2nd Distributed Energy Valuation Roundtable:
Toward Technical, Business, and Policy Solutions

ROUNDTABLE SUMMARY and CONCLUSIONS

Princeton Roundtable (April 10, 2014)

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Table of Contents

Table of Figures

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2nd Distributed Energy Valuation Roundtable
Summary and Conclusions

Introduction

This paper synthesizes the discussion and identifies opportunities emerging from the 2nd Distributed Energy Valuation Roundtable (Roundtable) held at Columbia University on April 10, 2014. This Roundtable was a follow-up meeting to a similar event hosted at Princeton University on April 26, 2013, and was attended by many of the same participants, along with a few new ones.

This Roundtable again brought together a diverse and influential group of stakeholders, including state and federal utility regulators, utility and distributed energy (DE) company CEOs and executives, as well as industry and academic subject matter experts in the fields of economics, environment, engineering, and law. State regulators and utility representatives primarily came from Northeastern and Mid-Atlantic states, which operate within competitive power generation markets and regional transmission organizations (RTOs). To ensure that the focus of the Roundtable included all aspects of distributed energy, the voices of CEOs, executives, and academics from the distributed generation (DG), energy efficiency (EE), demand response (DR), and distributed storage (DS) space were all represented.

To encourage frank discussion, Roundtable leaders set a ground rule of non-attribution. Accordingly, this synopsis reflects comments made throughout the day, but does not identify particular speakers. The conclusions and recommendations do not purport to reflect a consensus of the participants, except where specifically indicated, but, rather, are drawn from inputs received through the Roundtable process.

The Roundtable started with an update on the technology cost advancements, penetration potential, and policy landscape of distributed generation, followed by an overview of the importance and options for an integrated grid. The second half of the meeting was dedicated to discussing technical, business, and policy solutions to enable greater deployment and proper compensation of distributed solutions.

As a foundation of the discussion, it was noted that the grid has provided universal service to all customers for over 100 years. While it has become much more efficient in the past decades as competition has improved the performance and lowered the cost of generation units, recent changes have been profound. Natural gas fracking technology has brought unexpected and substantial savings to customers, causing a reduction of emissions of SO_2 and NOx and has the potential to reduce CO_2 emissions. Changing Environmental Protection Agency (EPA) air quality regulations have put pressure on coal generation. Nuclear facility starts have stalled, and retirements are accelerating.

At the same time, continuing technological advancement and public policy desires around distributed energy resources (DER) are driving the need to change how the grid is managed. With improving costs and public policy incentives supporting DER technologies, such as energy efficiency, DG solar, and direct load control that can further lower emissions and give customers more choices, these technologies are enjoying increasing market penetration. If cost declines continue and they become competitive with current rates, and/or if public policy support continues to provide incentives from the overall customer base to further the deployment of these technologies, it will be critical for the utilities to invest in and manage the grid to accommodate and optimize these tools and for rate design to adapt in order to fairly address cost and value attribution for all parties. Getting these rules right in advance of substantial penetration is critical.

A Clear Consensus:
Distributed energy represents a profound and permanent change to the electricity model, posing both risks and opportunities to utilities, consumers, and society.

Building on the 2013 Roundtable, this 2nd Distributed Energy Valuation Roundtable reaffirmed the crucial need for a just, reasonable, and transparent valuation approach to DE resources. Participants expressed the importance of initiating this conversation "early on," while DG still represents a small percentage relative to retail sales (between 0.5% to 4% in top solar states, according to SEIA, 2013), and emphasized the need to place the consumer at the center of the distributed energy discussion.

The main points of agreement expressed throughout the day were:

- DE resources are on a path of accelerated deployment, for reasons of both policy and economics;
- In many cases, DE solutions have the technical ability to support the grid;
- The pace at which DE resources are progressing – especially solar – creates a sense of urgency, which must be balanced with the challenge of "getting the rate design right." In other words, DE resources represent "the next frontier" in market design;
- Consumer and industry support of the incorporation of more distributed energy both hinge on principles such as: fairness, affordability, clarity, cost efficiency, and reliability;
- In order for the full costs and benefits of DE resources to be recognized, a set of outstanding technology, business, and policy issues must be addressed.

Value of distributed energy vs. value of the grid

Even with this consensus, many different perspectives emerged, often reflecting the specific experience of one or more of the very diverse participants. For example, it was suggested that the very framing notion of the "value of solar" (or what was fair to compensate the DG intervention on the grid) needed to be balanced with the contra-perspective of the "value of the grid" (or what it is worth to society and consumers that the grid remain available and reliable).

For many returning participants, the grid is seen as the most likely vehicle for the deployment of DE, but for DG proponents and those who have experience in the more penetrated European markets, the potential for continuing loss of net load and volumetric payments is changing the perception of the utility's role. No one was ready to affirm the likelihood (or even the strong possibility) of large-scale grid defection, but a number of suggestions that the economic pressures were building created cause for concern.

Everyone agreed that to accommodate all of the DE opportunities, grid modernization is needed, while acknowledging that in some parts of the country, the grid is already on its way to becoming an integrated, two-way system, capable of providing support and taking advantage of distributed resources. However, due to the costs associated with grid modernization (and the associated concerns of regulators on the true value of approving), several participants emphasized that in an increasingly DE environment, the value of the grid, just like the value of solar, needs to be better understood.

