How Should Residential Tariffs Be Modernized?

PRESENTED BY
Ahmad Faruqui

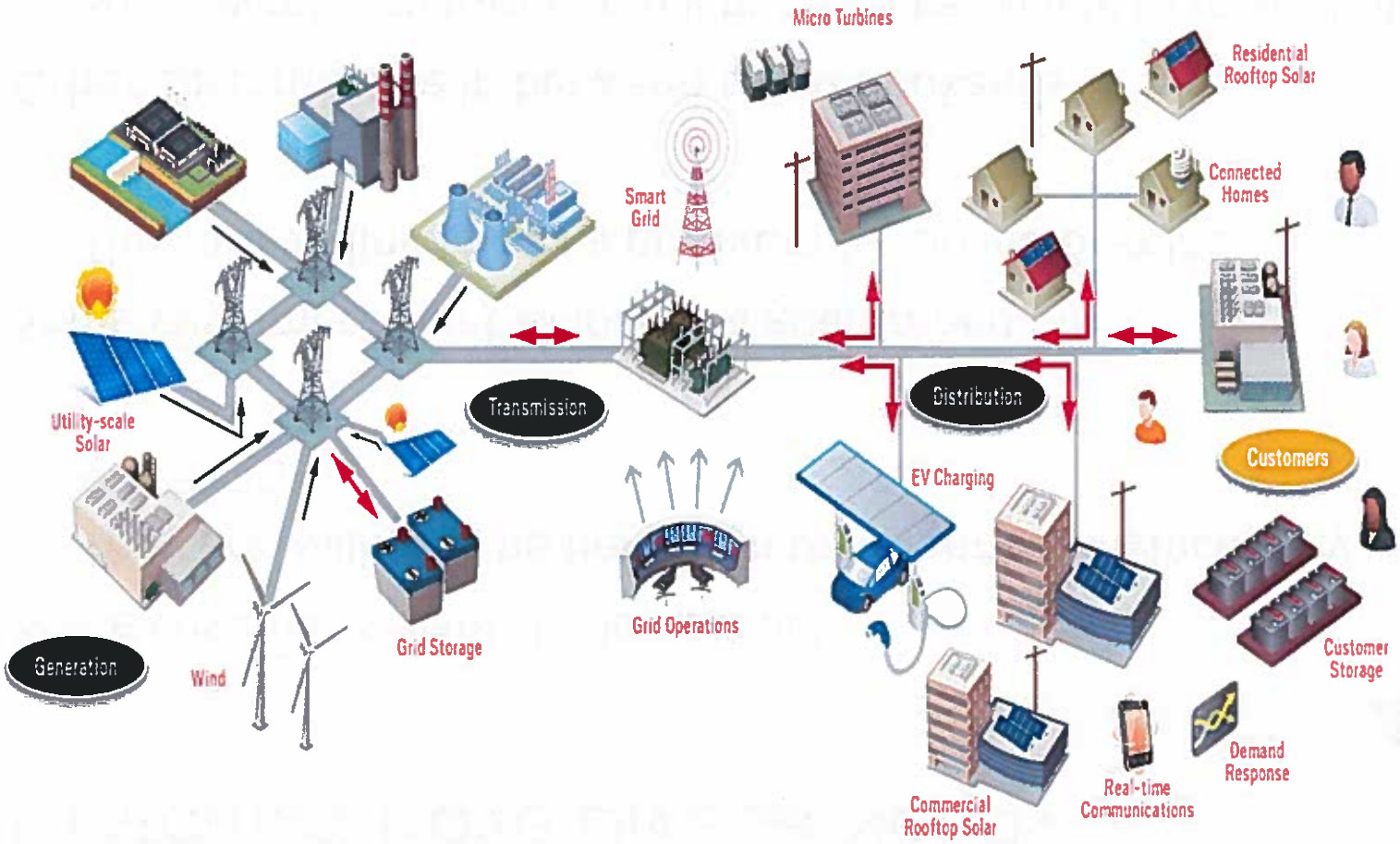
March 6, 2019

THE Brattle GROUP

Digital Technologies Are Changing The Way Customers Interact With Electric Utilities

