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White paper

Intelligent energy management

Contents

Intelligent energy management

Executive summary

The United States currently relies on an outdated, inefficient power system that fails to balance energy supply and demand. The recent emergence of the smart grid – a modernized electricity network using digital technology for metering and communication – further complicates the energy problem.

Intelligent energy management offers a new class of solutions to this complex energy problem. It meets today's market demands and shapes the future by delivering bottom-line and operational benefits for utilities, C+I users and residential consumers.

With intelligent energy management, providers and users have the insight they need to make informed decisions about energy consumption. Utilities can reduce problems with load management and peak demand. C+I users can reduce electricity waste, lower expenses, and increase marketability to increasingly green-minded customers. Finally, homeowners will have consistent data on their energy consumption, which they can use to save energy and reduce their power expenses.

Introduction

Today's energy problems

As energy costs and demands rise and more renewable energy sources come available, the existing energy infrastructure struggles to keep pace. The aging electricity grid does not efficiently balance supply and demand, resulting in needless waste, expense, threats of blackouts and brownouts, and carbon dioxide emissions.

While the development of a real-time, proactive, and intelligent grid (or smart grid as it is widely known) promises to solve energy problems in the long term, consumers and businesses need effective and affordable solutions today for managing their energy consumption and costs.

Intelligent energy management technologies can provide these immediate solutions. Properly implemented, intelligent energy management cannot only help cut energy use, spending, and emissions, but also provide a solid foundation to build tomorrow's smarter energy infrastructure.

This paper will detail the need for intelligent energy management technologies and services, as well as the benefits they bring to utilities, C+I, and residential energy consumers.

Drivers for change

The following issues drive the need for intelligent energy management solutions:

Peak Demand Challenges

Energy use changes from one hour to the next, depending on many influencing factors, like outside temperatures. Because energy needs can change abruptly, the energy infrastructure must always have the capability of meeting the highest – or peak – demand. Though the nation's energy use reaches peak demand levels for fewer than 100 hours every year, we maintain inefficient, pollution-causing "peaker" plants for use on these rare occasions.

Aging Infrastructure

Technologies developed more than 100 years ago inform the current power grid's structure, yet the grid delivers power to countless contemporary digital devices.

The antiquated infrastructure shows signs of stress. Outages and problems with power quality cost U.S. businesses $100 billion-plus each year, and three major blackouts have occurred in the past decade. Brownouts across the grid affect more and more people on a regular basis.

Already, it will cost an estimated $1.5 trillion to bring the U.S. grid up to date during the next 20 years. Upgrading the grid will only cost more the longer it is left in its current state.

Rising Prices

Consumers will bear a 50 percent increase in electricity prices over the next seven years, according to projections, because of increased consumption of fossil fuel and climate change initiatives that make carbon-based fuels more expensive.

Rising Demand

Since 1982, the nation's increased demand for electricity has outpaced the grid's transmission capacity by 25 percent annually. Over the next 20 years, overall electricity demand is expected to rise by another 30 percent.

Legislative Impact

While the U.S. has yet to enact federal carbon regulations or pricing laws, other government regulations affect future energy supply strategies. In Pennsylvania, for example, a new law requires a 4.5 percent reduction in peak energy demand by 2013.

Increased Use of Renewable Energy

By 2015, U.S. stimulus spending promises to support an additional 50,000 megawatts of renewable energy sources. These types of energy present intermittency challenges: the wind does not always blow and the sun does not always shine. As a result of intermittency, energy management systems must incorporate rapidly accessible response reserves for use during power shortages.

The Coming Age of Plug-In Vehicles

Plug-in hybrid and all-electric cars, like the Nissan LEAF and Chevy Volt, promise to help reduce both carbon emissions and dependence on imported oil; however, they also increase demands on power plants and transmission lines.

Existing solutions to the energy problem

In the past, demand response technologies helped shave peak energy demand using one-way communications from suppliers to customers and reactive measures that responded to demand spikes. These first-generation solutions had limitations: they could not predict changes in demand, nor could they provide everyday energy management solutions.