On the benefits side, the reliability, modularity, and ability of the grid to serve as both a markets facilitator for greater economic efficiency, and a platform for an "all of the above" energy policy were mentioned, though many of these activities are not currently accommodated under regulatory structures.

On the costs side, the grid's current capacity, ongoing operation and maintenance, as well as important modernization investment needs, were pointed out. Participants also noted

similarities between valuing distributed solar and the grid. For example, just like the value of solar, the value of the grid depends on:

- Territory (in some cases, DG is placed in areas where it supports the grid, or in other locations where it places further strain on the grid)
- Time of the day (one participant stated that distributed solar demand is not consistent with peak demand, as its production often falls off near 5:00 p.m. while peak demand continues to 7:00 p.m. or 8:00 p.m.)
- The notion of incremental investment impact (when a DG penetration triggers an additional investment)

Steps to improve business models and rate design can be made, but better information on quantifying the range of benefits and identifying precisely where and when these benefits and costs exist, can improve those efforts.

Solutions for Distributed Energy Challenges

To accommodate a more distributed electricity architecture, several innovative, simultaneous, and overlapping improvements in the technical features, business models, policy constructs, and regulation of the grid will be required. Each of these factors has a role to play, but DE is also conditioned on progress being made in all of the factors.

1) Technical Solutions

The deployment and adequate compensation of DE resources hinges on a set of technical solutions – often talked about in the context of grid modernization, or "smart grid." The Roundtable discussion around technical solutions focused on energy, information, and communication infrastructure (such as storage, smart inverters, and smart meters), as well as advanced management and control systems. Participants agreed that DE solutions have the ability to support the grid and that the value of integrating DE into the grid is multifaceted:

- Investments in energy efficient equipment and related measures are typically the most cost effective resource and is an important tool to lower emissions;
- Demand response/direct load control can be a cost effective measure to reduce costly peak energy prices and to defer investments in generation and, in some cases, distribution
- Distributed generation, such as solar, is another renewable resource that lowers emissions and can, in some cases (with further investments), provide a measure of resiliency, voltage support, loss reduction, and distribution optimization.

Communication standards and interconnection rules

To encourage the adoption of DE, it was argued that the availability of plug-and-play technologies is crucial. With the many types of devices and manufacturers, interoperability among third parties (for example, ones that produce software solutions) and the grid is crucial. At the moment, the lack of appropriate grid codes and harmonized interconnection rules inhibit technologically ready solutions from being implemented. Better standards are needed to support both of these issues and to allow the adoption of a communication protocol for the management of DE assets. Work on improved standards has already started and legislation is underway, but it is key to maintain a pressing focus on the progress of these technical regulations, as the gaps that currently exist threaten both the value of the grid and the value of distributed energy from being fully realized.

Smart inverters and intelligent control as microgrid enablers

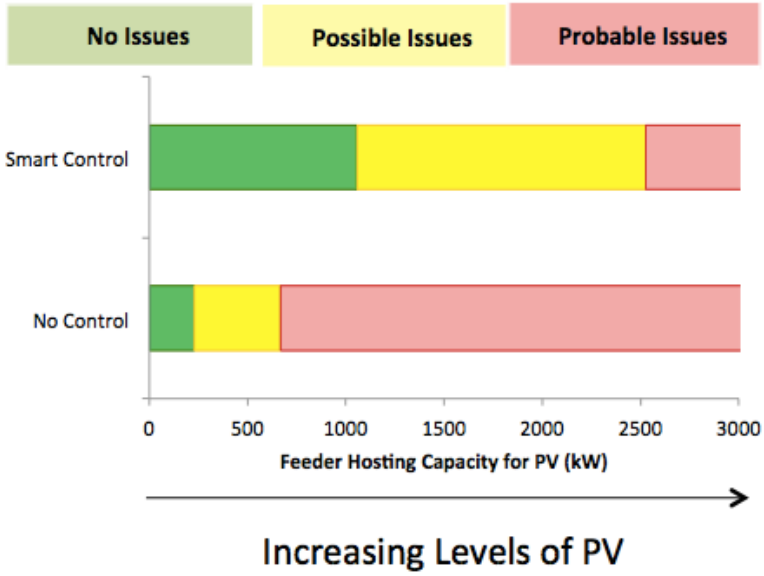
Microgrids are often mentioned as one of the features of a modernized smart grid. At the heart of the value proposition for microgrids' value is the ability for users to operate

independently, off the grid. To do so, a device called a smart inverter allows the microgrid to disconnect from the main grid (in times of poor reliability) and continue providing power.

Princeton University serves as a prime example of the benefits of being on a microgrid; during the catastrophic Hurricane Sandy of 2012, where many areas in the Northeast were powerless, Princeton provided power to campus buildings using its own generators. On the issue of grid reliability, however, Roundtable participants pointed out that, on average, there is an overall 90 minutes per year of power outage in the United States (or less than .02%), a statistic that shows a highly reliable grid system.

Smart inverters and intelligent control can also increase the amount of photovoltaics (PV) that can be accommodated on the grid. As shown below, one piece of data highlights that by adding an intelligent control technology and smart inverters, the levels of PV allowed with no voltage issues increase by about four to five times.

Figure 1: Smart inverters and control improve PV feeder host capacity (Courtesy: EPRI)



Storage

One misconception about storage is that in order to properly integrate DE into the grid, storage is an absolute necessity. This implies that a reliable grid with integrated DE is not possible until storage technology is fully mature and prices decrease. However, one of the main points raised during the discussion on technology is that this misunderstanding needs to be corrected; in fact, one participant noted that the grid itself acts as a "pretty good battery." For example, at the consumer level, a very small fraction of DG users actually 'disconnect' from the grid.

