AMERICA'S
POWER PLAN

NEW UTILITY BUSINESS MODELS:

Utility and Regulatory Models for the Modern Era

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REVIEWERS

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EXECUTIVE SUMMARY

Much of the U.S. electric power sector has changed little over the past 100 years. But the industry now faces an unfamiliar and uncertain future. Potent new pressures are building that will force fundamental changes in the way that the electric utilities do business. Consumers are demanding a new relationship with the energy they use, and new technologies are proliferating to meet demand. At the same time, innovative new technologies and suppliers have come on the scene, disrupting relationships between traditional utilities, regulators, and customers.

If the U.S. is to meet necessary climate goals with electric utilities remaining healthy contributors to America's energy future, business models used by these familiar institutions must be allowed and encouraged to evolve. This agenda has implications not only for companies themselves, but also for the legal and regulatory structures in which they operate. A new social compact is needed between utilities and those who regulate them, and this paper suggests ways in which this might evolve.

Several motivations exist to move to an electricity system powered by a high share of renewable energy: changing consumer demand and requirements, improved technology, market and policy trends, a smarter grid, weakened utility financial metrics, aging plants, tougher environmental requirements, climate damages, and "de facto" carbon policy. Utilities will respond to these motivations in different ways, which will result in a range of new utility business models. The minimum utility role may result in a "wires company," which would maintain the part of the grid that is a physical monopoly – the wires and poles – while competitive providers supply the rest. At the other end of the spectrum lies the maximum utility role, or the "energy services utility," which would own and operate all necessary systems to deliver energy services to consumers. Between these two, a "smart integrator" or "orchestrator" role for utilities would entail them forming partnerships with innovative firms to coordinate and integrate energy services without necessarily delivering all services themselves.

Because utilities respond first and foremost to the incentives created by the legal and regulatory regimes in which they operate, this paper focuses its recommendations on how utilities are regulated. Regulators must determine desired societal outcomes, determine the legal and market structures under which utilities will operate, and then develop and implement correct market and regulatory incentives. Three new regulatory options emerge. The UK's RIIO model is an example of broad-scale performance-based incentive regulation with revenue cap regulation. It focuses on how to pay for what society wants over a sufficiently long time horizon, rather than focusing on whether society paid the correct amount for what it got in the past. The Iowa model stands for a series of settlements entered into by parties and approved by regulators that led to electricity prices that did not change for 17 years. There, the utility and regulators negotiated shared earnings in a less adversarial process than most. The final regulatory model described in the paper is called the "grand bargain," which combines elements of the RIIO and Iowa models, where a commission would encourage utilities and stakeholders, including commission staff, to negotiate a comprehensive settlement to a range of desired outcomes.

Among the nation's 3,000 or so electric utilities across 50 states, there are many variations but a fundamental truth: current business models were developed for a different time. A modern electricity grid will require a new social compact between utilities, regulators and the public.

INTRODUCTION

Much of the United States electric power sector has changed little since the early 20th century. But the industry now faces an unfamiliar and uncertain future. Potent new pressures are building that will force fundamental changes in the way that the electric utilities do business. One of the key changes we will focus on here is the potential for a dramatic increase in the amount of renewable energy included in the resource mix of the future.

If the U.S. is to meet necessary climate goals with electric utilities remaining healthy contributors to America's energy future, the business models used by these familiar institutions must be allowed and encouraged to evolve. This agenda has implications not only for the companies themselves, but also for the legal and regulatory structures in which they operate. A new social compact is needed between utilities and those who regulate them, and we will suggest ways in which this might evolve.

A short list of the new pressures on electric utilities includes burgeoning environmental regulation, aging infrastructure, changing fuel and generation economics, cyber security demands and, importantly, reduced or flat load growth. As a result of these forces, utilities will need to deploy capital at an accelerated rate while simultaneously being deprived of the familiar engine of earnings – customer load growth. There is no precedent for this combination of pressures and challenges.

These pressures will be amplified or modified by a dramatic increase in the use of renewable energy. This paper will examine how utilities can adapt to a high-penetration renewable energy future. Assuming that at least 80 percent of energy supplied to consumers comes from renewable resources has implications for utility investment strategies, capital formation, earnings levels, rate structures and even the fundamental question of the roles that electric utilities will play in the U.S. energy market.

IMPLICATIONS OF HIGH PENETRATION OF RENEWABLE ENERGY ON THE GRID

The Renewable Electricity Futures Study (*RE Futures*), conducted by the National Renewable Energy Laboratory (NREL), investigates the extent to which renewable energy can meet the electricity demands of the contiguous U.S. over the next several decades. NREL examined the implications and challenges of various renewable electricity generation levels, with a focus on 80 percent of all U.S. electricity generation from renewable technologies in 2050.

Here are the major conclusions of *RE Futures*:

- Renewable electricity generation can be more than adequate to supply 80 percent of total U.S. electricity generation in 2050 while meeting electricity demand on an hourly basis in every region of the country.
- Increased electric system flexibility can come from a portfolio of supply-side and demand-side options, including flexible conventional generation, grid storage, new transmission, price responsive loads and changes in power system operations.
- There are multiple paths using renewables that result in deep reductions in electric sector greenhouse gas emissions and water use.
- The direct incremental cost of transitioning to a high penetration of renewable generation is comparable to costs of other clean energy scenarios.

NREL presents its energy modeling analysis in the form of a "prism" or "wedge" graph that shows the fraction of energy requirements that would be met by each major type of energy resource in a baseline 80 percent renewable generation scenario. This type of presentation was pioneered by the Electric Power Research Institute (EPRI) in a series of projections prepared from 2007 to 2009, called the EPRI Prism Analyses.

