Providing Energy Services in a Changing Industry

2010 Energy Policy Forum

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Foreword

The Aspen Institute's 34th annual Energy Policy Forum considered a host of issues comprising the challenge to the electricity industry of "Providing Energy Services in a Changing World."

A group of energy leaders and policy experts invited to Aspen July 1 to 5, 2010, examined different visions for the future, explored obstacles to achieving these visions, discussed how other industries had dealt with transformative change, considered how climate change legislation might affect the electricity sector, and explored the challenges and opportunities for various primary energy sources.

The format of the Forum includes brief introductory presentations in each session followed by extensive dialogue among diverse participants with different perspectives. To encourage candor and the freedom to explore new ideas, no one may be quoted by name or affiliation.

This year's Forum was chaired by Duke Energy CEO James E. Rogers. One of the longest serving utility CEOs in the country and an active participant in the public policy arena, his experience allowed him to focus the discussion, and his skill and good humor kept difficult issues from becoming divisive. The highly qualified group of speakers and session chairs provided a wealth of information, and the expertise of the well qualified group of participants added to the richness of the dialogue.

The Institute acknowledges and thanks the following Forum sponsors for their financial support. Most have been participants and supporters for many years. Without their generosity and commitment to our work, the Forum would not be possible.

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On behalf of the Institute and the Forum participants, I also thank Gernot Wagner, who served as rapporteur. His ability to capture the highlights of a wide-ranging discussion and express them in lively language provides an example of policy writing at its best. Timothy Olson and Julia Bien-Aime managed the administrative arrangements for the Forum. Their hard work contributed to a smoothly run meeting, and I am grateful for their support.

This report is issued under the auspices of the Aspen Institute. The chairs, speakers, participants, and sponsors are not responsible for its contents. It is an attempt to represent ideas and information presented during the Forum, but all views expressed were not unanimous and participants were not asked to agree to the wording.

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Providing Energy Services in a Changing Industry

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Day in the Life of an Electron

July 1, 2010. Anyone following the path of an electron today could be excused for thinking he or she was in the wrong millennium.

"Dinosaurs" still rule the world. Large, central power stations produce the vast majority of electricity. Coal, natural gas, some oil, or uranium enters on one end. Electrons and various other byproducts—some innocuous, most not—leave on the other, pushed over long distances across aging transmission lines. Many get lost along the way.

Once at their final destinations, electrons are piped, anonymously, into businesses and people's homes. The vast majority of customers don't care about their origin or the way they get there, as long as they do, reliably, day after day.

Most people only interact with their utility when there is a service interruption and, once a month, when a plain white envelope announces the previous month's electricity use. The bill might include a quick chart, showing energy use compared to last year's, but most still remains a mystery. The frequent reaction to a bill, any bill? Anger. Why so much? Which device was responsible? How can I save money?

Utilities see the world through entirely different eyes: How to convey the message that a $200 bill buys more and better services than $20? Electrons in 1980 supplied 3 devices in the average house-

hold: the TV, the fridge, and the washing machine. Today, the number is 25. Should people even be our ultimate customers? Why not devices, leaving humans as payment authorizers? How to strike the trifecta of delivering "affordable, reliable and clean" electrons? How to stay nimble in an ever-changing world?

July 1, 2050, or perhaps as soon as 2020. Will dinosaurs still be around? Will they grow larger? Will they still be recognizable to someone today? Will they have learned to dance, treading lightly?

We know the "known unknowns," in Secretary Donald Rumsfeld's words. At least we think we do.

We know there will be a price on carbon backed up, some think, by a limit on emissions, just not when and how high.

We know there will be tighter regulation of SOx, NOx, and other pollutants, just not when and in what ultimate form.

We know there will be more devices per household than today's 25; at least we think we do.

We know natural gas will challenge coal as the fossil fuel of choice, but how successfully?

We know that the current state-level regulatory regime will shift, just not how.

None of this even mentions what we simply don't know. Worse, we don't know what we don't know. Few predicted the financial crisis. Fewer predicted the BlackBerry. Even fewer saw shale gas as a dominant force in U.S. energy policy by 2010 at a time when the majority of the fleet of coal powered plants now in operation was built. Call them "unknown unknowns," black swans, or just good old surprises. Call them what you will, they define the outcome and likely the world in forty, twenty, or even ten years.

Sir Arthur C. Clark is sometimes credited with saying that all change is overestimated in the short term and underestimated in the long term. He also wrote that:

> "If we have learned one thing from the history of invention and discovery, it is that, in the long run—and often in the short one—the most daring prophecies seem laughably conservative."

Which is it? And how should we prepare?

And what about the world beyond America's shores? Electrons don't travel well overseas. Other forms of energy do and, most importantly, so does money. It doesn't take much to assume major shifts in the balance of power—the one related to geopolitics and the one linked to the production, distribution and use of electrons. Combine a slow economic recovery in the United States with severe budget constraints on federal, state and local levels, a shift away from central power generation, and a scenario where continued technological change will outstrip traditional utility regulation, and you very quickly end up in a world where the East, rather than the West, defines how electrons move from producer to consumer, and whether there will even be much of a distinction between the two. Who will hold the patents that define energy generation in the future?

