EMPOWERING CONSUMERS
Through a Modern Electric Grid

Report of the Illinois Smart Grid Initiative

April 2009

Illinois
SMART GRID
Initiative

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More information at *www.ilsmartgrid.org.*

ABOUT

Since 1978, Center for Neighborhood Technology (CNT) has been a leader in promoting urban sustainability—the more effective use of existing resources and community assets to improve the health of natural systems and the wealth of people, today and in the future.

CNT is a creative think-and-do tank that combines rigorous research with effective solutions. CNT works across disciplines and issues, including transportation and community development, energy, natural resources, and climate change.

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GALVIN ELECTRICITY INITIATIVE

Sponsored by The Galvin Project, Inc.

The Galvin Electricity Initiative, launched by former Motorola CEO Robert W. Galvin, has brought together many of the nation's leading electricity experts to reconstruct our electric power system into one that is much more affordable, reliable and fuel-efficient.

The Initiative has created innovative business and technological blueprints for the ultimate smart grid—a Perfect Power System—based on smart micrograds that best meet the needs of 21st century consumers and provide the most reliable, secure electricity service regardless of nature's wrath or security threats.

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A NOTE ON THIS REPORT

The Illinois Smart Grid Initiative (ISGI) involved an *ad hoc* and voluntary assembly of individuals and organizations interested in improving Illinois' electric power system and services for consumers. The ISGI was coordinated by the Center for Neighborhood Technology with the support of the Galvin Project, Inc., and held four meetings between June and October 2008. This report summarizes much of the information that was presented at those meetings, a complete detailing of which can be found at the ISGI web site: *www.ilsmartgrid.org*. This report also identifies several key policy considerations that CNT believes should be examined in future work to develop the smart grid concept in Illinois, including the workshop and collaborative meetings held under the auspices of the Illinois Commerce Commission. It should be noted that the choice of these policy topics and the method of their examination here does not necessarily reflect the views of all participants in the ISGI process.

PREFACE TO THE REPORT

Center for Neighborhood Technology, April, 2009[1]

For the last eighty years, the electric industry in Illinois has had two legislatively-mandated and stakeholder-supported goals: reliability and affordability. During this time, utility regulation and policy has focused on achieving those goals. And overall, the inflation-adjusted price charged to end use consumers fell throughout most of that period and widespread and persistent blackouts were relatively rare for most communities.

However, times change: the future of electricity in Illinois does not look like the past. The Illinois electric utility industry and its customers are faced with a set of challenges the scope and scale of which are unprecedented since the advent of widespread electrification in the 1920's. These challenges include:

- **Increased likelihood of a carbon constrained future to mitigate the effects of human-induced climate change:** Environmental concerns will continue to place restrictions on the uses of traditional fossil fuel energy sources as the world prepares for, and adapts to, a carbon-constrained future.

- **Significant new infrastructure investment:** Huge new investment needs are required to both replace a rapidly aging electricity infrastructure as well as build to meet new demands. In addition, electricity infrastructure will compete with other public infrastructure needs in the coming years. Investment in the roads, railways and public transport networks, water, sewer, natural gas and oil delivery systems, schools, waterways, airports, and other public infrastructure investment is expected to balloon as existing infrastructure is replaced and new infrastructure is added.

- **New uses of electricity:** Electricity has become a more important energy source as new digital technologies and sophisticated production techniques penetrate markets, which adds to the total demand for power and adds stress to the power grid.

- **Continued globalization:** Local economies will continue to feel pressure from the global flow of capital. Power cost and quality for both consumers and producers will gain importance as local economic growth begins to depend more heavily on the electric grid.

- **Increasing energy prices:** Energy prices have increased dramatically in the last few years; and with demand from the globalization of the economic system increasing, the competition for energy resources will only become more acute.

The scope and scale of these challenges is unprecedented. Not only will meeting them require extensive investment in and adoption of new and revamped tools, technologies, consumer behaviors and governance institutions, but they will require a re-thinking and expansion of the legislatively-mandated goals of the system – in the future, the electricity system will need to meet three goals: reliable, affordable and clean.

The addition of the third goal greatly complicates meeting all three. Decarbonizing the electricity system - even if it occurs over the next generation - by itself is an enormously complex task. Add to it, however, the stresses of globalization, the new uses of electricity and the necessary replacement of an aging and outdated infrastructure - and meeting "reliable, affordable and clean" becomes an enormously complex task. But that is our collective task. And these three goals are increasingly recognized as priorities by policymakers, consumers, and business.

Where do we begin?

We have to begin by acknowledging and recognizing that the first foundational step towards building a new electricity system that meets "reliable, affordable and clean" is that it has to be as efficient as possible. We can no longer afford to waste 70% or 80% of energy inputs. In the past, when fuel or new capacity was perceived as cheap or technology was not available to avoid it, it might have made sense to engineer inefficient solutions or to incent inefficient consumption behaviors. But the future will be different from the past. In light of all the challenges facing the electricity system, "affordability" may be the most difficult goal to achieve and it will only be achieved by improving the efficiency with which electricity is produced, transmitted and consumed.

But to get to that level of efficiency, we need a system that is much smarter, self-aware and interconnected than the system that we currently have. What would be the components of such a system and how would they work towards "reliable, affordable and clean"? A workable definition of "smart grid" would have to begin not by defining "smart grid" from an engineering perspective as a bundle of technologies, but as a new system with four major components, including:

Smart technologies – Smart technologies encompasses both utility-side technologies, better equipment along the wires and poles of the distribution system that turn the grid a dynamic system, as well as consumer-side technologies that encompass appliances and devices that can respond to information about energy prices and grid conditions and adjust energy consumption accordingly.

Smart rates – Smart rates provide opportunities for consumers to reduce their electric bills through energy management, taking advantage of the opportunities that new technologies enable. Such rates must recognize and reward the shifts in risk management that new and innovative rates will create.

Smart consumers – Smart technologies and smart rates create opportunities for consumers. But opportunities are not enough. If those technologies and rates aren't used by consumers, their value is lost. Robust, clear and ongoing educational and marketing efforts will be essential to enabling consumers to make smart choices that optimize their energy use and cost and benefit the energy system.

Smart governance – To take full advantage of the opportunities of the smart grid requires changes in the traditional relationships between utilities, customers and regulators. New rules may be needed for a range of issues from establishing standards of service, consumer protections, rate making and investment decisions, reliability standards with new rewards and penalties, and more.

Recommendations

If our intent is to create a new electricity standard of "affordable, reliable and clean" in a 21st Century context, our challenge is how to accomplish that transition and at what speed. As this report reflects, according to the best experts in the field, part of that transition - perhaps a foundational one - will be the transition from an analog electricity delivery system to a digital one. As the report further indicates, the technologies to make that transition - the hardware and software - already exist and are being deployed by utility systems around the world. What is missing in Illinois is a relevant governance framework, one that focuses as much on the future as on the past, has the resources to understand the importance, relevance and dynamism of these issues and whose success and accountability metric is - at least in part - how well it does in meeting the new "clean, affordable and reliable" standard.

In order to meet those goals this report contains a discussion of six policy areas that were discussed during the meetings convened by the Illinois Smart Grid Initiative over the summer and fall of 2008 to frame the process of crafting a smart grid policies for Illinois. This analysis identifies several issues that must be resolved to move forward toward grid modernization investments in Illinois. These include:

- Smart grid metrics planning, monitoring, and evaluation;
- Evaluation of smart grid investments from a societal perspective;
- Alternative methods of ratemaking for smart grid investment;
- Non-utiity investment in the electric grid;
- Modification of default service pricing;
- Effect of statutory renewable resources, demand response and energy efficiency.

It is our hope that this discussion will provide a structure for the ongoing smart grid work at upcoming Illinois Commerce Commission workshops and collaborative meetings as well as in other venues.

While the details of those policies are important, and getting them properly resolved is necessary for a well implemented smart grid in Illinois, in its most immediate sense, there are three overarching actions that could be taken quickly and are required now:

1. Explicitly redefine "procurement" so that investments in increased efficiency, whether through public investment or private action and behavior change - be considered on an equal footing with the purchase of additional kilowatt hours or kilowatts.

Today, our procurement practice is simply to buy additional kilowatt hours and kilowatts. Yet the same resources that are used to buy more and more expensive power could be used to purchase **reduced power use** through efficiency and demand reduction. In a governance sense, we are blind to the possibility that the only real and cost-effective path to "reliable, affordable and clean" is through increased efficiency - from generation through transmission and distribution to end-use consumption. The fact that - based on the expert analysis in this report and a multitude of others - a redefinition of the procurement process would begin to save customers money, improve system efficiency and reduce our environmental impact - is currently not considered within the current governance practice. Until we redefine "procurement" to explicitly incorporate this concept - to allow for the investment of "procurement dollars" in tools, technologies and customer behavior that will lower our demand and improve our efficiency, we will make little or no progress towards achieving "affordable, reliable and clean".

Thankfully, in Illinois, we have a new institutional framework with sufficient existing funding that could quickly develop the requisite cost-benefit analysis of the choices outlined above. The Illinois Power Agency, created in statute last year, has the money and the authority to do this work. With supportive executive leadership its efforts could be expanded to accomplish this mission.

2. Give customers real choice

In Illinois we have talked about customer choice since the early 1990's. As envisioned by the proponents of retail competition in the electricity marketplace, customer choice was supposed to bring new competitors, new technologies and new opportunities to reduce costs to Illinois consumers. For large industrial and commercial customers, this has largely been accomplished. By the end of 2007, nearly 100% of the industrial load and nearly 50% of the commercial load were supplied by neither Ameren-Illinois nor ComEd, but by independent retail providers. When the numbers are available for 2008, they are expected to significantly increase, particularly for the commercial class.

But retail choice - as defined in the 1997 law - has been an abject failure for small customers. At the end of 2007 zero percent of small retail customers were served by retail providers. As of 2008, virtually all of small customer electricity was purchased through plans devised by the Illinois Power Agency and by the end of 2009, all of the mass market electricity will be purchased through plans devised by the IPA.

Given the structure of the power purchases of the IPA, it is unlikely that we will see any increase in retail competition as defined in the 1997 law for small customers. But that does not mean that the benefits of choice should be denied them. And those benefits are very real. As the report aptly demonstrates, by providing customers with a range of voluntary smart rates that allow them to choose how much and when they want to consume and matching that with the digital technology a smart grid would provide, consumers can capture the bulk of the benefits that retail competition would have provided. In addition, this smart rate structure will create the necessary market incentives for a competitive entrepreneurial smart service market in which consumers can choose the most user-friendly innovation to transform the efficiency and quality of their electricity use based on enabling electricity "prices to devices". Finally, enabling new options such as community based aggregation and the aggregation of meters in multi-tenant buildings could provide additional consumer value.

3. Educate consumers

Capturing these benefits, however, is dependent on smart consumers. Without informed and empowered consumers, the likelihood of achieving "reliable, affordable and clean" is close to zero. Electricity service until now has had little in it for the smart consumer. For the most part, consumers have not been given the information or the frameworks to be anything other than passive players in the electricity marketplace. While consumers make choices about appliance purchases and lifestyle choices, they have not been able to use information about energy use to tune their consumption to the best balance of economy and comfort. In the same way as phone plans have changed over time and consumers have responded by changing how they use telecommunications, the right combination of smart offerings (smart technologies and smart rates) can enable smart consumers to make choices that minimize their costs and maximize their benefits. Even before new technologies are deployed, it's essential to establish a priority on substantive, ongoing consumer education and on who will be responsible for its implementation.

Conclusion

The recommendations outlined above present a real opportunity for Illinois, and the time is now to act. The newly formed Illinois Statewide Smart Grid Collaborative, created by the Illinois Commerce Commission, provides an important venue for action. Combined with a growing national interest in the smart grid, exemplified by the significant funding now proposed in the Federal Stimulus package, work in Illinois must move forward to adopt the best smart grid policies that bring benefits home to consumers While significant hurdles remain to be worked out, the potential benefits for consumers, for utilities, for society and for the environment all argue for action. It is the hope of the Center for Neighborhood Technology and of many ISGI participants that this report and the work of the Initiative will provide a framework for that action.

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INTRODUCTION AND SUMMARY: TOWARD A SMART ENERGY FUTURE FOR ILLINOIS CONSUMERS

The Illinois Smart Grid Initiative

During the past several years, the idea of *green energy* and the need for greater energy efficiency – whether to protect the environment, secure energy independence or to save money – have begun to take hold in Illinois and indeed across the nation. Millions of people are taking action to reduce energy consumption, and millions more want to learn how to do it in a way they can understand and afford. Both of the major party Presidential candidates promised a green energy future during the 2008 campaign, and President Obama has since made green recovery and green jobs as part of his economic stimulus plan. The recently passed *American Recovery and Reinvestment Acts* include over $4.5 billion for smart grid related investments.

At the same time that green energy consciousness has been growing, the idea of *modernizing* the electricity grid as part of that future has received increasing attention in the U.S. and abroad. When the U.S. Congress enacted the *Energy Independence and Security Act of 2007*, it included a new Title to establish a smart grid as a national goal. The smart grid concept, as defined by Congress and the many others who have worked to develop it, combines new information technologies with the traditional electric power infrastructure to improve utility operations and to extend greater control to customers. Additional information about conditions on the grid, including customer information, can allow utility service to become more reliable and efficient; and information in the hands of consumers can enable savings on energy bills and choices that protect the environment.

Yet, despite these changes, a shared understanding, particularly among consumers, of how we will transform our energy economy is still in a nascent stage. And, the smart grid concept as a tool in the transformation of the energy economy has only recently left the domain of engineers in search of a broader audience. New political and community leadership will be necessary to create a vision for a sustainable, reliable, and efficient energy future that can begin to address environmental challenges through the introduction of new technology. And practical, local action – by utilities and their customers – will be needed to achieve it.

The Center for Neighborhood Technology (CNT) undertook the ***Illinois Smart Grid Initiative (ISGI)*** in 2008 with support from the Galvin Electricity Initiative and assistance from the United States Department of Energy Smart Grid Team. CNT saw the ISGI as an opportunity to transform the work of these and other organizations into a real-world, consumer-focused dialog with the potential to enhance thinking about the future of Illinois' electric power system.

The Illinois Smart Grid Initiative had two primary objectives: (1) to engage Illinoisans in examining the nature and potential benefits of the *smart grid* for consumers; and (2) to identify policies for achieving those benefits. These objectives were premised on the views that electric power systems must undergo major changes in the coming years to support a sustainable, reliable, and efficient green energy future, that smart grid technologies may have the potential to transform the product and service value propositions available to consumers, and that change in this extensively regulated arena will require rethinking public policies in a way that maximizes consumer value and integrates the values and viewpoints of a wide diversity of interests. In designing this Initiative, CNT paid particular attention to advancing the broadest possible range of stakeholder perspectives, and especially consumer interests and points of view.

To achieve the first objective, invitations to participate in the Initiative were widely distributed; and over 125 people attended four ISGI meetings held between June and November. (A roster of participants appears as an Appendix to this report.) To support understanding of the smart grid concept and stakeholder identification of critical policy issues, extensive briefing materials and independent expert advisers guided policy discussions. The dates and subjects of meetings and all materials presented at ISGI meetings can be found on the ISGI web site: *www.ilsmartgrid.org*.

Various processes were used during and between ISGI meetings intended to encourage and allow maximum participation by stakeholders. At initial meetings, question sessions following expert presentations encouraged question-and-answer among participants; and small group break-out discussions helped to shape understanding of potential consumer benefits of grid modernization. At the final ISGI meeting, subject matter experts facilitated the more extensive small group discussions of policy topics that were later reviewed in a plenary session of the group. A web-based forum was created at the mid-point of the six-month process to collect the views of participants on public policy issues related to smart grid deployment; and contributions to the forum were summarized and distributed to participants. A web site was used to keep a complete record of all ISGI meetings as well as help participants find additional resources.

Smart grid deployment will be a complex, multi-year endeavor. Among utilities throughout the country that have started the deployment process, the focus of investment has ranged from the specific benefits that can be achieved solely from optimizing utility operations to a broader set of societal benefits including enabling customers to fully benefit from, and participate in, energy markets. The ISGI was created to explore how consumer interests can be most effectively taken into account in the discussion of the deployment of smart grid technologies and policies with this broad and diverse perspective.

During the course of the ISGI's meetings, the Illinois Commerce Commission ordered the initiation of a workshop to test (ComEd) and collaborative process to plan (ComEd and Ameren) grid modernizations in Illinois. The former workshop began in December; and the latter collaborative will start early in 2009. The ICC's orders initiating these processes will provide the primary guidance, and also create the necessary public forums, for continued smart grid policy considerations in Illinois. <u>One objective of the ISGI, and this report, is to provide consistent, verifiable information, guidance and analysis that will be useful inputs into these two policy processes.</u>

The next part of this Introduction and Summary briefly reviews the potential consumer, utility, and societal benefits of electric grid modernization. The succeeding part presents six policy topics examined in ISGI meetings that deserve further consideration in the workshops ordered by the ICC.

What are the Potential Benefits of a Smart Grid?

The Illinois electric power system, like systems throughout the world, faces major challenges to meet the changing needs of consumers in the 21st century. While modern information technologies have transformed much of the economy, the electric industry - and in particular the distribution portion of the value chain - have not yet embraced and implemented these technologies. "Smart grid" is a term that refers to the modernization of the electric system through the integration of new information-age technologies, new strategic public policies, and new market processes. Smart grid technologies, business models and policies allow for new uses of the electric grid, both in operations and through new customer side applications, which extract the benefits of more efficient operation, more efficient use of grid assets, and more cost-effective expansion of the electric grid. The operational and economic benefits of smart grid investments all derive from one fundamental change – smart grid investments transform the electric power network from a passive physical network of equipment into an active, dynamic, *transactive* network that brings together economic actors with diverse preferences, enabling them to exchange for mutual benefit. A transactive network empowers the different actors (including generators, utilities, grid operators, vendors, retailers, and consumers) to make more efficient electricity production and consumption decisions based on assessments of the net benefits of each transaction. This transactive capability creates economic value through enabling more reliability, better security, better individual information, and, in turn, better decision-making and control over electricity consumption.

A smart grid can create benefits through:

- **Improvements in grid reliability** by reducing the frequency and duration of power outages and the number of power quality disturbances, including reducing the probability of regional blackouts.

- **Improved security and safety** by reducing the vulnerability of the grid to unexpected hazards and promoting a safer system for both workers and the general public.

- **Reductions in the relative cost of electricity** through the interaction of the demand side of the market (consumers) with the supply side (suppliers) and the integration of wholesale power markets and retail consumers and suppliers. The smart grid may also hold down prices through more efficient grid operations.

- **Enabling new products and services** to give consumers greater choice and flexibility in energy consumption and to create value for end users.

- **Improved operational efficiencies** for grid operators. Smart grids help grid operators optimize the use of the grid assets and increase the efficiency of the system, leading to lower expenses and potentially avoiding or delaying new capital expenditures. Reducing operating expenses and investment costs can also keep downward pressure on electricity prices.

- **Improved environmental quality** by enabling easier integration of cleaner, lower-carbon-emitting generation at scale, creating information transparency, awareness, and market signals to allow consumers to modify their demand patterns, and allowing access to more environmentally-friendly central station generation as well as clean or renewable distributed generation. A reduction in system losses can also reduce the total amount of generation required.