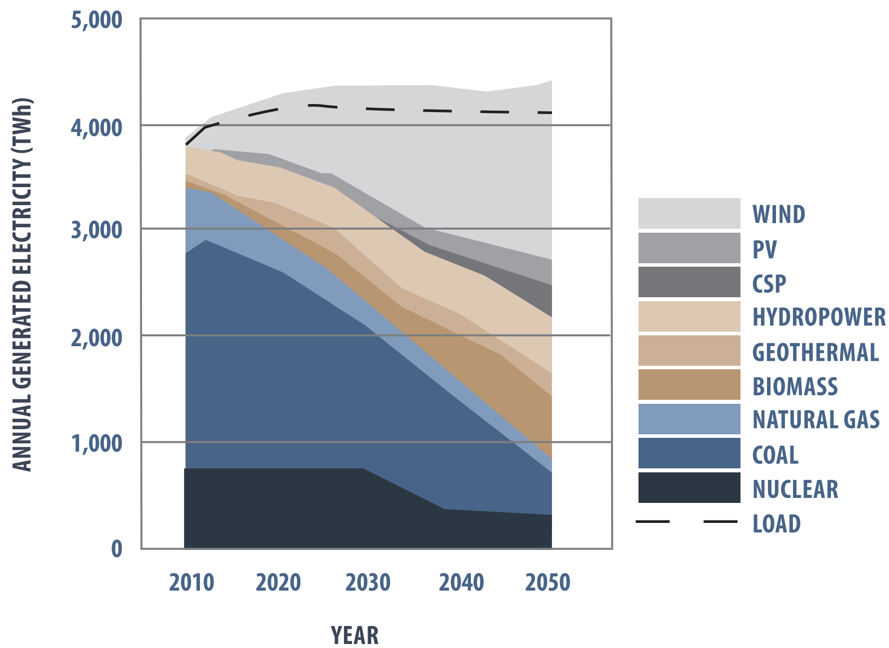

Figure 1. *RE Futures* "Prism" Analysis of baseline scenario

NREL's baseline scenario in the figure 1 chart shows the energy mix progressing from the actual portfolio in 2010 to a high renewable 2050 scenario. Renewable energy comprises only about 12 percent of the nation's electric energy in 2010 but makes up 81 percent of the energy mix by 2050. Each contributing resource (wind, photovoltaics, geothermal, biomass, etc.) is shown as a colored wedge in the graph. The fraction of energy supplied by nuclear power and fossil fuels shrinks from a 2010 level of about 88 percent to about 19 percent in 2050.

To understand the significance and context of the *RE Futures* study, consider an earlier "prism" analysis prepared by EPRI in 2009, at about the same time the U.S. Congress was considering climate legislation to limit greenhouse gas emissions from utility generation. EPRI modeled a low-carbon future that relied to a great extent on additional nuclear power and the assumed ability of fossil generators to implement carbon capture and sequestration. Needless to say, both of those assumptions (more nuclear and CCS for coal) have been heavily debated.

Figure 2 shows the results of the EPRI modeling. Two aspects of this chart are important to note:

- Compared to *RE Futures*, the EPRI study assumed greater net energy growth (net of demand reductions) from 2010 to 2050.
- EPRI projected that renewable energy would comprise only about 31 percent of U.S. electricity supply in 2050.

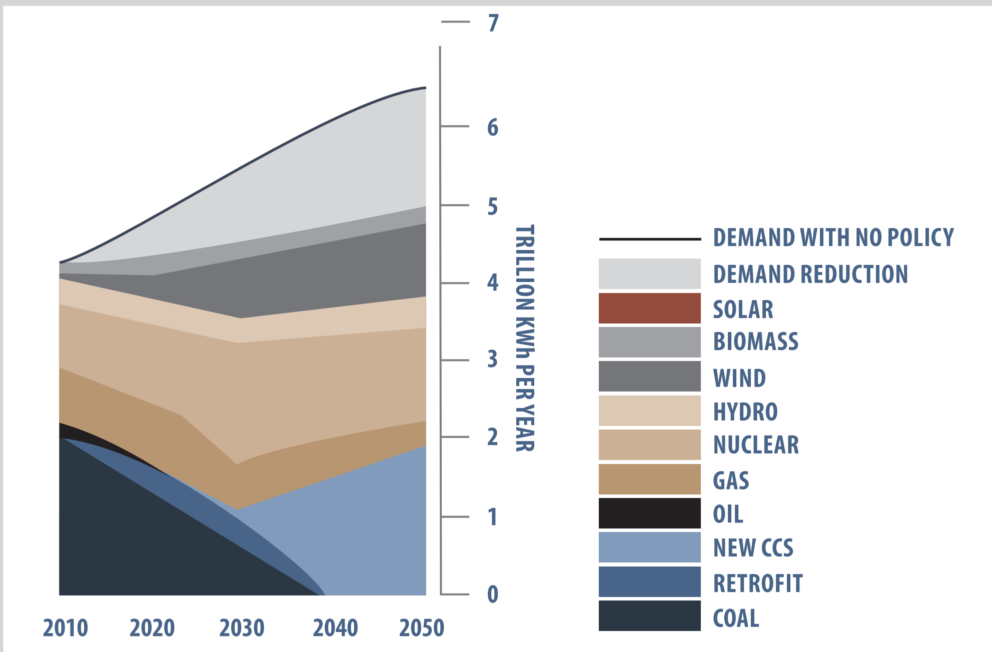

Figure 2. EPRI 2009 Prism Analysis of a low carbon scenario.

The difference in assumed 2050 total energy use between the two studies is explained by two factors: NREL uses a lower 2010 starting point and assumes a higher level of energy efficiency in its study. The lower starting point is due to the Great Recession of 2008-2010, which actually lowered U.S. energy use, a fact unavailable to EPRI in 2009. The higher level of assumed energy efficiency is likewise justified by recent increases in the observed level of energy efficiency activities by utilities and their consumers.

The most striking difference between the NREL and EPRI studies is, of course, the mix of energy resources resulting from modeling (which reflect the scenario designs), especially at 2050. Prior to the *RE Futures* study, the common wisdom seemed to be that "intermittent" resources such as wind and solar could not be relied upon to supply a majority of U.S. energy needs, and certainly not 48 percent of those needs as incorporated in the *RE Futures* work. Instead, the EPRI study postulates much less renewable energy and much more "base load" production from nuclear energy and from coal and natural gas with carbon capture and sequestration (CCS). In this context, then, the main contribution of the *RE Futures* study is to demonstrate for the first time the feasibility of supplying the nation's electricity needs with an 80 percent renewable resource portfolio, at a similar cost as other low-carbon strategies. These renewables would be augmented by an array of flexible conventional resources, grid storage and additional transmission capacity.

By comparing the traditional narrative (exemplified by the EPRI analysis) with the *RE Futures* study, we can identify four major implications of the RE (Renewable Energy) future:

- Much higher levels of variable generation ***at the bulk power scale.***
- Greater penetration of distributed energy resources ***at the distribution scale***.
- Greater need for flexibility in the grid components, operations, and architecture.
- Higher levels of energy efficiency (sufficient to eliminate load growth).

The *RE Futures* study represents one of the growing pressures on utilities – a change in most of the nation's generating capacity. Taken seriously, it will affect the types of investments utilities must make, the roles played by utilities in operating the grid, and the way in which utilities make money – in short, the RE future will affect the utility business model.

Utility Market Segments

The variety of utilities and market circumstances in which they serve has resulted in different business models among the roughly 3,000 utilities in the U.S. Investor owned utilities (IOUs) serve the bulk of U.S. electric power and are typically regulated by the federal and state governments. Publicly owned and consumer owned utilities (POUs) serve customers in a wide diversity of circumstances. Nebraska is a wholly public power state while large municipally owned systems serve communities including Los Angeles and Seattle and small city-owned systems are common in some regions. Consumer owned cooperative utilities typically serve electric customers in suburban and rural areas. Boards of directors or municipal officials provide direction and oversight for POUs.

The market structures in which either IOU or POU utilities serve have impacts on what new utility business models might be relevant. In about half of the U.S., markets have been restructured so that traditional utilities have divested their generation assets, and independent power producers compete to provide generation service.

