Scaling Clean Energy: Lessons Learned and New Approaches



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The Aspen Institute
Energy & Environment
Program

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2013 Aspen Institute Clean Energy Forum

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THE ASPEN INSTITUTE
ENERGY & ENVIRONMENT
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Published in the United States of America in 2014
By The Aspen Institute

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Foreword

The Energy and Environment Program of the Aspen Institute convened the fourth annual Aspen Institute Clean Energy Forum in Aspen, Colorado from June 20-23, 2013, to examine how to quickly and efficiently move toward a clean energy future. Building on the Institute's highly successful Energy Policy Forum (examining the U.S. electric utility industry) and Forum on Global Energy, Economy and Security (examining the international oil and gas markets), the Clean Energy Forum brings together a broad cross-section of emerging energy, finance, and policy experts and entrepreneurs for an in-depth conversation on the future of clean energy.

Co-chaired by Andy Karsner, CEO of Manifest Energy, and Roger Ballentine, President of Green Strategies, Inc., the Forum offered a unique opportunity for a select group of high-level clean energy experts – current and former government officials, entrepreneurs, executives, and others – to share information and insights. A dialogue format was used to encourage new, collaborative thinking. A few discussion-starting presentations started each session, but much of the time was reserved for discussion. An informal atmosphere and a not-for-attribution rule encouraged candid exchanges and creative thinking. Insights from the Forum are summarized in the following pages, and the agenda and list of participants are appended.

The Aspen Institute acknowledges and thanks the following sponsors for their generosity and commitment to our work.

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I would also like to thank the rapporteur, Dave Grossman, who was able to capture the richness of the wide-ranging discussions and distill the highlights into this informative summary. Thanks also to Tim Olson whose efficient and cheerful management of the preparations resulted in a pleasant and smoothly run Forum.

Summaries such as this are issued under the auspices of the Aspen Institute's Energy and Environment Program. This particular summary is an attempt to present some of the key ideas and information raised during the Forum, but not all views expressed were unanimous (nor were unanimity and consensus sought), and participants were not asked to agree to the content or wording of this summary. The co-chairs, the speakers, and the Forum participants are in no way responsible for the contents of this summary.

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Rapporteur

Executive Summary

We are still in the early stages of a transformation of the U.S. electricity sector into a cleaner, more flexible, more resilient, and more dynamic system. The early history of investment in and adoption of clean energy technologies and practices has been mixed. The venture capital model has proven to be inadequate for scaling up clean energy, and anticipated policy developments have been slow to be realized. The sector-reshaping impact of unconventional gas, uneven capitalization of clean energy companies, and the mixed signals of government policymakers have slowed the march to a more distributed energy economy rooted in the greater use of renewables, the more efficient use of energy, and the optimization of information technologies in the energy sector.

Yet few doubt that the future energy economy will be cleaner and smarter. Business models, financing structures, and government policies can accelerate that future. Taking a clear-eyed measure of past failures and the considerable progress that has occurred over the last decade can illuminate some of the keys to that acceleration.

The current (and future) clean energy landscape relies upon the interaction of technology, capital, and policy. In most cases, lack of technology has not been the obstacle to greater deployment of clean energy resources and practices. Market uptake has been limited by mixed policy signals, the inertia of incumbency, and lack of sustained access to affordable capital. The current technological landscape includes increasing numbers of large-scale renewable energy projects, increasingly affordable clean distributed energy resources, cheap natural gas, advances in energy storage, growing numbers of electric vehicles, increasingly robust demand response markets, the advent of information and communication technologies (ICT) to meet the need for a tremendous amount of data management and analysis, and other innovations. Annual new renewable energy generation capacity worldwide has continued to increase, despite declining global investment in clean energy overall and greater skepticism on the part of institutional investors with respect to clean tech. Leading corporations, too, are taking greater steps to optimize their energy usage, including incorporation of more energy efficiency and renewable energy. On the policy front, only modest energy measures have any chance

of getting through the current dysfunctional Congress, so policy leadership is expected to come instead from the Administration and from public utilities commissions (PUCs) and the states.

Driven by technology changes, some market innovation, and/or new policies, new business models and innovative approaches are beginning to appear in the electricity sector. Regulated utilities are seeing their business models challenged by energy efficiency and distributed energy resources that are shrinking the pool of ratepayer kilowatt-hours (kWh) from which utilities recover their costs. In response, some utilities are exploring new rate structures, financing models, and investments in renewable energy generation, distributed energy resources, energy storage projects, smart meters, and the like. The core regulatory model, however, may face increasing stresses in the face of more renewable energy, distributed generation, and customer choice. While there has been some policy innovation within regulated and restructured markets (e.g., performance metrics to reward utilities for providing value to customers), hurdles related to volumetric pricing and the shrinking kWh pool remain. Utilities may need to realign their business models to focus on achieving a right-sized core of regulated assets that are a good fit for a natural monopoly.

