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SMART LIGHTING TECHNOLOGY

CONFIDENCE + FLEXIBILITY

Partnership Reaching Into The Future: SunView LED Lighting + APANET Green Technology Systems

APANET Green Technology System's partnership with SunView LED provides the finest, most innovative, adaptable, reliable, effective, and efficient cost saving lighting solutions available in the industry. We can address customer's needs and help them move into the future with confidence and flexibility. Those future moves are a tiered process: Smart Lighting, to Smart City, to Smart Grid. Through the entire process, the APANET Green Technology System can develop, integrate, and deliver advanced networking solutions for customers and utilize existing technological and electrical resources to save time, cost, and assure future smart grid compliance. SunView LED can design, retrofit, and replace lighting solutions with the finest LEDs in the industry with zero down affordable payback programs.

APANET, established in 2003, was a partnership focused on the design and production of modern microprocessor controls and entire automation control systems. APANET is one of the seventeen best Polish technology companies in the field of environmental protection promoted for the workplace, as well as one of the largest manufacturers of LonMarks technology in Europe. In 2010, the limited liability company APANET Green Technology System was established through the parent company for the creation and sales of systems aimed at the reduction and rational use of energy consumption. A large part of the production is the development of control managed automation for intelligent buildings was the initial company focus. The company's interest has much wider applications. APANET's Research and Development strive to provide advanced level projects from concept to production for various industries. This progressive and aggressively innovative aspect of our company creates systems to help implement ideas related to the development of Smart Lighting, Smart City, and the Smart Grid. APANET is a member of LonMark International (LMI) a global standard setting organization whose aim is excellence in interoperable integration solutions.

Standards for Excellence

In the early 1990's, Echelon, an American based company, created its trademark, LonWorks. These control-networking platforms today control more than 100 million industrial devices. LonWorks control networks consist of intelligent devices, sensors, actuators, and controllers that communicate with one another using ANSI/EIA/CEA – 709.1 protocols over one or more communication channels. A control network is a group of devices working in a peer to peer fashion to monitor sensors, control activators, communicate reliability, manage network

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operations, and provide local and remote access to network data. The LonWorks standards are used in 95% of network installations worldwide.

Besides the approved 709.1 standards, LonWorks control networking technology ISO/IEC 14908, Parts 1, 2, 3, and 4 is approved by the International Standardization Organization (ISO), the International Electrotechnical Commission (IEC), and the Joint Technical Committee 1 (JTC 1) as presented by the US International Committee for Information Technology Standards (INCITS) in 2008. In America, the National Institute of Standards (NIST) recognizes both of the above series of standards as acceptable reliable interoperability standards for the framework and the development of the electric smart grid base. The standard protocol provided by the LonWorks platform makes it possible to design open control systems using products from multiple vendors. Because APANET is a certified member of LonMark International, our research and development aims towards the same international open interoperability standards advocated by LonMark.

Reliable interoperability standards for the framework and development of the electric smart grid base

Global standards are used to create, promote, and advance the development of efficient and effective integration of open, multi-vendor control systems that utilize ISO/IEC 14908-1 and related industry standards. A LonMark certification and the use of LonWorks technology assures a customer that APANET is offering the most advanced and robust open system solutions in the industry. The concept of 'open system' conjures up multiple definitions. Many organizations in the energy industry today are industry specific, proprietary focused, and geographically limited. Imagine having an internet or computer system that can only access or be accessed by one information source. This is the problem with proprietary and geographically limited providers.

LonMark International is one of the only independent organizations that offers the global market open control systems that consist of devices, connectivity products, tools, and management interfaces utilizing Simple Object Address Protocol (SOAP) and Extensible Markup Language (XML). APANET's GLC100 device series is certified by LonMark International. Standards exist for system-to-system communication and for interfacing to subcomponents. One of the most powerful aspects for a local operating network is the ability for any device to be able to share information from any other device. User interfaces are treated the same as any system controller. Therefore, these interfaces are neither masters, nor slaves. They are just devices on the network. APANET is able to provide truly situational customized solutions for customers and utilize interoperable standardized devices and components in any integration project.

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This information sharing process is familiar to us all, because that is exactly how the internet works. Any computer can request information from any server worldwide without restrictions as from whom or from where the information comes. Computers from any standards abiding company can be added to the network without restriction. LonWorks operates the same way and follows many of the same rules as the internet, but it is designed for the more real time demanding needs of control networks. It also simplifies management and significantly reduces the cost to implement control devices. Manufacturers have the flexibility and freedom to implement both simple and complex devices without having to spend millions on development. Very low cost solutions exist in chip-level form. For more demanding, higher volume applications, manufacturers can add LonWorks to their devices by using their own implementation of the standard.

Interoperability Guidelines

LonMark International recognizes and responds to the interoperability guidelines and device profile architecture in support of the rapidly growing Industrial Internet of Things (IIoT). Therefore, LonMark products enable connectivity options for street lighting networks and their resultant interoperability. LonWorks control networking technology has approval standards in Europe (EN 14908), in America (ANSI/CEA.709), and in China (GB/Z 20177). APANET's technology complies with this international interoperability standard and allows for multiple integration functionality.

LonMark members are across the globe with their presence in the Americas, Asia, and Europe. No matter where you are globally, our technology is adaptable and certified because we use the aforesaid standards.

LonMark products enable connectivity options for street lighting networks and their resultant interoperability

Due to the dynamic nature of LonMark's object-based standard for device connectivity, an industry-independent architecture can be provided for connecting together products from multiple manufacturers. Devices, subsystems, and systems containing LonMark certified products can be linked together to create completely open solutions using an impressive collection of tools from multiple vendors. This enables the evolution for Smart Street Lighting by connecting smart communicating luminaries offered by a variety of suppliers via a single wired or wireless network. Or, as in APANET's specific ability, utilize current existing Power Communication Lines (PLC). From Smart Lighting, a consumer can begin to build a platform towards Smart City and, eventually, connect efficiently with the Smart Grid.

The LonMark brand is one of the most recognized marks of excellence in the world. The organization helps member companies achieve global acceptance, whether for open-system devices, programmable systems, or quality processes. Manufacturer's products certified by LonMark International benefit by the organization's long-time reputation as a leader in the promotion and advancement of open control systems. LonMark is different because it is a single leading industry with a focus on open system solutions. It supports system-level solutions and has a global reach via the many LonMark members worldwide. LonMark sponsors cross-functional system integrator training, certification programs, and also provides universal web-based certification tools. APANET Green Systems Technology fully acknowledges the work and vision of LonMark and its excellent pursuit to promote products and systems that are open, interoperable, and able to commit to the future of energy resource management. SunView LED has partnered with APANET, because the two companies are equally aligned to the same progressive lighting solutions vision that is the basis for future energy use worldwide.

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The Interoperable Technology for Future Installations

Perhaps the better question is who in the world does not use LonWorks technology? Those who do not use LonWorks are unaware of the problems and expense of closed, proprietary systems or the seemingly 'open protocol' systems that some system vendors offer. There is a growing need for information and training regarding the unexpected difficulties and the resultant expense associated with not choosing interoperable systems and the benefits in choosing those devices and systems that enable a present and future upgraded technology path. Building owners and system installers need to be sure they are selecting and investing in the right long term solution. They need to avoid the problems and engage the benefits by asking the industry specific hard questions:

- After the initial installation will my system be open to competitive bids?
- Is the system I plan to install able to communicate with multiple user interfaces from multiple suppliers?
- Does this system have inherent security at even a low level network infrastructure level?
- Am I able to maintain the system by myself?

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- Will all of the necessary tools to fully maintain this system be given to me during the installation?
- Am I able to consider outside and multiple bidders for my sub-system needs?
- Will I be able to integrate all of the devices and products I require, even from multiple sources, into one overall reliable enterprise system?
- Is my system designed to work effectively with all of the components I want and need, or does it function for only a small portion of my integration needs?
- Am I able to select and purchase diverse products from several vendors and distributors instead of being limited to only one single vendor approved source?
- Will all of the products and devices that I select for my enterprise system have a guarantee that they will work on the same network infrastructure?
- Will my investment cost realize better energy consumption and genuine return of the cost in a short period of time?
- Will the system I am installing allow me to upgrade in the future without having to replace the entire system due to it being outdated and non-compatible with a future system?

Building owners and system installers need to be sure they are selecting and investing in the right long term solution.

If you have a negative answer to any of the above questions, you need to reconsider your energy system installation options. Not having the flexibility to develop a multi-task, interoperable, future compliant system with upgrading devices and components, could cost you a huge future expense, on top of the money you are investing for the present system. Only products, technology, services, that have interoperable integration ability will guarantee that your upfront cost will not only be an investment into the future, it will save you money over time, and alleviate a huge upgrade investment in the future.

