# Optimal Procurement of Distributed Energy Resources

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The electricity industry is currently undergoing substantial change throughout the world. Historically, electricity has been transported from centralized generation facilities to customers via transmission and distribution infrastructure owned and operated by large vertically integrated utilities. Today, the industry employs substantial distributed energy resources (DERs) that can take many forms, including rooftop solar panels, remote storage of electricity, demand-side management, and enhanced energy efficiency. Advances in these DER technologies offer the prospect of less costly and potentially more reliable electricity supply.

Regulators and policymakers have expressed keen interest in motivating utilities to identify DER projects that are more cost-effective than traditional investment in distribution and transmission capacity. Regulators have also been implementing policies that seek to motivate utilities to work diligently to integrate the most promising DER projects at minimum cost, knowing that such identification and integration have the potential to substantially reduce the bills of residential and industrial electricity customers. However, the optimal design of such policies is challenging, in part because regulators typically have limited information about the potential cost savings from new DER projects and about the utility's ability to manage project costs.

We analyze the properties of the regulatory policy that minimizes the expected cost of procuring a specified enhancement of energy services in an environment where the enhancement can be secured by undertaking either a core (traditional) project or a non-core (DER) project. The cost of implementing the core project is known to all parties. However, the utility has superior information about both the likely cost of the non-core project and its ability to manage project costs.

We demonstrate that the optimal regulatory policy often requires the utility to share realized cost savings under the non-core DER project with its customers. The cost sharing motivates the utility to deliver cost-reducing effort while securing for customers a portion of the benefits of this effort. The optimal policy can entail a bias against a DER project that is more cost effective than traditional core investment. This bias limits the utility's incentive to understate the cost reduction that can be achieved under the DER project.

In some jurisdictions, regulators offer utilities a menu of optional compensation structures in order to better tailor the prevailing compensation structure to the environment in which it is

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implemented. We find that an optimally designed menu of compensation structures typically does not reduce procurement cost substantially. However, such a menu can reduce the utility's profit considerably and thereby limit allocative inefficiency.

The optimal regulatory policy varies with the characteristics of the potential non-core DER project. In particular, the optimal policy often requires the utility to share less of the realized cost savings with customers when the DER project is "internal" (i.e., designed and managed by the utility) than when it is "external" (i.e., designed and managed by an unaffiliated third-party entity). Further, procurement cost can increase substantially if the compensation policy that is optimal when the DER project is internal is applied when the project is external (or *vice versa*). This finding may be of particular interest in the many jurisdictions where regulators and policymakers are presently debating whether to permit utilities to pursue internal DER projects and how to structure compensation for both internal and external DER projects.

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