EXECUTIVE SUMMARY

RATE DESIGN FOR THE DISTRIBUTION EDGE

ELECTRICITY PRICING FOR A DISTRIBUTED RESOURCE FUTURE

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The U.S. electricity system is on the cusp of fundamental change, driven by rapidly improving cost effectiveness of technologies that increase customers' ability to efficiently manage, store, and generate electricity in homes and buildings. With growing adoption of these technologies, the electricity system is shifting toward a future in which the deployment and operation of distributed energy resources (DERs) will have far-reaching implications for grid operation, investment, and security. Yet, there is a looming disconnect between the rapidly evolving new world of distributed energy technologies and the old world of electricity pricing, where relatively little has changed since the early 20th century. By changing electricity pricing to more fully reflect the benefits and costs of electricity services exchanged between customers and the grid, utilities and regulators can unleash new waves of innovation in distributed energy resource investment that will help to reduce costs while maintaining or increasing system resilience and reliability.

The stakes are high in getting this transition right. With or without pricing reform, distributed resources are likely to account for a growing share of total electricity system investments. DER developers and customers will optimize their investments and operations against the price signals provided by the utility, regardless of whether these prices are aligned to create the greatest value for society as a whole. The types of pricing structures most common today for residential and small commercial customers—bundled, volumetric block rates—provide little or no incentive for the deployment and operation of DERs at the times and places where they can create greatest overall benefit. The perpetuation of these pricing structures in the face of ongoing improvement in DER cost and performance and increased adoption of these technologies will result in lost opportunities for cost reduction and inefficient utilization of assets on the part of both customers and utilities.

Creating a clean, efficient, and secure 21st century electricity system will pivot, in part, on successfully integrating DERs into the design and operation of the electricity grid—and pricing provides the incentive structure needed to achieve this integration. More granular pricing, capable of reflecting marginal costs and benefits more accurately than today's rates do, will provide better incentives to direct distributed resource investments, regardless of whether investments in and management of DERs are undertaken by customers, by utilities, or by third-party service providers. Ultimately, prices could be adapted to fully reflect a two-way exchange of value and services between utilities and customers.

Making the transition to new pricing approaches, however, will undoubtedly pose challenges. In particular, it will require making trade-offs against one of the hallmark principles of traditional rate design: simplicity. In addition, introducing new and more sophisticated pricing structures could have disruptive effects on existing business models for DER developers. Developing and implementing new pricing structures will therefore require effective collaboration among utilities, regulators, technology developers, and customers. By creating a shared vision of the future trajectory for prices, however, these parties could create a pathway whereby DER technology and services can co-evolve with increasingly advanced price signals.

This report discusses a pathway for deliberately and incrementally increasing rate sophistication along three continuums for residential and small commercial (i.e., mass-market) customers:

1. ***Attribute unbundling***—shifting from fully bundled pricing to rate structures that break apart energy, capacity, ancillary services, and other components
2. ***Temporal granularity***—shifting from flat or block rates to pricing structures that differentiate the time-based value of electricity generation and consumption (e.g., peak vs. off-peak, hourly pricing)
3. ***Locational granularity***—shifting from pricing that treats all customers equally regardless of their location on the distribution system to pricing that provides geographically differentiated incentives for DERs

A transition to more sophisticated pricing is attainable for large portions of the country, but will require careful planning and customization to local circumstances. The introduction of more pricing options for customers—allowing customers to opt in to new rates that allow them to benefit from actions that reduce system costs—could allow the implementation of new approaches in stages, while providing an opportunity for customers and service providers to experiment with new rates. For example, pricing options could include a default pricing option that gradually changes to become more sophisticated over time, while providing alternative opt-in pricing structures that are more or less sophisticated than the default for customers who want or need such choices.

This paper discusses six evolutionary pricing options to consider, individually or in combination (see Table 1 and Figure 6).

TABLE 1: **NEAR- AND LONGER-TERM EVOLUTIONARY RATE STRUCTURES**

NEAR-TERM DEFAULT OR OPT-IN POSSIBILITIES	LONGER-TERM, MORE SOPHISTICATED POSSIBILITIES
Time-of-Use Pricing	Real-Time Pricing
Energy + Capacity Pricing (i.e., demand charges)	Attribute-Based Pricing
Distribution “Hot Spot” Credits	Distribution Locational Marginal Pricing

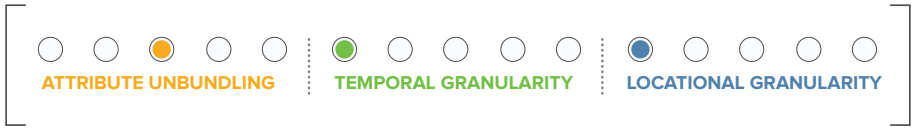
FIGURE 6: **INCREASING SOPHISTICATION THROUGH RATE STRUCTURE EVOLUTION**

TODAY'S BUNDLED, VOLUMETRIC, BLOCK PRICING

In the simplest system, prevalent today, there is no unbundling (i.e., fully bundled pricing) with no time- or location-based differentiation.