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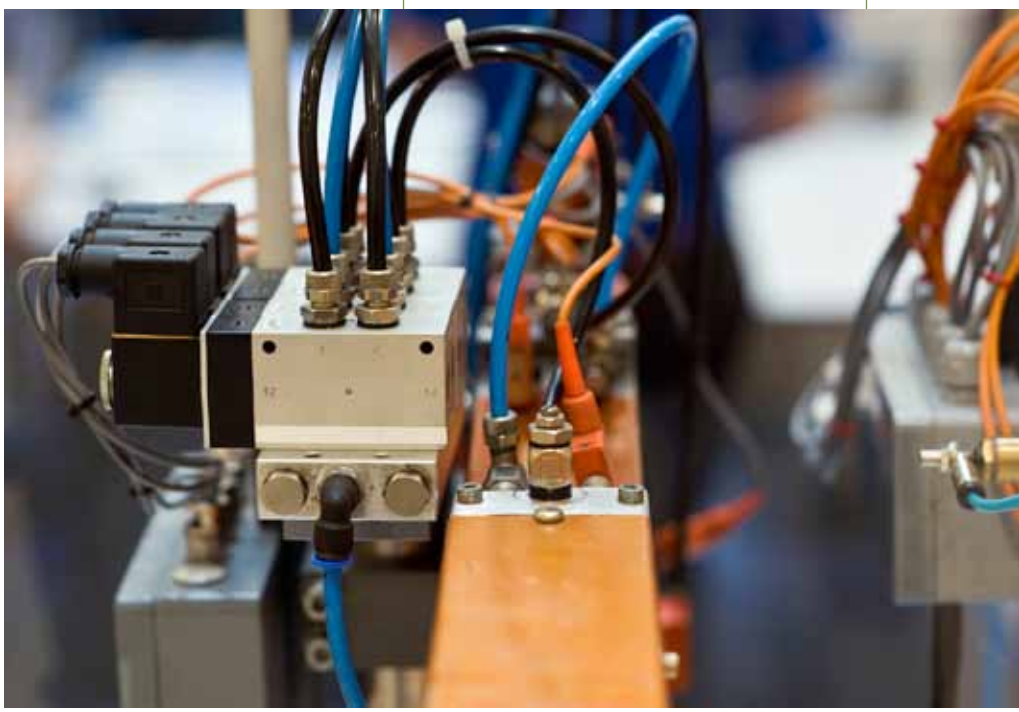
Product Availability, Flexibility, and Affordability

More than 4,000 products are available for the LonWorks market. LonWorks product manufacturers often sell their products through both closed channeled and worldwide distribution. Anyone can buy open LON products without high priced, long term contacts. Many other solutions do not support an open distribution model. For the owner or investor this means that if your service contract expires and you need spare parts, you do not have to pay the high prices that some vendors charge for their products, unless you re-sign with their service department for a costly annual service contract. Simply buy your products from any of the LonWorks distribution companies and pay a competitive price.

Many owners find that LonWorks technology offers more flexible options for upgrades and changes. Employees can become so proficient in LonWorks technology due to its adaptability that they implement simple projects internally. Good system specifications always require that the installer train the owner on the system, as well as provide all the tools and software needed for basic system enhancements. This is why APANET chooses to utilize the LonWorks open system technology. LonWorks technology is the state of the art in the industry. Using it reduces wasted time, services, work, and keeps costs to a minimum. An open system is not just an open protocol. It must take into account all of the aspects of the system, from the lowest level devices to the highest level enterprise integration. LonWorks was designed and is being implemented to exacting standards to fulfill the needs of many different industries and markets. From buildings to utilities, home to trains, semiconductor equipment to concert halls, LonWorks is the most widely used and accepted solution available. APANET and SunView LED Lighting do not want to waste your time or ours. Therefore, we offer you the best options in the industry, because we know they work.

LonWorks technology offers more flexible options for upgrades and changes.



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Open Systems and Cost Savings

Saving time and money are two key benefits of an open, interoperable control system. Specifying an open system with good planning and coordination prior to installation saves time and money later during system design and commissioning. Good consulting engineers consider the entire system, not just the individual subsystem when writing specifications and making installation decisions.

There are five elements that need to be defined in an open specification system

When designing an open specification, it is more than just the protocol that needs to be specified. Defining a common system architecture using a standard open method is more appropriate than specifying the 'buffet" style that allows anything to be used. In today's technological offerings, thinking you can utilize a buffet style process could end in disaster for your system and your finances.

In an open specification system development, there are five elements that need to be defined:

1. The network infrastructure
2. The system's control device
3. The network management tools
4. The user interface, and
5. The enterprise/ I-level interface

The network infrastructure includes the protocol, routers, media type, Intelligent Technology (IT) connectivity, and basically, the overall concept of what the customer would ultimately want to develop for their final system solution. The control devices are the workhorses that consume or manipulate data and control/monitor the system. The network management tools configure, commission, and maintain the system. The user interfaces (Human-to-machine interfaces, or HMIs) are typically the visualization tools that the user or control manager uses to obtain a view

into the system, including both Pc software and instrumentation panels. The enterprise/IT-level interface is the method for connecting the control network into the data network. We call it the LON-LAN-WAN architecture and it is defined in the specifications using standard open systems methodologies. There are no gateways. Instead, the system uses standard routers.

Along with these elements, system specifiers must design each subsystem and define the system functionality and the requirements for how each subsystem will share information with one another. Here are some examples that will make what reads as a technologically difficult concept easier to understand. An occupancy sensor is used to determine if someone is in a specific space at a particular place like in a building, at a train station, or walking in a parking lot. The sensor does not determine what happens when a presence or 'occupation' occurs, it merely provides data that states 'occupancy detected' and can give a specific location. Traditional systems may have a lighting system connected to the occupancy sensor system. Therefore, when someone enters a space, the lights will turn on automatically responding to the sensor's indication.

But, this information could be very useful for other systems in that particular location. If it is a building, perhaps a heating ventilating or air-conditioning system (HVAC) could turn on or be turned up for more use. Conversely, when occupants leave an area, the lighting and the HVAC systems can be regulated to diminish energy usage for a vacant area. Another component that could be useful to an occupancy system is a security system. Trespass into a restricted area could be reported. A parking lot sensor after hours could record an occupant which could alert security personnel. An elevator system could relate with an occupancy system and deliver an elevator to the floor where the occupancy is reported. There are so many ways to converge a full enterprise system. Detailed planning is needed to know exactly what you might require or want for your final system.

Power Line Communication (PLC)

Because LonWorks is a worldwide standard for distributed automation and control systems and is used for the communication standard protocol LonTalk, it allows devices from different manufacturers to work together without any obstacles between or among them. This is convenient for users for several reasons. The networking is not tied to the strength of the sole solution from one manufacturer and provides the ability for a customer to choose from a wide range of devices from different manufacturers. LonWorks network communications can be carried out using a variety of media. The most important and cost saving one is the Power Line Communication (PLC) which is able to transfer data and control signals on the mains 230V. With this option there is no need to install additional lines of communication and a system of controls can easily be created based on the existing power network. Virtually all of the Smart Lighting, Smart City, and Smart Grid concepts can be based on using this cost saving communication technology.

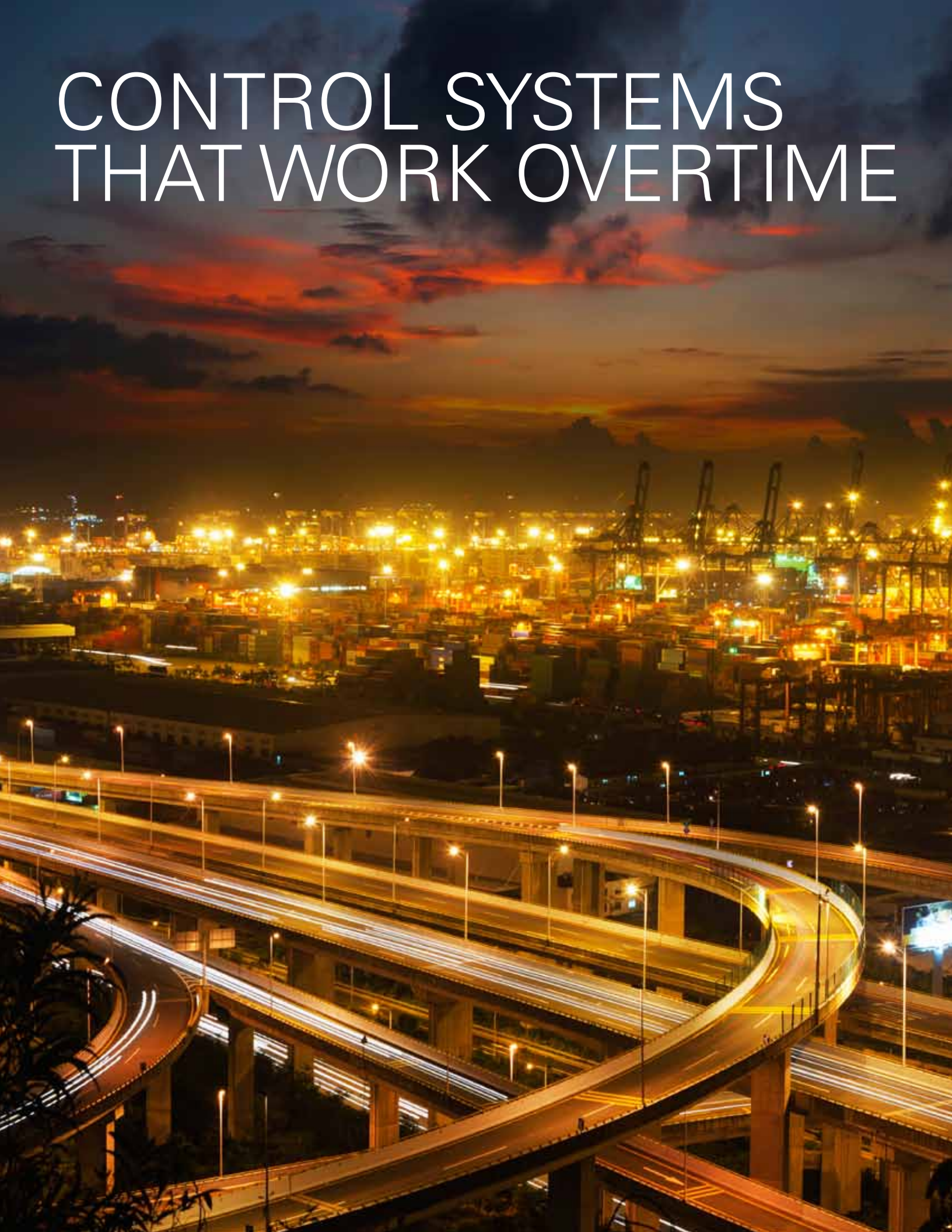
A system of controls can easily be created based on the existing power network.