In some states, consumers can choose their power supplier, and utilities provide mainly delivery or "wires" services. In these restructured markets, Regional Transmission Organizations (RTOs) or Independent System Operators (ISOs) dispatch all generation based on competitive bidding and dispatch in order of lowest marginal cost.

Different forms of doing business (shareholders versus owners) and market situations (restructured versus vertically integrated and regulated) shape different utility business models. We see that, in practice, there are five dominant ownership and market structure combinations in the U.S. utility industry:

1) Investor-owned Utilities
    a) Competitive generation markets
        i) Retail competition (retail choice) ❶
        ii) No retail competition ❷
    b) Vertically-integrated and traditional generation arrangements ❸

2) Publicly-owned Utilities (Municipal and Cooperative)
    a) Competitive generation markets ❹
    b) Vertically-integrated and traditional generation arrangements ❺

Much of our focus in this paper is on vertically integrated and regulated utilities, but most of the analysis applies as well to utilities operating in restructured markets.[1]

MOTIVATIONS TO MOVE TO A HIGH SHARE OF RENEWABLE ENERGY GENERATION

Utility industry leaders, consultants, analysts and experts have outlined a number of reasons utilities might be motivated to move in the direction of the high renewables penetration scenarios analyzed in the *RE Futures* study.

Aging plants

Utility investment demographics show large plant investments in previous decades are coming due for high cost repairs and replacement. The Brattle Group estimates $2 trillion in electric sector investment requirements over the next 20 years, about half of that for generation resources.[2] Combined with falling costs of renewable generation and growing pressures to reduce greenhouse gas emissions and other traditional pollutants, the required investment could lead in the direction of much more renewable energy choices as described in the *RE Futures* study.

Tougher environmental requirements

Tighter environmental regulations raise questions about how to maintain utility business models that depend on earning equity returns on investments in plants that require major new clean up investments. The advance of these regulations means utilities will face higher operating costs to meet new regulatory requirements as well. Old, depreciated assets may need to be retired early because of new environmental regulatory costs.

Likely EPA regulation of CO2 emissions for existing fossil units, coal ash disposal, mercury and water issues all compound utility investment decision making. Higher operating costs are likely to follow for existing fossil units. The business question is how to manage these costs while considering clean alternatives such as those found in the *RE Futures* study. A renewable energy future along the lines of the NREL study provides a number of solutions, if the risks can be reduced and rewards increased for investments in new clean equipment – even as write offs and write downs of old investments need to be absorbed.[3]

Technology costs, market and policy trends

Wind and solar technologies have made very significant gains, leading to much lower costs and rapidly increasing deployment. Distributed technologies, employed in the context of more intelligent grid technologies and operations have drawn attention, especially in the popular imagination and in military circles. Long sought energy efficiency and demand side management programs are spreading among utilities, equipment suppliers and consumers – so much so that many utilities ponder flat or very low load growth going forward. Most states have policies in place requiring minimum amounts of renewable energy and many of them have increased their targets as lower renewable energy costs make the minimums more cost effective to achieve. Technology trends are moving strongly in favor of the RE future.

Smarter grid

As more computer and communications technologies pervade utility operations, and as distributed generation such as solar, Combined Heat and Power and micro turbines become more commonplace, utilities will face more complex issues regarding distribution, investment operations and rate design. The uptake of electric vehicles and their charging requirements, together with their potential to provide grid support, raise related issues. These developments will present new challenges in the areas of reliability, rate equity and recovery of fixed and variable costs of service.

The complexity of a smart grid and the proliferation of potential new services will raise issues of consumer sovereignty, the type and quality of consumer services and issues of consumer costs. The utility could create new revenue streams associated with customer service. Third party disintermediation (new providers getting between a traditional utility and its traditional customers) will challenge utilities to justify and provide services. They may also make partnerships with other providers work to the advantage of customers who wish to avail themselves of these options. Resolution of these trends could spur change in the direction of the RE future – especially at the distributed generation scale – but most of the discussion is about issues at the consumer, rather than the bulk power end of the business.

Changing consumer requirements

Other customers such as companies that operate large computer server locations and military bases have evolving requirements that challenge existing utility business formulae. As providers of clean power compete with utilities to serve customer segments that demand clean power to meet their own goals and standards, utilities are challenged to either offer, or facilitate other providers' offerings, to meet these customer requirements. Utilities that have enjoyed relatively exclusive single provider status may be challenged to provide the levels of consumer options and service that are required. More demand for clean power from large-scale consumers moves strongly in favor of the RE future.

Weakened industry financial metrics

Utility bond ratings have weakened significantly since the sector last faced large-scale investment requirements. Twenty years ago there were many AAA and AA rated utilities, now there are very few. All along the sectors' ratings, declines have far outpaced improvements over the period. Questions relevant to a renewable energy future are the cost of capital for utility investments associated with investors' perception of risks, and managing the transition from fuel cost expense to investment in generation without fuel costs.[4]

Climate damages and recovery, liability costs, fuel risks

A simple computer search on the terms "climate damage litigation" will reveal results that suggest this often mocked issue might emerge as a multi-billion dollar risk to utilities and other emitters. Risks could be at the "bet your company" level if these firms are found to be financially responsible for damages caused by weather extremes, spread of diseases and damage to agriculture and natural systems. In 2010 the SEC issued guidance about disclosure of risks and opportunities related to global climate change in response to concerns that investors and others raised about financial impacts from emerging regulations for addressing it. As contingent risks of liability for climate change damage are better appreciated, the RE future scenario moves closer.

"De facto" carbon policy

While too early to be called a universal trend, some jurisdictions have embarked on policies limiting carbon emissions that could spread more broadly. California, Oregon and Washington all have limited new carbon-emitting electric power generation sources. California has opened its carbon cap and trade market. Boulder, Colorado and British Columbia have small carbon taxes in place. Some utilities' plans show that they will not consider new coal plants because investment risks attendant on climate issues are too hard to judge. Some have undertaken coal plant retirements that advance planned unit retirement dates. As the retiring CEO of Xcel Energy, Richard Kelly, told a Minneapolis newspaper, "We've got to get off of coal. The sooner the better."

CURRENT TRENDS IN UTILITY BUSINESS MODELS

One CEO observed that utilities organize themselves around standards. In his view, utilities' organizations and efforts are driven by engineering and reliability concerns, those that result in keeping the lights on. Financially, utilities are accountable to their investors, who assess risk based on their views of economics, and particularly on comparisons across firms that assess how capital is employed and what returns result. For utilities, an industry wide standard uniform system of accounting provides the basis for cost-of-service regulation. This supports equity returns on plant investments – the fundamental regulated utility profit incentive, as well as fuel cost and other rate adjustments that support what is essentially a commodity sales business model.