Various stakeholders may benefit from the smart grid in different ways:

- **Residential and Small Commercial Customers:** Mass market customers can benefit from greater individual control over their energy use and monthly bills by using smart grid technologies and the options, information and controls they provide. By connecting prices and quantity of usage, customers will be transformed from passive "ratepayers" to active, engaged participants exercising choice in electricity markets. These customers can also benefit from new products and services, including those that create environmental benefits by helping customers manage the "green-grey mix" in the fuels used to generate the electricity they consume.

- **Low Income Customers, Customers on Fixed Incomes, and the Elderly:** Elderly people are most at risk from extreme heat and cold when power is lost. A more reliable grid will limit the risk and duration of outages and accelerate the restoration of service. In addition, by helping to reduce the need for costly new generation, transmission, and distribution facilities a smart grid can help relieve upward pressure on prices to the benefit of families on low or fixed incomes. Finally, new information technology-enabled products and services can bundle valuable functions such as home health care monitoring with electricity service, enabling vulnerable customers to live more independently in situations where they might otherwise not be able to, relative to today's electricity technology and retail markets.

- **Large Customers:** Large commercial and industrial customers require access to information, including price signals, to make efficient energy decisions. As they represent a significant, but only partial, share of the overall demand for electricity, broad availability of price transparency and demand response to small commercial/industrial and residential customers also is in their interest of large customers as it can help control peak power prices and improve reliability for everyone. A smart grid will provide additional benefits from more detailed information, better reliability and enhanced power quality. To the extent that improved reliability attracts or retains businesses and jobs in Illinois, large customers will benefit from avoided relocation costs and growth in the local economy, and these benefits will flow through to consumers who purchase products created by these large customers.

- **Local Governments:** Local governments can benefit from higher reliability and lower outage duration through reduced burdens on local fire, police and other city resources that must help with such events. Greater information and control over the distribution system will also allow grid operators to assist with emergency situations, such as fires and storms, by turning off power to individual customers or small areas, or by restoring power faster and more efficiently, particularly for those customers who depend on electricity for life support. Local governments are also consumers of electricity and can take advantage of the consumer-related benefits of smart grids, to the benefit of residents and taxpayers.

- **Utility/Grid Operators:** Grid operators will benefit from direct cost reductions, enhanced system reliability, and higher customer satisfaction. Direct cost reductions can come in the form of lower meter reading and servicing costs; avoided meter capital costs on existing meters; more efficient deployment of field staff as a result of better information on grid conditions; labor and non-labor operations cost savings; increased utilization of existing facilities; and improvement in efficiency of billing, customer connections, and other utility processes. Other benefits include reductions in working capital needs, reduction in bad debt expense, reduction in theft and energy losses, improved and more efficient customer service, more efficient planning and maintenance of the system, and more efficient use of back office resources.

- **State and Local Economies:** These economies can benefit from increasing the reliability of the power system, creating a modern infrastructure for 21st century commerce and attracting or retaining new and innovative businesses that create new jobs and income.

In particular, the access to superior levels of power quality can be a magnet that attracts new high tech industries. To the extent that they produce new functionality, products, and services that create substantial consumer benefit, these new jobs will contribute to new value creation in the economy.

Key Policy Considerations for Smart Grid Deployment

Decisions to create a smart grid require different planning processes and considerations than decisions about traditional utility capital investments. **Smart grid planning** is critical for understanding and articulating a clear vision for the features a smart grid might provide and for evaluation of the smart grid deployment process, including how the investments will be paid for. Smart grid planning involves a broader set of issues and needs to include a broader set of participants than traditional utility planning as more participants and their behavior will need to be considered.

At least six policy aspects of the planning process should be considered when moving forward:

1. **Maximum Participation:** Participation in the smart grid planning process by the widest group of stakeholders possible is critical to obtain the necessary commitment and to provide the necessary input into smart grid design and functionality. The breadth and variety of potential benefits from smart grid investments means that many stakeholders will feel the effects of the smart grid policy decisions made in Illinois and at the federal level, and widespread stakeholder participation in shaping forward-looking smart grid policy will help ensure that consumer interests are integrated into the planning and the system deployed.

2. **Smart Grid Definition:** A stakeholder-driven definition will help provide the common vision for the smart grid and help in understanding the necessary planning steps in deploying smart grid by representing the diverse preferences of the various groups of individuals who may benefit from smart grid investments.

3. **Smart Grid Drivers:** Decisions to deploy smart grid technology should be driven not only by technological capabilities, but also the public pressure, through regulatory and legislative means, to improve the ability of utilities to provide more reliable service and for customers to take more control over their energy consumption. It should also be driven by its potential to enable entrepreneurs to bring more innovative products and services to retail customers, especially small residential and commercial customers who currently have few opportunities and choices in the current regulatory environment. The degree of regulatory and utility managerial leadership will also help drive the degree to which smart grid is deployed, as well as its timing.

4. **Business Case:** The business case evaluates the costs and benefits of investing and deploying smart grid technologies. While the business case must include the traditional approach to utility cost and benefits, the nature of the smart grid and its costs and opportunities requires the business case to include an understanding of the external and societal benefits of smart grid investment (e.g., demand response, conservation, reliability, pollution reduction, etc.), and how those benefits can be most effectively realized by consumers, communities and utilities.

5. **Standards:** Standards for communications and information flow to and from the grid is of critical importance. Interoperability, or the ability of parties to exchange information across

different types of technologies or across business boundaries, will be a critical component of creating the benefits that are possible through smart grid investments. Interoperability necessitates common, shared understandings of the information content and meaning in data flowing across those boundaries. For that reason, various industry parties and stakeholder groups are working to create a set of shared interoperability industry standards for the wide variety of transactions in the electricity value chain. Illinois will need to be aware of, and participate in, the national efforts to define these standards as well as incorporate standards into the planning and deployment of smart grid technology.

6. **Metrics:** The purpose of metrics is to identify performance expectations such as reliability metrics, cost metrics, and carbon metrics. Metrics provide specific measurable improvement targets which will demonstrate performance milestones for smart grid deployment. Metrics can help provide,regulators, stakeholders, and investors with clear criteria for measuring the effectiveness of smart gird polices, designs, and plans.

Evaluation of Smart Grid Investments from a Societal Perspective

Smart grid investments will enable consumers to benefit from changes in their behavior, from new products and services, and from new ways of pricing electricity. However, traditional utility investment criteria customarily have not considered "external benefits" like these; and consequently the justifications for smart grid investments may be unreasonably narrow. The Illinois Commerce Commission has recognized this potential dilemma by directing stakeholders to consider "methods of estimating, calculating and assessing benefits and costs, including evaluation of non-quantifiable benefits (and costs)."

Alternative Methods of Ratemaking for Smart Grid Investment

There are a number of ways in which smart grid investments are very different from traditional utility investments and the traditional ratemaking methods may not enable decisions that best serve the public interest. There are additional consumer benefits that can be enabled by smart grid investments, though these may be difficult to quantify precisely or to guarantee. There is risk of obsolescence of investment in technology as well as the possibility of displacing assets that are currently on a utility's books. Traditional ratemaking processes are not conducive to considering these factors and alternative forms of ratemaking may be appropriate and necessary to deploy smart grid technology.

Non-utility Investment in the Electric Grid

Distribution utilities are charged with investing in the electric grid and managing the operations of the grid. However, smart grid operations may present opportunities for non-utility parties to invest, to the benefit of themselves and others. These investments might include micro grids, advanced metering, and other investments designed to increase reliability, reduce costs, or otherwise benefit a local area. While in aggregate smart grid investment does require coordination and planning to deliver benefits cost-effectively, that planning does not require that all smart grid investments must be made by utilities and paid for by ratepayers, and the regulatory environment should not deter willing non-utility parties from making those cost-effective investments.

Modification of Default Service Pricing

Today's flat rate default electric service pricing for mass-market customers (residential and small commercial), reinforced by aggregate long-term wholesale procurement contracts, promotes inefficient consumption and limits opportunities for customers to economize their own electricity purchases. It also deters competitive retail suppliers from entering the market to serve those customers, depriving mass market customers of the opportunity to choose from among competing options as they do in most other consumption decisions they make regularly. In the longer run flat rate pricing may also inhibit the introduction of innovative products and services (e.g., demand response products, distributed energy resources, plug-in electric hybrids, etc.). A smart grid, and in particular smart meters, make measurement of the consumption of electricity far more precise, and therefore enable a wide range of changes to electricity pricing. Rate offerings can take advantage of that opportunity to provide meaningful choice to consumers. To realize the benefits to customers and ratepayers as a whole, it may be desirable to consider modifying the default rate to reflect the changing cost of electricity production, to modify the way wholesale procurement is implemented so that it does not act as a barrier to consumer choice, or to encourage customers to choose time-of-use rates that are linked to the actual wholesale price of electricity.

Effect of Statutory Renewable Resource, Demand Response and Energy Efficiency Goals on Smart Grid Planning and Implementation

Smart grid investments may enable greater integration of renewable sources of energy, may increase aggregate and individual customer demand response, and may promote energy efficiency. Existing Illinois laws establish targets for energy efficiency, demand response, and renewable energy procurement. The Commission has recognized that these existing laws may have an “effect on smart grid planning and implementation.” This issue also intersects with the aforementioned recognition of the importance of incorporating “external benefits” into the benefit-cost analyses performed in the process of creating business cases for smart grid investments.

Electric grid modernization is about more than asking utilities to invest billions of dollars in the upgrade of the current electric delivery system. Grid modernization, or moving to a *smart grid*, is about changing the perspective of utilities, customers, regulators, competitors, and other stakeholders. It is about facing the challenges of the new century with a new approach. Smart grid deployment holds the promise of addressing, at least in part, many of the pressing energy issues of our day. How can the energy economy be transformed into a vibrant, clean, and consumer-focused economy? Who will make the necessary investments that will sustain the system over the long-run? How will those investments be financed and what can be done to ensure that the necessary investments are utilized in the most efficient manner? These questions persist, in part, because of the reliance on a system that is nearing the end of its useful life. While the system begins with the legacy equipment and technologies, utility operations, the regulations that govern the system, and the trading arrangements that connect one participant to another are all part of the system, and many of these also need revisions to realize the benefits that updated technologies can bring.

Like others throughout the nation, the Illinois electric power system faces many challenges and is in need of significant renewal. The price of power has risen over the past several years. Despite recent short-term downward trends in fuel commodity prices, the cost of building new power plants and projected electric generation capacity needs may lead to further price increases in the future if action is not taken now to arrest the escalating and inefficient use of electricity.[2] Perhaps as important, the electric power system is out of date. The electric grid infrastructure in place today was designed largely before the advent of the microprocessor and the digital revolution.[3] In addition, the whole electric infrastructure system, from generation to transmission to distribution to end uses by consumers, was developed at a time when efficiency was not a priority. Today, local and global environmental concerns imply that electricity, and the resources used to produce electricity, must be used in a more efficient manner over time.

To meet the requirements of the future demand for electric service, the grid of the twentieth century must evolve to power this century's digital economy, and must change to meet significant environmental dangers. These circumstances give rise to a number of difficult challenges, both internal to the industry and external. These challenges provide the context for change in the electric industry to empower consumers, enable utilities and grid operators to operate more efficiently and effectively, and promote new products and services that will benefit consumers.

External Challenges

The costs of energy from all sources, including electricity, have risen substantially in recent years and may continue on an upward path.[4] This is driven both by increases in underlying commodity prices and by large increases in the costs of building new generating capacity. Mounting environmental concerns – especially concern with climate change from greenhouse gas emissions – have spurred intense interest in conservation, efficiency improvements, and green power. Increasing reliance on electricity and new concerns with reliability and power quality in the digital economy are shaping consumer expectations for improvements in electricity service. The electricity distribution infrastructure is aging, outmoded in design, and stressed by increasing levels of demand. In sum, the Illinois electric industry is facing external stress from a number of factors:

- **Carbon Constrained Future:** Environmental concerns will continue to place restrictions on the uses of traditional fossil fuel energy sources as the world prepares for, and adapts to, a carbon-constrained future.[5]

- **New Uses of Electricity:** Electricity has become a more important energy source as new digital technologies and sophisticated production techniques penetrate markets, which adds to the total demand for power and adds stress to both the distribution and transmission grid.[6]

- **Infrastructure Investment:** Electricity infrastructure will compete with other public infrastructure needs in the coming years. Investment in the roads, railways and public transport networks, water, sewer, natural gas and oil delivery systems, schools, waterways, airports, and other public infrastructure investment is expected to balloon as existing infrastructure is replaced and new infrastructure is added.[7]

- **Continued Globalization:** Local economies will continue to feel pressure from the global flow of capital. Power cost and quality for both consumers and producers will gain importance as local economic growth begins to depend more heavily on the electric grid.

- **Increasing Energy Prices:** Energy prices have increased dramatically in the last few years; and with demand from the globalization of the economic system increasing, the competition for energy resources will only become more acute.[8]

Internal Challenges

In addition to the challenges posed by external pressures, the Illinois electric power industry and its customers are facing numerous challenges related to traditional concerns of the industry. Affordable, reliable, efficient, clean, and competitive electricity services have been goals of regulation, and therefore of electric utilities, established in the *Illinois Public Utilities Act* ("IPUA") for over 20 years.[9] However, the IPUA does not provide sufficient guidance, nor does it provide specific duties or responsibilities for achieving these goals over time as technology and other factors change the environment that utilities and consumers face.

This deficiency in the IPUA has become more acute due to the challenges faced by the industry, including:

- **Reliability, safety and security concerns:** U.S. consumers and businesses could experience more than $100 billion in annual costs related to power outages and power disruptions.[10] Sun Microsystems claims that power outages can cost up to $1 million per minute.[11] Many communities and areas in Illinois experience significantly higher outage frequencies and durations when compared to the State and national averages. More importantly, Illinois' average reliability performance lags many of our international trading partners. As a result, Illinois consumers face $6-11 billion annually in costs related to power outages and power disruptions.[12] For example, during an hour long power outage in 2000 the Chicago Board of Trade could not execute roughly $20 trillion in trades.[13]

- **Inefficiency in supply:** Central generation can be up to two-thirds inefficient in the physical burning of fuel. To the extent that some central generation can be displaced through localized generation, overall system efficiency will be improved. The use of waste heat from the generation process, along with the elimination of transmission and distribution electrical losses, can make local distributed generation much more energy efficient.

- **Increasing losses in the electric delivery system:** At least five percent of generated electricity is lost in its transport to end users. These line losses are increasing because the system is becoming overloaded. The amount of energy lost over power lines has doubled between 1980 and 2006 costing roughly $12 billion in additional costs that consumers pay. More efficient transmission and distribution systems, an important aspect of the smart grid, will result in less energy wasted in power delivery and therefore reduced emissions from power plants.

- **Lack of consumer information, choices, and price-response:** Consumers face dramatic choices in today's energy economy. No longer is the choice simply to consume or not consume an energy service at a given price. Today electricity is a bundle of characteristics that make the price of electricity a multi-part value. This includes an ever changing cost of producing the electricity itself, external costs in terms of climate change, costs related to future required generation and transmission investments, and the costs of ensuring reliability of the service. For example, it is estimated that as much as $70 billion in new electric generation will be needed nationally over the next 20 years, and someone will need to pay for it. Technologies can empower customers to respond to prices in order to potentially avoid a portion of this investment while operating existing generation more efficiently.[14] This reduction in investment in inefficient generation will free up capital to flow to more productive uses as well as mitigate future electricity price increases.

- **Adverse environmental impacts:** Unlike local distributed power generation, traditional fossil fuel centralized generation stations can lose as much as two-thirds of heat content of the fuel burned to generate (and deliver) electricity.[15] By contrast, distributed cogeneration resources, or fossil fuel generation that captures and recycles waste heat at or near the end use site can reach efficiency levels greater than eighty percent.[16] Additionally, there remains significant untapped energy potential in distributed renewables, such as rooftop solar and residential-scale wind that produce no emissions. In 2006, the Energy Information Administration reported that an average of approximately 1,140 pounds of carbon dioxide (CO_2) is released for every MWh of electricity generated in Illinois.[17] However, utilizing energy efficiency and price responsive technologies during peak hours will actually eliminate significantly more carbon per MWh because during peak electric usage hours Illinois relies heavily on coal-fired resources to meet that demand.[18] These resources emit larger amounts of CO_2 as well as other pollutants. Therefore, utilizing energy efficient and price responsive technologies during peak hours can have a large affect on reducing carbon emissions.

Unnecessary Consumer Costs

The average annual electricity bill for Illinois residential customers is approximately $900 and has been increasing over the past few years.[19]

However, each residential consumer also incurs higher hidden costs as a result of several items:

- **Higher cost of goods and services:** Unreliable electric service that reduces productivity with resulting avoidable increases in the price of all goods and services. This hidden cost can add between $200 and $1,100 annually year to each household's cost of purchasing goods and services in the U.S.[20]

- **Inefficient end-use of electricity and electric industry infrastructure:** The inefficient use of electricity due to the lack of consumption information and limited customer participation in dynamic, time-of-use, electricity pricing is one source of additional consumer cost. Many customers could save money simply by switching to time variant, market-reflective pricing.[21] Receiving consumption information and price signals could also help consumers use energy more efficiently. This in turn reduces the overall cost of electricity for all customers by lowering peak demand.[22] In addition, there are several other system inefficiencies.

» Consumers in both the mass markets (i.e., residential and small commercial) and larger customer markets could benefit from increasing the efficiency of their energy consumption. For example, one source suggests that there are well over one-thousand different cost-effective measures that could be taken by customers in Illinois. Nearly one-hundred of these measures would help residential consumers lower energy consumption.[23]

» Maximum system demand may occur only a few hours the entire year. As a result, the industry must build enough power generating capacity to support a few hours of maximum demand. With proper pricing and reliability signals, consumers can reduce system demand peaks and defer or eliminate these investment costs.

» Inefficiencies in distribution result from lack of knowledge of actual power levels reaching individual consumers. Without a way of measuring what end users receive, systems over-distribute, causing excess consumption systemwide of up to 5%.

- **Cost associated with theft of electricity:** Estimates reveal energy theft typically ranges from 0.5 to 3 percent of retail revenues in developed countries.[24]

CONSUMER OPPORTUNITIES IN THE SMART GRID

Introduction

Defining a smart grid is not a simple task. The smart grid combines physical assets, operating systems, and new engineering design standards with economic, policy, and consumer behavioral changes. The exact nature of each of these factors is often jurisdiction- and utility-specific, and because of this diversity, the most valuable way to define a smart grid is in terms of its functional capabilities. The U.S. Department of Energy Office of Electricity Delivery and Energy Reliability and its Modern Grid Strategy Team led by the National Energy Technology Laboratory, among others, have been working for several years to build consensus on a definition of smart grid and more recently to implement smart grids through Title XIII of the federal *Energy Independence and Security Act of 2007*. ("EISA07")[25]

At a national smart grid workshop in June 2008, participants agreed on seven defining characteristics of a smart grid, noting that, "a properly planned, designed, implemented, and operated smart grid will:[26]

- (i) Enable active participation by consumers;
- (ii) Accommodate all generation and storage options;
- (iii) Enable new products, services, and markets;
- (iv) Provide power quality for the range of needs in a digital economy;
- (v) Optimize asset utilization and operating efficiency;
- (vi) Anticipate and respond to system disturbances in a self-healing manner;
- (vii) Operate resiliently against physical and cyber attack and natural disasters.

