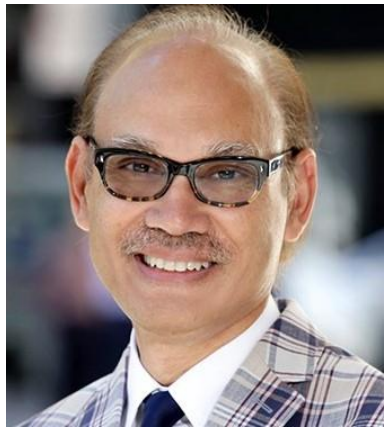
Customer Driven Rate Design: The Wave of The Future

Special Guest: Ahmad Faruqui, Ph.D, Principal, The Brattle Group
Dave Wells, Director, Apogee Interactive, Inc.

Our Speakers:



Dr. Ahmad Faruqui specializes in smart grid strategies involving the consumer. His expertise includes demand forecasting, innovative rate design, energy efficiency, demand response, advanced metering infrastructure, technology assessment, and cost-benefit analysis.

He has worked for nearly 150 clients on five continents. These include electric and gas utilities, state and federal commissions, independent system operators, government agencies, trade associations, research institutes, and manufacturing companies.

Dr. Faruqui 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, ECRA (Saudi Arabia), and Texas. He has presented to governments in Australia, Egypt, Ireland, the Philippines, Thailand and the United Kingdom and given seminars on all 6 continents.

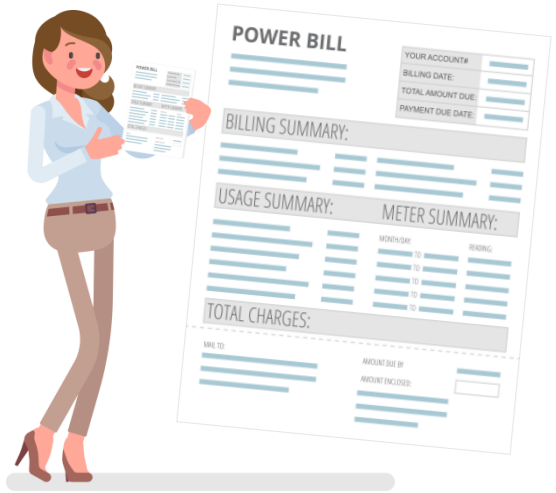
Dave Wells, has more than 25 years experience in the utility and energy industry. His expertise spans across numerous areas including utility and enterprise SaaS solutions, customer engagement, demand response and capacity resource management, renewable energy resources, energy efficiency and data analytics, engineering, and regulatory rules and regulations. Dave began his career in the energy industry with National Grid where he worked in engineering and key account management roles for over 13 years. From there Dave expanded and grew his business development career to deliver significant value and direct savings to large C&I customers and utilities across the country and internationally. Dave has been delivering strong value propositions to all customer classes across the energy universe and will utilize his experience and industry knowledge to drive significant value for Apogee and our utility clients.

The 3-Rs of Apogee

Customer Relationship Programs

Program Lists
Bill Explanation
Service Messaging

Rate Transformation Programs



Program Lists
TOU
Demand

Revenue Enhancement Programs

Program Lists
Beneficial Electrification
Recommendations
Online Store

Customer-Driven Rate Design: The Wave of the Future

PRESENTED BY
Ahmad Faruqui, Ph.D.
925-408-0149

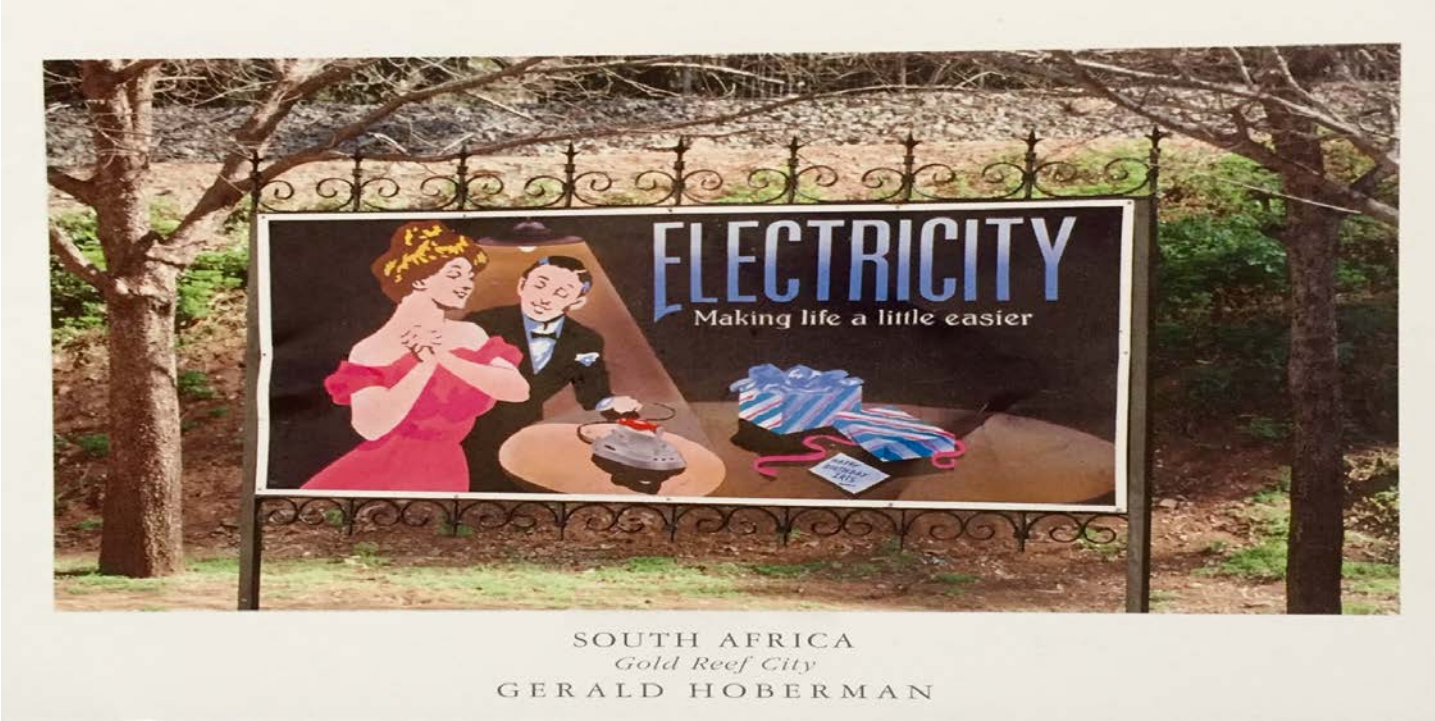
April 25, 2019

THE Brattle GROUP

In 1951, originality in rate design was questioned

"The vast literature on electricity tariffs shows so many different views that it would be difficult to be original in proposing tariff changes."

