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Solving the rate puzzle: The future of electricity rate design

Systemic trends are forcing utilities to confront the need for rate design changes.

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US electric utilities are seeing their industry transformed. Renewable portfolio standards,[1] nonutility generators of renewable electricity,[2] net metering,[3] behind-the-meter storage,[4] and other distributed energy solutions have drawn revenues and customers away from traditional utilities and created a mismatch between electricity rates and utilities' costs.[5] In the long term, policy and technology trends, largely spurred by decarbonization,[6] could continue to motivate customers to decrease their dependence on—or even abandon—traditional utilities in favor of third-party suppliers. There is no cure-all, but electricity rate designs must be reformed to ensure a stable transition to less carbon-intensive sources and secure utilities' role in the future system.

Historically, electricity rate structures have bundled all electric services into one volumetric rate—charging customers by kilowatt-hour of use served all major stakeholders' objectives. Customers within the same rate classes (commercial, industrial, residential) received the same level of service and understood that their electric bills varied based on the amount of electricity they used. Utilities recovered their costs and capital investments without significant rate increases. Policy makers liked that volumetric rates encouraged energy efficiency. And with few substitute options for customers, the system was stable.

Today, against the backdrop of decarbonization, increasing customer sophistication, and new competition, utilities' fixed costs are increasing. Grid modernization and investments to meet sustainability goals come at significant capital expense. As a larger share of electricity is sourced from renewables, utilities must ensure enough system flexibility to maintain reliability when supply from renewables is intermittent or low. With volumetric rates, mounting fixed costs are passed on to customers who have not taken advantage of decentralized, third-party arbitrage opportunities (such as net metering or behind-the-meter storage). Customers find their bills confusing as a result, unable to understand why their bills are increasing despite limited changes in their usage and level of service.

Unless utilities update their pricing and offerings, they will find themselves with a shrinking base of customers among which to distribute rising costs. With regulatory processes that can last years, rate-design reform must start today if utilities hope to address the problems coming in the next decade.

Principles of rate-design reform

Progress toward a lower-carbon, customer-centric electric-power industry is underway; previous McKinsey research has explored flexibility and resilience questions underlying decarbonization.[7] A critical element needed to enable this transition is an overhaul of rate design. An updated rate design must align rates with system-wide costs, encourage flexibility, and address customers' differing needs.

Ensure that rate structure reflects cost structure

With the adoption of renewables growing, fixed costs make up an expanding share of the cost of funding the grid. Unlike fossil-fuel generation, renewables have no fuel costs and relatively minimal operation and maintenance costs.[8] Renewables are also intermittent power sources, which necessitates increased grid flexibility. As a result, utilities have made significant capital expenditures to upgrade

[1] Renewable portfolio standards are regulations that require utilities to ensure that a specified share of the electricity they sell comes from renewable sources.

[2] Also known as independent power producers, nonutility generators are companies that generate electric power for sale to utilities and end users.

[3] Net metering allows consumers who generate their own electricity to connect their own generators to a public power grid and transfer surplus power to the grid. Under the current system, net metering helps consumers offset the cost of electricity they draw from the utility. In practice, this leads consumers who do not use net metering solutions to carry a disproportionate amount of the system's fixed costs.

[4] Behind-the-meter storage refers to battery-energy storage systems that customers install on-site to reduce their peak demand or otherwise arbitrage energy costs.

[5] Distributed energy systems generate or store electricity (often from renewable sources) for a single customer. These systems can also be used to reduce or shift customer loads.

[6] Decarbonization is the process of reducing carbon dioxide emissions in electric-power generation and other industries.

[7] For more, see Evan Polymeneas, Humayun Tai, and Amy Wagner, "Less carbon means more flexibility: Recognizing the rise of new resources in the electricity mix," October 2018, on McKinsey.com.