Innovation has come on the capital side as well, with companies arranging securitized transactions involving energy efficiency and distributed generation projects and creating REITs and REIT-like entities focused on clean energy infrastructure. New technologies (e.g., "learning thermostats", "big data" analytics) are also enabling new business models focused on the needs of energy consumers.

A key area of technological innovation (which in turn will depend on business models and regulatory structures) will be the development of "smart electricity networks" that serve as open-access, multi-directional transactional platforms enabling optimization of a range of objectives (e.g., safe, reliable, clean, distributed). Such networks could offer numerous benefits, including grid optimization, greater demand response opportunities, better incorporation of intermittent renewables, reduced peak load, and improved energy security and resilience. Given the fragile and increasingly unreliable current grid, microgrids could be of particular value in improving energy security and resilience. It can be challenging, however, to develop and deploy microgrids and smart electricity networks, in part because our system treats electricity as a generic commodity and is not set up to allow for different prices reflecting the different value elements electricity can offer to different customers (e.g., availability in a time of crisis, renewable/clean). In addition, the mechanical, conservative nature of the electricity sector means that it may face immense challenges in managing and utilizing "big data" analytics.

Moving forward, advancing clean energy and smarter electricity networks at the scale and scope required to meet greenhouse gas, energy security, and other goals will likely require changes in policy, business models, and financing, as well as continued open, honest, values-based discussion. Potential areas of focus include the following:

- ***Policy:*** Policy reforms and innovations – at the federal and state levels – will be needed to optimize markets and adapt to technological innovation.
- ***Technology:*** Clean energy discussions may benefit from a better understanding of how advanced technologies – both available and just over the horizon – can be inserted into the future grid and into the revenue models of regulated and non-regulated entities.
- ***Business models:*** Efforts to reform the traditional regulated utility model may be better focused on the broader energy value chain and on trying to design an electricity system that more optimally determines where natural regulated monopolies, organized markets, and competition can best play a role.
- ***Funding:*** More focus is needed on how to get private capital off the sidelines and into clean energy innovation; philanthropy, too, should figure out how to optimize grant making to spur new business models and innovation in the sector.
- ***Collaboration:*** Greater collaboration by utilities, major corporate customers, and other stakeholders on advancing clean energy could somewhat negate the need for major policy changes.
- ***Celebrating successes:*** There is a need to showcase successes, including leadership by PUCs, politicians, utilities, companies, foundations, and non-profits in creating or supporting new business models, financing structures, and technologies, as well as in deploying huge amounts of clean energy.

Choices will likely have to be made with regard to where one can get the biggest bang for the buck in the shortest time to move the clean-energy ball forward.

The Current Clean Energy Landscape

We are in the early stages of a transformation of the U.S. electricity sector into a cleaner, more dynamic system, though the predictions from a few years ago about the pace, shape, and mode of the transition largely have not come to pass. Venture capital has proven to be an inadequate model for scaling up clean energy, and anticipated policy developments have been slow to be realized. At the same time, unconventional natural gas has been reshaping the sector.

Yet the future energy economy will almost certainly be cleaner and smarter. Over the next decade, we will see more change in the sector than we have seen over the last 100 years (though that is not a high bar). Whatever the nature of the transformation, electricity has to remain reliable and affordable while also being environmentally responsible.

The clean energy sector rests upon three connected pillars: technology, capital, and policy. Generally speaking, it has not been lack of technology that has hindered greater clean energy deployment, but rather mixed policy signals, lack of sustained access to affordable capital, and the inertia of incumbency. While discussions about clean energy often focus on market-driven policy and policy-driven markets, new technologies (and new business models) are creating more opportunities for delivering value and are forcing policy to innovate as well. An appreciation of all three pillars is necessary for understanding how clean energy can scale.

Technology

The current U.S. electricity system is basically a hub-and-spoke model, with passive one-way flow to a static consumer. This model is relatively easy to operate, plan, regulate, and invest in, though it is also balkanized, congested, and inefficient. This system is being challenged by the introduction of large-scale and distributed renewable energy, new customer-side demands, energy storage, electric vehicles, the advent of information communication technology (ICT), and other technological innovations, all of which create more flexibility, uncertainty, and dynamism in the system.

