Smart Electric Power Alliance

Beyond the Meter

RECOMMENDED READING FOR A MODERN GRID

IN PARTNERSHIP WITH

AEE INSTITUTE

ROCKY MOUNTAIN INSTITUTE

JUNE 2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

COPYRIGHT

AUTHORS

Tanuj Deora and **Vazken Kassakhian**, Smart Electric Power Alliance

Lisa Frantzis and **Coley Girouard**, Advanced Energy Economy

Mark Dyson, Rocky Mountain Institute

ABOUT THE SMART ELECTRIC POWER ALLIANCE (SEPA)

SEPA facilitates collaboration across the electric power industry to enable the smart deployment and integration of clean energy resources. Our focus centers on solar, storage, demand response, electric vehicles, grid management, and other enabling technologies.

ABOUT ADVANCED ENERGY ECONOMY INSTITUTE (AEE INSTITUTE)

AEE Institute is a charitable and educational organization whose mission is to raise awareness of the public benefits and opportunities of advanced energy. AEE Institute is affiliated with AEE, a national association of businesses using policy advocacy, analysis, and education to enable the rapid growth of advanced energy companies and bring about a prosperous economy based on secure, clean, and affordable energy. Advanced energy encompasses a broad range of products and services including but not limited to energy efficiency, demand response, energy storage, natural gas electric generation, solar, wind, hydro, nuclear, electric vehicles, biofuels and other smart grid technologies.

ABOUT ROCKY MOUNTAIN INSTITUTE (RMI)

RMI—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

ACKNOWLEDGEMENTS

We would like to thank the following SEPA staff for their involvement in the development and review process: Erika Myers, Christine Stearn, K Kaufmann, Mike Taylor, and Mike Kruger.

Introduction

Keeping up with the influx of new information on distributed energy resources (DERs) can be daunting. The energy industry's focus on DERs is driven by their potential to help solve the problems in modernizing the grid. In 2015, U.S. electric utilities spent $103 billion in capital expenditures to maintain and upgrade the grid, and they now expect average annual spending of around $100 billion through 2018, even as growth in electricity demand slows.[1,2]

Combined, new investments needed to maintain and upgrade the grid and reduced load growth could raise retail rates significantly for electricity customers. If the grid is to be modernized for two-way energy flows and incorporate new, connected technologies while maintaining minimal rate impacts, then all available resources, including DERs, need to be put to their best use.

To reach this goal, we need to start with a common base of foundational knowledge on DERs. Therefore, we have assembled a document identifying key articles and resources that are easily available to all stakeholders to use as a knowledge base. Working together to compile this list was an initial collaborative effort for co-authors Advanced Energy Economy Institute (AEE), Rocky Mountain Institute (RMI) and the Smart Electric Power Alliance (SEPA), three organizations with similar long-term visions of a clean energy future, but with different approaches and perspectives.

We started from a basic, common understanding about DERs: that they can provide positive net value to the grid, such as avoided infrastructure investments, improved resilience, and increased integration of clean energy. However, integration of these resources will require a new planning paradigm. Finally, the solutions for the challenges that lie ahead will be rooted in information sharing, partnerships, and collaboration.

DEFINITION OF DISTRIBUTED ENERGY RESOURCES (DERS)

DERs are physical and virtual assets that are deployed across the distribution grid—typically close to load, and usually behind the meter—that can be used individually or in aggregate to provide value to the grid, individual customers, or both. A particular industry interest centers on DERs that can be aggregated to provide services to the electric grid, such as solar, storage, energy efficiency, electric vehicles, and demand management.

Our goal here is not to forecast the future of DERs, but to provide, in effect, a "DERs 101" syllabus that demonstrates the value of DERs and provides insights on:

- How different DER technologies can provide energy, capacity, and ancillary services for both the distribution and bulk power systems;
- How we can develop DER benefit-cost frameworks that offer a fuller, more accurate accounting of the benefits and costs related to these services;
- What valuation options exist for benefits and costs of each type of DER; and
- What implications DERs may have for changes in planning, market design, operation and oversight.