Will distributed generation become disruptive in the best, Schumpeterian sense of the word and ring in an energy revolution akin to those in the communications or computing sectors? Or will disruption jeopardize reliability and affordability to a point where staid utilities become the most attractive model? Which type of dinosaur will survive: the Asian and European model of integrated electricity companies, or the common U.S. model of utilities as distinct from other entities in the energy supply chain?

What's the role of policy? The internet was a government creation. Should the smart grid be one as well? Will regulation or technology

come first? Will good policy spur a modernized grid and with it solar panels on each roof and an electric vehicle in each garage, or will distributed solar generation and EVs spur policy reform and be the enablers—rather than beneficiaries—of the smart grid?

July 1 through 5, 2010 saw the 34th incarnation of the Aspen Institute's Energy Policy Forum. It started just as participants of the annual Security Forum were leaving the glorious Aspen Meadows campus, and it ended on the first day of the Ideas Festival—a fitting metaphor. Energy policy often starts as a fundamental question of security and ends with a *cri de coeur* for ideas.

This year's Forum was no different. It raised many questions, provided some answers, and ended with a slew of ideas for how energy policy could look at the time of the 35th, 45th, and 55th incarnation.

All of these ideas and statements shall remain anonymous. That also goes for comments voiced during the open discussions. Most everything in this report has been borrowed liberally from others in attendance, often verbatim—without fear, favor, and without attribution.

Envisioning the Future

One possible vision of the future, call it "Seismic Shifts."

First, a few assumptions: The United States economy will recover slowly, at least compared to the awesome, double-digit growth experienced in some emerging economies. Deficits in the West will only grow in the foreseeable future just as populations are aging, putting real strains on public finance, especially on the state level. All the while, Asian and other emerging economies grow and modernize rapidly.

The probable immediate consequences? Infrastructure investments will happen in Asia, the multi-speed recovery will endanger the unipolar world and lead to global shifts in power, causing risks of political instability in the West.

What does this mean for energy in the United States? For one, the search for lost win-win opportunities will intensify. Buildings and transport will become more efficient. Populations will be more urban, with more rental and fewer second homes, which all leads to less demand for primary energy, as long as we can overcome the inherent disincentives renters face to investing in efficiency improvements.

Slow or even negative demand growth will make large central station generation much less important. That includes new nuclear plants as well as utility-scale renewable developments, except as they are used to replace existing generation capacity.

Underlying all of this is the assumption—not too far-fetched—that technology will outstrip regulation and that state Public Utility Commissions (PUCs) will increasingly be sidelined to the point where they could even become irrelevant to energy policy-making in the United States.

These "Seismic Shifts" assumptions point to several themes. One is the shift to Asia, tied into what The Economist calls "frugal innovation," a search for technologies that benefit the budget-minded and ultimately the global poor. Health care is one such example with large shifts looming on the horizon. In the West, most equipment is built for large, centralized hospital systems. Rural Asian clinics require small-scale, cheap innovation, and that is where the trend is going. These trends in health care have immediate effects on energy, especially linked to battery storage and electric vehicles for better access. They also have parallels to the world of distributed energy generation, where small scale and local or regional independence will be in and large central generation and distribution systems may no longer be as attractive.

Another theme is the general move toward electrification, perhaps best exemplified through the emergence of electric vehicle (EV) technologies. China is the fastest growing car market and has little legacy infrastructure. Cheaper and better EVs will be driven by demand in Asia.

EVs will also change the way electricity is produced. They can serve as grid storage and, thus, back up renewables when the sun does not shine or the wind does not blow. Clean technology and smarter grid infrastructures will lead to an entirely new energy system unavailable (and perhaps unimaginable) in the West.

The large question is what this vision of Seismic Shifts entails for the dinosaurs in the field. On one level, adaptation in this new world is not a mandatory condition, so change is not absolutely required. On the other hand, of course, there may well be good reasons for large utilities to play a continued, strong role long after this vision has become a reality.

Adaptation entails a radical shift from past practices. The emphasis cannot be on changes on the margin—load shedding, load shifting or load shaping—but it ought to be on designing an entirely new system and mindset. Clean technologies will play a major role in this vision, as will building efficiency, EV storage, and distributed generation.

Most of all, thriving in this vision of the future requires true visionary leadership on top. As Henry Ford is often quoted as saying, "If I had asked my customers what they wanted, they would have said a faster horse."

Another possible scenario sees changes akin to those in the telecommunications sector over the past two decades, a shift to a more "Customer Centric" vision.