Current examples of utility models changing

There are many examples of utilities that have diversified beyond the basics of the utility business. The traditional utility basics can be summarized as, "invest in plant, earn a return, and turn the meters." Some utilities have subsidiaries that provide clean energy diversification. They are in the business of building wind and solar generation for other utilities. Examples include NextEra, a subsidiary of Florida Power and Light and the nation's largest wind plant owner, and MidAmerican, a subsidiary of the holding company Berkshire Hathaway, the largest utility wind owner and a recent entrant in the wind and solar developer market. Some utilities are engaged in utility consortia that expand member utilities' service offerings beyond provision of electricity. For example, Touchstone Energy is a cooperative project that provides a variety of services to cooperative customers, from efficiency and other energy services to discounts on hotels and prescription drugs.

Joint construction of generation and transmission projects have a long history in the industry, where the different segments cooperate to finance and build large scale generation and transmission assets and then share in their ownership, operations and benefits. Some utilities have diversified into independent transmission companies, engaged in building transmission in other utilities' service areas. For example, the Sharyland Utility is building part of the Texas ERCOT Competitive Renewable Energy Zone (CREZ) transmission lines.

There have been examples of both successful and unsuccessful utility diversification efforts into a range of enterprises, from drilling for natural gas and building generation plants across the U.S. and the world, to providing appliances and appliance repairs to consumers. So utilities are not strangers in trying different lines of business and a variety of business arrangements that expand their scope and scale beyond the basics of providing customers with power from power plants across lines they own and collecting on a utility bill.

As utilities have tried these expansions and diversifications, regulators have faced very significant challenges policing the line between regulated and unregulated enterprises. A business model where the regulated firm is the low but steady return "cash cow" and subsidizes the unregulated high return "star" enterprise both surcharges monopolized customers and harms competing firms in unregulated sectors. The lessons learned from current utilities' engagement in businesses related to, but beyond the scope of, their basic utility business will be relevant as a RE future unfolds.

REQUIRED CHANGES TO ENABLE RE FUTURE: NEW BUSINESS MODEL OPTIONS

A spectrum of possible utility roles emerges from Peter Fox-Penner's book "Smart Power" and from discussions within the context of a recent feasibility study of new utility business models and regulatory incentives. These possible roles range from the potential for utilities to be minimally involved in the transition to the RE future, to the potential for utilities' maximum involvement. Since the U.S. is so large, the number and kinds of utilities so various, and the situations so different by region, market, state and locality, the outcomes are likely to vary across the entire spectrum. What we can say with certainty is the one size won't fit all. Nevertheless, discussions are starting to happen about utility roles, and how business plans can reflect them, and we can see the beginnings of how these discussions might usefully lay out some constructive options.[5]

Minimum utility involvement

Those who advocate for minimum utility involvement in transitioning to a renewable energy-dominated future point out that utilities are the last place in business where innovation can rationally be expected to occur. Utilities are creatures of engineering, and financial standards and expectations primarily centered on keeping service reliable, returns steady and costs reasonable. Thus, they have few incentives to understand or take risks that come with rapid rates of change or innovation. As single providers in their markets, these monopoly providers are far less responsive to the motivations for change discussed above than would be other firms that face competitors who will angle for advantage in the face of challenges.

Utilities are also single buyers in their markets for energy supplies (as well as for a number of other specialized inputs from suppliers of specialized power engineering services, grid equipment, etc.) and as "monopsonies" (single buyers in a market) they have strong incentives to prevent market entry by competitors. Those who provide disruptive generation like wind and solar challenge utilities' traditions of reliance on fossil fuel for generation. Because most regulation allows utilities to offload most fuel costs, risks and liabilities onto their customers through fuel cost adjustments, they are further likely to tilt away from new renewable supplies. These are critical issues facing a transition to a high penetration renewable energy future that must be confronted.

There seems to be an assumption among certain economists, many customer segments, and some evidence from the organized RTO/ISO markets, that suggests certain of the utilities' lines of business can be opened to market forces to the benefit of customers. Industrial customers, faced with increased utility costs around 1990, led efforts to restructure the electric industry. Results varied around the country, but left a legacy of more competition within the utility sector.

Competitive entry in generation, for example, is found both in RTO/ISO as well as in markets where regulated utilities are required to obtain generation in response to transparent planning and open bidding. Some states, such as Wisconsin, have moved in the direction of requiring utilities to divest transmission into separate companies, which are then encouraged to compete to provide transmission investments and services.

In support of a minimal utility role, there is continuing discussion of how much the electric industry could be like telecommunications, where new technologies – especially mobile phones – have changed the business realities of traditional regulated telephone companies so entirely that a regulated monopoly structure has nearly disappeared. A lot of customers on the winning side of that equation believe that technology in the electric sector will have the same impacts.[6]

Some of the Silicon Valley investors in clean technology research and development along with start-up firms seem to have this same outlook: they assume Moore's Law applies to the electric sector and will cause the current utilities' business to evaporate as customers find a myriad of new ways to get the services they need outside of current utility technology and business models.

Skeptics of this point of view emphasize that even the best restructured electric markets still struggle to meet public policy requirements for long term supply reliability, to amass capital for long term investment and to meet current minimum renewable energy standards, much less the 80 percent goals discussed in the *RE Futures* study. FERC has recently started enforcement actions against several firms regulators charge have manipulated markets unlawfully, and for many in the West in particular, the Enron legacy of market manipulation in California still seems like a current threat likely to prevent any discussion of, much less movement toward, expanding markets.

A minimum utility role has both supporters and detractors, but it raises the specter that utilities face a potentially dignified "death spiral" in which their business model is made irrelevant by new technology and customer demands, and they will be forced to raise their prices for their least desirable customers because their best customers depart for more appealing options from other providers.

Middle way: Utility "smart integrator" or "orchestrator"

Along the spectrum of potential utility degree of involvement in a RE future, the middle way option is described in "Smart Power" as providing productive partnerships between utilities and innovator firms. In this model, the utility role is one of facilitating technology and service changes but not necessarily providing all of them. The utility role here brings change along through its business processes. Utilities would maintain their strong engineering and reliability standards, but adapt and apply them to new technologies and service offerings. New standards and changes to existing standards would be needed to incorporate new equipment, simplify and rationalize interconnections between new equipment and utility distribution and transmission grids and integrate new generation into utility operations and markets.

With new standards, pilot and demonstration programs of new technologies and services would present lower risk profiles to both utilities and investors. Consumers might benefit from a rational progression of new approaches as promising ideas grow from research and development, then make their way across what is now a "valley of death" for new ideas into utility pilot and demonstration programs that would prove up developers' claims. With demonstration project findings in hand, utilities, investors, regulators and developers could turn toward mass deployment and a variety of new technologies, business structures (like community generation ownership) and services would have a clearer path to markets. These outcomes would strongly support a RE future.

The business skills to accomplish these tasks would be analogous to the conductor's role in orchestral music. In this analogy, policy makers in both government and corporations choose the music for the orchestra's season, playing the music director's role. Then the utility, filling the orchestra conductor's role, trains the players to make a harmonious whole from the music selections and make programs available to the audience, the consumers. Some of the music might be classical, to appeal to those audience members who want to hear familiar tunes played in a traditional manner. These customers might prefer utility-based service offerings with few, if any, innovations and to face the fewest number of choices.

