EnerSys®

Power/Full Solutions

How gaining a **DEEPER INSIGHT**

into the **power management** of **electric** material handling vehicles can **improve profitability**

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If you're responsible for a group of warehouses – or even a single building – you likely need to have a large number of electric material handling vehicles, with associated motive power batteries, chargers and battery handling devices that need maintaining. Modern warehouses also include many other energy storage and power generation devices, such as solar panels and UPS systems. Keeping energy and power management systems, specifically the batteries and chargers used in electric vehicles, in optimum condition makes financial sense for a couple of reasons. Firstly, well-maintained batteries and chargers last longer and are more reliable, which leads to direct cost-savings. Secondly, any shortfall in battery reliability will impact lift truck availability and an operation's overall productivity.

While the concept of improved battery performance through careful management sounds attractive, it raises the question of how to achieve this in practice? To truly elevate the performance of material handling vehicles requires a higher level of information than has been available to most users to date. While data from individual lift trucks is often readily available, this becomes hard to understand and act upon if the fleet comprises tens or hundreds of battery units. The challenge therefore is to seamlessly bring together the data from batteries, chargers and trucks using a single, integrated platform.

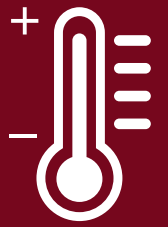
Presently, most warehouse operators are unaware of how efficiently the energy storage devices in their electric vehicles are performing. Some do not believe any viable means of efficiency improvement exists, while others are concerned that available solutions are too costly and complex to adopt. Another alternative, which is to develop an in-house solution from scratch, would certainly be time-consuming and potentially costly too. It would necessitate investing in the expertise required to design and implement extensive hardware, software and systems.

This is regrettable, as most companies' electric vehicles are operating at well below their optimum efficiency, which implies there is significant room for improvement and potential cost reductions. A solution is at hand, in the form of an power management system that gives electric vehicle users – from drivers to fleet managers – the insights they need to make productivity improvements and cost savings, without undue risk, installation costs or complexity during use.

This technical guide examines this solution and how users can make it work. It starts by looking more closely at issues that adversely impact battery performance, and should therefore be identified for corrective action. It then discusses the type of power management system that can best perform this task, and explains how an efficient power management system must be delivered as a service – a set of products alone is not sufficient. It also highlights how sourcing an effective system depends very much on working with a suitable supplier.

The guide then takes an in-depth look at an integrated power management solution from EnerSys®, and explores its key operating components and the benefits that it delivers. It goes on to demonstrate how, by deploying this type of system, operators of material handling vehicles can maximise their profitability, while ensuring predictable costs and sustainable productivity.

FACTORS AFFECTING FORKLIFT POWER SYSTEM EFFICIENCY



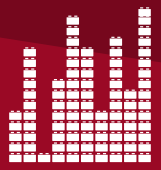
1. Excessive operating temperatures:

a. Reduces battery life
b. Can lead to premature failure

2. Insufficient water topping up = a fall in electrolyte levels and battery damage

3. Poor operator behaviour

a. Batteries not being changed at optimum times
b. Insufficient charging times



4. Poor equalisation = When different cells within a battery receive an unequal charge

POWER MANAGEMENT v FLEET MANAGEMENT

The concept of 'fleet management' is not new. The term is used widely by materials handling vehicle OEMs; who offer systems that provide information on vehicle location, along with advice on how vehicles should be safely deployed. They also typically report on issues such as shock detection, if a vehicle is driven into an obstruction, for example. Reporting on battery status is usually included in these types of service, but as part of the entire vehicle management package rather than as a utility with an in-depth focus on batteries.

EnerSys takes a different approach, focused on energy and power management. This is because it specialises in energy and power storage devices. In reflection of this, it offers an integrated solution, comprising innovative batteries and chargers with IoT wireless sensors and cloud-based software. The combined system uses wireless technology to collect data from sensors. It then automatically collects and analyses this data, before presenting actionable insights within easily-readable reports. These reports can be accessed via PC, tablet or smartphone devices and are available to users anywhere, in real time. The data can also be delivered wirelessly to a dashboard-mounted display module in each vehicle, allowing drivers to see and respond to battery status issues in real time. Compared with other available power management services, this provides users with a much deeper understanding of how the batteries within their material handling vehicles are performing.