The breakup of AT&T in the early 1980s led to a dramatic change throughout the telecommunications industry. New technologies such as cellular phones emerged. Already existing technologies, most notably computers, became orders of magnitude smaller, faster and cheaper, culminating in dramatic changes brought about by the advent of the internet. It is not hard to recall a time before email and Google, mainstays of today's life that were unavailable twenty years ago. The communications and information services industry went from meeting needs to creating wants, as evidenced by Apple's iTunes, iPhone, and iPad. The energy industry may well be at a similar inflection point now.

Today's electricity sector is singularly focused on the production of electrons and has little connection with customers. Smart grid and smart metering technologies will usher in important changes, but it is not enough to wait for these technologies to emerge. The customer education process needs to start now. Energy is an essential component to meeting needs of new technologies and pursuing wants of commercial and residential users, but customers rarely link energy directly to the satisfaction that is sought. If anything, cheap, reliable energy is considered a "right." This view will likely change dramatically with smart grid and smart meter communications, pro-

viding information and energy efficiency technologies that will help customers manage their energy use in ways that fulfill their lifestyle goals and enable a new level of customer interaction.

As a first step, utilities ought to redefine the customer relationship by providing more options and choices, leading customers to feel some sense of control when it comes to their energy bill. The more utilities are able to demonstrate to customers that it is "their" energy bill, the more value they may perceive because they will tie the purchase and use of equipment such as television sets to electricity usage. Right now, TV buyers for the most part simply don't think about the ensuing electric bill. As a result, many make purchasing decisions without knowing that their electricity usage—and their monthly bill—will increase, sometimes dramatically.

This vision relies on technology more than anything else. It is not farfetched to think that electronic intelligence within the home will provide an opportunity for customers to dictate a reasonable monthly bill and have household devices take over to assure that happens.

Some utilities are already experimenting with models of greater customer engagement, sometimes with surprising results. Customers who volunteer for disruptible technology—appliances that can be turned off remotely by a utility in cases of severe electricity shortages—report the highest customer satisfaction, mainly because the utility has a direct connection with them.

Ultimately, the "Customer Centric" vision will lead to a world where customers can look at their monthly bill and say, "I get it," much like what happens today with cable and cell phone bills. The more you pay, the more service you get, and you as the customer have the informed choice of determining the level of service.

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Whether one believes the "Seismic Shifts" vision or the more modest but still potentially disruptive "Customer Centric" view, change is coming. The world will necessarily be more complex,

dynamic, volatile, global, non-linear, digital, virtual, distributed, and driven by unsuspecting, far-out events than in the past. Every industry is going through this change. Energy will be no different. (Take the BP Gulf spill as the most prominent example of an unanticipated event with potentially enormous consequences for energy policy for years to come.)

What does this mean for how energy companies operate? One likely near-term change is the move toward distributed rather than centralized generation, toward light rather than large capital investments. This also means a further shift from monopoly to competition, from stable, regulatory environments to possibly volatile, market-based realities.

This shift will be much more disruptive than the move toward independent power producers taking on regulated utilities in the 1980s. Independent power producers still very much look like centralized utility companies. The new entrants will be the likes of Wal-Mart and Google. One is actively pursuing distributed generation and models of demand response that give it more control over its energy use; the other is entering the energy management services market. Neither is dependent on the whim of any single utility. It is also unclear whether either step requires regulatory approval. And what Wal-Mart and Google do, others will soon mimic or perhaps even surpass. Imagine what would happen if one of the larger car rental companies decided to change most of its fleet to EVs.

Perhaps the best analogy for the future of energy markets is the computer game Minesweeper. A single move can result in dramatic territorial expansion, or in everything blowing up all at once. That is not an appealing prospect for large incumbents, whose investments depend on stable demand projections and assurances of capital cost recovery through long-term purchasing commitments. It may well be a more appealing proposition to smaller, more nimble operators.

A requirement for any of these visions is the need for policymakers to step in and set clear goalposts, given the current state of a high degree of policy uncertainty. For example, the reality of climate change mandates steep cuts in emissions of global warming pollut-

ants. The big question—still, after over ten years of debate—is which form the policies will take and how they will interact with regulations for mercury, fine particulates and other criteria air pollutants that may soon face much tougher regulation.

The trend is clearly pointing toward cleaner generation. In 2008 already, global investments in renewables exceeded those in fossil fuel generation. Even without policy certainty, renewables provide a built-in fossil fuel price hedge. Generators try to avoid investments in new fossil fuel-based generation and instead invest in subsidized or mandated sustainable generation. Still, U.S. utilities are often hesitant to invest in renewables without such a clear framework for action.

It may be difficult to predict the future, but legislators can take a large part of the guesswork out of the equation by setting clear policy objectives. With or without a transition to cleaner generation, utilities need to spend hundreds of billions of dollars to replace aging plants and equipment. This money has to be raised from investors who are wary of uncertain goalposts. Taking the guesswork out of long-term investments by getting environmental policy right soon will mean a more affordable, more reliable, cleaner and, ultimately, more prosperous future for everyone involved.