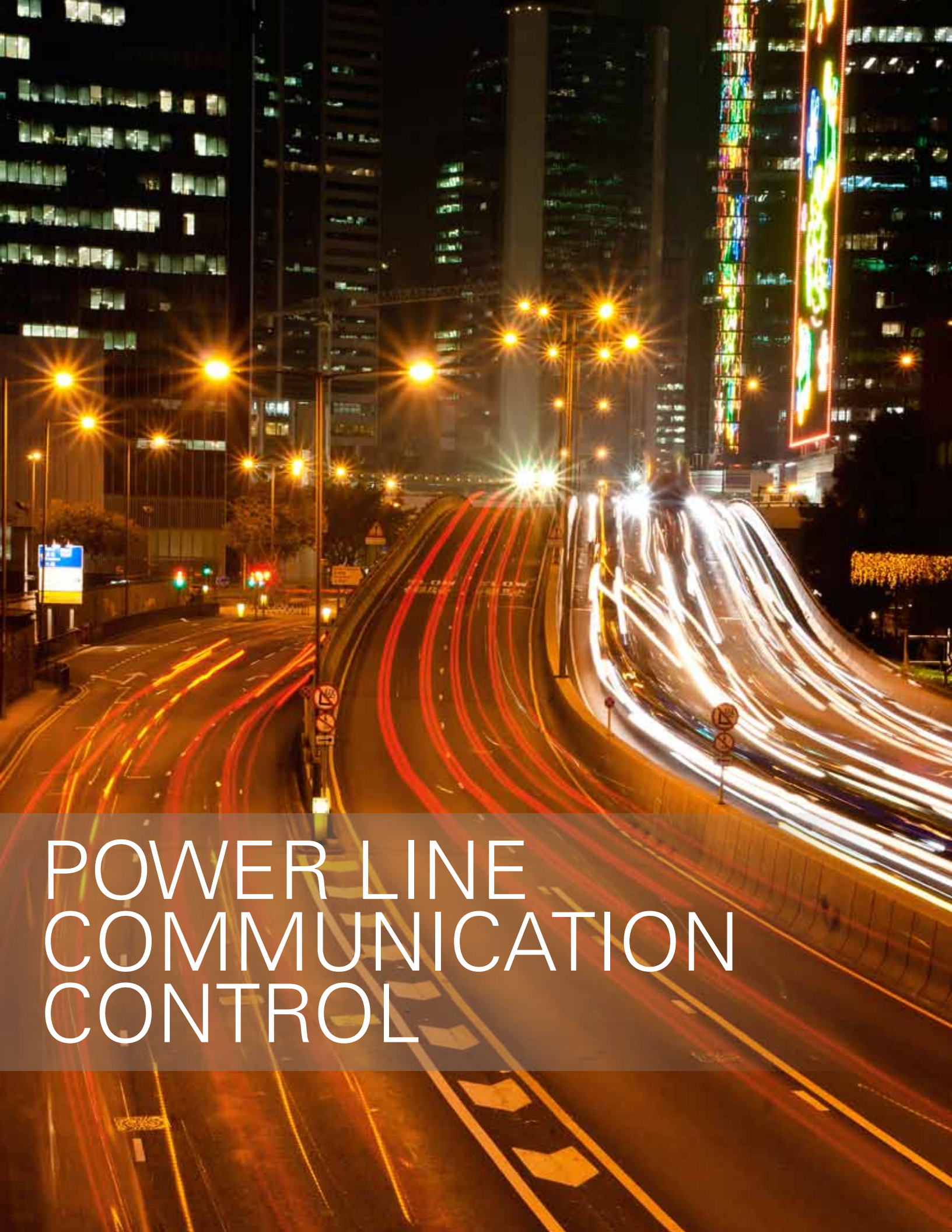
With this technology, data transfer is sufficient for a network with several hundreds of devices. Cost is minimized because existing technology is utilized in the project. Using additional hubs, routers, and other network devices can produce an almost unlimited expansion of the network. A remote network system developed for the reading of electricity meters and run by an Italian company, ENEL, is one of the largest networks utilizing LonWorks and has 27 million pieces of equipment. Because APANET's technology is certified by LonMark and we use the LonWorks technology, we are able to provide our customers with the same quality unlimited potential to address their specific needs. The following are the most important features of our systems:

- 50 % cost savings because of power reduction when lighting is not necessary to be at full shine power (using European standards)
- Compatibility with most streetlight technology including HP (High Pressure Sodium), MH (Metal Halide), and LED (Light Emitting Diode)
- Standard and interoperable openness for various application usage
- Ability to interact effectively with various manufacturer's equipment
- Provide a competitive edge that is good for the investor
- Lower prices, higher quality, and ease of installation and service
- Technology that is well known and widely understood by engineers worldwide

Using this standardized approach reduces cost and eliminates the wasted installation of inefficient non-adaptable technology. It avoids installing supporting network control systems with limited proprietary solutions offered by many vendors in today's market. The technology utilized in LonWorks has been a major power worldwide in the establishment of interoperable guidelines with a commitment to educating the market on the value of open, interoperable systems by providing tools, resources, and support for its members and their markets. This ISO/IEC approval acknowledges the standard of the highest level of international standards recognition.

CONTROL SYSTEMS THAT WORK OVERTIME





POWER LINE COMMUNICATION CONTROL

This allows a customer to purchase products and solutions from various interoperable capable vendors at competitive prices. Only those vendors with these standards really maintain products and applications that can withstand and evolve with the Smart Grid goals.

Smart Street Lighting

Rising energy cost and the need to reduce CO2 emissions are forcing cities, municipalities, regions, and countries to look for savings and conservative clean energy use. A significant part of the energy and cost for all of this is street lighting. The installation of modern and effective intelligent lighting control systems can save about 50% of the energy use cost and produce a safer, cleaner lighting solution with an enhancement to the lighted areas that includes the ability to control the lighting based upon hours of the day, needs, weather, and multiple other factors. This is the beginning of the concept termed, 'Smart Street Lighting.'

All intelligent lighting control systems are not necessarily Smart Street Lighting. Such systems, depending on their technological advancement, have different functions. The simplest system in this group is a system based on time which reduces the lighting power of the street lamps in the late hours of the night. Such systems, however, can not talk about true intelligent control and are being replaced by a comparable lower cost over time, more energy efficient, more robust lighting solutions. The new Smart Street Light Systems provide a much greater potential for energy savings while providing true intelligent control systems that communicate with each other and the master system through the power network.

Replacing high pressure sodium (HPS) lighting is one of the basic elements to modernize and provide energy-saving projects in street lighting. Conventional electromagnetic ballasts are highly energy intensive and will soon be withdrawn from the European market. Conventional solutions reduce the voltage across the network which results in the more worn lamps not working even though the nominal supply voltage operates for a long period of time. These solutions are not economically, nor energy efficient. Electronic ballasts are cheaper to operate and significantly

SMART SAFE LIGHTING

prolong the life of the lamps. They also have the advantage in that they are able to adjust to a wide range of light output. Replacing old electromagnetic ballasts with electronic ballasts, which have significantly lower energy consumption, will immediately reduce energy use cost. Saving the most money using a street lighting network is achieved by using a combination of the aforementioned components in exchange networks that use true intelligent lighting control systems.

Worldwide, cities, regions, and municipalities are considering this cost savings approach to reduce one of their largest energy expenses. In Olso, Norway, a comprehensive street lighting modernization project resulted in a 70% savings in street light costs while maintaining an acceptable European standard of home lighting. This project, utilizing LonWorks technology, is the first and largest of its kind in the world. It is also an example of how it is financially, as well as environmentally, worthwhile to choose an open system solution in one installation where several companies were able to combine their resources to complete the project successfully. APANET Green Systems Technology has facilitated projects where, depending on the chosen technology and set of algorithms, a 40% to 50% savings in lighting costs has been achieved.

Smart Street Lighting Systems have the ability to save energy, but that savings can be increased by expanding functionality by upgrading the present systems. Often street lighting networks are deteriorated and in very bad condition. Thanks to a Smart Street Lighting comprehensive installation, modernization, and upgrading replaces the typical costs of continually servicing outmoded lighting. This enables the municipalities to actually add future financial savings without additional spending. Repairing old street lighting systems is expensive. Maintenance is not always consistent and the light bulbs themselves are energy inefficient, expensive, and not environmentally safe. Often municipalities find a source of financing to ameliorate their street lighting use/cost issues, then find themselves somehow locked into a vicious cycle of spending huge amounts on street lights and maintenance, because they did not have the money to ultimately upgrade the entire lighting network.

