management Systems (BMS)

- The presence of a BMS, which controls charge rate, voltage and temperature, makes lithium batteries less likely to enter thermal runaway than traditional UPS batteries.
- The BMS automatically cuts the battery from the UPS load or charger should the battery reach its control temperature limit.

Li-ion UPS battery design

- Unlike consumer devices, Li-ion UPS batteries are not constricted by space. Hence UPS batteries have extra space to ensure that the plates inside will not short out, even in extreme conditions.
- Modern Li-ion battery packaging is also designed to dissipate the maximum amount of heat possible while incorporating safety fuses, overcharge protection, and hardened material layers for maximum stability.

Non-toxic

- Unlike lead-acid batteries, there is a low likelihood of any corrosive or poisonous materials leaking or spilling out of a Li-ion battery.
- Li-ion batteries are safe to handle on a daily basis.

International safety standards

- All Li-ion batteries used in Eaton UPS products or recommended by Eaton are manufactured in compliance with UL and other international safety standards.

Do Li-ion batteries pose a fire risk?

- At this time, there is a very low risk of thermal events in Li-ion batteries when package with proper BMS.
- The presence of a BMS has been instrumental in the detection and mitigation of any anomalies, cutting off power as soon as any issues are detected.
- Additionally, all of Eaton's lithium battery cabinets comply with UL 9540A testing, an international standard for evaluating the risk of thermal runaway fire propagation in battery energy storage systems.

What is Thermal Runaway?

- Thermal runaway occurs when the heat generated within the cells of a battery exceeds its ability to dissipate it, which can lead to an explosion, especially in sealed cells.
- The heat generated in the cell may occur without any warning signs and may be caused by overcharging, excessive charging, internal physical damage, internal short circuit or a hot environment.
- The presence of a BMS in Li-ion batteries cuts the risk of thermal runaway events dramatically, thanks to the system's ability to control charge rate, voltage and temperature.

What makes Li-ion UPS particularly suited for data centres?

Li-ion UPS solutions are well adapted to meet a range of conditions unique to highly-dense built up environments, common in rapidly growing cities.

Maximise limited data centre space

- Being smaller in size and lighter in weight grants Li-ion batteries a significantly higher power and energy density when compared to lead-acid batteries.
- This allows for a more efficient use of space in data centres located in high-density urban environments, many of which are located in high-rise buildings.

Better performance in warmer climates

- With cooling and ventilation a significant contributor to energy costs in any data centre, the ability to run a Li-ion UPS battery at higher temperatures can lower energy consumption.

Easier to maintain

- Using batteries with a longer life span means there's less likelihood of needing to replace parts or carrying out maintenance work.
- Furthermore, the built-in BMS also aids in tracking the battery's performance closely, alerting teams to any potential faults and failures. This "set it and forget it" value proposition can be especially useful as IT teams juggle to do more, with limited resources.

Optimised for renewables

- Li-ion batteries make a great energy storage option thanks to their higher round-trip efficiency.

EnergyAware

- The role of today's UPS has grown to allow data centre owners and operators to do more with their assets.
- While the UPS will maintain its primary role of ensuring continuity in the event of an outage, EnergyAware is a no-compromise solution that allows owners to fully utilise the UPS battery and power capacity to maximize the value of their investment.
- UPS owners can support sustainable energy solutions, optimize the cost of powering buildings and create additional revenue streams from power protection assets while maintaining complete control of deployed UPS and battery assets.
    - This is made possible with the higher cycle rates (in the thousands) and longer lifespan of lithium-ion batteries which can last up to 15 years, versus 3 to 5 years in VRLA batteries.

Considerations when selecting the right UPS for your data centre

Refreshing your data centre equipment and deciding on a suitable UPS solution involves first getting a good understanding of your current and future infrastructure priorities, as well as the regulations governing data Centres in your city or country. Before you begin assessing UPS models, the following four areas will help you better understand and prepare for the needs of your data centre:

IT Load

Know your IT load – the total power required by all the equipment in your data centre and understand how it will likely grow and fluctuate over time as the demand for computing resources grows.

Back-up requirements

Assess the current critical backup power plans you have in place in the event of any loss in mains power. Understanding requirements like the uptime needed will inform the capacity and performance requirements of your UPS solution.

Sustainability

A good measure of a data centre's power efficiency is its Power Utilization Effectiveness (PUE) score, the ratio of the total energy used by the entire data centre to the actual energy needed by the equipment. Regardless of size and age, reducing this PUE score should be every data centre's goal. Li-ion UPS batteries help improve this energy efficiency in many ways due to factors such as the better performance of the Li-ion battery and its ability to run safely at higher temperatures.

Also consider your current and future power grid stability conditions when assessing your UPS needs. Should renewable energy adoption or the risk of power quality disruptions be likely to increase, having UPS or a Li-ion energy storage solution will be even more critical.

Local regulations and standards

Data centre operations must have one eye on local requirements and standards and another on potential changes on the horizon. This can include pro-renewable energy policy changes or incentives that may have an impact on the existing power grid.

Selecting an adaptable UPS solution that will likely be compatible with anticipated regulatory changes and broader power management trends will be a good way to future-proof your data centre - especially when investing in equipment with a longer product life cycle.

Identifying the right criteria for your UPS solution

Selecting and commissioning the right UPS solution is largely influenced by the unique conditions of your data centre environment. Once these have been mapped out, align your selection criteria to your current and future power management needs and work with a UPS expert to build a UPS architecture that can help you achieve your desired metrics.

UPS Load/Capacity needed

The main factor affecting your UPS selection is your power capacity requirements. Simply put, this involves understanding how much back up power is needed, and for how long.