In the realm of power generation, there are numerous and increasing stresses on the existing generation fleet, including environmental regulations. Natural gas will be in the $4-$6 range for the foreseeable future, which has sweeping impacts on the cost parity of other sources. Solar power is starting to reach parity in retail markets, and solar photovoltaic costs continue to come down. Wind technology has made a lot of advances, supported by policy; the levelized cost of energy from wind is about one-third of what it was 10 years ago, while capacity factors have doubled and availability has increased from about 85% to 99%. Still, there are commercial and transmission barriers to large-scale renewable energy projects that need to be addressed.

The future power delivery network will need commercial solutions that can handle a tremendous amount of data management and analysis.

Changes in how customers interact with energy are occurring rapidly with improved energy efficiency, smart appliances, electric vehicles, energy management systems, and increased use of demand response and distributed energy resources. A lot of cheaper distributed energy resources are now available, including micro-CHP (combined heat & power) and distributed solar, and the pieces are all coming together so quickly that there may soon be cheaper round-the-clock availability of distributed generation resources at the small business and homeowner levels. In addition, even in the absence of changes in market rules, technology is now enabling customers to have access to demand response opportunities by linking customers with those who can make money from demand response. Virtual power plants – where companies or utilities aggregate demand response from many customers – are already delivering tens of thousands of "nega-watts", and the future power delivery network will likely have to enable improved management of customer loads as if they were generation assets. The future network will also need commercial solutions that can handle a tremendous amount of data management and analysis. The pace of change is unclear, though; it will be important to keep an eye on the rate at which some of these technologies are deployed. In the United States, the value proposition for many of these technologies is probably strongest for commercial and industrial customers, due to economies of scale and the ability to command retail prices that are more competitive.

Technologies' benefits, of course, are in no way limited to the United States and other developed countries. Robust R&D investments in the developed world on microgrids and clean energy technologies could help developing countries leapfrog directly to a clean energy system.

Capital

Global investment in clean energy declined in 2012, with global stimulus spending for clean energy dropping sharply since the 2010 peak. Venture capital investment in clean tech has been declining, private equity funds are finding few opportunities, and institutions such as pension funds are lick-

ing wounds from some early clean tech investments. The IPO market for the clean energy sector has been skittish at best and is now showing mixed signs of resurgence. Large utility clean energy projects are an area where project finance capital has succeeded, though capital has gone only to select types of projects in select countries – usually with strong policy support including tax equity investment. Increasingly, we are seeing innovative business models offering relatively de-risked investment opportunities in distributed generation assets, but uncertainty remains around credit risk, policy risk, energy price risk, and many other issues, all of which have to be measured and mitigated simultaneously.

Institutional investors have a much different perspective on clean tech than they did a few years ago, viewing the sector now with much greater skepticism. The financial community significantly underestimated how long it would take for entities to come to market and be successful, as well as the capital intensity of the sector. The market now wants to see companies that have growth not just in revenues but also in earnings. Many believe, however, that the risks of climate change remain vastly underpriced, while the market also undervalues the opportunities related to reducing climate risks.

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Nevertheless, annual new renewable energy generation capacity has continued to increase, with investment occurring all across the globe. The US and Europe remain key markets, but policy uncertainty and fiscal austerity are having an impact. The emerging markets, meanwhile, are a growing play. There are also increasing East-to-West capital flows, with China in particular looking at renewable energy acquisitions and projects overseas. In addition, corporate venture capital is playing a bigger role.

We will likely see more new models and sources of capital over the next few years. For that to happen at scale, however, there is a need to standardize a lot of the product so it can be more easily securitized. There is also need to de-risk investments in the electricity sector.

A key part of de-risking investments in renewable energy projects is the bankability of the off-taker of the energy and the quality of the power purchase agreement (PPA). Increasingly – driven by financial, energy security, brand equity, regulatory, and competitive risks – corporations are taking steps to optimize their energy usage, including energy efficiency and incorporation of more renewable energy (third-party and self-generated). However, multinational companies think globally when thinking about where to invest their capital, and many things can kill investment in U.S. renewable energy projects (e.g., terms of the PPAs, permit delays).

Policy

Few sectors are more dependent on policy than energy – both traditional and new. There is an interesting tension between the energy world in general moving incredibly fast and the government moving really slowly. Policy is lagging the technology.

