2014 Aspen Institute Clean Energy Forum

Tectonic Shifts in the U.S. Electricity Sector


Andy Karsner & Roger Ballentine, Co-Chairs
Dave Grossman, Rapporteur

The Aspen Institute Energy & Environment Program

Tectonic Shifts in the U.S. Electricity Sector

2014 Aspen Institute Clean Energy Forum

Andy Karsner & Roger Ballentine, Co-Chairs
Dave Grossman, Rapporteur

For additional copies of this report, please contact:

The Aspen Institute
Publications Office
2014 Carmichael Road
P.O. Box 222
Queenstown, MD 21658
Phone: (410) 820-5326
Fax: (410) 827-9174
E-mail: publications@aspeninstitute.org
Web: www.aspeninstitute.org/eee

For all other inquiries, please contact:

The Aspen Institute
Energy and Environment Program
One Dupont Circle, NW
Suite 700
Washington, DC 20036-1193
Phone: (202) 736-2907
Fax: (202) 467-0790

The Aspen Institute
One Dupont Circle, NW
Suite 700
Washington, DC 20036-1193

Published in the United States of America in 2014
By The Aspen Institute

Printed in the United States of America

14/020
ISBN: 0-89843-614-1

TABLE OF CONTENTS

PREFACE

The Aspen Institute Clean Energy Forum brings together top energy, finance, cleantech and policy experts for an in-depth and forward-looking examination of the transition to a clean energy economy. The overall objective of the Forum is to generate action pathways that can drive change in the transition to a cleaner, more resilient, and more connected energy system. This report summarizes discussions at the fifth convening that took place in Aspen, Colorado, from July 10-13, 2014.

A consistent strength of the Forum is the interaction among experts with diverse views trained in different disciplines. I thank all the participants who joined the conversation with their expertise and candor which enabled new, collaborative, cross-disciplinary thinking.

I want to give a special thank you to our co-chairs, Andy Karsner and Roger Ballentine, who both put in countless hours to ensure we had a robust agenda and the right participants in the room. Their strong moderating skills also ensured everyone remained productively engaged and motivated. It has been a true honor to work with them both over the last several years.

Our rapporteur (and raconteur), Dave Grossman, ably captured the richness of the wide-ranging discussions and distilled the highlights into an eminently readable summary. Tim Olson, Nikki DeVignes, and Kellee Lockwood efficiently and cheerfully managed the preparation details that enhanced the substantive focus of the Forum.

We are especially grateful to Gil Forer and EY for their generous support of the forum as our anchor sponsor over the last three years. Sincere thanks also goes to the following supporting sponsors: Walmart, GE, NREL, VanNess Feldman, NRG, Argonne National Laboratory, Duke Energy, Hannon Armstrong, The Austin Technology Incubator (UT Austin), and Distributed Sun.

This summary is issued under the auspices of the Aspen Institute's Energy and Environment Program. The participants are listed for identification purposes only and are not responsible for the summary's narrative, conjecture or any errors.

David Monsma
Executive Director
Energy and Environment Program
The Aspen Institute

FOREWORD

There are many differing views on the actual pace and plans by which the United States is transitioning to a cleaner energy future, even among those who are actively pursuing it. Many advocates long believed that top-down regulatory policies and a perceived inevitability of social demand addressing environmental imperatives would be a catalyst of change. But a complex array of market forces, especially rapid technology advance and integration and consequent economic disruption to existing business models in the electricity sector are amongst the most powerful and influential sources of fundamental change. Policies and enlightened social imperatives are increasingly showing themselves to be only partial drivers – if not by-products – of change being more profoundly driven by empowered customers, better business models, competitive forces, and technological advances. The industry is entering a new era in which energy companies are selling consumers on valuable, technology-enabled products and services, beyond non-differentiated commodity electrons. With greater transparency and simplicity for consumers to increasingly gain greater control over how they use energy, trends are emerging demonstrating greater value on price certainty, reliability, control, cleanness, and other attributes that often match social priorities and practical expectations about perceived quality of energy delivery services.

But even as powerful market forces of rapid innovation and business model disruption are driving change in the electricity sector, public policy and regulatory decision making continue to play an important role in determining outcomes. Notably, some policies and regulations are accelerants, while others are impediments to the pace of inevitable change. New regulatory frameworks, commensurate with the broad availability and planned integration of new technology, must productively evolve. Some states, whether needing to adapt or desiring to enable such change, are leading in the development of accommodating policy and regulation, while others are lagging, and seemingly attempting to postpone the inevitable.

As pressure mounts to update and reform state electricity policies, the impacts of federally mandated efforts to reduce power sector greenhouse gas emissions must be taken into account. Some states may defer fundamental market reforms in favor of layering new mandates and mechanisms for emissions reductions on top of their largely unchanged market structures. However, the exercise of finding emissions reductions could – and, many would argue, should – only accelerate the need to rethink the electricity sector and how it is regulated so as to better respond to unprecedented surge in technological change, consumer empowerment and expectations, and broader entrepreneurial participation in an increasingly competitive market. While deep emissions reductions may likely correspond to additional regulatory promulgation, it will be at least as important to dismantle and reduce some of the regulatory approaches that impede market forces to better enable positive environmental and social outcomes.

In Aspen, we intensively explored both current and imminent changing dynamics of the electricity sector. Mindful of the “social compact” between electricity providers and citizenry, We sought to examine and imagine future scenarios in which emerging consumer-led business models, enabling and integrating a flood of new technology services and devices, were met with policy and regulatory design, at the state and federal level, that facilitated both progress and profitability for households, industry, utilities, and society at large.

That pace of change and adaptation of the electricity sector’s future is undoubtedly promising and exciting, albeit still uncertain.

Our goal was to convene and contribute a wealth of diverse thought leadership and informed, experienced insight into developing an energy future a good society should aspire to, and define practical pathways and optimal practices to arrive there in a timeframe that is consequential and beneficial for generations that follow.

The catalyst of changing technology has set us on our way, and each successive Aspen forum seems to contribute to even more, better, and faster solutions for creating beneficial change. Thanks to all who make that happen.

Roger Ballentine	**Andy Karsner**
President	CEO
Green Strategies	Manifest Energy

TECTONIC SHIFTS IN THE U.S. ELECTRICITY SECTOR

Dave Grossman
Rapporteur

EXECUTIVE SUMMARY

The U.S. electricity sector is nearing an historic inflection point. A confluence of mutually-reinforcing factors is putting unprecedented pressure on the century-old model of monopolistic supply of electrons at approved rates of return, flowing from central generation stations to end-users. Cleaner energy generation technologies continue to improve, are getting less expensive, and are being deployed at an accelerating rate. Innovations in the financial markets and in business models are spurring cleaner energy deployment and increasing competition for providing customers with energy services. A new generation of customers accustomed to transparency, control, and choice in all aspects of their consumption of goods and services is increasingly expecting the same from energy providers. Information technologies that have enabled rapid change in communications and entertainment are now starting to be applied to energy. And public policies are beginning to enable, if not encourage, fundamental changes in how electricity is generated and provided.

The current utility model is colliding with this confluence of factors, leading to a system in conflict, with the old system trying to accommodate more irregular dispatch, customer or third-party-owned distributed generation, a range of social equity issues, and societal desires for a stable, clean, interactive, and hardened system. While part of the answer to these challenges may lie in a reformulation of the regulated utility business model, others believe that a more fundamental re-ordering of how energy is produced, delivered, managed, and owned is in the offing.

This vision of a re-ordered, more diverse, more competitive, and more integrated electricity system could be thought of as "Cleantech 3.0". This vision involves better systems (not just better devices), smart and connected devices of all sorts, a dynamic and flexible two-way grid, more active and involved consumers, and business models that do not rely on subsidies. It also envisions clean energy not just as a commodity but as a way to provide value to customers (e.g., comfort, mobility, health). Achieving Cleantech 3.0 will require society to grapple with some tough equity and policy challenges, including whether to keep and/or adapt the traditional regulatory compact, how to treat low-income consumers and consumers not generating their own power, and which policies and institutions should be created, reformed, or eliminated to create the proper enabling environment for change.

The electricity sector is already starting to witness the rise of a class of customers empowered by technological advances to start to re-think their relationship to energy. These empowered customers have social needs and practical preferences for which they are willing to pay, including price certainty, reliability, resilience, and cleanness. The industry is thus entering a new era that focuses less on selling electrons than on offering consumers valuable services.

