Rate Design Trends and Case Studies

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Rate design principles have evolved over the years

The following principles are derived from the academic literature and field experience.

They are most often cited in utility rate cases throughout North America:[1]

- Economic Efficiency
- Equitable Cost Allocation Among Customers
- Revenue Stability
- Bill Stability
- Customer Satisfaction
- Affordability
- Decarbonization

[1] The seminal work on rate design is by James C. Bonbright, Principles of Public Utility Rates, Columbia University Press, 1961.

Questions and Discussion

The mismatch between how utilities recover revenue and how they incur their costs are prompting many utilities to modernize their rate designs

Cost Categories	Utility's Costs	Customer's Bill
Variable ($/kWh) - Fuel/gas supply - Operations & maintenance	Variable = $60	Variable = $115
Fixed ($/customer) - Metering & billing - Overhead	Fixed = $10	
Size-related (demand) ($/kW) - Transmission capacity - Distribution capacity - Generation capacity	Demand = $50	Fixed = $5

Note: Illustrative example for an electric utility.

Today's rate designs have the following structure

Mass market consumers (residential and small commercial)

- **Customer charge** (aka fixed charge/service charge/monthly charge)
  - a monthly fee that doesn't vary with the level of consumption
- **Energy charge**
  - Measures the flow of electricity ($/kWh)
  - May vary by time of consumption
  - Usually makes up the bulk of the bill

Large commercial and industrial customers

- Also have a bill similar to that of mass market
- **Demand charges**
  - Measures the width of the pipe ($/kW)
  - Can be max demand or max coincident demand or both

Questions and Discussion

Market research has shown that customers have diverse needs

Some customers want the lowest bill

- They are willing to be flexible in the manner in which they use electricity

Some customers want to lock in a guaranteed bill

- They are willing to pay a premium for peace-of-mind

Other customers lie in between these bookends

- Some want a guaranteed bill but may be willing to lower it if rebates are offered for reducing peak demand
- Others are happy to subscribe to a given level of demand

DEVELOPMENTS IN RATE DESIGN

Utilities are rethinking rate design to accommodate these diverse customer needs and to improve cost reflectivity

- Conventional Options
  - Flat rates, inclining block rates and seasonal rates
  - Increasing fixed charges
  - Introducing demand charges
  - Net metering

- Innovative Options
  - Time of use (TOU) rates, dynamic pricing, peak time rebates, and subscription plans with the ability to lower the bill by reducing load during critical times

There are several types of modern rate designs (1)

Rate Design	Definition
Fixed bill or a subscription plan	Customers pay a fixed monthly bill accompanied with tools for lowering the bill (such as incentives for lowering peak usage)
Seasonal Rates	The year is divided into different seasons, commonly winter and summer, each of which have distinct rates. Prices are higher in peak seasons to reflect seasonal variation in the cost of supplying energy.
Demand Charges	Customers are charged based on peak electricity consumption, typically over a span of 15, 30, or 60 minutes.

There are several types of modern rate designs (2)

Rate Design	Definition
Time-of-Use (TOU)	The day is divided into peak and off-peak time periods. Prices are higher during the peak period hours to reflect the higher cost of supplying energy during that period.
Critical Peak Pricing (CPP)	Customers pay higher prices during critical events when system costs are highest or when the power grid is severely stressed.
Peak Time Rebates (PTR)	Customers are paid for load reductions on critical days, estimated relative to a forecast of what the customer would have otherwise consumed (their "baseline")

There are several types of modern rate designs (3)

Rate Design	Definition
Variable Peak Pricing (VPP)	During alternative peak days, customers pay a rate that varies by day to reflect dynamic variations in the cost of electricity.
Demand Subscription Service (DSS)	Customers subscribe to a kW demand level based on the size of their connected load. If they exceed their subscribed level, they must reduce their demand to restore electrical service.
Transactive Energy (TE)	Customers subscribe to a “baseline” load shape based on their typical usage patterns, and then buy or sell deviations from their baseline.
Real-Time Pricing (RTP)	Customers pay prices that vary by the hour to reflect the actual cost of electricity

Questions and Discussion

TRENDS

Why are rate designs changing?

Utilities throughout the US and indeed throughout the globe are rethinking rate designs

- A major driver is the adoption of smart, digital, WiFi technologies by customers
- A second driver is the “greening” of customer tastes
- Another driver is the desire by customers to have options in rate design
- A major enabler is the rollout of smart meters
- As these drivers impact utility financial models, utilities need to adjust rate design in order to continue providing service.