[8] US Energy Information Agency, "Levelized cost and levelized avoided cost of new generation resources in the annual energy outlook 2018," March 2018, EIA.gov.

grid assets to provide reliability, flexibility, and security. As forward-thinking commercial, industrial, and residential customers take advantage of opportunities in distributed energy such as rooftop solar and behind-the-meter storage, the remaining volumetric users are left to shoulder an outsize amount of the growing fixed costs associated with these system-wide changes.

Utilities could remedy the discrepancy by matching a fixed-charge component (a set monthly fee) and a demand-charge component (a payment per kilowatt peak) to actual grid costs. These rate components are already part of many commercial and industrial rates and, to a lesser extent, residential rates. However, the rate components do not reflect their costs to the system. Accurately reflecting system-level cost breakdowns will motivate distributed generation, behind-the-meter storage, and other distributed energy resources (DERs) where they are economically efficient.

It is important to consider the regulatory response to any proposed changes to rate structures. Recent experience has shown that utility commissions usually reject large increases in fixed and demand charges. However, many utilities have seen success with small increases in these charges, which can gradually align rates with costs.

Use rate structures to encourage flexibility

Load shaping through rates is a first step toward addressing systemic flexibility needs by, for instance, reducing the height of an afternoon peak and decreasing the need for fast-ramping generation assets. The marginal cost to generate and distribute electricity varies significantly from hour to hour, season to season, and from different locations on a power grid. However, under most rate models today, customers pay the same rate throughout the day, regardless of their location—failing to discourage inefficient use of electricity at peak periods.

Utilities need to implement a time-of-use (TOU) pricing component for energy and demand charges, under which prices are higher during peak periods. Consider if electric vehicles were charged at peak times; they would create a substantial burden on the electricity grid and necessitate capital investments. But a TOU-linked demand charge would help stimulate optimal charging behavior (such as charging overnight when demand is lowest) and smooth demand throughout the day. In this way, TOU pricing can reflect actual cost variability and encourage customers to efficiently time their electricity use.

To mitigate the need for capital-intensive grid assets, customers can also participate more actively in contributing flexibility to grid operations. Customers can help balance supply and demand using their own home-automation devices to control electricity consumption and battery storage, but only if grid operators give them the right incentives to do so. For example, some utilities offer demand-response tariffs that pay customers who reduce their demand during peak periods. These tariffs could be expanded to encourage load reduction during steep ramping periods or in response to supply swings from renewable resources. The rates could also include dynamic pricing, a step beyond TOU pricing, in which customers see prices that change from period to period based on real-time wholesale prices. Similarly, utilities could incorporate location-based pricing to encourage customers in capacity-constrained areas of the grid to adjust consumption. Such pricing would help mitigate the need for costly transmission and distribution upgrades.

With the right prices as incentives, customers can contribute to grid operations in multiple ways, including demand-response, flexibility, and distributed generation. Over time, customers can be integrated into an on-grid market that prices energy, capacity, and flexibility in real time based on system needs. In this future, the utility could function as a platform that facilitates transactions—for a fee—between itself and customers, between third parties and customers, and between customers. Rate-based compensation for these services is a potential first step toward such a grid-based market.

Meet customer needs with differentiated offerings

Current rate structures deliver standardized service, which means all customers receive the same level of power quality, reliability, resilience, and renewables share—however, different customers have different needs. For instance, backup power is essential for hospitals and some manufacturers. High power quality is important to other manufacturers and data centers.[9] Meanwhile, sustainability-minded customers value a higher share of renewables.

Utilities' undifferentiated service offerings have driven many customers to work with nonutility third-party providers to meet their evolving needs. To remain competitive in the future, utilities could offer services—such as heightened reliability, 100-percent-renewable procurement, additional service levels, and DER equipment installation—on a cost-plus basis. Customers who value these offerings could opt in to add-on tariffs and receive corresponding services. Those tariffs would cover costs and avoid nonparticipating customers' subsidizing participating customers. For instance, hospitals and manufacturers that value resilience could pay for backup power through extra generators, microgrids, advanced distribution management systems, and other equipment that the utility could install and maintain. And customers who value renewable energy could pay to receive up to 100 percent of their energy from renewable resources without scaling back or abandoning their relationships with utilities.