These smart grid characteristics can be divided into two broad categories of functional capabilities: those that enable (1) *informed customer participation* in markets and intelligent and informed customer use of energy, and those that support (2) *improved utility performance*. The first four defining characteristics of a smart grid primarily belong to the former category, and are particularly relevant to the goals of efficiency, affordability and competition; and the last three characteristics belong to the latter category, and are most relevant to the goal of reliability. Figure 1 provides an overview of the

Example of an Illinois Smart Grid:
Illinois Institute of Technology Perfect Power Prototype*

Objectives: The objective of the Illinois Institute of Technology (IIT) Perfect Power prototype is to demonstrate that utility customers can participate with utilities to build smart grids. Specifically, IIT will leverage savings and revenue from real time pricing, capacity payments, and other market price signals to pay for grid modernization downstream of the site substations while ComEd makes SmartGrid improvements to the utility-owned grid.

Participants: IIT, Galvin Electricity Initiative, S&C Electric, Endurant Energy, and ComEd

Drivers: IIT loses power approximately three times per year at a cost of up to $500,000 a year in expenses, lost productivity and ruined experiments. In addition, ITT's distribution system is over 70 years old requiring replacement of a number of out of date components. IIT's enrolment is expanding like surrounding neighborhoods in Chicago, straining the existing distribution system.

Expected Benefits: The planned Perfect Power system at IIT will reduce electricity costs through real time electricity procurement, take the advantage of capacity payments from the grid operator for its on site generation, and eliminating power outages. The system replaces obsolete "dumb" equipment with "smart" technology that will sense failures and reroute power to prevent blackouts. The system will also benefit Illinois consumers by eliminating 10MW of demand at the time of the greatest strain demand on the grid. The Perfect Power system will also reduce campus carbon emissions by 4,000 tons a year.

Costs: The Perfect Power system will cost roughly $10 million while producing annual savings/revenue of $1.3 million and eliminating the need for and costs of a planned $5 million east campus substation.

* Michael Meiners, Galvin Electric Initiative, presentation to the Illinois Smart Grid Initiative, August 5, 2008, Chicago, IL

characteristic transformations of the electric grid of today into the smart grid of the future. Sidebar 1, "Example of an Illinois Smart Grid", presents an overview of one smart grid project being developed in Illinois at the Illinois Institute of Technology.[27]

Figure 1. The Transformation of the Electric Grid

Today's Grid	Principal Characteristic	Modern Grid
Responds to prevent further damage. Focus is on protection of assets following system faults.	**Self-heals**	Automatically detects and responds to actual and emerging transmission and distribution problems. Focus is on prevention. Minimizes consumer impact.
Consumers are uninformed and non-participative with the power system.	**Motivates & includes the consumer**	Informed, involved and active consumers. Broad penetration of Demand Response.
Vulnerable to malicious acts of terror and natural disasters.	**Resists attack**	Resilient to physical and cyber attack. Less vulnerable to natural disasters rapid restoration capabilities.
Focused on outages rather than power quality problems. Slow response in resolving Power Quality (PQ) issues.	**Provides power quality for 21st century needs**	Quality of power meets industry standards and consumer needs. Various levels of Power Quality (PQ) at various prices.
Relatively small number of large generating plants provide majority of generation. Numerous obstacles exist for interconnecting Distributed Energy Resources (DER).	**Accommodates all generation and storage options**	Very large number of diverse distributed generation and storage devices deployed to complement the large generating plants. "Plug-and-play" convenience. Significantly more focus on and access to renewables.
Limited wholesale markets still working to find the best operating models. Not well integrated with each other. Transmission congestion separates buyers and sellers.	**Enables markets**	Mature wholesale market operations in place; well integrated nationwide and integrated with reliability coordinators. Retail markets flourishing where appropriate. Minimal transmission congestion.
Minimal integration of limited operational data with asset management processes and technologies. Siloed business processes. Time based maintenance.	**Optimizes assets and operates efficiently**	Greatly expanded sensing and measurement of grid conditions. Grid technologies deeply integrated with asset management processes to most effectively manage assets and costs. Condition based maintenance.

Smart Grid Technology

In practice a smart grid requires using a number of new technologies, with the technology choices being a consequence of the design decisions about how to deliver the desired functional capabilities of a smart grid. A wave of new technology, built on the applications of modern digital technologies and communications systems, now provides the opportunity for full customer participation and investment into a smart grid. These new technologies allow for the integration of electric generation, delivery, and consumption systems utilizing advanced communication systems. Digital technologies are making this integration possible and are becoming less costly over time. Such technologies include, but are not limited to, remote sensing and detection devices for faults and outages, automated substation communications and operations, advanced metering infrastructure, and intelligent end-use devices that can respond automatically to data communication signals, particularly price signals.

As defined by the National Energy Technology Lab (NETL) the modern grid will be based on five Key Technology Areas:[28]

- **Integrated Communications –** High-speed, fully integrated, two-way communication technologies will make the modern grid a dynamic, interactive "mega-infrastructure" for real-time information and power exchange. Open architecture will create a plug-and-play environment that securely integrates networks grid components and operators, enabling them to talk, listen and interact.

- **Sensing and Measurement –** These technologies will enhance power system measurements and enable the transformation of data into information. They evaluate the health of equipment and the integrity of the grid and support advanced protective relaying, eliminate meter estimations and prevent energy theft. In addition, they enable consumer choice and demand response, and help relieve congestion.

- **Advanced Components –** Advanced components play an active role in determining the grid's behavior. The next generation of these power system devices will apply the latest research in materials, superconductivity, energy storage, power electronics, and microelectronics. This will produce higher power densities, greater reliability and power quality, and enhanced electrical efficiency resulting in major environmental gains and improved real-time diagnostics.

- **Advanced Control Methods –** New methods will be applied to monitor essential components, enabling rapid diagnosis and timely, appropriate response to any event. They will also support market pricing and enhance asset management and efficient operations.

- **Improved Interfaces and Decision Support –** In many situations, the time available for operators to make decisions has shortened to seconds. Thus the modern grid will require wide, seamless, real-time use of applications and tools that enable grid operators and managers to make decisions quickly. Decision support and improved interfaces will amplify human decision making at all levels of the grid.

Advanced metering infrastructure (AMI) is often at the heart of the discussion of smart grid. This is appropriate as AMI is an important subset of smart grid technologies and perhaps the most visible to the casual observer. AMI is "a metering system that records customer consumption [and possibly other parameters] hourly or more frequently and that provides for daily or more frequent transmittal of measurements over a communication network to a central collection point."[29] The basic AMI system connects meters capable of frequently recording consumption and is enabled with two-way communications functionality through a communications network to a data collection system.[30] More so than other smart grid technologies, AMI is an enabling technology – it more than any other technology creates opportunities for the development of different products and services and the deployment of innovative end-use technologies. This platform can enable consumers to use consumption and price data to optimize their own consumption as well as enabling demand response programs in which they benefit financially from reducing energy use at peak demand times, direct load control, and outage management.

Goals for Smart Grid Deployment Nationally

While the regulation of local electric service remains, and will so for the foreseeable future, in the hands of state governments, the U.S. Congress and the Department of Energy have addressed the deployment of smart grid, nationally, in the long-run. This is important to Illinois as Federal law can have an influence on decisions concerning energy industry funding, regulation and other aspects of the industry that affect Illinois citizens. Perhaps more important for the current debate in Illinois is the Federal government's view of the direction for the industry. This "vision" of the future industry suggests a standard electric service that is quite different from the electric grid of today.

Beginning with the policy direction, the U.S. Congress has determined that smart grid is a policy goal for the United States. Title XIII of the *Energy Independence and Security Act of 2007* creates federal policy on the smart grid, and begins with this statement:

> *"It is the policy of the United States to support the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth and to achieve each of the following, which together characterize a Smart Grid:*
>
> 1) Increased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid.
> 2) Dynamic optimization of grid operations and resources, with full cyber-security.
> 3) Deployment and integration of distributed resources and generation, including renewable resources.
> 4) Development and incorporation of demand response, demand-side resources, and energy-efficiency resources.
> 5) Deployment of "smart" technologies (real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices) for metering, communications concerning grid operations and status, and distribution automation.
> 6) Integration of "smart" appliances and consumer devices.
> 7) Deployment and integration of advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air conditioning.
> 8) Provision to consumers of timely information and control options.
> 9) Development of standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid.
> 10) Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services."

In addition, the U.S. Department of Energy has challenged the electric industry in the U.S. to move toward a fully automated electric grid that incorporates more renewable power, and provides consumers with greater flexibility in consumption decisions by 2030.[31]

This call for action envisages a set of goals that ramp up over the next twenty years:[32]

Vision 2010

- Smart meter enabled with two way communication;
- Intelligent home and smart appliances;
- Demand side management & distributed generation;
- Advanced conductors and higher transmission capacity.

Vision 2020
- Perfect power quality through automatic correction for voltage, frequency, and power factor issues;
- High temperature superconductivity generation, transformers, and cables will make a significant difference;
- Superconducting cables for long distance transmission.

Vision 2030
- Reliable and secure digital grade power for customers;
- Access to affordable pollution-free, low-carbon electricity generation produced anywhere in the country;
- Affordable energy storage devices available to anyone;
- Completion of a national superconducting backbone.

As a result of policy direction from Federal and state policymakers, many utilities are moving toward smart grid implementation.

Figure 2 illustrates the factors that influence the deployment of smart grid technologies.[33] Many of these programs start with AMI deployment (i.e., the communications and metering infrastructure).

Figure 2. Forces Affecting Smart Grid Implementation

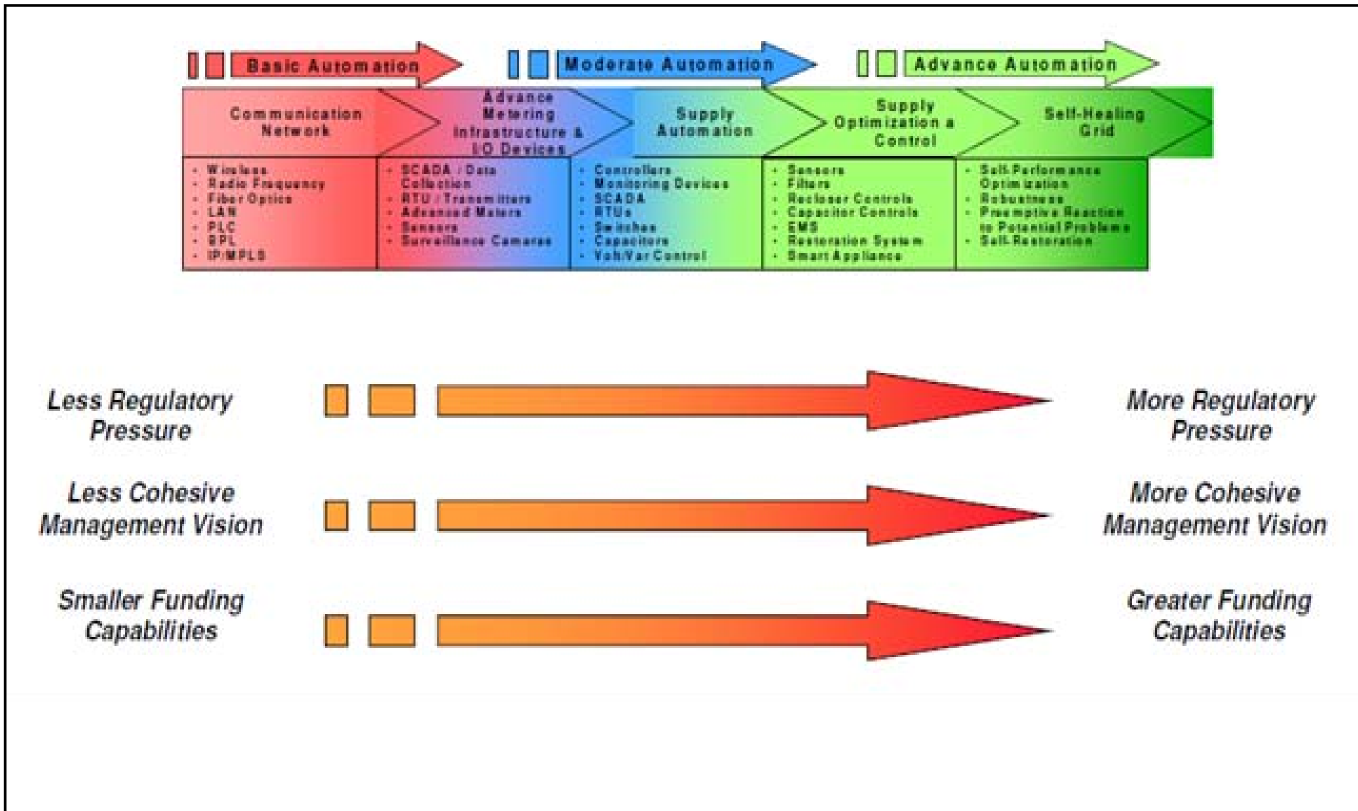
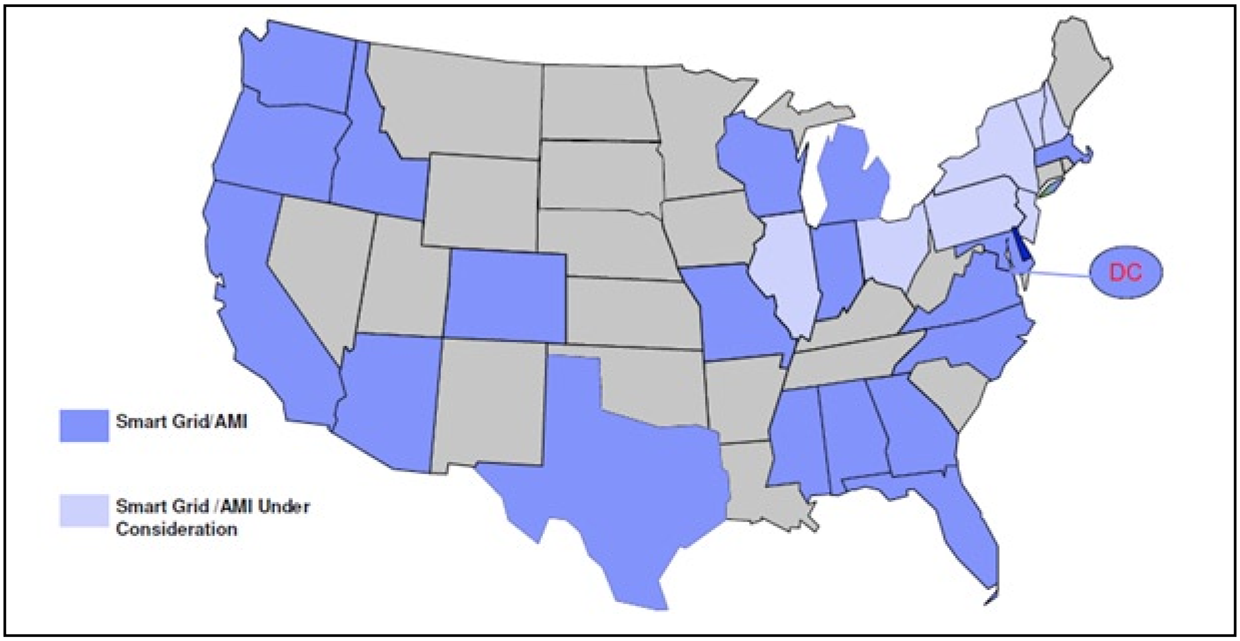


Figure 3 provides an overview of the smart grid/AMI initiatives in the United States as of the summer of 2008.[34]

Figure 3. Smart Grid Deployment in the U.S.



POTENTIAL BENEFITS OF A SMART GRID FOR ILLINOIS CONSUMERS

Introduction

As so much of our economic activity is driven by energy consumption, the rising cost of energy and uncertainty about future energy prices places significant strains on the economy. Businesses who are already fighting to remain competitive in the global marketplace and customers who are struggling to pay their bills can scarcely afford significant increases in bills. In this highly-charged environment, smart grid technologies might be perceived as only a burden on customers.

However, significant potential customer benefits can arise from technologies and policies that make up a true smart grid. In general, there are five broad categories of benefits:[35]

- **Improvements in Reliability:** Smart grids will help reduce the *frequency and duration* of power outages and reduce the number of *power quality* disturbances. Smart grids can also substantially reduce the probability of regional blackouts.

- **Improvements in Security and Safety:** Smart grids can help reduce the vulnerability of the grid. The self-healing aspect of the modern grid will also promote a safer system for both workers and the general public.

- **Lower Relative Electricity Costs:** Use of smart grid technologies can mitigate or reduce the price of electricity through the interaction of the demand side of the market (consumers) with the supply side (suppliers). Smart grids can also create a platform on which retailers can create and offer new products and services to give consumers greater choice and flexibility in energy consumption and create value for end users. The reduction of congestion costs caused today by limited transmission is another significant economic benefit.

- **Improved Operational Efficiency:** Grid operations will benefit from the self-healing nature of the Smart Grid and due largely to the better and more detailed information concerning the grid, operators will be able to diagnose and treat problems more efficiently and more effectively utilize preventative measures. In addition, smart grid technologies will help grid operators optimize the use of the assets by reducing electricity (thermal) losses, more effectively providing voltage support, and avoid unnecessary expenditures.

- **Environmental Quality:** The smart grid will allow utilities and customers to purchase larger amounts of cleaner electricity from the grid and produced locally. Smart grid will promote a more even deployment of renewable energy sources and allow access to more environmentally friendly central station generation. It will allow a significant increase in smaller, more efficient distributed generation that is closer to the load. This pr oduces multiple benefits from reduced transmission line losses, fewer new transmission lines, and an opportunity to use the waste heat associated with electrical generation. In addition, the smart grid will allow for more efficient consumer response to prices which will reduce the need for additional fossil-fuel fired generation capacity, particularly peaking capacity. As a result, CO_2 and other pollutants will be minimized.[36]

A smarter grid will improve power quality for customers, reduce outage frequency and duration, and create a much more reliable electric system. However, perhaps the most significant benefit to customers comes from their increased empowerment and control over their usage and their bills. While there is no guarantee that a smart grid will actually reduce customers' bills, it will provide small customers with a new set of tools to manage their usage and total bills more effectively.[37] Customers can choose to receive access to their own hourly (or more frequent) usage data, which will give them information about their energy consumption patterns, and provide choices that can help them take control. With or without the help of technology, consumers can save money by shifting all or parts of their consumption to lower priced hours of the day or seasons of the year.[38] These shifts can be achieved without sacrificing customer convenience or comfort and will help balance the system, reduce costs, and avoid costly infrastructure upgrades. Moreover, once this price information exists and is more readily accessible due to AMI, retailers would be motivated to bring new products and services to the retail market that could be valuable to consumers; for example, a home management system with a visual interface can make it easy and user-friendly for consumers to program their own preferences for price responses into their house settings, and to change them remotely if they so choose. Beyond this, as customers begin to better understand their electricity usage; they can also focus more on energy conservation strategies.[39] They could also, for example, choose to modify their consumption based on the "green-grey mix" in the generation being used to fuel their electricity consumption; this option is particularly relevant if, for example, a consumer has solar panels installed, and wants to program the home's appliances to reduce electricity consumption once the installed solar has reached its generation capacity. Smart grid technology is expected to make it easier and cheaper for consumers to see their electricity use, to have access to value-enhancing dynamic pricing, and to use this increased information to change their behavior, either manually or autonomously.