However, having the technology to collect and present battery and charger data is just part of the solution. Ownership of the data must be complemented by an understanding of battery behaviour, and an insight into how measured values will impact future battery performance. This must extend to providing advice on how to successfully manage an entire battery fleet and optimise its performance.

KEEPING POWER MANAGEMENT SYSTEMS IN OPTIMUM CONDITION MAKES FINANCIAL SENSE FOR TWO REASONS:

1. Well-maintained batteries and chargers last longer and are more reliable

2. Any shortfall in battery reliability impacts lift-truck availability and overall productivity.

WHAT INSIGHTS DOES THE ENERSYS® POWER MANAGEMENT SYSTEM PROVIDE?

The Wi-iQ® wireless monitoring devices positioned on each vehicle battery assess status in terms of temperature, water level, discharge current, charge current, cell voltage imbalance and state of charge. This information is passed to the vehicle's Truck iQ smart battery dashboard, if fitted. Drivers can see this information while using the vehicle, and respond immediately as appropriate. It also allows the Xinx™ cloud-based battery operations management system to alert users to a battery with either actual or potential problems. Perhaps most crucially, operators are warned of impending battery failures.

Reports that direct users to individual batteries requiring attention are highly valuable, yet the battery monitoring system goes beyond this. It addresses the root cause of problems and reveals both how to fix them and prevent their re-occurrence. For instance, by revealing optimal battery changing times double cycling can be practically eliminated. This contributes towards equal utilisation of motive power batteries in a warehouse.

The system also highlights best practice for battery charging. Additionally, the system encourages operators to stop removing batteries from charge during equalisation, which prevents over-discharge. At warehouse-level, the system can also help identify the best location for charging rooms and opportunity charge points. Going further, it reveals how full advantage can be taken of fast and opportunity charging possibilities, as well as partial State of Charge (SoC) operation. In summary, even small changes in charging routines and profiles can have huge impact on overall energy efficiency and truck productivity.

In addition, the system can detect if a battery has been incorrectly sized for an application, and therefore is liable to over or under cycling. What's more, low run time batteries can be identified, enabling batteries to be replaced based on their actual performance.

Maintenance procedures can also be streamlined. For instance, the system reveals the most efficient intervals for refilling water in conventional flooded lead-acid batteries, as well as how to maintain correct water levels, to ensure proper equalisation.

