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WHITE PAPER

Reducing Energy and Operational Cost at Industrial, Warehouses and Distribution Centers

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Executive Summary

Facility managers at warehouses, distribution centers and industrial buildings are facing more pressure than ever to decrease cost of operation. With the ever-increasing utility rates, improving energy efficiency has become a top priority for facility, operations, and sustainability professionals. Considering that Lighting is the biggest energy expense for a non-refrigerated warehouse, replacing existing lights with more energy-efficient lighting sources such as LEDs is one of the easiest ways to reduce this massive pool of energy use. Savvy companies have responded by installing efficient lamps, occupancy sensors and stand-alone controls at their facilities. However these measures, although a step in the right direction, can deliver only incremental savings of around 20%.

An even greater level of energy reduction comes from turning off lights when not needed, optimizing light levels with task tuning to suit occupant needs, day light harvesting, and reducing overall demand for lighting energy. Improving system-wide control over lighting is the best way to ensure that lighting consumption is automatically reduced as much as possible. Some of the network control solutions, based on wireless technologies, have expanded applications to include HVAC and Plug-Load Control and are proven to reduce facility energy consumption in commercial and industrial buildings by up to 90%.

Advanced wireless network building control solutions offer comprehensive controls that go beyond Lighting and include HVAC, Demand Response, Plug-Load Control, Fault Detection, Remote Monitoring and more applications. These next generation solutions leverage powerful control strategies and are available at a fraction of the cost compared to conventional wired solution. Available as an on-premise or Cloud-based deployment model, these solutions are designed to meet the security, scalability and applications needs (e.g. BMS integration) of all types of industrial facilities that range from a few thousand square feet to one million square feet with multiple locations across the country.

High ceiling facilities such as warehouses are prime candidates for wireless control systems due the high cost, complexity and inflexibility of traditional hard-wired systems. Commercial and industrial buildings that embrace Wireless Network Control (WNC) will see dramatic energy savings, become code compliant and transform into future-proof connected buildings ready to take advantage of the promise of the Internet of Things.

This white paper provides an introduction to the features and the benefits of WNC and describes how warehouses, distribution centers and industrial facilities can benefit from advanced control solutions.

Background

Warehouses and Distribution Centers play a vital role in the commercial and industrial world. The ever-increasing complexity of today's economy has made the role of these facilities more demanding. With a primary purpose to provide storage and processing of inventory along the supply chain as goods moves between manufacturing and final destination for consumption, Warehouses are doing more work than ever - assembly, sorting, labeling, packaging, shipping, and handling refurbished and returned merchandise.

In the retail industry, traditional warehouses designed to house inventory are being replaced by much large and more technologically sophisticated distribution centers that work towards maintaining a "just-in-time" inventory in stores and making the goods shelf-ready. In contrast to traditional warehouses, modern distribution centers are essentially operations centers, managing the flow of information and goods between retailers and suppliers through the use of standardized bar codes, high-speed conveyors, laser scanners, and computerized databases.

Warehouses can range from a few thousand square feet to million square feet in size. The advent of ecommerce and popularity of same day delivery service has increased the demand for giant distribution centers (over one million square feet) located in proximity to major population centers. Due to the unique requirements, operating conditions and harsh environment, warehouses and distribution centers are characterized by:

- Variable occupancy, many areas see no activity
- Heavy activity in loading docks
- Ineffective and many times over illumination
- High operating and maintenance cost and tremendous waste of energy

The fact that warehouse operation can cost up to ten percent of company revenue, a significant number for a firm of any size, is causing strong headwinds. Facility managers have come under pressure to decrease cost of operation and are struggling with how to do more with less. It appears that the trends of cost control, budget constraints and ongoing cost pressure are here to stay. Also greater emphasis is being placed on environmental impact, reduction in CO_2 emission and corporate sustainability.
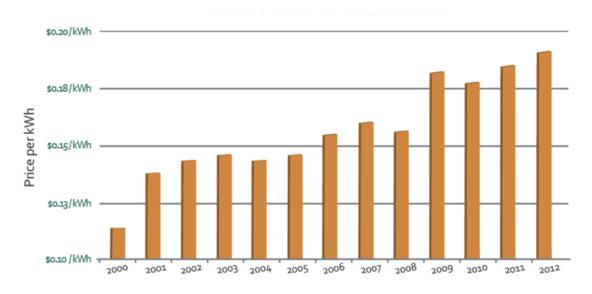
Utilities and The Regulation

The following chart from the California Public Utility Commission shows the increase in Utility rates for the State of California from 2000-2012. With the ever-increasing utility rates, improving energy efficiency has become a top priority for corporate, sustainability and building operations professionals.

