White Paper

Turning Locational Value into Real Dollars

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Shareables

- Understanding the locational value of distributed energy resources supports utility solutions that can save costs, strengthen customer relationships, and enhance program cost-effectiveness.
- Our case study finds that capturing even modest distribution deferral values can still lead to meaningful 4%–27% increases in energy efficiency program cost-benefit ratios.
- Utilities can target the most beneficial grid locations using a multi-channel marketing plan to increase program participation, even without increasing incentives.

Executive Summary

Technological improvement in distributed energy resources (DER), cost declines, and consumer interest in clean energy are causing two kinds of market change: customers adopting distributed energy solutions — in some places quite rapidly — and utilities thinking proactively about how to pursue new program options and pilots to take advantage of these technologies. For utilities that want to manage DER growth or actually leverage these technologies to create revenue, value, and better customer relationships, understanding the value of DER on a locational basis is a key first step. This allows a utility to design more effective tariffs, explore non-wires alternatives (NWAs), or improve demand management programs.

The benefits that utilities and their customers can derive from these approaches could be substantial, including: bending the cost curve to reduce rate pressure in a low load growth environment, crafting more cost-effective programs with better returns for customers and shareholders, and enhancing customer relationships as customer interest in DER continues to grow.

A recent case study demonstrates how ICF has leveraged our work with multiple utilities to develop an efficient methodology for calculating locational value. Our study found meaningful differences from one feeder to another, both in terms of the value of different DER and the specific value of distribution avoided costs.

Of course, once you have determined locational value, the next question is what to do with it. Among the three "P's" of bringing DER onto the grid — prices, procurements, and programs[1] — there are a number of options for getting DER to the right locations to capture the most value. One can redesign tariffs or pilot non-wires alternatives in key locations. Here, we focus on using locational values in utility energy efficiency programs. Our case study found that the value of deferred distribution capacity on one utility system was relatively small compared to other components of the value stack; but nevertheless could still lead to meaningful 4%-27% increases in efficiency program cost-benefit ratios. It also showed the variation in locational value from one place to another. That can be highly useful information for designing and targeting programs. ICF has implemented geo targeting approaches for demand side management programs that have increased utility program participation even without increasing incentives, demonstrating a simple and effective approach for capturing locational benefits and making utility programs more cost-effective.

Case Study: Analysis Reveals Locational Value

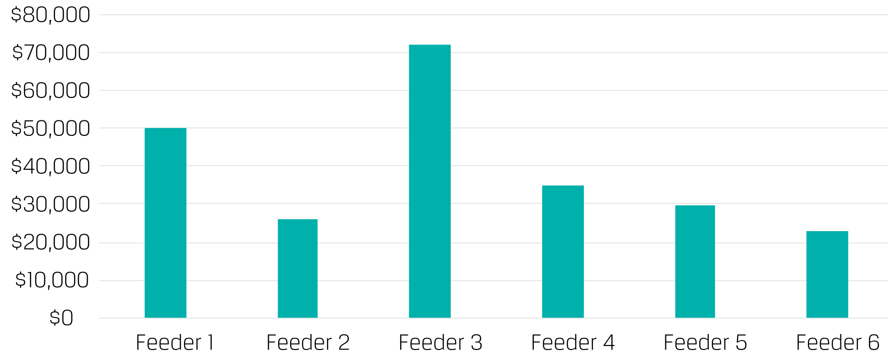
ICF worked with a major US utility to analyze distribution system data and identify grid locations with the greatest need for capacity upgrades — typically locations that are forecast to experience significant load growth.[2] ICF, together with the utility, analyzed these constrained areas and applied "traditional" infrastructure solutions such as feeder reconductoring to alleviate capacity needs. We then estimated the cost of these solutions as shown in Exhibit 1.[3]

[1] The framework of the three "P's" to bring DER onto the grid was first introduced in the work of the "More Than Smart" initiative in California. Prices refers to rate designs and tariffs, a common example being net energy metering. Procurements refers largely to direct utility purchase of DERs, often through an RFP/RFO as part of a non-wires alternative. Programs refers to utility-run demand management programs such as for energy efficiency and demand response.

