A WALK ALONG THE RATE DESIGN FRONTIER

A NOONTIME TALK AT THE BERKELEY LAB

PRESENTED BY

Ahmad Faruqui, Ph. D.

DECEMBER 10, 2021

Brattle

Foreword

The deck you are about to read is part memoir and part professional history.Much of what I say is based on first-hand observations as an energy economist who has been pounding the pavement on rate design on six continents for four decades. Once in a while, I felt like I was journeying into the future. Most of the time I felt like I was pushing a boulder uphill. Sometimes I felt like I was caught in a time warp. At other times, I felt like I was in an echo chamber, with everyone nodding their heads. Then there were those moments when I felt like I was in a chamber of horrors.

I am also a consumer of energy and have tried a variety of rate designs, demand response programs and energy efficiency programs over the years. Currently, I am on a three-period time-of-use (TOU rate). To cope with rising costs, I did a major home house energy upgrade in 2016. I installed a SEER 18, 4-ton five-speed variable speed compressor a/c system and a 97% efficient gas furnace, thoroughly insulated my attic, installed two attic fans, and reduced duct leakage down to 8%. The house has double-glazed windows. The bills went down but not enough. Three years later, I installed 25 solar panels (8 kW) and paired them with a battery (9.8 kW). I also bought a Model 3 (long range) and installed a Level II charger.

I entered the field of rate design in 1979 …

… when I joined the Electric Utility Rate Design Study (EURDS) as a project manager

W. Eric Gustafson, the professor who had brought me into UC Davis, from where I had earned my doctorate, said: "Ah, you will become a public utility economist"

- I did not even know what that term meant

The EURDS was being run by the Electric Power Research Institute (EPRI) on behalf of the National Association of Regulatory Utility Commissioners (NARUC)

- It was directed by a Project Committee comprised of commissioners and utility vice presidents – at one point, it was headed by the legendary Fred Kahn, who chaired the New York Public Service Commission
- R. Robert Malko, a former Staff Economist from the Wisconsin Commission managed it and was my boss

Several advisory committees guided the work

- The committees included representatives from all three utility trade associations -- APPA, EEI and NRECA – and state commissions

The EURDS focused on time-of-use (TOU) rates

The PURPA legislation of 1978 was the driving force behind the EURDS

The EURDS went through four phases and published nearly a hundred reports

- I was involved in the second phase but kept on tracking its work for the next two phases

Everyone of the EURDS advisers agreed that TOU rates should be cost reflective, in accordance with the Bonbright principles

- However, there was little agreement on whether they should be based on marginal or embedded costs

There was universal agreement that a big barrier to implementing TOU rates was the absence of interval metering

- Some utilities went ahead and installed interval meters
- A few utilities deployed TOU rates on a mandatory basis for their large commercial and industrial customers

Load research was emphasized along with cost-benefit analysis

Customer acceptance and response were deemed critical

The Federal Energy Administration (later the US Department of Energy) under President Jimmy Carter funded more than a dozen pilots to test customer acceptance of and response to TOU rates

I published a report for the EURDS (Topic Paper 1, Phase II, EURDS 84) showing that the FEA experiments provided evidence that customers lowered their on-peak usage by curtailing it and/or shifting it to off-peak periods, thereby improving load factor and lowering costs

Later, I managed a project where we took the data from the five best experiments and developed a model that utilities that had not carried out their own pilot could use for simulating the likely impact of TOU rates

- It was called RETOU
- The model languished, like a rarely visited curiosity in the Smithsonian Institution

Demand Side Management (DSM) entered the room

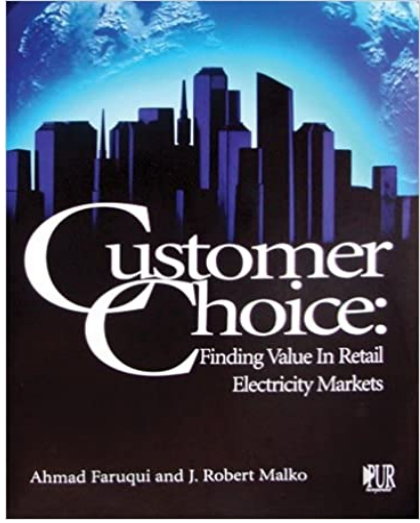
It was designed to help lower customer bills which were spiraling upwards due to the oil crises