1 Edison Electric Institute, EEI Finance Department, Company Reports, S&P Global Market Intelligence (August 2016). http://www.eei.org/resourcesandmedia/industrydataanalysis/industryfinancialanalysis/QtrlyFinancialUpdates/Documents/EEI_Industry_Capex_Functional_2016.08.24.pptx

2 "Total U.S. electricity sales projected to grow slowly as electricity intensity declines," Today in Energy, Energy Information Administration, June 15, 2016. http://www.eia.gov/todayinenergy/detail.php?id=26672

This report provides a set of foundational overview resources, followed by a more detailed set of reports—presented in matrix form—to allow for a deeper exploration of the capabilities and grid services DERs can furnish. Together, these resources will help build a better understanding of key DER issues and opportunities.

Specifically, the foundational overview resources look at: developing new benefit-cost analysis frameworks to evaluate DERs; describing the different values and services that DERs can provide to support a more flexible and efficient grid; examining how regulators and other stakeholders should value DERs on the distribution system, and; laying out the framework for a high DER future, including the concept of a distributed system platform.

That said, many important topics are not covered here, mainly, those related to rate reform and redesign. A wealth of resources now exists on these topics, including the National Association of Regulatory Utility Commissioners' (NARUC) Distributed Energy Resources Rate Design and Compensation manual.[3]

Our initial focus here on foundational resources is aimed at providing a common understanding of the technical and economic value of DERs on the grid, before any discussion of potential options and mechanisms to realize that value.

Distributed Energy Resources Overview Materials

1. NEW YORK STATE DEPARTMENT OF PUBLIC SERVICE STAFF, WHITEPAPER ON BENEFIT-COST ANALYSIS IN REV, 2015[4]

This report is critically important for the simple reason that it allows an apples to apples comparison of traditional utility distribution system investments with DERs. That in turn allows for the evaluation of opportunities to avoid traditional utility distribution investments by calling upon the marketplace to supply DER alternatives to new or upgraded grid assets. The whitepaper explains the need for the development of a benefit-cost analysis (BCA) framework, how the BCA framework will be employed by utilities, and proposed components of the BCA framework. It also provides suggested guidance on calculating the values of those components.

Table 1 shows the New York Department of Public Service Staff's proposed list of benefit and cost components for the benefit-cost analysis framework evaluating distributed resources. As of January 21, 2016, the New York Public Service Commission has approved the Societal Cost Test (SCT) as the primary cost-effectiveness measure. The investor-owned utilities in NY can supplement their respective analyses with the other cost-effectiveness tests, such as the Utility Cost Test (UCT) and the Rate Impact Measure (RIM) shown in Table 1, but the SCT is the primary measure of cost effectiveness.

3 *Distributed Energy Resources Rate Design and Compensation*, National Association of Regulatory Utility Commissioners (NARUC), 2016. https://www.naruc.org/rate-design/

4 *Staff White Paper on Benefit-Cost Analysis in the Reforming Energy Vision Proceeding*, New York Department of Public Service, 14-M-0101, July 1, 2015. http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/c12c0a18f55877e785257e6f005d533e/$FILE/Staff_BCA_Whitepaper_Final.pdf

TABLE 1: LIST OF BENEFIT AND COST COMPONENTS FOR ESTABLISHING A DER BCA FRAMEWORK			
BENEFITS	**RATE IMPACT MEASURE (RIM)**	**UTILITY COST (UCT)**	**SOCIETAL (SCT)**
BULK SYSTEM			
AVOIDED GENERATION CAPACITY (ICAP), INCLUDING RESERVE MARGIN	■	■	■
AVOIDED ENERGY (LBMP)	■	■	■
AVOIDED TRANSMISSION CAPACITY INFRASTRUCTURE AND RELATED O&M	■	■	■
AVOIDED TRANSMISSION LOSSES	■	■	■
AVOIDED ANCILLARY SERVICES (E.G., OPERATING RESERVES, REGULATION, ETC.)	■	■	■
WHOLESALE MARKET IMPACTS	■	■	—
DISTRIBUTION SYSTEM			
AVOIDED DISTRIBUTION CAPACITY INFRASTRUCTURE	■	■	■
AVOIDED O&M	■	■	■
AVOIDED DISTRIBUTION LOSSES	■	■	■
RELIABILITY/RESILIENCY			
NET AVOIDED RESTORATION COSTS	■	■	■
NET AVOIDED OUTAGE COSTS	—	—	■
EXTERNAL			
NET AVOIDED GREENHOUSE GASES	—	—	■
NET AVOIDED CRITERIA AIR POLLUTANTS	—	—	■
AVOIDED WATER IMPACTS	—	—	■
AVOIDED LAND IMPACTS	—	—	■
NET NON-ENERGY BENEFITS (E.G., AVOIDED SERVICE TERMINATIONS, AVOIDED UNCOLLECTIBLE BILLS, HEALTH IMPACTS, EMPLOYEE PRODUCTIVITY, PROPERTY VALUES, TO THE EXTENT NOT ALREADY INCLUDED ABOVE)**	■	■	■