Customers who want simple bills could opt in to a volumetric rate design—even a fixed bill—at a premium to today's rates. This design accounts for the flexibility needs these customers would impose on the grid (they don't respond to TOU pricing), allowing them to find a rate structure that meets their needs while efficiently pricing grid services and avoiding disintermediation.

Utilities can meet distinct customer needs with a menu of options instead of a single, undifferentiated tariff as seen in the exhibit below, illustrating a hypothetical utility offering based on a future rate structure. Updated rates accurately reflect the size and share of costs and TOU pricing, and new services include high renewables share, higher reliability, and DER installation and servicing. And again, customers could also participate in offering additional flexibility to the electrical grid. For customers who prefer volumetric rates or a flat bill, these options would still be available at a premium to new rates.

Both utility and nonutility industries have seen success with different billing models, from flat fees to free periods. For more, see sidebar, "Innovative billing: Models from within and outside the utility industry."

Four keys to a successful rate-redesign implementation

Utilities need to make significant progress to overhaul their rate designs in ways consistent with the principles discussed above. Some have updated elements of their rate design, such as adding green tariffs and TOU pricing. Comprehensive reform will continue to grow in importance for utilities in the coming years. As more utilities begin discussions about the best way forward, it is worth keeping in mind several elements of a successful rate-design implementation.

Internal support and capabilities

Utilities must have the capabilities and resources necessary, such as advanced metering infrastructure, to implement a new rate design. The organization will also need to expand its talent pool to support tracking and categorizing costs of generation and distribution. A marketing push focused on gaining customer support and segmenting customers based on their specific needs will also be vital.

Customer acceptance

Customers must adopt updated rate designs as the result of their perceived value or because they are easy to understand. Success requires staying close to key customer groups, gathering feedback, and providing ongoing support to ensure adoption and positive customer experiences.

Sensitivity to the regulatory process

Rate design must be performed jointly with regulators. This approach entails working groups, frequent communication, and a transition plan. For example, many regulators have resisted increasing

[9] Power quality can be framed as the compatibility between the current that flows from an electric outlet and the power required to operate the associated device.

Exhibit

Utilities can meet distinct customer needs with a menu of options (illustrative example, not reflective of a current utility offering).

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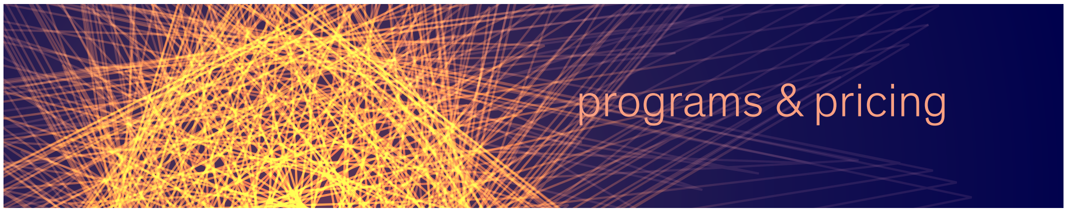

Choose the rate that is right for you.

Base rate

Fixed charge	Demand charge	Energy charge	
$10 per month	$1 per kWp during peak hours	$0.20 per kWh on-peak	$0.08 per kWh off-peak
Fixed fee for interconnection	Based on your highest level of demand between 4:00 p.m.–8:00 p.m.	On-peak hours are 4:00 p.m.–8:00 p.m.	

Sign up

Buy additional products & services

100% renewable energy	+$0.01/kWh	Add
Ultra-high reliability	$0.50/kWp	Add
Install an EV charger	+$40/month (for 12 months)	Add

Provide value to the grid

Demand response
25% off demand charges

Customer flexibility

Battery pack for grid services
–$15/kW/month

Grid-optimized electric vehicle charging
–$5/kW/month

Or stay with a simple rate (but at a small premium)

Simplicity option $0.16/kWh — Sign up

Flat bill $350 per month for up to 2,000 kWh — Sign up

Sidebar

Innovative billing: Models from within and outside the utility industry

Rate designs inside and outside the electric-power industry can serve as inspiration for utilities.