Some customers, such as the elderly, are at the greatest risk to extreme heat and cold when power is lost. A more reliable grid will help limit this risk. In addition, by helping to reduce the need for costly new generation, transmission, and distribution facilities a smart grid can help relieve pressure on low income families and those living on a fixed income. Smart grid policies can also help to shift the burden of an ever expanding network onto the private sector and away from customer's utility bills by leveraging the value inherent in the ability of consumers to control their demand. Large customers also require access to information and better price signals to make efficient energy decisions. These customers tend to be price conscious and have and will continue to take advantage of cost savings where available. A smart grid will allow customers to integrate their production, storage and efficiency investments into wholesale market operations which can reduce the energy costs of the entire market.[40] Finally, by connecting prices and quantity of usage, customers, especially mass market customers, will be transformed from the passive "ratepayers" of the twentieth century to active, empowered participants in electricity markets.

Smart grids allow for the ready incorporation of distributed and renewable lower carbon energy sources. In addition, consumer empowerment provides not only for the reduction of demand and energy usage through price signals, but will allow consumers to purchase more and varied green energy products. Local environmental issues from utility investment will be minimized as delivery assets are used more efficiently and with higher capacity factors. To the extent that smart grid technologies enable the use of electric and plug-in hybrid electric vehicles, tailpipe emissions would be reduced. These changes all contribute to lower emissions and a more efficient use of society's scarce resources. A recent study by the Electric Power Research Institute (EPRI) suggests that smart grid investments could reduce CO_2 emissions by 23 to 120 million metric tons annually, which is the equivalent of removing between 4 and 20 million cars from U.S. roads.[41]

Grid operators will benefit from direct cost reductions as well as enhanced system reliability and higher customer satisfaction. Direct cost reductions can come in the form of lower meter reading and servicing costs, avoided meter capital costs on existing meters, more efficient deployment of field staff as a result of better information on grid conditions, labor and non-labor operations costs savings, improvement in efficiency of billing and customer connections, as well as many other utility processes. reductions in working capital needs, reduction in bad debt expense, reduction in theft and energy losses, improved and more efficient customer service in call centers, more efficient planning and maintenance of the system, and more efficient use of back office.[42] The ability of the utility to sense and respond to the instantaneous load provides a new control dimension that can be used to improve reliability and reduce cost. In addition, improved capacity utilization translates into reduced need for capital investment in generation, transmission and distribution assets. Lower emissions from generating plants will save money when these emissions are monetized, which may occur in the near future through national, and perhaps, international emissions markets.

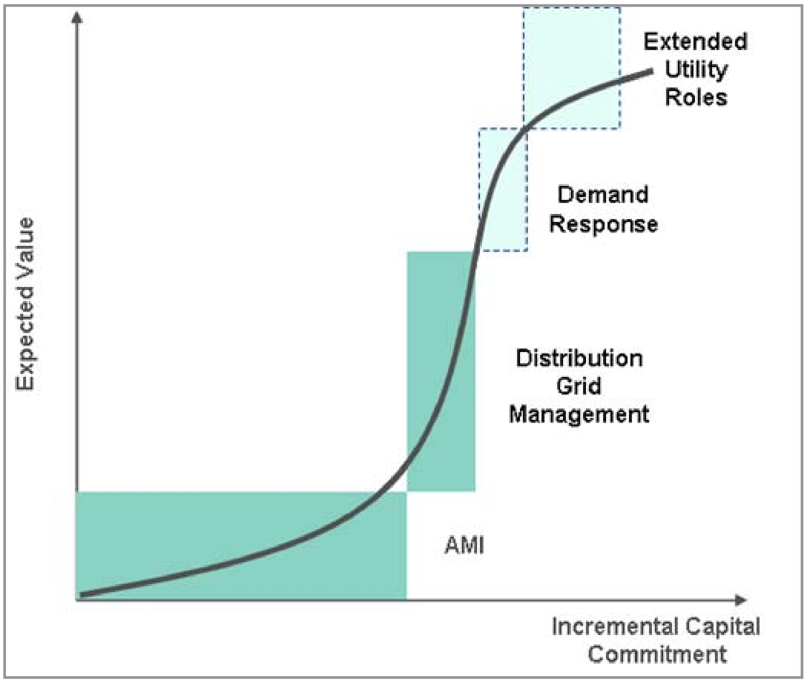
Smart grid investments can also provide benefits to the broader community through enabling more economic deployment of electric vehicles thereby reducing tailpipe emissions, improving management of energy resources, avoiding new capital investments for power plants and power delivery, and helping to dampen price increases while increasing the security of the energy delivery system through a more decentralized delivery model.

Addressing the Net Benefits of Smart Grid Deployment

Smart grid deployment in Illinois, as in other jurisdictions, faces challenges in evaluating the propriety of investments. The challenge faced by utility executives, regulators and other stakeholders stems from the fact that much of the smart grid investment is an upfront capital cost incurred by the utility, while the benefits accrue over time to not just the utility but also to a broader range of stakeholders, including, to some extent all of society. In addition, these benefits are less amenable to estimation prior to investment. This central dilemma of smart grid investment requires an understanding of the stream of cost and benefits and the limitations in estimating benefits, and to some extent, costs over a long period of time. While utility regulators are not unfamiliar with forecasting costs and benefits of utility investment over a long time horizon, the unique nature of smart grid investments and the broad categories of benefits will require special attention.

Figure 4 provides a graphically representation of the dilemma facing decision makers. This figure shows that much of the cost to deploy smart grid technologies relates to upfront capital investments – and, many of the benefits are external to the utility operations, but are predicated on this initial capital investment.[43] Traditionally, utility investment decisions are based on achieving the lowest present value of the revenue requirement (i.e., the annual level of revenue that the regulator allows to be collected in rates). In this traditional view, if two capital investments with the same initial capital outlay are being contemplated, the utility is to choose the investment that produces the lowest expenses. Alternatively, if two capital investments have differing initial capital outlays, the utility should choose the one with the higher capital outlay only if the reduction in expenses from the investment will, at least, offset the higher initial cost.[44]

Figure 4. Value-Added from Smart Grid Deployment



However, in the case of smart grid investments, much of the reduction in future expenses are realized by the consumer or the larger community, not the utility. This can be seen as the upper area of the expected value curve in Figure 4, especially the demand response area. Using the traditional approach to valuing investments will almost assuredly show, at least at this time, that smart grid investments will not reduce utility expenses enough to justify investment.[45] But if one considers the potential benefits of using a smart grid that are outside of the utility, this calculus may change. Both energy efficiency and demand response can play a vital role in meeting future customer energy needs while controlling rising bills. Providing real-time feedback to customers can lower energy use by a few percentage points. Inclining block rates can reduce energy consumption by up to 6 percent in the short run and may additionally lower peak demand. Dynamic pricing rates can reduce demand by 13 to 27 percent during critical peak periods and enabling technology tends to magnify the demand reductions.[46] These demand reductions will tend to lower energy costs even for the non-participating customers. The choice of pricing structures for commodity pricing can vary.

Figure 5. Pricing Options for Electricity

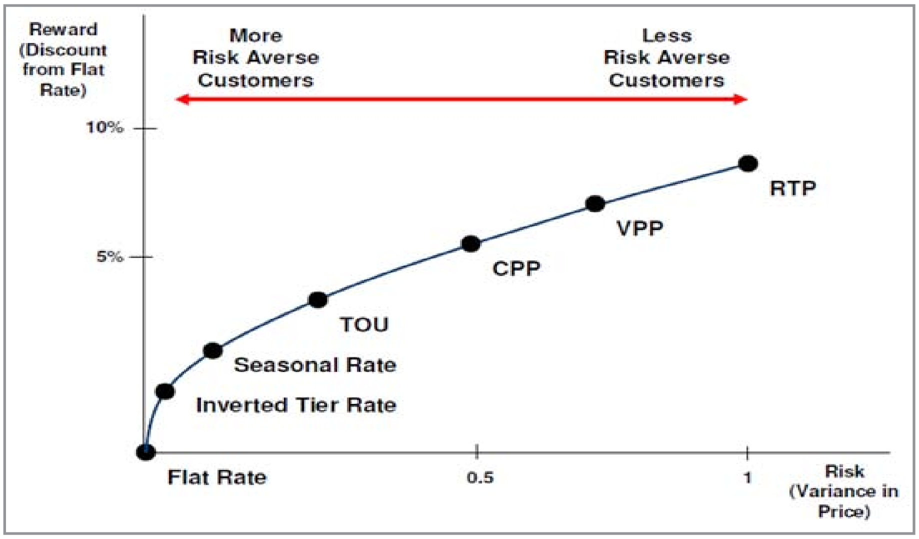


Figure 5 provides a graphical illustration of the relationship between the potential reduction (i.e. reward) in rates vis-à-vis flat rates and the short to medium term volatility of prices for various rate options.[47] Taken together, these measures can make a substantial contribution to meeting Illinois' future energy needs at a reasonable cost.

Electricity Commodity Pricing Options Shown in Figure 5

Background: Electricity production costs change frequently throughout the day and season as a result of changing electricity demand. Changes in demand will require different types of generation resources to be used that can have dramatically different costs of operation. Costs tend to be higher during the day when demand is high (peak period) and fall off when demand is lower (off-peak period). Demand also fluctuates by season. In Illinois, the summer period is the highest demand season and demand falls off during the non-summer period.

Flat Rate: Price does not change during the year.

Inverted Tier Rate (Inclining Block Rate): Price increases as consumer consumes more consumption, generally based on monthly consumption. For example, if a typical consumer consumes 900 kWh a month, the first 400 kWh would be at one price and the consumption between 401 kWh and 900 kWh would be a higher price.

Seasonal Rate: Rates are set by the season of the year (e.g., summer and non-summer), but do not change over the day.

Time of Use (TOU): Price changes by time of day and season of year. Under this pricing approach it is common to have different prices for peak and off-peak periods during the day as well as different prices for summer and non-summer seasons. For example, consumers might be shown four different prices during the year summer peak and off-peak and non-summer peak and off-peak. TOU could also be applied to more seasons of the year such as Summer, Winter and a "Shoulder" season. In this case, the Shoulder season is those months that are not Summer or Winter.

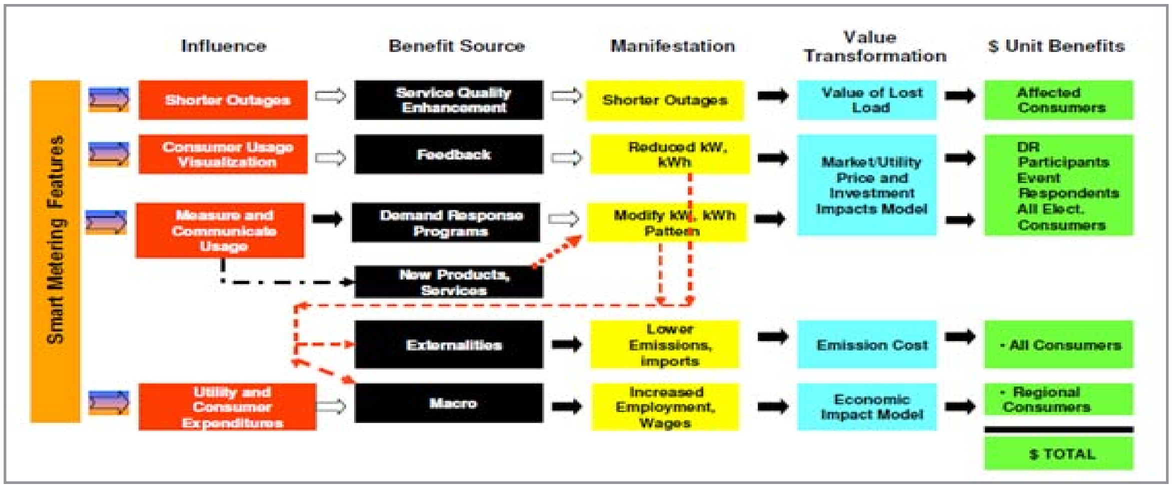
Critical Peak Pricing (CPP): Under this approach a TOU pricing structure is used, but allows for certain crucial peak periods in which prices more closely reflect the much higher costs of production during those periods. It is common in these types of programs to limit the critical peak periods to a pre-defined number of days. For example, if the peak period is defined from 2pm to 7pm on weekdays during the summer, the crucial peak period might be limited to 10 days during the summer. Customers are provided advance notice of the crucial periods and the price in those periods.

Variable Peak Pricing (VPP): This approach is similar to CPP, but sets the peak prices on a daily basis.

Real Time Pricing (RTP): Under this approach prices are set by the hourly, generally day-ahead, market for all hours of the year. It is possible under this approach that consumers could see a different price in every hour of the year.

benefits can be used to offset the costs of smart grid investment. Such benefits include, for example, the value of the reduction in peak power prices and avoided generation capacity costs to all consumers from the reduction in usage by some customers who respond to more accurate price signals (i.e., price signals that more directly reflect the cost of producing electricity at any given time). For example, Figure 6 illustrates the framework that could be used to evaluate the societal benefits associated with modification of customer behavior as a result of smart pricing utilizing smart metering, which is a foundational investment in smart grid.[48]

Figure 6. Societal Benefits Framework



Several methods can be utilized that focus on the types of programs that could be implemented with (and without) a smart grid, the participation rates of consumers in those programs, the extent to which consumers will respond to prices, and the benefits in terms of reduced energy costs, increased reliability value, and reduction in environmental damage.[49]

The Electric Power Research Institute, in a study of investments required to achieve the electric delivery system of the future, has placed the benefit to cost ratio at somewhere between 4 to 1 and 5 to 1.[50] The business case for smart grid investments in Illinois should take into account the utility specific cost benefits and the external or wider societal benefits.

As shown in Table 1, there are multiple utility business cases, at least for the AMI portion of the smart grid, in which the net benefits, that is, when taking into account the external benefits associated with demand response and other consumer behavioral changes, are positive. The business case for a complete smart gird may be even better than that for AMI alone.[51]

Table 1. Examples of AMI/Smart Grid Implementation in the United States with Positive Net Benefits (Compiled Summer, 2008)[52]

Utility (Jurisdiction)	Cost Recovery	Estimated Total **Net Benefits+**	Demand Side **Benefits&**	Regulatory Initiated	Planning Process
Southern California Edison (CA)*	Direct recovery of AMI costs/benefits ratepayers outside of rate case.	$109m	$841m	Explicit Order on AMI from Regulator	Collaborative with vendors and stakeholders
San Diego Gas and Electric (CA)	Recovery of pre-determined AMI costs/ benefits ratepayers.	$40m-51m	$87m (residential and large customer)	Explicit Order on AMI from Regulator	Settlement Process with on-going AMI Advisory Committee
PEPCO (DC/DE/MD)*	Separate tariff for net costs	PEPCO claims benefits will exceed $5-$7 monthly cost to customers	Not quantified	Workshop	Plan filed with regulatory body includes on-going Advisory Committee
Consolidated Edison (NY)*	Surcharge for net costs recovered between rate cases	$782.5m	$234m (includes other load benefits)	Explicit Order on AMI from Regulator	Plan filed with regulatory body
Portland General Electric (OR)*	Limited time tariff for recovery of net costs between rate cases	$37-$80m	$2 – $46m^	No explicit order from regulator	Workshops part of tariff filing
Rochester Gas and Electric (RGE) and New York State Electric (NYSEG) and Gas (NY)*	Surcharge for net costs recovered between rate cases	$48m (RGE) $101m (NYSEG)	Not quantified	Explicit Order on AMI from Regulator	Plan filed with regulatory body

Original research prepared by ISGI Staff (June 2008)

* Still in litigation

\+ This represents the total benefits less the total costs of implementation. Total benefits include demand side benefits as well as utility operations and other cost savings. Total costs include all incremental capital costs and associated expenses. Net present value is calculated over a planning horizon (differs by utility).

& Demand side benefits are included in net benefit calculation (i.e., demand side benefits are calculated as part of total benefits from which total costs are subtracted). Definitions vary and may include benefits from price responsive tariffs, avoided capital spending and other load-related benefits such as avoiding generation, distribution, and transmission capital spending.

^ Estimated $34m in net benefits from operational cost savings. Remaining is attributed to customer and system benefits. (Direct testimony of B. Carpenter and A. Tooman, field in Oregon PUC Case UE 189, July 27, 2007, pp. 9-10)

The Illinois Electric Industry: A Context for Policy Change

In 1997 the Illinois General Assembly passed the *Electric Service Customer Choice and Rate Relief Law of 1997* (the "1997 Law"). This change was chiefly predicated on a concern over electric rates that had increased substantially for most Illinois consumers after the generation building programs of the 1970s and 1980s. The 1997 Act held out the promise of lower rates and more consumer-centric electric service providers as well as the possibility of new and innovative services.

Specifically, in 1997 the General Assembly found that:

> *Competitive forces are affecting the market for electricity as a result of recent federal regulatory and statutory changes and the activities of other states. Competition in the electric services market may create opportunities for new products and services for customers and lower costs for users of electricity. (220 ILCS 5/16-101A(b))*

While the 1997 Act focused on providing for a competitive market for electricity supply, it also provided for a safety net rate for mass market (i.e. residential) consumers that was fixed at the then-existing rate levels. This price cap remained in effect until January 2007 when prices were envisaged to move to market levels. This time frame in which prices were frozen was called the *transition period*. The transition period was created for the express purpose of providing sufficient time for market participants and consumers to adjust to the new market arrangements. The transition period ended in January 2007.

However, even after a decade-long move toward competition, the Illinois marketplace has developed in an asymmetric fashion. The Illinois Commerce Commission has noted this trend:

> *Despite the successful foundation that has been laid during the...transition period, the [ICC] is concerned that the benefits of customer choice have not yet reached the smallest-volume customers to the same degree that it has benefited larger-volume customers.*[53]

This trend was expected to change at the end of the transition period (i.e., January 2007) as the low fixed rates paid by mass market consumers mandated by the 1997 Act were moved to market levels.[54] However, to date, the number of mass market consumers that have taken advantage, of the pricing options afforded by either the real-time pricing or from alternative suppliers is small.[55] Indeed, the end of the transition period brought with it the concern over *higher* prices as a result of moving mass market customers to market-based rates as the cost of fuel and other inputs into the production of electricity had increased during the decade-long price freeze.[56] By the summer of 2007, just after the end of the rate freeze, the Illinois General Assembly made this conclusion:

> *The transition to retail competition is not complete. Some customers, especially residential and small commercial customers, have failed to benefit from lower electricity costs from retail and wholesale competition. (220 ILCS/3855/1-5 (2))*

As a result, the General Assembly determined that an independent agency be tasked with developing a plan for procuring power for the mass market--a kind of statewide retail aggregation. This entity, the Illinois Power Agency ("IPA"), was created by the Illinois Power Agency Act, P.A. 095-0481 (the "IPAA"). The IPA is tasked with procuring power for Commonwealth Edison Company, which serves the large majority of Illinois consumers, and the three Illinois Ameren Companies (AmerenCILCO, AmerenCIPS, and AmerenIP) that serve most of the rest of Illinois' electric consumers.[57] In addition, the IPAA required that major utilities meet goals for energy efficiency programs and renewable resources.

While the IPA has recently finalized its initial plans for procurement, it remains unclear how exactly how the IPA will reconcile its statutory objectives to obtain the "lowest total cost over time," while "taking into account any benefit of price stability", promoting "investment in energy efficiency and demand response" and supporting "the development of clean coal technologies and renewable resources."[58]

The Illinois electric industry is currently going through the second significant round of restructuring. The first, begun in 1997, was focused on generation supply. The current phase of restructuring is focused on activities that attempt to modify the cost of generation supply, the make-up of that generation supply (e.g., renewable resources and clean coal) and ability of consumers to take an active role in managing their own energy consumption (e.g., demand response, energy efficiency). Smart grid deployment can offer options to facilitate each of these objectives as this report has illustrated. In particular, smart grid deployment is essential to support broad-based price responsive consumer behavior necessary for an efficiently operating wholesale and retail market. However, to enable smart grid deployment to achieve these ends, certain policies may need consideration or reconsideration as the next phase of electric restructuring attempts to achieve the goals set forth in the initial phase of electric restructuring- namely a competitive wholesale and retail market that benefits all consumers in a timely fashion.