Adapting to Change—Learning from Others

Today is not the first time the U.S. utility sector has faced major transformations and some tough policy choices. The Public Utility Regulatory Policies Act (PURPA) of 1978 ushered in a first wave of changes. Billed as a conservation policy to encourage independent power producers to enter the market with cogeneration and renewables, the law morphed into the vanguard of electricity deregulation in the early 1980s.

PURPA prompted shifts in the financing model for power generation. Regulated utilities mitigated risk by passing costs to customers through the regulatory process that approves new power plants and sets rates. The new crop of independent power producers emerging under PURPA used long-term contracts to deal with risk. These contracts allowed new entrants to attract financing for long-life assets. Independent power producers managed to reduce costs significantly. Utilities used to build new generation for roughly 7 cents/kWh. With PURPA, new entrants were able to lower costs to around 4 cents/kWh, although avoided cost rules in several states kept prices from falling proportionately.

Notably, PURPA's implementation depended on state regulators. Some, like those in California, used the Act to jumpstart renewable builds and encourage co-generation, plants supplying both electricity and steam. Many other states virtually ignored the Act.

Carbon policy is today's PURPA. Policy uncertainties abound, but even the most myopic scenarios—assuming no price on carbon—show significant investments in renewable and cleaner generation capacity, given that current laws already favor green investments over new coal plants. The higher the assumed carbon price, the higher are projections for clean investments. Big winners will be nuclear, wind, solar, and other renewables, but also natural gas, which is relatively cheap even without a price on carbon.

A climate bill could practically phase out conventional coal generation in the United States by 2050. Even gas generation might begin to decline well before that date. Carbon policy will have profound impacts on U.S. generation decisions in the foreseeable future and for decades to come.

The energy sector can also learn by looking past its own history. Three comparisons seem particularly informative: airlines, telecommunications, and finance. All three industries have experienced major upheaval in the past couple of decades. At some point they have all been dominated by large incumbents that are now facing significant competition from upstart companies, some of which themselves have turned into major players.

Airlines present a particularly striking example, but not necessarily (just) because of low-cost carriers challenging the majors. An even more important development is happening behind the scenes, in the way tickets are sold, managed, and distributed.

The entire sector has significant global economic staying power: a $500 billion industry with over one billion tickets sold per year. Sixty percent of all ticket sales go through indirect channels, which are dominated by three global distribution companies. The distribution price per ticket is fixed at around $15. Core distribution technology dates back some 30-plus years and focuses almost exclusively on price and schedule, not any other conveniences that make flying enjoyable.

Complexity has protected the industry's three ticketing incumbents, but that is bound to change. Airlines are trying to reassert control of their own products across all distribution channels without having to go through any of the three. In theory, the distribution price per ticket could be slashed to $2 from its current $15—a significant change anywhere and especially in such a low-margin business.

These changes would put airlines in much closer contact with their customers and enable them to look beyond seats as their sole product. Still, change has been slow. After decades, airlines are finally wresting control of their product from the incumbents. The main reason? Technology and an upstart entrant.

Negotiating with distribution companies has made little difference in decades. Now that new web-based systems can provide the same services much more cheaply, a new player has emerged claiming to offer airlines everything they get from today's incumbents, plus the benefit of new technologies, at a cost of $2 per ticket. This upstart will not uproot the entire industry overnight, but it—and possibly similar entrants—may bring about long-overdue changes.

Telecommunications has been completely transformed in the last three decades, starting with the breakup of AT&T. Today, there are three regional monopolies on landlines—AT&T, Verizon, and Quest/US West—but also many other moving parts, starting with mobile media. These changes did not happen by themselves.

Statutory impetus played a key role. In particular it helped merge two formerly separate industries. The 1996 U.S. Telecom Act, coupled with wireless spectrum auctions, has moved the voice-centric telecommunications industry closer to the data-centric computer sector. The profound implications hardly need elaboration. Hundreds of billions of dollars worth of shareholder value has been created since.

These changes may well be dwarfed by coming changes in the energy sector. Landline telephony has achieved a 20-25 percent worldwide reach. Personal computing and data networks have achieved a 40-50 percent worldwide penetration in a fraction of the time. Cellular phones now reach 50-65 percent of people worldwide. Access to electricity is currently at a global penetration level of above 70 percent.

This comparison also points to a significant difference between telecommunications and energy. Telecommunication companies largely grew into the void. Customer needs changed as technologies became available, and companies have ended up fulfilling demands that were unimaginable only a decade ago.

Electricity is different. Whatever energy revolution may come, or may already be under way, it is not growing into a void. Energy innovation, for the most part, will replace and update existing infrastructures rather than build entirely new ones. That gives utility incumbents more opportunity for control. It also puts a greater burden on regulators to enable innovation while ensuring that basic needs are met.

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Finance is a third industry ripe for comparisons with energy. Banking has undergone considerable periods of booms and busts in its thousand-year history. Most were periods of intense innovation followed by a bust and subsequent regulations trying to prevent problems of the past: innovation, boom, bust, regulation, innovation, boom, bust, regulation. Almost by definition, regulators have been lagging behind the innovation trends. The latest cycle has proven to be no different, except that (de)regulators helped jumpstart the process.

