The Rate Design Imperative

Why the Status Quo is not viable

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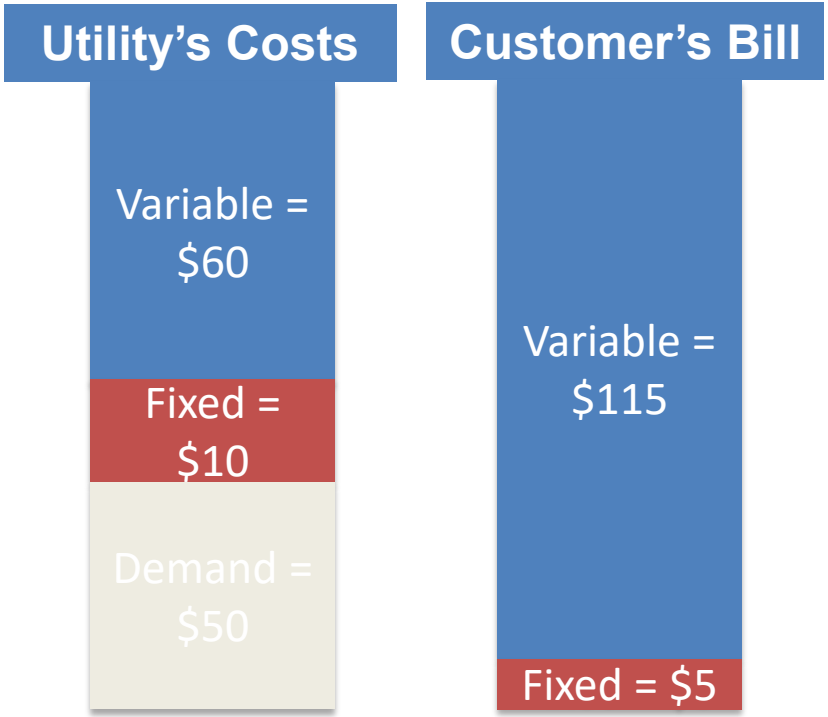
Today, utilities recover revenue for mass market customers primarily through volumetric rates

- Most of the revenue comes from a charge on the consumption of electricity, expressed in $/kWh
  - In most cases, the charge does not vary with time of day
  - In a few cases, it rises or falls with usage
- The fixed charge is nominal in most cases; non-existent in some cases
- Demand charges, ubiquitous for larger customers, are virtually non-existent

There is a mismatch between how revenues are recovered and how costs are incurred

Cost Categories
Variable ($/kWh) - Fuel/gas supply - Operations & maintenance
Fixed ($/customer) - Metering & billing - Overhead
Size-related (demand) ($/kW) - Transmission capacity - Distribution capacity - Generation capacity



Note: Illustrative example for an electric utility.

Why is this an issue?

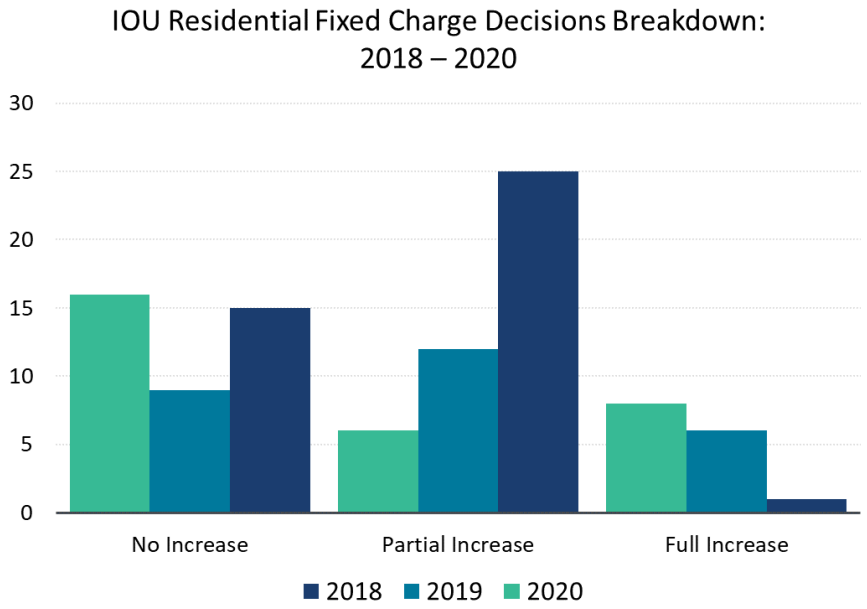
- Electricity consumption has slowed down dramatically from the pre-recession era
- Here are the primary drivers of the slowdown in growth
  - Utility energy efficiency programs
  - Governmental codes and standards
  - Greening of customer tastes
  - Digitalization

Will electrification restore robust growth?