Key Policy Issues Relating to Smart Grid Deployment in Illinois

The Illinois Smart Grid Initiative had two primary objectives: (1) to engage Illinoisans in examining the nature and potential benefits of the "smart grid"; and (2) to identify policies for achieving those benefits.[59] These objectives were premised on the view that electric power systems must undergo major changes in the coming years, and that change in this extensively regulated arena will require rethinking of public policies in a way that integrates the values and viewpoints of a wide diversity of interests.

As of early 2009, the fully realized "smart grid" largely remains a concept, not yet a reality on a utility-wide basis anywhere. While significant projects are underway in many jurisdictions, none has been fully built and fully put into operation, nor has one been evaluated against its engineering promise. Nonetheless, a national policy to support modernization of the electric grid was enacted in 2007,[60] a number of states are deploying or considering deployment of elements of smart grids, and the Illinois Commerce Commission in September initiated a statewide smart grid planning process involving both the ComEd and Ameren distribution utilities.[61]

Although these are nascent policies, they may become the foundation stones for more far reaching public actions. Both of the major party Presidential candidates in 2008 identified electric grid modernization as a goal;[62] and there the Obama administration is now pursuing this as part of a larger "green economy" development process. Specifically, President Obama has called for increased investment in the next generation power grid (i.e. smart grid) to help reach the goals of ensuring that renewable sources provide 10% of our electricity by 2012 and 25 percent by 2025 and placing 1 million plug-in hybrid electric cars on the roads by 2015.[63] However, regardless of what happens in Washington, D.C. in the coming years, a perfect storm of environmental and economic forces continues to motivate interest in new public policies to minimize resource use in meeting energy needs. These forces, combined with impending political and policy change, argue for action by states and utilities and all others concerned with the future of electric power to give immediate and serious consideration to the smart grid concept and its potential applications.

The September 2008 orders of the Illinois Commerce Commission put Illinois on just such a path. The ICC has ordered an immediate evaluation of advanced metering infrastructure (AMI) in the ComEd territory, and has also ordered the development of strategic plans for smart grids for both ComEd and Ameren Illinois. These orders provide the primary guidance, and also create the necessary public forums, for smart grid policy considerations in Illinois.

The policy discussion that follows examines six topics that were explored in ISGI meetings and that may be key concerns in the workshops ordered by the ICC. These topics are: (1) smart grid planning considerations; (2) the societal perspective on investing in smart grid; (3) rate making methods for smart grid investments; (4) non-utility investment in the electric grid; (5) pricing of electricity service; and (6) the relevance of smart grid to Illinois' energy efficiency, demand response, and renewable energy goals.

1. Smart Grid Planning, Monitoring, and Evaluation

Smart grid planning is a critical feature for understanding and articulating a clear vision for the features a smart grid might provide and for evaluation of the smart grid deployment process. The goal of planning and implementing a smart grid is to ensure that consumers are provided with an electric service delivery model that enables the most innovative and cost effective electric system that delivers added value to consumers, utilities, market participants and society. While the planning process is a detailed long-term endeavor there are at least six policy aspects of the planning process that should be considered when moving forward.

a. Maximize Participation: Participation in the smart grid planning process by the widest group of stakeholders possible is critical to obtaining the necessary commitment and providing the necessary input into smart grid design and functionality.[64] This implies that smart grid deployment should use coordinated efforts, to the extent feasible, to allow local initiatives, such as renewable or energy efficiency plans, to leverage smart grid investments.

b. Smart Grid Definition: Smart grid has been defined in many different ways by different stakeholders and organizations. A stakeholder driven definition will help provide the common vision for the smart grid and help in understanding the necessary planning steps in deploying smart grid.[65]

c. Smart Grid Drivers: Smart grid deployment is not only driven by technological capabilities, but also the public pressure, through regulatory and legislative means, to improve the ability of utilities to provide more reliable service and for customers to take more control over their energy consumption. The degree of regulatory and managerial leadership will also help drive the degree to which smart grid is deployed as well as the timing.[66]

d. Business Case: The business case concerns the costs and benefits of investing and deploying smart grid technologies. This process is fundamental to smart grid planning as it will guide the financial and economic decisions that must occur in order to deploy smart grid. The business case must include the traditional approach to utility cost and benefits, as well as a new understanding of the external benefits of smart grid investment (e.g., demand response, conservation, reliability, etc.)

e. Standards: Standards for communications and information flow between physical devices on a customer's premises and electricity markets as well as third parties and utilities is a critical part of providing the necessary infrastructure for consumers to benefit from a modernized grid. Illinois will need to be aware of, and participate in, the national efforts to define these standards as well as incorporate standards into the planning and deployment of smart grid.[67]

f. Metrics: In June 2008 the U.S. Department of Energy conducted a workshop to develop "metrics" for evaluating progress in smart grid implementation.[68] Although the purpose of this workshop was primarily to support preparation of a Smart Grid System Report to Congress,[69] it may also be instructive for smart grid planning in Illinois. The purpose of metrics is to identify milestones for smart grid deployment. Metrics were developed at the workshop for each of the seven major smart grid characteristics. For example, one of the characteristics of a smart grid is to "enable active and informed participation by customers" in the electric market.

The following illustrates the metrics associated with that goal:[70]

- Percent of customers/premises capable of receiving information from other economic actors on the grid;
- Percent of customers opting to make decisions and/or delegate decision-making authority;
- Number of communication-enabled, customer-side of the meter devices sold ;
- Number of customer-side of the meter devices sending or receiving grid-related signals;
- Amount of load managed; and
- Measurable energy savings, both in kWh and in financial terms, by customers.

These six planning issues should be considered as Illinois moves toward smart grid deployment. Some of these factors, such as smart grid drivers and participation, have been addressed by the Illinois Commerce Commission in creating the Statewide Smart Grid Collaborative.[71] In addition, the process the ICC has developed is designed to test AMI projects for ComEd and could lead to better tests of expanded smart grid deployment and design approaches. It will be important for policies to be flexible enough to incorporate lessons that are learned from the pilot project and allow for modifications of those pilots over time to test new or different aspects of AMI and smart grid deployment.

2. Evaluation of Smart Grid Investments from a Societal Perspective

Smart grid investments may enable consumers to benefit from changes in their behavior, and from new ways of pricing electricity. However, traditional utility investment criteria customarily have not considered "external benefits" like these; and consequently the justifications for smart grid investments may be unreasonably constrained. The Illinois Commerce Commission has recognized this potential dilemma by directing stakeholders to consider "methods of estimating, calculating and assessing benefits and costs, including evaluation of non-quantifiable benefits (and costs)."

Electric utilities have traditionally been regulated under a cost-plus or rate of return regulation scheme. This method of regulation sets an allowed return on capital expenditures and allowed expenses which can then be recovered through the utility's rates. In Illinois, as in many states, the allowed level of capital and the allowed expenses are set by the regulatory body, the Illinois Commerce Commission, in a general rate proceeding. This allowed return on capital and allowed expenses, added together, is called the revenue requirement. In reviewing the appropriate level of capital expenditures to be included in the revenue requirement, the regulator generally uses an investment rule that ensures that capital expenditures included in the revenue requirement will *minimize* the revenue requirement. For example, assume a utility is making a decision between two capital projects.[72] The first project has a high initial capital outlay, but lower expenses over the life of the project. The second has a lower initial capital outlay, but higher expenses over time. The rule would require the utility to compare the entire cost (capital plus expenses) of the two projects and choose the one with the lower overall costs. This is often referred to as the minimizing of present-value revenue requirement ("min-PVRR"). The min-PVRR criteria does not evaluate investments based on benefits and costs to consumers or to society, but only benefits and costs to the individual utility.

Smart grid investments, however, raise a dilemma for the traditional min-PVRR investment criteria. First, smart grid investments, while having significant benefits for reducing a utility's own costs, tend to have high initial capital expenditures. This creates a high hurdle for any calculation of net present value. Second, smart grid investments are seen as creating benefits that would not traditionally be included in the min-PVRR calculations.[73] These benefits generally fall into four general categories:

1. **Demand Response:** Commodity price reductions as a result of demand response and conservation efforts on the part of consumers. In addition, demand response may help delay or avoid certain investments in generation.

2. **Reliability:** Improved outage management and higher reliability as a result of improved control over the electricity delivery system can provide benefits to consumers and to other entities, such as local governments.

3. **Environmental improvements:** To the extent that the system is used more efficiently, both as a result of the utility's operations and as a result of consumer's using energy wisely, there may be reductions in the emissions of green house gases and other pollutants. Other potential longer-term benefits may arise from the smart grid's enabling of more energy efficient technologies such as plug-in electric vehicles.

4. **General Economic Benefits:** The smart grid benefits may extend into the general economy as well. For example, if smart grid enables new technologies, new products and services, jobs will be created and local economies will benefit. In addition, as the overall economy continues to evolve toward more penetration of digital technologies and production processes, higher reliability from smart grid will help retain and attract new business.

Third, while the external benefits are somewhat easy to contemplate, the quantification of these benefits is much more difficult. There are a range of methods that can be used to estimate the value of the external benefits.[74] Yet each method has its own pros and cons leading to the conclusion that there will be uncertainties concerning the ability of the smart grid to deliver on its potential benefits. This creates uncertainty as to the value of the benefits and further complicates the investment criteria calculation. Fourth, as a result, smart grid investments may be qualitatively different than other, more traditional, utility investments. Smart grid investments, for example, are predicated on more modern digital technologies that constantly evolve creating the risk of obsolesce.

Compared to the current technology embedded in a distribution utility's capital investments, which has remained relatively unchanged for many years, smart grid investments appear to be qualitatively different in nature. Both the risk of obsolescence and the large potential, but uncertain, external benefits also create regulatory risk for utilities that undertake smart grid investments. This risk is manifest in a number of ways including the after-the-fact reviews of investment, the risk of the loss of current investment that has not yet been fully depreciated, and the risk that investment may not be fully utilized. Separately, or combined, these factors can create a risk premium on these investments that traditional min-PVRR criteria cannot capture.[75]

Policy Considerations and Opportunities

As a result of these complications in using the traditional min-PVRR investment criterion, a more expansive investment rule that specifically takes into account external or societal benefits of utility investment should be considered. Illinois has used such expansive investment rules in evaluating energy efficiency and renewable investments.[76] In addition, Illinois law appears to support including external effects of utility investment in determining the allowed investment. (220 ILCS 5/1-102) However, the methodologies should also consider alternative investments or policy changes that generate the same external benefits at a lower cost than full smart grid deployment.

Finally, in calculating the value of the external benefits, methodologies should be used that incorporate uncertainties, to the extent possible, in the calculations. For example, the utility could track repetitive repair costs on certain circuits which could then justify investment into reliability improvements. The utility could also track the costs of outages to consumers through surveys. This includes lost food, damaged goods due to basement flooding, commercial loses due to business operation interruptions, and so forth. Generating the value of external benefits under different scenarios for key parameters will help provide the range of possible outcomes and lead to more robust decision-making.

3. Alternative Methods of Ratemaking for Smart Grid Investment

As already outlined, smart grid investments may be qualitatively different than traditional utility investments for a number of reasons, including the additional benefits to consumers that are enabled by the investments, risk of obsolesce, and uncertainty in quantifying or projecting enabling external benefits. Smart grid investment may also displace current assets that still have value on a utility's books. The unusual nature of smart grid investments means that existing forms of ratemaking do not necessarily serve either utilities or consumers and alternative forms of ratemaking should be considered.

Traditional rate of return regulation as practiced in Illinois uses an after-the-fact prudence review to determine the appropriateness of utility expenditures. This approach coupled with the fact that capital expenditures are granted a return based on the risk associated with an average utility investment will tend to discourage innovative capital investment. This approach discourages unnecessary risk taking on the part of the utility, but it also discourages risk taking that could benefit society.

Smart grid investments have at least three characteristics that will tend to dampen a utility's incentive to invest under the traditional form of regulation. First, by the nature of the digital technology used, smart grid investments have a risk of becoming obsolete before the accounting life of the asset is reached. This creates a risk that the regulator will disallow any remaining book value of the assets from rates, leaving the utility with unrecovered capital expenditures. Second, smart grid investments are expected to create external benefits for consumers, businesses, and the economy in general. However, these benefits are uncertain and depend on many factors beyond the utility's control, such as the level of electricity prices, the regulator's approach to pricing options, consumer behavior, and the evolution of the digital economy. If the expected benefits from smart grid investments do not materialize, utilities could be subject to disallowances in an after-the-fact review. Third, the loss of kilowatt hour sales from greater demand response and energy efficiency measures undertaken by end use customers will reduce utilities' revenue.

Smart grid investments may represent the type of innovative capital expenditure that could have large payoffs for society, so society may want to promote investment in smart grid. To do so, however, it may be necessary to recognize the limitations of traditional regulation. For example, many states that have pursued AMI and smart grid investments have used alternative forms of regulation for smart grid investment.[77]

Policy Considerations and Opportunities

Considering the possible disincentives to investment in smart grid under traditional regulation, Illinois should consider a method of regulation that produces the desired investment, while providing utilities with the proper incentives to efficiently and effectively deploy smart grid and implement new smart policies, such as new pricing options. Options that may be considered could be performance-based standards for investment and operation, recovery of capital costs through a surcharge or special tariff, or automatic adjustments to rates to reflect the prudently incurred costs of service. In reviewing these options, the goal should be to improve the ability of the regulators to elicit behavior that will provide the greatest likelihood of obtaining the potential benefits from smart grid deployment, while protecting consumers from unnecessary increases in costs.

4. Non-utility Investment in the Electric Grid

Distribution utilities are charged with investing in the electric grid and managing the operations of the grid. However, smart grid operations may present opportunities for non-utility parties to invest. These investments might include micro grids, advanced metering, distributed energy resources and other investments designed to increase reliability or otherwise benefit a local area.

Traditionally, utility investment is implemented as part of a system-wide approach to utility planning. Specific localized issues, such as a demand for higher reliability, are sacrificed in order to create a utility system that attempts to provide a reasonably similar service in all areas of the state. This approach to public policy making is predicated on the need to maintain a minimum level of service for all communities or customers. However, this public policy approach can be criticized as not being responsive to localized issues (such as poor reliability in certain communities) and perhaps may not even meet the goal of providing reasonable similar service to all consumers. Much like the public school funding debate, a public policy dilemma is created when those communities that have the ability to pay for a "better" local electric grid are allowed to create inequities in the level of service provided across the state. There may be other issues related to the accounting and operations of the electric grid that will need to be addressed if non-utility investment in the electric grid is allowed to a significant extent.

Most of the rules for investment in the grid were written prior to the advent of competition and the new technologies contemplated for use in smart grid. Non-utility players may be willing to shoulder some of the cost of utility infrastructure upgrades. This may include:

- Localized reliability upgrades;
- Master meter investments for smart meters to reduce tenant costs;
- Local small-scale generation used to hedge market prices and promote reliability.

Policy Considerations and Opportunities

The rules related to electric grid investment should define the proper domains of utility and non-utility investment. This may require formalization of grid operations rules (e.g., in a "grid code") as well as the formalization of the property rights on the system.

These rules would address:

- Ability of governmental and other entities to have long-term financing of investments in the grid and the rules by which utilities would address requests for such service;
- Ability of third parties to finance and utilize utility-owned systems including rights of way.
- The necessary operations and engineering rules to allow for the incorporation of third party investment;
- Penalties for misuse of the system by third parties;
- Master metering for large commercial and residential buildings;[78]
- Interconnection of localized generation; In particular,
  - » Issues related to timelines for interconnection;
  - » Utility discretion over switching capabilities;
  - » Network interconnection issues.

In addition, non-utility investment can be supported by revenues from demand response and other commodity-related revenue sources. Some policies at the regional level may need to be changed in order to maximize benefits to Illinois consumers; consideration should be given, for example, to supporting changes in the regional wholesale market. (e.g., allowing third parties to install meters that can be used to bid demand reductions into the wholesale market). If the regional transmission operators (RTOs) establish clear, transparent rules and processes for validating a meter and having it accepted as a revenue meter, even if it is not a utility meter, this would reduce the barriers to privately-funded smart grid investment

5. Modification of Default Service Pricing

Today's flat rate default electric service pricing for mass market customers promotes inefficient consumption and limits the customer's opportunity to economize their own electricity purchases. In the longer run flat rate pricing may inhibit the introduction of innovative products and services (e.g., demand response products, plug-in electric hybrids, etc.). Therefore, it may be desirable to consider modifying the default rate to reflect the changing cost of electricity production, or to encourage customers to choose time-of-use rates.

Beginning in 1997, there was a ten year period of statutorily frozen electric rates in Illinois. As a result, most customers did not see any changes in the rates they pay for electric service until the freeze ended in 2007. Since that time, the flat rates that customers pay have increased. The problem is that these flat rates bear little relationship to the underlying cost structure of the electricity system. As a result, the rate increases that customers have seen do not accurately reflect the way that generation is actually constructed and used.

The electricity grid must be kept in almost perfect balance, meaning that at any given moment there needs to be precisely as much electricity being put into the grid as customers are taking off. As demand increases, and more and more electricity is being taken off the grid, increasingly more costly generation is turned on to meet that demand. The highest levels of demand, however, occur only for a few hours the entire year. As a result, the industry must build and maintain enough power generating capacity to support only a few hours of maximum, or near maximum, demand. Some of this generation is only run for a few hours a year and is therefore very expensive. With proper pricing and reliability signals, customers can "see" the real cost of this generation, and that may provide them with an incentive to reduce usage – thus reducing system peaks and deferring or eliminating investments in expensive new generation.

This mismatch between costs and rates takes on more importance as the costs of electricity production change over time. For example, the increase over the past decade in the price of fuel and increases in the costs of building new generating capacity place increasing stress on the system if demand grows unchecked. In addition, mounting environmental concerns – especially concern with climate change from greenhouse gas emissions – have spurred intense interest in conservation, efficiency improvements, and green power. Increasing reliance on electricity and new concerns with reliability and power quality in the digital economy are also shaping consumer expectations for improvements in electricity service. The electricity infrastructure is aging, outmoded in design, and stressed by increasing levels of demand.