The path, however, is not without obstacles. The role for traditional utilities in this customer-focused market is unclear; such a focus has not historically been part of their business and is not one of their strengths, and the utilities have been operating in a sector unaccustomed to significant change. Clean energy companies, too, can find it challenging to develop new profitable business models. Even the energy efficiency industry, which offers the fastest and lowest cost pathway to a cleaner energy future, may struggle to sell and scale energy efficiency unless market structures and enabling policies can align with improving technologies to realize the full value proposition of smarter energy delivery and consumption.

Regulators have been struggling to figure out how to address the suite of changes facing the electricity sector as well. Current physical and policy infrastructures do not seem to be up to the task. There appear to be three interdependent tectonic plates in motion – long-term utility generation planning, mid-term smart grid design, and very near-term device and software design and deployment – that are not aligned, are moving at dangerously different speeds, and are not properly engaging with each other on a regular basis. Regulatory models must be devised that are more flexible, adaptive, and open to rapid advances in technology. There are some places now, such as Hawaii and New York, where regulatory innovation is occurring to try to get ahead of some of these issues.

While the challenge of rethinking utility regulatory models falls largely in the hands of state policy makers, the Environmental Protection Agency's proposed rule for carbon dioxide emissions from existing power plants, issued under section 111(d) of the Clean Air Act, might have profound implications for how state policies and markets will impact energy efficiency and clean energy. The draft rule would set 2030 emissions goals for states and then give states flexibility on how to meet those goals. The draft 111(d) rule is complex, and a variety of concerns have been raised about it. It is not known how the final rule will be modified to address concerns and comments, nor how the almost certain litigation will be resolved. At the very least, the draft rule is already spurring conversations in every state that have not been had to this point at the level and scale necessary, forcing states to think about how emissions reductions will be achieved, what their energy mix will be, what role clean energy will play, and how state policies and market structures need to change in the years ahead.

Those conversations can help contribute to broader discussions about creating a clear and compelling vision of the near-future state of U.S. clean energy. Those discussions need to include a range of actors, including the many regulators and utility executives who think the U.S. is still in Cleantech 1.0 and does not need to go anywhere else. There is a need to figure out how to bring those people along and help them start to understand the speed and nature of the changes that are occurring.

CURRENT STATUS OF THE CLEAN ENERGY SECTOR

There are trends and technologies causing disruption in the electricity sector, and new policies and market structures may be needed to deal with them. The industry is at a strategic inflection point, where smart people have different views of where things are going; those who get it right will dominate, while those who do not will go out of business.

Technologies

There are exciting technologies – some big and disruptive – that are beginning to transform the energy system. Solar, wind, electric vehicles (EVs), batteries, light-emitting diodes (LEDs), efficiency, and other clean technologies are approaching or are at cost competitiveness – and technologies will continue to improve. These technologies are pulling many billions of dollars of customer spending away from the legacy industry and down other paths.

> ***There are exciting technologies – some big and disruptive – that are beginning to transform the energy system.***

Renewables accounted for 53% of new generating capacity globally in 2013, with wind and solar leading the way. In the United States, wind and solar accounted for more than 40% of new power generation installed over the last few years. More solar power was installed over the past two years than over the previous 40 combined. This is due in large measure to the dramatic reduction in solar technology prices; solar power was $77 per watt in 1977, compared to less than $1/W today. The average cost of solar power in the United States has come down to 16 cents per kWh for retail generation, and that is still going down, whereas the average cost of electricity in the United States is 13.7 cents per kWh for retail generation, and that is going up. At some point in the next few years, those curves will cross (and they already do in some places). Rooftop solar has been particularly disruptive and is expected to continue growing (though there are questions still to be settled about the proper net metering policies). As for wind, ten years ago it was an 8 GW a year market globally; today it is a 40 GW market. Renewable energy is competitive, providing social, economic, energy security, and climate benefits.

Renewable energy is competitive, providing social, economic, energy security, and climate benefits.

Beyond renewables, energy efficiency technologies have cut electricity demand significantly, and there is clear dynamism now in the energy efficiency market, with new business models, new pathways of financial innovation, and emerging technologies. Compact fluorescent light bulbs (CFLs) and LEDs have had huge effects, with plummeting LED prices taking away the most profitable customers from utilities. In addition, energy data and analytics (connected with devices) have great potential and are becoming more transformative.

As big as some of these technologies are getting, they are still just at the beginning stages, and there are much larger changes still to occur. As they get even bigger and achieve greater scale, they will see improved efficiencies and cost reductions, though they may also encounter greater headwinds.

Other key technologies that show significant potential are still rather nascent. Storage, for example, is viewed by many as the Holy Grail technology, and it will clearly be a key factor in the overall structure of the electricity sector, but storage still needs technological improvements and declines in cost. It is likely that very different conversations about storage will be happening in a few years as the technologies improve. Similarly, microgrids show great potential, but the electricity sector has only scratched the surface with them so far. People also tend to think smart grid technologies and rollout are much further along than is the case; the reality is that smart grid is probably only at step 2 of 10, and advanced information technology has yet to really be applied to the grid.

Smart grid is probably only at step 2 of 10, and advanced information technology has yet to really be applied to the grid.

Other fuel technologies are part of the mix, as well. Hydropower, for instance, tends to get overlooked in a lot of clean energy discussions, even though hydro writ large is forecast to be the dominant source of renewable energy generation growth globally. Nuclear power, meanwhile, generates more than 60% of America's non-carbon electricity, far more than hydro or wind; looking forward, small modular nuclear reactors are still worth keeping an eye on, but they are very expensive.

In addition, it is worth remembering that forecasts for the power mix a decade or more from now still see more than 60% of all electrons coming from coal and gas, so it is important to keep working on getting cleaner coal and gas. The natural gas boom is making the transition away from coal without carbon capture and storage more possible and cost-effective in the United States, but it is also important to pay attention beyond the U.S. borders; the U.S. is reducing its coal usage but exporting coal at record rates.

Market Trends & Drivers

Asia has emerged as a clean energy investment power, but global clean energy investments have declined over the past couple of years (in part because clean energy is cheaper now), and investments in renewables still pale in comparison to investments in conventional energy. The industry, particularly solar, is also experiencing significant consolidation, with fewer players across the value chain. China, for instance, has increased its solar panel manufacturing from five years ago but has a smaller number of manufacturers. Still, the cleantech industry is maturing and scaling rapidly worldwide, with more than $1 trillion in revenues.

There are numerous factors around the globe that are driving the maturation and growth in the cleantech market. One key driver is the accelerating adoption of renewables and distributed energy resources as prices plummet, technologies mature, and production scales up. Another is that emerging markets are expected to double their energy demand over the next decade, with over 80% of all new electricity growth expected to occur in those markets. In many markets, this exploding demand for energy is still largely being met by building the cheapest traditional generation available, but governments across the globe, especially in emerging markets, are also starting to really understand the role of cleantech in their national economic, development, and environmental strategies. In Mexico, renewable energy is cheaper than conventional. In South Africa, interest in renewables has mostly been about job creation and providing energy to areas without a grid. The burgeoning demand in developing markets in Africa, Southeast Asia, and elsewhere is leading to growth in distributed power at a rate 60% greater than centralized power. In addition, given the massive urbanization numbers in emerging markets around the world, especially China, there have been and will continue to be opportunities to marry sensing data and analytics with energy use in cities.

The cleantech industry is maturing and scaling rapidly worldwide, with more than $1 trillion in revenues.

In contrast to emerging markets, developed markets are experiencing flat or shrinking demand and are thus more in replacement mode, which suggests that installation of large amounts of new low-carbon power may mean lots of retirements of existing plants. Already, growth in demand from data centers in the U.S. has masked a lot of weaker growth in other areas, and as data centers invest in improved efficiency and on-site backup from renewables and gas, demand will drop even further – and from the commercial sector too, which is where a lot of utility dollars come from.

Innovations in the financial markets were among the biggest drivers in the cleantech sector over the past year. With third-party leasing, yieldcos, green bonds, REITs, crowd sourcing, state green banks, and other innovations, the financing code for energy efficiency, distributed generation, and cleantech in general is starting to get cracked. As risk is a very powerful driver of decision-making in the financial sector, a key development has been the maturation of renewable energy into a grown-up, incredibly low-risk asset class. In contrast, the cleantech industry is littered with failed venture capital investments and other efforts to find capital for high-risk investments; high-risk efforts may have to rely more heavily on entities outside the traditional sector that have vast cash supplies and a different investment mindset.

Other major drivers of cleantech market growth include increased recognition of the urgency of climate action, a big shift at the highest levels of Chinese leadership to address air pollution, and the U.S. shale gas boom.