- **Smart homes:** Smart appliances, smart thermostats, and smart phones are becoming ubiquitous
- **Electric vehicles:** Some car manufacturers have said they will stop making gasoline-powered cars in the next decade
- **Distributed generation:** Customers are increasingly turning into prosumers, by installing rooftop solar panels, battery storage, and fuel cells; this requires the grid to be modified to accommodate two-way energy flows
- **Smart metering:** Advanced metering infrastructure (AMI) now covers half of the United States
- **Missouri experience:** The state is beginning to move ahead with grid modernization, AMI, EV charging, and solar rebates

To Deal With These Challenges, The Integrated Grid Is Beginning To Take Shape



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

What Have The Last Century's Tariffs Looked Like?

They are mostly volumetric in nature, with a small fixed charge and no demand charge

They feature no time variation; a few have some seasonal variation

Some feature block rate structures

Empirical Evidence On The Conservation Effects Of Inclining Block Rates (IBRs) Is Mixed

Koichiro Ito's research in California found that customers did not understand the tiered structure and simply responded to the average price of electricity (*American Economic Review*, 2014)

Brattle's model simulations with three different methodologies found that removing or flattening IBRs in California would have no adverse effect on conservation (*Public Utilities Fortnightly*, 2015)

Thus, In Most Places IBRs Are Being Replaced With Time-of-Use (TOU) Rates

Canada

- British Columbia. Conservation impacts have not persisted.
- Ontario. Replaced IBR with TOU ten years ago.

California

- SMUD. IBR replaced with TOU last October.
- Investor-owned utilities. IBR being flattened, TOU being introduced as default tariff in 2020.

Colorado

- Fort Collins. Replaced IBR with mandatory TOU last October.
- Public Service Company of Colorado. Initial evidence of conservation but no recent evidence.

Michigan

- The Commission has decided to replace IBR with default TOU rates
- Consumers Energy is going to rollout default TOU in January 2020, possibly followed by DTE soon thereafter

What Should Be Reflected In Modern Tariffs?

They should reflect the cost structure of electricity and thereby promote economic efficiency and equity

Customers want to have control over their electricity use and bill

- Modern tariffs should allow customers to do that

The modern customer wants to be a part of an environmentally sustainable electrical system

- Modern rate design must incentivize energy efficiency and facilitate the development of clean energy resources

No two customers are exactly alike

- Modern rate design must feature multiple rate offerings
- All customers want choice but they only want what they want

What Are The Trade-offs In Tariff Design?

The Bonbright Principles are predicated on **cost-causation,** and allow the following objectives to be achieved

- Equity/minimization of cross-subsidies
- Reduced long-run costs due to more efficient use of the network
- Efficient siting of distributed energy resources (DERs)

Customer considerations will require that strictly cost-reflective tariff designs be modified

- Simplicity / understandability
- Customer acceptance / appeal / perceived fairness
- Mitigating large bill changes / volatility
- Protecting vulnerable customer segments

What Are Some Examples Of Modern Tariffs?

Rate Design	Definition
Critical Peak Pricing (CPP)	Customers pay higher prices during critical events when system costs are highest or when the power grid is severely stressed.
Demand Charges	Customers are charged based on peak electricity consumption, typically over a span of 15, 30, or 60 minutes.
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")
Real-Time Pricing (RTP)	Customers pay prices that vary by the hour to reflect the actual cost of electricity
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.
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.
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.
Fixed bill	Customers pay a fixed monthly bill accompanied with tools for lowering the bill (such as incentives for lowering peak usage)

Is There An Ideal Tariff?

Yes. It would promote economic efficiency and equity by reflecting the cost-structure of generating and delivering electricity. The tariff would have three elements:

- A fixed monthly charge to recover the costs of billing, metering, and customer service
- A demand charge for recovering grid capacity costs
  - Will cover distribution capacity, and optionally transmission and generation capacity costs
  - Based on a combination of non-coincident peak and coincident peak concepts
- A time-varying energy charge for recovering energy costs
  - Could be static or dynamic

What Are Some Of The Places Where Modern Tariffs Are Being Offered?