Continued

Continued

TABLE 1: LIST OF BENEFIT AND COST COMPONENTS FOR ESTABLISHING A DER BCA FRAMEWORK			
COSTS	RATE IMPACT MEASURE (RIM)	UTILITY COST (UCT)	SOCIETAL (SCT)
PROGRAM ADMINISTRATION COSTS (INCLUDING REBATES, COSTS OF MARKET INTERVENTIONS, AND MEASUREMENT & VERIFICATION COSTS)	■	■	■
ADDED ANCILLARY SERVICE COSTS	■	■	■
INCREMENTAL TRANSMISSION & DISTRIBUTION AND DSP COSTS (INCLUDING INCREMENTAL METERING AND COMMUNICATIONS)	■	■	■
PARTICIPANT DER COST (REDUCED BY REBATES, IF NOT INCLUDED ABOVE)	—	—	■
LOST UTILITY REVENUE	■	—	—
SHAREHOLDER INCENTIVES	■	■	—
NET NON-ENERGY COSTS (E.G., INDOOR EMISSIONS, NOISE DISTURBANCE)	—	—	■

Source: New York Department of Public Service, 2015

2. ADVANCED ENERGY ECONOMY INSTITUTE (AEEI) AND SYNAPSE ENERGY ECONOMICS, INC., BENEFIT-COST ANALYSIS FOR DISTRIBUTED ENERGY RESOURCES: A FRAMEWORK FOR ACCOUNTING FOR ALL RELEVANT COSTS AND BENEFITS, 2014[5]

The paper provides a summary of the extensive universe of relevant DER cost and benefit impacts on all customers, participants, and society. Additionally, the paper presents an illustration of preferred valuation options for each type of DER benefit and cost. The paper presents the limitations of current cost-effectiveness methodologies, offers alternative frameworks as potential fixes to better capture a more inclusive set of DER benefits, and recommends a benefit-cost analysis framework and a set of templates to use when evaluating DERs.

Table 2 provides an overview of the universe of costs and benefits that may be attributed to DERs grouped by the party affected: all customers, participants, and society as a whole.

3. SMART ELECTRIC POWER ALLIANCE (SEPA), BEYOND THE METER | DISTRIBUTED ENERGY RESOURCES CAPABILITIES GUIDE, 2016[6]

This guide describes how DERs can support a more flexible and efficient grid, and evaluates technologies based on their abilities to provide energy, capacity, and ancillary services for both the distribution and bulk power systems. The report's DER Capabilities Matrix illustrates the technical capabilities of various DER types (solar, solar and advanced inverter functionality, storage, interruptible load, direct load control, behavioral load shaping, and energy efficiency) and their potential to provide grid services.

5 Woolf, T., Whited, M., Malone, E., Vitolo, T., Hornby, R., *Benefit-Cost Analysis for Distributed Energy Resources*, Advanced Energy Economy Institute, September 22, 2014. http://www.synapse-energy.com/sites/default/files/Final%20Report.pdf

6 *Distributed Energy Resources Capabilities Guide*, SEPA, 2016, https://sepa.force.com/CPBase__item?id=a12o000000SjefkAAB

