

ELECTRICITY SECTOR FRAMEWORK FOR THE FUTURE

SUMMARY



August 6, 2003

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This document is the first in a set of three reports covering the Electricity Sector Framework for the Future (ESFF). This Summary report highlights the key findings and recommendations of the ESFF. Volume I describes these results in greater detail and evaluates them against key stakeholder criteria. Volume II is a reference document that includes eight in-depth “expert discussion papers” based on interviews and workshops involving key stakeholders.



One year ago, the EPRI Board of Directors encouraged EPRI to examine the serious challenges facing the electric power sector. This report reflects the comprehensive results of the examination. The goal is to define the characteristics of a more vital, robust sector and to help develop an actionable leadership framework for achieving this future. The importance of this effort is underscored by the fact that electricity is our most critical energy supply system, and has become the nation’s indispensable engine of progress and prosperity. This profound value was recently underscored by the U.S. National Academy of Engineering when it declared that “the vast networks of electrification are the greatest engineering achievement of the 20th century.” This achievement has been the product of a robust public/private partnership maintained over the better part of a century.

Stakeholder Vision

EPRI has engaged a broad cross-section of stakeholders representing business, labor, government, and consumer and environmental organizations, in addition to those in the electricity sector, to inform the Framework summarized in this document. Subsequently, EPRI has supported a series of Board member–sponsored regional workshops to test and refine the Framework. A remarkably congruent vision of a transformed electricity sector, and the issues limiting that vision, has emerged through this interactive process. The EPRI Board’s leadership in initiating this process of stakeholder engagement is also broadly applauded as an essential mechanism for building mutual understanding and trust, and for gaining support for the Framework’s vision and needed actions.

In broad strokes, the vision is one of a highly reliable, affordable, environmentally friendly power system that provides essential public services and supports the economic aspirations of all classes of customers. It embraces regional and ownership diversity and supports an economic framework of efficient, transparent electricity markets. Within this transformed system, the electricity sector is encouraged and able to invest in new functional capabilities to ensure its operational effectiveness and support the evolving needs of the U.S. economy and society. The key issues limiting the achievement of this transformation, as expressed by the stakeholders, are the depressed financial health of the sector and the continuing jurisdictional confusion in regulation.

The Past as Prologue

The historic development of the electric power sector during the 20th Century was dominated by the quest for ever-lower commodity costs. This is typical of basic commodity industries, but electricity is a “manufactured” commodity uniquely dependent on an exceptionally complex and expensive technical infrastructure for its “just-in-time” production and delivery. During the first 70 years of the 20th Century, this quest for lower costs was consistently successful as rapid demand growth, coupled with economy-of-scale advances in both production and delivery technology, led to electricity cost reductions that averaged some 20% per decade. During this period, the electric utility industry became a franchised, vertically integrated, monopoly enterprise, regulated to assure the essential balance between owner and consumer value. The obligation-to-serve embedded in this regulatory compact achieved a level of investment and a consequent standard of performance that made electricity a highly dependable, low-cost “entitlement” (from the perspective of consumers and their government representatives) that was largely taken for granted.

By 1970, the extended period of declining cost that the electricity sector had enjoyed came to an end. Diminishing economy-of-scale returns coupled with slowing demand growth, higher fuel costs, and rising environmental requirements, all converged to challenge the traditional declining cost-commodity business model and structure of the electric utility industry. The past 30 years has seen many well-intended efforts—culminating in competitive restructuring—all focused on restoring the sector’s declining commodity-cost tradition. All have failed to meet this challenge, and there are no “silver bullets” on the horizon that are likely to change this reality within the context of today’s aging infrastructure for electricity.