-Hendrik Houthakker, 1951

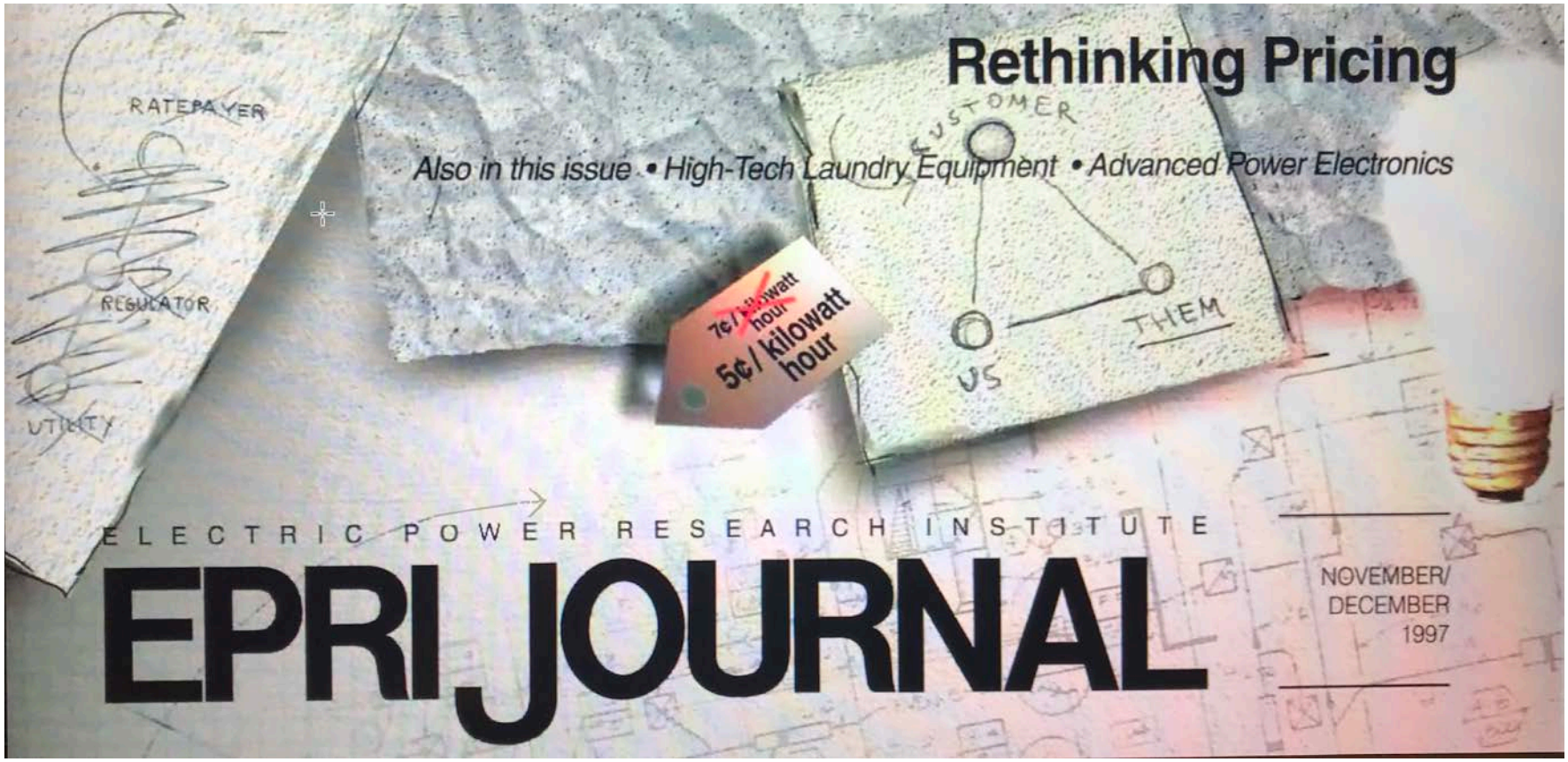


In 1976, NARUC asked EPRI to launch the Electric Utility Rate Design Study

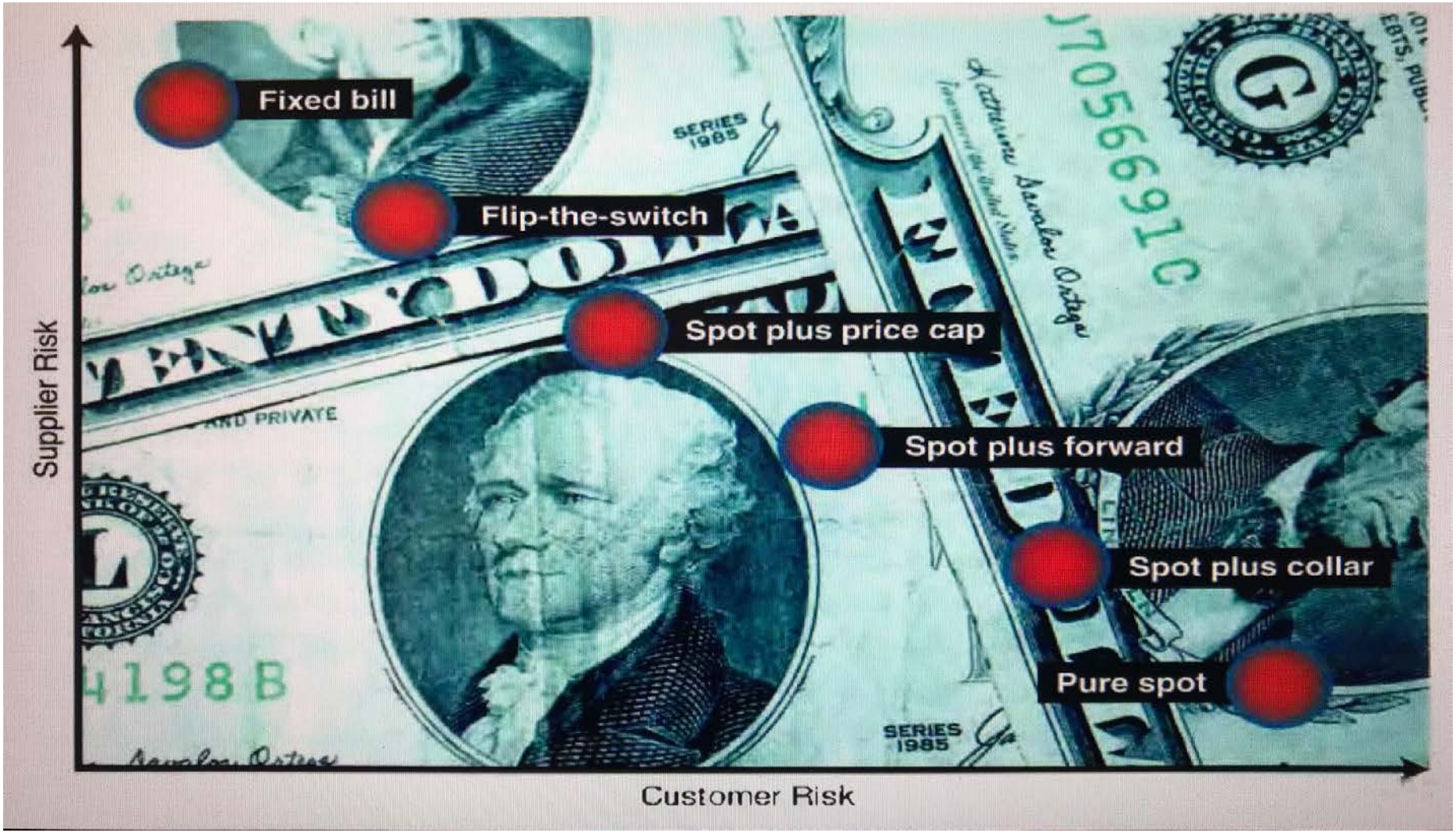
"The consumer pressures exist, the equipment is being developed, and the costing methods are being studied for setting rates in localized applications. Considering the rapidly evolving economic and political realities, this airing of costing concepts and ratemaking principles, as well as the evaluation of new technology for load management, seems both necessary and prudent."

-Robert Uhler, Executive Director, Rate Design Study, 1976

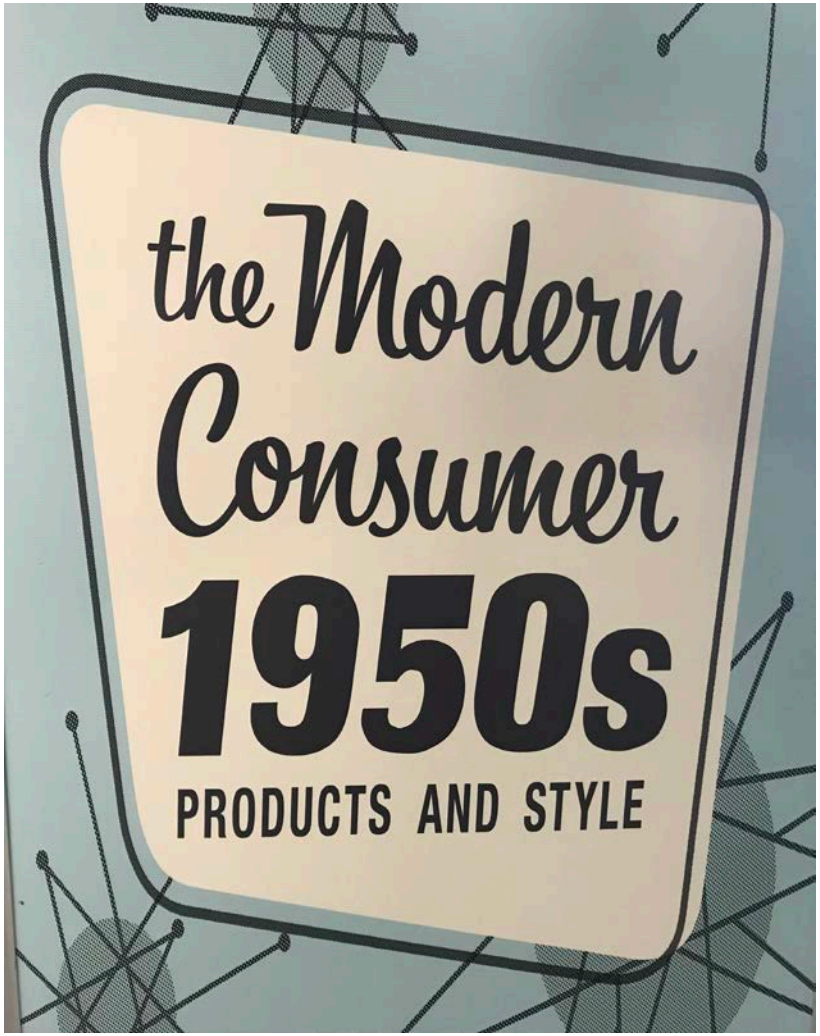
In 1997, EPRI published an essay on the need to modernize rate design