TABLE 2: UNIVERSE OF RELEVANT DISTRIBUTED ENERGY RESOURCE IMPACTS			
IMPACTS ON ALL CUSTOMERS			
BENEFITS		**COSTS**	
CATEGORY	**EXAMPLES**	**CATEGORY**	**EXAMPLES**
1. LOAD REDUCTION & AVOIDED ENERGY COSTS	Avoided energy generation and line losses, price suppression	**1. PROGRAM ADMINISTRATION COSTS**	Program marketing, administration, evaluation, incentives to customers
2. DEMAND REDUCTION & AVOIDED CAPACITY COSTS	Avoided transmission, distribution, and generation capacity costs, price suppression	**2. UTILITY SYSTEM COSTS**	Integration capital costs, increased ancillary services costs
3. AVOIDED COMPLIANCE COSTS	Avoided renewable energy compliance costs, avoided power plant retrofits	**3. DSP COSTS**	Transactional platform costs
4. ANCILLARY SERVICES	Regulation, reserves, energy imbalance		
5. UTILITY OPERATIONS	Reduced financial and accounting costs, lower customer service costs		
6. MARKET EFFICIENCY	Reduction in market power, market animation, customer empowerment		
7. RISK	Project risk, portfolio risk, and resiliency		
PARTICIPANT IMPACTS			
BENEFITS		**COSTS**	
CATEGORY	**EXAMPLES**	**CATEGORY**	**EXAMPLES**
1. PARTICIPANT NON-ENERGY BENEFITS	Health and safety, comfort, tax credits	**1. PARTICIPANT DIRECT COSTS**	Contribution to measure cost, transaction costs, O&M costs
2. PARTICIPANT RESOURCE BENEFITS	Water, sewer, and other fuels savings	**2. OTHER PARTICIPANT IMPACTS**	Increased heating or cooling costs, value of lost service, decreased comfort
SOCIETAL IMPACTS			
BENEFITS		**COSTS**	
CATEGORY	**EXAMPLES**	**CATEGORY**	**EXAMPLES**
1. PUBLIC BENEFITS	Economic development, reduced tax burden	**1. PUBLIC COSTS**	Tax credits
2. ENVIRONMENTAL BENEFITS	Avoided air emissions and reduced impacts on other natural resources	**2. ENVIRONMENTAL COSTS**	Emissions and other environmental impacts

Source: AEE and Synapse Energy Economics, 2014.

TABLE 3: DISTRIBUTED ENERGY RESOURCE CAPABILITIES MATRIX

TECHNOLOGIES	ENERGY	GENERATING CAPACITY	DISTRIBUTION CAPACITY	VOLTAGE REGULATION	FREQUENCY REGULATION	LOAD FOLLOWING	BALANCING	SPINNING RESERVES	NON-SPINNING RESERVES	BLACK START
DISTRIBUTED SOLAR	Energy Generator	◑	◑	●	●	●	●	No	No	No
DISTRIBUTED SOLAR + ADVANCED INVERTER FUNCTIONALITY	Energy Generator	◑	◑	⊙	⊙	◑	●	No	No	No
BATTERY STORAGE	Energy Storage	⊙	⊙	⊙	⊙	⊙	⊙	Yes	Yes	Yes
INTERRUPTIBLE LOAD	Load Shaping	◐	●	●	●	●	⊙	Yes	Yes	No
DIRECT LOAD CONTROL	Load Shaping	◐	◐	●	◐	⊙	⊙	Yes	Yes	No
BEHAVIORAL LOAD SHAPING	Load Shaping	◑	◑	●	●	◑	◑	No	No	No
ENERGY EFFICIENCY	Reduce Load	◐	◑	●	●	●	●	No	No	No

● Unsuitable for reliably performing the specified service.

◑ May be able to perform a service, but is not well suited or can provide partial support.

◐ Able to perform a service, but may be limited by factors such as availability or customer behavior.

⊙ Well suited to perform a service; may exceed legacy technologies for providing the service.

Source: Smart Electric Power Alliance, 2016

Table 3 illustrates the potential for DERs to provide energy, capacity, and ancillary services. Although it is possible for specific applications to provide more than one service at a given time, on the table, each is represented individually. Please note that the ratings here represent basic technical capability, rather than actual current applications. Some of the technologies do not yet offer many of the DER services listed here due to regulatory or market reforms, communications infrastructure, or software control mechanisms that are in process or still lacking.