The focus of regulation shifted toward designing DSM programs, analyzing their cost effectiveness, implementing them and evaluating their impacts

A whole new industry was created comprised of consultants, contractors and policy wonks

Rate design reform was moved to the back seat

In the late 1990's, Retail Choice eclipsed DSM



There was much excitement in the market

Customers thought they would instantly see lower bills

Now it was DSM that took a back seat

Many utilities restructured themselves, created a parent company, divested themselves of their generation assets, created subsidiaries that were generators, retailers or both

New entrants such as Enron Energy Services entered the room to great acclaim

The California energy market exploded in 2001

That crisis revealed a big fissure between retail and wholesale markets

It spurred interest in dynamic pricing which would induce demand response and help balance demand and supply

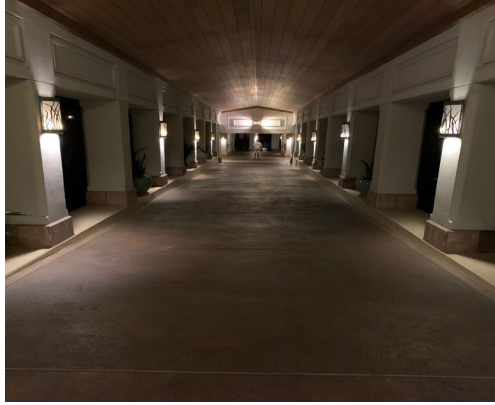
Utilities experimented with dynamic pricing, initially in California, then in Connecticut, Maryland, Florida and Illinois

- In a decade, experiments were being carried out in several other states
- DOE funded several pilots with different forms of dynamic pricing and TOU rates

Digital (“Smart”) meters began to replace analog meters

- Ontario, Canada proceeded with default deployment of TOU rates for all customers with digital meters
- Puget Sound Energy (PSE) in the state of Washington moved some 300,000 residential customers on default TOU rates (they had automated meter reading capability)
- California’s investor-owned utilities began replacing analog meters with smart meters in the late 2000’s but did not move them to default TOU rates (That would not happen until 2020)

Other considerations appeared in the late 2000's



The Great Recession of 2008-09 significantly slowed down sales growth

- Unlike prior recessions, sales growth did not return to pre-recession levels even after a year

Utilities sought to raise fixed charges and introduce demand charges to ensure recovery of customer service and capacity costs

- Interveners successfully opposed these changes in most cases

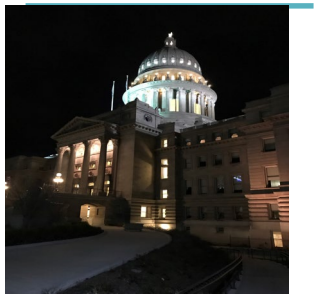
Distributed energy resources (DERs) made their appearance, threatening to further erode the viability of the utility business model which was premised on volumetric recovery of revenue

Utilities had one more reason to raise fixed charges and introduce demand charges

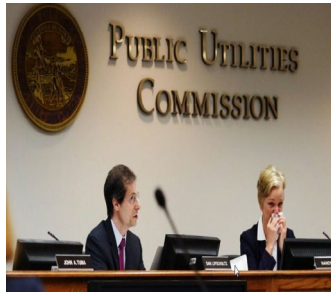
Many rate cases were filed to bring about those changes

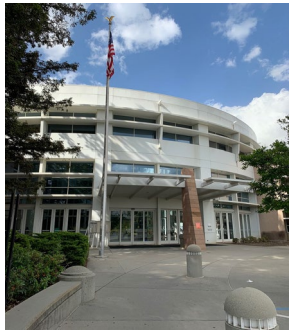
- Failures outnumbered the successes

I began testifying on rate design issues in 2005














Where do we stand today?