	Mandatory	Opt-in	Opt-out
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)	Texas	SMUD (California)
Dynamic volumetric rates (CPP, PTR, and RTP)		Oklahoma, Illinois	California

Have Customers Widely Accepted Modern Tariffs?

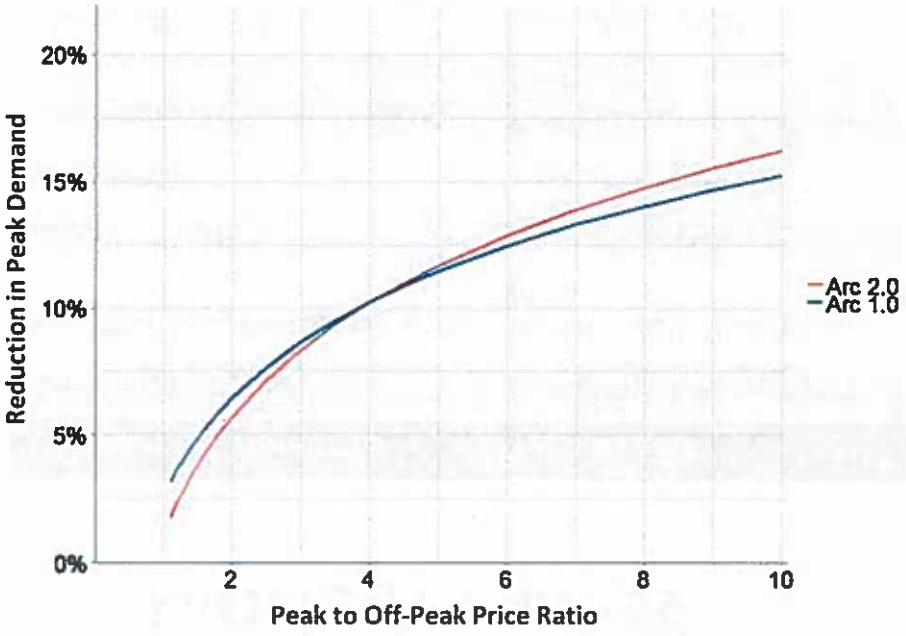
Utility or Location	Type of Rate	Applicability	Participating Customers
Oklahoma Gas & Electric	Variable Peak Pricing (VPP)	Opt-in	20% (130,000)
Maryland (BGE, Pepco, Delmarva)	Dynamic Peak Time Rebate (PTR)	Default	80%
Ontario, Canada	Time-of-Use (TOU)	Default	90% (3.6 million)
Great Britain	Time-of-Use (TOU)	Opt-in	13% (3.5 million)
Hong Kong (CLP Power Limited)	Dynamic Peak Time Rebate (PTR)	Opt-in	27,000
Arizona (APS, SRP)	Time-of-Use (TOU)	Opt-in	57% of APS' residential customers (20% of which are also on a demand charge), 36% of SRP's
California (PG&E, SCE, SDG&E)	Time-of-Use (TOU)	Default (2019)	TBD – 75-90%*
California (SMUD)	Time-of-Use (TOU)	Default	75-90%*
Colorado (Fort Collins)	Time-of-Use (TOU)	Mandatory (for residential)	100%
Illinois (ComEd, Ameren Illinois)	Real Time Pricing (RTP)	Opt-in	50,000
France	Time-of-Use (TOU)	Opt-in	50%
Spain	Real Time Pricing (RTP)	Default	50%
Italy	Time-of-Use (TOU)	Default	75-90%*