As noted earlier, the Illinois electricity grid is now facing a number of external and internal challenges. These challenges create a very uncertain future for electricity prices in Illinois. The smart grid can help manage some of this uncertainty. One of the benefits of smart grid technology is the information flow that it creates for customers. Customers can receive more information about both their electricity usage and the underlying cost of the electricity they use. However, information alone may not provide the proper signal for customers to reduce their usage. Proper rate structures are also needed. It has been shown that providing real-time feedback to customers can lower energy usage by a few percentage points. In addition, relatively minor modifications to existing rate designs, such as the introduction of an inclining block rate, can reduce energy consumption by up to 6% in the short run and may also lower peak demand. More complex dynamic pricing rate structures can reduce demand by as much as 13 to 27 percent during critical periods. These demand reductions will result in lower energy costs for **all** customers (even ones not on time-based rates). Taken together, these measures can make a substantial contribution to meeting Illinois future energy needs at a reasonable cost.[79]

Reductions in usage have a tremendous value to the system. Widespread deployment of information technology that allows consumers to easily control their power consumption could add $5 billion to $7 billion per year back into the U.S. economy by 2015 and $15 billion to $20 billion per year by 2020.[80] This occurs from reducing usage at peak times--indeed even a 5 percent drop in peak demand can yield substantial savings in generation, transmission, and distribution costs, enough to eliminate the need for installing and running some 625 infrequently used peaking power plants and associated power delivery infrastructure. At the national level, this translates into a savings of $3 billion a year, or $35 billion over the next two decades.[81]

Policy Considerations and Opportunities

There is significant evidence that modifications to Illinois' current flat, default service rates may benefit a wide range of customers.[82] The various other rates described in Figure 5 and Sidebar 2, "Electricity Commodity Pricing Options Shown in Figure 5", illustrate the range of potential rate options.

A flat rate provides a consumer with a certain 24-7-365 price for electricity. Flat rates eliminate price risk (i.e., the risk of a change in price) by holding price at a constant level regardless of any change in the underlying cots of supplying electricity. However this assured price does not come without a cost. These products contain a "risk premium," or added amount in the price to cover the cost of providing the "insurance" against large price changes. Rates that vary with time of use force consumers to bear a price risk in line with the actual costs of supplying power, but do not include an added charge or premium. The rate options that appear along the curve in Figure 5 show a trade-off between risk/certainty and price/reward. (The "reward" refers to the ability of consumers to potentially save money by taking on some of the price risk.)

Any consideration of changes to default rates should carefully consider this and other trade-offs. How much risk are customers willing to take in exchange for potentially lower prices? How does exposure to more risk affect customers? What tools will customers have to manage exposure to risk -- including how information and automation potentially available from a smart grid might be used to manage risk exposure. Are there segments of customers for whom exposure to more risk is not appropriate and should remain on flat rates?

In addition, the general nature of a default rate design should be examined. Does the default rate have to be a single, one-size-fits-all rate? Or, would a menu of pricing options be preferable in terms of customer acceptance and behavioral change? How should the default rate balance the needs of customers who do not have the ability to respond to price signals with the needs of customers who can change their consumption in response to price changes?

If a move away from flat, default rates is seriously contemplated, its planners should give careful consideration to consumer education. The vast majority of Illinois households and small businesses have paid flat rates for electricity forever. And, although experience in Illinois has shown that customer acceptance of time-variant electric pricing is possible, that same experience has also shown that customers need support in adapting to such rates. Sidebar 3, "Illinois' Experience with Residential Real-Time Pricing", describes Illinois' experience with residential real-time prices (RRTP), a form of time-variant electric rate. The successful multi-year pilot test of these rates that preceded legislation to make the rate available to all households included carefully planned and delivered assistance to participants both before and during their use of the rate. And, based on that program design, the General Assembly required utilities to contract for independent administration of the customer interface for RRTP.

6. Effect of Statutory Renewable Resource, Demand Response and Energy Efficiency Goals on Smart Grid Planning and Implementation

Smart grid investments may enable greater integration of renewable sources of energy, as well as demand response, and may promote energy efficiency. Existing Illinois laws establish targets for energy efficiency, demand response, and renewable energy procurement.[83] The Commission has recognized that these existing laws may have an "effect on smart grid planning and implementation."

The integration of renewable energy, demand response and energy efficiency is required by Illinois law, which directs utilities to procure resources through a renewable portfolio standard (RPS), and energy efficiency portfolio standard (EEPS), and a demand response portfolio standard (DRPS). These standards were designed to stimulate the entry of new renewable generation sources, demand response programs, and energy efficiency programs in Illinois.

Utilities are required to meet the goals of each standard, subject to cost constraints.

Smart Grid technologies, and the information flow they create, can enable greater integration of energy efficiency, demand response, and renewable energy into both physical and financial energy markets. The integration facilitated by a smart grid is not achievable with the existing electricity grid. As a result, there will inevitably be interaction between the resources procured under the RPS, EEPS, and DRPS and the smart grid. In addition, the ease of integration created by a smart grid can help to reduce the cost of renewable energy, energy efficiency, and demand response.

Policy Considerations and Opportunities

The interaction between the existing RPS, EEPS, and DRPS and the smart grid should be carefully studied. To the extent that smart grid technologies can enable more robust integration than is currently possible, the interaction of these new resources with cost caps should be examined. For example, Illinois has recently enacted fairly robust interconnection and net metering provisions to encourage small scale renewable generation. However, those provisions are still framed in a conventional metering environment and will need to be revisited as smart meters and a smart grid is deployed. Likewise, the current EEPS currently favors traditional approaches such as an emphasis on measures such as compact florescent lightbulbs. The enabling legislation will need updating to allow a broader definition of energy efficiency that recognizes the value of the information systems created by the smart grid.

Illinois Laws and Regulations Applicable to Electric Grid Modernization

The *Illinois Public Utilities Act* (the Act) provides sufficient policy guidance and authority for the initial and essential stages of grid modernization in Illinois; namely, the near-term planning and deployment of *AMI* (automated metering infrastructure) and of other related improvements to utility facilities and services. It also appears that statutory changes would not be necessary for a process to determine how to implement the policy issues (e.g., changes in pricing, etc.) examined in this Report.

At the broadest level of policy relevant to grid modernization, the Act states that "the health,

Illinois' Experience with Residential Real-Time Pricing

Illinois has a unique opportunity to take past experiences and use them to inform future smart grid planning. Unlike many states where smart grid and smart meter deployments are preceding any innovation in dynamic pricing options for customers (or only experience from very limited pilots), Illinois has had residential real-time pricing options available since 2003.

The experience gained from existing residential real-time pricing provides support for the notions that a segment of residential customers will choose dynamic pricing, that residential customers will respond to price signals and reduce peak electric demand and overall energy use, and that customers can reduce their bills.

From 2003 through 2006 the Community Energy Cooperative (now CNT Energy) operated a pilot program with ComEd called the Energy-Smart Pricing Plan. The pilot had approximately 1,500 participants. Over the course of the four years participants saved roughly 10 percent on their bills compared to what they would have paid on the flat rate. In addition, third-party evaluations showed an elasticity of demand to price, which means that when the price of electricity went up, participants' demand for electricity went down compared to what would have been expected. The demand reductions were equivalent to 15 to 20% of peak demand of participants. Notably, this was achieved with most participants having no access to automated air conditioner controls. Those that did achieved larger reductions. In addition, over 90% of participants felt the program met or exceeded their expectations.

Based on the success of the Energy-Smart Pricing Plan, in 2006 the Illinois General Assembly passed Public Act 94-977 which required Ameren and ComEd to start offering optional third-party administered real-time pricing programs to their residential customers. These programs will be evaluated after four years of operation to determine if they are generating net economic benefits to residential customers. The current real-time pricing programs, RRTP for ComEd welfare and prosperity of all Illinois citizens require the provision of adequate, efficient, reliable, environmentally safe and least cost public utility services..."[84] And with regard to the regulation of electric service, current law provides that the Illinois Commerce Commission should promote efficiency, environmental quality, reliability, and the equitable treatment of customers.[85] In addition, two particular legislative findings in Article XVI of the Act[86] are also relevant to the *smart rates* and to the use of renewable resources integral to modernization:

- The efficiency of electric markets depends both upon the competitiveness of supply and upon the price responsiveness of the demand for service. Therefore, to ensure the lowest total cost of service and to enhance the reliability of service, all classes of the electricity customers of electric utilities should have access to and be able to voluntarily use real time pricing and other price response and demand response mechanisms.

- Including cost effective renewable resources in a diverse electricity supply portfolio will reduce long term direct and indirect costs to consumers by decreasing environmental impacts and by avoiding or delaying the need for new generation, transmission, and distribution infrastructure. It serves the public interest to allow electric utilities to recover costs for reasonably and prudently incurred expenses for electricity generated by renewable resources.

These policy declarations indicate that the General Assembly contemplated evolving changes in the electric industry and its regulation that might provide customers with new opportunities for efficiency gains and environmental improvements. To the extent that these goals might be more readily achieved through the deployment of a smart grid, modernizing the grid clearly is consistent with the current law governing regulation of electric utilities.

This view is evident in the fact that the ICC has already instituted the first step on the road to deploying a smart grid -- the deployment of utility-financed advanced metering infrastructure.[87] The ICC's authority to direct utility planning and approve utility investments and cost recovery are well established.[88] Therefore, in the near term future there does not appear to be a need

(cont)

customers and Power Smart Pricing for Ameren customers are currently underway and participation in them continues to grow.

Like the pilot program, both programs do not use smart meters. Instead they use interval recording meters which are solid state meters that are read by traditional meter readers on a monthly basis. These meters do collect similar data to what could be collected by smart meters, but do not have two-way communications. This means that customers can't see their energy use in a timely manner, and the meter can't be used as a communications gateway for the automation of home energy management and display systems. Smart meters and their accompanying infrastructure have the potential to take the positive results to date from residential real-time pricing and increase their reach, scope and cost effectiveness.

For More Information:

Energy-Smart Pricing Plan (2003-2006):
www.cntenergy.org/reports.php

Power Smart Pricing (Ameren):
www.powersmartpricing.org

ComEd RRTP:
www.thewattspot.com

for changes in the ICC's authority or any other particular law or regulation. In the longer term, some aspects of the law or of ICC regulation may need revision to address levels of required service reliability, non-utility investment in the grid, competition in automated energy management services, and perhaps other areas to support later stages of the implementation of a smart grid in Illinois. But the need for such policy changes is neither pressing nor certain.

The following paragraphs briefly explain how current statutory authority and administrative rules may bear on the grid modernization issues identified in the Report:

Smart Grid Planning, Monitoring, and Evaluation: One possible exception arises with respect to monitoring electric grid reliability. Smart grid investments can improve service reliability, a matter the ICC regulates under Part 411[89] of its administrative rules, which was developed pursuant to Sections 8-401 and 16-125 of the *Public Utilities Act*. Beginning with the year 1999, and at least every three years thereafter, 83 Illinois Administrative Code Part 411.140 requires the Commission to assess the annual reliability report of each jurisdictional entity and evaluate its reliability performance. Changes to that reliability reporting or other metrics made as the result of grid modernization may require changes in the law and rules.

Evaluation of Smart Grid Investments from a Societal Perspective: The Illinois Commerce Commission is required to review electric utility investments for cost effectiveness, and may include the external benefits of utility investments in the cost effectiveness measures for investments. (220 ILCS 5/1-102) This existing authority should allow the proper consideration of grid modernization plans and capital expenditures.

Alternative Methods of Ratemaking for Smart Grid Investment: A utility may propose an alternative method of regulation under Section 9-244 of the Act, including a regulatory method to accommodate smart grid deployment.[90] In addition, the ICC has concluded that it may utilize riders and other post test year ratemaking methods to allow cost recovery (although these decisions are currently on appeal)[91] for infrastructure modernization.

Non-utility Investment in the Electric Grid: If the Commission determines at some later date that a grid code is necessary to achieve the full benefits of a modern electricity grid, it could do so under its existing rule making powers. However, this would require an extensive evaluation of existing rules, because portions of a potential grid code (e.g., rules and tariffs concerning mastering metering, interconnection, etc.) are already embedded in the Illinois Commerce Commission's rules. (For example, Part 466 of 83 Illinois Administrative Code details the requirements for grid interconnection of generation less than 10 mW.[92] Also, Part 305 of 83 Illinois Administrative Code addresses certain minimum standards for safe operation of the utility system. And there are many other examples that could be cited.

ComEd Rider LCG addresses investment costs required by local ordinance. For example, municipalities may require that certain equipment be placed underground for either safety or aesthetic purposes. Under the terms of this Rider, ComEd charges the consumers in the affected local area for the costs of complying with the government requirement. The non-utility (i.e., local government) financing of these investments under Rider LCG has never been addressed; and it is not clear that a local government would be allowed to finance the investment without the acquiescence of the utility and perhaps even the ICC. It is further not clear whether local ordinances could require significant changes in the manner in which the utility plans and operates its system that go beyond the traditional investments covered by Rider LCG. There are also certain rules that may provide disincentives for non-utility investment. For example, Part

410.130 of 83 Illinois Administrative Code requires that all individual customers be provided a separate meter. This rule includes all units in multi-unit buildings and is intended to apply to all customers (with some limited exceptions).[93] There has also been concern raised that without the ability to aggregate customers in a cost effective manner, mass market consumers may be less likely to benefit from potential non-utility investment in the electric system.[94] Municipal aggregation which allows a local government unit to aggregate the customers in its area, has received attention.[95] In 2003, the ICC recommended that a task force be convened to study all of the necessary changes that would have to occur for municipalities to develop the ability to engage in such programs.[96] Further, this same report indicates that legislative change would be necessary to implement a potentially workable municipal aggregation program.[97]

Modification of Default Service Pricing: The ICC has wide latitude to implement the goals of the Illinois PUA through its rate making powers. But a change in default service pricing could only occur under new tariffs introduced in a rate case or other formal proceeding. In addition, any such change would necessarily have to dovetail with the Illinois Power Agency's plan for purchasing electric power and energy for default service customers, including especially the portion of the load procured under a fixed rate contract versus the spot market.[98]

Illinois law does make dynamic pricing an optional choice for customers. (See Sidebar 3) ComEd and Ameren rates include an option for all customers to take utility-procured energy priced using real-time (or near real-time) prices; and residential customers have the additional option of real-time pricing in conjunction with a third-party administered program that provides additional services and support. Sidebar 3 discusses the Illinois experience with real-time pricing.[99]

It does not appear the ICC lacks authority to implement prices structures of its choosing, provided that the structures are supported by evidenced and comply with other laws and regulations. However, pricing changes or new pricing options would have to occur from today's flat rate structure if customers are to take advantage of smart grid enabled technologies such as real-time metering of consumption.

Effect of Statutory Renewable Resource, Demand Response and Energy Efficiency Goals on Smart Grid Planning and Implementation: There are no statutory changes that are necessary to address these issues in the planning and implementation of smart grid.

Illinois Commerce Commission Smart Grid Process

In September 2008, the ICC issued orders in the ComEd and Ameren Illinois Utilities rate cases that addressed smart grid policy for Illinois.[100] In modifying the ComEd proposed system modernization tariff, the Commission created a statewide collaborative process to develop the polices needed to plan and potentially deploy smart grid.

The Illinois Statewide Smart Grid Collaborative ("ISSGC") that the Commission created is specifically tasked with the following:[101]

- Developing a "strategic plan" to guide smart grid deployment including:
  - » Goals
  - » Functionalities
  - » Timetables

- Recommend policies to guide SG deployment
  - » Foundational policies (13 listed)
  - » Utility-specific issues

- Analyze benefits and costs for utilities and consumers

In particular the ICC ordered the ISSGC to address, at a minimum, the following thirteen policy and technical issues that can be grouped into four generic areas:[102]

- **Consumer Education**
  1. Consumer education and dissemination of information about smart grid technologies, demand response programs and alternative rate structures; (7)

- **Different Pricing**
  2. Implications of smart grid technology for future policies regarding rate design, consumer protection, and customer choice (5);
  3. Mechanisms to flow through to customers any utility smart grid revenues (11);
  4. Adoption of new demand response programs (12).

- **Inclusion of Non-Utility and Non-Quantifiable Costs and Benefits**
  5. Methods of estimating, calculating and assessing benefits and costs, including evaluation of non-quantifiable benefits (and costs) (4);
  6. Effect of statutory renewable resource, demand response and energy efficiency goals on smart grid planning and implementation (6).

- **Smart Grid Definition**
  7. Definition of a smart grid and its functionalities (1)

- **A New "Rulebook"**
  8. Principles Illinois should use to guide smart grid planning and deployment, for example, interoperability, open architecture, and non-discriminatory access (2);
  9. Uniform standards (3);
  10. Standards for interconnection of third party equipment (8);
  11. Data collection, storage, management, security, and availability to third parties (9);
  12. Open architecture and inter-operability standards for technological connectivity to the

RTO and/or ISO to which a utility may belong (10);

13. Access by electricity market participants to smart grid functionalities (13).

When the ISSGC has completed its work, which is scheduled to occur by the end of September 2010, the Commission will begin a Smart Grid Policy Docket for ComEd to address the issues raised by the ISSGC. After this docket is completed ComEd is allowed to re-file a request for cost recovery of smart grid related investments. This "Utility Filing" proceeding will be the implementation proceeding for utility-sponsored smart grid investment.[103]

Summary of Recommendations

This report has identified six major policy areas that should be considered at the state of Illinois moves toward implementing a smart grid. As noted above the ICC has begun a process of smart grid planning and policy development that has been charged with addressing thirteen key policy issues. As an *ad hoc* gathering of stakeholders, the ISGI has provided an overview of the important factors that go into smart grid decision-making and potential implementation. This report summarizes the information and policy considerations that stakeholders can now use to help inform the deliberations in the Illinois Statewide Smart Grid Collaborative and other potential venues for policy change as identified in Table 2. This table provides a high level mapping of the issues identified in this report with the potential venues for addressing those issues. We note that the thirteen issues identified by the ICC in the ComEd Smart Grid Order as laid out in the previous section have overlaps with the ISGI issues.

Table 2. Potential Venues for Addressing Smart Grid Policy Areas in Illinois

	Venue for Addressing ISGI Report Issues			
Illinois Smart Grid Initiative Policy Areas	ISSGC	Other ICC Docket(1)	Legislation	Utility Filing(2)
Smart Grid Planning, Monitoring, and Evaluation	√	√		√
Evaluation of Smart Grid Investments from a Societal Perspective	√			√
Alternative Methods of Ratemaking for Smart Grid Investment		√	√	√
Non-utility Investment in the Electric Grid		√	√	√
Modification of Default Service Pricing	√	√	√	√
Effect of Statutory Renewable Resource, Demand Response and Energy Efficiency Goals on Smart Grid Planning and Implementation	√	√	√	√

(1) May include a rulemaking, a rate case or other ICC formal or informal proceeding

(2) Refers to the utilities' filing after ISSCG is complete (AIU) or after policy docket (ComEd). See note 103

Table 3 maps the ISGI policy areas with the ICC policy issues as identified in the ComEd Smart Grid Order. While there are several areas of overlap between the ICC policy issues and those areas identified in this report, the issues raised in this report are broader in scope and nature than those specifically addressed by the ICC. The ISSGC can use this report as a guide to addressing the issues that the Commission specifically identified as relevant, but may also choose to report back to the Commission with observations and recommendations that go beyond the policy issues identified by the Commission.

Table 3. ISGI Key Policy Areas and the Relation to the ICC Policy Issues

	ICC Policy Issues(1)												
ISGI Report Policy Areas	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Smart Grid Planning, Monitoring, and Evaluation	√	√	√				√	√	√			√	√
Evaluation of Smart Grid Investments from a Societal Perspective		√	√	√								√	
Alternative Methods of Ratemaking for Smart Grid Investment		√									√		
Non-utility Investment in the Electric Grid		√	√					√	√	√			
Modification of Default Service Pricing		√			√		√					√	
Effect of Statutory Renewable Resource, Demand Response and Energy Efficiency Goals on Smart Grid Planning and Implementation		√				√	√						
(1) See ComEd Smart Grid Order at 141. Numbers refer to the issues as identified in the previous section of this report.													