The choices would trade-off supplier risk against consumer risk



In 2019, what was modern in 1950 is no longer modern



The "post-modern" customer is totally different from the "modern" customer of the 1950's

The post-modern customer has the following features:

- Smart meters and web portals
- Wi-Fi thermostats
- High-efficiency air conditioners and other appliances, often with Wi-Fi capability
- Digitally-controllable LEDs
- Some have PVs or are considering their installation
- Some have EVs or are considering their purchase
- The Millennials want clean air and better control of their energy lifestyles
- Who knows what Generation Z will want

We stand at the cusp of a revolution in rate design

Arizona

- 20% of customers on opt-in demand charges for one utility
- Mandatory demand charges for DG customers for another utility
- TOU energy rates popular for both

British Columbia

- One of two utilities has been authorized to consider eliminating its inclining block rates
- The other utility is considering doing the same

Revolution in rate design – 2

California

- Mandatory TOU rates plus minimum bill for DG customers
- The investor-owned utilities are moving all other customers to default TOU in 2019/20
- SMUD has begun moving its customers to default TOU
- LADWP has introduced a fixed monthly charge that varies with customer kWh usage

Colorado

- Fort Collins has moved all customers to mandatory TOU rates
- Default deployment of TOU rates is being considered by the investor-owned utilities
- IBRs seem to be on the way out

Revolution in rate design – 3

Idaho

- DG customers have been designated a separate rate class
- Details of the rate are being worked out

Kansas

- Mandatory three-part rates for DG customers; opt-in for others

Maryland

- BGE and PHI have deployed opt-out peak-time rebates (PTR) for several years
- More than 75% of customers are receiving rebates
- The state has initiated a new opt-in TOU pilot which will involved substantial LMI customer participation (PC 44 proceedings)

Revolution in rate design – 4

Montana

- Northwestern Energy has filed for designating DG customers as a separate rate class and for moving them to mandatory three-part rates

New York

- The state is considering moving DG customers to demand charges or TOU energy rates or a combination

Oklahoma

- 20% of customers on a dynamic pricing rate that is paired with a customer-controlled smart thermostat

Revolution in rate design – 5

Ontario, Canada

- Flat bills for distribution costs have been introduced for the nearly 70 local distribution utilities over a four-year period
- TOU charges for default energy supply
- 90% of residential and small commercial and industrial customers are on the default TOU rate for energy

Revolution in rate design: EU

Estonia

- Thousands of customers on a real-time tariff
- It's the default energy supply option

Italy

- Millions of customers are on a default TOU rate

Spain

- Millions of customers are on a real-time pricing tariff
- It's the default energy supply option

Revolution in rate design: Great Britain

UK Power Networks in London is piloting a peak time rebate (PTR) targeted specifically at low-income customers

A couple of pilots have tested other types of time-varying rates

- One rate featured a “wind twinning” tariff, which was intended to encourage consumption increases/decreases at times of unexpectedly high/low output from wind generation
- Some of the rates tested were dynamic in nature

Ofgem, the regulator, is examining new ways to increase the role of price-responsive demand

Revolution in rate design: Great Britain – 2

13% of customers are on a TOU rate (Economy 7) designed for customers with thermal energy storage

- The rate that has been offered for many years, is based on old technology, and the number of participants is in decline, but provides a conclusive evidence of customer acceptance and response to time-varying tariffs

A start-up retailer has introduced a TOU tariff with a strong price signal

British Gas offers a FreeTime tariff, which allows customers to pick one weekend day during which their electricity is free

A pilot tested the “Sunshine Tariff,” which charged a lower price during mid-day hours to alleviate local distribution system constraints due to net excess solar generation

Revolution in rate design: Hong Kong

CLP Power ran a pilot with peak-time rebates (PTR) for its residential customers

The pilot found that customers understand price incentives and respond to them

The utility, which has universal deployment of smart meters, has begun deploying PTR to several thousand customers

Old myths about rate design, strongly held for decades, are being slayed

The status quo is not sustainable

Modern rate designs have become a necessity, not a luxury

Customers understand modern rate designs

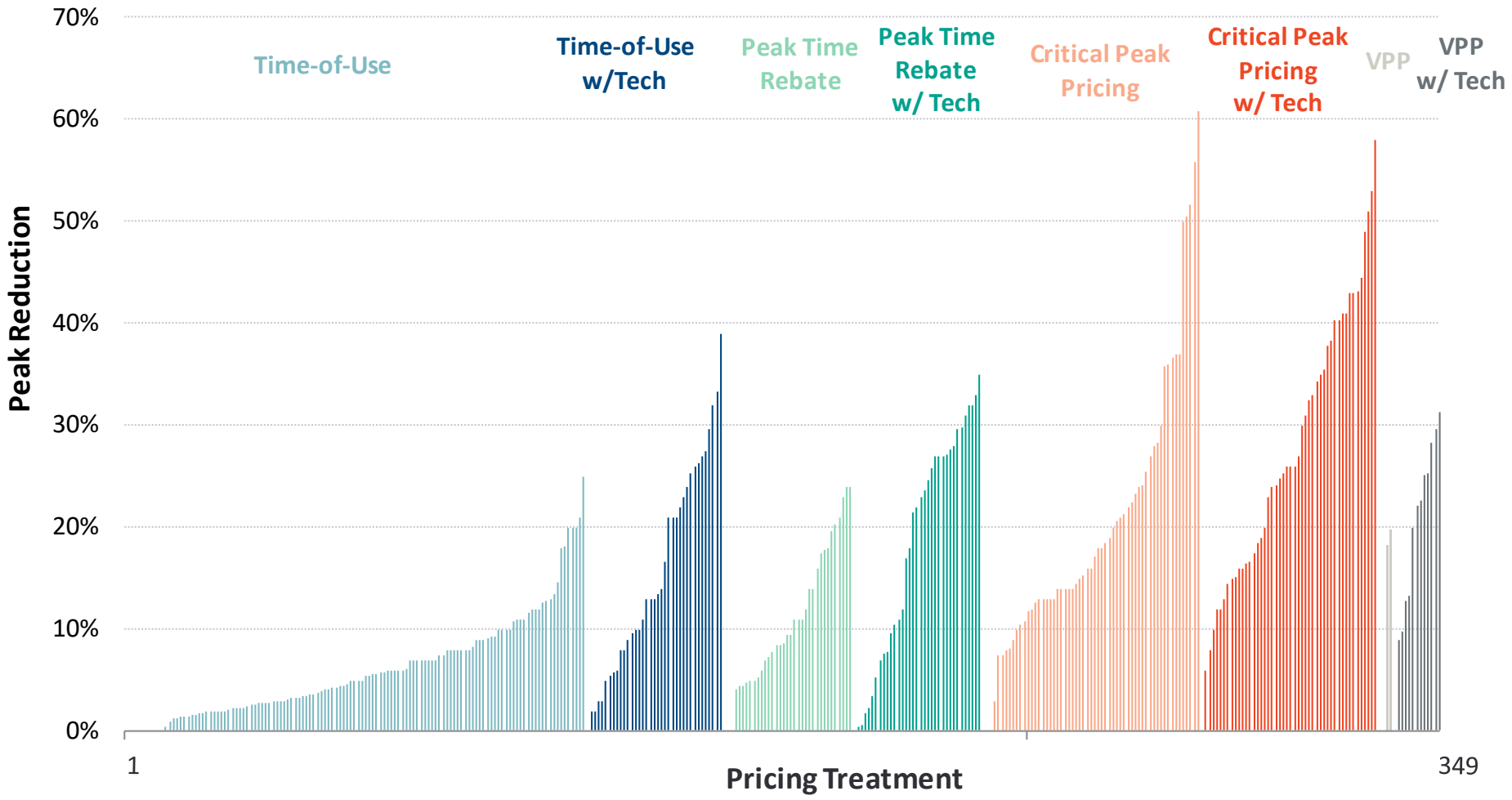
- They accept them
- They respond to them
- They encounter them in all other walks of life (parking meter, sporting events, Amazon Prime, Netflix, airlines, hotels, car rentals, movie theaters, opera theaters…even groceries)

Rolling out post-modern rate designs will enhances economic efficiency and promote inter-customer equity