*Estimated participation based on historical trends

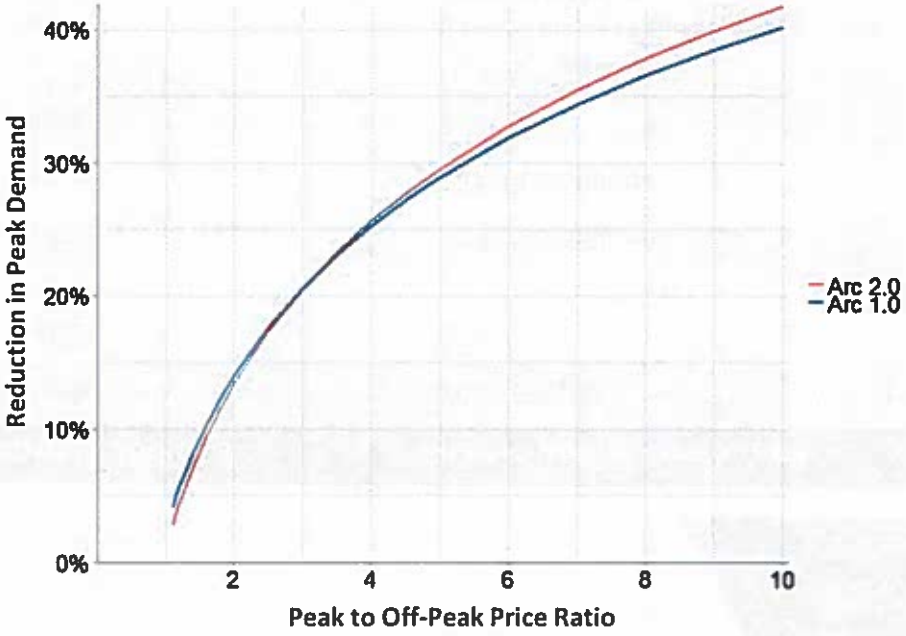
What Has Been The Impact Of Modern Tariffs On Load Shapes?

Evidence from more than 300 deployments worldwide shows that when customers face a strong price signal (a higher on-peak price), they reduce peak electricity usage. And if the price signal is accompanied by enabling technology, they reduce their peak electricity usage even more.

Price Responsiveness without Enabling Technology



Price Responsiveness with Enabling Technology



Note: Arcturus 1.0 is a database of 163 experimental pricing treatments from 34 pilots, originally published in 2013. Arcturus 2.0 is a database of 337 treatments from 63 pilots, published in 2017.

What Is The Best Pathway Moving Forward?

Keep it simple and don't introduce detours

Address two major misconceptions

- Modern tariffs are too difficult for customers to understand
- Modern tariffs will lead to increased customer bills

Don't let these misconceptions perpetuate the status quo

How Have Other Jurisdictions Addressed Transition Impacts For Customers Who Face Higher Bills?

- Rolling out the tariffs on a gradual basis
- Providing bill protection for the first year or two
- Offering the modern tariffs on an opt-in basis, with the clear understanding that one of them will eventually become the default tariff
- Supplementing the tariffs with enabling technologies
- Structuring the tariff in two stages, where the first stage reproduces the current bill, and the second stage is based on the tariff structure

Conclusions

The time has come to modernize tariffs to promote economic efficiency in the utilization of scarce capital and fuel resources and to promote equity between customers

Utilities and commissions need to work together to make this happen

It would be best to lay out a long term vision of the end-state and to go about achieving it through two or three rate case cycles

References

"Status of Residential Time-of-Use Rates in the U.S.," with Ryan Hledik and Cody Warner, *Public Utilities Fortnightly*, November 1, 2018.
https://www.fortnightly.com/fortnightly/2018/11/status-residential-time-use-rates-us

"Net Metering FAQ – Rate design and subsidies," with Steve Mitnick, *Public Utilities Fortnightly*, October 2018.
https://www.fortnightly.com/fortnightly/2018/10/net-metering-faq

"Rate Design 3.0 – Future of Rate Design," *Public Utilities Fortnightly*, May 2018.
https://www.fortnightly.com/fortnightly/2018/05/rate-design-30