In the 1960s, banking was a relatively stable industry. Four investment banks controlled two-thirds of the business. In the late 1970s

and early 1980s, legislators and regulators took several steps that reverberated throughout the industry. Merchant banking started in earnest in the early 1980s, prompting a 25-year run that culminated in the spectacular crash of the late 2000s.

What caused all of this? The need for finance because of high economic growth surely played one role. Disruptive technologies, like high-powered computing, globalized finance and likely contributed much more directly. But policy—or the lack thereof—had the largest impact of them all.

Over-the-counter trading led to little or no transparency throughout large parts of the finance sector. Putting liabilities off balance sheets allowed enormous amounts of leverage completely out of proportion to the underlying risks. And changing attitudes toward risk played another important role. Banking culture changed dramatically as risks were offloaded onto others.

Not unlike the telecommunications sector, we have already seen re-consolidation in banking as well. We are once again in a world where fewer than ten companies do most investment banking business. Going forward, we will see less leverage, less profit, and also some risks that banks will migrate offshore. The charge once again falls on regulators to prevent the perilous cycle from repeating itself.

Perhaps the most important parallel to the energy sector is one related to the wider risk structure. Financial firms, much like utilities, have traditionally socialized costs of their actions—unmitigated risk in one case, capital risk and pollution externalities in the other. Neither is sustainable, either in the financial or environmental sense of the word.

Once again, the burden is on policymakers to set the right framework for action. Utilities themselves have long experimented with alternative business models. As early as 1991, the Sacramento Municipal Utility District experimented with interruptible demand to turn off air conditioners for twenty minutes in return for a small payment to customers.

The question is how to set the right policies and create the right rewards structures to enable more innovation like that and also ensure its wider distribution.

Now. Not in another twenty years.

Impediments to Achieving the Vision

Talking about impediments to achieving the vision assumes that there is indeed a vision.

There is a vague agreement that America needs a "clean energy economy," but that is far from a unifying vision. We know the themes. We can draw up different scenarios—different visions—of the future. But what people mean by this, expressed in what policies they advocate, differs widely.

Lack of a single vision is intimately related to a host of uncertainties: from the macroeconomic (around U.S. medium and long-term growth projections) to the regulatory (around timing and extent of environmental legislation and rules) to the technological (around the availability of a secure and reliable smart grid).

In the end, it is not just uncertainties that drive the outcome, it is disagreement over the value of policies, their cost to the economy, and, more than anything else, the distributional impacts (winners and losers) of the policies.

The underlying uncertainties and policy disagreements pose real challenges but also provide ample opportunities to actors within and outside the energy sector. They will imply new sets of winners and losers, which may well be unique to each regional and state market.

Another key impediment to moving forward is the often arcane regulatory structure throughout the industry. Electricity generation is defined by a fractured, state-by-state regulatory system. The present regulatory system may suit politics quite well, but it does not reflect the physical reality of electricity transmission. Electricity is a national not a parochial issue. Some states have decoupled markets, some don't. Some are regulated, some deregulated. And it is not simply a states-versus-federal divide. Federal regulation itself is split into regions with regional transmission organizations (RTOs) and those without.

Disparate regulatory environments can be fruitful laboratories for policy experimentation and also encourage new entrants, but, on balance, they likely do more harm than good. It is clear that many squash innovation by incumbents.

One significant barrier in this context is the tendency of regulators to choose winners and losers. In most cases, regulators are simply not in a position to decide among different innovations. That ought to be left to the market and, ultimately, the customer.

Despite talk about deregulation, the electricity industry remains one of the most heavily regulated industries in the United States. While the absence of regulation is unrealistic for such a critical industry, true innovation cannot thrive in the current environment.

Yet not all of the blame lies with legislators and regulators. Utilities are often as guilty. Instead of focusing on the final customer, they tend to see regulators as their client and tailor innovation and project ideas to them. That may be a prudent short-term strategy, but it hinders long-term changes. Innovation by incumbents means giving up control. That goes for utilities as much as for regulators. Most every regulated, incumbent firm has renewable energy groups within its organization. The question is how to give the right signals to each division and foster innovation from within. Of course, utilities may well require a strong regulatory impetus to in fact shift toward innovative new models instead of creating barriers to potential new entrants.

One potential barrier is the need for and possible difficulty in obtaining appropriate financing for new utility projects. The utility sector faces the unenviable task of investing in a forty-year cycle, while equity markets today are operating under extremely short time horizons. Add to that the fact that we are entering a period of investments unseen in over thirty years, and the problems become clear.

With more expensive financing come higher electricity rates. After years of near-constant rates in real terms, price increases due to financing constraints are very likely. Combined with carbon pricing, which provides another reason why rates would go up, this may well lead to as of yet unseen increases and poses a clear threat to the industry. Most prominently, it may well lead to populist calls for less ambitious climate policy.