[2] The analysis focused on areas needing investment tied to load growth. There are other types of distribution system infrastructure investment, for example to replace aging or damaged infrastructure or relocate a circuit based on other construction. However the ability of DER to defer or avoid the need for such investment is less clear-cut, so these types of projects are not identified in this analysis.

[3] DER can also provide other grid services at the distribution level besides capacity deferral, however, methods to value and capture these components are still in development and are not considered in this analysis.

EXHIBIT 1. AVOIDED DISTRIBUTION COSTS ON SAMPLE FEEDERS

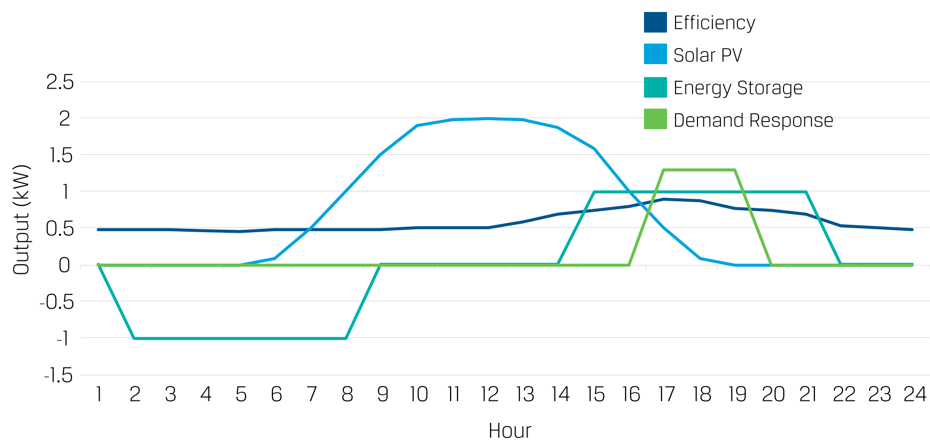


Source: ICF

As Exhibit 2 demonstrates, ICF's analysis identified a range of avoidable costs varying by a factor of greater than three from one feeder to the next.

ICF then modeled the varied operating characteristics of each DER technology on each selected feeder using detailed engineering models that captured the temporal generation (or load modifying output) behavior of each DER technology and its coincidence with the load profile of each feeder (Exhibit 3).