- Electric utilities are promoting EVs and Heat Pumps
- Eventually, these will boost load growth but by how much is uncertain
- We have a long ways to go on electrification
- California has almost half of the EVs in the US
  - But only 2.2% of the cars on the road are EV's even in California
  - The US number is closer to 1%
- Heat pumps face similar challenges
  - They are more expensive than conventional air conditioners
  - They can cost twice as much to operate as gas furnaces

Utilities are seeking to move fixed charges closer to fixed costs

It's proving to be an uphill battle!



Utilities are seeking 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

Utilities are offering time-varying rates (TVR)

According to the US Energy Information Administration, in 2019 **365 U.S. utilities offered at least one form of TVR** to residential customers

- 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)

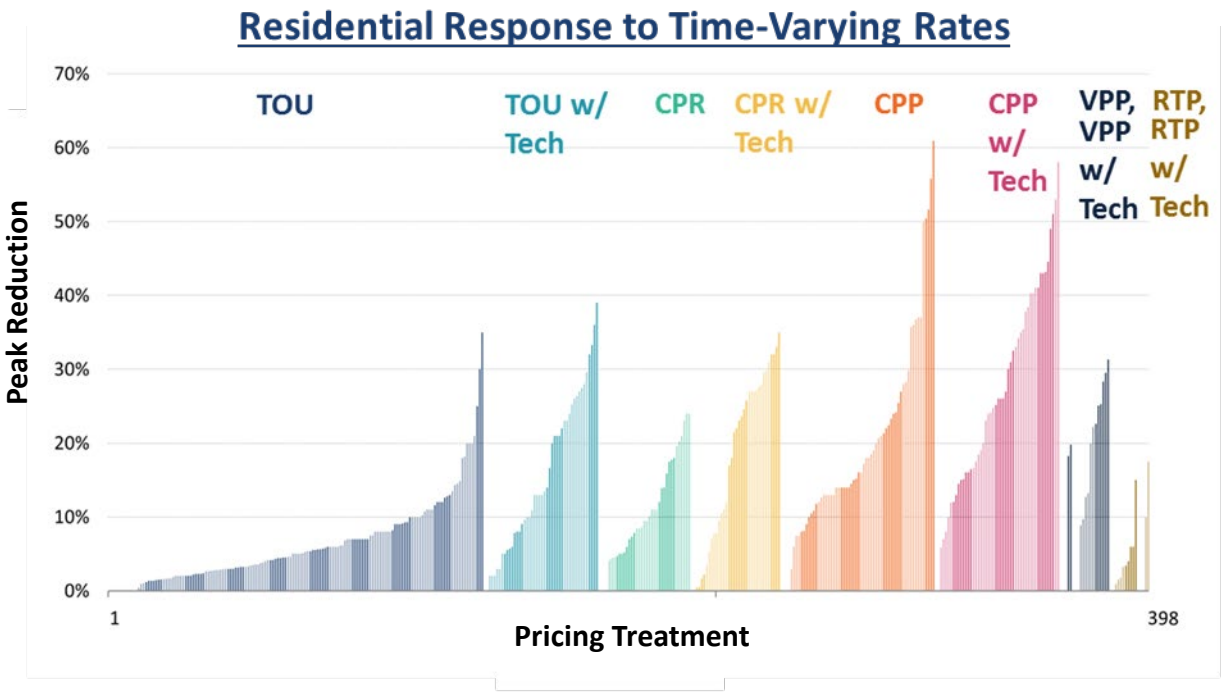
But only 4.5% (6 million) of all residential customers were enrolled on one of these TVRs

By 2025, the percentage of customers on TVRs is expected to rise to 15% as California, Colorado and Michigan move forward with default deployment

Will customers respond to TVRs?

- That question has been debated for decades
- Since the California energy crisis of 2000-1, hundreds of pilots have been carried out across the globe to answer the question
- As of today, we have results on customer response from nearly 400 deployments of TVRs
- We have compiled them into the *Arcturus* database

Arcturus has information on customer response from 398 TVR deployments



Source: Results from 79 pricing pilots and programs and 398 individual treatments in the Arcturus database.