Another fundamental barrier is the lack of accurate and clear price signals throughout the electricity market. The smart grid holds enormous promise to put the customer in charge of his or her electricity demand, but the grid, no matter how smart, cannot live on new technologies alone.

The smart grid requires smart market design.

If price signals are mashed and squashed and averaged over time, the smart grid—any grid—will face enormous difficulties in reaching its full potential. Accurate, transparent, real-time price signals throughout the entire grid are the *sine qua non* of policy design that can foster rather than impede innovation.

We also need to keep in mind that customers, in the end, care little about real time rates. Regulators care about rates. Customers care about monthly bills. Rates are part of the equation, but equally important are ways to respond to these rates in real time. That may well be something that requires new technologies and demand response mechanisms, which will allow customers to control monthly bills without having to worry about fluctuating rates themselves.

The electricity sector has already experienced substantial shifts over the last ten to twenty years. We have seen decoupling of economic growth and electricity use throughout the country. We have seen awesome technological leaps in renewables and grid design. We have also seen a general movement toward deregulation. However, regulators are not going to go away, nor should they.

The question facing the industry now is how to change regulation and how to adjust to this changed and changing regulatory environment. Ingrained institutional and other constraints are mindboggling. At the very least, though, there is an emerging consensus that things ought to change. Here's hope that this change will be for the better.

Achieving a Low-carbon Future

Climate change is a real and present danger to our planet.

Comprehensive climate policy limiting greenhouse gas pollution is inevitable.

These are the starting points. It was hard to find anyone in Aspen who disagreed with them.

The question is when federal legislation will come and what form it will take. Who will be required to act? Who will be exempt? And, ultimately, will legislation do the job science requires it to do? Will we be able to put the framework in place now for steeper emission cuts later? Will we see one comprehensive legislative package or a patchwork of different efforts, updated over time with legislative uncertainty for years to come?

We know that with or without carbon policy virtually every power plant except hydro will be replaced by 2050. One question is how fast this transition will happen and in which direction it will go. The longer we wait to set up clear goalposts for carbon policy, the costlier the transition will be.

So, when can we expect comprehensive legislation?

This was supposed to be the moment for action. Sixteen years after President George H.W. Bush signed and the Senate ratified the United Nations Framework Convention on Climate Change, pledg-

ing to prevent "dangerous anthropogenic interference with Earth's climate system," both presidential contenders in 2008 were strong supporters of climate action in general and economy-wide cap-and-trade systems in particular. Then-Senator Barack Obama made it one of the pillars of his campaign. Senator John McCain had been a co-sponsor of climate bills in the past.

The policies were all lined up. Market-based programs combined progressive policy goals (the cap) and conservative tools (the trade), enabling a bipartisan coalition. In fact, the House passed comprehensive climate legislation in June 2009, but the Waxman-Markey bill passed with little Republican support.

At the time of the Aspen Forum, all eyes were on the Senate. The policy was roughly the same; the politics were very different. Twenty-five percent of votes for the House bill came from New York and California. In the Senate, these two States command four percent of the votes. In light of the politics, especially during an election year, the final outcome of a bill this year looked uncertain. Could it be a "power-sector first" cap? Would it be combined with a bill in response to the BP Gulf spill? Would there be an "energy-only" bill without establishing a price on carbon? If so, how would it be reconciled with the House version?

The politics are tricky, in particular given the current demonization of cap and trade. Most Aspen participants agreed that market-based mechanisms are fundamentally the best idea. Tarnishing them irrevocably with election-year political calculations is not just bad policy; it is also bad politics in the long run. Of course, it is possible to oppose cap and trade and still put into place policies that decrease carbon emissions. Texas is a prime example. The state has put in place significant direct support for wind generation, through a direct command-and-control mandate, although it is unclear whether this approach can be taken nationwide and even less clear that it should.

Stepping back from the day-to-day politics, it is important to remember that whatever happens in Congress in the remainder of

2010, albeit very important, will likely pale compared to what will happen in the next few years, with or without Senate action.

One important element in the equation is regulation under the Clean Air Act. Almost three years after the U.S. Supreme Court decision giving EPA authority to regulate carbon dioxide, EPA has created stricter mobile source standards and, barring any further legislative changes, it will start regulating carbon from stationary sources in 2011.

While effective in some sectors, top-down EPA regulation will come at a relatively high cost compared to comprehensive market-based legislation. The prospect of this kind of regulation ought to serve as an inducement for Congress to take action with a better approach.

A crucial question is whether EPA *may* (legally) create a carbon cap-and-trade system under existing Clean Air Act authority. Probably. There is positive precedent from the limited emissions trading program in the 1970s, the highly successful lead phase-down in the 1980s, and the NOx budget program implemented in the early 2000s. (By contrast, the successful sulfur dioxide trading program in the 1990s was created through legislation, the 1990 Clean Air Act Amendments.) Even more important, though, is the question whether EPA *can* (politically) create a significant carbon market. The answer to that question is less clear.