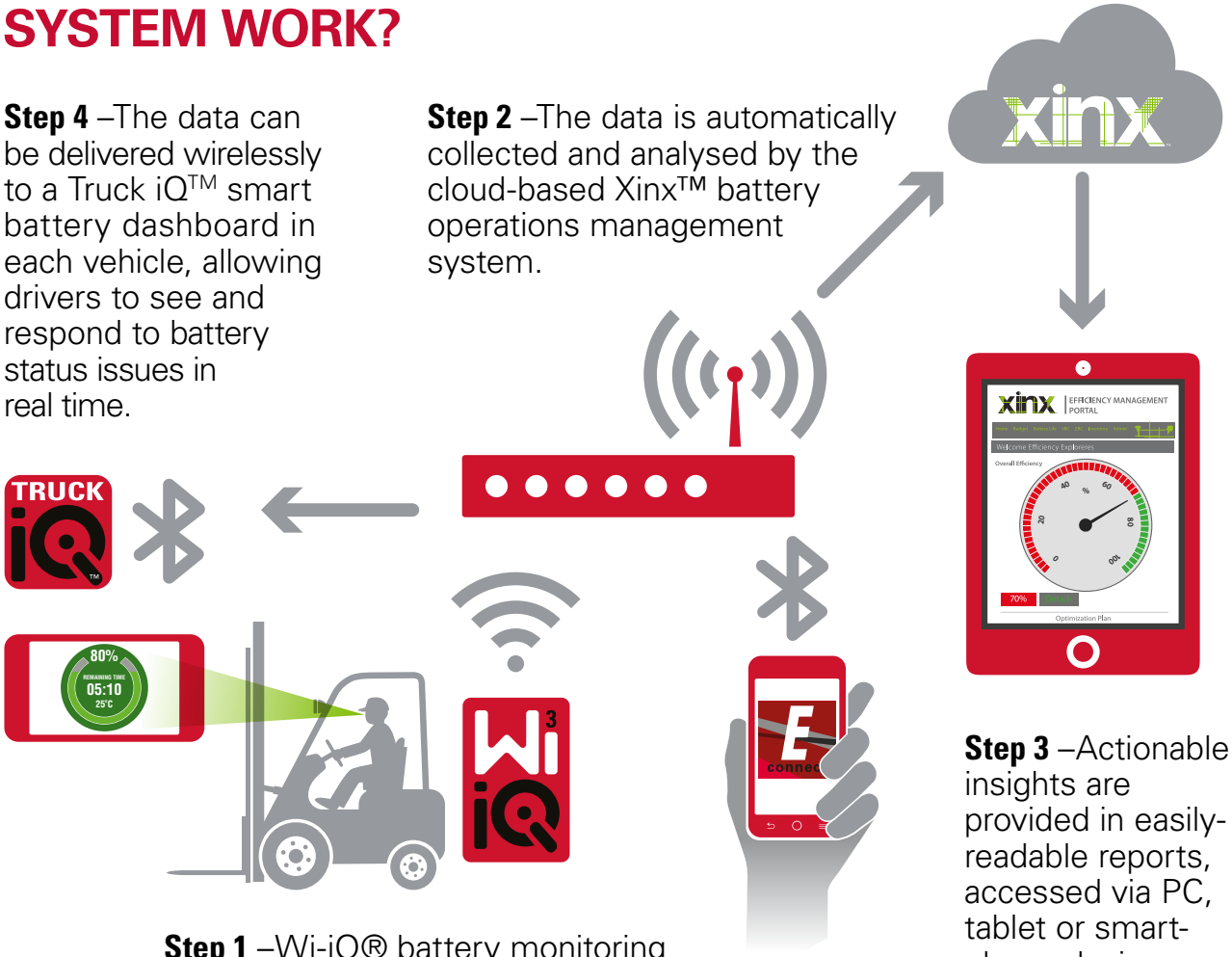
While the system offers many features that improve battery service life and productivity, it also provides data on trucks' energy consumption. This shows the kWh they consume during discharge in operation, and absorb while charging. Overall energy use for an entire warehouse vehicle fleet can therefore be accurately assessed.

These strategic benefits are complemented by the battery status visibility given to each driver by their Truck iQ™ smart battery dashboard, if fitted. This informs them continuously on the battery's state of charge, temperature and remaining run time. It also generates alarms – some audible as well as visual – when the battery needs charging, has a high temperature, a low electrolyte level, or a cell unbalance. Their decision to continue using the truck, or bring it in for maintenance or charging, is based on accurate, timely information. Productivity is improved, while the risk of battery damage is significantly reduced.

HOW DOES A POWER MANAGEMENT SYSTEM WORK?

Step 4 –The data can be delivered wirelessly to a Truck iQ™ smart battery dashboard in each vehicle, allowing drivers to see and respond to battery status issues in real time.

Step 2 –The data is automatically collected and analysed by the cloud-based Xinx™ battery operations management system.



Step 3 –Actionable insights are provided in easily-readable reports, accessed via PC, tablet or smart-phone devices.

Step 1 –Wi-iQ® battery monitoring devices collect usage and charging data from vehicle battery sensors.

HOW THE SYSTEM DELIVERS ITS BENEFITS

The Xinx™ battery management system's value to users is driven by the quality of data it collects, its ready availability at any location, and the depth of insight it enables analysts to provide.

The process starts with the vehicle battery sensors. These sensors transmit their data using the Bluetooth Low Energy (BLE) protocol to a Wi-iQ® battery monitoring device installed on the battery harness. These devices also measure current using a current sensor cable clamp. Meanwhile, a CANBUS port allows connection into the vehicle's CANBUS system.

The Wi-iQ® battery monitoring device then uses a wireless connection to communicate with an amplifier/receiver and gateway. The device's wireless output can also be picked up by the Truck iQ™ smart battery dashboard. As no part of the path from sensors to gateway uses Wi-Fi, any installation restrictions that could apply to a Wi-Fi system area are avoided.