Electric-power retailers

As retailers compete in crowded markets, they develop rate structures that appeal to customers by providing clear value signals.

Flat bills typically charge customers a set amount per kilowatt-hour (kWh) based on their energy usage tier, appealing to customers who like predictability and are accustomed to "cell phone–style" pricing. For example, if a customer signs up for a 500-kWh plan, he or she might pay $60 for up to 500 kWh of use. Each kWh over the 500 kWh limit results in a premium per-kWh rate.

Free nights provide customers a period every day (for example, from 9:00 p.m. to 6:00 a.m.) during which their electricity is free. However, customers pay a premium rate during other hours. Usage during free periods rarely offsets the premium rate they pay during unfree hours, resulting in increased margins for retailers.

Green tariffs, such as premiums on volumetric rates or monthly fees, are effective rate structures for pricing renewable energy.

Combination rates featuring innovative approaches to different rate structures are emerging. For instance, TXU Energy in Texas offers a plan called Free Nights and Solar Days, which combines the free-nights concept with green tariffs.

Other industries

Industries that face similar billing issues as utilities have developed different approaches to rate design.

Road infrastructure developers use the way they charge drivers to alleviate traffic congestion while funding new investments. For example, tollways and express lanes provide a pay-per-use option for drivers who are willing to pay a premium to avoid traffic or to take an optimized route. This rate structure creates an effective demand charge for drivers who want to avoid traffic. Developers also use high-occupancy vehicle lanes to motivate drivers to reduce demand during peak times.

Cell phone carriers offer fixed fees that cap data and phone usage at different levels. If a customer exceeds those limits, he or she pays a premium unit price. This structure is simple and easy for customers to understand.

Airlines have shifted from bundled to disaggregated services—for example, charging for baggage and preferred seats.[1] They also set ticket prices using time-of-use pricing using inputs such as demand levels. This lets them align prices to demand and costs. In a utility rate-design context, a similar approach could help create differentiated offerings to meet customer needs.

Internet service providers charge customers a fixed monthly fee for home internet. The price level is based on the preferred download and upload speed, flipping the concept of volumetric pricing toward one based on capacity.

[1] For more on connected-car ecosystems, see Markus Löffler, Christopher Mokwa, Björn Münstermann, and Johannes Wojciak, "Shifting gears: Insurers adjust for connected-car ecosystems," May 2016, on McKinsey.com.

fixed charges or policies that appear to discourage energy efficiency and are regressive to low-income customers. Utilities must start the rate-design process by allaying those fears and set the stage for a transition from today's rates. For example, utilities could propose gradual increases to fixed costs for some customer segments while balancing cost increases with other energy efficiency incentives. Because the regulatory process can be iterative and incremental, utilities can work with policy makers to tweak rate designs over a series of rate cases and regulatory proceedings.

Sustainability for business operations

A new rate or tariff structure must generate enough revenue to fund grid investment, maintain its operation, and ensure its reliability. To achieve this objective, utilities have experimented with using high fixed charges and high demand charges to compete with DERs on pricing, but most attempts have been unsuccessful. Instead, rate components (fixed, demand, and energy) should accurately reflect their costs. This transparency will help make sure that grid power is cost-competitive when it is the optimal solution—with no institutional intervention required. A sustainable rate design uses transparency to create incentives for customers to contribute to the system's financial and environmental sustainability.

As the need for rate design grows, utilities would benefit from positioning rate-design reform to gain regulatory approval, customer adoption, and revenue generation. Early action, cooperation with regulators, and a customer-centric approach can help transform utilities' one-rate-for-all model into a rate structure that helps retain customers, create revenue that contributes to the upkeep of the grid, and make customer behavior and utilities' operations more sustainable.

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