Due to the current high cost of batteries, any excess output is sold to the grid and bought from the grid later. This points to the need to recognize the values of DG putting energy onto the grid and the consumer using the grid for voltage control while DG is in use and as a battery and back-up system when DG is unavailable. One piece of evidence given to support this claim of using the grid as a battery is that in several European countries, such as Denmark and Spain, 45-47% penetration of renewables was achieved in 2013, without storage, simply by using technologies developed over the past 20 years. With current technologies, renewable penetration beyond current levels is capable in many regions and investments can be made to achieve further penetration, if warranted.

This is not to say that the grid does not stand to benefit from additional storage. It was pointed out that the benefits of additional storage are the greatest at the utility level and in certain weak spots in the grid (but would only be feasible if they could be deployed and fairly

compensated for their use). Frequency regulation was mentioned as one area where battery storage and other fast-start DE can help provide higher quality power to consumers. Storage could also support higher penetration renewables, and, in some cases, if significant cost declines are realized, might be much more economical to provide capacity than additional costly transmission and distribution infrastructure.

2) Business Solutions

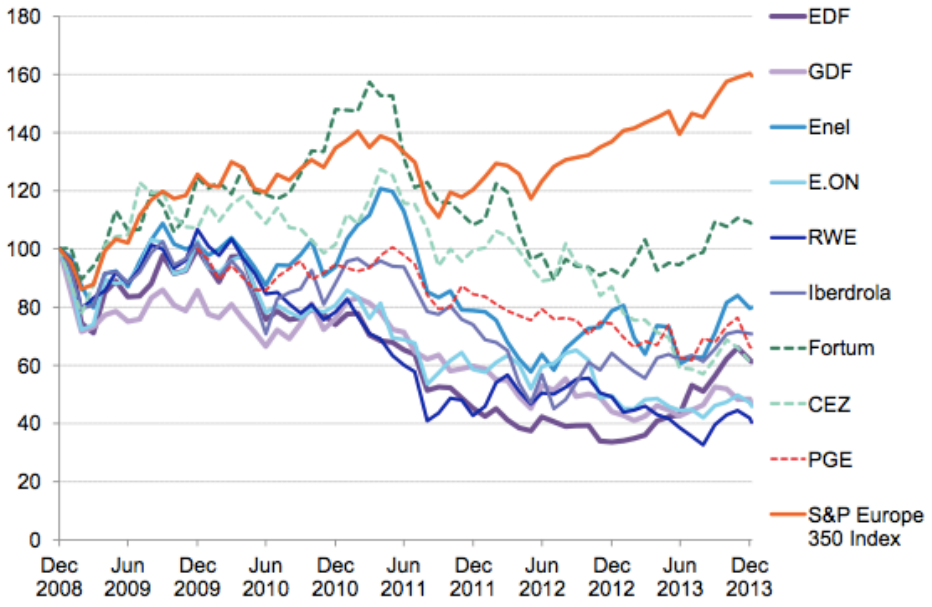
With the issue of how to value DE in the U.S. on the one hand, and troubling news about European utilities on the other, the participants discussed how utilities might adapt their business models in the future. Of particular focus was how utilities could adapt or expand their offerings in order to strengthen reliability, reduce costs for customers, and achieve company financial sustainability in the face of challenges from distributed energy. Utility leadership in energy efficiency services emerged as a potential path forward, though a number of questions remain to be resolved.

The European distributed energy experience offers a cautionary tale

Participants agreed that the deployment of DG in Europe has had a self-reinforcing "contagion" effect, in which penetration continues to accelerate as a result of growing public awareness, and as distribution rates have materially escalated as fixed utility costs and solar subsidies are spread across an increasingly smaller base, causing the decreasing number of customers who have not invested in, or do not have access to net metered solar, to bear the burden of the overall grid for all customers.

The group observed that the penetration of distributed generation has put acute financial pressure on European utilities over the past several years. This pressure has manifested itself via reduced cash flows and valuations, asset write-downs, and lowered credit ratings (and, thus, higher financing costs in the capital markets). The graph below shows the declining market trends that European utilities have been experiencing, partly due to their initial inability to change the rate design in advance of the rise of DG.

Figure 2: European utility stock prices since 2008 (Courtesy: BNEF)



Note: Prices normalised to 100 on 31 December 2008.

Source: Bloomberg, Tickers: EDF FP Equity, GSZ FP Equity, ENEL IM Equity, EOAN GR Equity, RWE GR Equity, IBE SM Equity, FUM1V FH Equity, CEZ GR Equity, PGE PW Equity

In response, many European utilities have pursued adaptive strategies, such as producing their own distributed generation, moving into energy services, and investing in utility-scale renewables.

Given the "firestorm in Europe," the group debated the relative urgency of evolving utility business models in the United States. Some attendees suggested carefully calculated and measured approaches given investment scope, but others urged more aggressive action to avoid a "death spiral" of stranded assets and fixed costs in the face of decreasing grid participation by customers. Some participants noted that investing in upgraded transmission and distribution (T&D) infrastructure comes with costs and regulators in several jurisdictions remain cautious about certain investments, such as smart meters. Questions were raised about how to avoid stranded assets resulting from the rapid obsolescence of some new technology (e.g., smart meters), costs of new technology that exceed current solutions (i.e., batteries and certain renewables), and overbuilding transmission and distribution, and there was substantive discussion about how to spread investments in base reliability and value-added services across customer bases that continue to shrink as a result of net metering via DG. In addition, there was debate about whether issues like the value of DE can be addressed on a stand-alone basis or if a system-wide approach to evolving utilities' business models and rate design will be necessary.