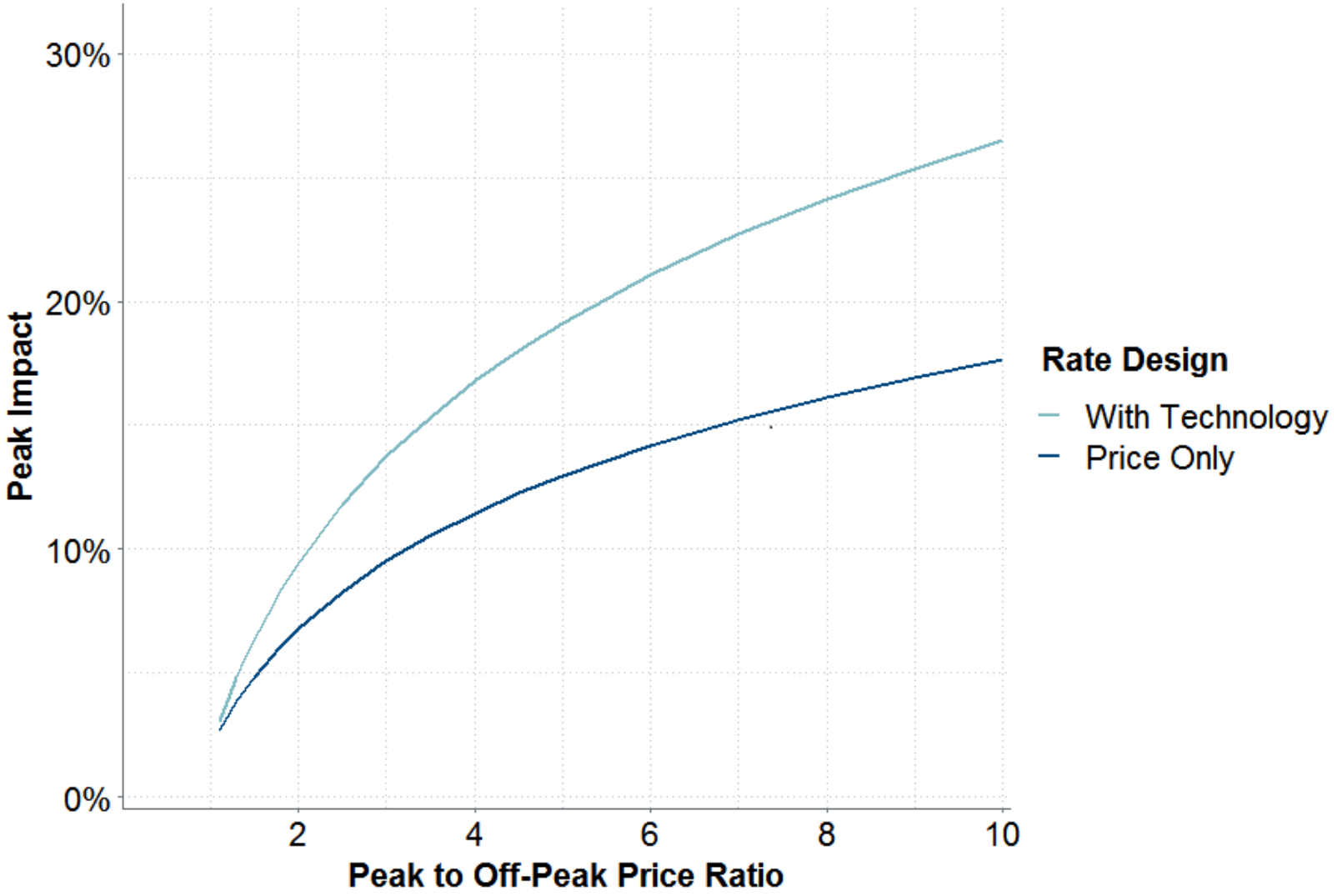
Post-modern rate design encompasses three elements

- Time-varying energy rates
  - TOU
  - Critical-peak pricing (CPP)
  - Peak-time rebates
  - Variable-peak pricing (VPP)
  - Real-time pricing
- Demand charges to recover capacity costs
  - Coincident peak
  - Non-coincident peak
  - Connected load
- Fixed charges to recover the costs of “revenue cycle” services

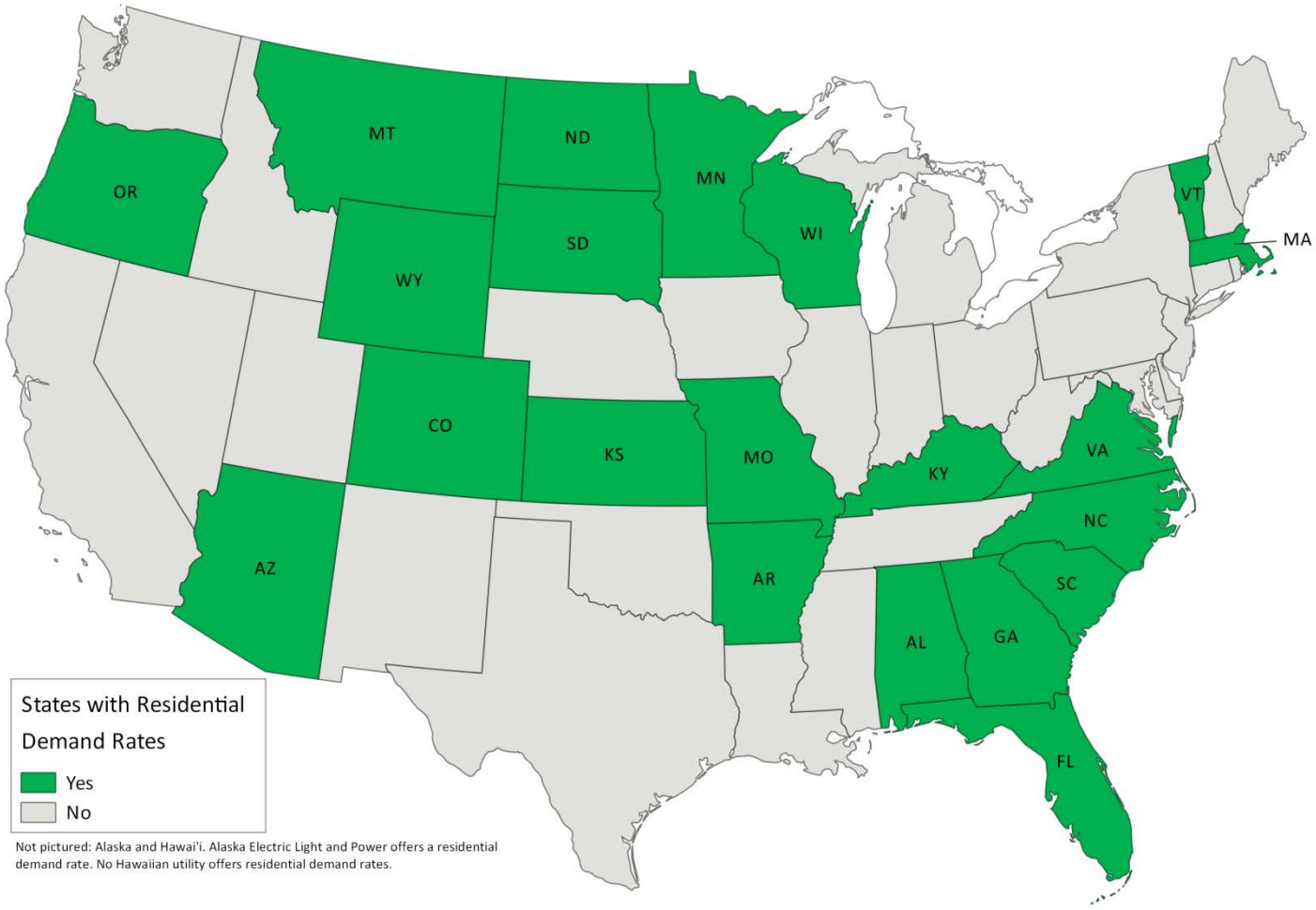
There is mounting evidence that customers respond to time-varying rates



Based on 350 tests, customers respond to electricity prices as they do for other products and services



Residential demand charges are being offered in 22 states



Not pictured: Alaska and Hawai'i. Alaska Electric Light and Power offers a residential demand rate. No Hawaiian utility offers residential demand rates.

Do residential customers understand demand charges?

Demand charges can be easily explained to customers

- The size of many common household items (light bulbs, electric irons, clothes dryers and microwave ovens) are expressed in watts
- The circuit breaker drives home the point about capacity constraints regardless of time

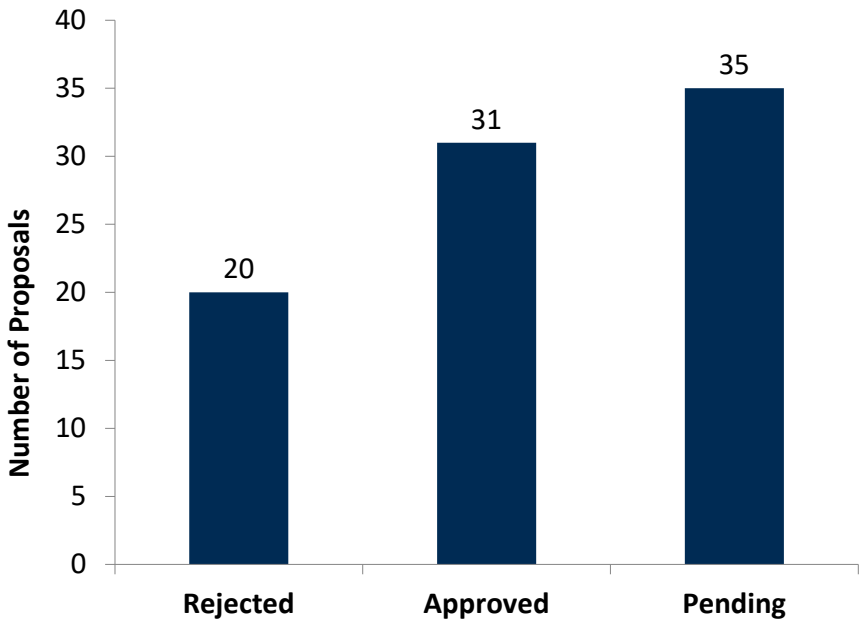
Customers can be provided typical demand ratings of major appliances and loads in their house