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Welcome to the best news about APANET's Smart Street Lighting System! With new cleaner, less costly over time LED lighting, maintenance is less. The ability to predict, repair, and control street lighting becomes a more efficient, easier, and far less expensive venture. The use of existing power communication lines to facilitate the system greatly reduces overall installation costs. Municipalities reap the financial benefits in a short time due to decreases in energy cost and increases in municipality safety with several other factors that can be applied easily into the future without much additional infrastructural cost or development.

Energy cost savings are highly influenced by the reduction in operating costs of a Smart Street Lighting system. This intelligent system records from each lamp, collects information on their current power, their power factor, and other electrical parameters. This allows the administrator insight into the health of the entire lighting network at one view. Information from lamps that have failed to reach the system for a few minutes are immediately noted, located, and can be pinpointed for maintenance. The available information about the current energy consumption and estimated time for replacement of individual luminaries enables the administrator to plan an efficient maintenance schedule for individual sections of the lighting network. The system is smart in that it monitors all aspects of the street lighting and returns data that in the past was invisible. It also provides visible information to keep the lighting system efficient throughout the entire network. Blind aspects of expense costs are now totally visible and known.

The intelligent lighting control systems of Street Smart Lighting adapts to the actual lighting levels the user needs and responds to the requirements of the local applicable standards. Current regulations allow reduction in the levels of lighting in the event of a reduction in traffic on the road. It is also possible to adjust the power if the streetlights to weather conditions. For this purpose, the sensors are mounted with traffic (usually loops) and weather sensors. The intelligent system gathers information from the sensors and depending on the current control algorithm automatically adjusts the lighting. With the continuous lighting control optimization algorithm, a user can achieve a high level of savings.

A very important feature of our Street Smart Lighting Systems is that the control algorithm can be different at different points on the same network. For instance, in hazardous areas like crosswalks and intersections, it is essential to ensure very good lighting while in some parts of the network the lighting power can efficiently and safely be reduced. If the lighting on an individual street or even single lamp needs to be adjusted or turned off, the system operator can, with one click of the mouse on the computer supervisory system, turn on, adjust, or turn off a lamp or lamps. The system operator also has online access to current data about the efficiency

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of lamps and energy meter readings which are included in each lamp socket. These features effectively facilitate the information needs of those responsible for lighting in various parts of their supervised area.

Reduction of individual street lights is carried out by the drivers built into the luminaries or installed on poles. A segment driver is mounted in a cabinet on a given lighting power line. Sectional individual drivers are connected to the internet and work with higher level systems, like Street Light Vision, to complete a system architecture that allows an easy development of the system from one street to an entire connected city of streets. To avoid problems during expansion, it is imperative to use standardized open solutions, which is the way APANET Green System Technology is constructed. These types of solutions can always be extended and integrated with multiple company products and services. This approach assures that at each stage of the installation the investor will be able to choose the most advantageous solution, not just a solution that will be dictated by a proprietary supplier.

One of the technical problems in developing a vast diverse urban lighting system into one Smart Street Lighting system was to find a method for bi-directional data transfer. The problem is solved by a communication technology using existing power cables. APANET Green System Technology optimizes power line communication (PLC) which allows the transmission of data with network control systems without expensive investment in constructing a separate infrastructure for the network. As 95% of the world's installations use LonWorks, APANET uses only this standard in developing and providing an intelligent comprehensive network.

The basic functions of an APANET intelligent Smart Street Lighting control system includes among other functions the lighting control of streets, squares, and parks are as follows:

- control of individual street lamps (HPS, LED or MH)
- enabling on/off lights and limiting their power
- automatic modification of the expected level of lighting depending on road conditions, increased traffic, reduced visibility or night time special situations like sporting events
- independent control of different lamps of the same network, such as in and around crosswalks without reducing power
- recording the energy consumption and operating time of each lamp and lamp group, as well as all additional devices powered by the same system like seasonal Christmas light illumination
- ability to control the electrical parameters of each lamp separately (voltage, current power factor, active power, reactive power, etc.).
- control of the proper operation of the lamp in the event of failure of the system
- up to the minute system notification for the operator and service teams to address intervention needs like sending SMS
- detection of unauthorized opening of the lamp housing without notification to appropriate services
- the ability to measure the temperature of the electronic equipment in the lamp
- effective metering of lighting use and responsible assignment for cost
- differentiation among several users in a particular area like residential lighting versus community lighting responsibility and expense

APANET Green Technology System's resourceful use of the communication system of existing power cables and LonMark standardized equipment of LonWorks open protocols and interfaces allows minimal investment costs while maintaining maximum flexibility and efficiency. As a result, it is possible to achieve energy cost savings that will be seen in a very short time. In some cases, this is in only two to four years for a financial recovery from the initial installation investment and continual savings into the future.

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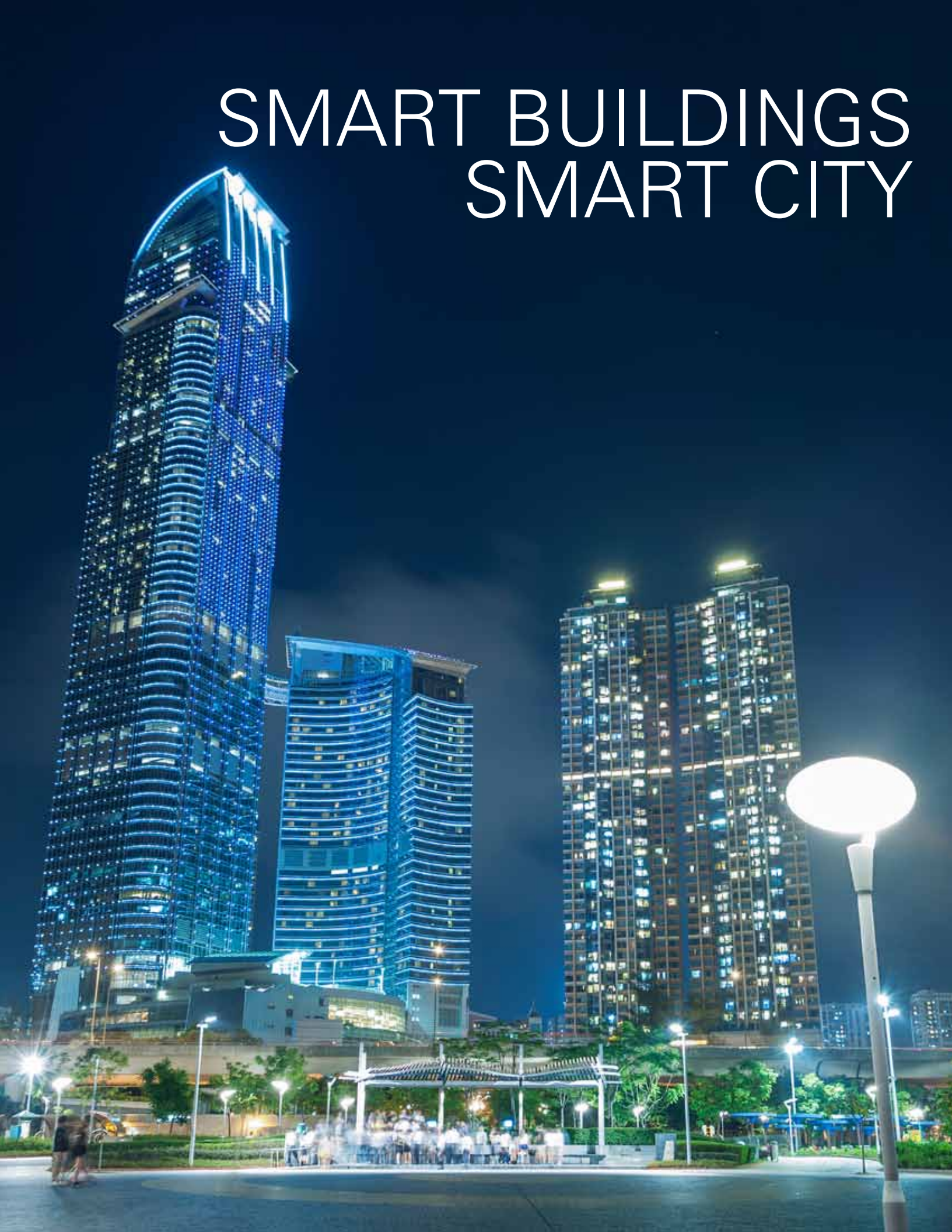
SMART BUILDINGS
SMART CITY



INTEROPERABLE

Smart Building

Globally, human history begins with common categories: food, sleep, companionship, work relations, worship, and protection. The protection category involves an environment into which occupants gather, exchange ideas and sustenance, keep comfortable, perform essential daily tasks, and sleep in safety. These are features fundamental to the concept of a building and have not altered much since the dawn of civilization. Where humans gather to live, to work, to enjoy, or to worship, a building represents humans working with and/or against a natural environment that either supports their needs or must be managed to supply those needs.

Modern building architecture can astound us with its complexity and dazzle us with the technologies necessary to provide comfortable occupancy. However, the truly amazing ability of buildings is still to be demonstrated in the ongoing development of Smart Building concepts. Common features like lighting, heating, air conditioning, security, and ventilation, are all being threaded together into compatible information sharing intelligent system networks. These networks are built on applications that can be layered onto one another over time, and eventually lead to interaction with the Smart Grid.