Following this, the gateway passes data to the Xinx™ battery management system's cloud server via a local LAN connection if possible, otherwise through a 3G/4G modem. It also transmits raw data to the Wi-iQ® battery monitoring device report suite, for users who wish to perform their own analysis at a single-battery or combined fleet level.

The benefit of using the Xinx™ battery management system's online portal is that it presents comprehensive battery information, including voltage balance, daily usage and rotation, water levels and other efficiency parameters, in an easily understood and actionable format. An analyst assigned to the customer's account can evaluate these process and asset issues every 30 days to identify root cause and actions for optimisation. To ensure that this analysis drives improvement, they will post efficiency optimisation plans to the portal, which notifies management. Efficiency benchmarking on the portal home page tracks month-on-month improvements.

The analysis facilitates forecasting as well as process improvements. Under-performing batteries, and those requiring test or repair are updated on the portal's budget tab every 30 days, together with incremental battery needs to meet current demands. The customer can also call on the analyst to assist with annual battery budgeting.

Users seeking similar insight, but at a more moderate engagement level, can set up an appropriate analysis process based on data collected from the Wi-iQ® battery monitoring device report suite.

Users can also communicate directly with the Wi-iQ® battery monitoring device from their smartphones and tablets through ENS connect - a mobile app available for iOS and Android. It can then download and display historical data, and transfer it to a remote server for deeper analysis. A share button allows site data to be shared with another user via email. Additionally, ENS Connect manages vehicle-mounted battery chargers. Access to the app is protected by login and passwords with multiple access levels.

Information displayed on ENS Connect includes the number of Wi-iQ® battery monitoring devices and chargers on site, battery technologies, capacities, IDs and revision numbers, states of charge (SOCs) and warnings, depth of discharge (DOD) warnings and alerts, battery temperatures, V, A, V/c, electrolyte levels and equalisation, remaining Ah and cycles data. Data can be displayed as graphs, with day, week or year filters. Finally, the Truck iQ™ smart battery dashboard, as described above, provides another, driver-oriented, view into battery status at a per-vehicle level.

WHAT'S THE BENEFIT OF LIFT-TRUCK POWER MANAGEMENT?

- Productivity improvements
- Reduced risk and complexity during use
- Lower installation and operational costs
- Better operator behaviour

CONCLUSION

The introduction to this guide highlighted how awareness of energy and power efficiency in electric warehouse vehicles is relatively low. This is surprising in today's commercial environment where customers increasingly expect lower costs and fast deliveries. Many warehouse operators have wanted to address this situation, but felt they previously lacked access to essential information.

The guide then describes how an energy management system from EnerSys® presents as an answer to this scenario. It is easy to set up and simple to use by managers in any location. Its coverage is comprehensive, extending from the Truck iQ™ smart battery dashboard informing the drivers' activities on the warehouse floor through to the Xinx™ battery operation management system that allow fleet-wide status monitoring and supports strategic decision-making.

By highlighting problems related to both battery health and operator behaviour, battery runtime and longevity can be vastly improved. Further savings and environmental benefits arise through eliminating on-site data collection visits.

The actionable insights provided by the management system fully support higher-level decisions and management processes. Battery and charger fleets can be correctly sized based on actual usage, with timely purchases and accurate budgets. As a result, operational changes can be implemented more smoothly, while new technologies become easier to evaluate.

Why EnerSys®

EnerSys is the global leader in stored energy solutions for industrial applications. For many years it has manufactured and distributed motive power, reserve power, aerospace and automotive batteries; along with chargers and associated accessories. These technologies are used in a wide range of applications - from electric forklift trucks and commercial electric-powered vehicles to satellites, submarines, renewable energy and nuclear plants and the transportation and medical industries. More than two million EnerSys batteries are currently in operation worldwide. This gives EnerSys the best combined knowledge and intelligence in the industrial energy storage market today.

EnerSys has applied this experience to its energy management solution for material handling vehicles. Its combination of innovative battery and chargers, IoT-based sensors and cloud software is already proving instrumental in enhancing existing customers' energy strategies and performance, and can be further optimised through on-going engagement with in-house analysts from EnerSys.