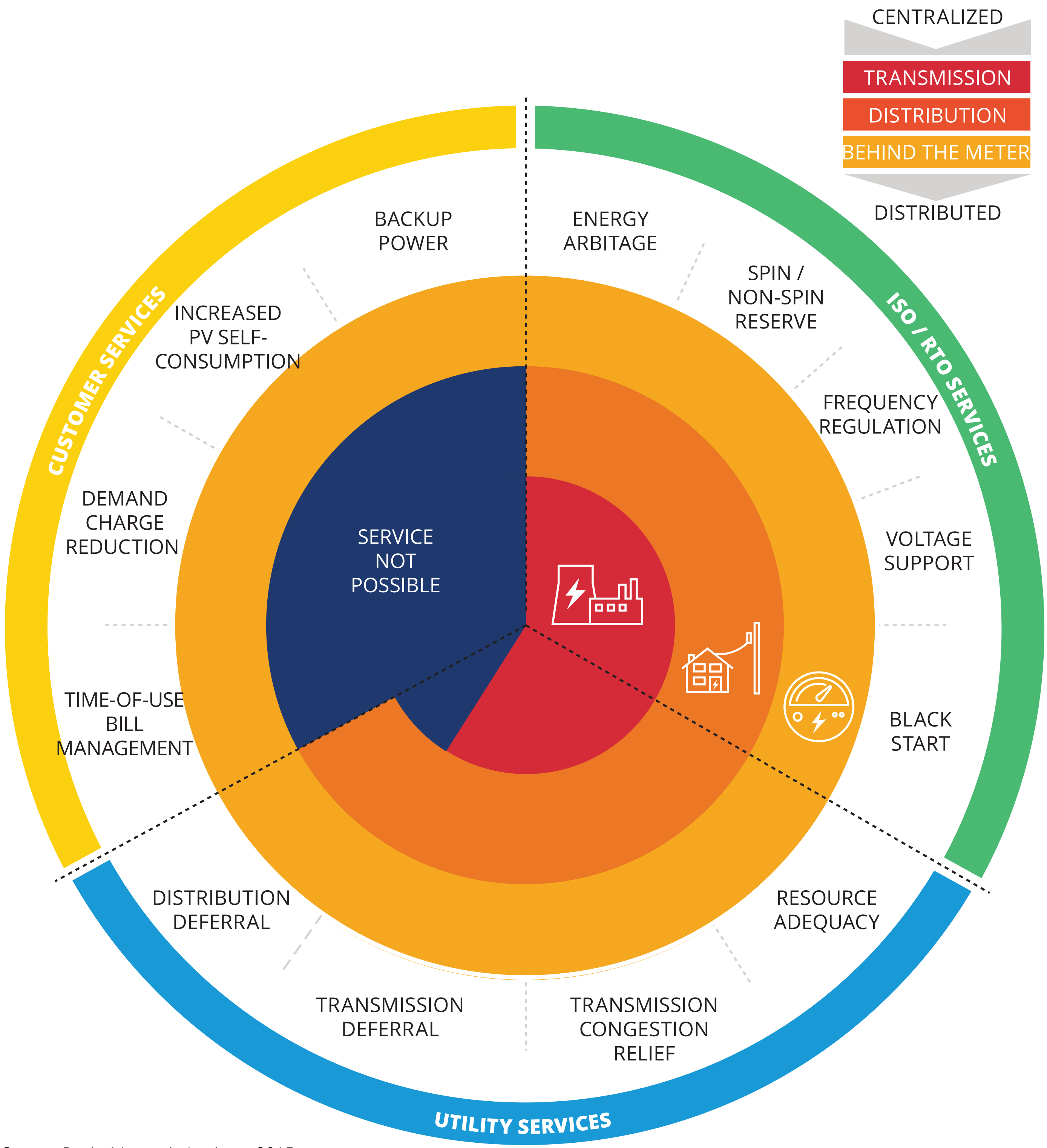
4. ROCKY MOUNTAIN INSTITUTE, THE ECONOMICS OF BATTERY ENERGY STORAGE, 2015[7]

This report addresses four key questions:

- What services can batteries provide to the electricity grid?
- Where on the grid can batteries deliver each service?
- How much value can batteries generate when they are highly utilized and multiple services are stacked?
- What barriers, especially regulatory, currently prevent single energy-storage systems or

7 Fitzgerald, G., Mandel, J., Morris, J., Touati, H., "The Economics of Battery Energy Storage," Rocky Mountain Institute, October, 2015. https://rmi.org/insights/reports/economics-battery-energy-storage/

FIGURE 1: SERVICES PROVIDED BY BATTERY STORAGE



Source: Rocky Mountain Institute, 2015

aggregated fleets of systems from providing multiple, stacked services to the electricity grid, and what are the implications for major stakeholder groups?

Using a literature review, an energy-storage valuation framework, and the results of a modeling exercise, this report is intended to help overcome the many cost, regulatory, business-model, and procedural barriers to making energy storage a meaningful component of the U.S. electricity future. While the paper is focused on one particular type of DER, batteries, many of the insights and recommendations can be generally applied to all DERs.