At the same time, electricity has become increasingly politicized as an essential retail entitlement where market price volatility is effectively allowed to operate in only one direction—downward, often at the expense of longer-term value. This combination of rising supply cost and artificially constrained price creates a cost vise on electricity that is steadily tightening to squeeze out more and more value from both the sector and the nation. As a result, there is growing concern that the electricity sector’s aging infrastructure, workforce and institutions are losing touch with the needs and opportunities of the 21st Century. Unless these sector assets are urgently “reinvented,” they risk being left behind as industrial relics of the 20th Century. For some, this pressure is immediately urgent, for others less so, but the longer the sector remains focused only on the commodity value of electricity, the greater the threat is likely to become.

This threat results primarily from the dominant financial imperative to contain immediate costs at the expense of infrastructure development and investment. While the “obligation to serve” remains, the incentives to build the means to serve have steadily declined. For example, the capital expenditures of the electricity sector, both regulated and deregulated, as a fraction of its electricity revenues over the decade of the 1990s, was about 12%, less than one-half of historic minimum levels, and in fact, a level approached only briefly during the depths of the Depression, when private investment was generally at its historic low. Even after accounting for intervening changes in demand and technology, this is still an inadequate level of investment in terms of maintaining the level of reliability and service that society expects. The investment gap—inadvertently reinforced by the regulatory uncertainty of electricity restructuring—is exacting a significant reliability cost that is seen as just the tip of the iceberg in terms of the electricity infrastructure’s growing vulnerability to capacity, reliability, security and service challenges.

This tendency to mortgage the future will, unless urgently corrected, inevitably impose a heavy price on the nation's productivity and economy, and on the welfare of its citizens.

Current Problem

Electricity service is, by its nature, an extraordinarily capital- and technology-intensive, politically constrained enterprise, and coherent leadership is needed to break today's conflict logjam. Since the open access order in 1992, the institutional structure for the electricity sector has been dismantled, but it has not been replaced by an alternative structure with coherent institutions and rules. As a result, elements of the diverse electricity sector are already in crisis, and the impacts have been spreading. The investor-owned utilities, in particular, are laboring under an inconsistent and conflicting set of regulations. The public power sector, while relatively stable, is now also being impacted by the ripple effects of restructuring. Market reforms—worthy, limited experiments that have shown mixed success—have resulted in rules that differ from state to state, and in many cases, from utility to utility within a state. At the federal level, open access has been mandated but without clear direction on how it is to be implemented. Fluid environmental policies and proposals have simply added to the uncertainty in the electricity sector, even though many of the proposals are intended to reduce uncertainty.

Any of these problems alone might have been manageable. But the simultaneous convergence of several independent issues has caused serious turmoil in the business aspects of the electricity sector. Wholesale markets are increasingly thwarted by the inability of an aging U.S. power delivery system to support transactions. Further expansion of retail deregulation has essentially come to a full stop. Credit markets have shut out nearly all of the high-risk “merchant energy” companies, whose business in recent years has turned from boom to bust. Other industry members have seen their credit ratings drop, and financing costs for the industry have risen dramatically. The impact of these difficulties is an inability to plan, an unwillingness to invest, and a stalemate in strategy for achieving a way out of the current dilemma.