For those who want a more modern flair to their orchestra experience, the conductor would drop his or her baton on more modern scores. Such additional services might include access to a custom generation resource mix, real-time pricing that delivers "prices to devices" or a variety of energy management services.

Some utility customers want yet more choices. They may want solar on their roof, or to own a wind plant and have wind energy delivered by the utility to their computer server farm. They may want to build and live in a net zero energy home, or to have their military base supply its own power when the main grid is down due to a cyber attack. All of these customer options would find a way into the overall music program that the utility conductor would facilitate and be able to present.

The key in the "middle way" role would be for the utility to maintain a series of partnerships with innovative providers that would benefit both partners and the customers they serve. This "Goldilocks" outcome (not too hot, not too cold, just right) probably has the most appeal to utilities, who can find a positive future in it. The middle way also is likely to appeal to many stakeholders as well as most regulators, who would be busy managing the equity and cost of service issues in a much more complex setting. Advocates for a strongly market-oriented approach may find these messy compromises annoying at best or terminally unworkable at worst.

Maximum utility role: "Energy services utility"

While it is easy to imagine a utility role in which the utility is the ultimate enabler that "just makes it happen," it is harder to suggest how such a maximum utility role squares with the rates and levels of change that are required to get and stay on the path to the RE future. The activist role is particularly challenging to develop given the fundamental critique of utility abilities and incentives: utilities are not change agents.

For a utility to play the central role in a transition to the RE future, a widespread political consensus could lead a state legislature to mandate a structure in which utilities stay in charge, but with new marching orders. In places where utilities have enough political authority to sway legislative policy in their desired direction, this outcome is possible. Perhaps in response to calamity of sufficient magnitude, utilities would be given the direction by public policy makers to take care of rebuilding to solve a crisis. Rebuilding damage to utilities resulting from Hurricane Sandy will be an interesting case study of some of these tensions.

The intersection of the maximum utility role with new technology presents similar conundrums. Perhaps the utility in this setting would control the computer platform for the "smart grid," allowing innovators to add applications that meet customer requirements. Utilities might be encouraged to expand their business scope and scale by buying up innovator firms, acquiring their competitors and making the most out of their special competence in managing large-scale, complex, engineering construction projects.

These outcomes might be strongly supportive of a rapid move to the RE future, and would be consistent with a social agreement on the need to make a rapid move away from carbon-based electric power.

Maximum role utilities might be expected to diversify their service offerings, as customers segment themselves into groups with different service requirements. For example, a utility could serve military bases and other gated communities with their own solar or other power generation, along with high levels of reliability and resilience against weather damage and cyber interference – and the ability to drop off and rejoin the main grid depending on circumstances (or economics). Such a utility would target distributed generation to the most valuable places in the system.

Other customers might desire absolute least cost service, be willing to sacrifice reliability for lower cost and be unwilling to spend the time or money to add much in the way of their own generation or end use control systems.

A utility serving a variety of evolving and changing customer segments beyond the traditional residential, commercial and industrial categories will be faced with creating additional value propositions to support each offering. Such diversification will also entail more complex equity claims and cross subsidy concerns. Packages of services aimed at particular customer segments might result.

The model might be closest to integrated telecommunications companies such as the telephone and cable companies that can now combine landline phone, wireless, internet and television services in one bill. A bundled services approach could offer new services, define value and convenience for customers, and frame and provide services across a range of offerings and price points.

A utility at the maximum involvement end of the spectrum might be described as an end-to-end aggregator, doing business at the core of change and expanding its scope and scale. Such a utility would be supported by public policy in its central role, and, hopefully, seek continuous improvement of its economic, environmental and financial performance. Some of the offerings the maximum role utility would undertake would vary in degree rather than kind from those described in the moderate utility role. In certain political and policy settings, which are bound to be encountered across the wide variety of utility experience in the U.S., a maximum utility role outcome could be the avenue of choice that leads in the direction of the RE future outcomes.

PUBLIC POLICY RECOMMENDATIONS: NEW REGULATORY OPTIONS

As we have seen, numerous forces are conspiring to change fundamental features of the environment in which the traditional electric utility operates. These forces will alter the role of the utility and will require modifications to utility business models if utilities are to fulfill their new roles while remaining financially viable. These pressures for change are magnified by the assumption of a high-penetration RE future that NREL has shown is possible. Significant changes will be required regardless of whether utilities play a minimal, middle or maximum role in the transition to the RE future.

Consider these implications of the NREL study:

- Much higher levels of variable generation ***at the bulk power scale*** will require:
  - Greater flexibility in the grid and a successful system integrator at the bulk power level.
  - Significantly more investment in transmission facilities.
  - Investment in grid-level storage and other ancillary grid services.
- Greater penetration of distributed energy resources (DER, both supply-side and demand-side) ***at the distribution scale*** requires much more sophisticated planning and operation of the distribution grid, and may require significant investment in at least portions of distribution systems.
- In addition to operational considerations, greater penetration of customer-owned renewable energy facilities (DG) means less revenue for utilities and lower load growth.
- NREL's *RE Futures* study core scenarios assume levels of energy efficiency sufficient to eliminate load growth from now until 2050; this likely means much larger and more sophisticated energy efficiency efforts by utilities or other EE providers. In either case, this trend will render the traditional utility "volumetric" rate structure increasingly ineffective as a means to compensate the utility.

Depending on one's assumptions about the essential role of the utility, these implications of the NREL report spawn a host of new requirements for the industry and its regulators in getting to the high penetration renewable future and for operating a reliable electric system once that future has been attained.

Mapping the RE future challenges to structural and regulatory options

We now turn to the question of the impact these RE future-specific challenges will have on utility business models and the implications for the mode of regulation for those portions of the industry that remain regulated by economic regulators.

We examine these RE future-specific impacts across the three basic orientations for utilities described previously:

- Minimum utility involvement.
- Middle way: utility as "smart integrator" or "orchestrator."
- Maximum utility role: "energy services utility."

Minimum Utility Involvement Model		
RE FUTURE IMPACT	**IMPLICATIONS**	**RESPONSES**
Greater levels of variable resources	Requires improved access to expanding wholesale markets for variable resources; competitor firms provide new, more responsive supply side and demand side resources.	Requires price on GHG emissions; some need for state or federal RPS or tax policy, depending on economics of RE and fossil fuels. Regulators search for and implement opportunities for markets to serve customers and limit utility market power.
More sophisticated grid operations	RTO and ISO markets expand, balancing areas consolidate. Will require more smart grid investment; more sophisticated ISO skills; greater supply of ancillary services.	IT investment in control systems increases. Dynamic pricing is desirable; enhanced ISO ability to accommodate variable resources.
Greater transmission investment	Greater reliance on independent transmission owners; regional transmission planning includes independent projects.	More private market involvement in transmission development, financing. PMA's are privatized.
Higher levels of customer-owned resources	Distributed resources have easy access to wholesale markets.	Retail choice proliferates, competitors enjoy retail open access. Rate structures change.
More sophisticated distribution operations	Retail choice, competitive disintermediation, and rapid technology development and deployment.	IRP-style approach to distribution investment; smart grid performance metrics.
Higher levels of EE	Robust energy service company market required, simple consumer financing.	Distribution wires companies regulated with revenue cap.
Pressure on customer rates	Customer resistance to higher rates.	Communicate climate goals, service value.