At the national level, Congress is in a state of near-total dysfunction and is operating in an era of fiscal constraint. No major climate-related legislation can pass this Congress. Proponents of clean energy and energy efficiency are often going to be on the defensive, including with respect to House budget proposals that propose major cuts related to clean energy. Comprehensive tax reform is possible but still unlikely in this Congress, which may affect what happens to a suite of clean energy-related tax credits due to expire at the end of the year. Within the tax code, the passive loss limitation can be very disruptive to investment in clean energy. This Congress (or one in the near future) may be able to make progress on extending Master Limited Partnerships (MLPs) to the clean energy sector (perhaps in exchange for a multi-year phase-out of the Production Tax Credit) and on the Shaheen-Portman energy efficiency bill, though there are hurdles for both.

There is an interesting tension between the energy world in general moving incredibly fast and the government moving really slowly.

Looking over the horizon a bit, the big opportunity to do something meaningful at the national level may be a revenue-neutral carbon tax as part of comprehensive tax reform, though some remain skeptical that Congress would ever really pass such a tax (especially at a level high enough to make a difference). Another option could be a Clean Energy Standard, perhaps with payments to coal not to produce power.

There is much more action coming – and expected – from the Obama Administration, including (but not limited to) the development of rules under the Clean Air Act to deal with greenhouse gas emissions from new and existing power plants. Energy Secretary Ernest Moniz has also committed to developing a Quadrennial Energy Review, which could be another vehicle for advancing clean energy goals.

Government has used a few basic tools to support clean energy, including mandates, purchasing preferences, subsidies, and regulation. Uncertainties around policy durability and changing political attitudes render many of these approaches sub-optimal. Clean energy investors and project developers would vastly prefer a system of simplicity, consistency, and duration. In addition to the politics in Washington being broken, therefore, it may be that the clean energy policy model is as well, with its over-reliance on short-term subsidies and lack of attention to drawing private capital into the market. Another tool that government can use toward that end is smart deregulation and interpretation, such as the Obama Administration's efforts to streamline permitting for large renewable

energy projects. Governments always pick winners and losers, making it harder or easier to make money doing certain things; it makes sense for governments to pick societal outcomes we want, but there is more disagreement when it comes to governments picking particular technologies.

While federal policies are likely essential for achieving the level of emission reductions needed to have any chance of avoiding the worst impacts of climate change, the government (i.e., Congress) is too dysfunctional to adopt such policies, which makes it essential that states lead. States are a vital part of the electricity policy landscape. More than 200 million Americans live in states with some renewable electricity standard, and about 240 million live in states with some kind of energy efficiency resource standard. States determine whether third-party leasing for solar power systems is allowed; in some states, those account for over 80% of installs. Some states' policy frameworks are also beginning to focus more on using limited government money to leverage private capital – such as by creating green banks, lowering transaction costs (e.g., standardizing contracts), and adopting commercial PACE (property assessed clean energy) programs.

While state policies have been critical drivers of progress, state regulations that are politicized and that are different in every state hurt investment certainty.

Policy hurdles exist at the state level, too, however. For corporate buyers, there are barriers related to independent power production, the ability to directly negotiate PPAs, self-production, permitting, and wheeling across state lines. PUC policies can present barriers to entry for entrepreneurs, including issues such as interconnection standards and safety standards. On the supply side, the tremendous fragmentation of the state-by-state, PUC-by-PUC regulatory model can lead to very divergent utility models and actions with respect to clean energy. In addition, clean energy has become more politicized at the state level since 2010, though attacks on state clean energy policies have thus far been unsuccessful, even in conservative states. While state policies have been critical drivers of progress, state regulations that are politicized and that are different in every state hurt investment certainty.

Innovation & New Business Models

Spurred by changes in technology, markets, and/or policies, new business models and innovations are currently being deployed in the electricity sector, in regulated, restructured, and competitive electricity markets. New financing models are also being created, while new technologies are seeking to change electricity demand by focusing on the needs of energy consumers.

Utilities

Regulated utilities' actions are directly linked to and dependent on the regulatory environment in which they operate, so a change in regulatory models will lead to a change in business models for utilities and for innovators (though some regulated utilities also have operations in competitive markets).

New technologies and models in the electricity system can represent a different risk profile for investors and would require a shift in utilities' investor bases.

The traditional regulated utility business model currently relies on recovering utility costs from the pool of kilowatt-hours used by ratepayers, but greater adoption of energy efficiency and increasingly cheap and widely-deployed distributed energy resources could pose a serious challenge to this business model. Leading corporations, for example, are already increasing their energy efficiency and self-owned or third-party renewable energy use, reducing their need for utility power. As this pattern expands more broadly – as distributed energy resources become cheaper to consumers than some utilities' rates – utility sales volumes decline, shrinking the pool of kWh across which to recover costs. The smaller pool means utility rates have to increase, which makes distributed energy resources even more attractive, thereby leading to what many refer to as the potential "death spiral" for regulated utilities. (Even if not a "death spiral", the traditional regulated utility model is unquestionably under stress.)