Once your IT load has been mapped out and measured, speak to your UPS vendor about designing a solution that can accommodate future capacity needs. These requirements will impact the type (also known as topology) of the UPS solution deployed and will influence other factors such as space requirements and cost.

Space and floor loading

As your IT and digitalisation approach evolves, so will your data centre. However, space restrictions will inevitably place increasing emphasis on selecting hardware that is more space-efficient to free up more space.

Pay attention to the lifetime costs

While UPS powered by VRLA batteries are a familiar technology that offers affordability, Li-ion batteries are known for their significant improvements on charging speed, safety, reliability and longer life-cycle. Despite their higher upfront costs, these benefits bring down the Total Cost of Ownership (TCO), offering greater value over time, by lowering maintenance and replacement costs.

How to integrate modern UPS systems into your data centre

Integrating a new UPS into your data centre environment can be a daunting task, but when done correctly will go a long way in ensuring that it will perform at its best when needed.

Deciding on a location

- Thanks to its smaller size and weight, newer UPS solutions with Li-ion batteries offer greater flexibility in terms of location within the data centre.
- Other factors that will need to be considered include allowing space for expansion and easy access during maintenance as well as ample airflow for cooling. Attention must also be paid to the connection to power points and the weight that the floor can support.

Training

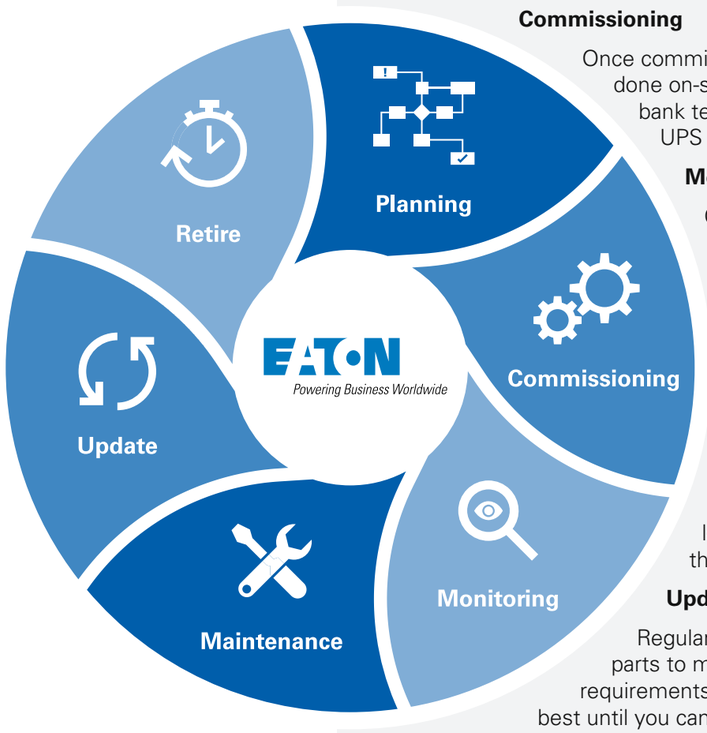
- While many UPS vendors offer a certain service level agreement when it comes to issues, it is also important that teams be given ample training from the very start on how to manage any challenges that may arise.
- Comprehensive training at the installation phase and regular refresher sessions throughout the lifecycle of the UPS will help ensure that staff are kept up to date on the latest innovations and technology improvements.

Regular load testing

- Once installed, load bank tests need to be run to ensure that the run time and capacity is sufficient for the UPS in its new environment.
- Even though testing may have already been done at the factory, each data centre's environmental conditions are unique, and testing should be done again on-site.
- Regular load bank testing must also be done as part of ongoing preventative maintenance.

Eaton supports customers at every step of this process

Our comprehensive portfolio of services spans the entire life cycle of your data centre. We work closely in partnership with our customers to drive efficiency and create value for their organisations through close support and innovative solutions.



Planning

We start with a thorough assessment, provide design counsel and work to customise a UPS solution based on various unique requirements. Factory Witness Testing is also offered when needed.

Commissioning

Once commissioned, careful assembly and start-up is done on-site to ensure seamless integration. Load bank testing is also done to ensure that the new UPS can support your full IT load.

Monitoring

Our intelligent monitoring and data centre infrastructure manager (DCIM) solutions leverage analytics and automation to identify issues before they happen allowing you to focus on your business' core requirements throughout the life cycle of your hardware.

Maintenance

A combination of comprehensive service agreements, preventive maintenance as well as parts and labour coverage, provide peace of mind throughout the lifecycle of your UPS.

Update

Regular software updates and the upgrading of parts to meet your changing capacity and efficiency requirements can help to keep any UPS running at its best until you can plan for a refresh.

Retire

Our support continues even at the end of your UPS' life cycle. This includes providing safe de-installation and removal as well as ensuring that battery components are recycled disposed of responsibly.

A modern UPS solution for tomorrow's data centres

Li-ion batteries play a pivotal role in shaping the energy future of modern data centres. Not only are they safer and more reliable, but they are also a natural fit for today's modern, distributed workforce, allowing us to fit more into smaller spaces, and reduce man-hours needed for monitoring, maintenance and replacement.

As we balance our growing demand for energy with the pivot towards renewable energy, tomorrow's grid is expected to be increasingly volatile and UPS solutions will need to be more intelligent and adaptable to eliminate downtime. With Eaton as your partner, our industry-recognised solutions such as EnergyAware, enabled by Li-ion batteries, help businesses navigate this new reality by allowing data centres to play an active role in balancing these gaps between power generation and consumption.

For more information, visit

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