Smart Integrator or Orchestrator Model		
RE FUTURE IMPACT	**IMPLICATIONS**	**RESPONSES**
Greater levels of variable resources	If utility is vertically integrated, likely more reliance on PPAs. Incentives for fair market shares, transparent "make or buy" bids and bid evaluations.	Improved long-term planning; IRP with presumption of prudence; robust competitive bidding regime for PPAs.
More sophisticated grid operations	Enhanced role for system integrator, either ISO or utility. Will require more smart grid investment; development of new operating regimes.	Candidate for reliability incentives. Competitor firms' satisfaction evaluations determine performance rewards, symmetrical penalties.
Greater transmission investment	Higher capital requirements; upward pressure on rates. Joint projects and more industry partnerships.	Award presumption of prudence tied to planning process. Long term needs met with larger scale projects. Rights of way acquired in advance of need.
Higher levels of customer-owned resources	Heightens need for smart integrator. Reliability, capability requirements change.	Utility identifies preferred distributed generation locations. Rate structures change. Service options expand.
More sophisticated distribution operations	Will require smart grid investments.	IRP-style approach to distribution investment; smart grid performance metrics.
Higher levels of EE	Lowers load growth; demand responsive loads.	Revenue cap regulation with decoupling adjustment.
Pressure on customer rates	Customer resistance to higher rates.	Communicate climate goals; encourage increased firm efficiency; use price cap.

Energy Services Utility Model		
RE FUTURE IMPACT	**IMPLICATIONS**	**RESPONSES**
Greater levels of variable resources	May require new regulatory approaches to planning and prudence determinations; different approach to portfolios, more PPAs.	May require renewable portfolio or energy standards, depending on renewable energy economics. Reliability incentives; long-term planning; integrated resource planning with presumption of prudence; robust competitive bidding regime for PPAs.
More sophisticated grid operations	Will require more smart grid investment by utility; new operating regimes.	Candidate for output-based incentive regulation; reliability incentives.
Greater transmission investment	Higher capital requirements; upward pressure on rates.	More sophisticated state and regional transmission planning; award presumption of prudence tied to planning process.
Higher levels of customer-owned resources	Lowers utility sales; pressure on rates.	Rate structure changes.
More sophisticated distribution operations	Will require smart grid investments.	IRP-style approach to distribution investment; smart grid performance metric.
Higher levels of EE	Lowers load growth.	Revenue cap regulation with decoupling adjustment.
Pressure on customer rates	Customer resistance to higher rates.	Regulators must communicate climate goals; regulate to encourage increased firm efficiency, using revenue- or price-cap style regulation.

Studying these charts, the implications are clear. Depending on the assumed level of utility involvement, market structures must be improved and, in some cases, created. Regulation must turn its focus towards some new goals for the utilities for those portions of the industry that remain regulated.

Focus on regulation

We might begin this inquiry with the question, "what must a new utility business model look like?" Instead, our analysis and recommendations start from a different place. We know that utilities respond first and foremost to the incentives created by the legal and regulatory regime in which they operate. For that reason, our recommendations focus on how utilities are regulated.

The essential problem of 21st century electric utility regulation is how to compensate utilities fairly while providing incentives to pursue society's broader policy goals. This contrasts with the economic regulation practiced in the U.S. from the 1930s to the 1990s that focused mainly on overseeing utilities' profits, servicing growing customer demands and maintaining rate stability and service reliability.

The regulator's duties today must now become more subtle and complex. Utilities must now be encouraged to decarbonize their fleets, improve both their firms' overall efficiency and project-level efficiencies and serve customers in new ways. In short, regulation today needs to align regulatory incentives so that healthy utilities can pursue society's broader policy goals in ways that also benefit customers and shareholders.

A logical approach to designing appropriate regulation will seek to answer the following questions:

- What outcomes does society want from the electric utility industry?
- What role should utilities fulfill in the future?
- What incentives should law and regulation provide?
- How must regulation be modified to provide these incentives?

These questions illustrate the close connection between how utilities operate and make money (their business model) and the incentives provided by the legal structure of the industry and its regulation (the regulatory model). Utility business models should evolve to respond to the outcomes that society wants. Until we adjust regulation to enable and encourage those outcomes from the utilities, adjustments to their business models will be hard to justify.

1. **Determine desired societal outcomes**. In this report, we have assumed a high-penetration renewable energy future. This can come about in response to public demand, as evidenced by consistent public polling results over the last few decades that show two or three to one support for more renewable energy. The government, responding to public demand, can mandate a move toward the RE future. The economics of various energy resources and pricing for a low-carbon future can drive us to high-penetration renewable resources, or external causes such as widespread realization of climate damage at unsustainable levels may provide the required motivation. In any case, we may assume that society wants a high penetration of renewable resources. Other desirable societal outcomes include service reliability, equity, sustainability, efficiency, energy diversity, energy 'independence', economic development, risk minimization and environmental results.

2. **Determine the legal and market structures under which utilities will operate**. We take this to be a (temporarily) settled matter in most regions of the country, although evolution of market structures continues. Our recommendations for regulatory incentives will be formatted to apply in the case of each of the major market structures (vertically integrated, partially competitive, retail competitive, etc.). Similarly, we assume that the industry segments (investor-owned, publicly-owned or cooperative) are fixed.

3. **Develop and implement correct market and regulatory incentives**. This is the main task: modifying regulation to induce regulated utilities to adopt business practices that lead to society's desired outcomes. As regulated IOU firms' experiences build toward new models, we expect best industry practices to move into POUs. They are not regulated in the same way as IOUs, but many of the same principles advocated here will apply in some fashion to municipal utilities and coops. The diversity of market structures means that there will be a spectrum of regulatory arrangements, providing different incentives as appropriate to the market structure.

The late economist Alfred Kahn once observed that, "all regulation is incentive regulation." By this he meant that the manner of regulation inevitably shapes the behavior of regulated entities. State utility regulation, which might have been adequate for the 1950s through the 1970s, remains rooted in concepts and practices that, while still important, are not adequate to the challenges of the 21st century. Current regulatory structures simply don't provide the right incentives.

We believe that regulation must shift and broaden its focus from monopoly-era economic issues, to a larger and more generalized set of issues. We believe these issues are best addressed through regulation based on performance so that utilities have incentives to change their ways.

As cost-of-service regulation has evolved in the last three decades, it has shed any realistic claim that it induces regulated companies to be efficient. One of the important roles of regulation, identified by James C. Bonbright in 1966, is to motivate the utility to be efficient as a company. Interviews with utility CEOs confirm that today's regulatory structure offers few incentives for corporate efficiency throughout a utility. This is significant because increased profitability, derived from eliminating inefficiencies, could be used to offset anticipated cost increases utilities are facing. Utility efficiency could potentially be used to "fund" certain outcomes desired for utilities, such as the movement towards cleaner generation resources and new consumer services.