The utility sector is generally quite conservative when it comes to innovation and adaptation, though after a substantial time lag, the sector can actually move rather rapidly. Some utilities are exploring new rate structures and financing models, and some also have sizable investments in renewable energy generation, distributed energy resources, energy storage projects, and smart meters. The various clean energy technologies in themselves are not frightening for utilities, as utilities figure that technologies that can be implemented in a market can be implemented even better at economies of scale by utilities. The technologies give utilities more flexibility in running the system.

However, investors invest in utilities because they represent government-like bonds with a very low risk profile; new technologies and models in the electricity system can represent a different risk profile for investors and would require a shift in utilities' investor bases, on which investor-owned utilities rely to meet their tremendous capital requirements.

Ultimately, despite the innovation, progress, and optimization occurring in regulated, restructured, and competitive markets, it is possible that a new over-arching rule-set is needed to achieve our clean energy, greenhouse gas, and energy security goals.

In addition, the regulatory model generally depends on volumetric pricing and sometimes other problematic elements (e.g., a least-cost standard), presenting barriers to building an intelligent grid and a business model that can support renewable energy, distributed generation, and customer choice. There has been some policy innovation within regulated and restructured markets, such as Illinois adopting performance metrics in a recent bill in order to reward utilities for providing value to customers, but many hurdles remain. Performance-based rate-making, decoupling, and allowing utilities to include distributed energy resources in their rate base present new challenges. Utilities may need to realign their business models to focus on achieving a right-sized core of regulated assets that are a good fit for a natural monopoly, selling or spinning off assets associated with distributed energy resources (e.g., microgrids) that might be a better fit for competitive markets. The risk, of course, is that significantly down-sizing utilities could lead to collective stranded assets, and a solution would have to be found for dealing with those costs.

The subsectors of the electricity industry that have been particularly successful (e.g., energy savings performance contracts, corporate investments in clean energy) have been so because their business models do not require them to ask any regulators for permission or to act within the confines of a regulatory structure. They find the white space where there is no incumbent rule structure – where policy and regulation do not really matter.

Ultimately, despite the innovation, progress, and optimization occurring in regulated, restructured, and competitive markets, it is possible that a new over-arching rule-set is needed to achieve our

clean energy, greenhouse gas, and energy security goals. In other words, it is certainly better to have balkanized, byzantine, dysfunctional markets that are optimized than ones that are not, but we have to be able to do better than that.

Finance

Innovation has also occurred on the capital side, with companies arranging billions of dollars in securitized transactions involving energy efficiency and distributed generation projects (though without a secondary market) and creating REITs and REIT-like entities focused on clean energy infrastructure. In effect, these companies are creating surrogates for clean energy financing structures that policy has not yet provided.

Technology

Within the clean energy space, much of the past focus on market entry and policy design has been a top-down approach driven by macro-data objectives (e.g., percentages of renewables, volumes of ratepayer funding). New technologies are focusing on the needs of energy consumers and are looking to change demand from the bottom up. The Nest thermostat, for instance, is a "learning thermostat" that uses occupancy sensors to automatically program a schedule for home occupants, adjust it based on changing conditions, and engage consumers in a conversation about participating in demand response opportunities. Across the United States, average savings on heating/cooling bills have been about 20 percent. There is a disconnect, though, between state or utility requirements for 2-year monitoring and verification (M&V) studies and the fact that Silicon Valley technology companies are creating new software every few months; there may be a need to match the M&V pace to the pace of technology.

There are also companies developing technology and software packages for utilities to interface with electricity users and manage the petabytes of data coming from consumers. It would be helpful for actors in the sector to have a better understanding of what the software options do in terms of managing and utilizing "big data".

Developing a Smart, Resilient Electricity Network

The traditional electricity grid is in the early stages of transformation to a "smart electricity network". At an Aspen Institute roundtable on smart electricity networks in May, the participants seemed to coalesce around the idea of a smart electricity network as an open-access, multi-directional transactional platform that enables optimization of a range of objectives, including not only those objectives that are the foundation of the current electricity system (providing universal, affordable, reliable, and safe power), but also new objectives such as enabling clean power, distributed generation, consumer choice, and innovation.