The message can be succinctly expressed

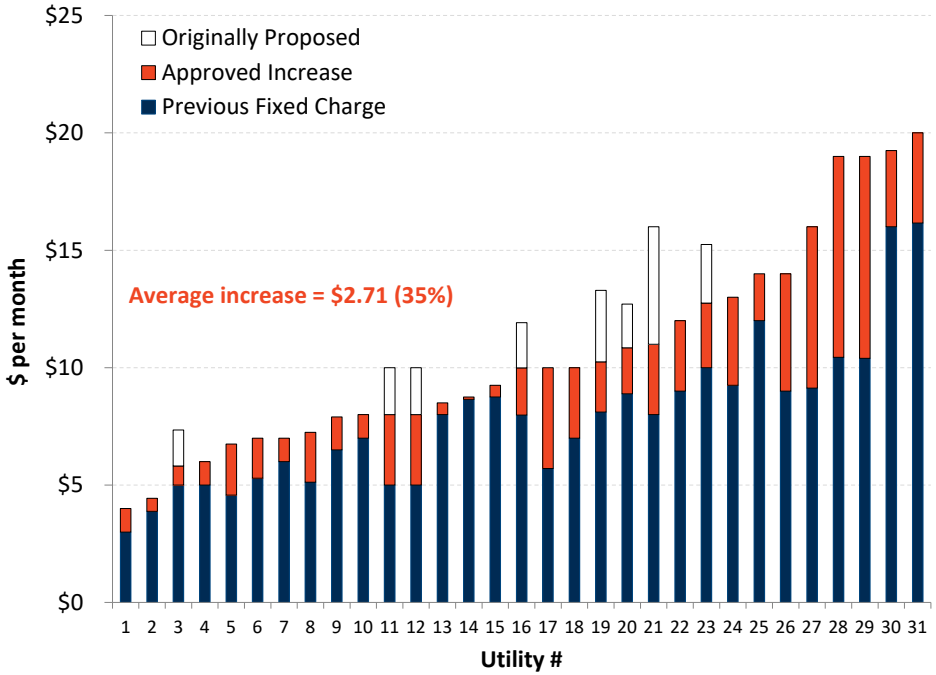
- Don’t use all your major appliances at the same time (APS)
- Give your appliances the afternoon off (SCE)

Fixed charges are being moved closer to fixed costs

Recent Proposals to Increase Fixed Charge



Amount of Approved Increase



Data sources: NC Clean Energy, "The 50 States of Solar," Q2 2015. Supplemented with review of additional utility rate filings.

What does the future hold?

Flat volumetric rates will cease to be the standard tariff

Inclining block rates, often imposed to promote energy conservation, will yield to TOU rates

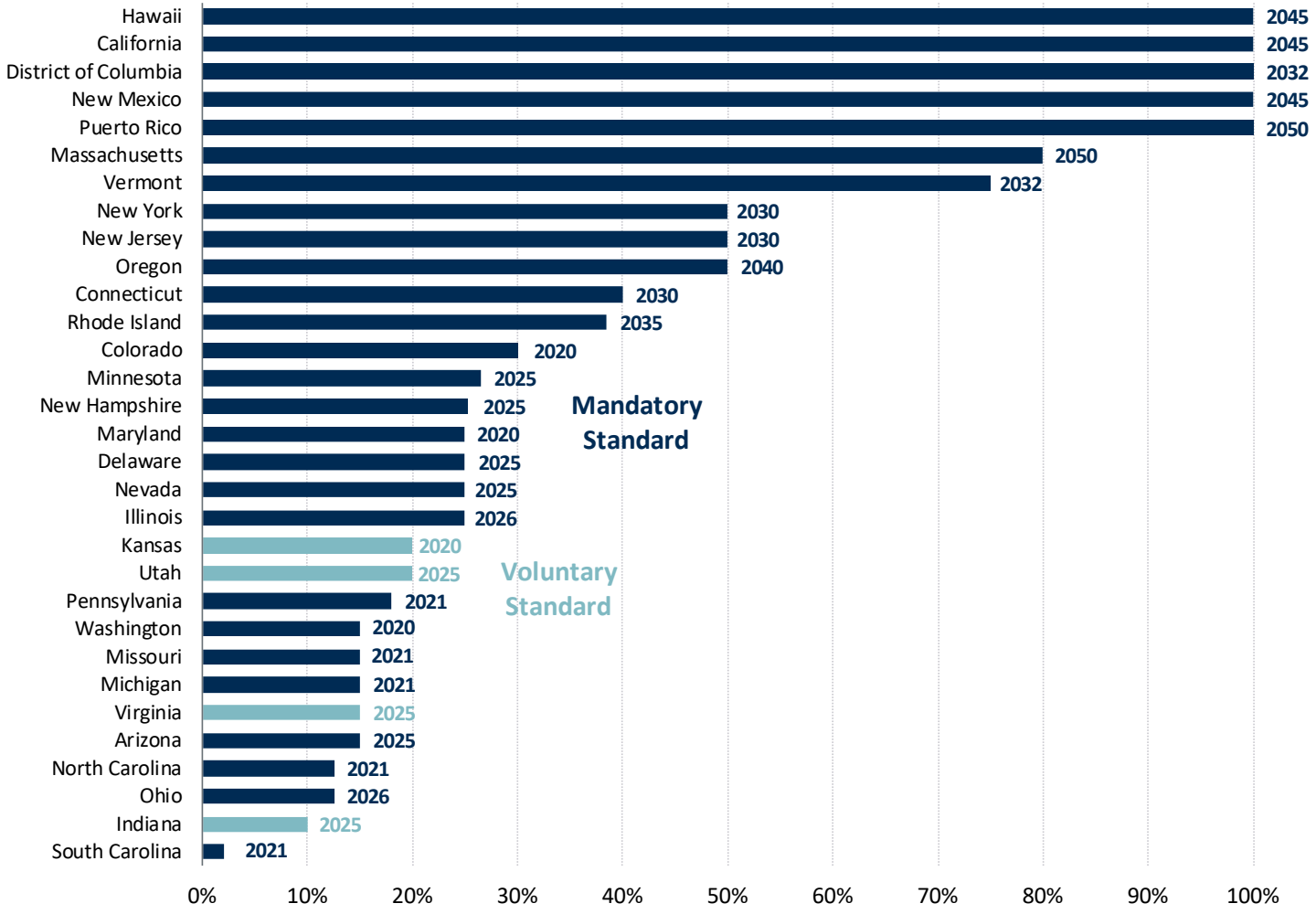
Default TOU rates (or possibly dynamic pricing rates) will become the norm, as they have in California, Colorado, Michigan, and Ontario

Flat bills (“Netflix pricing”) will be available as well

The world will shift toward renewable energy, making dynamic pricing a key ingredient of post-modern rate designs