TRENDS

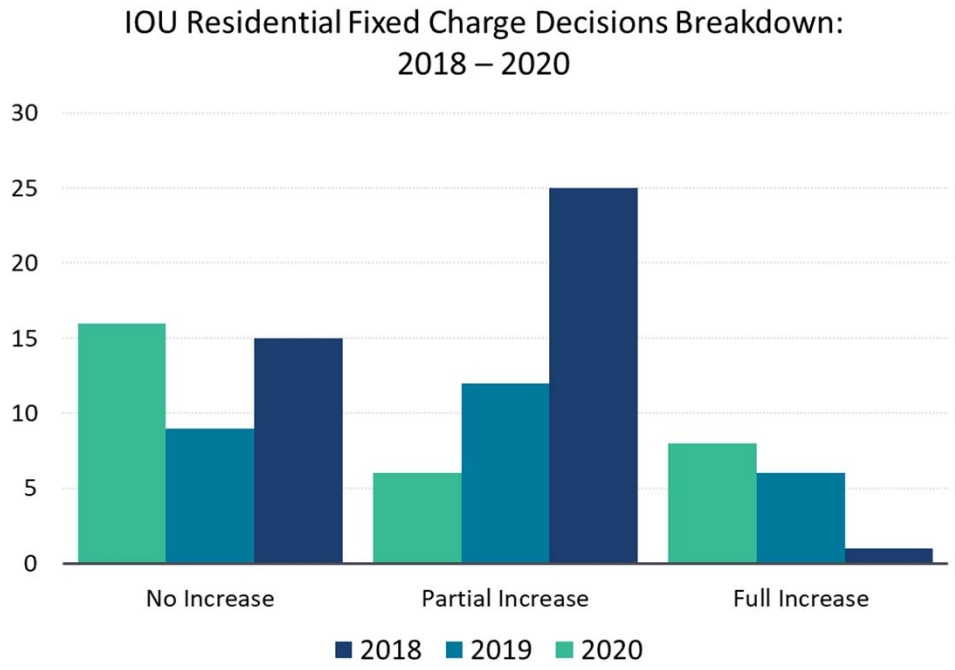
Modern rate designs are being offered in several jurisdictions

	Mandatory	Opt-out	Opt-in
Flat bill			Georgia Power, Oklahoma Gas & Electric
Peak-time rebates		Maryland, California, Illinois	
Demand charges			Arizona Public Service, Black Hills, Salt River Project,
Time-of-use (TOU) volumetric rates	Fort Collins (Colorado)	SMUD (California)	Texas
Dynamic volumetric rates (CPP, PTR, and RTP)		California	Oklahoma, Illinois

TRENDS

Throughout the industry, there is a desire to move fixed charges closer to fixed costs

Many utilities have proposed to increase the fixed charge, with varying degrees of success



Source: NC Clean Energy, "The 50 States of Solar," 2020 Annual Review. Average partial increase was 26% of utility's request in 2017, and 40% in 2018.

Questions and Discussion

TRENDS

There is a desire to introduce demand charges

Capacity charges based on the size of the connection are mandatory for residential customers in France, Italy, and Spain

Demand charges are being offered by more than 50 utilities across 24 states in the United States

Utilities such as Arizona Public Service and Salt River Project offer these rates to customers with solar panels on their roofs

Questions and Discussion

TRENDS

And there is a desire to offer time-varying rates

According to the US Energy Administration's Form-861, **365 U.S. utilities offer at least one form of time-varying rate** to residential customers in 2019

- 335 offer Time-of-Use (TOU) rates
- 31 offer Critical Peak Pricing (CPP)
- 13 offer Peak Time Rebates (PTR)
- 6 offer Variable Peak Pricing (VPP)
- 9 offer Real-Time Pricing (RTP)

Nationally, 4.5% (6 million) of all residential customers are enrolled on one of these time-varying rates

By 2025, the percentage of customers on time varying rates is expected to rise to 15%

In the rest of this presentation, we will briefly discuss some utility case studies

Questions and Discussion

Case Studies

CASE STUDIES

Sacramento Municipal Utility District (SMUD) – raised fixed charges and introduced TOU

Sacramento Municipal Utility District (SMUD), with 600,000 residential customers, transitioned all residential customers in 2019 to default TOU rates

- The rate has a peak period of 5-8 PM year around

Before filing for TOU, SMUD conducted a successful pilot program in 2012 and 2013 testing TOU, CPP, and TOU/CPP rates

The Time-of-Day (TOU) results of the first summer in 2019 showed that:

- Customers reduced the residential peak by ~8%
- Customers saved about 2% or $3 per month on their summer electric bill
- 96% of customers stayed on the TOU rate

Fixed charge was raised gradually to $20/month

SMUD™
Sacramento Municipal Utility District

CASE STUDIES

California's investor-owned utilities (IOUs) – Inclining block rates and TOU

Pacific Gas & Electric (PG&E) currently has ~400,000 customers on opt-in time-varying rates. The other two California IOUs, Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E), have approximately 370,000 and 155,000 customers on opt-in time-varying rates respectively

- Almost 99% of customers that participated in SCE and SDG&E's TOU pilots chose to stay on a TOU plan

