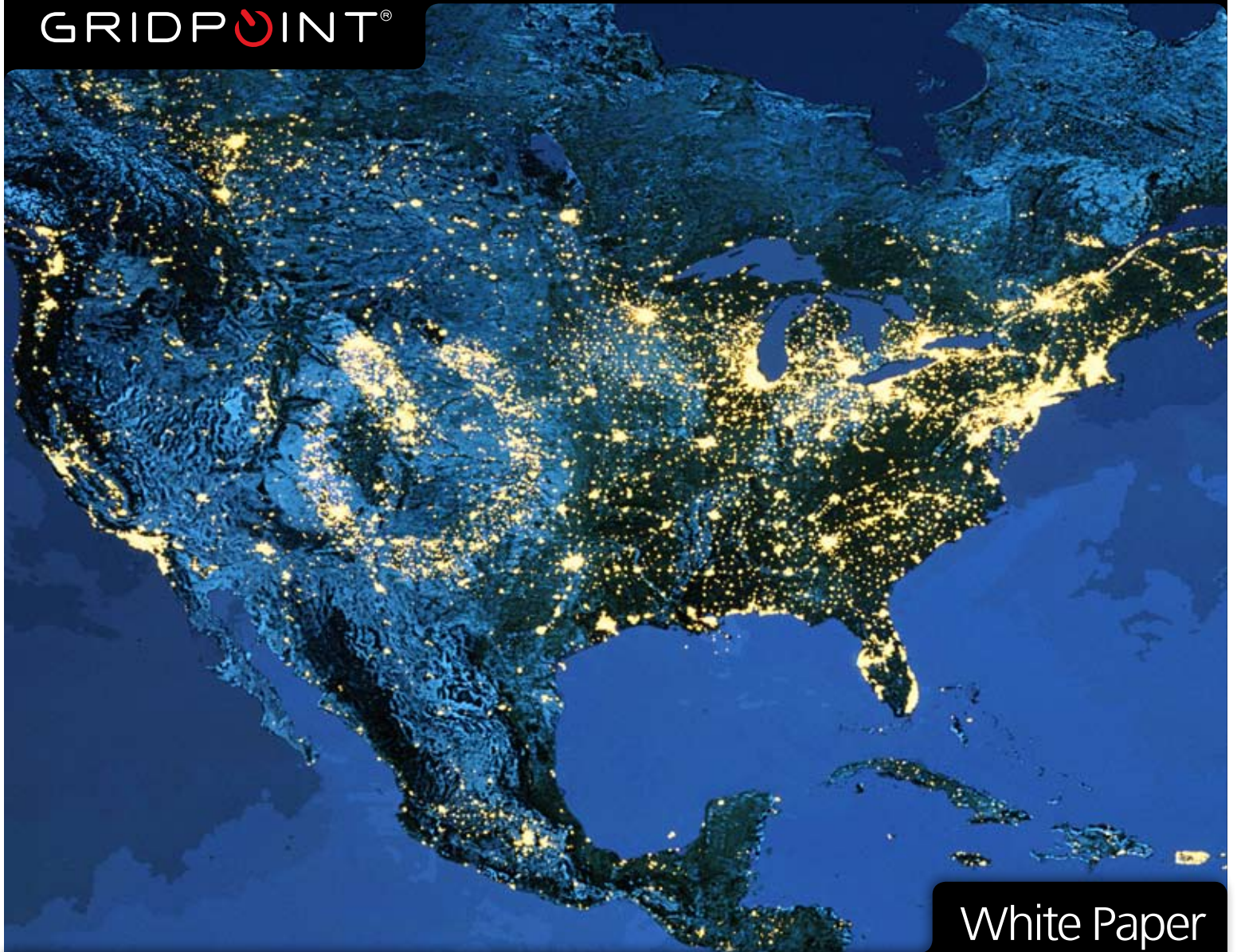


GRIDPOINT®



White Paper

Creating our 21st Century Economy through a Smart Grid

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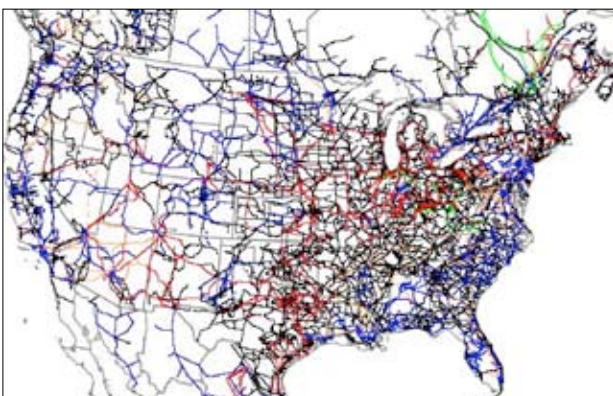
Early every morning from Bar Harbor to Malibu alarm clocks go off, coffee pots turn on, lights, TVs, hair dryers begin waking up with Americans in a daily ritual that is as routine as putting on socks or combing your hair. And with the waking of Americans comes the waking of businesses, factories and farms from coast-to-coast as they turn on machines, motors, lights, heaters, computers, copiers, and more. While some equipment has quietly worked through the night, most wake from being idle just as their users show up for work, school, and various daily activities. This is the sign of a healthy digital economy that feeds our diverse and growing appetites for energy another day. We've become very dependent on this daily routine in America, more than any other country, and largely take for granted the comfort, security and safety customarily provided.

And what feeds this waking giant of an economy day in and day out? Mainly a vast, largely transparent, energy infrastructure: train loads of coal criss-crossing the country on their daily trips from Wyoming, West Virginia and other states to thousands of behemoth power plants strategically placed next to major water sources, thousands of miles of natural gas pipelines stretching from

Canada to Mexico and from California to New England, giant metal towers and wooden poles marching like soldiers across mountains and prairies alike, with millions of miles of wire draping from tower to tower and pole to pole, along streets and through neighborhoods, to the glass bubble by the back door. The electrical power grid, a massively complex machine, the largest on earth, was recently acclaimed by the National Academy as "the most significant engineering achievement of the 20th century." And it's really no wonder, given its vital role in our everyday health and prosperity.

Unfortunately, we've taken this massive infrastructure, the power grid, somewhat for granted as it rapidly ages and as we more frequently push its physical limits with our growing demands. Demands that will continue to grow as the population increases, as the climate warms and air conditioners are needed in

Electricity... the primary driver of our economic development for nearly a century ...significantly increasing public health, safety, comfort, and security throughout the 20th century.



Electricity...the primary change agent for the 21st century "digital" economy... increasing the speed and span of information, changing how we buy and sell goods, cleaning our environment and supporting our need for increased security.