Figure 1 illustrates the wide variety of benefits energy storage can provide at three different levels: behind-the-meter, at the distribution level, or at the transmission level. Energy storage deployed at all levels on the electricity system can add value to the grid. While this particular example is based on battery storage, the framework of grid services can be applied to all DERs.

5. ANALYSIS GROUP, THE VALUE OF "DER" TO "D": THE ROLE OF DISTRIBUTED ENERGY RESOURCES IN SUPPORTING LOCAL ELECTRIC DISTRIBUTION SYSTEM RELIABILITY, 2016[8]

This paper focuses on two essential questions relating to DERs. How should utility regulators, distribution utilities and other stakeholders think about the value of DER to the distribution system ("the value of DER to D")? And what are the implications for distribution system planning, DER procurement and DER compensation that result from those interactions between DERs and the local distribution system? The report illustrates some of the issues and insights by examining developments and analyses under way at two electric distribution utilities, Consolidated Edison in greater New York City and Southern California Edison.

6. LAWRENCE BERKELEY NATIONAL LAB, DISTRIBUTION SYSTEMS IN A HIGH DISTRIBUTED ENERGY RESOURCES FUTURE: PLANNING, MARKET DESIGN, OPERATION AND OVERSIGHT, 2015[9]

This report offers a practical framework to consider DER growth and address its effects in a logical sequence in order to guide distribution system evolution with clear lines of sight to overarching regulatory and public policy objectives. Specifically, the report intends to address key questions on how to best define the value of the distribution network and related operational structure for a high-DER future in their jurisdictions, and how to structure the regulatory framework and rules to enable that future.

8 Tierney, S., *The Value of "DER" to "D": The Role of Distributed Energy Resources in Supporting Local Electric Distribution System Reliability*, Analysis Group, March 21, 2016. http://www.analysisgroup.com/uploadedfiles/content/news_and_events/news/value_of_der_to%20_d.pdf

9 De Martini, P., and Kristov, L. *Distribution Systems in a High Distributed Energy Resources Future In Future Electric Utility Regulation Report Series*, Edited by Lisa C. Schwartz. Vol. FEUR Report No. 2., 2015. https://emp.lbl.gov/sites/default/files/lbnl-1003797.pdf

7. THE DEPARTMENT OF ENERGY'S NEXT GENERATION DISTRIBUTION SYSTEM PLATFORM (DSPX)[10]

Volume 1 defines the functional scope of a modern grid platform with a taxonomy framework organizing capabilities and functions based on grid modernization objectives. It also includes grid architecture, comparative assessment of industry applications and use cases. Volume 2 provides a taxonomy of technologies and identifies the gaps between existing commercial technologies and the needs of a modern grid. Volume 3 is a Decision Guide to support decisions related to implementing modern grid functionality.

Specific Grid Services Resources

DERs offer an array of services to support the grid and maintain reliability. Below we outline the key categories of grid services and offer up additional readings to delve deeper into how DERs provide particular grid services. Please note beneath the table are definitions for each grid service.

GRID SERVICES CATEGORY DEFINITIONS

CATEGORY: BULK SYSTEM SERVICES

Energy. DERs provide energy value when they displace the need to produce energy from another resource. The energy value has two components: (1) Avoided energy production by central generation resources, and (2) avoided losses on the transmission and distribution system, due to DERs' proximity to end-use loads.

System-level capacity. DERs provide system-level capacity value when they defer or avoid investment in generation and transmission assets. The system capacity value of DERs depends on the DERs' utilization capability during system peak periods.

Flexibility. DERs provide flexibility value when they operate in a way that allows grid demand and supply levels to balance. This value is realized at multiple timescales, from very fast (e.g. frequency regulation on the order of seconds) to longer-term (e.g. load shaping on the order of hours).

Operating reserves. DERs provide operating reserve value when they can be used to increase supply or reduce demand on the grid in place of central generators that would otherwise be used in case of contingencies (e.g., forced outages). DERs can provide both fast-response reserves (e.g., spinning reserves) and slower-response reserves (e.g., supplemental reserves).

CATEGORY: DISTRIBUTION SERVICES

Distribution-level capacity. DERs provide distribution-level capacity value when they defer or avoid investment in distribution assets. The distribution capacity value of DERs depends on the DERs' utilization capability during local peak periods.

Power quality. DERs provide power quality value to distribution systems by modulating their production and/or consumption of power, e.g. providing reactive power to improve voltage profiles on distribution feeders. This capability can reduce energy losses and avoid voltage excursions on distribution feeders.