More than 100 million customers have smart meters

- But less than 10 million customers are on a time-varying rate

By 2025, 15 percent of customers may be on time-varying rates

- The increase is primarily coming from default deployments of TOU rates in California, Colorado and Michigan

That's still a long ways from where we need to be to encourage the participation of renewable energy resources into the grid

- Of course, we need to go far beyond TOU rates to promote dynamic load flexibility

However, dynamic pricing remains a hard sell

- A one-day conference was held on the ethics of dynamic pricing at Rutgers University in 2010
- Consumer advocates continues to think time-varying rates will hurt low income customers
- Peak-time rebates have been introduced to address their concerns
- Fixed bills are being offered to bring peace of mind to customers

Ten lessons emerge as I look back TO 1979

1. Design rates based on cost causation
2. Engage with stakeholders early in the process
3. Design customer-centric rates
4. Market the new rates
5. Test the new rate designs through pilots
6. Decide on your deployment strategy
7. Seek a settlement with stakeholders
8. It’s mostly politics
9. It’s virtually impossible to please everyone when you change rates
10. Everyone’s an expert on rate design

Lesson #1: Design rates based on cost causation

Such rates will enhance economic efficiency and promote equity between customers

- Base the rates on a current cost of service study
- Make sure that the cost of service study includes results from recent load research studies by customer class
- Integrate marginal cost signals in rate design to the maximum extent possible

In practice, some utilities follow this rule, many don't

- Some use really old cost of service studies that are based on even older load research studies
- Some design rates to promote specific technologies (not a good idea, use rebates to promote technologies)
- Some design rates to promote other social goals (not a good idea, use the tax code to promote social goals)
- All deviations from cost of service carry unintended consequences (they will haunt you for years)

Lesson #2: Engage with stakeholders early in the process of designing rates

- Identify your stakeholders
  - Err on the side of being more inclusive rather than less inclusive
  - A stakeholder is anyone who represents an important viewpoint on rate design
  - Be sure to include all parties that have participated in prior rate cases
- Organize stakeholder meetings to identify their rate design objectives
  - Use the nominal group technique and the scorecard method to identify areas of convergence and divergence
  - This technique ensures that all stakeholders will participate in the discussion
- Organize a second round of stakeholder meetings to prioritize rate designs
  - Identify which rate design best meets which rate design objective
  - Develop a path for moving forward with rate design reform

Lesson #3A: Design customer-centric rates

If the rates don’t appeal to customers, they won’t take them

- Most customers want to reduce their bills
- Some want to help promote a cleaner environment
- Some want bill stability
- Others are willing to be flexible in how they use energy in order to lower their bills
- Choices of tariffs should be offered to customers, since no two customers are alike
  - Most utilities don’t do that today; a few are beginning to offer choices (more on this later)
- For each tariff, the design should be customer-centric, not utility-centric
  - Most tariffs are couched in language that customers can’t understand
  - Customers can’t respond to rates unless they understand the rates

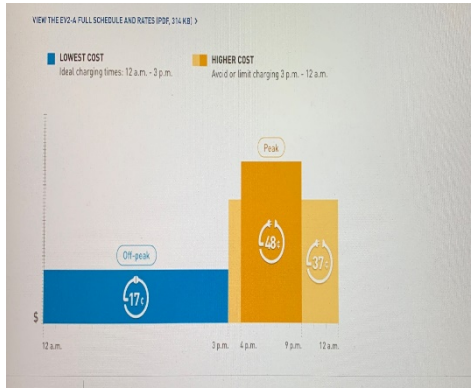
Lesson #3B: Design customer-centric rates

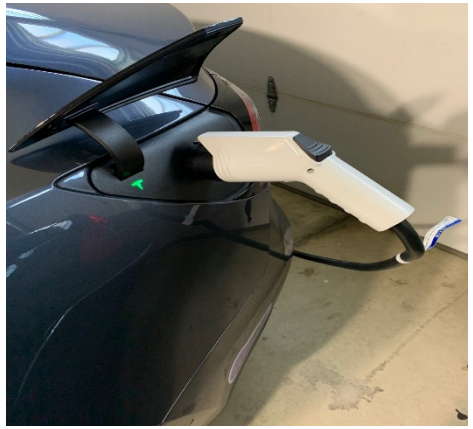
- As an example, when designing a TOU rate, don't have a peak period that covers most of the day
  - For years, on-peak periods tended to run for 12—16 hours
- Ensure there is a significant savings opportunity for customers by ensuring that the off-peak rate is substantially lower than the on-peak rate
  - Several TOU rates violate this precept and thus few customers take them
  - To create substantial savings opportunities, some utilities have allocated a substantial portion of generation capacity costs to the on-peak rate
  - Some utilities use marginal costs to estimate the relationship between on-peak and off-peak costs and then scale up the values to recover embedded costs; this usually yields significant savings opportunities for customers
  - In the late 2000's, Ontario, Canada rolled out default TOU rates but with a small price differential; Around 2001, PSE had made the same error (https://www.power-grid.com/news/why-time-ran-out-on-pses-time-of-use-program/).
- When designing a rate with demand charges, some utilities make them customer-friendly by not basing them on maximum non-coincident peak demand but basing them on maximum demand during the on-peak period