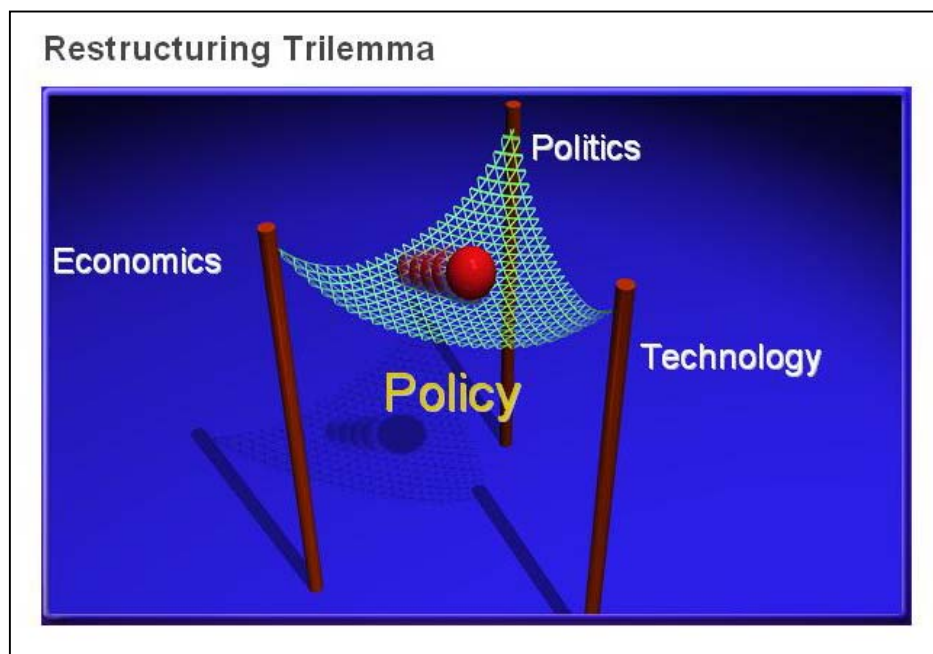
The result is growing stakeholder concern that the health and welfare of the electricity sector, as currently constituted, are out of step with that of the nation at large. When the current pause in economic growth ends, will the sector be able to keep pace with the nation's energy quantity and quality needs, and also satisfy investor expectations without resorting to high-risk financial schemes? In spite of these issues, there remains a major disconnect between reality and the general public's perception, which ranges from completely unaware to indifferent, as long as the lights stay on. When they do not, the public reaction is immediate and severe.

One key stakeholder summed up the current situation in the following way:

The stated objective of competitive restructuring—more efficiency for consumers—is being missed as a result of political distractions. Certainly there has been a loss of incentive to serve customers at the lowest cost or to invest in the power system. This reflects the fact that energy supply is a very complex enterprise, inevitably susceptible to becoming a political tool. In the old public service model, it was always better to be 100 megawatts oversupplied rather than one kilowatt undersupplied. Today, the reverse is true, and the incentive for system improvement has been lost.

Based on this pattern of experience, the successful liberalization of electricity supply markets depends first on the condition that the public, through its government representatives, be accountable for providing the incentives needed to maintain a robust, reliable and efficient electricity infrastructure—one designed to keep pace with the needs of all consumers and the society they represent.

In effect, a “trilemma” of economics, politics and technology circumscribes the development of the electricity sector. All three must be synchronized to meet stakeholder need and expectations. In large measure, the disappointing results from restructuring policies can be traced to their failure to effectively address and resolve the trilemma challenge. Not only is the U.S. electricity supply network the largest, most complex machine ever created, but it also engages the most complex enterprise. Some 5,000 corporate entities, with multiple forms of ownership and levels of regulatory oversight, serving 130 million customers, must function at all times with absolutely balanced supply and demand, while simultaneously trying to satisfy often conflicting economic, social, political and environmental objectives. In this reality, restructuring is the equivalent of “rocket science.”



Pathway Forward

No one can solve the trilemma alone, and no universal solution exists. It appears that the only effective way forward is for all stakeholders to find the means to move on a broad front at the same time as a matter of both overriding mutual self-interest and the imperative of national security and prosperity. The solution depends on reestablishing a sustainable balance among the three dimensions of the trilemma such that the costs and benefits are seen as equitably shared by the stakeholder community, both public and private. Another criterion is whether the health of the electricity sector is effectively realigned with that of the nation at large.