Along with these financing innovations, a declining cost of capital could prove to be a significant driver for distributed generation, as projects cannot get built without someone putting in all the money up front, which happens when investors think they will earn their desired return based on the upfront tax structure and long-term contracts. Last year in the United States, the average cost of capital after tax of distributed generation was a 9% yield; there is no reason that cannot get down to 6%, which is where the low-income housing tax credit market is. If the average cost of capital drops to 6%, solar's average cost of 16 cents per kWh for retail generation would likely drop to 6 or

7 cents per kWh, which would be a game changer. There is a risk, though, that the costs of capital could also go up; debt will not be free forever.

Other major drivers of cleantech market growth include increased recognition of the urgency of climate action, a big shift at the highest levels of Chinese leadership to address air pollution, and the U.S. shale gas boom.

As for policy, it is unclear whether it is an indispensable predicate to growth in cleantech markets or just a useful accelerant. For instance, there is an argument to be made that solar power and storage are economic in very few markets in the United States without the subsidies and supportive policies that have driven their growth. There are starting to be some instances, though, where that is not the case, such as a recent low-price solar power purchase agreement in Texas that has no subsidy involved. Texas, in fact, provides an interesting case study of a place where cleantech markets have been expanding despite non-existent policies and hostile ideologies. Texas has no direct subsidies or mandates for renewable energy, and there is hostility to the idea of climate change – and yet the growing Texas population (largely because of immigration), the abundance of cheap, flat, sunny, windy land, and a marginal-cost market design have spurred tremendous deployment of renewable energy in the state.

Government Involvement

Regardless of whether policy is essential or just useful, the actions and policies of governments are clearly extremely relevant to the clean energy sector.

In the U.S., much of the policy action is occurring at the state level or through federal agencies, with state renewable portfolio standards, state energy efficiency standards, high-profile federal efforts like the Environmental Protection Agency's new proposed rules for carbon emissions from power plants, and many other initiatives. Government efforts have been shifting from being very widget-focused (i.e., making some particular technology cheaper) to more systems-focused (e.g., reducing the sort of non-technical "soft" costs that make solar more expensive to install). In addition, Order 1000 from the Federal Energy Regulatory Commission (FERC) on transmission planning and cost allocation represents a near-term opportunity to advocate for system-level planning on the wholesale level to enhance the potential for renewable energy entry.

As for Congress, it appears to be completely gridlocked now, though past legislative efforts have had significant impacts on the sector. Cleantech markets took off in many places around 2008-2009, when states saw the opportunity to grab federal stimulus dollars and create jobs. The federal investment tax credit has also been driving renewables, especially solar.

A lot of renewable energy project development has been moving from the realm of state-level policies to the realm of local-level permissions (e.g., lots of meetings, papers, and studies), which is impeding the ability of project developers to get their capital deployed. Tweaks in policies and relatively modest actions at the state and local levels might therefore have a big impact. For instance, many localities have no experience in developing a renewable energy project, and yet the process is remarkably similar from place to place, so localities may benefit from some kind of overarching guidebook that describes the steps involved and what generally happens. While no two cities or communities think they are exactly alike, a guidebook could help reduce some of the soft costs developers face in educating local officials. In addition, allowing the transmission and power sides of a utility to talk to each other would help developers of utility solar know that they will be able to interconnect with the grid (which could reduce financing costs).

Political obstacles to clean energy are also still present in many states, including major political and economic interests (e.g., industrial customers, realtors, homebuilders, bankers) that may oppose energy efficiency and other clean energy programs.

MOVING TO CLEANTECH 3.0

The current path of the U.S. electricity sector is not sustainable – environmentally or economically – but the path is shifting toward a more diverse, integrated electricity system.

Tensions in the Current Grid

The current utility model is what it is for a reason. In the early days of the grid, everything was focused on economies of scale, where bigger was better and cheaper. Electricity was deemed a public necessity and a primary enabler of economic growth. Because development and provision of electricity were so capital intensive, utilities were seen as natural monopolies. The result was large plants that are far from load, centralized operations, and a few large-scale regional owners. The "regulatory compact" required utilities to provide affordable, reliable, universal service in exchange for their monopoly and an authorized rate of return. (The regulatory compact is a fairly remarkable achievement; the U.S. has not done it with healthcare, has not done it well with education, and has not been able to figure it out for broadband.) Early decisions around rate design were focused on making things simple for the customer, leading to average rates that are easy to understand and provide some semblance of equity. There was a clear logic behind the monopoly, and it was evident who was accountable for cost and reliability.

The current utility model is colliding now with technology, which is enabling new avenues for investment and value creation at the customer level (e.g., electric vehicles, Nest thermostats, microgrids). New business models are emerging, with rooftop solar as the prime example. The collision is leading to a system in conflict. In terms of siting, large plants far from load are now being joined by small, modular, scalable sources close to load. Centralized dispatch is being joined by uncontrolled dispatch. The few large-scale regional owners are being joined by power that can be financed, installed, or owned by customers or third parties. Other priorities are entering the picture, such as stability, cleanness, and hardening the system against physical and cyber threats. Social equity issues are arising, including how those who are not self-generating are treated, how to ensure there is a grid for everyone when some people leave it, and how self-generators should be compensated for what they are providing to the grid and charged for what they take from it.

The current utility model is colliding now with technology, which is enabling new avenues for investment and value creation at the customer level.

Many have said this collision is leading to an industry death spiral. Big central builds are no longer necessarily cheaper, and not all electricity functions are necessarily suited for a monopoly anymore. In addition, utilities cannot assume they can recover their costs for maintaining the grid through averaged rates; it is easy to finance a growing grid but not one with flat to declining loads, which means rates will go up, which exacerbates the spiral.

Understandably, then, there is a lot of tension in the system, with fights occurring over net energy metering, microgrids, and a range of other issues.

Vision of Cleantech 3.0

Amidst these tensions, distributed energy resources currently are getting connected in a way that is not smart or strategic, and there is a risk of it getting worse. In about 10 years' time, based on current technology and price trends, many people will be able to buy a solar-plus-storage system that gives equal reliability and quantity while being carbon-free. If all those people leave the grid, it will strand a lot of capital and increase the cost burden on those that remain. However, most people rely on the grid, at least for backup, and it is not disappearing any time soon. In all likelihood, to meet the incredibly variable needs of consumers, there will likely be a need for electricity that is centralized and distributed, fossil and renewable, traditional and disruptive – and there will be a need to find a way to integrate them all so that the system still works.

Cleantech 3.0 is about better systems, not just better widgets.

This new integrated system of electricity could be thought of as an element of Cleantech 3.0. At a strategic level, Cleantech 3.0 is about better systems, not just better widgets – and those systems integrate not just renewable energy and energy efficiency but also the existing asset base. (There is still plenty of work to do on the widgets, though; lots of technologies still have to improve to make them effective in a network.) In Cleantech 3.0, the grid is two-way, dynamic, flexible, diverse in terms of scale and fuel, enhanced by information technologies, and with more active and involved consumers. It also has to be secure, especially as energy and IT get more connected; the bigger these systems get, the more they will be targets for attacks. There is a broader vision of what Cleantech 3.0 could encompass, as well. With regard to policy support, Cleantech 3.0 sees subsidies as unreliable and as something one cannot build a business model around; 3.0 recognizes that it is hard to make a buck when government programs can get pulled out from under you and that businesses need to be able to win not because of subsidies but because they can compete. Cleantech 3.0 embraces the notion that cleantech is no longer a commodity (or a commodity plus some cool apps) but rather is about value (comfort, mobility, health, etc.).

On Our Way to Cleantech 3.0?

	1.0	2.0	3.0
Supply	central generation	DG entering fleet transition	diverse and dynamic
Delivery	one-way flow, very rigid	system straining	two-way dynamic and flexible
Customers	passive and fixed	drawn to cool things	fully engaged
Product	conventional commodity	really cool apps	value not commodities
Data	provider owns limited analysis	customer demands increasing analytics	customer owns data mining
Applications	plug loads	new uses (EVs, heat pumps)	coupled domains (energy/water)
Policy	incentives accelerate	incentives at risk	can't depend on policy
Strategy	beat incumbents through innovation	chasing a moving NG target	**better systems not just better widgets**

Today, the clean energy sector is probably somewhere around Cleantech 1.8, with strains and conflicts beginning to show on the system and some early cool apps. The sector is rising into 2.0 but has no real idea of what the action plan is to go beyond that and achieve a 3.0 grid with any sense of urgency. The sector also has little clarity on which of the nearly infinite number of things that it could do it should, in fact, do.