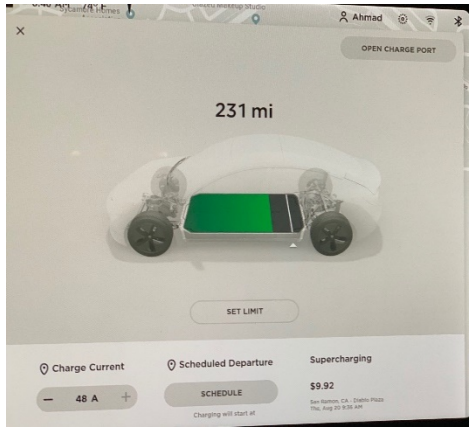
Lesson 3C: Design customer-centric rates

- Solicit customer input on key design features
  - For example, while designing TOU rates, should there be two or three TOU periods?
    - What should be the duration of the on-peak period?
    - Should the rate be offered year round or just during the peaking season?
    - Should the rate be paired with a smart thermostat?
    - How much lower should be the off-peak rate relative to the on-peak rate?
- Reach out to customers via focus groups and interviews
- Follow up with a comprehensive survey that allows you to read the customer's mind; i.e., identify and quantify the trade-offs that customers are willing to make between design features
  - This is most often carried out through conjoint analysis, a widely used market research technique in virtually all industries
  - Some of the best rates in the country have been designed through conjoint analysis

Lesson 3D: Today's consumer will most likely be tomorrow's prosumer and day-after-tomorrow's prosumager