How do you define 'Smart Buildings?' Because each building is different and each owner requires a definition that explains their particular need, defining a smart building can only be accomplished by citing what application capacities can be used in a building. The foundations of these capacities are intelligent automation, analytics and integration. Automation is programmed into the building function for more efficient building operation and management. Analytics that include sensors and controls that can be remotely managed are used to improve energy efficiency, lower operating and maintenance costs, and provide asset reliability. Integration of the building with current connection to smart energy systems within and beyond the building completes a general definition.

Smart Building technology can be installed during building planning and construction or retrofitted to address existing building needs. Intelligent technology (IT) can provide intelligent control to manage connected devices, equipment, or groups of equipment with networked systems and an overall supervisory system. Many of these systems involve machine-to-machine (M2M) communication. This communication requires open system responses to accommodate connectivity between all of the equipment and the systems in the building. Applications can be designed for intelligent control of electricity to manage lighting and general electric use, heating and air conditioning systems, security systems, telecommunication systems, loading dock delivery areas, parking garages, exterior parking and building campus areas, and architectural lighting. The list is defined by the building owner's needs.

Quick detection of any system malfunction is another asset of Smart Buildings. Maintenance response is exacting and no labor time is wasted for necessary replacements or repairs. Maintenance can be proactively planned and not reactively performed. Fundamentally, smart buildings will provide services that make all occupants and visitors comfortable and productive.

Lighting, thermal comfort, air quality, safety, security, refuse removal, sanitation, and bridging to the world beyond the building walls will allow integration of data gleaned from many sources to provide energy efficient and cost effective building management through systems that share information and optimize building performance.

In 2015, the US Government Services Administration (GSA) plans to cut the energy level use in all government buildings by 30%. This reduction can not happen with technology alone, but must involve human understanding, acceptance, and participation. Building occupant's responses and suggestions to these changes add to the information data used to improved efficiency into the future. The ideal approach to Smart Building functions contains the following connected components:

- Integrated building systems
- Technological and human intelligence
- Addressing bottom line expenses
- Awareness of global environmental issues
- Connection to the Smart Grid
- Development of future enabled intelligence solutions

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The practical approach to Smart Buildings contains elements that work with the people using the facility, facility owners, and considerations beyond the facility. Using an office building as an example of the interconnection of the three aforesaid elements, the intelligent use of office light can be analyzed and redefined. The small electron voltage in the sensitized coating of electromagnetic windows will allow those windows to darken or to lighten in direct response to the outside sunlight. These windows darken when the sun is brilliant upon the outside of the window and reduce the solar heat within the room. Conversely, if the sun is setting or the day cloudy, the windows react to become transparent to allow maximum light into the room. These features, automatically and remotely controlled, alleviate light and room temperature fluctuations, thus reducing costs. Automatic controlled shading can be combined to contribute to balanced room temperatures and cost free lighting.

LED Lighting and Smart Building Efficiency

LED lighting can provide dimmable light fixtures that use efficient electronic ballasts and allow for sensor control. SunView LEDs are the finest bulbs on the market with the highest lumens and the lowest wattage. Using these LEDs will further reduce electricity power consumption and lower electricity costs. Rooms can be fitted with occupancy sensors that reduce lighting, heating, or air conditioning needs as a room is filling or emptying of occupants. These sensors can also be integrated to security systems.

These same practical principles can be applied to residential Smart Building use.

Smart Electric Meters will be a critical link between the intelligent home network and the Smart Grid. These meters will calculate energy use in 15 minute or less intervals and record usage over time periods. Customers will be able to view their energy and time use and compare this to the peak and off-peak energy use rates. This will allow them to choose using electricity at a lower cost time period. In cases of power outages or malfunctions, the necessary repair location can be exactly pinpointed thereby alleviating excessive downtime or wasted maintenance detection time. This 'Smart Building' function will give home owners more efficient, effective electricity service and allow them to chart and choose their price points for service. In certain applications, a home owner will be able to collect energy, share it, or sell it back to the utility company for discounts, refund, and/or direct payment to the home owner.

Just as an office building intelligently connects its systems and equipment for remote control and efficient management, a homeowner will be able to perform similar tasks through use of their 'Smart Appliances.' These appliances are already on the consumer market. They contain computerized programmable chips with wireless and remote capabilities that will allow an

owner to remotely switch on/off their appliances to take advantage of peak and low energy use rates. Plug in switches at a residence that are connected to the Smart Grid will allow an owner to plug in their electric vehicle to charge batteries at optimum times. The goal of residential Smart Building is essentially the same for any other building. The end user can monitor energy consumption, in-place or remotely, adjust their energy use for personal preferences or needs, and save on electricity power costs. Distribution operators will be able to program a customer's devices, limit peak hour consumption, and, if necessary, switch a device to off. A consumer becomes proactive with the energy distributor and can decide how their energy will be consumed. Through this dynamic power consumption, a consumer's role changes from one who merely receives energy, to one who is able to choose the lowest energy cost and the possibility to become a 'prosumer,' or one who can sell excess energy back to the utility grid.

These intelligent network systems must be created with the interoperability of open systems in order to accommodate the multiplicity of devices, the maximum choices, and the full functional integration of the system. Because APANET Green Technology Systems utilizes only LonWorks technology, we can offer the interoperability that will allow a customer to develop layers of programs that will adapt and allow future technological upgrades. Financial budgets require technology that people who use, operate, and manage a building can understand and utilize with ease. LonWorks technology is that choice. Many people learning to use LonWorks technology become easily proficient as the technology is designed with people in mind. A building may be smart, but it is the people managing the intelligence who really define that level of intelligence.

Global Environment and Functional Connection

Building management systems have historically focused only on function, meeting comfort and safety standards, and providing security for occupants in whatever roles required by the building's activity. Until recently, the tracking and reduction of pollutants was not a primary focus. The sustainability for buildings, cities, and nations is now fundamentally tied to sustaining the environment by the reduction of CO2 and Greenhouse Gas Emissions (GGE). Smart Building intelligence systems can capture this data and develop operational systems that can reduce environmental pollution and decrease energy power use. These systems allow an organization to participate actively in global environmental sustainability efforts and mange their own carbon footprints for the future. The Smart Building will ultimately connect to the informational data and knowledge base beyond the building complex walls and into the Smart Grid. This connection will allow building owners and managers dynamic participation in their own electricity consumption. It will also provide their occupants and the public with information on a variety of levels to create a future sustainable environment.

On a functional level, Smart Buildings are able to impact the security and safety of both human and capital resources. Equipment can be maintained more efficiently and effectively. Humans can experience better health and safety. The building itself becomes a source of accessible information that can be utilized for public welfare. With large building complexes, connection

to the Smart Grid allows that building the potential to become a virtual power generator by which owners are able to sell excess electricity back into the market. This process can assist the electric grid to offset electrical outages due to malfunctions, brown or blackouts, or natural disasters. Smart Buildings become contributors to social well being and not simply consumers of energy.

These real benefits for the building and for society are not temporary solutions, but are resources that extend over the building's lifetime. Therefore, the building is not just a structure of concrete, stone, and metal. It becomes animated with intelligent purpose and ability to provide an information infrastructure that is connected to the intelligent system network of the future.

INTELLIGENT INFRASTRUCTURE

APANET Green Technology System and Smart City Solutions

The concept and development of the Smart City is so new that finding a fully working city system is difficult. Many cities worldwide are working to implement intelligent energy power systems with intelligent logistics to develop intelligent resource efficiency of individual cities and regions. This is the idea behind what is called Smart City or Smart Region. One of the first implementation examples of a smart grid for a Smart City is in Boulder, Colorado, USA. This Smart City concept consists of four main components:

Power Smart Grid Infrastructure

- This is a layer of communication in which all points in a network connect with the substation automation system and allow for the redirection of the energy of overloaded lines, early warning, and identification of the causes of network failures.

Smart Electricity Meters (Smart Meters)

- These are the essential link between the home network and the intelligent network as they collect energy consumption data at intervals of 15 minutes or more often, as in the case of power outages. Smart Meters allow faster location of faults and reduction of down and off time for electric service.

Smart Home Devices

- These wireless thermostats, plug-ins (switches), and in the future a management module battery charged by electric vehicles connected to the Smart Grid will allow the end user to monitor energy consumption and adapt it to personal needs and preferences. The operator will have the option to turn off individual client devices during such times of limited peak power.

Web Site

- This will enable customers to get detailed information on their electric consumption by generating detailed reports, suggest time consumption profiles which further reduce the cost of energy intake, as well as provide the rationalization for consumption. Studies show that even a simple procedure involving user's knowledge of their current electricity consumption converted into specific costs that encouraged them to rationalize their consumption and translated into a savings of 10% .

The city of Amsterdam in the Netherlands implemented a Smart City project that contains an example of the goals of the concept. The concept was implemented by local companies and authorities in 2008 to investigate a sustainable way of life, work, mobility and public space involving new technologies, but also to change the behavior of the participants (residents) and promote partnerships among multiple entities (companies, manufacturers, government, and organizations) to achieve a common goal. The following lists the findings of the field implementation goals and projects:

1. Public space street lighting and facades of building can save energy in three ways:

   - **Smart Street Lighting:** Illumination can be adapted to the current road conditions and the time of night. In practice, this means that late at night, when there is less traffic, the irradiance is reduced and thereby saves electricity consumption for lighting streets.
   - **Integration of Street Lighting and Facades:** Eliminate excessive lighting from street lamps by equipping buildings with energy-saving light sources.
   - **Lighting Trams and Billboards:** These draw energy from integrated photovoltaic panels.