Newer informed demand response technologies help shape energy demand, predict available load, and then precisely shape that load. In particular, informed demand response enables distributed intelligence end-points, verifiable results, accountability and measurement, and comprehensive data analysis.

Despite these advances, significant barriers to energy management remain. Customers still lack the avenue for two-way communication with energy providers that would enable them to use the data they receive to proactively manage their energy use.

The case for intelligent energy management

Intelligent energy management solutions build on traditional and informed demand response practices by incorporating several new elements that help energy providers and consumers leverage a true, two-way dialogue that is lacking today. Perhaps most importantly, intelligent energy management provides a platform that empowers real-time insight, analysis and control, as well as integration with the expanding smart grid infrastructure. In particular, intelligent energy management:

- **Leverages the emerging two-way, real-time communication between utilities and customers to provide enhanced services.** Intelligent energy management technologies empower intelligent end points that provide real-time tracking and management of energy consumption. Whether communicating through displays or smart thermostats, intelligent energy management enables utilities to increase opt-in rates for energy efficiency programs while enabling the user to take a more active role in their energy consumption.
- **Enabling better energy control.** Two-way communication technologies allow homeowners and C+I users to set operation times for energy-using devices and incorporate automatic temperature adjustments or price signal responses. The same technology also enables utilities to schedule energy cycling to better manage demand across the grid.
- **Providing insight into problem areas needing improvement.** Intelligent energy management-enabled sensors gather data on energy use so customers can analyze their consumption habits and identify ways to improve efficiency, resulting in significant cost savings.
- **Making energy loads more predictable.** Using radio signal-based digital control of air-conditioners, hot-water heaters, pool pumps and other devices, utilities can help avoid energy load peaks. Utilities can send control commands to appliances when they need to shed their energy load and send follow-up commands when it is safe to return those devices to previous levels of energy use.
- **Allowing for rapid and flexible response to changing conditions.** C+I customers can earn cash incentives by agreeing to use conservation measures when peak demand across the grid becomes dangerously high. For instance, when extremely hot weather creates risk that energy demand will exceed supply, participating customers receive an activation notice to switch off non-essential lighting or turn to a backup generator to reduce their organization's energy footprint.
- **Automating energy management.** Intelligent energy management technologies can integrate into existing building automation systems to find new ways to manage demand. For example, intelligent energy management can program building temperatures to drift within a range rather than stay at a specific reading, thereby reducing both power consumption and cost without noticeably affecting comfort or operations.
- **Enabling quicker, easier service changes.** Utilities can establish or disconnect service to homes or businesses using wireless communication, eliminating the need for on-site visits.
- **Improving management across the grid.** Intelligent energy management devices can help utilities control capacitor banks across their distribution networks. The technology can work with other demand response systems to switch banks on or off as needed to maintain an effective power grid.
- **Bridging to the promise of the smart grid.** Through a direct interface with residential or C+I users, utilities can support renewable energy programs and make adjustments to meet customers' ever developing energy needs.