Marrying consumer information with what grid operators need to know in order to operate the grid more efficiently will generate enormous value for utilities and consumers. The smart grid could enable "transactive energy", where consumers have all the information and tools they need to be "prosumers", controlling their own energy use and buying and selling energy as needed. For utilities, grid optimization and other capabilities from the smart grid could generate hundreds of millions of dollars of value. A smart electricity network could help manage and incorporate intermittent renewables and help reduce peak load (e.g., by enabling greater use of demand response), yielding substantial savings. (The current cost of the electricity system is largely defined by peak load, which occurs on only a few summer days per year and which relies on starting up the oldest, dirtiest power plants at the highest cost; 10 to 20 percent of total electricity costs come from 80-100 hours on the system.)

Marrying consumer information with what grid operators need to know in order to operate the grid more efficiently will generate enormous value for utilities and consumers.

Smart grids – and, in particular, microgrids, which offer small-scale power production and the ability to be islanded from the main grid – could also help improve energy security and the resilience of our electricity system, which takes on greater importance in a world facing more severe weather extremes due to climate change. For the military, for

instance, renewable energy and microgrids in-theater can translate into fewer casualties and fatalities related to trucking fuel in to bases, while for military facilities in the U.S. that are currently dependent on a fragile and increasingly unreliable grid, they can increase energy security and ensure power availability under virtually all scenarios. Increasing outages are also spurring some other consumers to adopt highly decentralized solutions – paying a premium to become, in essence, a "nano-grid".

Part of the challenge in developing and deploying microgrids and smart electricity networks is developing the business models, partnerships, and valuations to make it all work. For example, identifying the economic net-present-value of energy security is not easy, but there is clearly a value to it. It is not reasonable to expect that regular electricity provision and a smart cyber-secure "islandable" microgrid will cost the same, as there is much greater value in the latter than the former. It may be critical to get away from understanding electricity as a generic commodity and instead to understand the different value elements electricity can offer to different customers (e.g., availability in a time of crisis, renewable/clean). These are value elements for which people should pay; "affordability" has sometimes been a crippling element in discussions about advancing clean energy, as there are just going to be times and places where the cost of energy is and should be high. The inability to really put a value on energy security and the lack of tools (regulatory or otherwise) to get people to pay for energy security at scale represent shortcomings of the current system.

In addition, the mechanical, conservative nature of the electricity sector means that it faces an immense challenge in integrating the concepts of the smart grid, cloud computing, and "big data" analytics. Some utilities may be in a position to handle, analyze, and utilize the enormous amounts of data generated by smart meters, smart appliances, and the smart grid, but for others, the value proposition of these advances only works if the utilities recognize that managing petabytes of data is not within their core competency and choose instead to work with third parties with "big data" expertise.

Regardless, utilities and others have to be careful to design and deploy smart electricity networks in a smart way. PUCs are tasked with protecting the public interest and monitoring the use of ratepayer money, so issues concerning privacy of data and prudence of costs related to smart grid implementation have and will continue to come before them.

Big Ideas and the Way Forward

Advancing clean energy at the scale and speed required to meet greenhouse gas, energy security, and other goals will likely require changes in policy, business models, financing, and technology, as well as continued open, honest, values-based discussion.

There are likely many successes and failures around the world that could be instructive for the U.S. situation. There may be lessons the United States can learn, for instance, from emerging markets that do not have the legacy systems, PUC-type management, and other barriers that the United States has; those markets think differently and move the agenda in a different way.

It may not be possible, though, to attack every problem in the clean energy sphere with the same intensity, focus, and money. Choices have to be made with regard to sequencing, focusing on where one can get the biggest bang for the buck in the shortest time to move the clean-energy ball forward.

Policy

Policy reforms and inquiries are needed at a range of levels – big and small, state and federal – to optimize markets and adapt to technological innovation. In general, there may be a need to engage in sustained work to figure out how state and federal carbon policies, technology policies, and PUC policies can change (or be worked around) to spur private capital and economies of scale for clean energy.

Starting with big and federal, it may be fruitful to try to squarely confront the federal policy hurdles that will be involved in advancing clean energy. For example:

- A fundamental restructuring of the electricity grid nationally – especially in the West – may be required to achieve at scale the clean energy results we want, and that will require policy changes.

- Restructuring the traditional regulated electric utility model will involve confronting several major federal statutes (e.g., the Federal Power Act) that are very difficult to amend.
- Federal policy (or at least support) is needed to promote development of utility-scale renewable energy on public lands (and offshore) proximate to load.
- There are things that markets do not do well, such as internalize externalities, that require policy.