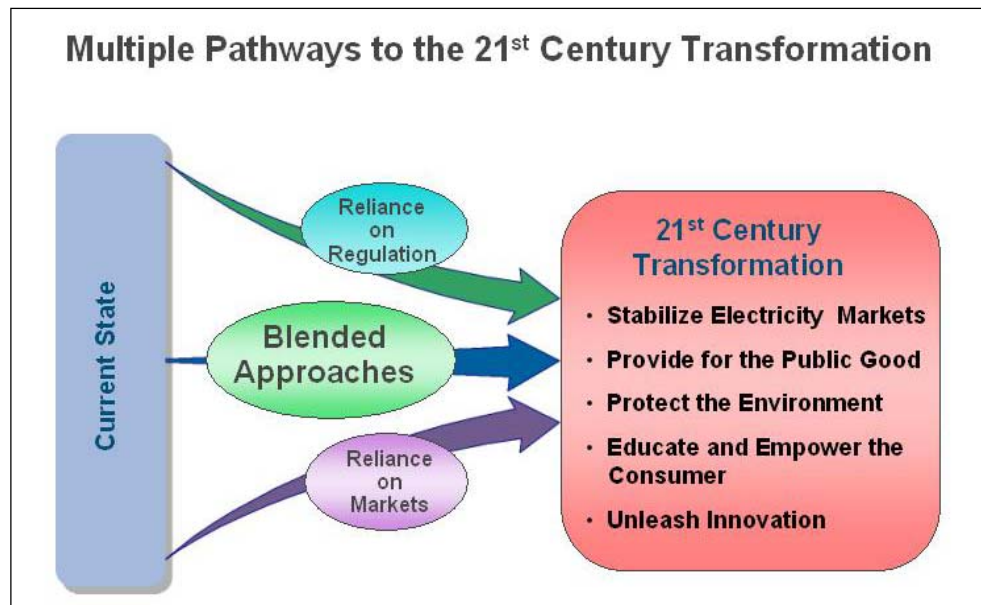
Fortunately, there is flexibility in the pathway forward, allowing regional and sector experimentation with different market models. The stakeholders foresee an array of possible routes lying between the boundary conditions that are characterized by reliance on either regulation or on market forces. Most stakeholders conclude that managing a blend of regulation and market forces will prove to be the most pragmatically effective transition pathway since all segments of the electricity enterprise are not equally conducive to competition, and are, in fact, composed of both regulated and competitive markets. In this regard, the currently conflicted role of the regulator as both “protector” and “enabler” must be reconciled.

Today, this stakeholder consensus is reflected in legislative and regulatory decisions that tend to retain regulation on the “wires” side of the enterprise while extending competition in varying degrees to the “energy” side of the enterprise. The current broad spectrum of these blended approaches reflects the fact that maintaining a combination of regulation and competition requires resolution of several difficult problems:

- The boundary between regulated and competitive activities.
- Redesigning regulation from setting electricity price to just setting the price of regulated activities.
- Managing dealings and organizations that cross the regulated/competitive boundary.
- Determining how regulated and competitive entities cooperate to, in effect, satisfy the obligation to serve.

The lack of consistency and predictability in the resolution of these issues is at the heart of the liquidity crunch that is now paralyzing much of the sector. There is a striking uniformity of viewpoint, however, among the stakeholders—irrespective of their position on regulated versus competitive markets—that, outside the realm of public power, the role of government should be limited. Rather than assuming a direct service responsibility, for example, government should assure the necessary incentives and penalties that maintain industry accountability for the obligation to serve. This would include, for example, maintaining the technical reliability of the power system, ensuring common carrier access, acting as “provider of last resort” and undertaking long-term R&D.

In each case, stakeholders urged that the costs of these service responsibilities be recovered wherever possible from the consumer, not the taxpayer. However, recognizing that electricity is the lifeblood of the nation’s economy and quality of life, there is general support for the need to stimulate greater capital investment through government incentives. Such support might include improved tax treatment of dividends, investment tax credits, shorter depreciable lives for tax purposes on new infrastructure investments, and even infrastructure lending programs.