EXHIBIT 2. TEMPORAL OUTPUT CHARACTERISTICS OF DER TECHNOLOGIES



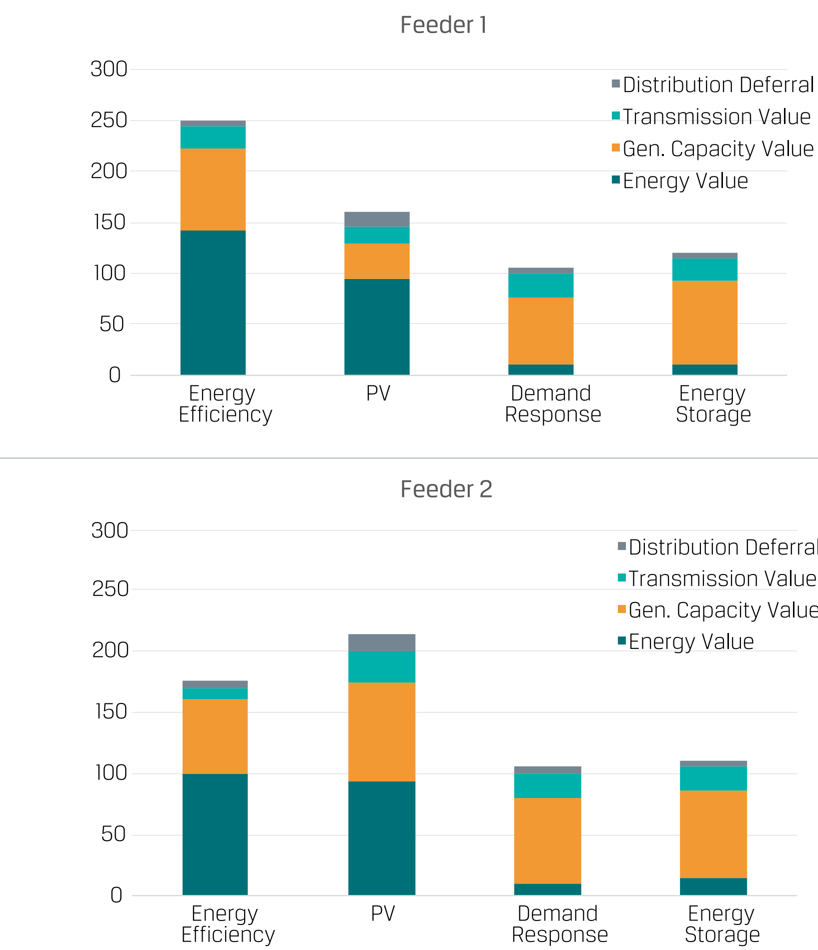
Source: ICF

Distribution system analysis determined whether each DER technology was able to replace conventional distribution upgrades to resolve the identified grid issues. For each DER technology, ICF evaluated the avoided distribution system investment. We also evaluated the impact of the DER technology in offsetting wholesale system energy, capacity and transmission costs (Exhibit 4). By analyzing these different value streams, ICF assembled a representative value stack across the utility system. In the case in question, ICF found that the value of distribution investment deferral was a relatively small contributor to the full value stack.[4]

[4] While there can be variation in this value component from one system to another, our findings here are consistent with other studies. See Susan F. Tierney, Ph.D., "The Value of "DER" to "D": The Role of Distributed Energy Resources in Supporting Local Electric Distribution System Reliability," The Analysis Group, Inc. March 30, 2016, p.16.

Exhibit 4 presents the value stack for each DER technology on two sample feeders to illustrate variation in locational value. The variation is due to a combination of factors: the level of constraint in a given location, the cost of a traditional upgrade to address it, the achievable DER potential at that location (taking into account hosting capacity as a boundary condition for PV), and the coincidence of DER output with local demand curves. For example, the locational value of energy efficiency on Feeder 1 is almost 140 percent of its value on Feeder 2. On the other hand, due to higher PV potential[5] and its coincidence with Feeder 2 loads, which were dominated by commercial offices, the value of PV on Feeder 2 is 130 percent of its value on Feeder 1, which is dominated by residential loads.

EXHIBIT 3. DER VALUE ON TWO FEEDERS



Source: ICF

[5] While not a focus of this paper, the analysis included an evaluation of hosting capacity to determine a boundary condition for PV potential. Hosting capacity is defined as the amount of DER that can be safely accommodated on a circuit without adversely impacting power quality or reliability.

These locational value findings can be used in a number of ways: optimizing tariff design, constructing non-wire alternatives by procuring DER portfolios to meet locational system needs, targeting demand management programs, or offering geographically-differentiated incentives for DER. In this case study, ICF applied the findings to evaluate how they could impact the benefit-cost ratios of utility energy efficiency programs.

Applying locational value to energy efficiency cost-effectiveness tests

Energy efficiency (EE) cost-effectiveness tests compare costs and benefits of different programs to measure overall performance. Getting the cost-benefit calculation right is incredibly important for deciding which programs are cost effective and should be implemented or continued. And as increasing codes and standards and penetration of EE measures has captured existing potential, the next increment of efficiency benefit has been harder to get, making cost-effectiveness harder to achieve.

Another challenge is that often, while costs are evident, it can be harder to estimate benefits: the benefit streams involve both direct and indirect impacts as well as externalities that are difficult to capture and quantify. The more complex benefits, such as distribution avoided costs, are frequently omitted entirely or estimated through a variety of methods which may or may not capture the full value. Furthermore, when distribution avoided costs are estimated, it is often done by applying a high-level relationship between load growth and capital costs.