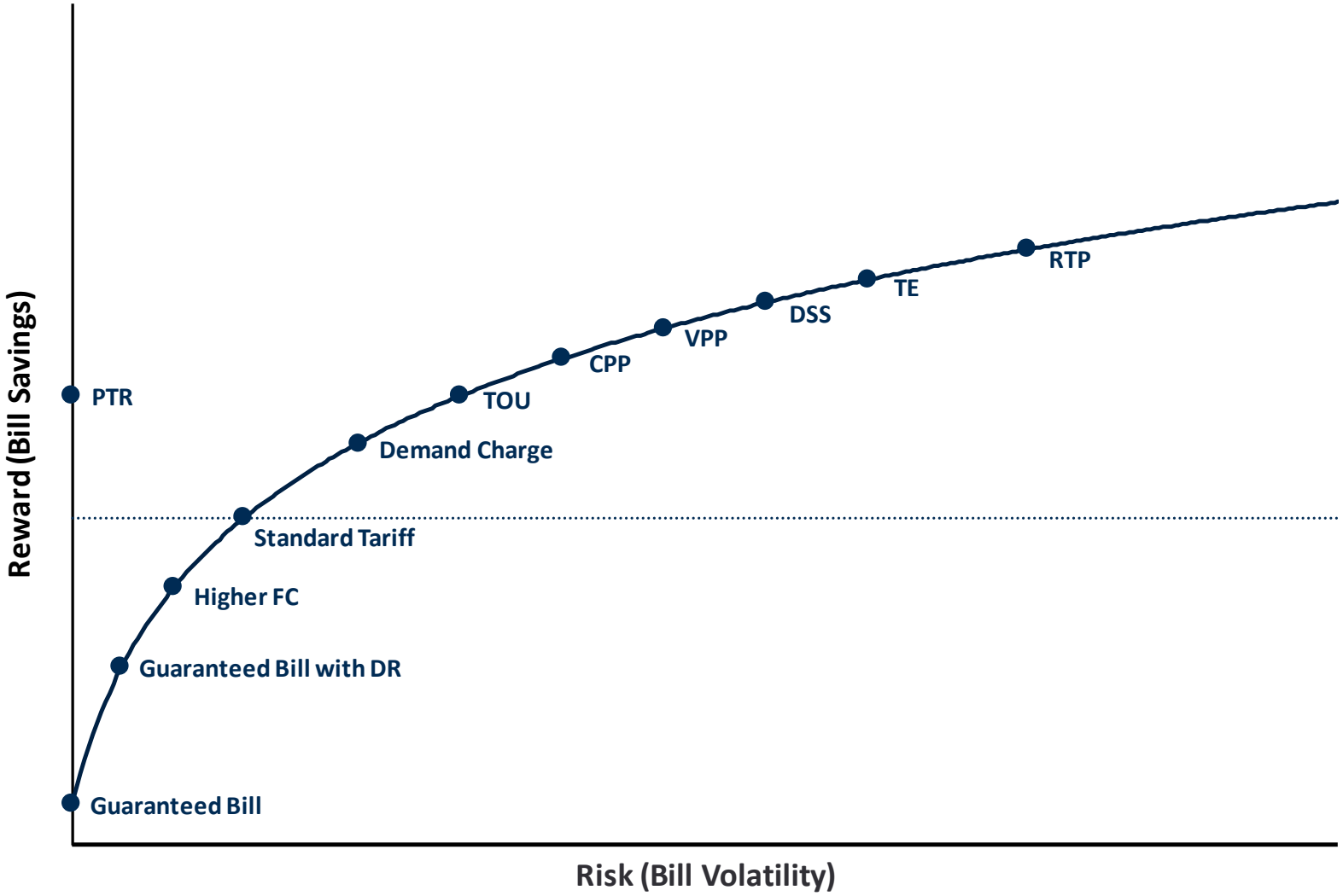
The shape of things to come – as seen by Taiwan Power

Clean energy mandates by state in the US



Notes: Data labels represent the year by which each standard must be met. Texas has voluntary target of 10,000 MW by 2025 for retail entities.
Puerto Rico's 100% target was recently passed by legislature and awaits the governor's signature. Massachusetts' goal of 80% by 2050 is based on its Clean Energy Standard. Massachusetts also has a separate Renewable Portfolio Standard with an implied target of 35% by 2030, and the Class I requirement growing by 1% per year thereafter.

Customer engagement means giving customers choices that trade-off bill savings against bill volatility



APS provides a great example of post-modern rate designs

Residential Plan Comparison*

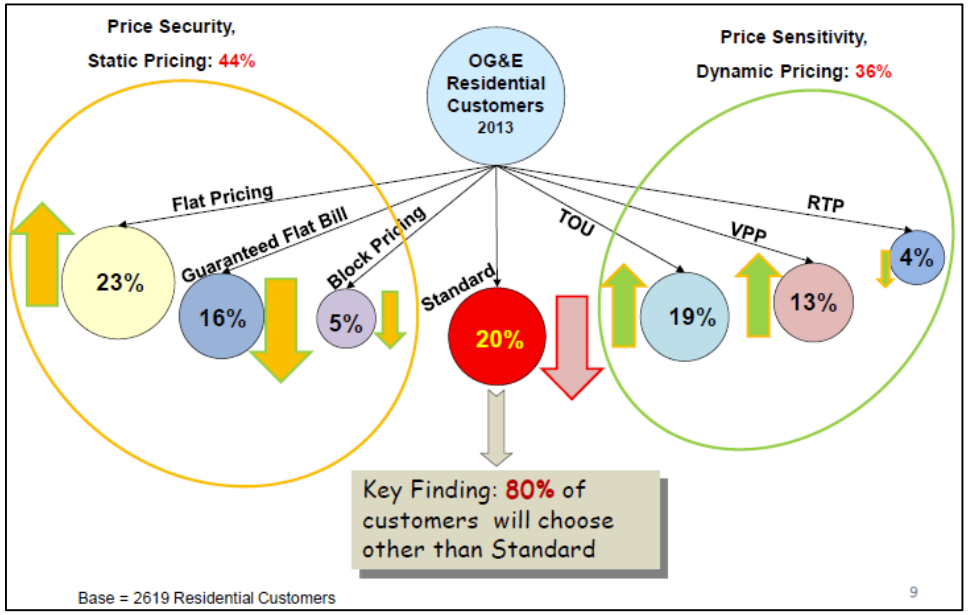
PLANS	BASIC SERVICE CHARGE (PER DAY)	ENERGY CHARGE (PER kWh)	OFF-PEAK PRICING	SUPER OFF-PEAK WINTER PRICING	ON-PEAK SUMMER PRICING	ON-PEAK WINTER PRICING	ON-PEAK SUMMER PEAK USAGE (DEMAND) CHARGE PER kW	ON-PEAK WINTER PEAK USAGE (DEMAND) CHARGE PER kW	OFF-PEAK HOURS	SUPER OFF-PEAK WINTER HOURS	ON-PEAK HOURS	ENERGY USE RESTRICTIONS (12-MONTH AVERAGE)	RENEWABLE ENERGY COMPATIBLE
Saver Choice	42.7¢	-	10.873¢	3.200¢	24.314¢	23.068¢	-	-	8 p.m.–3 p.m. weekdays, all weekend +10 holidays	10 a.m.–3 p.m. weekdays	3 p.m.–8 p.m. weekdays	-	Yes (with grid access charge)
Saver Choice Plus	42.7¢	-	7.798¢	-	13.160¢	11.017¢	$8.40	$8.40	8 p.m.–3 p.m. weekdays, all weekend +10 holidays	-	3 p.m.–8 p.m. weekdays	-	Yes
Saver Choice Max	42.7¢	-	5.230¢	-	8.683¢	6.376¢	$17.44	$12.24	8 p.m.–3 p.m. weekdays, all weekend +10 holidays	-	3 p.m.–8 p.m. weekdays	-	Yes
Lite Choice	32.9¢	11.672¢	-	-	-	-	-	-	-	-	-	Under 600 kWh per month	No
THE FOLLOWING PLAN IS AVAILABLE TO ELIGIBLE CUSTOMERS AFTER A TRIAL OF 90 DAYS ON ONE OF THE SAVER CHOICE PLANS.													
Premier Choice	49.3¢	12.393¢	-	-	-	-	-	-	-	-	-	601–999 kWh per month	No

Source: Arizona Public Service, Residential Plan Comparison, https://www.aps.com/library/rates/PlanComparison.pdf, accessed March 2019.

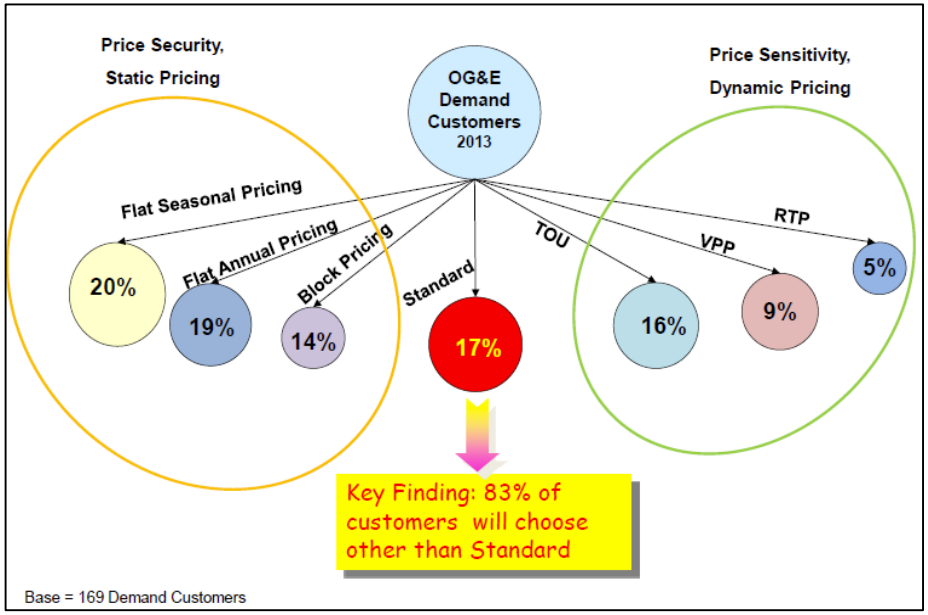
So does OGE, which used conjoint analysis to understand customer psychology

Customer Choices Among Pricing Plans (2013)

Residential Customers



Demand Customers



Source: Direct Testimony of Bryan J. Scott on behalf of Oklahoma Gas and Electric Company, Before the Arkansas Public Service Commission, Docket No. 16-052-U, August 26, 2016. Survey responses include both Oklahoma and Arkansas customers. Arrows next to the residential customer results represent changes from an earlier survey conducted in 2010.