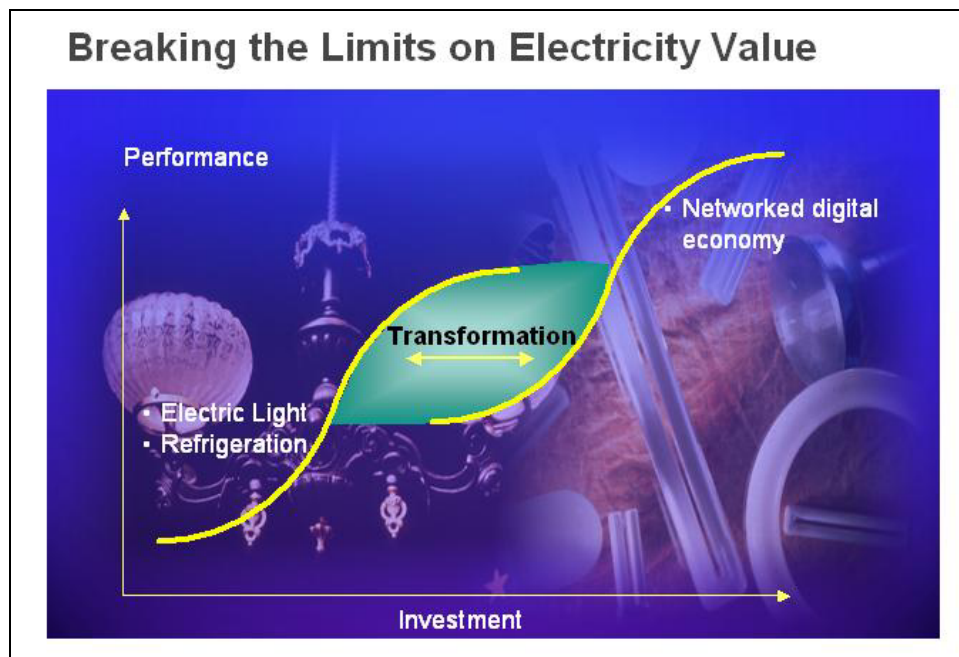
The 21st Century Transformation

The stakeholders generally expect that the various blended pathways into the future will in time converge as the “21st Century Transformation” unfolds. To be successful, this transformation must be grounded in a series of public and private policies that will simultaneously seek to stabilize electricity markets, provide for the “public good,” protect the environment, educate and empower the consumer, and unleash innovation.

The 21st Century Transformation reflects four fundamental realities:

1. Electricity is more than a form of commodity energy—it is the nation’s indispensable engine of prosperity and quality of life.
2. Electricity is a service-based enterprise whose value to consumers depends on the world’s most technically complex and precise infrastructure.
3. The innovative opportunities for technology, as we enter the 21st Century, lie principally in the ability to increase functionality and differentiate the service value of electricity.
4. The ability to realize these new value opportunities requires a corresponding transformation of today’s electricity infrastructure. This transformation will enable all consumers to become active participants in and beneficiaries of the electricity enterprise, rather than remaining captive to the obsolete commodity model.

Major investments in the nation’s electricity infrastructure are required over the coming decade to restore its resilience and to keep pace with the growth in electricity demand. The only cost-effective way to address this urgent need is through innovative technology that creates a smart, self-healing electricity supply system capable of powering an increasingly networked, digital economy.



This 21st Century Transformation depends on incenting the development and deployment of transformative innovations that enable

- Digital control of the power delivery network.
- Integrated electricity and communications for the user.
- Transformation of the meter into a two-way energy/information portal.
- Integration of distributed energy resources into the network.
- Robust advanced power generation portfolio, including coal refining.