"Arcturus 2.0: A meta-analysis of time-varying rates for electricity," with Sanem Sergici and Cody Warner, *The Electricity Journal*, 30:10, December 2017, pp. 64-72.
https://www.sciencedirect.com/science/article/pii/S1040619017302750

"Moving Forward with Tariff Reform," with Mariko Geronimo Aydin, *Energy Regulation Quarterly*, Volume 5, Issue 4, December 2017.
http://www.energyregulationquarterly.ca/articles/moving-forward-with-tariff-reform#sthash.ZADdmZ2h.D2l1yz9z.dpbs

"Innovations in Pricing: Giving Customers What They Want," *Electric Perspectives*, September/October 2017.
http://mydigimag.rrd.com/publication/?i=435343#{"issue_id":435343,"page":42}

"Moving Forward with Electricity Tariff Reform," with Mariko Geronimo Aydin, *Regulation*, Fall 2017.
https://object.cato.org/sites/cato.org/files/serials/files/regulation/2017/9/regulation-v40n3-5.pdf

"Enhancing Customer-Centricity," with Henna Trewn, *Public Utilities Fortnightly*, August 2017.
https://www.fortnightly.com/fortnightly/2017/08/enhancing-customer-centricity

References

"The Paradox of Inclining Block Rates," with Ryan Hledik, and Wade Davis, *Public Utilities Fortnightly,* April 2015.

https://www.fortnightly.com/fortnightly/2015/04/paradox-inclining-block-rates

"Do Americans Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing," with Koichiro Ito, *American Economic Association,* February 2014.

https://www.aeaweb.org/articles?id=10.1257/aer.104.2.537

Presenter Information

AHMAD FARUQUI, PH.D.

Principal | San Francisco, CA

Ahmad.Faruqui@brattle.com

+1.925.408.0149

Ahmad Faruqui is an internationally recognized authority on the design, evaluation and benchmarking of tariffs. He has analyzed the efficacy of tariffs featuring fixed charges, demand charges, time-varying rates, inclining block structures, and guaranteed bills. He has also designed experiments to model the impact of these tariffs and organized focus groups to study customer acceptance. Besides tariffs, his areas of expertise include demand response, energy efficiency, distributed energy resources, advanced metering infrastructure, plug-in electric vehicles, energy storage, inter-fuel substitution, combined heat and power, microgrids, and demand forecasting. He has worked for nearly 150 clients on 5 continents, including electric and gas utilities, state and federal commissions, governments, independent system operators, trade associations, research institutes, and manufacturers.

Ahmad has testified or appeared before commissions in Alberta (Canada), Arizona, Arkansas, California, Colorado, Connecticut, Delaware, the District of Columbia, FERC, Illinois, Indiana, Kansas, Maryland, Minnesota, Nevada, Ohio, Oklahoma, Ontario (Canada), Pennsylvania, Saudi Arabia, and Texas. He has presented to governments in Australia, Egypt, Ireland, the Philippines, Thailand, New Zealand and the United Kingdom and given seminars on all 6 continents. He has also given lectures at Carnegie Mellon University, Harvard, Northwestern, Stanford, University of California at Berkeley, and University of California at Davis and taught economics at San Jose State, the University of California at Davis, and the University of Karachi.

His research been cited in Business Week, The Economist, Forbes, National Geographic, The New York Times, San Francisco Chronicle, San Jose Mercury News, Wall Street Journal and USA Today. He has appeared on Fox Business News, National Public Radio and Voice of America. He is the author, co-author or editor of 4 books and more than 150 articles, papers and reports on energy matters. He has published in peer-reviewed journals such as Energy Economics, Energy Journal, Energy Efficiency, Energy Policy, Journal of Regulatory Economics and Utilities Policy and trade journals such as The Electricity Journal and the Public Utilities Fortnightly. He is a member of the editorial board of The Electricity Journal. He holds BA and MA degrees from the University of Karachi, both with the highest honors, and an MA in agricultural economics and a PhD in economics from The University of California at Davis, where he was a research fellow.