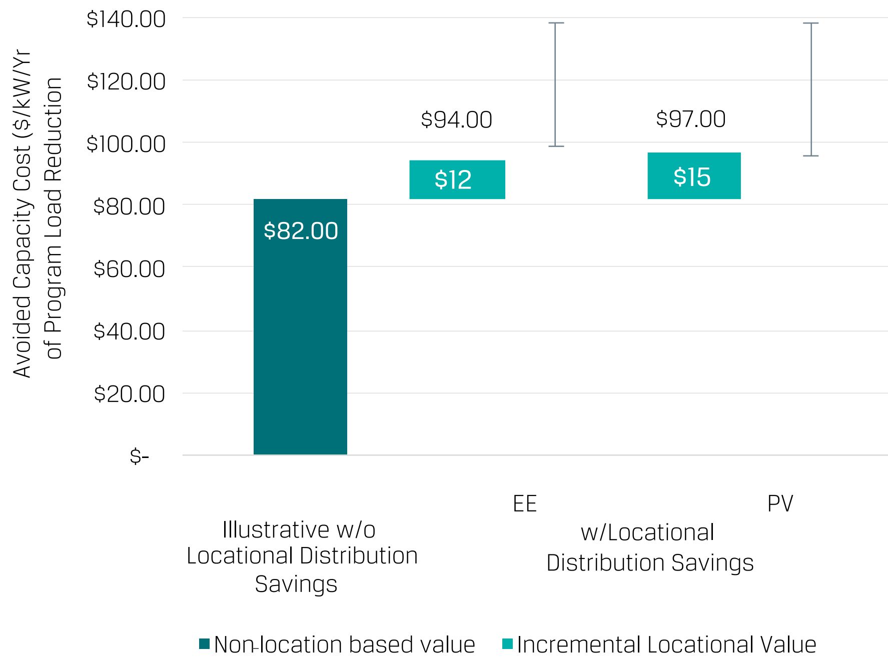
So the benefits of a locational methodology include:

- Greater precision in capturing distribution avoided cost
- Far greater empirical justification for the avoided cost figure, which could often be higher than what was previously applied.
- Highly useful information about the scale and proportion of locational avoided cost variation to support program targeting.

The bottom line is that the locational valuation analysis can more accurately define benefits that may not have been previously fully captured, and thereby enhance program cost-effectiveness. Exhibit V shows the impact in our case study of including avoided distribution capacity derived through locational value analysis. We find that locational distribution value increases the overall avoided capacity benefits from 7% - 50%. Those benefits flow through to the benefit-cost ratio. Based on past studies, ICF estimates that including locational value could increase the energy efficiency benefit-cost ratio in our case example from 4% to 27%.[6] The implication of this finding is that while the total amount of value derived from the distribution capacity portion of the value stack is relatively small compared to other components, it could still potentially make a meaningful difference in program effectiveness.

[6] There is no standard methodology for estimating the benefit-cost ratio. Benefits included in the analysis vary from one study to another. ICF estimates that the avoided capacity benefit would make up anywhere from 30% to 60% of overall benefits. The impact of locational value on benefit-cost ratio is estimated under these assumptions.

EXHIBIT 4. ENHANCED AVOIDED CAPACITY VALUE WITH LOCATIONAL DISTRIBUTION SAVINGS



Source: ICF

Moving from Analysis to Implementation

Having derived these results, the question is then how to achieve the right level of program participation in the right locations. The analysis can help utilities understand not only the amount of avoided cost that can be achieved, but where to focus efforts and in what proportion to get the best results. One approach would be to leverage these insights in justifying regulatory support for utilities to offer incentives or special DER-friendly rates in one part of a service area that aligns with the proportion of locational value available. Some jurisdictions are already examining these kinds of measures.

However, an immediately implementable and effective approach can also be to implement geo-targeted programs in specific geographic areas. ICF has previously used a multi-channel marketing plan designed to increase utility program participation even in the absence of higher incentives. Many aspects of this approach are based on community-based social marketing (CBSM) theory, which helps guide understanding of why some people might participate in DER measures and others do not. In contrast to media campaigns alone, which can be effective in raising awareness but can have mixed results in causing consumer action, adding CBSM can often successfully foster greater behavioral change and increased program participation.