CONCLUSION

The smart grid won't be built overnight. Significant issues of policy, technology and consumer behavior and acceptance remain to be determined. However it has been the goal of the Illinois Smart Grid Initiative to outline the potential benefits to consumers, utilities, the environment and society of pursuing a smart grid policy for the state. The costs that accompany those benefits will require an ongoing thorough and careful examination. The implications of the policy changes that will be required to enable utility and third-party investments in the smart grid need to be explored as well.

In the time between the beginning of the ISGI process and the issuing of this report a number of critical developments have taken place. The ICC orders for ComEd's AMI pilot program and for a statewide smart grid collaborative have set the stage for the next round of state-specific activities. The former will focus clearly on consumer oriented technologies while the latter will be a more comprehensive look at the specific components of the smart grid and the individual business cases and cost/benefit analyses required for them. At a Federal level, it is clear that the policy agenda of the Obama administration and the funding priorities embedded in the economic stimulus plan embrace movement towards a smart grid.

This is an exciting time to be considering how the smart grid can transform the energy use environment in Illinois. As detailed here, the opportunities for consumers in the implementation of new technologies must be considered and integrated into planning at all stages to ensure benefits are realizable and realized. We hope that this report will serve as a launching pad for a robust thorough and considered discussion of the necessary next steps for the adoption of various smart grid technologies by Illinois' utilities—and for action that will bring long-term benefits to Illinois consumers.

ENDNOTES

Preface

1– The views expressed in this preface reflect those of the Center for Neighborhood Technology and do not necessarily represent the views of all participants in the Illinois Smart Grid Initiative, the Galvin Electricity Initiative or the U.S. Department of Energy.

Section 1: Challenges Facing the Illinois Electric Power System

2– The North American Electric Reliability Corporation (NERC) reports that the bulk power system that includes the northern region of Illinois is expected to perform well in meeting the forecast demand obligations over the next ten years. For the rest of Illinois NERC also reports operating conditions should be adequate to meet demand. However, NERC also claims that, nationally, the electric generation mix will rely more heavily on natural gas than it does today. See "2008 Long-term Reliability Assessment: 2008-2017," NERC, October 2008.

3– See e.g., J. Miller, "Understanding the Smart Grid: Features, Benefits and Costs," presented to the Illinois Smart Grid Initiative, July 8, 2008, Chicago, IL

4– Recent forecasts for national electricity prices vary substantially. For example, the Energy Information Agency predicts that electricity prices will remain relatively stable, in real terms, over the next twenty years. (See Annual Energy Outlook 2008, http://www.eia.doe.gov/oiaf/aeo/electricity.html) Although apparently the EIA forecasts do not incorporate any new environmental standards for generation that may change the total cost over time

5– See e.g., B. Hendricks, "Greening the Grid: A Smart Solution," Center for American Progress, presentation to Illinois Smart Grid Initiative, July 8, 2008, Chicago, IL. Also see "Electric Industry Concerns on the Reliability Impacts of Climate Change Initiatives," NERC Special Report, November 2008.

6– Currently information technology applications may represent over ten percent of total electric consumption and the rise of computers, embedded chip applications and the growth in digital networks suggests that electricity demand for these sophisticated technologies is likely to continue to expand. See e.g., K. Stahlkopf, VP of Power Delivery, Electric Power Research Institute, "Power for a Digital Society," University of Wisconsin, October 20, 2000.

7– For example, the American Society of Civil Engineers estimates that it would require $1.7 trillion over a five year period in order to bring the U.S. infrastructure into "good" shape. See "Report Card for America's Infrastructure," 2005 at http://www.asce.org/reportcard/2005/index.cfm

8– See e.g., R. Lieberman, "Context and Framework: Musings on the End of (Cheap) Fossil Fuels," Illinois Commerce Commission, presentation to Illinois Smart Grid Initiative, June 3, 2008, Chicago, IL.

9– See e.g., 220 ILCS 5/1-102 or 220 ILCS 5/16 101A.

10– The uncertainly surrounding this estimate suggests that the costs could be as low as $22 billion or as high as $135 billion annually. "Costs of Power Interruptions to Electricity Consumers in the United States," K. LaCommare and J. Eto, LBNL-58164, Lawrence Berkeley National Laboratory, Berkeley, CA, February 2006.

11– "The Value of Electricity when it is not Available," http://www.netl.doe.gov/moderngrid/docs/The_Value_of_Electricity_When_It%27s_Not_Available.pdf

12– J. Miller, note 3

13– See note 11. Unanticipated service interruption in commodity markets can have negative global effects through disrupted trading, lost profits, and reduced efficiency of markets.

14– Integration of the consumer and "smart loads" within regional transmission markets could benefit consumers who offer their resources to the market and system operators who can utilize these resources to more efficiently manage grid operations. See e.g., G. Heffner, et. al. "Loads Providing Ancillary Services: Review of International Experience," Berkeley National Lab Report #LBNL-

62701, May 2007. Widespread deployment of informational technology could add $5 to $7 billion back into the economy by 2015 and perhaps $15 to $20 billion by 2020. See "Electricity Sector Framework for the Future: Achieving a 21st Century Transformation," Electric Power Research Institute, Palo Alto, CA, August 6, 2003. Even a five percent reduction in peak demand nationally could relieve the need to build over 600 peaking generation stations saving $3 billion annually. See http://www.energetics.com/madri/pdfs/ArticleReport2441.pdf; http://dx.doi.org/10.1016/j.tej.2007.08.003

15– http://www.coolkeeraghesb.co.uk/pdfs/Coolkeeragh%20power%20plant%20brochure.pdf

16– World Alliance for Decentralized Energy: http://www.localpower.org/ben_efficiency.html

17– http://www.eia.doe.gov/cneaf/electricity/st_profiles/illinois.html

18– PJM reports the fuel mix that meets the incremental demand in each hour for the wholesale market. See http://www.pjm.com/markets/jsp/marg-fuel-type-data.jsp

19– See "Comparison of Electric Sales Statistics," Illinois Commerce Commission, Table 7, various years. The national average residential price for 2007 was 10.63 cents per kilowatt-hour (kWh) and Illinois' average price was 10.20 cents per kWh. See http://www.icc.illinois.gov/publicutility/salesstatistics.aspx?type=e and http://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html#_ftn1

20– According to the Bureau of Economic Analysis, during the first quarter of 2008, U.S. consumption made up 70.8% of overall GDP. If the cost of unreliable power is between $22 billion and $135 billion annually as reported by LaCommare and Eto (note 10) and assuming there are approximately 122.5 million electricity using households, the total costs of unreliable power per household is between roughly $180 and $1,100 annually. (Number of households from: EIA's Electric Power Annual 2006 State Date Table).

21– "Quantifying the Benefits Of Dynamic Pricing In the Mass Market," by Ahmad Faruqui and Lisa Wood, The Brattle Group, Inc. and Edison Electric Institute, January 2008. Also see A. Faruqui, "Will the Smart Grid Promote Wise Energy Choices?" The Brattle Group, presentation to Illinois Smart Grid Initiative, August 5, 2008, Chicago, IL.

22– The state of Massachusetts completed a study to determine the impact of distributed generation on wholesale electricity prices and carbon emissions. The study evaluated the impact of 1.8GW (e.g. 10% of peak demand) of solar PV, local generation, and energy efficiency, and determined that wholesale prices would be reduced by about 5%. In addition, the study found that carbon emissions could be reduced by about 8%, and that peak power prices could be reduced $20 to $65/MWh. The carbon reduction results in Illinois could more than double due to the large amount of coal fired generation.

23– See "Direct Testimony of Val Jensen," filed in ICC Docket No. 07-0540, Table 2, November 15, 2007. A measure is "a device, appliance or practice which, when installed in a home, business or manufacturing process, results in a reduction in the amount of energy used per unit of useful service." An example of a measure is a compact fluorescent light that replaces a standard incandescent light. Id. at pp.5-6.

24– S. Eckles and S. Clark, "Pulling the Plug on Energy Theft," Utility Automation & Engineering T&D, September, 2007.

Section 2: Consumer Opportunities in the Smart Grid

25– See e.g., J. Miller, U.S. DOE Modern Grid Strategy Team, "What is the Smart Grid," and note 3, presentations to Illinois Smart Grid Initiative, June 3, 2008 and July 8, 2008, Chicago, IL. Also see discussion of Title XIII in the following sections of this report.

26– www.oe.energy.gov/DocumentsandMedia/Smart_Grid_Workhsop_Report_Final_Draft_08_12_08.pdf

27– Figure 1 is from: National Energy Technology Lab Modern Grid Strategy

28– These bullets are adapted from: A Compendium of Modern Grid Technologies, NETL, Modern Grid Initiative, June 2007, v 1.0. Also see The Path to Perfect Power: New Technologies Advance Consumer Control, Galvin Electricity Initiative, January 2007.

29– "Assessment of Demand Response and Advanced Metering," Federal Energy Regulatory Commission Staff Report, Docket No. AD06-2-000, Washington DC, August 2006, p. 17.

30– For the majority of consumers electricity consumption is currently measured by a watt-hour meter that is read monthly. These meters do not have the ability to record when, during that month, a customer consumed the electricity.

31– "Grid 2030: A National Vision for Electricity's Second 100 Years," U.S. DOE, Office of Electric Transmission and Distribution, Washington, DC, July 2003.

32– See D. Shpigler, "Developing the Smart Grid: Utility Benefits and Costs," The Shpigler Group, presentation to the Illinois Smart Grid Initiative, August 5, 2008, Chicago, IL.

33– Figure 2 is from: D. Shpigler note 32.

34– Figure 3 is from: M. Tihami, "Setting the Stage," IBM, presentation to the Illinois Smart Grid Initiative, August 5, 2008, Chicago, IL. See also "Demand Response and Smart Metering Policy Actions Since the Energy Policy Act of 2005: A Summary for State Officials," U.S. Demand Response Coordinating Committee, Fall 2008

Section 3: Potential Benefits of a Smart Grid for Illinois Consumers

35– The following bullets are adapted from: "Modern Grid Benefits," NETL, August 2007. http://www.netl.doe.gov/moderngrid/docs/Modern%20Grid%20Benefits_Final_v1_0.pdf

36– There are other environmental aspects of the smart grid. For example, the Smart Grid could provide better incentives for using electric vehicles that in turn can be used to bolster the electric grid when not in use and avoid emissions from internal combustion engines.

37– There is evidence that consumers will modify their behavior in response to prices. For example, the GridWise Olympic Peninsula Project, managed by the Pacific Northwest National Laboratory, showed that consumers reduced consumption in peak periods by 15-17 percent and lowered overall bills by 10-20 percent with those customers on real-time pricing saving the most. See e.g., L. Kiesling, "Consumer-oriented Smart Grid Benefits," Northwestern University, presented to the Illinois Smart Grid Initiative, July 8, 2008, Chicago, IL.

38– Electricity prices have both seasonal and daily variations and can vary dramatically from the lowest prices to the highest prices. Prices can range from less than $0.02 per kWh over night to a maximum of $1 per kWh on a peak day (although in Illinois peak prices have rarely, if at all, hit the allowed maximum price).

39– In addition, customers will also be able to choose how much price risk they wish to take. Customers on flat-rated plans pay a premium for that flat-rate. Many customers may be willing to take on more risk if it helps avoid such premiums and lowers their overall bill. These choices will reshape customer loads and reduce the need to buy power from costly peak generating units. Evidence from retail pricing projects in Illinois and elsewhere show that dynamic pricing can reduce peak demand by 5 to 20 percent, which reduces the overall price for everyone on the system.

40– "Benefits of Demand Response in Electricity Markets and Recommendations for Achieving Them; A Report to the United States Congress Pursuant to Section 1252 of the Energy Policy Act of 2005." Appendix B, U.S. Department of Energy, February 2006.

41– "The Green Grid: How the Smart Grid will Save Energy and Reduce Carbon Emissions," Electric Power Research Institute, Palo Alto, CA, August 30, 2007 (Draft).

42– Southern California Edison indentified these operational savings in its AMI filing to the California Public Utilities Commission. See "Edison SmartConnect Deployment Funding and Cost Recovery," Exhibit 3, filed in U-338-E, July 31, 2007.

43– From: E. Gunther, "Smart Grid Development, Collaboration, and Coordination," EnerNex, presentation to Illinois Smart Grid Initiative, October 14, 2008, Chicago, IL.

44– This is simplifying the decision somewhat. There may be cases where engineering standards require the higher capital outlay.

45– For example, Southern California Edison (SCE) claims that its SmartConnect program, which is an AMI program, was able to reduce utility operation costs by $1,235M, but cost $1.967M. Although SCE claimed that it calculated $841M in non-utility benefits. See Application in A.07-07-026, filed with the California Public Utilities Commission, July 31, 2007.

46– See e.g., A. Faruqui, "Will the Smart Grid Promote Wise Energy Choices?," The Brattle Group, presentation to the Illinois Smart Grid Initiative, August 8, 2008, Chicago, IL.

47– Figure 5 is from A. Farqui note 46.

48– Figure 6 is from: R. Hemphill, "Social Benefits Attributable to Smart Metering Investments – A Methodology," Black and Veatch, presented to the Illinois Smart Grid Initiative, August 5, 2008, Chicago, IL.

49– See e.g., R. Hemphill, note 48.

50– "Power Delivery System of the Future: A Preliminary Estimate of Costs and Benefits," EPRI, 1011001, July 2004.

51– See e.g. EPRI note 50.

52– This chart represents information presented at the ISGI workshops in 2008. There is no regularly updated clearinghouse of state by state activities, but resources such as www.smartgridnews.com can be useful for tracking the latest AMI/Smart Grid news.

Section 4: Smart Grid Policy Issues for Illinois

53– "Competition in Illinois Retail Electric Markets in 2005," Illinois Commerce Commission, May 2006, Springfield, IL.

54– See Illinois Commerce Commission, note 53, p. 10.

55– There are some exceptions to this rule as discussed in Sidebar 3.

56– The rates in place at the time of the 1997 Act were largely set prior to the passing of the 1997 Act. For example, ComEd rates had been set in a 1994 rate case and Illinois Power's rates were set in a 1992 rate case. Therefore, at least for base rates, most of the consumers in the state had rates frozen for more than a decade.

57– There are several other smaller investor-owned utilities that serve portions of the state of Illinois as well as many municipal utilities and cooperatives, In general these smaller electric suppliers are either exempted from the main requirements under the 1997 Act and the IPAA or are not regulated by the ICC.

58– 220 ILCS 3855/1-5.

59– See www.ilsmartgrid.org.

60– Energy Independence and Security Act (EISA) of 2007.

61– See ICC Docket Nos. 07-0585 (Cons.) (Ameren Illinois Utilities) and ICC Docket No. 07-0566 (ComEd). Collectively these orders are referred to as the "Illinois Smart Grid Orders." Separately the orders are referred to as the "AIU Smart Grid Order" and the "ComEd Smart Grid Order," respectively.

62– See: http://my.barackobama.com/page/content/newenergy and http://www.johnmccain.com/Informing/Issues/17671aa4-2fe8-4008-859f-0ef1468e96f4.htm

63– See http://my.barackobama.com/page/content/newenergy

64– E. Gunter, note 43.

65– J. Miller, note 12.

66– D. Shpigler, note 32.

67– See Report to Congress on NIST Activities in Support of the Energy Independence and Security Act of 2007, (forthcoming), National Institute of Standards and Technology, Gaithersburg, MD.

68– See "Metrics for Measuring Progress Toward Implementation of the Smart Grid," Results of the Breakout Session Discussions at the Smart Grid Implementation Workshop, Office of Electricity Delivery and Energy Reliability, U.S. DOE, June 19-20, 2008, Washington, DC.

69– The report is required by Section 1302 of the Energy Independence and Security Act of 2007, and is due December 27, 2008.

70– See DOE report, note 69, for a detailed discussion of these metrics.

71– See ComEd Smart Grid Order at 140-143.

72– This assumes that the capital project is necessary and both projects will achieve the same objectives for operations and other non-financial criteria.

73– See B. Hendricks note 5; D. Shpigler note 32; A. Faruqui, note 46; and R. Hemphill note 49.

74– See e.g., R. Hemphill note 50.

75– See Summary of ISGI October 2008 Breakout Sessions. http://www.cnt.org/news/media/breakout-group-discussion-guides.pdf.

76– For example, in Illinois the total resource cost test is used to evaluate energy efficiency investments. While this test does not include all societal benefits from energy efficiency investments, it does include external benefits associated with the consumption, or avoidance of consumption, of electricity. See ICC Docket No. 07-0540, Order at 3-4.
77– See e.g., Table 1; also see. U.S. Demand Response Coordinating Committee, note 34.
78– Master metering does have some potential downsides in terms of abuse of market power by the owner of a building. In addition, master meters may also send the wrong price signals if building owners do not use master meters as part of a demand response program. These, as well as other, issues would need to be addressed.
79– See A. Faruqui, note 46
80– "Electricity Sector Framework for the Future: Achieving a 21st Century Transformation," Electric Power Research Institute, Palo Alto, CA, August 6, 2003.
81– http://www.energetics.com/madri/pdfs/ArticleReport2441.pdf; http://dx.doi.org/10.1016/j.tej.2007.08.003
82– For example, the California Public Utilities Commission recently found that real-time pricing is the best way to promote economic efficiency and equity for consumers. http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/85984.htm
83– Supra note 99.
84– 220 ILCS 5/1-102
85– Id.
86– 220 ILCS 5/16-101A
87– See Illinois Smart Grid Orders.
88– See e.g., Article VIII and IX of the PUA. While there may be challenges to the ICC's authority to address particular items (e.g., a cost recovery rider) the basic premise that the ICC has authority over the services and rates of electric utilities in Illinois has not been challenged.
89– 83 Illinois Administrative Code Part 411 Electric Reliability.
90– The ICC must make eight findings under Section 9-244. These findings address, in part, the ability of the program to lower rates, create other benefits, maintain reliability, and equitably share benefits with customers.
91– See ICC Order in Peoples and North Shore Rate Case (Docket Nos. 07-0241/0242 (Cons.)) This issue was also addressed in the ComEd Smart Grid Order.
92– A 10 mW generation unit is considered a "small generator." To put this in context, a central station nuclear plant may be more than 1000 mW, whereas a small solar unit placed on an individual home might be in the range of 0.002 mW.
93– See e.g., Part 410.130 (c) and ComEd's Rider RESALE.
94– Mass market customers tend to have very high "acquisition costs" relative to the value provided by retail competitors. A reduction in these costs by allowing a municipality to bear the costs could help induce competitors to enter these markets and potentially invest in local areas.
95– See e.g., "Municipal Aggregation in Illinois: An Estimate of the Potential Costs and Savings from municipal Aggregation for Selected Illinois Communities," Illinois Commerce Commission Report to the Illinois General Assembly, March 18, 2003.
96– Id. p.v.
97– Id.
98– Illinois Power Agency Act of 2007.
99– Public Act 94-977
100–See Illinois Smart Grid Orders.
101–These tasks are summarized from the ComEd Smart Grid Order in: G. Busch and C. Peterson, "Plenary Discussion of the ICC's Smart Grid Orders," presentation to Illinois Smart Grid Initiative, October 14, 2008, Chicago, IL
102–See ComEd Smart Grid Order, p. 141. as categorized in: G. Busch and C. Peterson note 102. The number in parentheses corresponds to the number of the issue in the ComEd Smart Grid Order.
103–See ComEd Smart Grid Order. Ameren may file after the ISSGC has completed its work. See AIU Smart Grid Order.