Other analyses have described alternative regulatory approaches that appear to be appropriate in light of the well-recognized challenges facing utilities.[7] We now describe those alternatives in a more concise fashion.

New regulatory options

The United Kingdom RIIO model

Electric and gas distribution utilities in the U.K. are regulated under a relatively new, comprehensive structure called RIIO, which stands for "Revenue using Incentives to deliver Innovation and Outputs." The U.K. electric regulator, OFGEM, created RIIO to implement new government policies for the electric sector requiring meeting national climate goals. RIIO builds on the price cap regime that has been used in the U.K. for the past 20 years for energy companies (called "RPI-X"). RIIO adds to price regulation a system of rewards and penalties tied to performance on desired outcomes (or "outputs") to be achieved by regulated companies. Because RIIO also employs revenue decoupling, it is probably best described as "revenue cap regulation" coupled with "output-based incentive regulation."

RIIO differs from most U.S. utility regulation by focusing much less on the utilities' earned rate of return and focusing much more on the utilities' performance. By its own terms, this new U.K. model seeks "value for money." Rewards and penalties comprise an incentive system to encourage operational efficiencies, as well as funding for innovation and opportunities for utilities to involve third parties in the delivery of energy services.

Importantly, RIIO contemplates a relatively long period of regulation – the basic price and revenue trajectories for utilities, along with the system of rewards and penalties, will persist for eight years. This means that operational efficiencies achieved by regulated companies can result in higher profitability during the term of regulation, clearly rewarding efficiency.

Under RIIO, utilities are measured for the performance on seven output measures:

- Customer satisfaction.
- Reliability and availability.
- Safe network services.
- Connection terms.
- Environmental impact.
- Social obligations.
- Price.

While some may view the U.K. move to the RIIO model as a partial retrenchment in the U.K.'s march toward electric industry disaggregation, others suggest that it simply builds new goals into a reasonably workable regulatory structure that maintains a prominent reliance on market forces. Seen in the former light, RIIO begins to reassemble aspects of a policy driven, integrated electric system, reinserting additional public policy goals into the regulatory formula. By its own terms, RIIO highlights critical utility functions that include:

- Reliability.
- Environmental stewardship.
- Innovation.
- Price management.
- Efficiency.
- Social responsibility.

Utilities are required to submit new business plans for approval by OFGEM that show how their business models will change, how they propose to provide these critical functions and how they propose metrics and measurements by which their success (or failure) to do so can be judged. By monetizing success in these functions through a system of incentives and penalties, RIIO links financial success for the utilities to achievement of public policy goals. In this way the utilities begin to own the policy outcomes.

By focusing on outputs instead of inputs, RIIO moves from accounting cost regulation to a style of regulation that emphasizes the utility's business plan and measures the firm's ability to deliver on commitments. The RIIO slogan of "value for money" underscores the bottom line, "are we paying for what we wanted?" In contrast, much of U.S. utility regulation seems to answer the opposite question, "have we paid the correct amount for what we've gotten?" RIIO's adoption of an eight-year regulatory term means that the regulated entities have sufficient time to adjust their operations, employ innovative measures and wring out inefficiencies.

U.K. regulation focus:
Did we pay for what we wanted?

U.S. regulation focus:
Did we pay the correct amount for what we got?

Finally, by elevating public policy outcomes to the level they inhabit in RIIO, the U.K. is giving ***customers as citizens*** equal billing with ***customers as consumers***.

At its most basic structural level, the RIIO model appears to address many of the needs we have for reformed utility regulation in the U.S. While the RIIO model might have to be significantly modified for use in the U.S., its basic structure can provide appropriate incentives for utilities to move in the direction that society wishes them to go. Further, the price-cap element provides inducements to firm efficiency, making it possible to "fund" parts of the clean energy investment with higher earnings from efficiency gains.

Performance-based regulation

In the 1990s, the U.S. telecommunications market was remade by changed federal policy, technological innovation and the rise of competition, becoming both more complex and more competitive. Regulators responded (slowly) by moving away from cost of service regulation toward price cap regulation, various flavors of incentive regulation and regulatory forbearance for new market players.

The situation in the electric sector shares some features with the telecommunications sector (disruptive technologies, shrinking of monopoly functions) but there are very big differences as well. In particular, the telecommunications sector has become less capital intensive, is much more nearly "plug and play" and has many fewer negative societal externalities. And yet the regulatory prescription may be very similar: each industry's evolution will be enabled by a shift towards a type of regulation that focuses on outputs (prices and outcomes) instead of inputs (accounting costs) and enables the industry to become more efficient, eliminating some of its bad habits. The Federal Communications Commission and many states began to use price cap regulation for telecommunications carriers as competition began to enter their markets. This style of regulation, in both theory and practice, squeezes inefficiencies out of the regulated players in the former monopoly markets.

In short, performance-based regulation (PBR) adds performance outputs by function to basic cost of service regulatory design, values risk management and focuses on the longer term. Ideally, PBR will present utilities with a coherent set of positive and negative incentives, replacing the disjointed and often conflicting set of incentives that has grown up in many regulatory jurisdictions.

Modern 21st century regulation must also come to grips with another neglected outcome: innovation. As practiced today, U.S. utility regulation removes almost all of the upside for utilities that might choose to innovate. There is little incentive for a utility to become more efficient since any financial gains from innovation and improved efficiency are "taken away" in the next rate case. As mentioned earlier, the RIIO regime addresses this situation by creating an eight-year regulatory term, allowing utilities to retain the benefits of improved efficiency, and by creating a separate channel for funding innovation.

Finally, U.S. regulation will profit from moving away from short-term price considerations and toward the practice of developing long-term goals. As discussed in a recent Ceres publication, this strategy is key to managing both risk and costs for a utility.[8]

Two more approaches

We close this discussion with a brief consideration of two additional regulatory models, the "Iowa Model" and what we call the "Grand Bargain."[9]

The Iowa Model

For seventeen years, from 1995 to 2012, Iowa utility MidAmerican did not change its retail prices; nor did it utilize "adjustment mechanisms" to track costs. Instead, the rates in effect in 1995 were continued without change through a series of settlement agreements involving MidAmerican, the staff of the Iowa Utilities Board, the Office of Consumer Advocate and other interested parties. The terms of the settlement agreements evolved over time but generally provided for a fixed settlement period, a formula for sharing over-earnings and an "escape clause." It is important to note that MidAmerican continued to add generation resources during this period, including hundreds of megawatts of wind capacity.

The Iowa experience exhibits a system that provides longer-term stability in regulation and incentives for utilities to improve efficiency, while not technically based on a price cap. The Iowa experience relied on a settlement-based process that lessened the transaction costs associated with the adversarial process. This model can be adapted to emphasize clean energy goals by making them part of the periodic negotiations.