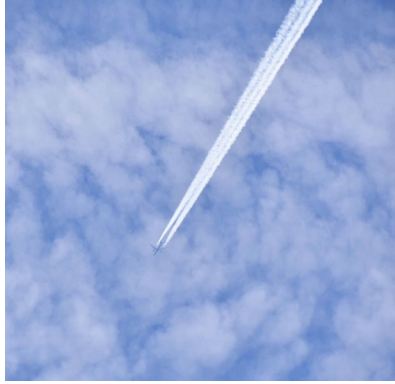


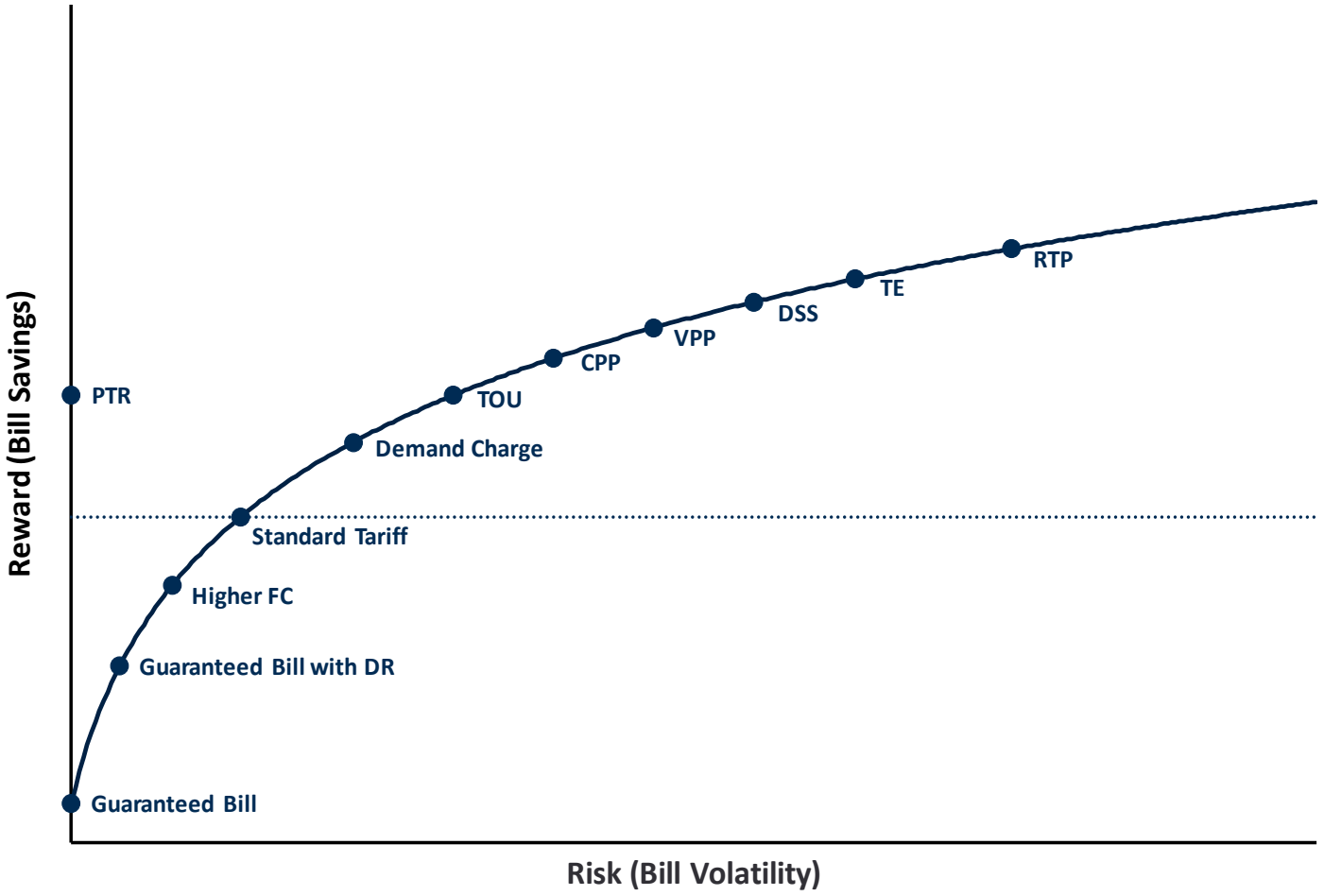


Lesson 3E: Offer rate design choices

- Make sure there are meaningful differences between the choices
- Some customers will be willing to change their load shape if that will lower their bills but would like the same rates across days within a season
  - They would go for a time-of-use rate
- Others may want to go a step further and be willing to change their load shapes on short notice
  - They would prefer a dynamic pricing rate
- Still others may want a guaranteed bill and be willing to pay a premium for bill stability
- Finally, some may be willing to pair their guaranteed bill with a peak-time rebate and curtail usage during critical times

Lesson 3F: Let customers choose the rate design that best meets their needs





Lesson #4: Market the new rates

- Don’t just file the tariff in a rate case and put it on your website
  - An amazing number of utilities do this today
  - They fear the only customers who will take the new rates will be those who will get lower bills just by switching rates
  - It’s no surprise that most utilities only get 1% of their customers to adopt the rate
- Do a strong and vibrant customer outreach campaign that harnesses the power of social media, the news media and talk shows to get the word out
  - Enlist celebrities in promoting the rates
  - Consider putting information about the new rates on billboards next to highways – at least one utility has done this very successfully
    - One utility created murals about families living with the tariff on their main building
- Place customer-friendly content on your website (including videos) and find ways to attract customers to the website
  - More and more utilities are beginning to do this
  - Keep the messaging simple