Nevertheless, there was widespread agreement that the time is ripe for change. Rate design hails from decades ago, and does not adequately address distributed generation and energy efficiency. And, as technology solutions enable the grid to function and communicate in a bidirectional fashion, the traditional "at the meter" scope of responsibility of the utility is up for debate. Finally, the group further recognized that customers demand power services that support their devices and lifestyle, but show little interest in the electricity commodity itself.

So, what options do U.S. utilities have when it comes to new business models?

The group discussed how U.S. utilities have many of the same options as those pursued by utilities in Europe. Ideas raised included both regulated and unregulated development (e.g., commercial scale solar), project and platform investments, rollout of enabling technology (e.g., smart meters), and becoming a service provider at either the back-end (installation, bundling) or front-end (lead generation/channel to market, branding).

One of the most intriguing ideas was that of the utility as a "market-maker" that would act on consumers' behalf to find, vet, finance, and insure a range of third-party DE solution options to make sure the best technologies were available at the cheapest cost. It was widely agreed that this model would only work if the reality (and the perception) of unfair use of market power by utilities, such as cross-subsidization or competition, were addressed.

More generally, several participants noted that utilities would need to decide if they should act as financiers, system integrators, acquirers, or as a "market-maker" for solutions. One of the biggest questions raised (and left unresolved) was what parts of new or expanded utility business models should be regulated or unregulated. The participants generally agreed, however, that utilities would need to take a portfolio approach to new business models, whether by choosing multiple models from the list above or within a given category (e.g., cross section of activities in solar), and emphasized the importance of working together with utility regulators in evolving their traditional business models.

There was notable excitement from some speakers about the potential role of utilities as energy efficiency service providers. A few participants highlighted their belief that utilities possessed unique attributes ideal for leading the charge in energy efficiency, such as:

- *Data about customers* – deep and powerful, but not monetized today
- *Existing communication channels and energy relationships with customers* – facilitating customer adoption

- *The ability to monetize energy savings* with a relatively low cost of capital through a regulated rate of return

By taking the lead in energy efficiency, utilities could become a sales channel for other service providers, such as those in demand response, energy efficiency, and smart meters/smart homes. The utility could then act as the system integrator and also as financier for the customer, playing a role familiar to customers and encouraging market access for all. Utilities would take the lead in energy efficiency upgrades, such as retrofitting homes and upgrading appliances, and would incorporate energy efficiency as part of regulated service.

Some stakeholders noted that the winners in such a model would include the environment, customers, and service providers in DR and EE (and of course the utility itself), while the main losers would be energy suppliers who have smaller energy price peaks and lower overall loads. A highlighted benefit was the transparency that would come from having a regulated utility leading – and earning from – energy efficiency. And, one person noted that this approach to energy efficiency should not create a cross-subsidization problem for customers since energy efficiency, by definition, shrinks costs across the entire customer pool. To this point, the utility's requirement is for universal service. By having the utility at the center of these investments, it can ensure that all parties benefit from them (as opposed to some solutions where the market gravitates towards those that can afford the investments). There was disagreement, however, about whether regulation of EE was actually required to prevent cross-subsidization. In addition, there was debate about the role for existing energy efficiency programs, with some participants calling for their continuation and others bemoaning those programs' ineffectiveness.

Implementation considerations for utilities to adopt new business models

Utilities face a number of important implementation considerations, regardless of whether they pursue becoming energy efficiency service providers or choose another approach. The Roundtable participants highlighted a few subjects, in particular:

- *Organizational culture:* The organizational culture of utilities was discussed as both a strength and potential obstacle. Several participants lauded how utility organizations have a strong sense of purpose – taking pride in serving the public good, encouraging economic development, ensuring safety, and responding to emergencies – and, given that utilities recover investments in the system after prudency reviews by regulators, a healthy degree of conservatism. At the same time, other participants noted that utility organizations might need to think about customer acquisition and focus on becoming entrepreneurial, dynamic, and competitive in arenas such as demand response, energy efficiency, and distributed generation.
- *Standardization:* As noted in the technology section, standardization of technical assets and communication systems (i.e., pursuit of a "plug and play" model for distributed energy technology) would help utilities expand offerings to customers without layering additional complexity. Data standardization in terms of collection, formatting, and privacy norms would further facilitate utility business model adaptation and engagement with other service providers.
- *Policy and regulation:* Importantly, several speakers reminded the group that, ultimately, states regulate what utilities can and cannot do. Some utilities are not allowed by law to operate in certain spaces such as electric services, or electricity generation. Many utilities' revenue is driven by sales volumes, so utilities are dis-incentivized to invest in energy efficiency programs. And, net metering approaches shift some costs (and some benefits) of the grid onto non-net metered customers. All of this clearly points to the need for regulatory changes in parallel to evolution in utility business models. Once policy is set, it will have to be regularly monitored and updated, as needed, to keep pace with market innovations or risk dislocating the markets and fair allocation of costs amongst customers. An additional question raised was how to set grid pricing overall and get real-time pricing to encourage EE and DG adoption.