All three IOUs have begun moving their customers to default TOU rates

- SDG&E began its rollout in March 2019, offering two TOU plans with a 4-9 PM peak period and a 2.1:1 peak/off-peak period, as well as an additional super off-peak period from 12-6 AM
- PG&E and SCE will transition customers in October 2020

The CPUC has ordered two customer guarantees as part of the rollout

- Customers will be provide an estimate of how their TOU bill compares with what their bill would have been on their old rate so they can see if they saved money or not
- A 12-month bill guarantee, such that customers whose first-year bill under the new TOU rate is higher than it would have been under their old rate will be credited the difference

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CASE STUDIES

Holy Cross Energy (HCE), Colorado - PTR

HCE, a cooperative in Colorado, offers a Peak Time Payback (PTP) program to both residential and commercial members.

- The baseline is calculated using historical hourly interval data to represent what a participant would have used in each hour during the event.
- Participants earn a bill credit of $1 for each kWh reduced compared to their baseline usage during “critical events,” and $0.5 for each kWh reduced during “high events.”
- Events typically occur between 4 and 9 PM on weekdays and typically last for two to three hours and the number of PTP event hours to be no more than 96 in a calendar year.
- No penalty for not reducing consumption when events are called.

CASE STUDIES

Fort Collins – TOU with a modest fixed charge

Fort Collins, a municipal utility in Colorado, went to mandatory Time-of-Day Pricing in 2018 for all customers.

- Fixed charge at $8 per month
- Off-peak hours cost approximately 30 percent less than current electric rates with higher prices during on-peak hours

- Summer On-peak hour (2 pm – 7 pm) and Off-peak (all other hours) with peak/off-peak ratio of 3.6.
- Winter On-peak hour (5 pm – 9 pm) and Off-peak (all other hours) with peak/off-peak ratio of 3.1.

Questions and Discussion

CASE STUDIES

Ontario Energy Board – TOU charges for energy and flat bills for distribution

Some 90 percent of Ontario's 4 million residential customers have been purchasing their energy through a regulated supply option, which features a three-period TOU rate.

- The TOU charge is deployed on an opt-out basis as smart meters were deployed in the province in 2014
- Off-peak, mid-peak, and on-peak prices are defined by season
- The TOU rates only apply to the energy portion of the customer's bill
- Analysis showed that load shifting impacts were lower in winter than in the summer period

The distribution charge is set equal to a flat bill, reflecting the fixed and non-volumetric nature of distribution costs.

Conclusions

Utilities throughout the US and indeed throughout the globe are rethinking rate designs

- A major driver is the adoption of smart, digital, WiFi technologies by customers
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- A major enabler is the rollout of smart meters

Some utilities have already begun the transition to modern rate designs

- In most cases, utilities are deploying various time-varying rates on an opt-in basis
- In a few cases, utilities are deploying them on an opt-out basis
  - Examples include California, Colorado and Michigan in addition to Ontario, Canada
- One utility has deployed them on a mandatory basis
- In several cases, pilots have preceded the full-scale deployment of these rates
- Some utilities are also offering three-part rates to customers

Comments and Discussion

Do you have any comments on the various rate designs that we have shared with you?

- If so, please share your comments.

Are there any other rate designs that you would like to suggest?

- If so, please describe them briefly and tell us why they are important.

Additional Readings

Selected Brattle papers on rate design

"The Tariffs of Tomorrow: Innovations in Rate Designs," *IEEE Power and Energy Magazine*, vol. 18, no. 3, pp. 18-25, May-June 2020.

"Time-of-Use Rates: An International Perspective," *Energy Regulation Quarterly*, June 2020 – Volume 8, Issue 2, 2020.

"Expanding customer choices in a renewable energy future," *Leadership in Rate Design: A Compendium of Essays*, American Public Power Association, July 2019.

"Customer centricity: Lynchpin of strategy," *Public Utilities Fortnightly*, November 1, 2019.

"2040: A Pricing Odyssey," *Public Utilities Fortnightly*, June 1, 2019.

"Rate Design 3.0 – Future of Rate Design," *Public Utilities Fortnightly*, May 2018.

"Status of Residential Time-of-Use Rates in the U.S.," *Public Utilities Fortnightly*, November 1, 2018.

"Net Metering FAQ – Rate design and subsidies," *Public Utilities Fortnightly,* October 2018.

Selected Brattle papers … (concluded)

"Innovations in Pricing: Giving Customers What They Want," *Electric Perspectives*, September/October 2017.

"Arcturus 2.0: A meta-analysis of time-varying rates for electricity," *The Electricity Journal*, 30:10, December 2017, pp. 64-72.

"Moving Forward with Electricity Tariff Reform," with Mariko Geronimo Aydin, *Regulation*, Fall 2017.

"Enhancing Customer-Centricity," *Public Utilities Fortnightly*, August 2017.

"The Paradox of Inclining Block Rates," *Public Utilities Fortnightly,* April 2015.