There is no longer, however, the luxury of time. Lots of time in the Cleantech 1.8 world is spent talking about the widgets, policy drivers, and incentives that are at risk, the impacts of natural gas, etc. That all has to become irrelevant if the sector is going to scale up at the level society needs. To achieve 2050 carbon goals, the U.S. has to decarbonize the economy. That first requires decarbonizing the electricity system by around 2035, which will likely happen in pockets before it happens economy-wide. Those pockets probably need to be going by 2025, which likely requires having the tools in the toolbox by 2020, which is only 5 years away. There is not a lot of time to achieve energy system transformation.

It is also worth remembering that it may not be necessary to get the theories and market frameworks exactly right to make progress. The history of the science of energy suggests that it might go the other way, with technologists and innovators figuring stuff out and leading the theory. The majority of the economy today runs on four technologies – gas turbine, steam turbine, gasoline engine, and diesel engine – that were all developed in the 1800s and that were developed to some degree without knowing how they worked.

In addition, it is important to recognize that the energy system is embedded in lots of other systems that have their own 3.0s to pursue (if they even have a vision of a 3.0), including water and transportation. The energy system does not operate or change in a vacuum. There is a need to think beyond the grid and figure out how to connect and communicate among the various systems in ways that enable optimization of both individual interests and system needs while also being responsive to and competitive in markets. If people could take the solar PV panels on their roofs and add an electric vehicle in the garage and a solar-powered machine that converts rainwater and gray water into potable water, then the economics of that PV system vastly improve while reducing gas bills, gas station trips, and water bills. The National Renewable Energy Laboratory (NREL) has a large R&D facility, the Energy Systems Integration Facility (ESIF), where companies and others can test and model this kind of systems integration.

The energy system does not operate or change in a vacuum.

To move to a Cleantech 3.0 type of systems focus, it would be ideal to have some kind of thoughtful design effort, since individuals pursuing their own goals will not necessarily scale up and cohere into a system that addresses climate and other issues. To achieve systems-based solutions, companies and regulators may need to think about things on an industry-wide or system-wide basis. For instance, utilities may have to be allowed to charge users who show up very rarely with a really big need for electricity a lot because they are imposing enormous costs on the grid overall.

Equity & Policy in a Cleantech 3.0 World

To achieve Cleantech 3.0 in the United States, society will have to grapple with some tricky equity and policy challenges.

For instance, there is the question of what to do with existing structures such as the regulatory compact. There is an argument to be made that the U.S. cannot move away from or get rid of the compact. On the other hand, there was a similar compact with regard to telephones (and the old Bell system phones had much higher reliability and voice quality than cell phones), and yet no one seems particularly bothered that that compact was broken in order to provide greater value to customers. Similarly, there is a strong public policy behind the requirement in some states that utilities have to pursue the least cost options, but that requirement is inconsistent with the reality that more expensive options (for instance, in the telephone world, smartphones) might enable more value. The original compacts and requirements on electricity were designed around certain technological assumptions and may need to be updated to reflect technological advancements.

The original compacts and requirements on electricity were designed around certain technological assumptions and may need to be updated to reflect technological advancements.

What equity demands in a 3.0 world is not clear. There is a common assertion that the poor are paying for the rich to put solar on their roofs. On the other hand, people living near fossil fuel facilities tend to be people of lower means, and it may not be equitable to say they get cheap electricity but their kids will get asthma or cancer from living near the facilities. The poorest are also often the most vulnerable to the impacts of climate change. Grappling with these issues, however, cannot be used as an excuse to slow down movement towards Cleantech 3.0; the electricity sector needs to speed up *and* get the equity issues right. Governments at the local, state, and federal levels will have a huge role to play in how energy systems develop, and if governments are not convinced social equity is being maintained, they can be roadblocks to innovation.

With regard to governments, there has not been much structured effort yet to figure out how to make a logical, coordinated transition from the old world to the clean new world, and more conversations and coordination between governments, utilities, and stakeholders would be helpful. The other alternative, of course, is that the transition is chaotic.

Envisioning the policies needed to get to Cleantech 3.0 can be challenging. While Congress has been pretty broken for a long time and is expected to remain so in the near future, it is worth beginning to consider what the Energy Policy Act of 2016 or 2017 might include to create a policy inflection point. Ideally, those policies would be simple and clear, to provide the clearest possible signals to innovators and to the market. Some view a carbon tax as the clearest and simplest policy and price signal, but it seems that many in the policy world have given up entirely on getting the price signals for carbon right in the United States, at least at a national level. Other federal government roles could include helping with standardized measurement and documentation, improving procurement processes (as the federal government is a huge electricity customer), and working to encourage banks and others to get behind distributed generation. In addition to thinking about the policies to include, it may also be worth thinking about the policies and institutions that need to be eliminated in order to create the proper enabling environment for startups, investors, and regulators. Either way, until the cleantech industry greatly enhances its political engagement and can figure out a way to provide more money or votes to policymakers (which are what they seem to care most about), policy may not change any time soon in a way that would help drive Cleantech 3.0.

THE RISE OF CUSTOMERS

A key development in electricity markets recently has been the emergence of a class of utility customers empowered by technological advances in areas such as energy efficiency, smart meters, and generation options – and thus the beginning of a shift in business models to the more customer-centric approach envisioned in Cleantech 3.0. Customers, including households, corporations, countries, and many others, are starting to think about their relationship to and the value created by energy.

A Class of Empowered Customers

Cleantech's costs have been declining rapidly, but the idea that somehow the price of clean energy will come down low enough to "win" against fossil fuels is not the right way to think about the business. The oil and gas industry continues to innovate and has only scratched the surface of innovation on source rock and hydrocarbon capabilities. The Stone Age did not end due to a lack of stones, nor because stones got too expensive, but rather because stones just were not good enough. The issue is whether cleantech can provide the services and value that customers want and that traditional industries are not providing.

Customers have social needs and preferences, as well as an increasing desire to control their own energy fate – and that changes the competitive landscape. Some customers just want to know what the price of power will be and lock it in long-term. Others depend on resilient power. Others want sustainability. It is not just about electrons anymore. It is about comfort, convenience, and other services that are of value to customers – and there is profit in providing value. Distributed energy resource options are at the cusp of being very disruptive in giving society different ways to provide services such as reliability, resilience, security, and cleanness. The industry is going through a de-commoditization process and entering a new era where companies are trying to reach consumers not by selling electrons but by selling valuable services.

Distributed energy resource options are at the cusp of being very disruptive in giving society different ways to provide services such as reliability, resilience, security, and cleanness.

There are now many companies trying to get into the home (or other places) to create value for customers; improved energy efficiency may be a result of that, but it may not be the driver. The rise of engaged customers and the entrepreneurial companies that serve them means there is now a fourth potential category of people who can pay for the price differential for energy that addresses environmental and other concerns. Generally, there have been three groups who could pay: ratepayers, shareholders, and taxpayers. Shareholders do not really pay for externalities, and taxpayers are pretty tapped out. That has left much of the burden on ratepayers, but now consumers are arriving on the scene that voluntarily choose to pay a premium in exchange for some characteristics of energy technology that they value. If customer and entrepreneur capital can replace ratepayer capital, everyone is better off.

A major source of such customer capital recently has been corporations, which have become very empowered and have a growing role in pursuing cleantech opportunities. Many companies have huge and/or specialized energy needs (e.g., for reliable power), and they are increasingly going out and getting (or installing) their own power sources. In July, a consortium of large corporate energy buyers announced a set of principles on purchasing renewable energy in hopes of spurring progress on resolving the regulatory challenges they face when trying to buy renewable energy.

Empowered customers making more decisions and deploying more capital does not necessarily translate to customers owning their own assets. There is a trend in the economy towards a shared economy model (e.g., the cloud, Uber), which creates great potential for shared energy resources such as community solar.

As empowered as some customers are, it remains unclear whether customers are actually the drivers of changes in the electricity system; stakeholders and industry may be the ones driving the technology, market, and policy changes. Most customers generally only see – and, for the most part, care about – the demand side. Customers in many places are used to energy being available and low-cost, and as long as their outlets and light bulbs work and they do not have to pay too much, they tend to be unconcerned about the supply side. A big communications effort to educate consumers about the value of clean electricity might help them recognize and value the "clean" part of clean energy. But as of now, the value propositions do not yet really exist to make most customers want to engage in a major energy shift.