This transformation will also accelerate end-use energy efficiency and environmental protection. The 21st Century Transformation envisions a new public/private electricity partnership that engages all sector players as an urgent matter of their mutual self-interest. This compact depends on ensuring that costs and benefits are equitably shared, as judged ultimately by the broad shareholder community. Such a compact would maintain accountability for critical public services, such as infrastructure development, provider-of-last-resort responsibilities, and protection of the environment. New consumer-based technology will enable greater empowerment of the electricity consumer, opening the door to new, innovative service combinations emphasizing speed, convenience and comfort, along with different levels and types of electric power. A smart, self-healing power delivery system becomes the conduit for greater use of productivity-enhancing digital technology by all sectors of the economy, leading to accelerated productivity growth rates. This transformed power system enables new energy/information products and services across the board, and reduces or eliminates the parasitic costs of power disturbances to the U.S. economy today.

The advantages of transforming the electricity/information infrastructure include:

- Enabling significantly increased U.S. productivity and GDP growth rates,

- Substantially improving energy efficiency,
- Accelerating the rate of reduction in carbon emissions,
- Improving the security of the power system,
- Achieving greater electricity system functionality and consumer value, all while
- Reducing the total costs of infrastructure system upgrades and expansion.

However, achieving these benefits will require an accelerated rate of investment. The pressures of cost containment have essentially stifled and deferred needed infrastructure investment in the electricity sector for at least two decades. This investment deficit is now on the order of \$20 billion per year and must be accounted for over and above the depressed investment levels of the 1990s if 21st Century service demands are to be confidently met. Through the consequences of inadequate electricity service, the nation's consumers (and voters) are already paying for this investment deficit several times over each year.

Conversely, and in personal terms, each consumer would save about \$500 per year in the cost of goods and services purchased in exchange for an infrastructure renewal charge of less than \$100 added to the annual residential electricity bill. In addition to this net savings of \$400 per year, the investment in smart electricity infrastructure can be expected to ultimately enable several thousand dollars per year in additional personal income growth potential.

As with the experience of other technologically based enterprises, the dynamic that pulls the electricity sector toward the 21st Century Transformation will be not so much the technology of supply but rather the technology of demand—intelligent technologies that enable ever-greater functional value and consumer involvement.

However, as long as consumer involvement is limited to the on-off switch and to time-of-day pricing, the obsolete “declining-cost commodity paradigm” will continue to dominate the electricity business and require counterproductive retail regulation to protect a relatively weak consumer from cost-constrained suppliers. The 21st Century Transformation represents a paradigm shift in which the central focus is placed on increasing the functionality and value of electricity rather than simply reducing its cost. The key instrument becomes the ability to access a growing array of consumer-based, electricity/information services whose value to consumers, society, and suppliers alike, even initially, far outstrips the costs of transformation.

Framework for Action

To be successful, the 21st Century Transformation must reflect careful consideration of diverse stakeholder concerns—a requirement that has often been overlooked in the recent years of regulatory and economic uncertainty. To help break this impasse, the following outlines a five-part Framework for Action, based on a synthesis of recommendations by stakeholders. While all stakeholders may debate the supporting action items recommended below, the five “high-level” goals are broadly seen as fundamental to any progress in the electricity sector, and represent goals that virtually all stakeholders should find to their long-term benefit. The Framework for Action is a tool to stimulate broader stakeholder discussion and provides a nucleus around which diverse stakeholder interests can logically coalesce. This Framework for Action is discussed in more depth in Volume I.

1. Stabilize Electricity Markets

Nothing can go forward until the financial health of the electricity industry is at least stabilized, and clarity over the rules, roles, and responsibilities of electricity regulation is reestablished. This is a problem that is seen as being resolved not by congressional action, but by agreement among the institutions and interests which are most critically impacted by industry change.

- **Develop a new public/private electricity partnership that lowers investment and market risks.**
- **Incorporate regional differences and lessons learned into market rules.**
- **Resolve uncertainty in federal/state regulatory roles, authority, and responsibilities.**
- **Achieve independent transmission operations.**
- **Regionalize integrated resource coordination and development.**
- **Create effective markets.**
- **Standardize electricity trading practices and ensure transparency** to help restore investor, consumer, and regulatory confidence in the trading sector.