2. Logistics and garbage disposal implementation:

   - **Refuse Removal:** Waste baskets with built-in garbage crushing powered by integrated photovoltaic panels are emptied five times less.
   - **Street Cleaning:** Local column reverse osmosis provides de-mineralized water for washing street benches and public areas like traffic stops, thereby reducing traffic congestion that results from trucks stopping and dropping off water to those places.

   - **Distribution of Goods:** Goods from different suppliers are delivered to a central location outside of the city center where they are stored and transported in an integrated way to the city center with the help of electric vehicles.
   - **Electric Vehicle Usage:** The transportation vehicles bring goods into the city center and as they return from the storage facilities they collect the pressed waste, thereby reducing traffic congestion and pollution.
   - **Harbor and Port Electricity:** The development of a multitude of electrical outlets on the quays for the reduction of emissions from vessels using generators.

3. Residential and office facilities:

- **Smart Electricity Meters:** The ability to immediately provide information on current consumption.
- **Display Energy Panels:** Posted panels with constantly updated information about electricity consumption and personalized tips on how to optimize that consumption by using data from the Smart Meters.
- **Public Information Platforms:** Display panels where one can find information about energy efficient lighting solutions, materials, and technologies for energy efficient use of buildings and encourage the daily behavior that reduces wasteful impact on the environment.
- **Smart Plugs:** Installed locally in electrical sockets and managed using software from home or office PC, these plugs will allow a consumer to remotely control the managed device.
- **Intelligent Tower Office (ITO):** This is a building equipped with the infrastructure to measure and analyze energy consumption and CO2 emissions which will provide a testing ground for the implementation of new and more efficient energy office solutions citywide.

The basis of the Smart City System is a well functioning infrastructure with data coverage of the entire city that allows integration of new services and functionality in the future. The aim of the Smart City is to reduce CO2 emissions, but also reduce the level of noise and air pollution, as well as to gain experience and knowledge on how to integrate elements of public space with new logistics concepts. The Smart Metering of electricity consumption and other media gleaned from information from public buildings can be combined to create a database that also derives informative data from the monitoring of school buildings and other municipal facilities. This information can be the basis for carrying out retrofitting work and improve energy costs for many properties. The entire Smart City Systems will eventually be integrated to the Information Control Technology (ICT) network of public buildings. This will allow for remote management of facilities, and, in concept designs, will be part of the Smart Grid, the System of systems, reflecting the modernized electricity network of the future.

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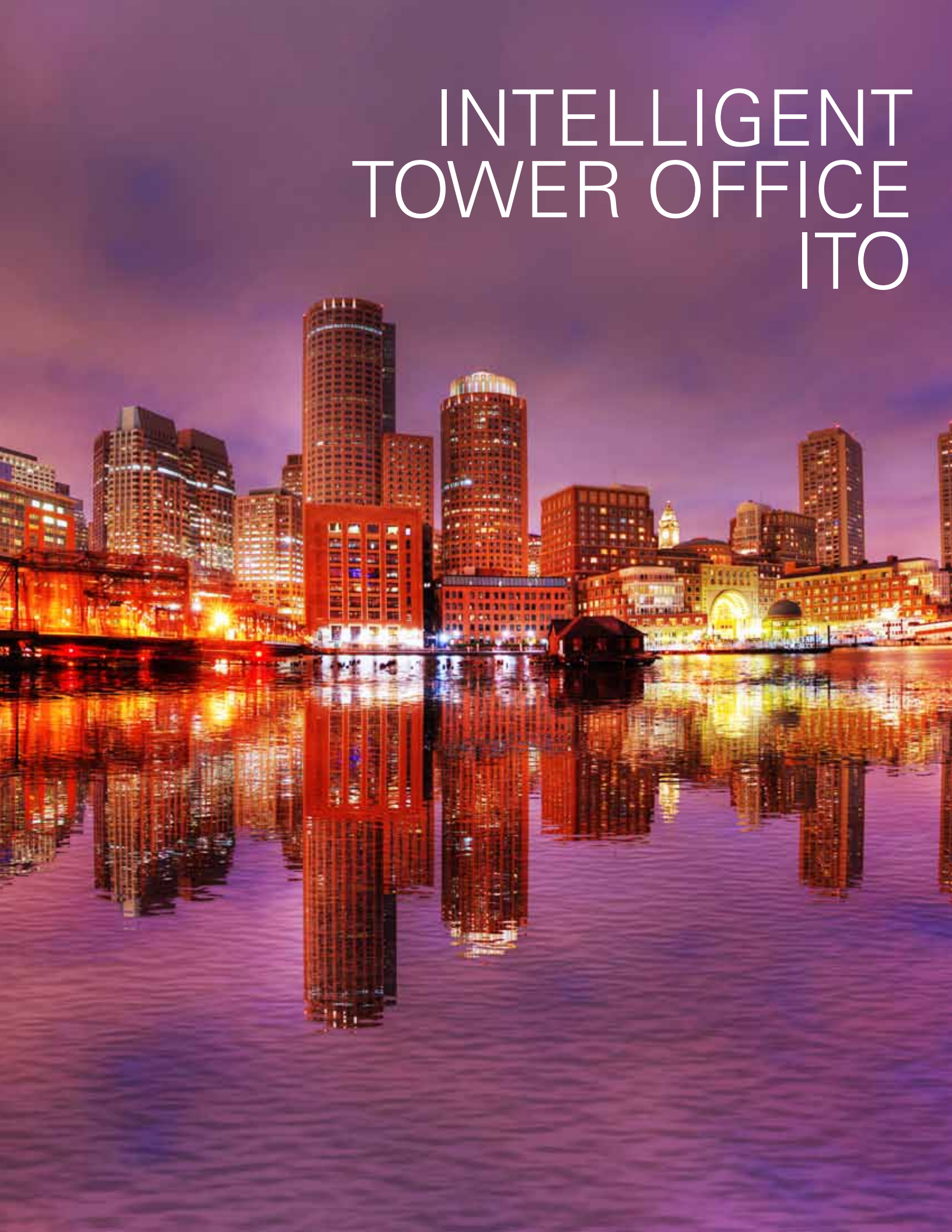
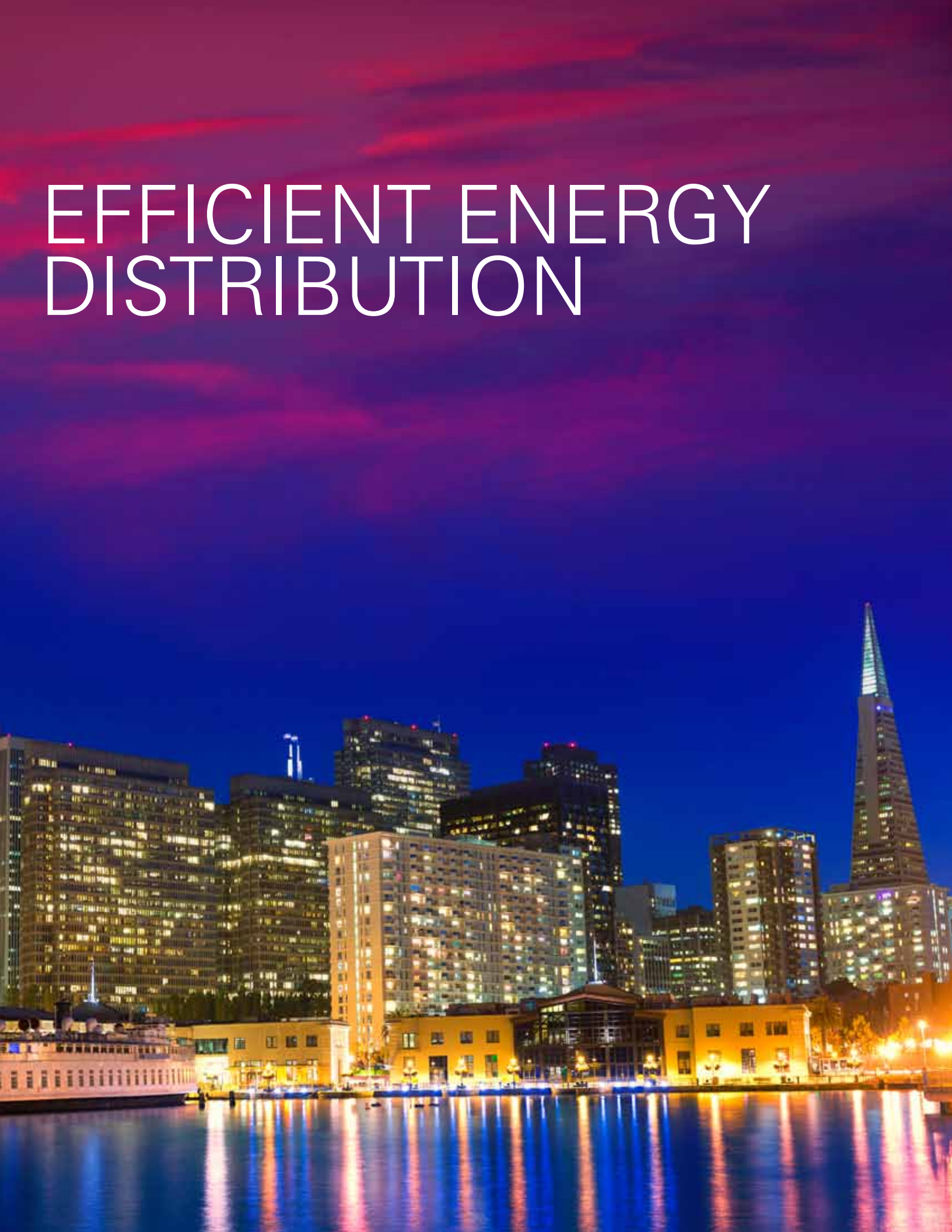
INTELLIGENT TOWER OFFICE ITO



EFFICIENT ENERGY DISTRIBUTION



The Smart Grid

The US Dept of Energy is charged under the Energy Independence and Security Act of 2007 (EISA 2007) with modernizing the nation's electricity grid to improve its reliability and efficiency. The act mandates modernization of the electricity grid policy of the United States to support effective, efficient, and reliable upgrading of the nation's electricity transmission and distribution systems to maintain a secure electricity infrastructure than can meet future demand growth and achieve the ultimate goals that define a Smart Grid (Title XIII Sec 1301).