Customer-Focused Business Models

The empowered customers that are choosing the values and services they want to buy represent huge business opportunities for the cleantech industry and companies that specialize in creating value propositions around services and products for customers. For example, customers such as hospitals that see having secure and reliable power as being mission critical might be interested in expanding traditional energy savings performance contracts to be security- and resiliency-enhanced performance contracts that capture generation and a broader suite of traits beyond just energy savings.

Figuring out business models can be hard, though. Solar, for instance, has seen remarkable growth and done an excellent job of providing value to customers, but the solar industry as a whole has not figured out how to make a profit yet. It has been focused on growth instead of earnings, and at some point that will have to shift. Another challenge is that many customers are not willing (or able) to pay more for energy, and looking globally, many potential new consumers are low-income. Cleantech's costs have been declining, but in many areas, the cleantech industry has to find ways to bring costs down more and devise business models that can serve low-income consumers, who are often the customers with the most to gain from demand response and energy efficiency programs.

The incumbent utilities are somewhat constrained by 19th century technologies and 20th century regulations that may not be well-suited to 21st century problems and consumer preferences.

The role for traditional utilities in this customer-focused market is unclear. The incumbent utilities are somewhat constrained by 19th century technologies and 20th century regulations that may not be well-suited to 21st century problems and consumer preferences. For instance, there is a question about whether having universal service conflicts with the idea of providing clean, resilient, secure power to those who want it most – in other words, whether there is a net-neutrality analogue for grid operators charging a premium for certain services. Utilities would also need regulatory approval to move from selling energy by the kWh to a flat rate plan for energy services, eliminating volatile energy costs for customers.

In addition, it will likely be hard for many big incumbent utilities to move to a consumer servicing model, as that is not their strength and has not historically been their kind of business. Some utilities are looking at building microgrids, getting involved in distributed generation, and other such efforts on their commercial/competitive side, but it can sometimes feel a bit cannibalistic, taking from the regulated side in a zero sum game – and the bigger struggle on these issues is in the regulated context. Utilities can also buy companies that are already doing the consumer-focused model successfully, but as utilities have such limited experience with consumers, acquisitions may best be kept separate.

SPURRING ENERGY EFFICIENCY

Energy efficiency is often the fastest and lowest cost pathway to foster the attributes of a sustainable power system that delivers equity for consumers and ratepayers, environmental protection, externality benefits (e.g., health), energy security, and economic competitiveness. Energy efficiency can decouple energy consumption from economic growth and is the cleanest, cheapest, most renewable kilowatt-hour that can be produced.

Despite massive improvements in energy efficiency, efforts to promulgate energy efficiency standards, and improvements in technology, over 60% of the primary energy that comes into the system is still wasted. It serves no useful function. McKinsey's study on energy efficiency found a lot of net-present-value (NPV) positive benefit, and yet less than one-fifth of that is currently on track to be captured. There is no way to have a 2050 economy that is significantly bigger with a fraction of the carbon emissions with the current levels of waste.

Efficiency in Buildings and Devices

If utilities adjust their business models (to respond to the changes driven by distributed generation and other factors) by increasingly trying to boost their fixed fees versus their variable rates, it could pose a potential challenge for the energy efficiency industry. Since energy efficiency cannot do anything about fixed fees, it is possible that in a few years the energy efficiency industry will not be able to claim that efficiency lowers customers' bills, in which case the industry will need to figure out what exactly it is offering to customers. For energy efficiency to sell and scale, there may need to be an increased focus on providing residential, commercial, and industrial customers with a few key attributes, including value (beyond just savings), appeal, time-efficiency, and as close to zero risk relative to alternatives as possible.

Delivering value, appeal, and time-efficiency require a focus on creating a good user experience with energy efficiency devices.

To provide these features to consumers, there will have to be improvements in data and sensing. Owners, managers, and occupiers of buildings generally do not understand how the buildings are actually used, and without that understanding, it is difficult to make buildings much more energy efficient. In the future, over time, there will be sensor networks that can get data from each and every section of a building and then use that data to optimize the building for the tasks being performed in it. There will have to be improvements in disclosing data, too. Public disclosure on building energy performance is not yet widespread; it is mostly occurring in New York City and Washington State. If building energy performance data is not disclosed, it is impossible for buyers to compare apples to apples and figure out where the value might be. The market is beginning to recognize a value premium (e.g., higher lease rates, higher occupancy) for large commercial buildings that are energy efficient, but that is not yet really the case in the mid- and small commercial or residential sectors, where it is unclear if energy efficiency results in a value premium (e.g., higher resale value).

There is also a need for better financing structures and wider adoption of policies to reduce risks, remove financial barriers, and drive better energy decisions by building owners, who tend to delay implementing efficiency upgrades and want short payback times (which could limit the changes to lighting). For instance, companies using GAAP accounting do not want to use scarce cash or credit for energy efficiency, but currently efficiency spending goes on the balance sheet; this small, nuanced financial barrier based on how capital allocation is done limits corporate spending on efficiency. Property Assessed Clean Energy (PACE) financing is another example. PACE can be a good way to finance commercial building upgrades in states, and more than 40 states have PACE enabling legislation, but only three states have more than half of their local jurisdictions adopting PACE.

Delivering value, appeal, and time-efficiency require a focus on creating a good user experience with energy efficiency devices. Nest, for example, has been successful because the company made the thermostat sexy, made people want to engage with it, and designed it to take over managing things that customers do not care about or want to bother with. The company is just one among many new entrants in the market that are creating devices to automate energy savings and behavior. Regulatory standards that focus on easily quantifiable metrics of these devices may reward technologies that perform well on paper but do not deliver persistent behavioral change – yet the key is to support technologies that can provide customer value (e.g., comfort), deliver long-lasting behavioral change, and persist in engaging customers in the next step on the journey towards interacting with and performing various energy load-shifting tasks. Those things may be harder to measure, but they are fundamentally more important.

Efficiency at the Systems Level

In addition to better devices, there is a need for better systems. Some appliances are 97% efficient and cannot really get much more efficiency squeezed out of them, so there is a need to look to systems that are smart, solve problems, and unlock value for consumers, such as by enabling those devices to interact with each other and with market signals to create efficiency. There is an expansive universe of behind-the-meter efficiency opportunities. HVAC systems account for about 40% of energy use, while lighting accounts for about 20%. Both need to be attacked – not just in terms of the efficiency of particular components, but at a systems level. Similarly, networked standby connected devices (e.g., cable boxes) are currently wasting about 400 TWh every year, and in a few years, it is expected that there will be 50-75 billion such devices. As the "internet of things" expands, it will be essential to develop and operate communication protocols, networks, and software in a standardized, open way in order to capture some of the huge opportunities for systems-based efficiency beyond the devices themselves. The challenge will be to figure out how to create and design these systems in the context of a regulated and increasingly smart grid infrastructure.

There is an expansive universe of behind-the-meter efficiency opportunities.

Beyond systems thinking, there is also a need for systems integration. A lot of energy waste occurs not only because of aging infrastructure and legacy equipment, but also because the pieces of infrastructure are operated in isolation – the grid does not know what the gas network is doing which does not know what the transportation system is doing, and so on.

REGULATORS REVAMPING THE SYSTEM

The legacy system of electricity infrastructure, both physical and policy, does not appear to be up to the task of tackling the array of emerging issues related to climate change, customer preferences, and innovation. Regulators need to find a way to get ahead of some of these issues.

Misalignment between Technology and Regulation

Customer-focused technology companies now starting to enter the electricity world generally have different backgrounds and expectations that do not mesh well with the current regulatory structure. Technology companies – some of which have big balance sheets, lots of capital, and a fairly high risk appetite – often grew with the generally unregulated internet and go out of their way to avoid regulation. These types of companies have great strengths in customer-facing innovation, but they have limited experience with regulatory risk and limited patience for time-consuming regulatory processes. It will be interesting to see the outcome of having these new types of companies joining the electricity world.

There appear to be three interdependent tectonic plates in motion. The first is the world of utility planning, generation, generation constraints, and 30-year targets. Above that is the second plate, a sophisticated layer involving design for an intelligent grid, which is in the 5-15 year timeframe. Above that is the third plate, a layer of devices designed to deal with things such as homeowner behavior – a layer that is iterating hardware and software in the span of weeks or months and going out to market in millions of units per week. These three plates are not aligned and are moving at dangerously different speeds, presenting risks such as billions being spent to develop an intelligent grid architecture but without homeowners being prepared to use it (e.g., not trusting time-of-use pricing or demand response signaling). Silicon Valley and the other device makers are not engaged with the other two plates and do not really understand the timeline, momentum, and direction of those plates. In fact, the plates are not properly engaging with each other on a regular basis at all. There is a need for a ladder or lifeline or lasso or something between them.