2. Provide for the Public Good

Electricity is critical to economic growth and will be increasingly important to the health, safety, and welfare of society. But the marketplace offers no incentives for many aspects of the public good that electricity provides; other provisions must be made to ensure the availability of public-good services in the transformed marketplace. Conceptually at least, this means separating public-good regulation from economic regulation for investor-owned utilities. Finding a realistic solution to the question of public and private responsibilities is essential to creating effective markets for all participants.

- **Achieve consensus on the critical public-good services.**
- **Establish effective accountability mechanisms.**
- **Define “default service” for all classes of consumers and set out a transition pathway** from today’s unlimited obligation to serve to a more narrowly defined set of default services.
- **Ensure fuel diversity** to meet the energy security imperative of the nation.
- **Improve the security of the electricity system.**

3. Protect the Environment

The environmental impacts of electricity represent a considerable challenge for the nation in the face of current and expected requirements. In addition, the electricity sector remains subject to an uncertain array of new regulations for air quality, water quality, and land use and restoration. At the same time, a transformed electricity sector can provide the solution to many environmental issues. It will be important to address these contingent environmental requirements in a way that enables real solution opportunities and does not impede progress on the other goals of the Framework for Action.

- **Ensure that the nation’s commitment to environmental protection remains an integral part of all electricity sector operations, planning, and investment.**
- **Provide incentives that promote the most efficient solutions to environmental risks.**
- **Increase R&D for technologies that result in reduced emissions.**

4. Educate and Empower the Consumer

Until consumers become full partners in the electricity marketplace, the need to protect them will continue to foster the notion of entitlement and to distort marketplace dynamics, regulation, and the efficient use of energy and capital resources. Once provisions for the public good are clearly defined and established, consumer economic protection can be reduced, while consumer services and choice are allowed to flourish. The result will be an expanding array of electricity-based services that will transform consumer benefits.

- **Develop the economic and public policy rationale for greater consumer participation in the marketplace.**
- **Ensure the investment required to create the energy/information portal.**
- **Increase the opportunity for service differentiation for various classes of consumers.**
- **Engage the consumer in end-use innovation.**

5. Unleash Innovation

In contrast to the current investment climate, the prospects for new technology have never been brighter. Technology stands poised to transform the physical operation and functional capability of the electricity system to meet the complexity and pace of competitive markets; to bring it fully into the digital age; to greatly enhance reliability, resilience and security; and to enable a cleaner and more diverse power generation portfolio. Without technical transformation, today’s power system risks losing its viability as the foundation for economic prosperity and quality of life. New policies are urgently needed that can unleash the innovative technology required to transform the electricity system and better serve these growing demands of society and the economy. If, however, efforts to cut costs and improve efficiency in the power system lead to disproportionate allocations of the savings, then the incentive to innovate will be muted accordingly—either by the supplier, the consumer, or society at large.

- **Digital control of the power delivery network** by replacing today’s relatively slow electro-mechanical switching with real-time, digital electronic controls.
- **Integrate communications** to create a dynamic, interactive power system that is merged with the communications network into a new “mega-infrastructure” of real-time information and power exchange.
- **Transform the meter into a two-way energy/information portal** that allows price signals, decisions, communications, and network intelligence to flow back and forth in real time between suppliers and consumers.
- **Integrate distributed energy resources** as an asset to system reliability and capacity.

- **Accelerate end-use efficiency** through digital technology advances throughout the electricity value chain.

Where Do We Go from Here?

The ultimate goal of this *Electricity Sector Framework for the Future* project is to establish a coherent set of actions and accountabilities that will enable the electricity sector to meet the escalating needs and aspirations of its customers, investors/owners, and society. In order to be effective, such a set of actions, by their political nature, must reflect mutual self-interest and equity across the broad electricity stakeholder community.