Lesson #5: Test the new rate designs through pilots

But make sure they don't become an end in themselves

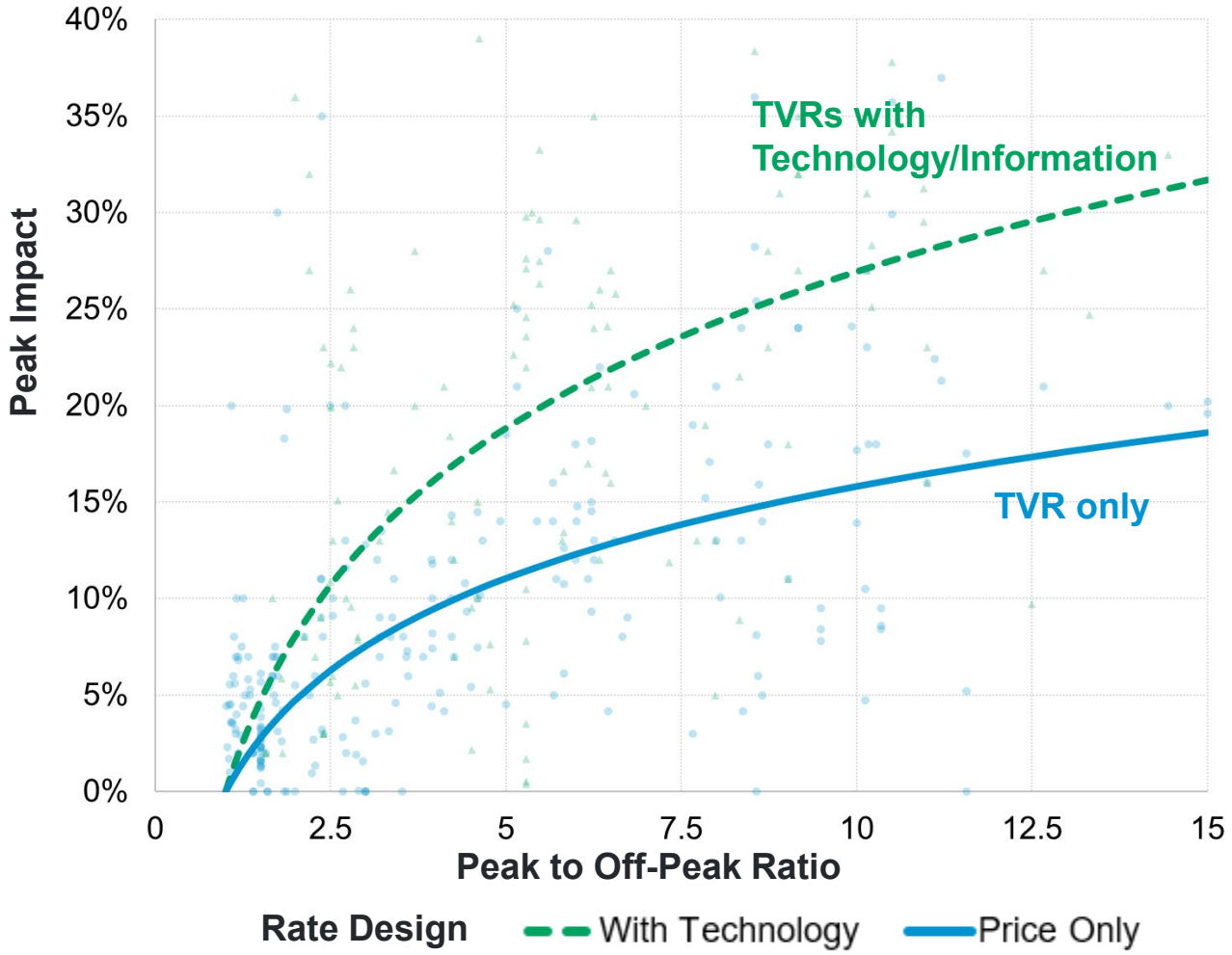
- That's happened in more than one case
- The only purpose of a pilot should be to fine tune the rate design prior to launching it

Design the pilots in such a way that the results can be generalized to the population of interest

- This involves following the scientific principles of experimental design
- These principles are routinely followed in clinical trials of new drugs
- A "treatment" group (which will be placed on the new rate) is randomly selected; a control group is paired with it
- Customer usage is observed before and after the treatment (i.e., the new rate) has been offered; these measurements are carried out for both the treatment group and the control group and a difference-in-differences estimate is derived of the response of customers to the new rate

Of course, there are several instances of well-designed pilots and they have yielded valuable insights – see the next slide

Lesson 5: Customers respond to price: technologies and information boost response