Vermont as well as Texas, and as computers, plasma TVs, and other electronics invade every home and business. These demands will certainly require new infrastructure, but will also require innovative new concepts and technologies to continue to drive the economy forward.

Electricity was a primary driver for change during the 20th century. From lights to motors to refrigeration to radio to manufacturing to television, electricity provided safety, security, comfort, increased productivity, communications, entertainment, and most recently electronic commerce. Automation, communication, and digitization were all concepts and functions derived from electricity and power.

Now as we begin the 21st century, it's time to revisit this critical infrastructure and rethink its ability to drive our security and prosperity for the next 100 years.

We need a different kind of electrical grid, a smarter one, one that is prepared for real-time information, countless choices, rapid decisions, and fast response. We've already seen the benefits this brings in other industries. While we file our taxes electronically, order books, flowers, clothes and even food online, and communicate around the world at nearly the speed of light via email, we still generate and deliver electricity much the same way we have for over a century.

While it has served us well, the current grid is antique, susceptible to power interruptions and outages that cost the economy nearly \$100 billion each year* and often threaten personal safety and security. We still generate and deliver electricity much the same way we've done for over a century – Thomas Edison would still recognize the meter spinning on the side of our homes today. **It's time for a change.**

The changes are rather simple conceptually, but represent a fundamental paradigm shift that when implemented will create a power delivery system that is as pervasive, intelligent and potent as the Internet is for our 21st century economy. And similar to the Internet, with broad agreement on a few concepts and conventions, the changes will emerge rapidly and organically rather than being driven by traditional chain of command. Unleashed innovation will drive the paradigm shift.

Industry consensus is developing around the following concepts, while the details are still being discussed and evolved.

First, it is clear that the appliances, equipment, and electronics that eventually consume the electricity must be able to communicate and ultimately support the optimal operation of the entire grid. Each of these devices must have the ability to understand the condition of the grid in order to prioritize their operation and use of electricity accordingly. By creating a simple but smart interface, these devices can rather easily be operated in alignment with the overall operational priorities of the grid. In addition, grid operators can measure and verify the efficient and economic operation of this equipment and properly incentivize superior operation.