Rising Cost of Electricity 2000-Present

Lighting is the biggest energy expense for a non-refrigerated warehouse. Hence replacing existing lights with more energy-efficient lighting sources such as LEDs is one of the ways to reduce this massive pool of energy use. Encouraged by Utility incentive programs (energy efficiency rebates) and strict regulations such as ASHRAE 90.1 and the California Energy Code, more facility managers are looking for advanced control systems that offer greater energy savings.
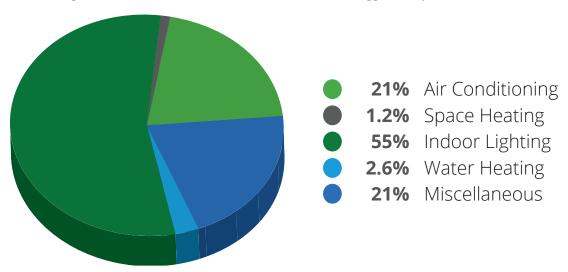
California building standards code (Title-24) went into effect in July 2014 and is aimed at improving the efficiency of commercial buildings by thirty percent. It requires mandatory demand response control for all commercial facilities above 10,000 square feet along with lighting control systems, plug load control, HVAC control, and a host of other measures. Other States are in the process of creating similar codes for energy efficiency and a number of measures are being passed at the Federal level as well.

Warehouse Energy Consumption

The following chart from Alabama Power shows the breakdown of energy consumption at a warehouse:

- **21%** Air Conditioning
- **1.2%** Space Heating
- **55%** Indoor Lighting
- **2.6%** Water Heating
- **21%** Miscellaneous

At 55 percent of the total energy consumption, lighting is the biggest energy expense for a warehouse followed by HVAC. The various sections in a warehouse - shipping docks, open bulk storage, active order-pick modules, and hi-piled racked storage aisles require different lighting level and consequently need an advanced lighting control system with better capabilities than simple occupancy controls.

Traditional wired control systems have been limited by cost, functionality and complexity. Removing the wires delivers on the promise of lighting control by providing even greater benefits, at a lower cost, and to a much broader set of potential customers. By deploying WNC for energy-intensive applications, warehouse facility managers can not only reduce energy consumption, but also gain greater levels of insight into their operations and improve warehouse safety and productivity.

Key Features And Benefits of Wireless Network Control

Wireless network control solutions offer comprehensive controls that go beyond lighting and include HVAC, Demand Response, Plug-Load Control, Fault Detection, Remote Monitoring and more. WNC can add value to warehouse and distribution center operation in the following ways:

Lighting Control

Retrofitting lighting with efficient lamps can save an average of 50 percent in energy costs. Smart control strategies such as task tuning, daylight harvesting and scheduling can deliver demand-based lighting optimized for each zone and activity. With dramatic reduction in cost, high bay LEDs combined with network controls can deliver up to 90 percent savings.

HVAC & Plug-Load Control

Adding HVAC and Plug-Load control can deliver substantial savings and reduce an additional 24 percent energy. All areas of a warehouse do not require climate control and cooling load can be optimized based on occupancy and shift schedule.

Plug-loads are rarely controlled, but represent a significant amount of energy waste. With Plug-Load control, devices that would be plugged into a standard plug strip or outlet such as large copiers, printers and others are instead plugged into a specialized "plug-load controller". These loads can then be managed according to a schedule or associated with an occupancy sensor. Plug-loads contribute towards 25 percent of total electricity consumed in offices according to a GSA report and can lead to significant energy savings.

Personal Control

Various studies have proven the positive impact of a worker's environment – and their control over that environment – on their productivity and happiness. It has also been found that when occupants are given personal control over lighting, their energy usage tends to be lower. Advanced WNC can use various forms of personal dimming to provide this control, ranging from remote controls to desktop dimming switches to "virtual" switches online, on a desktop computer or on a phone.

General Control

One of the advantages of WNC is the ability to add applications onto an existing network without the need to build out a new-dedicated infrastructure. WNC provides the ability to add general controls and one common warehouse application is the exhaust fan. These large industrial grade fans can be a huge energy drain. WNC can turn fans off when space is unoccupied or run them based on schedule. The fans can be programmed to crank in a sequence to reduce the sudden current surge and avoid the demand response peak load penalty imposed by utilities.