The data in *Arcturus* is drawn from 9 countries

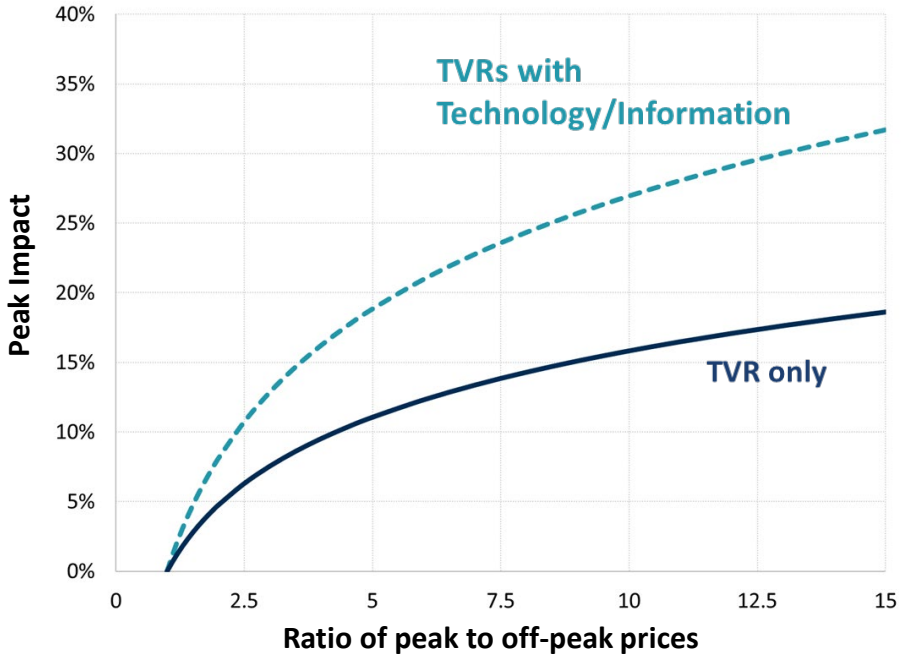
Geography Summary of Arcturus database

Country	N	CPP	TOU	PTR	VPP	RTP
Australia	14	12	2	0	0	0
Canada	50	8	39	3	0	0
Hong Kong	8	0	4	4	0	0
Ireland	16	0	16	0	0	0
Italy	1	0	1	0	0	0
Japan	12	8	0	0	4	0
New Zealand	3	0	3	0	0	0
United Kingdom	4	1	3	0	0	0
United States	279	79	127	62	11	11
Total	**398**	**108**	**195**	**69**	**15**	**11**

Source: Results from 79 pricing pilots and programs and 398 individual treatments in the Arcturus database.

Customer response rises with the price ratio but at a diminishing rate; technologies and behavioral messaging boost response

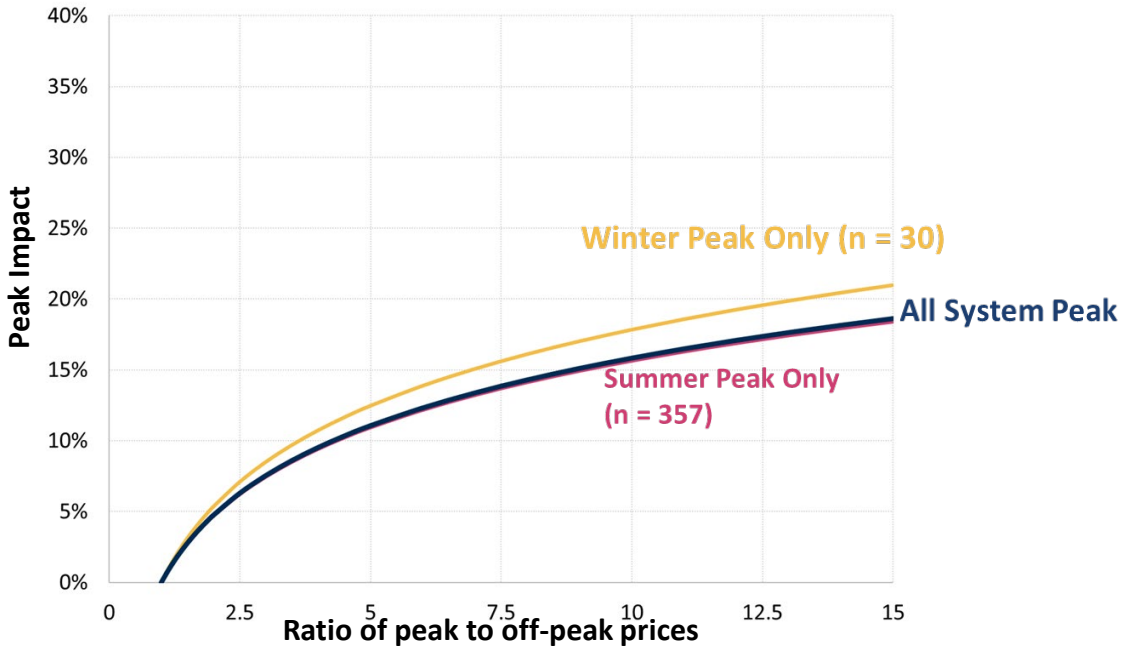
Arc of Price Response: TVR Only vs. TVR+Tech/Info



Notes: Data from 74 pilots and programs and 387 individual treatments. RTP treatments are excluded.