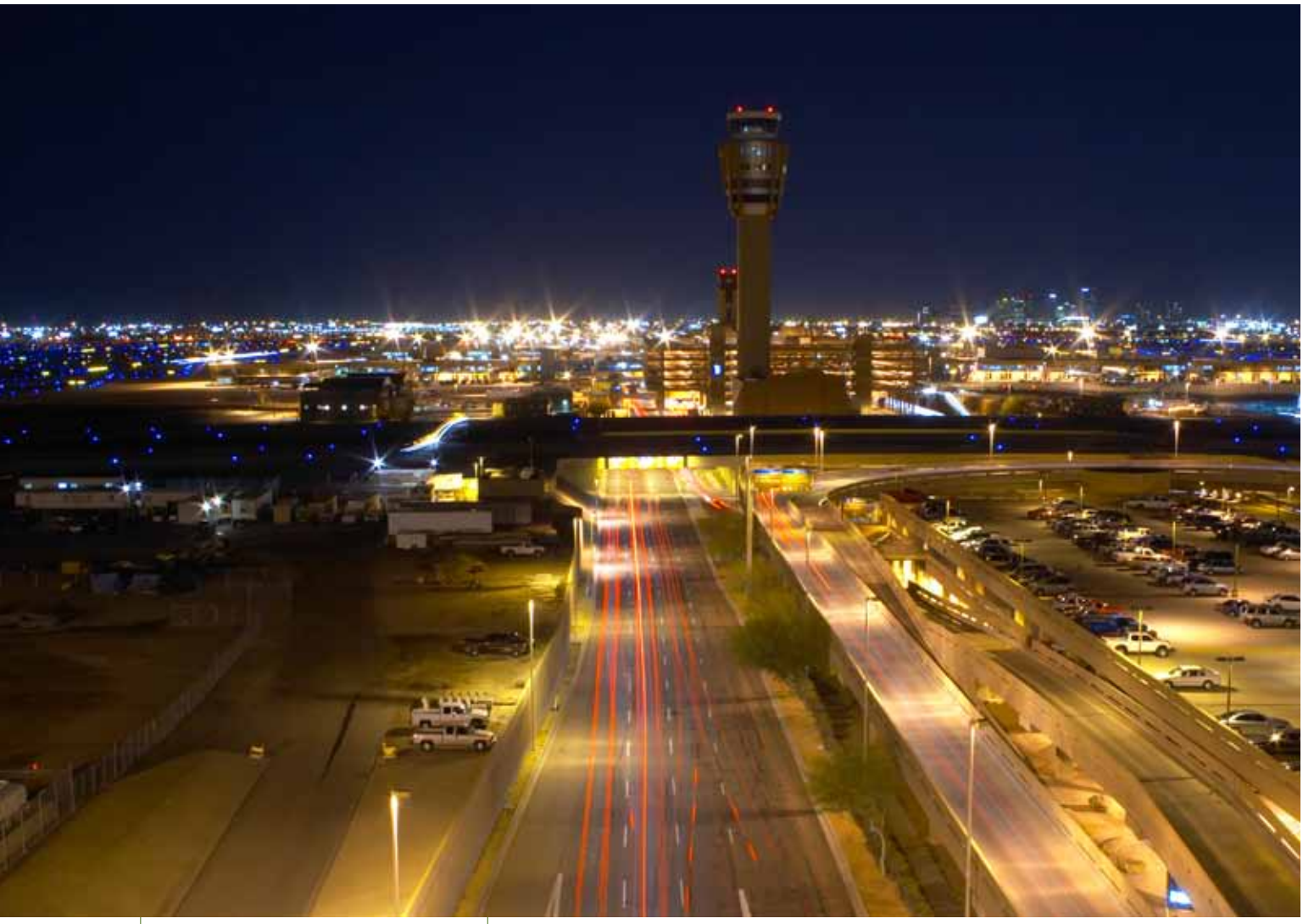
> Affordable Electricity, Efficient Distribution, Protected Environment

This Smart Grid will become the main platform for the nation's future energy grid. It will be the backbone of power nationwide. This Smart Grid must ensure resilience, identify and prevent cyber attacks, and incorporate innovations and controls to provide affordable, safe, reliable power for all citizens. Reaching these goals requires new business models, regulatory models, and new responsibilities, as well as obligations, for grid operators, consumers, and new providers who will all help develop further innovative solutions.

The details of the elements of Title XIII of the EISA 2007 are as follows:

- Increased use of digital information and control technology
- Optimization of grid operations and resources with full cyber security
- Deployment and integration of distributed resources and generation that include renewable resources
- Incorporation of demand response, demand-side resources, and energy-efficient resources
- Deployment of 'smart' technologies for metering, communications concerning grid operations and status, and distribution automation
- Integration of 'smart' appliances and consumer devices
- Deployment and integration of advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air conditioning
- Provision to consumers of timely information and control options
- Development of standards for communication and interoperability of appliances and equipment connected to the electric grid
- The lowering of unreasonable or unnecessary barriers to adoption

The American Council for an Energy-Efficient Economy (ACEEE) defines the Smart Grid as an umbrella concept describing electricity transmission and distribution systems that employ a full array of advanced electronic metering, communications, and control technologies. These technologies provide detailed feed-back to customers and system operators on energy use and allow precise control of the entire energy flow in the nation's grid. Distribution networks and consumers will gradually switch from being passive managers and receivers, to active



Electric outages cost America $150 billion annually

managers and empowered, engaged consumers. The changes the Smart Grid brings will affect everyone. Electricity will no longer merely be provided by professional energy suppliers, it will be controlled by end users. These end users will be connected to distribution networks which will replace simple electric reception through connection to transmission lines. Ultimately, state and local projects will be absorbed into the functional elements of the Smart Grid with emphasis on interoperability and cyber security.

In the absence of standards, the development of the Smart Grid technologies may produce diverse technological investments that will become prematurely obsolete or be implemented without adequate security measures. Therefore, the National Institute of Standards (NIST) has developed a series of standards that form the roadmap and framework to support state efforts in modernizing the nation's electricity grid. Interoperability is one of the key objectives in these standards. SunView LED Lighting and APANET Green Technology Systems are compliant with these standards.

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Reasons for the Smart Grid

There are several important reasons for the need to develop a national Smart Grid. The nation's current electricity grid is not equipped to meet the collective demands of current or future needs with the efficiency required to maintain citizen comfort and national security. Some studies claim that the present electricity generation and transmission system of the United States is ineffectual and wastes approximately two-thirds of the energy used to meet national electricity demands. With the current inefficient and often unreliable electricity system, the national economy loses approximately $250 billion annually. Outages alone cost America $150 billion each year. The price for electricity is rising steadily and in ten years it is predicted to increase over 30% of its present cost. When the rate increases, so does the cost of the losses.

Globally, utility fraud is second only to credit card fraud and costs about $85 billion worldwide. Billions of dollars are stolen from national grids, because it is easy to do and difficult to detect. The United States loses $200 billion in electricity loss and theft due to inefficient monitoring and the arduous efforts required to pinpoint the exact cause of loss. Overlooked transformers, illegal by-passes, and metering errors, coupled with aging technological equipment, contribute to this inefficient expensive loss.

Brownouts and blackouts occur due to the slow reset time of mechanical switches, lack of automated analytics, poor overall system visibility, and a lack of situational awareness on the part of grid operators. These outages move beyond simply waiting for lights to turn back on. Industrial production plants stop. Perishable food spoils. Traffic lights and credit card transactions become inoperable. These forms of outages cost American businesses on the average of $100 billion yearly. Anyone who has experienced a lengthy electricity outage due to a natural disaster understands the inconvenience, discomfort, and fear that results from an entire system breakdown. During recent national weather disasters, the fortunate, who still had homes, sat in the cold, wet, and dark waiting for the power to come back. Some had the comfort of kerosene generators as they waited. Teams of professional electricians were summoned from far away states to assist in finding and repairing the cause of the outages. We all remember their tired expressions of frustration as they toiled endless hours over massive lines searching for the source of the power damage in inhospitable weather. With the Smart Grid, malfunctions are noted immediately and locations pinpointed exactly. No time and expense is wasted.