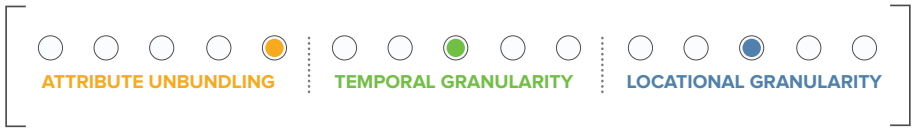
ENERGY + CAPACITY PRICING

Breaking apart energy and capacity values begins to unbundle prices, but leaves many still bundled. Time- and location-based differentiation is still minimal.



ATTRIBUTE-BASED PRICING

Attributed-based pricing more fully unbundles electricty prices, while doing so could also add time- and location-based sophistication.



TIME-OF-USE PRICING

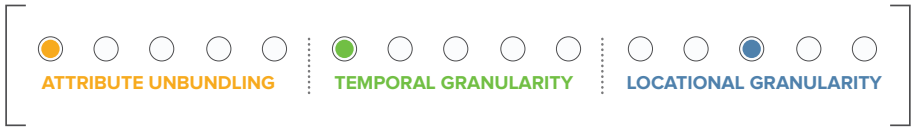
Relatively basic time-of-use pricing (e.g., off-peak, peak, critical peak) begins to add time-based differentation, but could still allow attributes to remain fully bundled with no location-based differentation.

REAL-TIME PRICING

Real-time pricing, with prices dynamically varying by one-hour or sub-hour increments, adds much time-based sophistication, but could still allow attributes to remain fully bundled with no location-based differentation.

DISTRIBUTION SYSTEM HOT SPOT PRICING

Identifying distribution system "hot spots" begins to add location-based differentation, but could still allow fully bundled attributes and little or no time-based differentation.



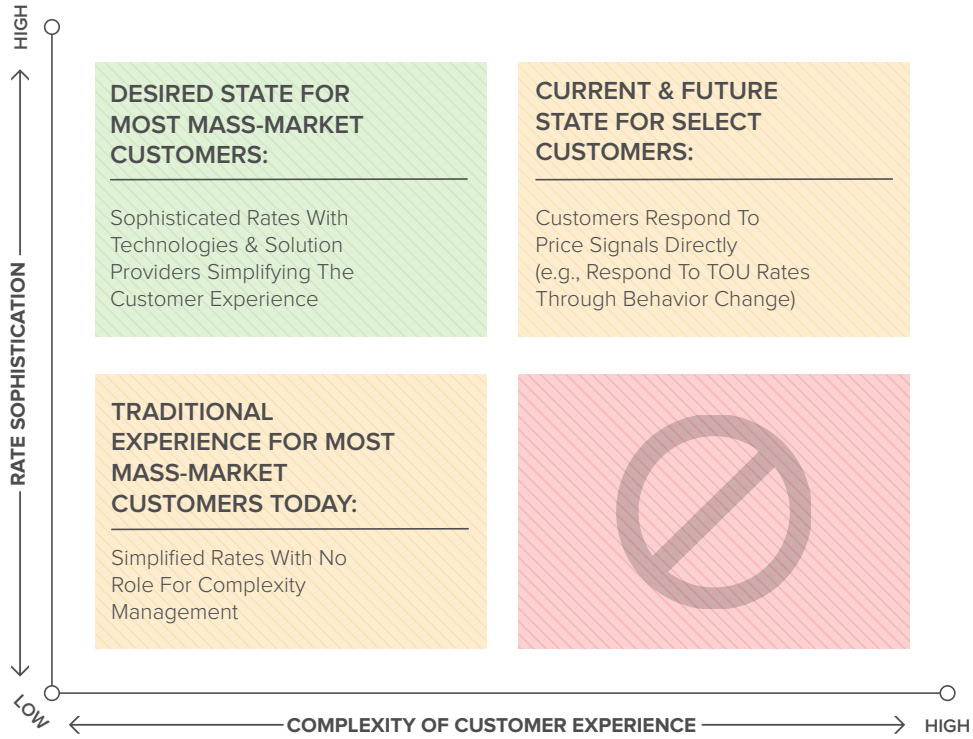
DISTRIBUTION LOCATIONAL MARGINAL PRICING

Distribution LMP adds location-based sophisiticcation, and in turn a high degree of temporal sophistication.

These more sophisticated pricing options need not introduce unnecessary complexity for customers—third-party aggregators, energy management software, smart thermostats, and other technologies can maintain a simple customer experience by optimizing performance behind the scenes even as greater differentiation gets built into the rate structures (see Figure 8).

Transitioning to some of the new rate structures explored in this report is possible today or will be realistic in the next few years in some markets, especially where utilities have already transitioned to advanced metering infrastructure. In other cases, implementation of more sophisticated rate structures will take more time—and possibly even legislative and regulatory reform—to achieve. Either way, the conversation about how to adapt electricity pricing to meet the needs of a 21st century electricity system has begun. Bringing this transition to fruition will require participation, dialogue, and collaboration among stakeholders to deliver successful outcomes.

FIGURE 8: **MANAGING RATE COMPLEXITY FOR THE CUSTOMER**



e-Lab is a joint collaboration, convened by RMI, with participation from stakeholders across the electricity industry. e-Lab is not a consensus organization, and the views expressed in this document are not intended to represent those of any individual e-Lab member or supporting organization.

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