Lesson #6: Pick your deployment strategy

There are three options

- Opt-in
  - Is the most frequent option
  - Yields higher savings per customer
  - Usually results in enrollment rates in the 20% range
  - Always runs the risk of losing revenue because only the instant winners sign up
- Opt-out (or default)
  - Has lower marketing costs than opt-in deployment
  - Generally yields lower savings per customer
  - Usually results in enrollment rates upwards of 80% and higher aggregate impacts
  - Is often very difficult to pull off for political reasons
- Mandatory
  - If done well, will yield the highest savings in the aggregate
  - Virtually impossible to implement

Lesson 7: Seek a settlement with stakeholders

If Lesson 2 has been heeded, it should not be too difficult arrive at a settlement

If unanimity is not possible, strive to arrive at a settlement with as many parties as possible

Here's a clip from a recent decision by the Nova Scotia Utility and Review Board(M09777, June 21, 2021)

"As stated by the Board in other proceedings, the Board welcomes settlement discussions, particularly when they result in an agreement widely supported by various parties to the proceeding, as is the case with respect to this agreement. The Board considers a properly structured settlement a success of the litigation process. That is particularly the case when dealing with new innovative rates undertaken in a pilot which will be reviewed at the end of a two-year period."

Lesson 8: It’s mostly politics

In October 2019 I was asked by opposing counsel whether rate design was a subject in which reasonable people could disagree. I.e., whether it was as much art as science

I said, “It’s mostly politics”

- The hearing room burst into laughter

A year or two prior, after I had testified in another rate case, a senior staff economist walked with me to my car and said, “That was great economic analysis. But I have to tell you, they are just going to kick the can down the road”

So don’t let delude yourself into thinking that all that economic and engineering analysis will prevail in the end

Lesson 9: It’s virtually impossible to please everyone

With any change in rates, there will be winners and there will be losers

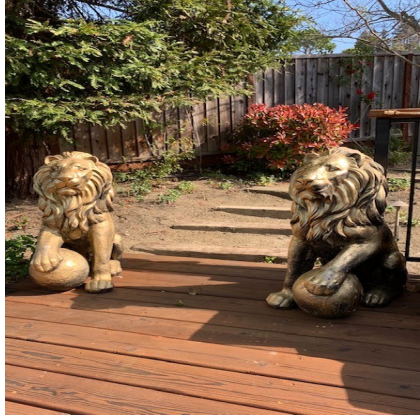
- The winner won’t talk about their winnings to the media
- The losers will be infuriated and will air their views loudly and vociferously

Thus, whenever I am beginning to feel elated about a new rate design, I remind myself of this quote from a book that was in Dad’s collection

“There has never been any lack of interest in the subject of electricity tariffs. Like all charges upon the consumer, they are an unfailing source of annoyance to those who pay, and of argument in those who levy them. In fact, so great is the heat aroused whenever they are discussed at institutions or in the technical press, that it has been suggested there should be a “close season” for tariff discussions. Nor does this interest exaggerate their importance. *There is general agreement that appropriate tariffs are essential to any rapid development of electricity supply, and there is complete disagreement as to what constitutes an appropriate tariff.*”

— D.J. Bolton, Costs and Tariffs in Electricity Supply, 1938

Lesson 10: Everyone is an expert on rate design



It’s not just the stakeholders in the ratemaking process

It’s everyone out there including friends, neighbors and relatives

It’s the contractors who install HVAC equipment, the mailman, the waiter in the restaurant, even the person sitting next to you on the plane

Anyone, in other words, that you talk to about rates will seek to convince you that you are wrong and they are right

Don’t be deluded into thinking that your degrees and qualifications will impress them

Additional Readings

I began writing on rate design in 1983

"The residential demand for electricity by time-of-use: A survey of twelve experiments with peak load pricing," with J. Robert Malko, Energy, Volume 8, Issue 10, October 1983, Pages 781-795

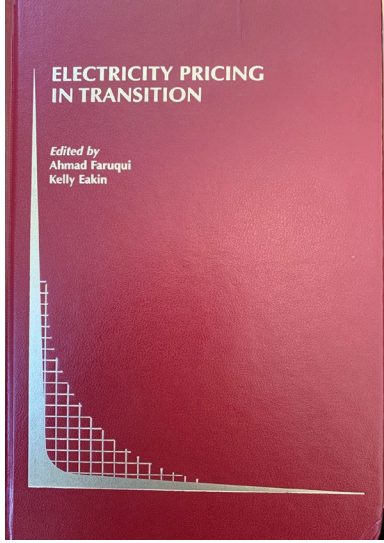
Here is what I have written since 2015 on rate design.