The components of intelligent energy management

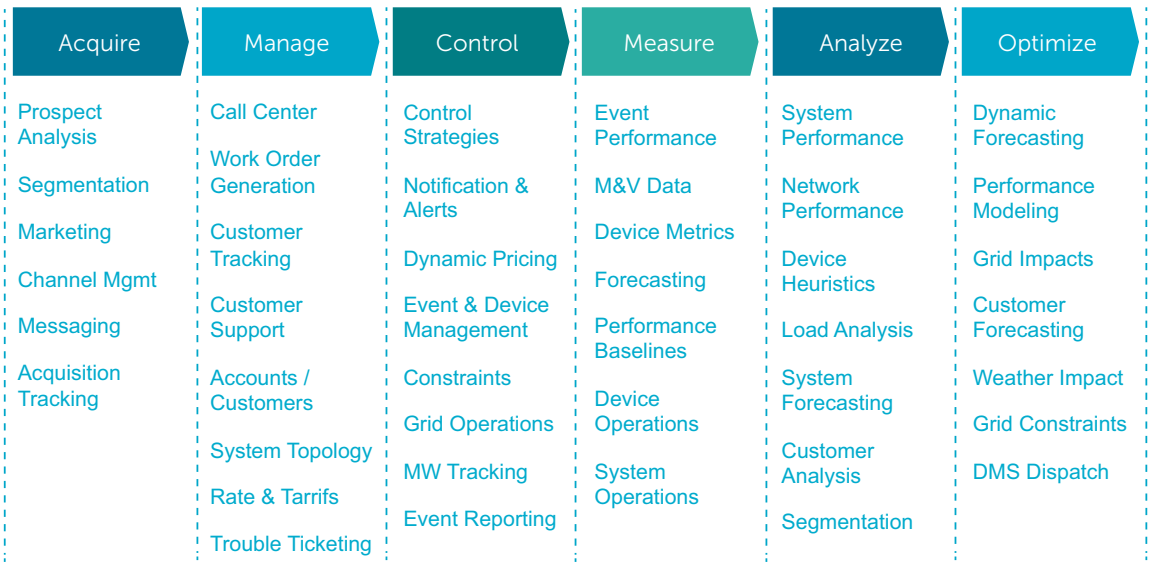
Intelligent energy management solutions must support six core business processes vital to delivering and supporting any comprehensive energy management program – acquire, manage, control, measure, analyze and optimize.

The delivery of energy management programs is complex, comprising many moving pieces and various stakeholders across a utility organization. No technology today provides comprehensive support from customer attainment to program optimization. Intelligent energy management provides customers with a single platform and dashboard to:

- **Acquire new customers:** Research potential customer prospects, segment and market to them based on their likelihood of participation and provide ongoing updates on new features, developments, etc.
- **Manage operations:** Provide support for call center operations, customer support, handling work orders and job completion, customer billing, and advise on the impact of rates and tariffs.
- **Control events:** Deliver notifications and alerts of impending events – such as the need to execute a demand response program during times of peak use – enable dynamic pricing programs, manage in-home devices, and maintain grid operations and upgrades.
- **Measure results:** Determine event performance after it has been executed, provide metrics on device usage and effectiveness, forecast futures based on past event participation, and ensure ongoing performance of device and system operations.
- **Analyze trends:** Leverage metrics to determine overall system and network performance, viability of pre-determined customer segments and customer opt-in rates.
- **Optimize programs:** Enhance programs through dynamic forecasting and performance modeling, address potential constraints on the grid, and account for the impact of harsh weather conditions.

Figure 1 — The requirements of intelligent energy management

The requirements of intelligent energy management



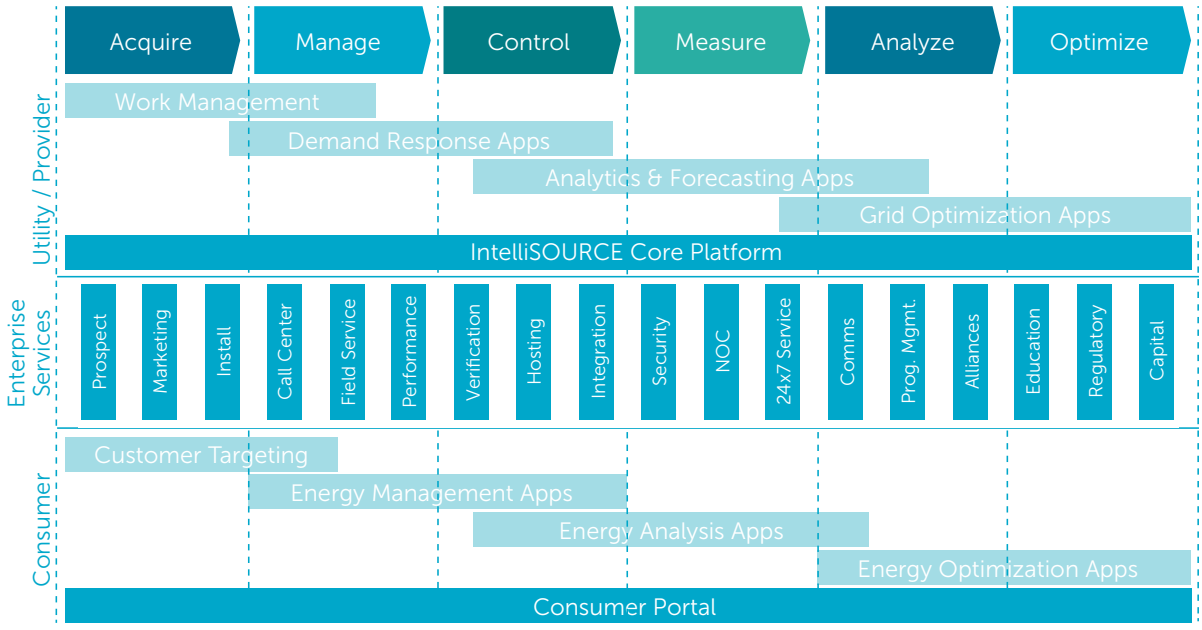
The components of intelligent energy management