Everything is changing so fast now that a program or rate structure cycle of five years no longer accommodates the pace of change. There is a need to enable faster thinking and change.

A model must be devised that is more flexible and adaptive; everything is changing so fast now that a program or rate structure cycle of five years no longer accommodates the pace of change. There is a need to enable faster thinking and change. If a technology company involved in a months-long regulatory filing submits an updated plan with new technology that provides better results, regulators may well be upset that the submission occurred so far into the process and may push the regulatory process back even further; there is a fundamental disconnect between the tectonic plates. Regulators need to be more open to technological advances and for faster processes to be accommodated in slower processes.

Regulatory Experiments to Change the System

Changing the regulatory system is far from simple. For one thing, utilities regulators are trying to address a wide range of goals, including meeting ever-changing individual and societal priorities, ensuring a thriving and reliable grid, creating a level playing field, balancing cost equity among customers, and many others. It is not easy (and perhaps not possible) to get wins on all of these goals simultaneously. In addition, commissioners usually have a sweeping range of subjects, initiatives, cases, and other matters to deal with, are often in the job for short periods of time, and make decisions based on 100-year-old statutes, none of which really affords them much opportunity to conceive of new processes and new systems.

Nevertheless, there are some places where regulatory innovation is occurring – where regulators are trying to get ahead of some of the issues that are coming. Hawaii, for instance, is considered a "postcard from the future" for the rest of the country in terms of the challenges it is facing in pursuing high levels of renewable energy deployment, particularly solar (plus storage). Following engagements with the U.S. Department of Energy and NREL, Hawaii adopted aggressive clean energy goals, approved decoupling, established on-bill financing, and is now – given the high penetration of distributed solar and the risk of the utility's long-term insolvency – moving into total regulatory restructuring out of necessity. San Diego, too, has been innovating, as it has started pursuing pricing for services, with the utility seeing itself as a platform like an iPhone, with others providing the energy "apps".

New York, meanwhile, is pursuing its Reforming the Energy Vision (REV) initiative, one of the most aggressive rethinks of the electricity regulatory process in the world. REV is driven by a range of factors, including: Superstorm Sandy, high electricity prices, peak power growing faster than average power requirements, rising costs for centralized power, declining costs for distributed energy resources, the slow pace of energy efficiency retrofits in residential homes, and ratepayers feeling burdened by the extra fees to support energy efficiency and renewable energy programs. In response, REV is aiming to make markets, create more economic activity, and bring change and innovation more quickly, which will provide customer value. New York is trying to change utility incentives to focus on system efficiency instead of on putting lots of capital into the ground (utilities generally have an incentive now, due to cost recovery and rate increases, to put as much capital to work as possible in things that have long lives, which discourages investments in things such as software that could improve system efficiency). The state is also trying to get better price signals for distributed energy resources, to encourage their deployment where they could help the grid. In addition, New York is trying to spur competitive markets around customers, encouraging utilities to understand the need to shrink the relative size of their rate-based business and giving utilities opportunities in competitive markets to earn market rates of return. Furthermore, New York is restructuring grants so that they are market enablers that reduce soft costs such as the cost of customer acquisition. New York's REV is an effort to line up innovation cycles, social equity needs, and the needs of capital to understand where markets are going.

There are two key variables that are likely to define the types of solutions adopted over time in different jurisdictions. The first is the amount of technology enablement, which greatly facilitates the creation of more value-oriented solutions. The second is the regulatory environment, which could lean more towards monopoly or towards competition. The sweet spot appears to be where technology is enabled and there is a push for competitive reform, allowing more of the market to be driven by innovation. More broadly, the key things to consider in pursuing regulatory reform are where the value in the system actually is, what the best market structures are to unlock the value, what the roles of utilities and other actors are within those structures, and how those utilities and actors should be compensated for those roles.

RAMIFICATIONS OF EPA CARBON RULES FOR CLEAN ENERGY

As part of President Obama's Climate Action Plan, the Environmental Protection Agency (EPA) has released high-profile proposed rules related to carbon dioxide emissions from power plants that might have implications for energy efficiency and clean energy.

In September 2013, the EPA released a proposed rule, issued under section 111(b) of the Clean Air Act, that sets new source performance standards for new electric generating units (EGUs). The extent of the 111(b) rule's impact is unclear, as it basically sets current sophisticated natural gas combined cycle (NGCC) plants as the standard for new gas-fired plants and sets partial carbon capture and storage as the standard for new coal plants, which virtually no one is planning to build anyway.

In June 2014, the EPA released another proposed rule, issued under section 111(d) of the Act, that would force every state in the nation to design and administer mechanisms to reduce carbon dioxide from existing power plants. The impact of this rule, dubbed the Clean Power Plan, is also unclear; some view it as perhaps the most impactful Clean Air Act rule in a generation, while others see it as only locking in business-as-usual.

The 111(d) Rule's Approach

The architecture of section 111(d) is very similar to the much more common State Implementation Plan process under section 110 (for meeting ambient air quality standards). The federal government sets goals, and the state regulators come up with compliance plans that translate the goals into requirements for regulated sources.

Under 111(d), the EPA is tasked with developing an emission guideline based on the “best system of emission reduction” (BSER) that the EPA finds has been adequately demonstrated. In developing the BSER for the power plant rule, the EPA decided to go beyond things that can be done at a power plant (“inside the fenceline”), such as co-firing and improving heat rates, to also include actions beyond the plant (“outside the fenceline”) that would ultimately reduce emissions at the plant, such as shifting dispatch to NGCC plants, replacing fossil fuel generation with nuclear power and renewables, and reducing demand through energy efficiency. The EPA’s draft rule sets emission guidelines for states, not for individual plants; accordingly, the rule does not say much about what will actually be required of individual sources, as that will be left to the states to determine. The EPA expressed the guideline in terms of an emission rate (pounds of CO_2 per MWh), not a mass-based cap. If finalized, the rule would begin implementation in 2020, with goals set for each state for two time periods: 2020-2029 (the interim goal) and 2030 onward (the final goal).

The EPA’s draft rule sets emission guidelines for states, not for individual plants; accordingly, the rule does not say much about what will actually be required of individual sources, as that will be left to the states to determine.

Most of the text in the lengthy Notice of Proposed Rulemaking was devoted to the EPA’s development of the state goals and the agency’s justifications for its approach. The EPA started with the 2012 emission rate of affected EGUs; very small plants and plants designed to have low capacity factors (e.g., peakers) were not included. The EPA then took that 2012 rate through the four building blocks that the agency determined constituted BSER. Block 1 is inside the fenceline and assumed every coal plant could improve its heat rate by 6%. Block 2 then assumed that any existing NGCC plant in a state could increase its utilization to 70% to substitute for coal-fired generation; this may well be the biggest single building block in terms of driving down emission rates. Block 3 then addresses zero emission generation (nuclear and renewables), factoring in nuclear plants under construction and keeping some existing nuclear generation that is at risk of closing, as well as utilizing a complicated system to project how much new renewable energy will be added in each state. Finally, Block 4 assumes that a 1.5% demand reduction per year is achievable and ratchets up individual state performance on energy efficiency over time to get to those levels. The formula produces goals that vary widely from state to state, with reductions from 2012 emissions levels ranging from the teens to over 50%. States are starting in different places and ending up in different places that are not particularly correlated to where they started. (The EPA is happy to get comments on a wide range of issues, including if states feel their goals were miscalculated or the building blocks incorrectly applied.)

The building blocks were just used to set the state goals. To meet those goals, however, states have enormous flexibility and can ignore the building blocks entirely if they wish. The real action, therefore, will be in how states structure their plans. The EPA explicitly mentioned in the draft rule some state actions that would be acceptable in plans, including renewable portfolio standards, energy efficiency resource standards, state or regional cap-and-trade programs, or other types of regional/multi-state initiatives. States can even convert their rate-based goals to mass-based goals. States will generally find the costs of compliance to be lower if they cast a wider net for emissions reductions – including going outside the fenceline and perhaps engaging with neighboring states – but the choice is theirs. It is likely, though, that all or most of the compliance obligation will ultimately flow to the EGUs.

Section 111(d) of the Clean Air Act does not get used very often, which from a legal perspective is both a blessing and a curse, as there is very little precedent. When the EPA is sued, which is a certainty, courts will have to decide if the rule (whatever its final form is) falls within the relatively untested parameters of statutory authority, including whether BSER can include "outside the fenceline" measures. The EPA made the building blocks severable, though, so even if building blocks 2-4 get tossed, block 1 will still remain, which is the least flexible. The EPA does have a pretty good track record in court recently.

