EVALUATING MODULAR DISTRIBUTED ELECTRICITY RESOURCES FOR UTILITY TRANSMISSION AND DISTRIBUTION UPGRADE DEFERRAL AND LIFE EXTENSION

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ABSTRACT

This paper documents an investigation, sponsored by the U.S. Department of Energy, of the prospects for modular electricity storage used to defer expensive upgrades to electric utility transmission and distribution facilities or to extend the useful life of existing equipment. Resulting benefits could provide the basis for attractive distributed energy resources value propositions, especially for distributed generation and distributed storage.

INTRODUCTION

Transmission and distribution (T&D) deferral involves use of small distributed energy resources (DERs), located electrically downstream from heavily loaded elements of the T&D system (hot spots) to either (1) delay the need to undertake an expensive upgrade of existing T&D equipment (deferral) or (2) extend the useful life of existing T&D equipment (life extension). In both cases, a relatively small amount of DER capacity is added "on the margin" to serve a portion of peak load during the few days per year when customer demand is highest. When used for T&D upgrade deferral, the DER serves the portion of total peak demand that would otherwise exceed the load-carrying capacity of the T&D equipment. In the case of T&D life extension, the DER reduces loading-on the T&D equipment, which reduces equipment wear, heating, and ground faults.

WHY DERs FOR T&D UPGRADE DEFERRAL AND LIFE EXTENSION ARE IMPORTANT

DERs will be an important and possibly significant element for the electricity grid and marketplace of the future for a variety of reasons.

Key elements of the DER value proposition include financial and societal benefits related to (a) lower overall cost-of-electric service, (b) more flexible utility capacity expansion approaches, (c) more optimal electric service reliability and power quality, (d) increased energy efficiency, (e) fuel diversity, and (f) variable renewable generation integration.

DERs used for T&D deferral or life extension could allow utilities to serve customer energy and power needs at lower cost, with more reliability, more efficiency, and with lower and fewer land and environmental impacts than is possible using standard capacity expansion approaches involving central generation plus conventional T&D equipment (primarily T&D wires and transformers and capacitors).

Due to the significant potential financial benefit, use of DERs for T&D deferral/life extension will be a key anchor benefit for a variety of DER value propositions (i.e., benefit combinations).

KEY INDICATORS

Using DER to provide capacity on the margin is not always a viable option. In many cases, the lowest-cost alternative is a conventional grid buildout. In other cases, there may already be as much DER capacity as is technically viable, or in the case of distributed generation (DG), the necessary fuel infrastructure for operating may not exist.

Criteria that indicate modular electricity storage (MES) might be viable for T&D deferral or life extension include (a) high T&D cost, (b) high peak-to-average demand ratio, (c) modest projected overload, (d) slow peak demand growth (rate), (e) uncertainty about the timing and/or likelihood of *block* load additions, (f) T&D construction delays or construction resource constraints that may be a challenge, (g) the T&D upgrade project competes with other important projects for capital, and (h) the same MES provides additional benefits – revenue or avoided cost – that can be aggregated into an attractive total value proposition, such as on-peak energy and electric supply capacity. MES is especially well suited to those locations if air emissions regulations, noise regulations, fuel storage, or other safety-related challenges restrict use of combustion-based DG and if the price differential is large between times when storage is charged and when it is discharged.

BENEFIT ESTIMATION FRAMEWORK

The investigation included development of a generalized framework for estimating the financial benefit of deferring a T&D upgrade for one year.

Two key criteria are (1) T&D equipment cost per kilowatt (kW) installed, and (2) the amount of MES capacity needed (storage portion). Benefit values for various combinations of those two criteria are shown in Figure 1. Those benefits are based on representative values for two other important criteria: (1) an “upgrade factor” and (2) a “fixed charge rate.” The upgrade factor is the amount of T&D load-carrying capacity to be *added* – 0.33 is used (for a 33% increase). The annual fixed charge rate for utility capital plant is assumed to be 11% of installed cost per year).

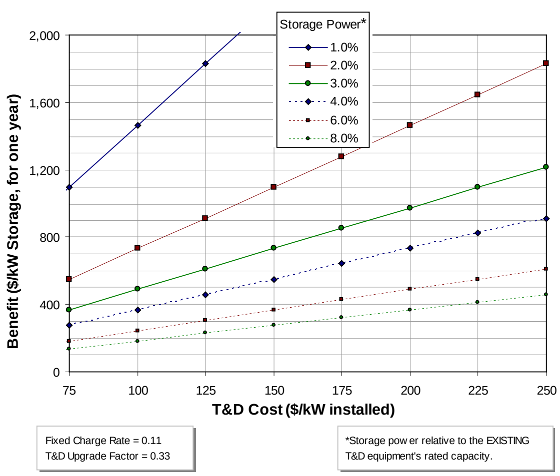

Fig. 1. Benefit values.

Per the figure, if DER capacity equal to 4% of the T&D equipment’s load-carrying capacity (labeled as *storage power* in the figure) can be used to defer a relatively expensive T&D upgrade with an installed cost of $125/kW (as shown on the X-axis), then the single-year deferral benefit is about $480/kW of DER capacity. That is the benefit for *one year* of deferral. If deferrals or life extensions are multiyear, then the benefits for each year are additive.

CONCLUSION

There are hundreds of milliwatts/year for which the T&D deferral/life extension benefit (a) is significant (hundreds of dollars per kW-year) and (b) may be combined with benefits from several other compatible uses, to comprise an attractive value proposition.

BIOGRAPHICAL NOTE

Conference presenter: Jim Eyer is the Principal and Senior Analyst for E&I Consulting. For the last 15 years, he has also served as the Senior Analyst for Distributed Utility Associates.

Mr. Eyer’s 27-year career has focused on energy efficiency, renewables, and advanced energy technologies, concepts, benefits, and markets. For the last 15 years, he has focused on energy storage with an emphasis on benefits and value propositions. He has authored or co-authored numerous reports and papers on these subjects for the U.S. Department of Energy, California and New York State energy agencies, utilities, and vendors. Notably, he is the lead author and principal investigator for the seminal report published by Sandia National Laboratories entitled *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide*.

Before Distributed Utility Associates, Mr. Eyer held a range of positions with Pacific Gas and Electric Company related to advanced electric technology and concepts research and development, electric supply planning, and commercial energy efficiency services.

He holds an undergraduate degree in physics and management from Sonoma State University and a Master’s degree in management, also from Sonoma State.