In addition to providing solutions in support of the above business processes, a comprehensive intelligent energy management suite empowers the following components:

- **Work management capabilities –** Enables vital facets of energy management programs related to customer attainment and delivery of services.
- **Enhanced demand response applications –** Predicts the energy load available in a system, as well as helps to shape demand.
- **Analytics and forecasting applications –** Helps customers understand their energy consumption patterns and make informed decisions about their usage habits.
- **Grid optimization applications –** Supports the emerging complexities being added to the grid, including electric vehicle charging, variable pricing and support for renewable energy resources.

Figure 2 — Comverge IEM enterprise suite

Comverge IEM enterprise suite



In providing these applications, intelligent energy management solutions will address the peak demand problems facing the grid today while paving the way to the future. Going forward, intelligent energy management will also serve as the operating environment that empowers next-generation applications coming onto the grid. These applications, while not necessarily prominent today, are on the roadmap and any energy management solution needs to be able to support the increased complexities they will bring.

Evaluation criteria

For a utility or C+I customer considering an intelligent energy management solution, several key criteria should be considered. To be truly intelligent and deliver the best results and returns on investment, intelligent energy management technologies should provide:

- **Support for open standards –** A technology based on open standards offers greater flexibility and support for a wide range of applications. An open standards-based technology also makes it easier to add future service and product upgrades.
- **Ability to measure and verify results –** Any insights into energy use and demands should be presented in clearly measurable ways. And that data should be easy to verify and validate to ensure the measurements you're getting are the measurements you want and need.
- **Insights and analysis –** While data is helpful, intelligent energy management technologies should also help you understand the implications of that data in an intuitive format of some kind.
- **Accessibility and portability –** While a user-friendly meter is helpful for managing energy use, the ability to also enable data analysis and control through a variety of endpoints – web-based portal, in-home display, smart or thermostat, etc. – is critical. The more easily you can manage your energy consumption the greater control over usage and costs you'll gain.
- **Control and automation –** Finally, the technology you choose should provide a variety of ways to act on the insights and analysis you gain to both reduce your energy consumption and make that process as easy as possible. This should include, for example, automated options for taking advantage of lower off-peak electricity prices.

Within any given utility environment, there are multiple groups and functions responsible for implementing technologies that help meet energy efficiency mandates. Therefore any intelligent energy management solution must also address the needs of multiple stakeholders within a utility, including demand side, customer care, grid operations and supply side SOU.

An offering can only be considered complete when it offers solutions to these audiences, but also takes into account the business process the key stakeholders in these utility business units must adhere to. For instance, the needs of systems operators, IT, marketing and AMI deployment teams are all different, but must be met with a single, integrated solution.