APPENDICES

A. List of Attendees

B. List of Presentations from ISGI Meetings

C. Comments of Other Organizations

- Galvin Electricity Initiative
- AARP
- International Brotherhood of Electrical Workers

APPENDIX A: List of Attendees

The following people attended one or more of the Illinois Smart Grid Initiative meeting held in 2008. Attendance does not necessarily imply any endorsement by the individual, or their organization, of the findings of this Report.

Kate Agasie, Metropolitan Mayors Caucus
Tom Barwin, Village of Oak Park
Annette Beitel, Future Energy Enterprises
Dan Belmont, West Monroe Partners
Dave Bieneman, Illinois Department of Employment Security
David Blodgett, Telvent Miner & Miner
Steve Bossert, US DOE NETL
Greg Busch, Illinois Smart Grid Initiative
Charles Box, Illinois Commerce Commission
Mike Brandt, ComEd
Nancy Brockway, NRRI
Mike Burns, Itron
Larry Bury, Northwest Municipal Conference
Claudia Calderon, Midwest Generation
Chris Childress, Progressive Energy Group
Sally Clair, Exelon
Torsten Clausen, Illinois Commerce Commission
Martin Cohen, Martin Roth Cohen & Associates
Dave Cook, Village of Hinsdale
Ellen Craig, Former Chair, Illinois Commerce Commission
James Crane, ComEd
Janice Dale, Office of the Attorney General, State of Illinois
Leslie Darling, Ungaretti & Harris LLP
Pat Devaney, Associated Fire Fighters of Illinois
Rebecca Devens, CUB
Dave Doherty, ComEd
Ron Donovan, ComEd
Richard Doying, Midwest Independent Transmission System Operator, Inc.
Justin Dyer, Grubb & Ellis Management Services
Jim Eber, ComEd
Patrick Evans, Illinois Energy Association
Anne Evens, CNT Energy
Ahmad Faruqi, Brattle Group
Cynthia Fonner, Constellation Energy
Lula Ford, Illinois Commerce Commission
Steve Frenkel, State of Illinois
Robert Galvin, Galvin Electricity Initiative
Robert Garcia, ComEd
John Gomell, Direct Energy Services
Brian Granahan, Environment Illinois
Michael Guerra, ComEd
Erich Gunther, Enernex
Mark Handy, KENJIVA Energy Systems
Bryan Harbin, Office of Former Speaker Hastert
Louis Harris, Illinois Commerce Commission
Steven Hauser, GridPoint
Susan Hedman, Office of the Attorney General, State of Illinois
Ross Hemphill, Black & Veatch Corporation
Henry Henderson, National Resources Defense Council
Bracken Hendricks, Center For American Progress
Hans Herrmann, Cost Containment International
Sharon Hillman, Wadsworth Energy LLC
Todd Hillman, Midwest ISO
Bruce Hollibaugh, Ameren Illinois Utilities
Norine Huges, Office of Alderman Rugai, Chicago City Council
Val Jensen, ComEd
Ron Jolly, City of Chicago
Michael Jung, Silver Springs Network
Rajan Kaul, Itron
Dave Kearns, S&C Electric Company
Patrick Keleher, Jo-Carrroll Energy
John Kelly, Endurant Energy
Lynne Kiesling, Northwestern University
Leslie Koczur, ComEd
David Kolata, Citizens Utility Board
Dan Kowalewski, ComEd
Laura Kratz, League of Women Voters
Fritz Kreiss, Alternative Utility Services, Inc
Robert Lieberman, Illinois Commerce Commission
Karen Lusson, Office of the Attorney General, State of Illinois
Fidel Marquez, ComEd
Barry Matchett, ELPC
Richard Mathias, PJM
Bryan McDaniel, Citizens Utility Board
Anne McKibbin, Midwest Energy Efficiency Alliance
Michael Meiners, Galvin Initiative
Michael Mertes, Village of Hinsdale
Robert Mille, Energy Resources Center
Joe Miller, Horizon Energy Group
James R. Monk, Illinois Energy Association
Stephen Moore, Rowland & Moore LLP
Sarah Moskowitz, Citizens Utility Board
Elias Mossos, Office of the Attorney General, State of Illinois
Kristin Munsch, Office of the Attorney General, State of Illinois
Michel A. Munson, BOMA – Chicago
Scott Musser, AARP - Illinois Legislative Office
Bernie Neenan, EPRI
Craig Nelson, Ameren
Erin O'Connell-Diaz, Illinois Commerce Commission

Phil O'Connor, Constellation New Energy
David O'Donnell, Department of Environment, City of Chicago
Tim Olson, Village of Lincolnwood
Antonia Ornelas, Department of Environment, City of Chicago
Rich O'Toole, ComEd
Katie Papadimitriu, Comverge
Ron Pate, Ameren Illinois Utilities
Carl Peterson, NERA Economic Consulting
Dan Pfeiffer, Itron
David Pope, Village of Oak Park
Anne Pramaggiore, ComEd
Mark Pruitt, Illinois Power Authority
Steven Pullins, Horizon Energy Group
Kathy Quasey, EMI
Chris Ragona, Village of Hinsdale
Wanda Reder, S&C Electric
Bruce Renz, US DOE Modern Grid Strategy Team
Ginger Rugai, Chair, City Council Energy and Environment Committee
Jim Runnion, Transwestern
Susan Satter, Office of the Attorney General, State of Illinois
Eric Schlaf, Illinois Commerce Commission
Denny Senko, Illinois Science and Tech Coalition
Mohammad Shahideapour, IIT
David Shpigler, The Shpigler Group
Tom Smith, Endurant Energy
Becky Stanfield, National Resources Defense Council
Anthony Star, CNT Energy
Al Stevens, S&C Electric Company
Dylan Sullivan, NRDC
Ron Tabaczynski, BOMA – Chicago
Kathy Tholin, Center for Neighborhood Technology
Chris Thomas, Citizens Utility Board
Michelle Tihami, IBM Corp - Global Energy Utility Industries
Deanna Troust, Vangaurd Communications
Gerald Turry, Village of Lincolnwood
Mark Vantrease, Ameren
Jackie Voiles, Ameren
Kenneth Wabel, Ameren
Tim Wolf, Plexus Research
Tom Wolf, Illinois Chamber of Commerce

APPENDIX B: List of Presentations from ISGI Meetings

The Illinois Smart Grid Initiative held a series of four meeting in 2008. The presentations made at those meetings are all available at:
http://www.ilsmartgrid.org/energy/isgi/resources

June 3, 2008: Organizational Meeting

- Statement of support from FERC Commissioner Suedeen Kelly
- Benefits and Issues Summary
- *What is a Smart Grid?*, Joseph Miller Modern Grid Strategy Team, U.S. Department of Energy
- *The End of "Cheap" Fossil Fuels*, Robert Lieberman, Illinois Commerce Commission
- IBM Report: *Plugging in the Consumer*

July 8, 2008: Introduction to the Smart Grid

- *Understanding the Smart Grid: Features, Benefits, and Costs*, Joe Miller, Modern Grid Strategy Team, U.S. Department of Energy
  - Handout: *What will the Smart Grid Look Like?*
- *Consumer Uses of the Smart Grid*, Lynne Kiesling, Senior Lecturer, Department of Economics & Kellogg School of Management, Northwestern University
  - Results of Small Group Break Out Sessions
- *Greening the Grid: A Smart Solution*, Bracken Hendricks, Senior Fellow, Center for American Progress

August 5, 2008: Dimensions of a Smart Grid Policy Plan

- *Setting the Stage*, Michele Tihami, IBM
- *Developing the Smart Grid: Utility Benefits and Costs*, David Shpigler, The Shpigler Group
- *A Consumer Perspective on Smart Grid Issues*, Nancy Brockway, NRRI
- *IIT-Galvin "Perfect Power" MicroGrid*, Michael Meiners, Galvin Initiative
- *Will the Smart Grid Promote Wise Energy Choices?*, Ahmad Faruqui, The Brattle Group
- *Social Benefits Attributable to Smart Metering Investments - A Methodology*, Ross Hemphill, Black & Veatch

October 14, 2008: Charting a Course to a 21st Century Electric System

- *Smart Grid Collaboration*, Erich Gunther, EnerNex
- Breakout Group Discussion Guides
- *Plenary Discussion of the ICC's Smart Grid Orders*, Greg Busch, ISGI

Galvin Electricity Initiative

GALVIN ELECTRICITY INITIATIVE
Sponsored by The Galvin Project, Inc.

Guiding Principles for a Consumer Driven Electricity System in Illinois

Introduction

The nonprofit, public interest Galvin Electricity Initiative advocates the consumer value-driven reinvention of how electricity is generated, delivered and used. The Initiative is motivated by the conviction that the economic vitality of Illinois and the nation is threatened by an obsolete and vulnerable electricity system, a system that has been starved of innovation and renewal for decades. What is lacking is not technology but a regulatory framework that encourages power system innovation for maximum consumer service value and quality. The Initiative, over the past nine months, has worked with an Illinois Team of Leaders to identify current policy gaps and disincentives. The result is the following set of consumer-focused Principles and Policy Objectives to address these constraints and to hold the state electricity regulatory process accountable to maximize the system's benefits to consumers.

Purpose

The profoundly imperfect quality of electricity service today literally robs thousands of dollars a year from each American household, wastes immense quantities of energy in the process, and is the largest contributor to man-made carbon emissions. These unnecessary costs are largely buried in the prices of all purchased goods and services, in lost jobs and competitiveness where they go unrecognized by most consumers and voters, and environmental impacts.

Today's policy structure severely limits improvement, innovation, consumer participation, customer choice, and private investment thereby increasing modernization costs and limiting consumer value. A new policy structure is called for that fosters innovation and leverages local capital and resources and will allow consumers to work in concert with utilities to transform today's grid in a cost effective manner. In fact, a new policy structure could guide grid modernization in a way that would produce consumer savings that exceed costs by four to five times.

A Team of Leaders in Illinois helped shape Principles and Policy Objectives designed to guide policy, rate, and rule changes to create a consumer-value driven electricity system. The resulting system will be much more reliable, cost effective, and greener. It will enable Illinois to compete in today's digital economy by attracting the best jobs and businesses to the state.

Why Change the Rules?

The ability of Illinois to compete for jobs and industry depends upon transforming today's electricity distribution grids. Electricity is the lifeblood of the Illinois economy. However, the electric power system in Illinois, like in many other States around the country, is facing a "perfect storm" of economic, energy, environmental and productivity threats that jeopardizes local economies:

- Many communities in Illinois suffer from power outages at a frequency that well exceeds the national average. One town reported an astonishing 150 outages in 2008. Consumers foot the bill, paying from $6 to 11 billion annually for power outages and disturbances in the state.
- Unreliable electricity jeopardizes the state's ability to attract new business and manufacturers – and to keep those that currently call Illinois home. The outdated Illinois electricity system inhibits the states ability to compete in the global marketplace as well.
- The average annual electricity bill for Illinois residential customers has been increasing over the past few years, and will continue to do so as the antiquated power infrastructure continues to fail.
- During periods of high electricity demand, Illinois relies heavily on coal-fired power plants, which are significant emitters of CO_2. Unfortunately, the Illinois grid does not offer consumers the tools such as smart meters and price signals that provide the ability and economic incentives to invest in demand reduction technologies.

GALVIN ELECTRICITY INITIATIVE

Sponsored by The Galvin Project, Inc.

Guiding Principles for a Consumer Driven Electricity System in Illinois

Why Now?

Now is critical time to implement wise policy structures for the electricity market. The Illinois Commerce Commission is embarking on a two year Smart Grid initiative to develop the technology platform and rules for spending billions of rate payer monies to modernize the Illinois electricity system. In addition, the Federal Government announced plans to provide funding for Smart Grids. The mayor's conferences and other key consumer groups are best suited to represent consumers in these proceedings. If new policies are not implemented, Smart Grid costs will far exceed the consumer benefits.

Principles

The following Principles should guide the making or revisions to the rules, rates, and policies that govern the Illinois electricity system:

1. Citizens must have the right and access to retail electricity services, dynamic prices, meter interval data, and alternative generation sources in free, competitive markets with user-friendly means and incentives to use this authority to their best advantage.
2. Citizens, businesses and communities must have the right to aggregate consumer electricity demand and to implement free-market distributed generation microgrids that best meet their individual service needs.
3. Citizens, businesses and communities must have the right to a standard and consistent level of electricity reliability and quality, one that meets the needs of today's digital economy while recognizing that electricity is now key to life safety and security.
4. Communities must have the right to participate in improving the grid through coordinated planning with utilities and long term public sector financing.
5. Electricity distribution utility revenues must be based on the reliability, quality, and efficiency of their bulk power distribution service performance. Utilities must be held accountable for how all rate payer funds are spent to provide this service.

Policy Objectives for Illinois

Illinois has taken the first steps toward a consumer driven electricity policy structure reflecting these Principles. This includes the implementation of retail access rules, legislation providing for community aggregation, revised distributed generation interconnects rules, and the Illinois Commerce Commission pilot of real time rates. Each of these policy changes empower consumers to take action to lower their costs and improve service. However, several remaining barriers were identified during a series of Illinois Smart Grid Initiative workshops and meetings between the Galvin Initiative and key consumer representatives.

These discussions identified the following initial set of Policy Objectives, based on the above Principles, designed to remove the remaining barriers to a more consumer guided and response electricity system. Specifically, Illinois policies, rates, and rules should:

- Provide consumers with dynamic pricing options and hourly energy usage data.
- Expand market based energy efficiency programs and initiatives to provide consumers with greater choice and access to innovative market based services. This includes providing consumers with long-term financing mechanisms.
- Provide communities with increased flexibility and options for municipal financing of electricity system improvements, including improved tax provisions.

GALVIN ELECTRICITY INITIATIVE

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Guiding Principles for a Consumer Driven Electricity System in Illinois

- Provide consumers with a standard level of reliability and quality that addresses the current importance of the grid to life safety, economic development, and security.
- Provide consumers with expanded capabilities to aggregate customer electric loads (e.g. at the building or community level) to procure electricity, master meter buildings, or create virtual energy districts. This will provide consumers with the tools to gain market power and improve load profiles, thereby securing lower cost electricity supply contracts while investing savings into advanced metering, energy efficiency, and or renewable generation.
- Provide consumers with the ability to build, own, and operate microgrids for redevelopment, new development, and special economic development zones; thereby attracting private investment into advanced energy systems
- Provide communities with information regarding the planned spending and accounting of expenditures for electricity system operations, maintenance, repairs, and improvements. This can be utilized to justify the return on investment for grid improvements that eliminate repetitive failures.

APPENDIX C: Comments from other Organizations

AARP

AARP

February 10, 2009

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To Whom It May Concern:

AARP submits the following comments on the Draft Report of the Illinois Smart Grid Initiative. AARP is a nonprofit, nonpartisan membership organization that helps people 50+ have independence, choice and control in ways that are beneficial and affordable to them and society as a whole. AARP has 1.8 million members in the State of Illinois, all of whom would be impacted by utility investment in "smart grid" technology and advanced meters. AARP has participated in the Illinois Smart Grid Initiative.

AARP recommends that the Illinois Smart Grid Initiative focus on the development of factual information and identify the costs and benefits associated with a variety of technologies to modernize and improve the distribution and transmission system, including:

- The costs and benefits to 1) lower income customers, 2) customers at different usage levels and 3) residential customers, in general;
- The bill impact resulting from payment for the new meters and communication systems, as well as the costs of implementing new rate options through the utility's current billing system;
- The impact on customer service, privacy, and consumer protection policies and programs that presently exist; and
- The implicit costs of alternate metering for consumers who will have to spend time and effort monitoring prices to participate in kilowatt-hour usage tracking programs.
- Further, the Report should recommend that:
    - The commission does not approve smart grid or AMI without an evidentiary proceeding;
    - Policies are developed that ensure specific customer groups including seniors, low-use customers, low-income consumers and consumers with health problems, do not suffer adverse consequences in the event that AMI results in substantially higher electric bills for these customer groups;
    - Dynamic pricing programs should not be mandatory and should not result in cost shifting on to other customers;
    - Any time-of-use metering and billing program is accompanied by a consumer education program that, at a minimum, informs customers of both the costs and

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benefits associated with the selection of the program, how to determine the impact of the program on the customer's annual electricity usage, and the costs of the customer's annual electricity usage;

- Pilot programs for residential customers includes and identifies low income customers and measures the program's impact on those customers who do not or cannot take actions to avoid the higher peak time prices;

- The AMI system is as transparent as possible so that it is clear how the system will work;
- It is clear how much the system will cost to implement and who will pay these costs; and;
- Utility companies provide data on the impact of any implemented AMI system to regulators so that regulators can gauge both the financial impact on consumers and how well the system is working to reduce peak demand.

Sincerely,

Scott T. Musser

AARP Illinois
Associate State Director

International Brotherhood of Electrical Workers

IBEW

INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

Local 15 | Local 19 | Local 51 | Local 309 | Local 649 | Local 702 | Local 1306

December 17, 2008

Honorable Richard M. Daley
Honorable J. Dennis Hastert
Honorary Co-Chairs
Illinois Smart Grid Initiative
2125 West North Avenue
Chicago, Illinois 60647

Gentlemen:

Illinois International Brotherhood of Electrical Workers Locals 15, 19, 51, 309, 649, 702 and 1306 commend the organizers of the Illinois Smart Grid Initiative on their efforts to advance consumers' voices in the planning and implementation of change in Illinois' electric power systems and to make available resources to assist in the formulation of public policy pertaining to these new technologies. These are undoubtedly worthwhile undertakings. In addition to considering the interests of both suppliers and consumers in the future of Illinois' power infrastructure, the IBEW Locals believe that such public policy explorations must also take into account the concerns of the people of the State of Illinois as they relate to the very specific areas of job retention and job creation.[1] Although the IBEW Locals have a particular focus on the preservation and creation of jobs for their members, good jobs like those in the utility industry have the potential to benefit more broadly the Illinois job market and the overall economy of the state.

IBEW Locals 15, 19, 51, 309, 649, 702 and 1306 represent over 12,000 employees who work day in and day out to help the utilities of this state provide service to their customers. These men and women understand the importance of a power infrastructure that provides reliable and affordable energy to the state's families and businesses. They are proud to be a part of this crucial industry. They are optimistic that the modernization of the power grid explored by the ISGI and currently being discussed pursuant to Illinois Commerce Commission orders will bring benefits to the state's utility consumers. But these employees are also concerned that as the costs and benefits of modernization to utilities and consumers are weighed, significant workforce-related costs and benefits may be overlooked.

Jobs like those in Illinois' utility industry form the backbone of the state's economy. Current record job losses, accompanied by precipitous drops in consumer spending and soaring

[1] The Illinois IBEW Locals did not participate in the meetings of the ISGI because the Locals were not informed of the initiative until after the last of the meetings had taken place.

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December 17, 2008

foreclosure rates, vividly demonstrate the inextricable relationship between the economic well-being of American workers and the health of the American economy. To the extent Illinois moves forward with modernization of its power grid, the work that must be done implementing and maintaining such technologies represents significant potential for the workforce and the economy of this state. That potential will not be realized, however, if the work is outsourced to low-wage workers elsewhere who have no stake in this state's economy. Nor will it be realized if the modernization of the power grid comes at the expense of the jobs of the existing utility employees.

The Illinois IBEW Utility Locals urge you and all the participants in the ISGI to insist that future public policy discussions pertaining to the planning and implementation of change in Illinois' power systems acknowledge and, in part, focus upon the preservation and creation of good jobs for Illinois citizens—jobs that are essential to the recovery and renewed vigor of the Illinois economy.

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