The fact that rates did not change over 17 years is an important aspect of the story, but it is not a central lesson about the experience. The particular energy economics in a state will determine whether prices could be kept constant over time. The important lesson from this model is its adaptability to emphasize the goals and incentives that the parties to the negotiation wish to achieve.

A Grand Bargain

Meaningful dialogue among utilities, regulators and other stakeholders is often difficult to achieve. The system of utility regulation has grown to be very confrontational, is often wrapped in judicial processes and usually exists in a charged political setting. This can be a very difficult atmosphere in which to examine fundamental aspects of the way we regulate.

In current practice, state regulatory agencies often treat utility prices and performance in an ***ad hoc*** fashion: one set of cost recovery mechanisms for this activity, another set for a different activity; one incentive scheme for this goal, another scheme for that goal. An alternative to this fragmented ratemaking process might be called "a grand bargain."

The Grand Bargain model, as we have termed it, combines aspects of both the RIIO model and the Iowa model. The object would be to produce, through negotiation, a thorough regulatory regime that would address a broad set of issues in a consistent manner. A regulatory commission might, for example, direct a utility to undertake negotiations with a broad set of stakeholders, including the commission's staff, which would be equipped with guidance from the commission. The direction from the commission would be to negotiate a multi-year agreement concerning rates, cost recovery mechanisms, quality of service goals, environmental performance, energy efficiency goals, incentives, etc.

The commission could supply as much detail and direction to the parties as it prefers. For example, a commission might specify that the eventual agreement must contain certain performance benchmarks for the utility, as well as incentives and penalties to motivate compliance with the agreement. To motivate parties to settle, the commission could indicate from the outset its likely acceptance of a settlement agreed to by a significant group of stakeholders, even if the agreement were not unanimous.

For each of the five essential elements of administrative due process, a less formal but still effective set of procedural processes could be used: notice, a hearing, a fair decision-maker, a record and a chance to appeal. Transparency would need to be maintained, so that outcomes would be reached in open discussions. Where agreements elude such a stakeholder-driven process, the commission could still apply its formal decision making routines, acting on a more limited and better-defined set of remaining issues.

The details of the Grand Bargain model are fluid. It stands principally for the concept that, with appropriate motivation and attention from a regulatory agency, a set of stakeholders might be able to craft a solution that is superior to, and more internally consistent than, a regime that arises out of multiple contested cases at a commission.[10]

All three regulatory models discussed in this section – RIIO, Iowa and the Grand Bargain – lead the way to a new utility social compact. Utilities benefit from investment certainty, lower risks and responses to a variety of threats facing the industry. Society benefits from having public interest goals built into utility business models through regulatory incentives.

CONCLUSION

Among the nation's 3,000 or so electric utilities across 50 states we find many variations but a fundamental truth: the business models were developed for a different time. If we agree that it is in the nation's interest to move towards an electricity future dominated by renewable energy, we must realize that a new social compact between utilities, regulators and the public needs to be forged.

Utilities and situations in states vary. In a country the size of the U.S., and in an industry of the magnitude of the electric utility sector, almost any possible model or potential outcome either has been, or will be, attempted. No logical reason suggests that a single, or a small number, of possible outcomes are the only logical or prudent ones to consider. Varying situations call for a variety of outcomes. There are motivations for utilities to consider changing their business models, and options for consideration exist.

Today's constellation of challenges and opportunities recall those that led to restructuring of large portions of the utility industry starting about twenty years ago. If changes at an even greater level are in prospect now, it makes sense to prepare carefully for the discussions that must happen. Across the range of potential outcomes, there are outcomes that support the RE future as well as a regime that meets the broader traditional goals for the utility sector. There are multiple, large scale benefits at stake for consumers. These should provide enough benefits for all contending parties to share, if they are willing to join in the work of gaining those streams of additional benefits.

Utilities need the right incentives to move towards a renewable energy future and regulators and their elected officials need a way to structure public interest goals into regulation. We have seen that utilities can affect the transition towards a renewable energy future at various levels of involvement and that a variety of options have proven workable for changing their business models. But regulation provides a critical incentive in these monopoly businesses and needs to evolve in order to allow the new business models to succeed. We have outlined a series of models that offer some of the required elements. Engaged stakeholders will prove critical in the success of this transition.

Regulation will need to change to support different business models. Both state and federal economic regulators, as well as utility boards of directors, need to consider whether today's goals, objectives, and methods are sufficient given today's challenges and opportunities. Some may decide that what they are doing now is exactly what they should be doing to prepare for the future. But most will consider what needs to change so utilities better serve society's needs. Fortunately, new methods of engagement for all stakeholders are available, through processes to establish performance goals and outcomes, in the analysis and reporting required to support them, and through well planned and facilitated policy dialogues.

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ENDNOTES

1 See *Aligning Wholesale Power Markets* by Michael Hogan for more detail about how market mechanisms can deliver important signals in restructured markets.
2 Marc Chupka et al., *Transforming America's Power Industry: The Investment Challenge 2010-2030*, The Brattle Group (Washington DC: The Edison Foundation, 2008) <http://www.brattle.com/_documents/UploadLibrary/Upload725.pdf>
3 Lehr, Ronald, "*Clean Energy Investments and Incentives: Choices for Investors, Utilities and Regulators*" <http://www.cleanenergyvision.org/wp-content/uploads/2013/01/Transition-Plan_Investments.pdf>. And see: See America's Power Plan report by Foley, Varadarajan and Caperton for more detail on how policy can address stranded assets and de-risk investments in new infrastructure.
4 See America's Power Plan report by Foley, Varadarajan and Caperton*, op. cit*. for additional detail.
5 Several organization have begun to examine and address the subject of the evolving utility model, including the Energy Foundation, the Edison Electric Institute, the Energy Future Coalition, the U.S. Department of Energy, Arizona State University, the Rocky Mountain Institute, and Energy Innovation, among others.
6 For more about this point of view, see the electricity chapter of *Reinventing Fire* by Lovins, Amory.
7 "Risk-Aware Planning and a New Model for the Utility-Regulator Relationship."Binz, Ron and Mullen, Dan. July 2012. ElectricityPolicy.com. Available at <http://www.rbinz.com/Binz%20Marritz%20Paper%20071812.pdf
8 "Practicing Risk-Aware Electricity Regulation: What Every State Regulator Needs to Know How State Regulatory Policies Can Recognize and Address the Risk in Electric Utility Resource Selection," Ceres Report, April 2012. Authored by Binz, Ron; Sedano, Richard; Furey, Denise; Mullen, Dan, <http://www.ceres.org/resources/reports/practicing-risk-aware-electricity-regulation/view>
9 For a fuller discussion of these approaches, see Binz, 2012.
10 Although the "Grand Bargain" model is described here as operating in the regulatory arena, it could also be used in the context of state legislation. Indeed, in some states it may be necessary or desirable for the legislature to modify existing laws that specify details of the current regulatory model or to cement the grand bargain.