3) Policy Solutions

Advocates from both sides of the meter voiced concerns over rate designs and pricing mechanisms created at the inception of the grid, which have remained static, despite the grid becoming increasingly dynamic. Currently, the conversations around the future of U.S. DE resources and the utility business models are crystalized around net metering. Across the U.S., net metering conversations are on-going at the state level. Although participants recognized that net metering may have been the single most impactful policy tool in the progression of distributed energy resources to date, it must not overshadow the discussion around the development of other policy measures and tools, such as establishing state-level solar tariffs.

Value of solar tariff – Minnesota VOST v. Austin VOST

There was broad consensus around the need to explore more efforts towards properly valuing distributed solar. As a case in point, the Roundtable participants discussed the differences between the recently approved Minnesota Value of Solar Tariff (VOST) and the Austin VOST (which had been discussed in detail in the previous Roundtable).

A stark difference between the Minnesota VOST and the Austin VOST is their pricing structures, specifically how the VOST price changes. In Minnesota, VOST tariffs are calculated once a year, and when the solar installation is erected, that year's tariff is the price the installation owner will receive for the length of its tenure. In Austin, the VOST tariff is recalculated every year to reflect changes in avoided fuel costs.

Figure 3: VOST components included in methodology
(Courtesy of Minnesota Department of Commerce, Division of Energy Resources)

Value Component	Basis	Legislative Guidance	Notes
Avoided Fuel Cost	Energy market costs (portion attributed to fuel)	Required (energy)	Includes cost of long-term price risk
Avoided Plant O&M Cost	Energy market costs (portion attributed to O&M)	Required (energy)	
Avoided Generation Capacity Cost	Capital cost of generation to meet peak load	Required (capacity)	
Avoided Reserve Capacity Cost	Capital cost of generation to meet planning margins and ensure reliability	Required (capacity)	
Avoided Transmission Capacity Cost	Capital cost of transmission	Required (transmission capacity)	
Avoided Distribution Capacity Cost	Capital cost of distribution	Required (delivery)	
Avoided Environmental Cost	Externality costs	Required (environmental)	
Voltage Control	Cost to regulate distribution (future inverter designs)		Future (TBD)
Integration Cost[3]	Added cost to regulate system frequency with variable solar		Future (TBD)

Another highlight of the Minnesota VOST calculation is that it is understandable. The framework outlines the benefits solar brings to the grid and its customers, and then attaches a price to it, all of which are weighted given their relative importance to line loss savings, avoided generation and capacity costs, environmental benefits, load matching, and fuel price offsets.

Finally, Minnesota VOST methodologies were brought up as a framework that could potentially be replicated in other states and jurisdictions. One of the positive lessons highlighted was that because advocates from both sides of the meter were included in the Minnesota VOST structuring, the process was less contentious than in other states and rate design meetings.

Rate redesign – the need for informed, dynamic pricing policies

The Roundtable participants also agreed that the pricing paradigm must shift to an intelligent rate design structure that features volumetric charges for the variable costs associated with electricity consumed and fixed charges for the utility's fixed costs of maintaining the grid and providing services, with separate pricing for investments in distributed generation, demand response, and energy efficiency.

Participants expressed that real time pricing tariffs would provide the necessary signals to customers so they could understand pricing levels during consumption and change their behavior as they see fit (though uptake in practice has lagged). If customers better understood and were exposed to the cost of system peaks, they could shift energy usage, which would reduce system peaks, thereby lowering overall system costs for their benefit. This requires, of course, the necessary technical capability to precisely measure and value the actions of individual customers, which is far from universal at this point.

Utility regulation

Another recurring topic during the discussion was utilities' role in deploying rooftop solar and energy efficiency. Participants felt that the "playing field" and regulation should not be stacked against utilities and policies that are "fair for SolarCity should be fair for utilities."

Building on these sentiments, frustrations bubbled with current regulatory restrictions that block utilities from coming to the other side of the meter. Freedom from these restrictions would allow utilities to deploy technologies and software to regulate consumption and balance the grid in times of high use, as well as engage in energy efficiency measures and optimize renewables. Others believed that third party market participants providing these services is a preferable path.

Policy harmonization and certainty

Finally, as discussed in the first Distributed Energy Valuation Roundtable in 2013, the varying state, federal, and jurisdictional issues surrounding valuing distributed energy, such as rate design, rate cases, and for what services utilities are allowed to provide and charge, present important roadblocks. Accordingly, sentiments in the room expressed the need for more appropriate pricing standards to be established, which will subsequently lead to penetration levels of distributed generation commensurate with their economics.

Conclusions and Moving Forward

By providing an open platform for frank discussion, this second Roundtable allowed a diverse group of energy leaders to share their latest thinking about possible ways of tackling the technology, business, and policy challenges that impact the deployment and proper compensation of DE.

Summary of conclusions

- **DE resources are on a path of accelerated deployment** due to a combination of policy and market drivers. Several tools are economic in many circumstances, such as energy efficiency investments and demand response, while technological advances continue to improve the cost effectiveness of other tools, such as renewables, which, with other subsidies such as federal tax incentives, can make them attractive to certain

customers. Other more costly tools, such as battery storage, may have niche applications to provide support to the grid or certain customers and have potential for steeper technological and cost improvements over time.

- **DE has the potential to support the grid** by lowering peak demands and providing other services. Investments in DE, if coordinated with the utility, could have the potential to avoid or defer other infrastructure investments in a number of circumstances. Examples from Germany, where widespread deployment occurred in the absence of coordination or clear codes (such as use of smart inverters or targeted deployment to manage other infrastructure costs in storage and transmission), illustrate the importance of a coordinated plan with common standards.