Sub-national policies such as California's Global Warming Solutions Act (AB 32), the Western Climate Initiative, and the Regional Greenhouse Gas Initiative (RGGI) in the Northeast play another important role. Originally, most if not all of these programs were conceived as stepping stones toward federal legislation, but they may well have to stand on their own.

There can clearly be sensible state-level policies with an economy-wide federal carbon-pricing policy in place. A federal cap-and-trade system by itself would not address all market failures such as

principal-agent problems regarding energy-efficiency investments in renter-occupied properties, which requires the local application of sensible building codes.

However, in the absence of meaningful federal action, subnational climate policies would have to be the core of national action. That raises significant questions around their effectiveness. A patchwork of different state-level rules would lead to clear inefficiencies that may render some of them much more expensive than necessary. Still, linkage of state and regional cap-and-trade may well become the *de facto* post-2012 national climate policy.

Leaving politics out of the equation, most agreed that the best alternative to economy-wide cap and trade in 2010 is economy-wide cap and trade in 2011, or even 2012. In reality, the answer to the question of what is the best alternative to economy-wide federal cap and trade in 2010 is more a political than an economic question.

In the end, a fundamental issue is that a large and growing minority of Americans does not even believe the climate is indeed in crisis. This is, in part, a result of the increasing polarization of our political system. It also points to a fundamental failure of communication. Bottom-up demand from the political populace for addressing this problem has not been the answer so far. In its absence, leadership from the top, bolstered by a very different communications strategy, will likely be necessary to get the message across. Talk of "capping smokestacks and taxing imported oil" might link good with bad policy. But it gets people's attention and may well be good politics.

Another push may come from markets themselves. We have always operated under the assumption that climate policy will drive technology and innovation. Perhaps technology and innovation—and the threat of being left behind in both areas—will prompt elected officials to act.

Fueling the Future

Despite all the uncertainties, unknown unknowns, and political delays, paralysis is not an option. The energy industry needs to move forward. Fueling the future will require a portfolio of responses, and a mix of fuels. The contribution each can make may depend on technological advances or regulatory changes.

Coal will likely continue to play a role in this mix, especially coal with carbon capture and storage (CCS). Advanced coal technologies still face some important technical, legal and policy issues, but a few states are already moving forward with enabling legislation and the U.S. Department of Energy is helping to fund several CCS demonstration projects.

The feasibility of CCS, ultimately, is a question of a price on carbon as well as of technological progress. Achieving capture rates of 90 percent of carbon is technically achievable. Storage will still be a major issue, but the most fundamental question is that of costs. Total costs of CCS right now are around 6-8 cents/kWh. Those either need to be brought down to 4-5 cents or lower, or carbon needs to be priced into the equation, to make CCS viable. Without a steep price on carbon, which is unlikely in the near future, direct subsidies will be necessary. Those should aim both at basic research to bring the fundamental cost drivers down and also at deploying CCS at scale, for example through demonstration plants co-funded by the Department of Energy.

Natural gas is a possible bridge to a low-carbon future. New gas plants are already underpricing new coal plants today, even without a price on carbon. There are abundant global resources, in particular in unconventional forms such as shale gas. This provides a marked shift from the situation only two or three years ago, when gas in the United States was seen by most as running up against real supply constraints. Environmental concerns about shale gas production may yet put these new reserves out of reach. If shale gas is environmentally unsustainable, it will be politically unsustainable.

Still, gas alone—without CCS—can only be a bridge. It may be less carbon-intensive than coal, but it is still a fossil fuel after all and cannot be the full answer to the need to decarbonize. That may prompt calls for CCS for gas, which would likely entail the need for similar subsidies as in the case of coal.

One zero-carbon fuel is nuclear. The industry is experiencing a global renaissance with over 60 plants announced internationally, over 20 alone in China, and expectations are that all of them will, in fact, be built. Similarly, France will be starting to replace its entire fleet soon, while the policy situation in the United States is unclear.

The most optimistic predictions point to very little impact on the national fuel mix by 2020, although, in theory, we could have as many as 45 new plants by 2030. The major issue is the relative cost of nuclear power and the financing of large projects in such a volatile policy environment. A concerted push for nuclear in the United States would likely require expanded financing guarantees and overall regulatory certainty.

A big problem for nuclear is that one serious accident anywhere in the world could derail nuclear efforts everywhere. The industry needs a strong international regulatory regime that puts safety first and a commitment by major international suppliers not to build new plants in countries without a strong safety infrastructure.

The largest changes in the energy mix will be in energy efficiency and renewables. Efficiency is the ultimate low-cost energy resource. McKinsey estimates that the United States could reduce its overall

energy use by as much as 30 percent by 2030, while even saving money at the same time (assuming behavioral obstacles can be overcome at no or low cost). The technologies are available today and are already in use in various forms. The question is how to enable consumer and utilities to monetize these efficiencies and to scale their use.