Many customers are on post-modern rate designs today

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%*

Conclusion 1: Post-modern rate design is the "secret sauce" for engaging with customers

Updated cost of service studies will continue to provide the foundation for rate design

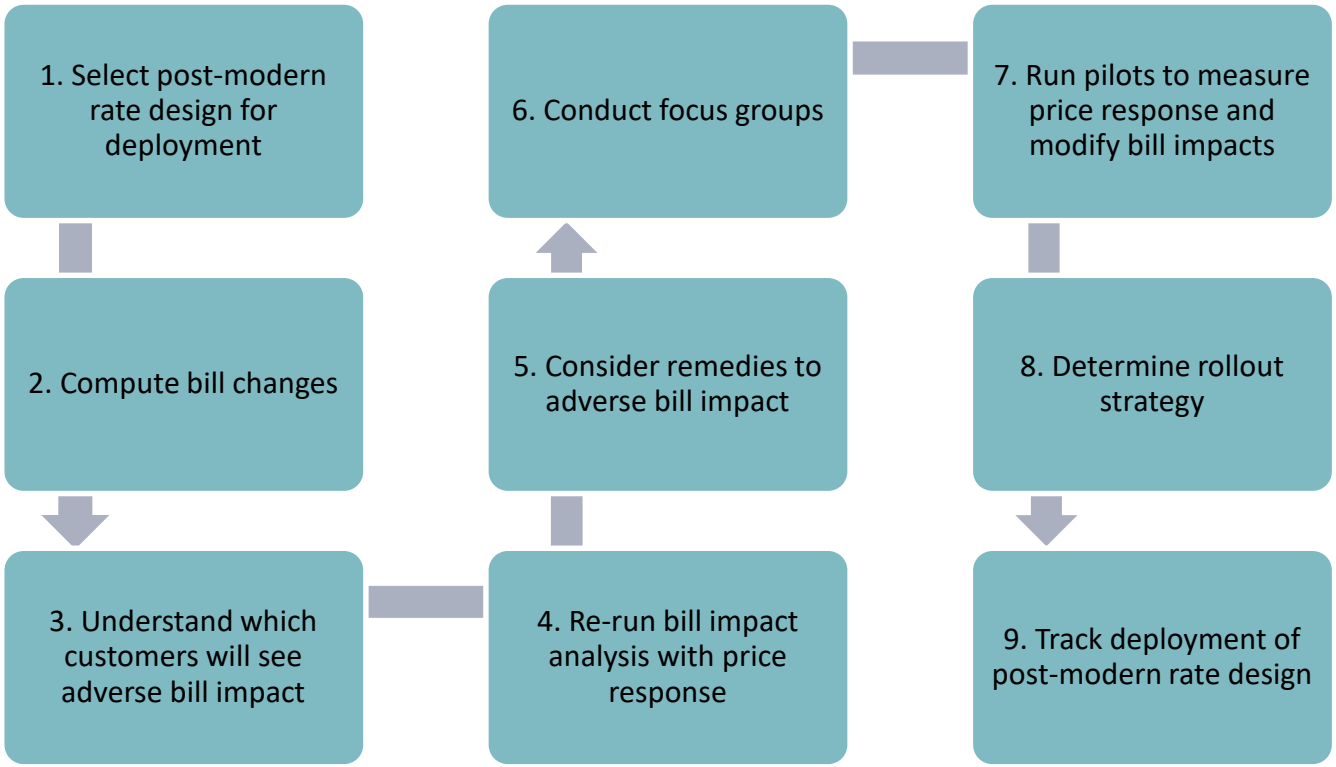
But we will also need to deepen our understanding of customer behavior and preferences

- Focus groups and customer interviews
- Big data (smart meters, socio-demographics and economics)
- Conjoint analysis and stated preference surveys

It will be important to introduce a "test-and-learn" mindset in the utility organization that integrates customer service, rate design, billing systems, and integrated resource planning

Discover new ways of listening to customers

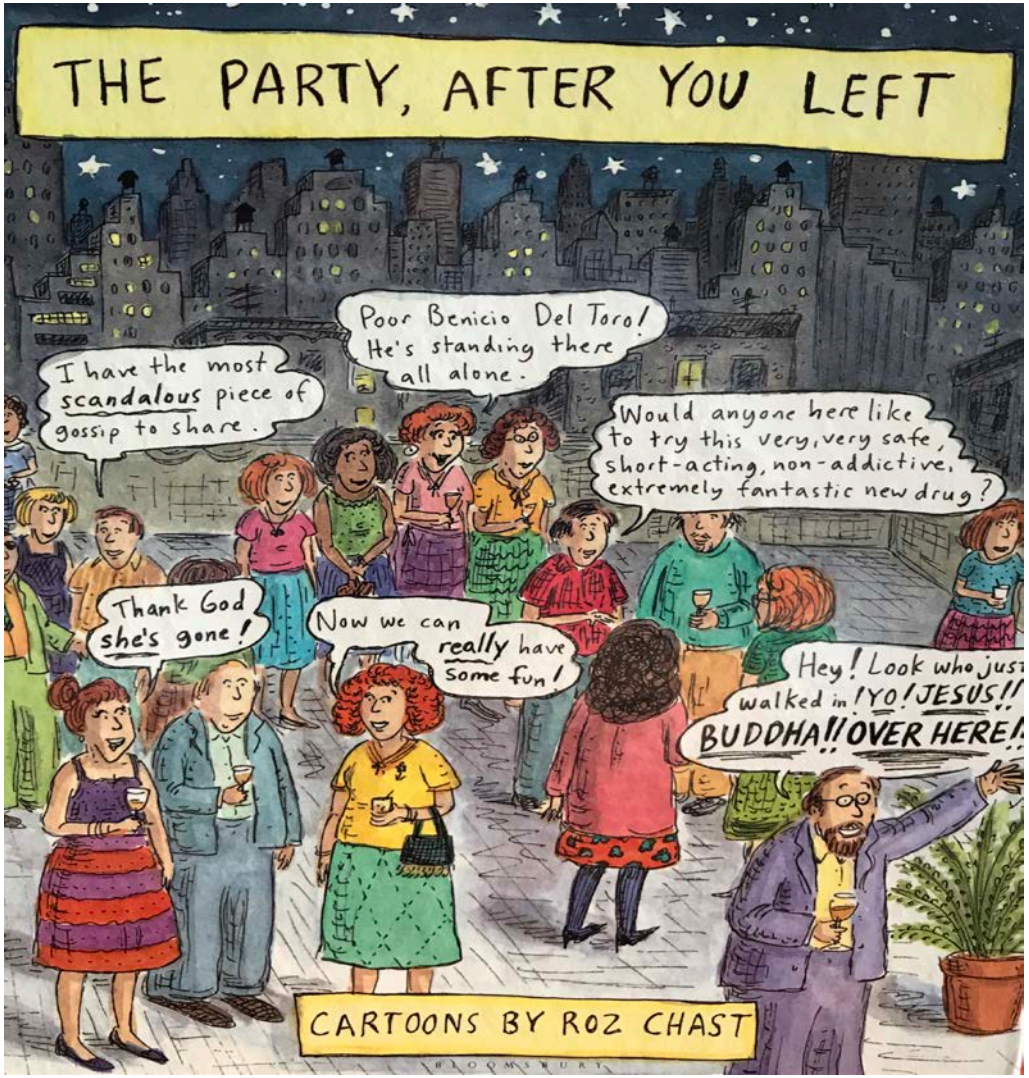
Conclusion 2: The transition to post-modern rate designs cannot be done overnight



Conclusion 3: To avoid backlash, cushion customers against adverse impacts

Remedy	Implementation
Gradualism	Roll out the new rates gradually for each rate design element. For example, to introduce a TOU rate, if the peak price will be 25 ¢/kWh and the current tariff is 15 ¢/kWh, implement a peak price of 17 ¢/kWh in the first year and increase it annually by 2 ¢/kWh until it reaches 25 ¢/kWh.
Bill Protection	Provide customers with bill protection for a limited period of time so that they pay the lower of their old and new bill.
Optional Rates	Make the new rate design optional for vulnerable customers, mandatory for the largest customers, and the default for all other customers.
Financial Assistance	Provide customers with adverse bill impacts financial assistance for a limited period of time.
Enabling Technologies	Install enabling technologies such as smart thermostats on customer premises.
Two-staged Rollout	Structure the rate into two stages, where the first stage charges customers the current rate if their usage resembles a historical reference period, and the second stage exposes them to the new rate.

Now comes the fun part!