- **Utilities' business models should adapt to increasing DE.** There are multiple roles the utility needs to actively take, such as:
    - becoming a distribution system platform provider managing the coordination of DE across the distribution network, such as in New York's Reforming the Energy Vision (REV) model;
    - providing energy efficiency and other DE tools on a universal access approach to customers;
    - identifying areas where DE has the most value within the grid to optimize costs against other infrastructure investments; and
    - working with regulators to establish a rate design that acknowledges the impact DE has on cost recovery and cost-shifting among customers.

  It is important to define these roles in the near term, given the increasing penetration of DE. Such roles should be part of a broader "solutions portfolio" approach, guided by consumer needs, principles of fairness, affordability, cost efficiency and reliability, supported by an updated regulatory framework.

- **Policy makers need to balance a variety of objectives**. Much of the current levels of DE deployment have been driven by public policy objectives related to lowering emissions. When setting goals, considerations must be given to rate impacts across the customer base, methods to target the most cost-effective solutions, and other objectives, such as diversity in fuel generation and economic development.

- **Determining the value of DE products fairly for stakeholders**. Efforts should continue to enhance new policy tools and measures to properly value DE, including DR (notable, given recent court rulings), EE, DS, and DG. DG solar is one of the more prominent tools and there are several potential pricing solutions, such as value of solar tariffs, retaining net metering along with a charge for using the grid, gross metering with incentives for solar, time of use, or other solutions. There is a pressing need for changing the way utilities are regulated and electricity rates are designed to allow for more informed, dynamic, and harmonized pricing policies.

Moving forward

All of the Roundtable participants found the opportunity to come together in a high-level multi-stakeholder group valuable. Although distributed energy resources are still in an early stage of adoption, the notably increasing penetration of these technologies and the conflict between developers, utilities, and certain other stakeholders in several jurisdictions has made this a challenging topic to address. These challenges made this informal forum a healthy means to exchange information and perspectives, and to discuss potential paths forward that could be acceptable to all parties and, most importantly, bring value to the overall customer base.

Most participants felt that the amount of time they and their organizations were spending to address these issues was growing and they expected this to continue. This Roundtable was a

useful way to update their information on what had transpired in the previous year, which was borne out as the topical knowledge of the participants was dramatically higher than it was the previous year.

We discussed several tracks of work that will advance the effort to properly recognize the value of these resources in the grid (and the value of the grid to the owners of these resources). Several of these efforts are on their own tracks through regulatory proceedings, such as New York's REV proceeding, while other tracks may be pursued by certain subsets of the stakeholders who attended the Roundtable.

Track 1 – Collect baseline data on system performance

Obtaining detailed information on system performance (such as DG solar, direct load control, or energy efficiency) will be important to understand the value that each tool brings. This effort is vital in establishing both WHAT is measured and HOW to precisely determine the metrics based on available data and methods. For example, what is the coincidence of solar production (and/or success in calling for load shedding through demand response programs) compared to peak demand times for the utility system? For DG solar, is its production aligned with peak use and, therefore, supporting the grid, or is it less correlated to peak use and, generally, using the grid as a storage mechanism? How much DER can the grid incorporate while maintaining voltage and reliability? These questions can be inputs into determining the extent to which these resources can be counted on to address peak system demands and the value that such investments bring. In the absence of a regulatory mandate to do so, utilities remain free to undertake this within their own strategic planning process or Integrated Resource Planning (IRP). This undertaking should continue and should be as transparent as possible to share best practices across many situations.

Track 2 – Analyze existing models and develop frameworks using lessons learned

Developing from the network models is something that is likely best handled through internal utility IRP. Methods and best practices should be established and made available to any utility operator that wants to do its own internal analysis of the value of DE interventions. While a number of groups, including this one, Rocky Mountain Institute's E-lab, and the DOE, have all proposed frameworks, precise data resides within utilities and must be collected and evaluated there. Existing operational and economic data from systems that have incorporated more DER should be gathered and compared (i.e., Hawaii, Arizona, California, Germany, and others) to incorporate lessons learned.

The enactment of the Minnesota VOST is the first attempt to create a value of solar mechanism at a state level. According to certain parties close to that situation, the features of this program provide improved visibility and reduced risk for participants. Time will tell how successful this becomes, and ensuring that the lessons learned are widely disseminated will help to pave the way for other interested jurisdictions to achieve similar outcomes more quickly and efficiently.

Track 3 – Expand Roundtable conversation and initiate regulatory forums to refine the utility business model

We successfully convened this Roundtable a second time, and in the interim year, other regional conversations around the country on this topic have emerged or expanded, including ones in certain Mid-Atlantic and Northeast states and another in California. At the Federal level, the DOE has established a Request for Information (RFI) process on the cost and benefits of distributed generation, and hosted their own roundtables.

One of the most exciting developments this past year is the emergence of a docket in New York to solicit input on the structure of the "Utility of the Future," through the REV proceeding. This proceeding will continue into 2015 and is actively incorporating

comments from the public and many stakeholders. In parallel, in July, PSEG Long Island made its required Utility 2.0 filing, which was centered on bringing value to customers and the marketplace through a variety of distributed energy resources, primarily energy efficiency and direct load control, with several programs focusing on less penetrated lower-income customers. ConEdison also filed to utilize DER to displace an investment in part of its distribution network.