A sustainable energy policy will likely require "all of the above." Barring major shifts, we cannot rely on any one fuel to revolutionize the future energy industry. A smart portfolio approach will require concerted, coordinated efforts. That will likely entail considerable trade-offs across sectors and tough decisions where limited funding ought to go.

Several potential interventions could make a real difference in the overall energy landscape and help bridge sector-by-sector differences.

First is a price on carbon, either by means of a cap or a tax. Short of that, a federal renewable energy standard could partially fill the void and overcome the patchwork of state-level standards. Other possibilities are federal tax incentives, nation-wide efficiency standards and a whole host of creative financing frameworks including HomeStar, alternative loan guarantees and others.

All of this requires more active government involvement in energy markets, in particular vis-à-vis funding of research and deployment. The American Energy Innovation Council talks about the need for $16 billion in federal clean energy funding, a three-fold increase of current funding levels. That would be a start. It will also be an important step to open up federal research funding. Currently, energy research and development funding decisions are largely an inside game. Research funding ought to be diversified to follow multiple paths and not simply go through existing channels.

Moreover, any research initiatives ought to include a focus on deployment of new technologies. That is the true strength of the Chinese push for renewable energy. New technologies will be important in the longer term, but most near-term gains lie in the

aggressive deployment of existing renewable technologies, driving down costs and, thus, creating positive spillover effects for others.

None of this should overlook the power of markets and incentives. One simple rule change around decoupling of utility revenue from sales can prompt enormous changes that reverberate throughout the industry and make tapping into efficiency potential pay. All too often, there is an almost religious fervor to put too much faith into technological breakthroughs that makes it easy to overlook the important, hard choices like getting market rules right—and pricing carbon.

Appendices

Agenda

"Providing Energy Services in a Changing Industry"

Chair:
James E. Rogers, CEO, Duke Energy

Friday, July 2

8:30 am—noon

SESSION I: Envisioning the Future

This session will consider various visions for providing energy services in the future, including roles for existing providers and new entrants.

Chair: **Jeff Sterba,** Chairman, PNM Resources

Speakers: **Jeff Miller,** Partner, The Tremont Group

Michael Yackira, CEO, NV Energy

Judy Warrick, Senior Advisor, Global Power and Utility Group, Morgan Stanley

1:30—5:00 pm

SESSION II: Adapting to Change—Learning from Others

Other industries, and to an extent the electricity industry itself, have gone through or are going through transformational changes. How are they similar to or different from what may be facing the electricity sector, what were some of the unintended consequences of past changes, and what can be learned that will help in dealing with the coming transition in electricity?

Chair: **Bill Dickenson,** Executive Managing Director, Navigant Consulting

Speakers: **Roger Naill,** Senior Associate, IHS CERA; and Founding Officer, AES Corp.

James K. Davidson, CEO, FareLogix Inc

Arjun Gupta, Founder and Managing Director, Telesoft Partners

William E. Mayer, Partner, Park Avenue Equity Partners

Saturday, July 3

8:30 am—noon

SESSION III: Impediments to Achieving the Vision

Whatever the desired vision for the future, achieving it will require participants to be flexible and able to determine their appropriate spot in the supply chain. It will also require the ability to overcome purposeful or inadvertent obstacles that may be imposed by the regulatory system, financial markets, entrenched or new entrants, or their own organizational behaviors and blind spots.

Chair: **Peter Fox-Penner,** Principal, The Brattle Group

Speakers: **Ram Sekar,** Consultant, McKinsey & Company

Dan Eggers, Managing Director, US Power and Utilities, Credit-Suisse

Suedeen Kelly, Partner, Patton Boggs

Merribel Ayres, President, Lighthouse Consulting Group

Sunday, July 4

8:00—11:30 am

SESSION IV: Achieving a Low-carbon Future

Policy decisions on climate change and their timing could have a large impact on how the electricity sector develops. What is likely to happen with cap-and-trade legislation, what are the pros and cons of other policy options that might be adopted, what should be done in the near term if legislation is delayed, and what is the cost of delay?

Chair: **James E. Rogers,** CEO, Duke Energy

Speakers: **Jason Grumet,** President, Bipartisan Policy Center

Robert Stavins, Harvard Kennedy School

David Hawkins, Director – Climate Programs, NRDC

Jeff Bingaman, Chair, US Senate Energy and Natural Resource Committee

Monday, July 5

8:00—11:30 am

SESSION V: Fueling the Future

However electricity services are provided in the future, the question of primary energy sources will remain. What regulatory or institutional changes or technological advances are necessary to allow various fuels to make their maximum contribution to a secure, affordable and environmental sustainable future?

Chair: **Ernie Moniz**, Professor of Physics and Director, MIT Energy Initiative

Speakers: **Susan Tomasky,** President, AEP Transmission

Melanie Kenderdine, Executive Director, MIT Energy Initiative

David Garman, Decker, Garman, Sullivan and Associates

Marvin Fertel, President, Nuclear Energy Institute

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