10 Next Generation Distribution System Platform (DSPx), U.S. Department of Energy. http://doe-dspx.org/sample-page/modern-distribution-grid-report/

TABLE 4: RECOMMENDED READING BY GRID SERVICE CAPABILITY

RECOMMENDED READING[11]	BULK SYSTEM SERVICES				DISTRIBUTION SERVICES	
	ENERGY	CAPACITY	FLEXIBILITY	OPERATING RESERVES	CAPACITY	POWER QUALITY
SEPA & NEXANT, BEYOND THE METER | ADDRESSING THE LOCATIONAL VALUATION CHALLENGE FOR DISTRIBUTED ENERGY RESOURCES, 2016					■	
ANALYSIS GROUP, THE VALUE OF "DER" TO "D": THE ROLE OF DISTRIBUTED ENERGY RESOURCES IN SUPPORTING LOCAL ELECTRIC DISTRIBUTION SYSTEM RELIABILITY, 2016					■	
SEPA & EPRI, ROLLING OUT SMART INVERTERS, 2015						■
NREL, ADVANCED INVERTER FUNCTIONS TO SUPPORT HIGH LEVELS OF DISTRIBUTED SOLAR, 2014						■
NREL, FEEDER VOLTAGE REGULATION WITH HIGH-PENETRATION PV USING ADVANCED INVERTERS AND A DISTRIBUTION MANAGEMENT SYSTEM, 2016					■	■
LBNL, FINAL REPORT ON PHASE 2 RESULTS: 2015 CALIFORNIA DEMAND RESPONSE POTENTIAL STUDY, 2016	■	■	■	■	■	
EPRI, TIME AND LOCATIONAL VALUE OF DER: METHODS AND APPLICATIONS, 2016	■	■	■	■	■	■
EPRI, CONTRIBUTIONS OF SUPPLY AND DEMAND RESOURCES TO REQUIRED POWER SYSTEM RELIABILITY SERVICES, 2015		■	■	■		■
LBNL, PLANNING FOR A DISTRIBUTED DISRUPTION INNOVATIVE PRACTICES FOR INCORPORATING DISTRIBUTED SOLAR INTO UTILITY PLANNING, 2016	■	■	■			
RMI, ECONOMICS OF BATTERY ENERGY STORAGE, 2015	■	■	■	■	■	
LBNL, AN EVALUATION OF SOLAR VALUATION METHODS USED IN UTILITY PLANNING AND PROCUREMENT PROCESSES, 2012	■	■				
LBNL, MASS MARKET DEMAND RESPONSE AND VARIABLE GENERATION INTEGRATION ISSUES: A SCOPING STUDY, 2011	■	■	■			
LBNL, FLEXIBILITY INVENTORY FOR WESTERN RESOURCE PLANNERS, 2015			■			

Source: SEPA, RMI, & AEE, 2017

11 Not included in the following list of reports is *Navigant's Distributed Renewables Monitoring and Forecasting Technologies* (2017). This report presents a market overview of monitoring and forecasting technologies for intermittent distributed resources. These monitoring and forecasting technologies play a critical role in overall DER grid integration, market participation for DERs, risk management, operations management, and reliability.

Conclusion

Utilities, regulators, and stakeholders are increasingly seeking information about how to modernize the grid, develop rates that send the right prices signals to customers, mitigate risks from DERs already on the grid, prepare for future DER integration, and make the best use of existing DERs. They are also trying to value the benefits and costs of DERs in order to investigate whether DERs can serve in place of traditional infrastructure investments.

This report identifies and annotates key readings and educational resources for a common base of knowledge that can be drawn on for further discussions about DER valuation. DER valuation is complex. The fundamental first step is understanding what capabilities DERs can provide and their resulting value to the grid.

Many questions remain, such as:

- How to drive DERs to particular locations of optimal deployment?
- How to align compensation, rates, and market structures to better realize this value?
- How can we provide customers with timely and more granular information so that they can make informed decisions about their energy use?
- Should utilities be allowed to own and operate DER products and services?
- How to evolve utility business models and regulatory models to properly value and take advantage of these opportunities?

This document provides a start to building a common knowledge set to explore the opportunities a 21st century electric grid provides.

Smart Electric Power Alliance

1220 19TH STREET NW, SUITE 800,
WASHINGTON, DC 20036-2405
202-857-0898