If the rule is finalized and implemented, the projection is that it will achieve a 30% reduction in emissions below 2005 levels by 2030. That is not a requirement of the rule, though; it is just the EPA's projection of what the results would be. The rule itself has no hard cap. Also, it is important to recognize that by 2012, emissions had already declined 12% from 2005 levels, so the remaining increment projected to be achieved by 2030 is around 18%.

As for the rule's timeline, comments are due in mid-October, and the final rule will be issued in June 2015. Litigation is very likely to be filed soon thereafter. State plans are due in June 2016, with possible extensions (e.g., 2-year extension if pursuing a multi-state plan).

Concerns about the Rule

The draft 111(d) rule is very complex, and a variety of concerns have been raised about it, including the following:

- States that have taken early actions appear to have more aggressive targets than states that have not.
- The rule seeks emission reductions for 2020 that are too large. Some states and regions facing large reductions under the rule and that have a lot of coal plants may face a big problem in terms of resource adequacy, as regional coal plant retirements under the rule could leave reserve margins too low in some areas. The EPA could instead have a ramp or glide path from 2020 to 2030 that avoids the resource adequacy problem and gives states and companies time to develop the needed systems. In drafting the rule, though, the EPA did have lots of conversations with regional transmission organizations (RTOs), independent system operators (ISOs), utilities, FERC,

and many others about the importance of reliability and keeping the lights on, down to the level of particular load pockets.

- Long-term reductions under the rule are too small and may not stimulate clean energy integration and deployment. The rule may just promote the easy, cheap, and fast solution of building more NGCC plants. On the other hand, there is a concern that the 2030 goals could preclude some states from building any new coal or gas plants, which could be an issue for meeting long-term demand growth.

- The rule puts too many complicated choices and tough program design challenges in the laps of state regulators. Instead of a menu of clear choices for states, the rule assumes that states will be doing it all from scratch. This could result in serious chaos and balkanization, creating opportunities for leakage and interstate conflict. Some states may also decide to just leave it to the EPA to do a federal implementation plan for them, and the EPA does not actually have authority to do a plan that includes most of the building blocks. The EPA could instead put some solutions into a model rule to make it easier for states. On the other hand, the EPA recognized that rules in the energy space get written at the level of states and utilities commissions and so felt it appropriate to give states enormous flexibility in what they decide to do – but even in that context, some things will make a lot more sense and be a lot more economical than others.

- The rule's building blocks may have been developed in isolation, without accounting for the interplay between them (e.g., between gas and renewables).

- Zero-carbon sources may be treated asymmetrically in the rule, with existing renewables counting for states but not existing nuclear and hydro.

- Having state plans all be federally enforceable may raise state concerns, such as about whether utilities' Integrated Resource Plans approved by the Public Utilities Commission will now be subject to citizen suits under the Clean Air Act.

Potential Impacts of the Rule

In evaluating the rule's impact, it is important to note that it is not known how the final rule will be modified to address concerns and comments, nor is it known how the litigation will be resolved. There will also be a new Administration in the midst of the process of the EPA reviewing state plans. Congress could theoretically intervene as well, but that seems unlikely.

The rule is definitely not equivalent to Congressional legislation on climate change. If one envisions the path of climate policy as a highway, though, it is littered with the burned-out cars of Waxman-Markey, Copenhagen, and other failed national and international efforts, and the Administration rolled out a tank in the Clean Air Act that is slow and imperfect but is at least moving. The Clean Air Act may not be the best vehicle to address these issues, but it is the vehicle the Administration had to use, as its tools are limited. Under the Act, all the rule can really do is add carbon dioxide into the decision-making mix. It cannot really add in additional values such as resilience and innovation, and the clear focus on air emissions means the rule can only do so much to address needs related to pipes and wires, nuclear power, or distributed generation versus centralized generation. It will be up to the states to decide how broad an approach to take and what other issues to bring into the mix. In that respect, this rule is very narrow – and the decisions at the state level are incredibly important.

> ***A clear impact the draft rule has already had is that it has created a venue for conversations about clean energy that have not been had to this point at the level and scale necessary.***

Assuming the final rule resembles the draft, the 111(d) rule is also not radical in that the U.S. would likely be close to the same level of emission reductions the rule envisions and coal would be about the same portion of the mix by 2030 even if the rule never existed. There is a case to be made that the EPA only did what the Supreme Court said had to happen, that the same rule would have come out of a Republican administration, and that the rule just captures business as usual. In the best case, this rule could be irrelevant, if fixing state rules and financing structures to allow new entrants, new technologies, new business models, systems optimization, etc. actually occurs, as that could have us blow past 30% reductions by 2030. However, if those things do not in fact happen and the technology and business models do not actually gain traction in the marketplace, the rule could be a really big deal and have much more impact.

It is too early to tell if the rule will be good for clean energy, but it is hard to see how it could hurt. The modeling in the Regulatory Impact Analysis for the draft rule projects huge uptake of energy efficiency because of its cost-competitiveness and significant increases for renewable energy towards the end of the compliance period – and the modeling likely underestimates the actual results. A clear impact the draft rule has already had is that it has created a venue for conversations about clean energy that have not been had to this point at the level and scale necessary; it forces every state to have a conversation about where it will be in 2020, 2025, and 2030 – hopefully with an eye to building momentum to reach even more aggressive climate goals beyond 2030. The rule presents an opportunity for all kinds of clean energy advocates to make their cases to each state, and the cleantech sector needs to be smart in how it manages this opportunity. In addition, the rule is making a difference to the international community and could help in the Paris negotiations on a new climate agreement next year.

HO'O PONO PONO & SPREADING THE WORD

The world has been waiting for U.S. leadership on climate change and clean energy for a long time. The U.S. will soon be known for exporting oil and gas. There is a need to define a U.S. solution for U.S. clean energy – a compelling vision of the near-future state of U.S. clean energy that is easy for civil society to understand and hard to disagree with. Defining such a vision will require greater discussion in the spirit of Ho'o pono pono, a Hawaiian concept of getting together and talking it all through until the right conclusion is reached. Such discussion would benefit from hearing the experiences of a broad range of actors, including customers (especially industrial customers) and companies operating outside the United States (to hear the U.S. experiences and share their own).

There is also a need to take these discussions to those who could benefit from them. While some clean energy discussions appear to be reaching a point of convergence, with people generally agreeing on what the problem is and what the goal is (though not necessarily on how to get there or on all the details), there are many regulators and utility executives who think the U.S. is still in Cleantech 1.0 and does not need to go anywhere else. There is a need to figure out how to bring those people along and help them start to understand the speed and nature of the changes that are occurring. Furthermore, apart from early adopters and companies that live and breathe clean energy, there is a need to convince others (e.g., capital providers) to enter this very complicated space more aggressively.

APPENDICES

AGENDA

Friday, July 11

9:00 AM – NOON

SESSION ONE: The Big Picture – Where is the Energy Sector Today and is its Future Clean?

This opening session will serve to frame the context for the entire Forum. We will level-set where the energy sector is today, how deployment of capital and investment in R&D and new technologies is signaling where the sector is going, and what outstanding questions need to be answered in order to determine whether and when we will transition to a significantly cleaner energy future.

Moderator: **Andy Karsner**

Discussants:

Amy Meyers Jaffe, Executive Director of Energy and Sustainability, UC Davis

Gil Forer, Global Cleantech Leader, EY

Matt Guyette, Chief Marketing Officer, GE Power & Water

David Danielson, Assistant Secretary of Energy, Energy Efficiency and Renewable Energy, DOE

1:30 – 3:00 PM

SESSION TWO: Evolution or Revolution in the Power Sector? – Regulatory Changes

The electricity sector today faces challenges and opportunities that scarcely resemble those facing the electricity sector of the past. Though an overused and imperfect analogy, is the electricity sector following the path of the telecommunications sector of the 1980's and 1990's? What regulatory structures do we need to foster the competitive forces that can maximize clean energy deployment and meet consumer demands? Can a system built on a century of regulating a centralized energy grid adapt to fostering a distributed energy future? Can the "death spiral" become a "stairway to Heaven" for utilities?