For example, a utility company's marketing department will benefit from an intelligent energy management solution that enables it to identify the customers most likely to be interested in a new service, while the firm's technicians will want an intelligent energy management offering that provides automated alerts for outages and other problems. The customer support team, meanwhile, will need a system that delivers detailed usage information for each account, along with automated trouble ticketing and real-time work order tracking.

Therefore, when evaluating an intelligent energy management solution, utility companies must also pay close attention to its ability to meet the requirements of the various utility stakeholders.

The same is true for C+I users, where multiple stakeholders have a vested interest in energy efficiency efforts. A steel mill operator looking to reduce energy costs, for instance, will want an intelligent energy management offering that can not only generate the desired savings but can deliver the validation and data that compliance officers need to provide to regulatory agencies, create detailed billing statements for accounting and integrate services across multiple buildings for facilities managers.

Looking ahead: The future market for intelligent energy management

In coming years, government legislation will open a global market for intelligent energy management. Lawmakers around the world continually adopt new regulations to improve energy efficiency, cut carbon dioxide emissions and reduce dependence on imported fossil fuels.

In the U.S., the federal government has directed billions of dollars toward the development of clean and efficient energy. According to politicians, rebuilding the economy and remaining globally competitive depends in part on investing in renewable energy sources and efficiency measures.

The European Union has focused on smart meters as a way to help reduce carbon dioxide emissions and meet climate change goals. The European continent strives to have 80 percent of all households equipped with smart electricity meters by 2020, while the United Kingdom set its goal at 100 percent of households.

Developing economies such as China, India, and Brazil will also depend on developments in intelligent energy management. Their burgeoning middle classes strain their energy infrastructures, as millions of new customers acquire refrigerators, air conditioners, televisions, home computers, and other energy-hungry appliances.

Large organizations such as Cisco, IBM, Siemens and GE all see huge growth potential in the market for intelligent energy management and smart grid offerings. They are all pursuing partnerships and investing in new products and services with an eye toward establishing a solid foothold in that market.

IBM, for example, is pursuing a global "Smarter Planet" strategy that will require "green infrastructures that are instrumented, interconnected, and enabled by intelligent energy management." It works with numerous business and government organizations to help implement such systems around the world, and is currently working on 150 smart-grid-enabling projects in both developed and developing countries.

Cisco, meanwhile, expects the market for smart-grid communications infrastructure alone to reach $20 billion a year over the next five years. Company executives say they believe that smart-energy networks could eventually grow to be "100 or 1,000 times larger than the Internet."

GTM Research sees the smart-grid market for the U.S. alone growing to $9.6 billion a year by 2015. The largest segment of that market, it predicts, will be distribution automation, followed by advanced metering infrastructure, smart utility enterprise and home area networks.

> "This new power scenario has placed the onus on utilities to integrate smart grid technology to cope with load management and next-gen obstacles such as 'green blackouts,' " according to GTM Research.

All combined, these developments will contribute to an ongoing and global demand for intelligent energy management technologies and services in years to come.

Summary

With pressures on the electricity grid compounding, but a fully "smart" solution still many years off, intelligent energy management products, software, and services can help now with reducing energy use and improving energy efficiency by offering several improvements:

- Two-way, real-time communication between utilities and customers for service alerts, consumption management, and more.
- Greater control over home and C+I energy use through intelligent end points that customers can manage remotely.
- Intelligent sensors that provide data on energy use so customers can easily identify areas where they can reduce consumption and costs.
- More predictable energy loads through smart control of electronic appliances.
- Faster response to changing conditions, with cash incentives to encourage conservation measures.
- Automated energy management that works with existing building systems to manage demand and shed load.
- Quicker, easier service changes via two-way, wireless communication.
- More efficient distribution networks across the grid.
- Support for smart grid applications such as time-of-use pricing, electric vehicle charging, and renewable energy sources.

Put into place properly, these intelligent energy management solutions can bridge the gap from today's inefficient, electricity system to tomorrow's smart, automated, fast-responding grid, while also reducing the increased complexities of managing this type of advanced system.