Humidity, CO2, and Environmental Monitoring

Multi-application WNC offers the ability to add environmental monitoring. Several emerging applications take advantage of environmental monitoring sensors, to report on conditions in a facility and trigger alerts if those conditions exceed a threshold. For example, some storage facilities such as refrigerated warehouses closely track temperature and humidity to avoid unplanned outages. In a lighting controls solution that supports this application, temperature and humidity sensors can be added to the network and report real-time data.

Safety & Productivity

The major activity in a warehouse occurs in few areas and there is no need to have high levels of illumination across intermittently occupied spaces. Conversely, motion sensors can automatically light up (100 percent bright) the entire aisle when forklifts are moving enhancing visibility and safety. The ability of WNC to detect luminaire or signage failure can prevent accidents and improve safety.

Remote Operation

Advanced WNC allows building personnel to monitor a facility remotely and send an alarm notification based on an event when a critical threshold level such as temperature or humidity is reached. For example, exhaust fans can be remotely switched on based on air quality or the CO_2 level inside the warehouse.

Failure Detection & Maintenance Automation

Proactive maintenance can prevent critical failures. Wireless sensors can detect luminaire failure and send alert signals. By monitoring and measuring energy usage at individual fixtures, some control systems can provide the capability to know when a bulb is out, or a sensor or ballast is malfunctioning. Likewise, similar information can be used to make an educated guess about when maintenance will be required. Finally, some systems can manually or automatically reconfigure in the case of a failure – for example, if an occupancy sensor fails, the lights can be re-associated with a neighboring sensor until maintenance replaces it. Together, all of this information can be used in an energy management system to improve the scheduling of maintenance calls, reducing the frequency (and cost) of lighting maintenance.

Analytics & Insight

Energy analytics enables facilities managers to explore data, uncover hidden opportunities and improve decision-making. By leveraging visual reports, usage trends and real-time data, facility managers can adjust their energy consumption. It is often said that you cannot manage what you cannot measure and centralized energy management software provides the capability to both measure and manage energy.

Energy management saves energy over time by providing ongoing improvements to all of the other controls strategies. As an example, analysis of building energy usage compared with occupancy data over a month might point out that the office's kitchen area sees occupants throughout the day but only for short periods of time. The system could recommend reducing the occupancy-based off-delay in this area from 15 minutes to 5 minutes, and would measure additional savings of that action.

Facility Reconfiguration

To facilitate cross-docking and manage ever-changing inventory levels, facility reconfigurations have become the norm. WNC make reconfigurations easier by implementing change through software without changing cable or rewiring fixtures. Instead of asking the maintenance personnel to climb forty feet to the top of warehouse ceiling, lighting levels can be adjusted at the click of mouse saving time and money.

BMS Integration

Some advanced lighting controls systems enable integration to a facility's Building Management System (BMS), typically via BACnet or another open protocol. Through this integration, the user interface of the BMS can provide integrated control and management functions. This strategy offers reduced management overhead (and the associated lower cost) for buildings that want to manage HVAC, lighting and other functions from a single console.

Functionality	Category	Network Control	Standalone Lighting	Standalone HVAC
Occupancy Sensing	Energy Savings	X	X	X
Daylight Harvesting		X	X	
Dynamic Fixture Control		X		
HVAC Control		X		X
Fan Control		X		
Multi-facility Management	Operational Efficiency	X		
Power Metering		X		
Analytics & Report		X		
Fault Detection & Diagnostics		X		
Remote Management		X		
Advanced Controls & Sensors	Code Compliance	X		
Automated Demand Response		X		
Environmental Monitoring	Safety	X		

This table summarizes the key differentiating features of a Wireless Network Control over standalone controls:
Wireless network controls offer tremendous value over stand-alone controls. Providing energy savings, increasing operational efficiency and enhancing safety.

Summary

Lighting and HVAC account for over 75 percent energy usage in the warehouse, distribution centers and industrial storage facilities. Advanced wireless network building control and management systems use factors such as occupancy, available daylight, task and time of day to deliver optimal lighting, heating and cooling thus providing significant energy and cost savings, a great level of flexibility and control for building owners and administrators, and added comfort for occupants. And as numerous studies have shown, greater comfort leads to higher productivity.

Wireless networking is bringing intelligence to a new generation of building control systems – helping companies take simple steps to save money and make progress on sustainability. Wireless networking is the most cost-effective solution for high ceiling environment, eliminating the need for expensive and complex cabling. WNC solutions make your facilities smarter, safer and more productive by automating Lighting, HVAC and other applications. These systems significantly reduce operating expenditure, improve system efficiencies and deliver a substantial boost to facility's bottom line.

Consequently, wireless network solutions for warehouse, distribution centers and cold storage facilities offer the fastest ROI with typical payback of two years or less.

References

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