Second, consumers themselves must also have the ability to understand grid operations and be able to adjust their consumption of electricity accordingly. This doesn't mean that we all become

* Unreliable power costs America more than \$100B annually... the equivalent of a 30-cent surcharge on every dollar spent on electricity (Galvin Electricity Initiative, 2005)

grid experts or study grid operations. It means that we create simple, understandable interfaces between the grid and the consumer that allow them to support the needs of a 21st century grid, much as they've adapted to 21st century communications and commerce. Consumers must be provided with the ability to manage the energy consumption of their homes and businesses in harmony with their lifestyle choices, values, and unique and variable requirements. Critical information must be routinely communicated to each consumer in ways that allow him to easily make decisions that align with community, regional and national priorities, turning all of us into active participants in and beneficiaries of a smarter grid.

Third, we create a grid that easily and effectively absorbs new technologies and systems that will inevitably be developed and deployed. Whether solar panels and wind turbines that generate clean power, fuel cells that run on carbon-free hydrogen, batteries that store electricity, plug-in hybrid electric vehicles that reduce tail-pipe emissions or technologies yet to be invented, the new, smarter grid must readily integrate them to ensure a healthy, growing economy. As we transition over the next decade or two to a less carbon-intensive economy, easily integrating a variety of new technologies will be critical to reaching our goals.

GridPoint is committed to making this vision of the Smart Grid real... aligning the driving forces of consumers, utilities, and the environment in a fundamentally different and enduring way.

The "smart grid" and "smart electricity" are already being created. Technologies that created the Internet and modern communication are already revolutionizing how we deliver electricity. From coast to coast, utilities are changing out traditional meters for new "smart" meters that will make the system more responsive. However, this is just the beginning. Appliances will soon be "smart" in a way that responds to grid operations and emergencies. Consumers will soon be able to understand their use of electricity like never before, and so be able to contribute in a tangible way, through smarter energy use and derived savings, to the health of the power grid and the health of the economy.

A growing number of utilities, businesses, and homes across America are stepping up to this new paradigm, one in which they collectively participate in the efficient, clean and reliable operation of the electricity infrastructure. GridPoint® is leading the transformation with its smart grid platform that aligns the interests of utilities, consumers and the environment to make the Smart Grid a reality.

The platform applies information technology to the electric grid to provide utilities with an intelligent network of distributed resources (e.g., advanced load control devices, batteries, solar systems) that reside at the point of consumption - the home or business. Additionally, the platform's modular, scalable and upgradeable architecture enables utilities to create a practical path for integrating new clean technologies (e.g., plug-in hybrid electric vehicles and fuel cells).

During peak demand periods, the platform enables utilities to efficiently balance supply and demand by discharging stored power or reducing loads with minimal impact on customers (i.e., controlling temperature versus shutting down air conditioners). Utilities can also optimize existing baseload generation assets and relieve stress on transmission and distribution (T&D) lines.

The platform serves as a virtual peaking power plant, enabling utilities to avoid the regulatory, environmental and "time-to-build" hurdles associated with building centralized plants while fueling

the mass adoption of renewable energy, reducing carbon emissions and conserving fuel, capital and land resources.

GridPoint understands that to make the Smart Grid a reality we must start at the point of consumption and provide technology that's easy for utilities and consumers to use.

For consumers, GridPoint's platform provides protection from power outages, increases energy efficiency through online energy management and integrates utility-controlled renewable energy systems, paving the way for the commercial success of residential and light commercial solar and wind energy sources.

The fundamental building block of the Smart Grid is the equipment and systems that reside in the home or business. By installing technologies at the point of consumption, we are creating a grid that is distributed, intelligent, cleaner and efficient.

GridPoint currently is deploying the second generation of this technology – an all-in-one device that contains power electronics, batteries and an on-board computer that communicates with the GridPoint Operations Center, the intelligent hub of the operating system. The center processes and exchanges information across the platform, monitors the health and performance of each system, and provides software applications for utility and consumer control.

The technology within the home or business makes intelligent decisions about when to produce, consume or store energy based on the commands provided by the utility's and consumer's software applications. Utilities manage supply and demand through the GridPoint Control Console, located in the utility control room, and customers manage their energy online through the GridPoint Customer Portal.