More focused thought is needed on how to make federal policy more responsive to clean energy and technology needs. There may also be a need for an objective, non-partisan, non-ideological voice to assess, validate, and synthesize the greenhouse gas emission reductions that the policies already in place (e.g., the Clean Air Act) are achieving.

Federal policies, for the most part, are aimed at promoting or accelerating clean energy. State policies, on the other hand, seem to be the primary ones posing specific, discrete barriers for much of the market. Given limited resources and bandwidth, there is an argument to be made that efforts may be better concentrated on removing the impediments posed by state policies and unleashing natural business forces. For example:

- Some states do not allow third-party solar leasing.
- Smart meters contain two radios – one to send data to the utility, and one to send data to the electricity user, but the second radio is usually turned off; state regulatory action could direct the utilities to turn on the second radio to allow for direct data transmission (and thus greater use of third-party vendors and energy management systems).
- State regulations related to independent power production, the ability to directly negotiate PPAs, self-production, permitting, and wheeling across state lines present barriers to corporations that would like to be off-takers for renewable energy projects, while issues such as interconnection standards and safety standards can present barriers to entry for entrepreneurs.

Tackling the highest value bite-sized impediments through modest regulatory changes, instead of pursuing overarching, market-changing reforms, could provide real value.

In addition, important, immediate battles – as are occurring with respect to net metering – are focusing so much of people's time and energy on the now that they are fundamentally unable to take the longer view. There is a need for thoughtful people to help put out the policy brushfires and find convergent (instead of divergent) resolutions.

Technology

Clean energy discussions may benefit from a better understanding of the longer technological view as well, thinking about how advanced technologies – both currently available and on the horizon – can be inserted into the future grid and into the revenue models of regulated and non-regulated entities.

Business Models

The focus on reforming the traditional regulated utility model in order to motivate private capital, innovation, and technology may need to be broadened somewhat to look at the entire energy value chain from end to end. Utilities occupy just one small space in that chain, and it is worth looking at the entire chain and determining where a monopoly can play a role, where in the chain various strategies are aimed, and where there are natural versus policy-caused conflicts within the chain. Taking this one step further, it could be a valuable exercise to start from scratch: design a blueprint of what the clean energy future ought to look like – where there should be organized markets, where there should be natural regulated monopolies, where there should be competition – and then test that design to make sure it addresses climate change, incorporates resilience and energy security, promotes consumer choice, is conducive to profitable business models, and would unleash private capital and innovation.

Financing

There is a need to figure out the critical issues hindering private capital's greater involvement in clean energy innovation; otherwise, progress will not occur at the pace desired. A lot of capital is still sitting on the sidelines (partly because of the lack of clear policy signals from Washington). Without venture capital, there is no innovation. Without private equity and growth capital, innovation cannot get to market. Without pension funds and a lot of other capital reallocated to infrastructure and renewable energy, we will not get to where we need to go.

Philanthropy, too, may need to devise smarter grant making strategies that support organizations promoting utility model redesign, the smart grid, and solutions to discrete policy barriers. As is the case with state green banks and state venture funds, small amounts of philanthropic funding, if done right, can be catalytic.

Collaboration

If utilities, major corporate customers, and other stakeholders can collaborate moving forward on how to advance more renewable energy, and then take that plan to the utility regulators, the regulators may have a hard time turning that plan down. Such collaboration could somewhat negate the need for major policy changes.

Celebrating Successes

It is simplistic – and counter-productive – to focus solely on the problems and barriers. Lots of progress has been made on clean energy in the United States and around the globe, and we should not forget it. Not enough people are aware of the successes. There is a need to showcase successes, including leadership by PUCs, politicians, utilities, companies, foundations, and non-profits in creating or supporting new business models, financing structures, and technologies, as well as in deploying huge amounts of clean energy. Telling the story of winners goes a long way.

Appendices

Agenda

Friday, June 21

9:00 AM – Noon

SESSION I: THE CLEAN ENERGY "DATA ROOM"

The opening session will provide a general overview of the clean energy landscape today, including a cursory assessment of clean energy prices and technology penetration in the US and globally, capital flows and the policy environment.