The CBSM approach can be slightly different in every location because each community is unique and presents different opportunities. In addition, the locational value analysis will also dictate the measure mix — which utility programs are most needed in what proportion in each location — which would also shape the overall look and feel of the campaign. However, the following components are the backbone of the model:

1. **Energy Ambassador:** A staff member is assigned to be responsible for integrating into the fabric of the target community, gathering intelligence, garnering participation through outreach, and providing customers with a line-of-sight to relevant utility programs and incentives.
2. **Energy Task Force:** Several local stakeholders are recruited to serve on the task force. The group meets regularly to advise the program and identify local opportunities.
3. **Community Challenge:** Based on feedback from the Energy Task Force, the Community Challenge provides motivation for customers to participate. The Challenge usually includes prizes for the community as a whole and for individual customers.
4. **Aggressive Marketing:** Multiple marketing channels are utilized to reach all residential and C&I customers.
5. **Unique Brand and Website:** A unique campaign theme is created to embody both the local community spirit and the cause of managing demand. The website serves as the central hub for the program allowing customers to learn about utility programs and the Community Challenge. Additional functionality can offer next-best-offers based on data analytics and/or engagement and rewards.

Evaluation results have shown that this approach is effective in increasing energy efficiency savings, demand savings, program participation, and behavior change as well as other non-energy benefits—and it can readily be applied based on locational value analysis results.

Conclusion

Our case study demonstrates that locational analysis can reveal significant value differences and provide useful intelligence for designing tariffs, DER procurements, and utility programs. In the context of efficiency programs, analysis results can flow through to meaningful differences in benefit-cost ratios that can demonstrate enhanced program effectiveness. Program design and geo targeting aligned with value results can help utilities to guide strategically increased DER penetration to the right areas, and in the right amounts, to benefit all customers.

About the Authors

Matt Robison is a Senior Manager with ICF. He leads client projects focusing on distributed energy grid integration and associated regulatory proceedings on the evolution of distribution system planning, operations, and markets. He has helped develop ICF views and perspectives for utility clients on a diverse array of power sector issues including wholesale market design and transmission, but focuses primarily on the implications of distributed energy.

David Pickles joined ICF in 2004. He has more than 28 years of experience in utility resource planning, energy efficiency and demand-side management, non-traditional product and service development, and operations of unregulated utility subsidiaries. He has testified as an expert witness on more than 25 occasions, and is a frequent presenter on utility energy efficiency programs and policies, innovative new business opportunities for utilities, regulation, and beneficial electrification. Expert in US electricity markets, with a special focus on ERCOT and CAISO and market design and issues affecting wholesale and retail power markets.

Steve Fine is a Vice President with ICF and leads the Distributed Energy Resources Team. Steve has particular expertise in evaluating the economics of conventional and renewable energy resources—both central station and distributed generation—within the context of developing technologies, market design and environmental regulations. He works with many of the major U.S. power companies and developers in evaluating the impact of distributed energy resources (DER) on their system and the implications for their business models and their distribution system planning and operations.

MD Sakib is a manager with ICF's Distributed Energy Resources Team. MD has more than 13 years of experience in the power engineering industry, including, transmission planning, distribution planning, substation design and commissioning, substation engineering and protection and power generation. MD previously worked for various utilities within United States. One of MDs focus on distribution planning lies on streamlining the interconnection process to integrate more distributed energy resources (DERs) into the utility's distribution system.

Kevin Duffy leads boundary pushing and innovative pilot programs at ICF that are paving the way for the utility of the future. He works with clients in engaging customers, introducing new technologies, and stimulating positive change in the way people use energy and interact with their utility.

About ICF

ICF (NASDAQ:ICFI) is a global consulting and technology services provider with more than 5,000 professionals focused on making big things possible for our clients. We are business analysts, policy specialists, technologists, researchers, digital strategists, social scientists, and creatives. Since 1969, government and commercial clients have worked with ICF to overcome their toughest challenges on issues that matter profoundly to their success. Come engage with us at **icf.com**.

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