Dozens of sensors within the technology ensure optimal operation, provide remote periodic updates, and track and report any anomalies. The on-board computer communicates with the GridPoint Operations Center as often as required (i.e., seconds, 1 minute, 5 minutes, hourly, etc.) to ensure the data collected are available not only to the end consumer and utility, but also to a proactive product support team. Communication may be achieved through any network means

GRIDPOINT CONTROL CONSOLE™



GRIDPOINT CUSTOMER PORTAL™



available including an end-consumer's own broadband connection or a wireless network/virtual private network offered by the utility.

The operations center is designed with open and secure architecture to readily accept signals and data from other vendors' devices. The center contains state-of-the-art data management tools and techniques combined with powerful analytic drivers to collect, store and analyze the data as needed to inform decisions by both utility operators and consumers.

GridPoint Customer Portal, a personal online Web portal, enables consumers to interact directly with the utility, understand their energy consumption, and self-manage or work with the utility to manage energy usage. Through the portal, consumers can easily create an energy profile according to their lifestyles, such as turning off the water heater during hours when they are regularly away from the home, or designating how they wish to respond to utility price signals and demand response requests. The technology automatically monitors and manages energy according to the consumer's preferences while lowering energy consumption and costs, reducing the household's carbon footprint as well as stress on the electric grid.

Additionally, utilities can use the portal to educate consumers, increase awareness of new program opportunities, communicate pricing and environmental information, offer incentives, and provide innovative new services. The portal also acts as a "call detail" of energy consumption for the consumer, taking the mystery out of kilowatts and kilowatt-hours and simply detailing their behavior to enable smarter decisions in the future. Innovative new ways of providing feedback on environmental impacts will allow consumers to develop a deeper understanding and appreciation of their own impact on national and global issues like climate change.

GridPoint Control Console, located in the utility control room, provides utility operators with an easy way to aggregate and control thousands of distributed energy technologies. Utilities can schedule, plan and view the impacts of "event requests" they may issue. An event may be a demand response or curtailment activity of devices within the home such as a water heater, thermostat adjustment, pool pump, etc., or a request that deploys the batteries and other distributed generators to supply energy and capacity into the grid. Various types of events can be planned and executed to meet unique and critical resources to defer the need for upgrading transmission and distribution lines, provide higher power quality, reduce emissions, etc. New releases of the GridPoint Control Console will provide utility administrators with the ability to optimize resources in the field, implement programs based on geographic needs, and track and report platform benefits to further prove the capabilities and strength of a smart grid platform in today's energy management crisis.

While somewhat unusual in a utility industry environment, similar networks of distributed devices and network operations centers successfully are used to manage complex enterprise systems that have already become an integral part of our 21st century economy. GridPoint builds on proven technologies based on these systems and elegantly adapts them to make the Smart Grid a reality.

GridPoint's vision for the smart grid provides a variety of significant and tangible benefits ... to the utility, to the consumer, to the economy and to the environment.

This is an assertive, proactive view of the Smart Grid that GridPoint believes is necessary to achieve the myriad of desired benefits that can and should result.

Generally speaking, utilities are faced with growing pressures that overlay all of their strategic decisions regarding the future: continually growing demand for electricity, difficulty in siting, building, and financing traditional capital assets, growing pressures to reduce emissions including carbon, and an old infrastructure that is getting older. Additionally, security concerns, rate volatility, an aging workforce and other issues make this a complex and delicate Gordian knot of immense proportions that calls for innovative alternatives.

GridPoint SmartGrid Platform™ addresses all of these issues by proactively managing a wide range of “assets” deployed throughout the grid and integrated to benefit the entire grid, the utility, the consumer and the economy as well as the environment. Examples of these benefits are described as follows:

For the utility

- New capacity requirements to meet growing demand can be provided both economically and incrementally by actively managing peak loads throughout the system, by incorporating distributed generation capacity and by strategically integrating electricity storage.
- Alternatives to instantaneous capacity while reducing costs, improving reliability, and enhancing dispatch ability.
- Serving loads largely stranded as “load pockets” because of geographical or system constraints more easily and without building expensive new power lines.
- Improving reliability by quickly isolating outages, islanding critical loads where appropriate, curtailing certain loads in emergency conditions, and actively anticipating and diagnosing potential problems before they create an event.
- Increasing load efficiency by making consumers aware of best available technologies and program opportunities, by measuring and verifying impacts of various programs, by proactively diagnosing compelling opportunities for making reductions, by automating implicit efficiency and by creating innovative new programs that are specifically targeted at these opportunities.
- Improving operational efficiency of the system by actively diagnosing and correcting problems, reducing the field operation and maintenance needs, proactively adjusting performance parameters to optimize performance.
- Proactively managing the integration of clean energy technologies to maximize their environmental benefits and improve their operational value.
- Other benefits include consumer retention, reduced financial risk and volatility, and the ability to adapt to future technologies as they become commercially available.