Moderator: **Roger Ballentine**

Discussants:

Technology and Resource Handicapping	**Bryan Hannegan,** *NREL*
Industry Uptake and Capital Flows	**Gil Forer,** *Ernst & Young LLP*
Investor Perspective	**Ted Roosevelt,** *Barclays*
Policy Landscape and Political Prospects	**Jeff Bingaman,** *Steyer-Taylor Center for Energy Policy and Finance, Stanford University*

1:30 – 3:00 PM

SESSION II: LESSONS LEARNED AND CHALLENGES DEFINED

The last decade has seen many successes and failures in the clean energy sector. Venture capital investment targets and commercialization strategies have yielded hard lessons but with some strong successes. Government policies at the state and federal levels have varied from top-down mandates, to ratepayer-funded commercialization attempts and various sector subsidies – all with mixed results. Corporate M&A, private equity investment, and consumer uptake have all shown some promise yet broad adoption remains constrained. What worked? What hasn't? And, what lessons

have we learned that should shape technology company strategy, policy development and consumer adoption approaches?

Moderator: **Andy Karsner**

Discussants:

The Challenge of Adoption	**Colleen Calhoun,** *GE*
The Failure of Capital	**Sandip Sen,** *Citibank*
Federal Lessons	**Jason Bordoff,** *School of International and Public Affairs, Columbia University*
State Lessons	**Bill Ritter,** *Center for the New Energy Economy, Colorado State University*

3:15 – 5:30 PM

SESSION III: NEW BUSINESS MODELS, COMMERCIALIZATION BREAKTHROUGHS AND WINNING STRATEGIES

New business models are needed to overcome the challenges identified over the last decade. Altering utility rate structures and clearing away barriers to new companies who focus on energy services are two examples of the kinds of innovations that need to take place. However, unlocking these business models will require regulatory and policy innovation across governmental and market boundaries. How can focusing on new business models, not solely on breakthrough technology innovations, accelerate how energy is bought, sold, and deployed in scalable ways?

Moderator: **Roger Ballentine**

Discussants:

The Onset of DG: competitive technologies and regulated distribution	**Steve Corneli,** *NRG*
Reassessing the Regulated Utility	**Hilda Pinnix-Ragland,** *Duke Energy*
Regulatory Restructuring: IL case study	**Anne Pramaggiore,** *ComEd*
The New Corporate Consumer	**David Ozment,** *Wal-Mart Stores, Inc.*
New Approaches to Deploying Capital	**Rhem Wooten,** *Hannon Armstrong*

Saturday, June 22

9:00 – 10:30 AM

SESSION IV: ENERGY PRODUCTIVITY, LEVERAGING OF DATA, AND FOCUSING ON THE ENERGY CONSUMER

For clean energy, much of the past focus on market entry and policy design has been a top-down approach driven by macro-data objectives (percentages of renewables, volumes of ratepayer and government funding, national energy intensity, etc.). Energy efficiency, for example, is widely recognized as perhaps the simplest, fastest, least expensive and lowest risk way to meet growing energy demand and achieve desired environmental outcomes. But end-users continue to make economically and environmentally sub-optimum levels of investment in efficiency. How can new approaches focused on the energy consumer – particularly given emerging breakthroughs in data acquisition, use and ownership – change demand and adoption from the bottom up?

Moderator: **Andy Karsner**

Discussants:

Demand-side Energy Management	**James Connaughton,** *C3 Energy*
Empowering Consumers	**Andy Baynes,** *Nest Labs*
Streamlining Regulation	**Joshua Epel,** *CO PUC*
Optimizing Energy	**Jim Davis,** *Chevron Energy Solutions*

10:45 – 12:15 PM

SESSION V: DEVELOPING A SMART ENERGY NETWORK

The promise of achieving a "smart grid" has yet to be fully realized. However, with the onset of ICT, cheap computing power, low-cost bandwidth, and "Big Data" flows all allowing for enhanced energy management and distribution, the traditional energy grid is in the early stages of transformation to a "smart energy network." What technology and policy challenges remain in achieving a smarter energy network? And, what pockets of smart grid innovation at the local level and with the military, for example, should we better understand and leverage to fully realize a smarter energy network?

Moderator: David Monsma

Discussants:

Establishing Technology Priorities	**Dan Delurey,** *Association for Demand Response and Smart Grid*

Promoting Policy Cooperation	**Dan Esty,** *CT Department of Energy and Environmental Protection*
Learning from Military Micro-Grids	**John Lushetsky,** *Department of the Army*

Sunday, June 23

8:00 – 11:30 AM

SESSION VI: BIG IDEAS AND THE WAY FORWARD

Building on the previous sessions, participants will work together to identify and organize market development and energy policy insights that support and accelerate the growth, development and penetration of clean energy technologies and resources. What are the metrics that should be used to identify progress and success? What type of leadership is necessary?

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

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