Important questions in these forums will be raised. Recognizing the impact of greater penetration of these technologies, how can incentives be aligned to support the advancement of the most economical solutions? Should the utilities' economic drivers shift from sales volumes or other metrics (i.e., decoupling or lost revenue adjustment mechanisms) to a more performance driven standard? Are the current fixed and volumetric tariff charges still appropriate in the current net metering environment? How should the tariffs evolve to address cost-shifting from DG users to those parties who do not have the resources for DG solar, such as apartment dwellers or lower-income demographics? How can the needs and limitations of the system at different points in the grid (which evolve over time) be incorporated into the utility's planning and into valuing DER? How can such investments be optimized, between the utility's expertise of the system and relationship with the customer base and the market's most effective technologies? Beyond the current revenues from wholesale energy and capacity prices, emissions values (i.e., existing emission pricing, SO_2, NOx, and Regional Greenhouse Gas Initiative (RGGI) for CO_2), and other existing tax and incentives, what other values can be quantified to recognize the value of DER?

These efforts and questions should lead to a specific understanding of the challenges and the concrete steps needed to put these ideas into practice in a large and complex state like New York.

We will seek to work with interested stakeholders to advance research on various frameworks to deepen the dialogue. This Distributed Energy Valuation Roundtable had a successful second meeting, and the goal is to convene this group again next year to continue pushing this multi-stakeholder dialogue forward.

Appendix: Pre-Roundtable Introductory Memo

2nd Distributed Energy Valuation Roundtable

Columbia University Faculty House
April 10, 2014
Introductory Memo

Dear Roundtable Participant:

We look forward to having you join us for this year's Distributed Energy Valuation Roundtable. As you can see from the attached Agenda, we anticipate that the Roundtable will be as balanced and thoughtful as last year's inaugural event. Many participants are returning and a few new stakeholders will be joining us. You should expect the Roundtable to be both informative and thought provoking, and it will have three goals:

Reviewing recent events and anticipating upcoming decisions

Much has happened regarding distributed energy in the last 12 months, and we have all been very active in trying to help move the conversation forward within our respective organizations and spheres of influence. It is a good time to come together and discuss what has transpired, any impacts of recent events, and what has not yet been addressed. It is also useful to understand the latest trends in pricing for distributed technologies in order to update our forecasts for the future.

We plan to discuss any major events that can be anticipated in the next six to 12 months. There are a number of open dockets around the country involving net metering, rate design and fairness. Knowing what is forthcoming will be helpful in planning where to put time and attention in the coming year.

Two leading organizations in this conversation, the Solar Energy Industry Association (SEIA) and Edison Electric Institute (EEI), have written and presented extensively on the rapidly changing landscape of Distributed Energy. We highly suggest that all participants review both SEIA's and EEI's short responses to a recent DOE RFI on best practices in value determination for these types of solutions **(Links 1 and 3 below**). We have also included a link (**Link 2 below**) to a joint statement between EEI and Natural Resources Defense Council (NRDC) proposing guidelines for fairness and completeness in designing state utility regulation solutions. All of these documents are illuminating reading and Rick Tempchin and Carrie Hitt will elaborate on these topics to kick off the first part of our discussion.

As always, it is critical to expand our understanding of these circumstances to include the impact of Energy Efficiency (EE), Demand Response (DR), and Distributed Storage (DS). The discussion of the appropriate use, compensation regulation and pricing methods of all of these technologies continues to grow, as does the discussion on how to integrate various solutions. The Roundtable will include leading voices in this conversation, including the CEOs of Enernoc, Opower, and the Rocky Mountain Institute, alongside utility innovators.

Providing a forum for solutions

This year's Roundtable is dedicated to solutions. The attached Appendix includes a list of the proposed solution pathways from last year's conversation, and it is important to note that some of this work has commenced. This year, we plan to highlight three dimensions in which solutions are proceeding – including technical, business, and policy pathways.

Technical Solutions

To enable the deployment and proper compensation of any distributed solutions, it is necessary to equip them with specific technical features and intelligence. Interconnection, advanced metering, sensors, and reliability enhancements are necessary for the greatest value to be extracted from DE interventions and for any costs or benefits to be accurately measured and allocated to the correct parties.

Tom Key, of EPRI, has provided EPRI's recent research report on the Integrated Grid (**Link 4 below**) and will lead us in a discussion about the technical requirements of the new distributed energy landscape. This work is very much in line with the *2013 Distributed Energy Valuation Roundtable Recommendations #1 and #3* (See Appendix below) from last year; thinking about best methods to move these technical solutions forward remains important.

Business Solutions

Third party providers are rapidly emerging and evolving, providing new channels to market and novel financing mechanisms. Utilities, too, are exploring new business models to preserve the reliability of the central grid while integrating DE solutions and exploring its own opportunities to bring additional value to its customers. It is clear that a business model focused on reliability, low cost solutions for customers, and environmental goals must be developed to promote value-creation for customers and offer both incumbent and emerging participants the opportunity to achieve economic benefits. It will be an ongoing effort to optimize the business models through financial investment, utility EE, DR, and DG programs, and on-bill repayment mechanisms, among others.

While looking for the best business models, it may be helpful to examine how this conversation is unfolding in places where the penetration of DE solutions is already higher to understand the positive results and the challenges of other efforts. Michel DiCapua has shared Bloomberg New Energy Finance's recent work on European Utility business model transformation (**Link 5 below**), and will discuss thoughts on how this trend is manifesting itself in the U.S.