For the consumer

- High-quality backup power for critical loads such as sump pumps, computer systems, refrigerators, lights, etc. during interruptions in grid power.
- Rich information on energy use patterns by specific circuit or appliance allowing better understanding and improved decision-making.
- Reductions in energy use and costs by adopting suggested strategies, improving equipment efficiency, measuring and verifying their impact.
- Reductions in carbon footprint through simpler integration of clean technologies and better understanding of financial options and impacts.
- Raised awareness of energy use, its relation to carbon, and its impact on society.
- Ability to more quickly and easily identify new technology options, their benefits and costs.
- Verifiable renewable energy and energy efficiency credits that can be monetized and the savings either captured or donated to charities.

For the economy and the environment

- Creates a clear path to improved energy efficiency throughout the grid and enables a platform for persistent and continued carbon reduction.
- Allows proactive consumer participation in managing the system more efficiently and effectively.
- Permits incremental and flexible changes to the system that reduce financial risks and simplify technology evolution.
- Reduces the need to build new power plants, which require land resources and face regulatory, environmental and “time-to-build” hurdles.
- Establishes a flexible and adaptable platform on which to build the 21st century “low carbon” economy.

The Grand Challenge we face is the real time balance of supply and demand ...and modern technology allows us to accomplish this in ways that Adam Smith could only dream of.

The energy future of our economy, nationally and globally, depends on resolving once and for all the tension between the supply of energy, where drilling wells and burning coal continue to deplete the precious finite resources of the earth, and the use of energy, where relatively inexpensive and seemingly endless energy has guaranteed the robust economy of the Western world for nearly 100 years.

The challenge is composed of key issues that have been the focus of research, innovation and analysis for more than two decades. None are new, but all have major impacts on the global consumption of energy resources that continue to grow. Fortunately, technology has evolved, as it often does, in the nick of time to offer us alternatives that we could have only imagined just a decade ago.

While we expect the economy of the Western world to grow and continue to support our lifestyle with the level of security, health and comfort we’ve grown to expect, the economy of the developing world is only now awakening to expectations similar to ours. Social equity

and environmental responsibility will demand a new paradigm – one that will support a new economy, a clean economy and an equitable economy globally.

Our new energy and electricity infrastructure must be much cleaner, more reliable, more efficient, and more flexible than the one we created in the 20th century. We can no longer mine coal in Wyoming to dry our hair in Houston or drill gas wells in Alberta to bake a pizza in San Diego. Consumers must participate in this 21st century energy grid. Appliances, equipment and loads of all types must be designed and operated to maximize efficiency and minimize the environmental impact. And the financial cost and risk must be manageable, understandable and acceptable.

New technologies are already available to deploy the Smart Grid now. Sound design, a clear framework and a robust platform will enable explosive innovation that will create a future system that will surprise and delight us.

It will take commitment, determination, and innovation to realize the enormous benefits to consumers, to the economy and to the environment. But most of all it will take leadership. Congress recently demonstrated its willingness to lead by passing the Energy Bill containing a Smart Grid Title. The US Conference of Mayors demonstrated their leadership by passing a resolution in support of “smart grids” and GridWise last summer. Now state legislators, regulators and utility executives across the country must demonstrate their leadership by aggressively moving ahead with large-scale deployments to fundamentally change the way we deliver power in the 21st century.

About the Author

Steve Hauser is Vice President of Strategy for GridPoint, Inc., the pioneer of an innovative smart grid platform to address today’s energy challenges while aligning the interests of electric utilities, consumers and the environment. He has been nationally recognized for more than 25 years as a leader in clean energy technology development efforts and was featured in MIT’s Technology Review magazine as a pioneer in the electric smart grid revolution. Mr. Hauser also serves as President of the GridWise Alliance, an advocacy group supporting a national imperative for modernizing the nation’s electric infrastructure.

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