Surprisingly, winter peak impacts are higher than summer peak impacts!

Arc of Price Response by Peak (Without Technology)



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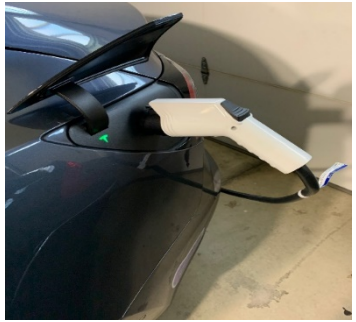
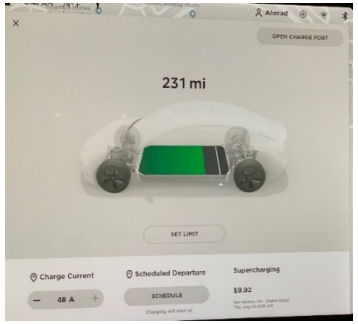
What lies ahead?

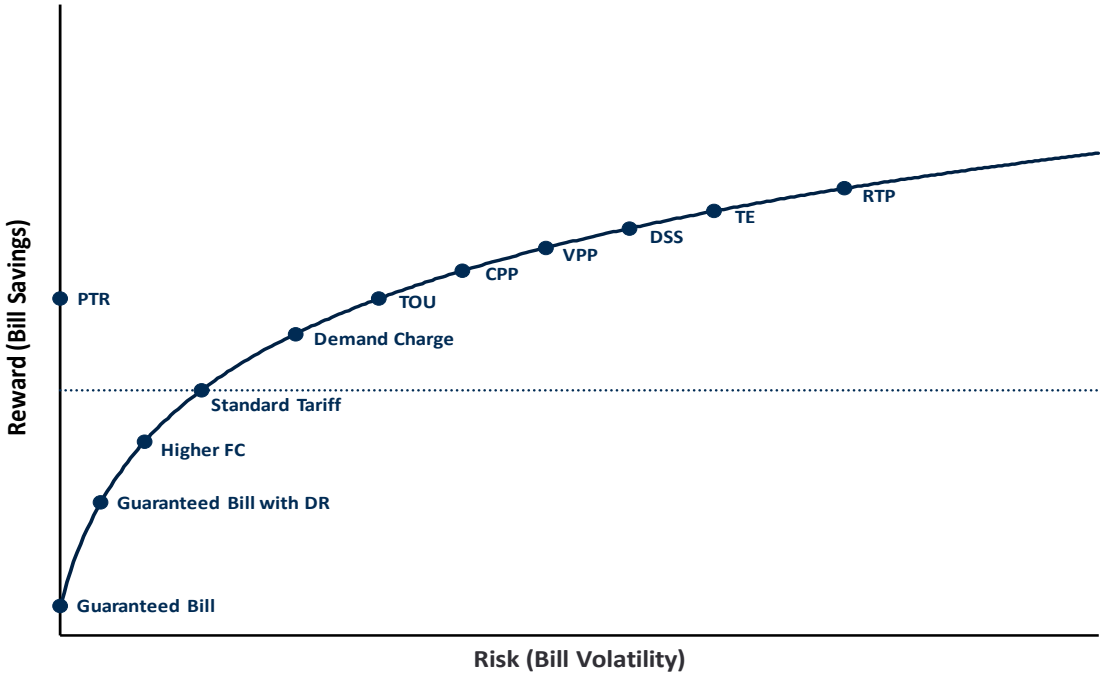
- Events like the August blackouts in California and the February blackouts in Texas remind us that we need more price-responsive demand
- TVRs will become more widely deployed around the globe
- RTP will begin to be deployed to residential customers once prices are paired with devices
- Subscription plans will be offered, often paired with demand response programs to lower bills
- DERs will begin to be integrated with innovative pricing designs

Yesterday’s customer is today’s prosumer and tomorrow’s prosumager





Utilities will begin offering choices to customers



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
  - A second driver is the greening of customer tastes
  - Another driver is the desire by customers to have choices in rate design
  - 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

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.

"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.

"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.

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

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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.