"The Battles over Net Energy Metering," *Energy Regulation Quarterly*, vol. 9, issue 2, July 2021, with Agustin Ros and Gordon Kaiser.

"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, with Cecile Bourbonnais.

Selected papers on rate design



"Refocusing on the consumer," *Regulation*, vol. 41, no. 1, Spring 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.

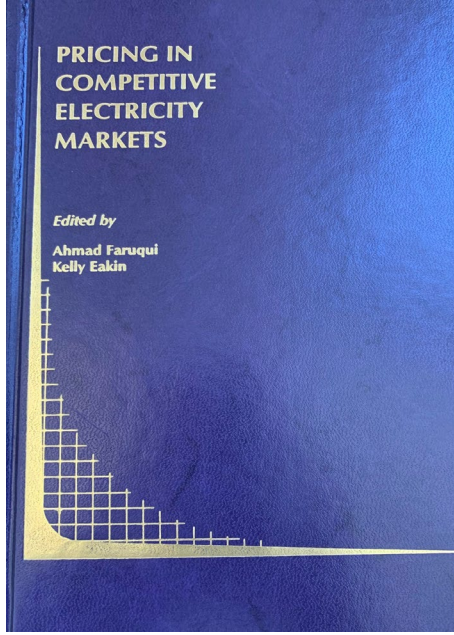
"Rate Design 3.0 – Future of Rate Design," *Public Utilities Fortnightly*, May 2018.

"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.

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

Selected papers … (concluded)



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

"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, with Ryan Hledik.

APPENDIX

A POCKET HISTORY OF RATE DESIGN

A Pocket History of Rate Design

Year	Author	Contribution
1882	Thomas Edison	• Electric light was priced to match the competitive price from gas light and not based on the cost of generating electricity
1892	John Hopkinson	• Suggested a two-part tariff with the first part based on usage and the second part based on connected kW demand
1894	Arthur Wright	• Modified Hopkinson's proposal so that the second part would be based on actual maximum demand
1897	Williams S. Barstow	• Proposed time-of-day pricing at the 1898 meeting of the AEIC, where his ideas were rejected in favor of the Wright system
1946	Ronald Coase	• Proposed a two-part tariff, where the first part was designed to recover fixed costs and the second part was designed to recover fuel and other costs that vary with the amount of kWh sold
1951	Hendrik S. Houthakker	• Argued that implementing a two-period TOU rate is better than a maximum demand tariff because the latter ignores the demand that is coincident with system peak
1961	James C. Bonbright	• Published "Principles of Public Utility Rates" which would become a canon in the decades to come

A Pocket History of Rate Design (Concluded)

Year	Author	Contribution
1971	William Vickrey	• Proffered the concept of real-time-pricing (RTP) in *Responsive Pricing of Public Utility Services*
1976	California Legislature	• Added a baseline law to the Public Utilities Code in the *Warren-Miller Energy Lifeline Act*, creating a two-tiered inclining rate
1978	U.S. Congress	• Passed the *Public Utility Regulatory Act (PURPA)*, which called on all states to assess the cost-effectiveness of TOU rates
1981	Fred Schweppe	• Described a technology-enabled RTP future in *Homeostatic Control*
2001	California Legislature	• Introduced *AB 1X*, which created the five-tier inclining block rate where the heights of the tiers bore no relationship to costs. By freezing the first two tiers, it ensured that the upper tiers would spiral out of control
2001	California PUC	• Began rapid deployment of California Alternative Rates for Energy (CARE) to assist low-income customers during the energy crisis
2005	U.S. Congress	• Passed the *Energy Policy Act of 2005*, which requires all electric utilities to offer net metering upon request

Presented By

Ahmad Faruqui

PRINCIPAL | SAN FRANCISCO

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 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 tech companies.

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, Missouri, Nevada, Ohio, Oklahoma, Ontario (Canada), Pennsylvania, Saudi Arabia, and Texas. He has presented to governments in Australia, Egypt, Ireland, 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.