The following are examples of such actions as gleaned from the breadth of stakeholder discussions and workshops on which this report is based. Each is within the context of the report's Framework for Action, and each reflects a considerable body of shared stakeholder perspective. As such, they represent a point of departure for developing the electricity sector's agenda for progress.

The dominant stakeholder viewpoint is that leadership accountability for most of these actions rests with the electricity industry itself. Although the obligation to serve may have been blurred by the turmoil of restructuring, the industry is still seen as publicly and politically accountable to keep the lights on, and thus to shape the electricity sector's destiny. It must also cohesively lead the effort to reestablish the incentives needed to build the means to serve. The nation's current economic malaise provides a temporary window of opportunity to develop and build broad support for the critical actions needed to keep the sector—and the nation's vital electricity supply capability—robust, dynamic, and secure.

General

1. Develop a unified industry leadership vision and commitment that electricity, through innovative technology, has a service value greater than its traditional basic commodity value.
2. Establish an inclusive “rallying cry” for the vision (e.g., the PTA’s “in the interest of the child”). The actions required will ultimately depend on a “political sale” through public policy leaders at the local, state and federal levels who can credibly advocate the message. A national forum should be convened to facilitate this initiative.
3. Expand the ESFF stakeholder outreach and education initiative as an essential mechanism for strengthening industry credibility, building trust, and gaining broad public and political support for the sector vision and its needed actions.
4. Independently validate both the benefits of electricity sector transformation and the costs of maintaining the status quo. Make these costs and benefits tangible, compelling, and urgent for all stakeholders, particularly consumers (voters).

Transmission & Wholesale Markets

1. Focus on transmission service as the likely “first point of meltdown” resulting from the lack of infrastructure investment incentives. A well-thought-out transmission plan incorporating

advanced technology is needed to help resolve siting issues while satisfying the needs of both generators and customers.

2. Promptly resolve the counterproductive debate between national and state regulation. This fundamental issue continues to delay progress and disincite the investment necessary to maintain the capacity of the transmission system and to enable efficient wholesale electricity markets. Regional differences are a reality, and the necessary flexibility, from both the federal and state perspective, must be provided.
3. Ensure that grid managers have adequate resources and access to energy, consistent with competitive markets, to maintain reliability, keep loads balanced, and improve grid controllability through advanced technology. They must also have the authority to allocate system upgrade costs efficiently and equitably among the system users.
4. Establish the national public/private commitment needed to transform the transmission system into a smart, self-healing network serving the needs of the 21st Century. This must include the accountability, incentives and funding mechanisms needed to achieve prompt demonstration and deployment.
5. Maintain well-functioning wholesale power markets as an essential precursor to further development of a market-based electricity sector. This includes establishing effective means for measuring and mitigating the possibility of peak-period market power in wholesale generation, even within nominally competitive market structures.

Distribution and Retail Markets

1. Develop a consistent set of guidelines for evaluating, communicating and acting on the knowledge (e.g., impact on retail and wholesale markets) being gained from the various state “restructuring” experiments.
2. Develop an up-to-date rate design methodology that incents efficient and equitable allocation of risk and reward sharing among consumers, investors and society in restructured, liberalized markets. The result must ensure that consumers do not “fall through the cracks,” and are allowed the opportunity to reap the benefits of market participation. At the same time, it must incent the needed distribution system innovation and investment.
3. Develop an enlightened state regulatory model for stimulating infrastructure investment while protecting the interests of the various stakeholders. Iowa House File 577 was noted as an example of such a model. It provides a regulatory process in which risks, rewards, and investment decisions are balanced up front in the ratemaking process. This has helped to provide the confidence needed to restore investment in Iowa.
4. Demonstrate the innovations that will transform the power supply system in a variety of local, state, and regional situations. This will both accelerate confidence and acceptance and tangibly show the functional benefits and cost savings that advanced technology can achieve on behalf of all consumers. Public/private cost sharing mechanisms will be essential to these first-of-a-kind applications.

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