Our current electric generation system annually produces 4.03 million tons of sulfur dioxide (SO2) and 2.1 million tons of mono-nitrogen oxide (NOx) which is transferred into our environment. These, coupled with other pollutants, add $125 billion to annual healthcare costs, cause 18,000 premature deaths, 27,000 cases of bronchitis, and 240,000 cases of respiratory distress. The noxious effects of rampant air pollution create approximately 2.3 million lost days of work nationwide due to illness. Adding to these dismal statistics are findings by the US Environmental Protection Agency (EPA). They state that nationwide there are 200,000 premature deaths per year due to combustion emissions especially from changes in particulate matter concentrations and 10,000 deaths occur per year due to changes in ozone concentration. From economic to environmental warnings, the development and implementation of the Smart Grid is critical to America.

VISIBLE NETWORK SYSTEM

The Smart Grid is a Visible Network System

The Smart Grid technology will make clearly visible what has been up to now an invisible power producing and delivery network. It will improve the ability to predict overloads and avoid outages by distribution methods that include renewable, non-renewable, and distributed energy resources (DER). These systems include natural gas fueled generation, combined heat and power plants (CHP), electricity storage, solar photovoltaics (PV), solar-thermal energy, wind energy, hydropower, geothermal energy, biomass energy, fuel cells, municipal solid waste, waste coal, coal-mine methane, and other forms of distributed generation (DG). In using megabytes of data to move megawatts of electricity, the delivery of electricity will be more reliable, efficient, and affordable. This process will create an electric system for the United States that will move from a centralized producer controlled network to less centralization and a more proactive consumer response network.

The Smart Grid will empower consumers to participate and choose using a public two-way communication between utilities and consumers. This will enable consumers to accurately view the electricity they use, when they use it, and how much that use costs. Through a sort of social behavior modification, consumers will be able to self-manage their own electricity use by investing in intelligent, energy-saving end-user devices or selling energy back to the utility company as excess stored energy in exchange for discounts, rebates, incentives, or revenue. This social behavior modification applies to utilities as well. Due to proactive customer participation in electric consumption, utilities will be able to use consumer demand as another alternative to alleviating the need to search for additional power generation. For the first time, residential customers will be on the same playing field and have the same discount options and demand responses presently offered to commercial and manufacturing customers.

Studies have been made that report over the past twenty years if the Smart Grid already was in place, the nation would have saved from $46 billion to $117 billion dollars by not constructing obsolete power plants, inefficient transmission lines, and ineffective sub-stations. The goal of the Smart Grid is to reduce utility costs, maximize efficiency system-wide, and prevent outages from natural, human actions, and cyber attacks.

The Smart Grid Provides Affordable Energy Cost

What will matter most to the consumer is effective delivery of electricity at an affordable cost. This is the realm of dynamic pricing which reflects hourly variations in retail power costs and gives consumers timely information to choose low cost hours of use. Consumers will be able to refuse to use or reduce their use during peak electric use hours. Demand responses will be created to allow all electric consumers from industry to residential to use energy in a rational manner by cutting energy use at peak times or when power reliability is at risk. Advanced Metering Infrastructure (AMI) will provide real time monitoring of power usage to consistently inform all consumers of their use and options. Distributive energy generation will

allow customers to use the generation of energy on their premises to offset their consumption costs by actually turning meters backward when they generate more electricity than they have demanded or simply providing them a credit for the excess energy in their next bill cycle.

For the reduction of toxic carbon, the Smart Grid's ranks the potential in providing cost effective clean energy using plug-in electric vehicles (PEVs), including plug-in hybrid electric vehicle (PHEVs), as the main response to this environmental threat. Although the vehicles by themselves will not produce the savings, the Smart Grid technology will allow them to generate their fundamental potential. The present idle production capacity of the nation's electric grid could supply 73% of the energy needs of the vehicles on the road with the use of existing power plants. Integrating that idle production would put that power back into the national grid. The use of electric vehicles would reduce 52% of net oil imports or about 6.7 million barrels daily, reduce CO2 emissions by 27%, and cut Greenhouse Gas Emission (GHG). To achieve this goal, vehicle charging must be done during off-peak hours. This peak time considerations will apply to electronically controlled appliances including ranges, dishwashers, refrigerators, microwaves, washers, and dryers. The Smart Grid will allow remote control of these devices using compatible global interoperable standards to transmit signals to and receive signals from devices while away from home. The benefits to consumers include their ability to make choices that save money, improve their personalized energy convenience, and impact the environment in a positive way.

The Smart Grid is the Future

Up to the present time and for most of us, energy use has been a passive purchase, unclear in exact cost, and confusing to consider. We receive bills. We pay them and hope there is not an outage especially in extreme weather conditions. Controlling the consumption, distribution, and generation of electricity by using the technologies of the Smart Grid will contribute to national and global environmental protection. If we choose to do nothing, polluting emissions will rise, electric rates will increase substantially, and consumers will be forced to pay excessively higher rates. We will have no choice or options. Brown/black outs will become a norm. This is not a future option for America.

When the nation implements fully the Smart Grid, it will change and hopefully enhance every aspect of the electric delivery system from generation, to transmission, to distribution, to storage. This implementation will create utility initiatives that will encourage and provoke consumers into new patterns of electricity usage. The modernization to the Smart Grid is central to national efforts to improve and increase the reliability of energy efficiency, transition to renewable sources for energy use, reduce greenhouse and carbon pollutants, and provide a sustainable, comfortable, safe environment for future generations. The Smart Grid will have requisite levels of interoperable standards that will enable innovative changes, some yet to be discovered. This interoperable system will exchange meaningful actionable information in a safe, efficient, and reliable manner. This System of systems will provide information sharing with flexibility, fidelity, and security to allow our nation to prosper and perform into the future.

Please note: For more information download our Interoperability Brochure.

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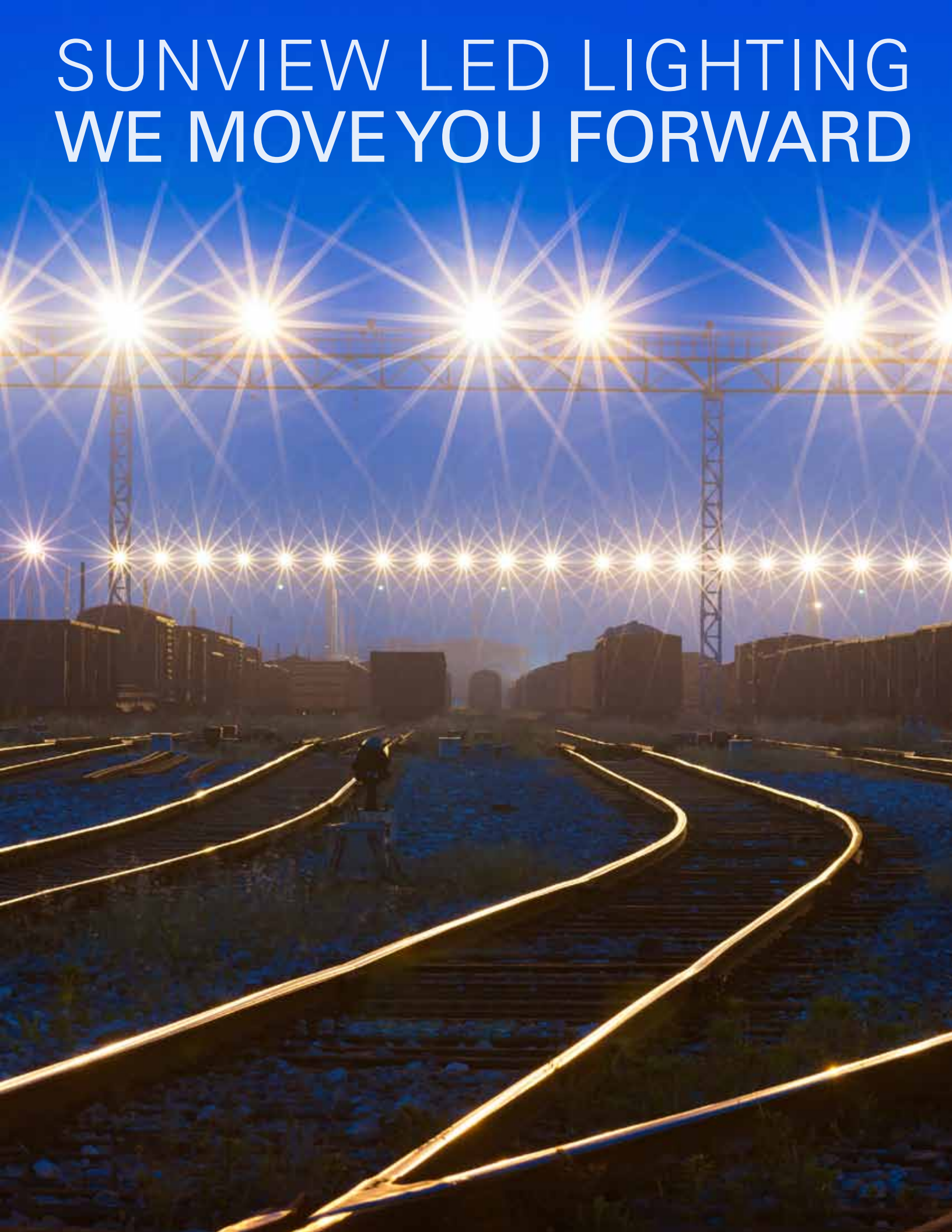

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