Moderator: **Roger Ballentine**

Discussants:

Jon Creyts, Managing Director, RMI

Richard Kauffman, Chairman of Energy and Finance for New York, Office of the Governor

Joshua Epel, Chairman, Colorado Public Utilities Commission

3:15 – 5:00 PM

SESSION THREE: Evolution or Revolution in the Power Sector? --Views from the Marketplace

Pressures to decarbonize and to be more secure and resilient are appearing at the same time that new and cheaper technologies, new energy sector businesses and changing consumer roles in the electricity system are challenging our legacy market design and generating interest from non-traditional/non-utility players. How are new business models seeking to deliver new value? How will the role of the energy consumer change and what do they want? Will the full potential of microgrids, distributed solar, energy storage, demand response and new energy-related IT take hold and are the regulatory changes being contemplated adequate to get there?

Moderator: **Roger Ballentine**

Discussants:

Sunil Garg, SVP, Chief Information & Innovation Officer, Exelon Corporation

Matt Handel, VP, NextEra Energy Resources

Jeff Weiss, Co-Chairman & Managing Director, Distributed Sun

Peter Littlewood, Director, Argonne National Laboratory

Saturday, July 12

9:00 – 10:30 AM

SESSION FOUR: Beyond Efficiency: Energy as the Conduit for Connectivity, Productivity and the Optimization of Customer Needs

The very nature of the relationship among energy, consumers and devices is rapidly changing. In addition to the economic and policy drivers for increased efficiency and other changes in the use of energy behind the meter, new technologies and smarter devices are fueling heightened customer demands and expectations. What does it mean to go "beyond efficiency"? Historically, we have judged efficiency as the rate of consumption of energy by devices; do we need to think instead about energy systems and optimization of those systems? What current or new business models are needed to effectuate that shift?

Moderator: **Andy Karsner**

Discussants:

Bryan Hannegan, Associate Lab Director, NREL

Scott Tew, ED, Center for Energy Efficiency and Sustainability, Ingersoll Rand

Tushar Dave, Chairman and CEO, EnLighted, Inc.

10:45 – 12:15 PM

SESSION FIVE: What Do the New EPA Carbon Rules Mean for Clean Energy?

EPA has released perhaps its most impactful Clean Air Act rule in a generation. The Clean Power Plan will force every state in the nation to design and administer mechanisms to reduce greenhouse gases from power plants using a broad menu of options ranging from unit by unit mandates to elaborate trading programs. What will be the real impact on renewable energy, energy efficiency, distributed generation and energy innovation? Are we certain that the rules will accelerate clean energy deployment? What are the key issues that state implementation plan drafters should consider when designing the most impactful and cost effective role for clean energy sources and demand side options?

Moderator: **Roger Ballentine**

Discussants:

Doug Smith, Partner, Van Ness Feldman

Ali Zaidi, Deputy Director for Energy Policy, White House Domestic Policy Council

Steve Corneli, SVP, Policy & Strategy, NRG Energy

Ron Kirk, Co-Chairman, Clean and Safe Energy Coalition

Sunday, July 13

8:30 – 11:30 AM

SESSION SIX: The Takeaways

Building upon discussions in the preceding sessions and looking forward strategically, what are the ongoing obstacles to the proliferation of energy innovation and market uptake? What are the priority needs that this group can identify or help clarify as the transition to a clean energy continues? Where should this discussion go next to add value?

Moderators: **David Monsma, Roger Ballentine, Andy Karsner**

PARTICIPANTS

Shannon Angielski
Principal
Van Ness Feldman

Atul Arya
Senior Vice President and
Business Leader
Energy Insight
IHS

Roger Ballentine (Co-Chair)
President
Green Strategies

Hannah Bascom
Business Development and
Energy Partnerships
Nest Labs

Andy Baynes
Director of Business
Development
Nest Labs

Jeffrey Brown
Senior Vice President
Finance & Strategy
Summit Power Group

Michael Bruce
Director
Hannon Armstrong Capital

Barbara Burger
President
Chevron Technology Ventures

Colleen Calhoun
Senior Executive Director
GE Ventures

Karen Clarke-Whistler
Chief Environment Officer
TD Bank Group

Steve Corneli
SVP, Policy & Strategy
NRG Energy, Inc.

Jon Creyts
Managing Director
Rocky Mountain Institute

David Danielson
Assistant Secretary
Energy Efficiency and
Renewable Energy
U.S. Department of Energy

Anthony Danti
Director of Legal Services
Silver Ridge Power

Tushar Dave
Chairman and CEO
Enlightened

Dan Delurey
President
Association for Demand Response and Smart Grid

Joshua Epel
Chairman
Colorado Public Utilities Commission

Gil Forer
Global Cleantech Leader
EY

Sunil Garg
Senior Vice President
Chief Information & Innovation Officer
Exelon Corporation

David Gold
Partner
Morrison & Foerster LLP

Matthew Guyette
Chief Marketing Officer
Strategic Marketing
GE Power & Water

Matthew Handel
Vice President
NextEra Energy Resources, LLC

Bryan Hannegan
Associate Lab Director
National Renewable Energy Laboratory

Bruce Harris
Senior Director
Federal Government Relations
Wal-Mart Stores

Marilu Hastings
Sustainability Program Director
Cynthia and George Mitchell Foundation

Eric Holdsworth
Director, Climate Programs
Edison Electric Institute

Mitch Jacobson
Co-Director, ATI Clean Energy Incubator
The University of Texas at Austin

Amy Myers Jaffe
Executive Director of Energy and Sustainability
UC Davis Graduate School of Management

John Jimison
Managing Director
Energy Future Coalition

Edward Johnston
Vice President of Research Operations
Gas Technology Institute

Andy Karsner (Co-Chair)
CEO
Manifest Energy

Richard Kauffman
Chairman of Energy and Finance for New York
Office of the Governor

Ron Kirk
Co-Chairman
Clean and Safe Energy Coalition

Jason Koman
Senior Director
Green Strategies Inc.

Linda Lingle
Former Governor of Hawaii
Linda Lingle LLC

Joe Lipscomb
Co-Founder and Partner
Arborview Capital

Peter Littlewood
Director
Argonne National Laboratory

Michael Luhrs
Vice President, Retail Programs
Duke Energy

Yoav Lurie
CEO and Founder
Simple Energy

Jason Mark
Senior Vice President, Director of U.S. Programs
The Energy Foundation

David Monsma
Executive Director
Energy and Environment Program
The Aspen Institute

Joseph Nelson
Partner
Van Ness Feldman, LLP

Brian O'Keefe
International Editor, Fortune Magazine
Co-chair, Brainstorm GREEN

Kyung-Ah Park
Managing Director
Head of Environmental Markets Group
Goldman, Sachs & Co

Anna Pavlova
Executive Director, Policy
Johnson Controls

Neil Pennington
Head of Smart Implementation
RWE npower

Mark Peters
Deputy Laboratory Director for Programs
Argonne National Laboratory

Chad Plotkin
Vice President, Strategy
Head of Investor Relations
NRG Energy

Glenn Prickett
Chief External Affairs Officer
Nature Conservancy

David Ramm
Chairman and CEO
BrightSource Energy

David Rodgers
Senior Climate Change Specialist
The Global Environment Facility

Alan Rose
Director of Marketing
Energy & Utilities Industry
Intel Corporation

Scott Sarazan
Global Cleantech Markets Leader
EY

James Schaefer
Senior Managing Director
Blackstone

Gia Schneider
Chief Executive Officer
Natel Energy

Alanya Schofield
Strategy, Communications & Continuous Improvement
Director, Emerging Technology
Duke Energy

Douglass Smith
Partner
Van Ness Feldman, LLP

Scott Tew
Executive Director
Center for Energy Efficiency and Sustainability
Ingersoll Rand

Pamela Venzke
Managing Director
Global Government Affairs & Policy
GE Power and Water

Simon Watson
Advisory Services
EY

Michael Webber
Deputy Director, Energy Institute
The University of Texas at Austin

Jeff Weiss
Co-Chairman & Managing Director
Distributed Sun

Alden Woodrow
Business Team Lead
Makani / Google X

Rhem Wooten
Executive Vice President
Hannon Armstrong

Robert Zabors
CEO
Enovation Partners LLC

Ali Zaidi
Deputy Director for Energy Policy
White House Domestic Policy Council

Rapporteur

David Grossman
Principal
Green Light Group

Observers

Alison Ford
Director, Corporate Governance
Duke Energy

Robert Foster
Executive Director
AMP – Accelerating Market-Driven Partnerships
The Aspen Institute

Layle Lopez Nelson
Senior Director
APCO Worldwide

David Schifrin
Manifest Energy

Staff

Nicole Alexiev
Deputy Director
Energy and Environment Program

Avonique (Nikki) De Vignes
Program Coordinator
Energy and Environment Program

Timothy Olson
Senior Project Manager
Energy and Environment Program