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Presenter Information

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Ahmad Faruqui is an internationally recognized authority on pricing electricity and natural gas. He has analyzed the efficacy of fixed charges, demand charges, time-varying rates, inclining block structures, and guaranteed bills. He has also designed experiments to model the impact of modern tariffs and organized focus groups and stated-preference surveys to study customer choice. Besides tariffs, his areas of expertise include customer choice, demand response, energy efficiency, distributed energy resources, advanced metering infrastructure, 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.

Appendix

A pocket history of rate design

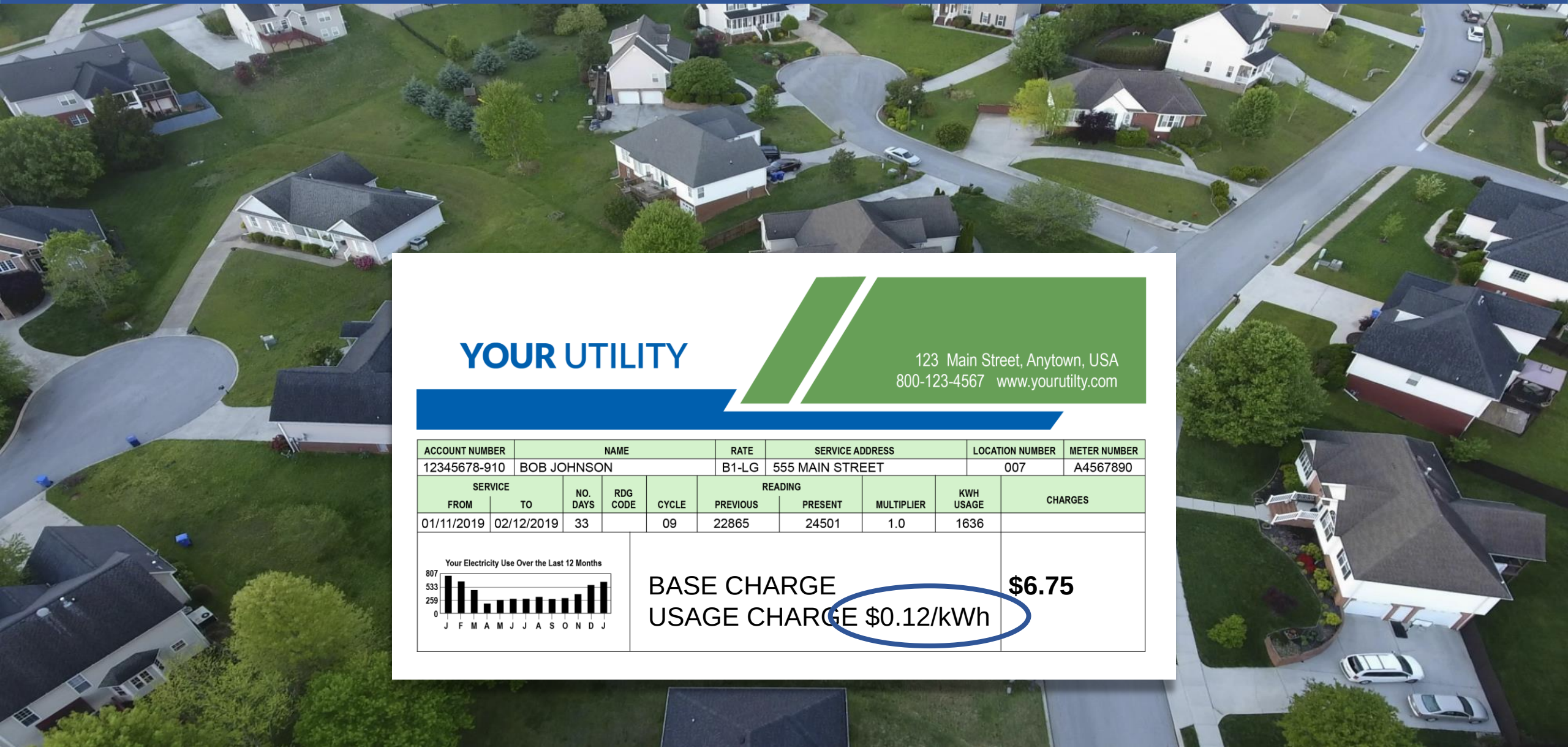
Year	Author	Contribution
1882	Thomas Edison	• Electric light was priced to match the competitive price from gas light and not based on the cost of generating electricity
1892	John Hopkinson	• Suggested a two–part tariff with the first part based on usage and the second part based on connected kW demand
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	• Laid out his famous Ten Principles of Public Utility Rates

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

Rate Education in a Digital Communications World

Rate Education - Understanding What They Have



YOUR UTILITY

123 Main Street, Anytown, USA
800-123-4567 www.yourutilty.com

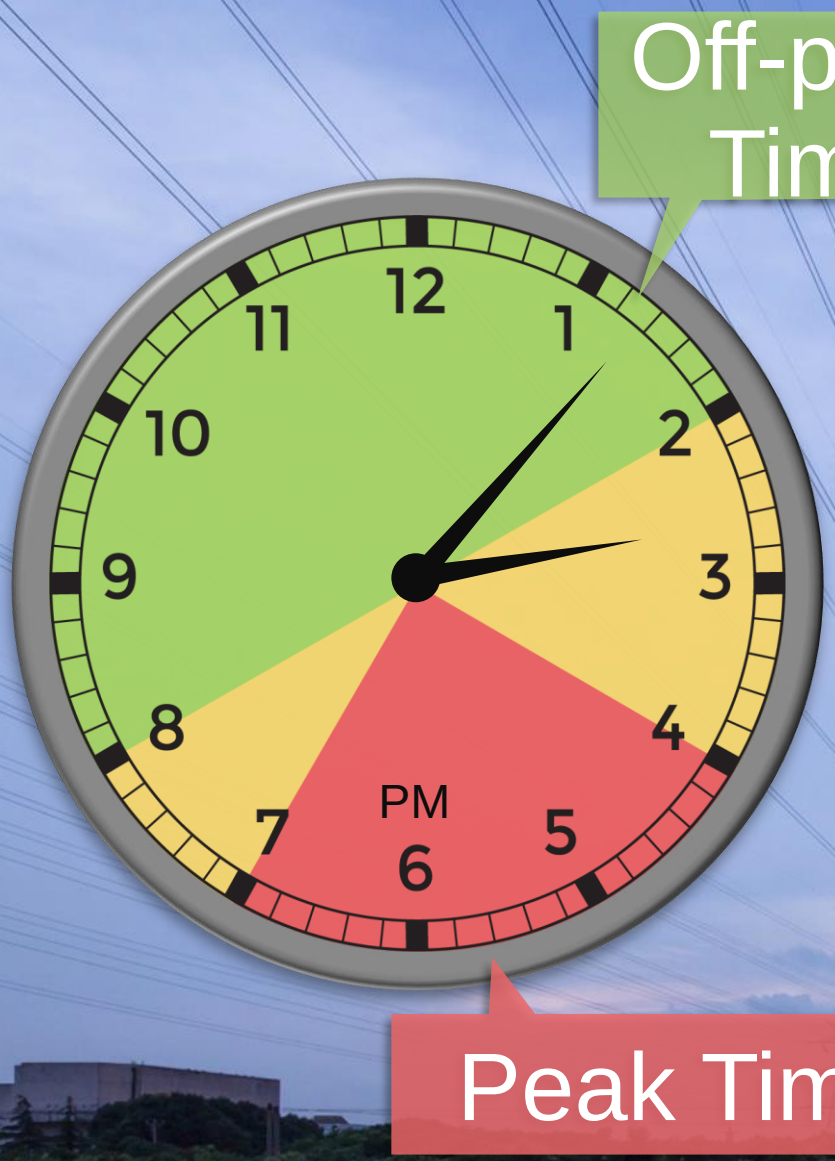
ACCOUNT NUMBER	NAME	RATE	SERVICE ADDRESS	LOCATION NUMBER	METER NUMBER
12345678-910	BOB JOHNSON	B1-LG	555 MAIN STREET	007	A4567890

SERVICE FROM	SERVICE TO	NO. DAYS	RDG CODE	CYCLE	READING PREVIOUS	READING PRESENT	MULTIPLIER	KWH USAGE	CHARGES
01/11/2019	02/12/2019	33		09	22865	24501	1.0	1636	

Your Electricity Use Over the Last 12 Months

807
533
259
0
J F M A M J J A S O N D J

BASE CHARGE **$6.75**
USAGE CHARGE $0.12/kWh



Rate Education

- How it (the rate) works
- What it saves (or costs)
- When it changes
- Why it’s important

Rate Relevance

- What appliances have an impact?
- Are they considering an Electric Vehicles?

Make it Personalized

Make it Relevant

Make it Meaningful

Make it Manageable

Questions

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415-217-1026

Utility Initiatives and Apogee Solutions

Engagement and Communications

Rate Transformation

Self-Service and Cost Avoidance

Customer Satisfaction

Revenue Enhancement

- Market Place
- Beneficial Electrification

Demand Response

Distributed Energy Resources

Low and Moderate Income