Policy Solutions

One of the most advanced recommendations from last year related to establishing a state-level Solar Tariff *(2013 Distributed Energy Valuation Roundtable Recommendation #5)*. Tom Hoff, of Clean Power Research, will open the conversation about the recently approved Minnesota Value of Solar Tariff (VOST) (see the paper by Clean Power Research describing the details **(Link 6 below**) and how it differs from the Austin VOST we discussed last year).

There are many other policy solution options to explore – changing rate structures including potential fixed charges, dynamic or Time-of-Day pricing, expanded capacity market design, etc. Understanding all of the policy tools that can help to align incentives to actions will be critical to rapid progress in the field. Making sure that any solution can encompass all of the Distributed Energies – including DR, EE and Storage – is critical, as well.

Increasing visibility for this conversation

Finally, we discussed the *2013 Distributed Energy Valuation Roundtable Recommendations #2 and #6* (See Appendix below) last year, specifically about the need to amplify this conversation in a multi-stakeholder forum with the correct "standing" in the debate to move thoughtful solutions forward. A recent thought piece (**Link 7 below)** by Greentech Media on establishing a National Electricity Council (NEC) (an organization similar in form and function to the National Petroleum Council) provides a provocative idea. Whether this Roundtable, or some other forum, is necessary to give this conversation the appropriate weight in the national discourse will be a good point to debate in our multi-stakeholder group.

Regardless of how the conversation emerges, we are looking forward to a robust and collaborative dialogue on these issues. Please feel free to contact us in advance with any suggestions on topics or solutions that you may want to discuss so we can make sure to include these in the conversation. See you on April 10th!

Complete List of Pre-read Materials, with Links:

1 - EEI_Comments_DOE.pdf

https://www.dropbox.com/s/jul5o26qx145not/1%20-%20EEI_Comments_DOE.pdf

2 - EEI-NRDC JOINT STATEMENT.pdf

https://www.dropbox.com/s/v7rj09xtev2rmic/2%20-%20EEI-NRDC%20JOINT%20STATEMENT.pdf

3 - SEIA-Comments_DOE

https://www.dropbox.com/s/7nwu9m3v5l1hcjl/3%20-%20SEIA-Comments_DOE.pdf

4 - EPRI -The Integrated Grid.pdf

https://www.dropbox.com/s/opl3ae6jhcxl54l/4%20-%20EPRI%20-The%20Integrated%20Grid.pdf

5 - BNEF-DistributedUtilityEurope.pdf

https://www.dropbox.com/s/yls7bp5n1ylalfu/5%20-%20BNEF-DistributedUtilityEurope.pdf

6 - MN VOS Methodology FINAL

https://www.dropbox.com/s/6xhw9c22y0o6ww7/6%20%20MN%20VOS%20Methodology%20FINAL.docx

7 - GTM Research Policy Brief - National Electricity Council.pdf

https://www.dropbox.com/s/88nscrtablywt05/7%20-%20GTM-National%20Electricity%20Council.pdf

APPENDIX: 2013 Distributed Energy Valuation Roundtable Conclusions

Participants reported that one of the most helpful aspects of the Roundtable was that it enabled them to better understand the perspectives of the various players involved in the DE sphere, and to validate each other's concerns as important and real. Over the course of the Roundtable, and in subsequent feedback, we received suggestions from participants for potential next steps:

1. Collect baseline data that was unavailable to participants, for example:
    a. The current proportion of fixed and volumetric charges for residential and commercial customers across various jurisdictions
    b. Income levels of current residential DE customers to determine if cross-subsidization across income levels is occurring
    c. A reliable range of forward cost curves of DE components and installations for planning purposes
2. Expand or replicate the Roundtable conversation in other regional groupings, including perhaps Western Region, Midwest Region, and the South – each with unique elements. Include a broad range of stakeholders, including federal and state regulators, utilities, DE providers, consumer and environmental organizations and academic experts.
3. Develop formal models of distribution networks to derive empirical data for inputs into the framework. For example, measure how the capacity and energy values of DG solar change as penetration increases and measure the physical impacts on the grid with changing penetration. Model the range of relative environmental externalities of replacing central-station generation (coal, natural gas, and nuclear) with distributed generation (renewable, gas, diesel, bio-fuels), with varying fuel mix assumptions and levels of penetration.
4. Conduct legal research to clarify the jurisdictional questions raised by the Roundtable. In particular, further research into state authority to adopt a comprehensive DE valuation methodology might prove useful.
5. Pursue an actual valuation process through a state regulatory proceeding (perhaps on a trial basis), so that the general ideas discussed at the Roundtable can be turned into a concrete proposal and test case. Include a pricing mechanism that incorporates real-time pricing elements and facilitates cost-minimization, including the cost of obtaining financing.
6. Convene an ongoing group of balanced participants to follow up the results here by:
    a. Surveying, evaluating, and publishing results of existing methods of calculating the various value elements included in the framework.
    b. Commissioning data collection to support metric development, where necessary.
    c. Recommending best practices for others to use in modeling their own intervention.

Many members of the Roundtable have individually expressed interest in working on these issues going forward and to link these efforts to others pursuing the same objectives around the country and around the world. It is our sincere belief that only through broad cooperation and collaboration can we hope to achieve a quick and comprehensive set of solutions that will benefit all stakeholders in this important transformation.