MODERNIZING TARIFFS IS NO LONGER AN OPTION, IT'S AN IMPERATIVE

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Throughout North America, residential tariffs are being modernized

Time-of-use (TOU) tariffs figure prominently in such reforms

- There is a strong desire to reduce peak loads and to shift load from peak to off-peak periods
- In many places, TOU tariffs are intended to replace inclining block tariffs (IBRs) which are viewed as sending the **w**rong price signal that contradicts electrification

TOU tariffs are being introduced in most jurisdictions on an opt-in basis

- Examples include Georgia Power and Ameren (Missouri)

Increasingly, TOU tariffs are being deployed as the default tariff

- SMUD, PG&E, SCE, SDG&E (California), Consumers Energy (Michigan), Xcel Energy (Colorado) and Ontario (Canada)

In one case, a TOU tariff is mandatory

- Fort Collins (Colorado)

The modernization movement has gone global

	Type of Rate	Applicability	Participating Customers
Oklahoma *(OGE)*	Variable Peak Pricing (VPP)	Opt-in	20% (130,000)
Maryland *(BGE, Pepco, Delmarva)*	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)*	Peak Time Rebate (PTR)	Opt-in	27,000
Arizona *(APS, SRP)*	Time-of-Use (TOU)	Opt-in	APS: 63%, SRP: 36%
California *(PG&E, SCE, SDG&E)*	Time-of-Use (TOU)	Default (2020)	TBD – 75-90%*
California *(SMUD)*	Time-of-Use (TOU)	Default	98%*
Colorado *(Fort Collins)*	Time-of-Use (TOU)	Mandatory	100%
Illinois *(ComEd, Ameren IL)*	Real Time Pricing (RTP)	Opt-in	50,000
Michigan *(Consumers Energy)*	Time-of-Use (TOU)	Default (2020)	TBD – 75-90%*
France	Time-of-Use (TOU)	Opt-in	50%
Spain	Real Time Pricing (RTP)	Default	40%
Italy	Time-of-Use (TOU)	Default	75-90%*

Often, utilities are offering more than one TOU tariff to customers

The tariffs differ in many respects

- The number of seasons: year around, peak season only, peak season and all other seasons, or four seasons
- The number of pricing periods: 2, 3 or 4
- The size of the monthly service charge and whether or not they include a demand charge

Three-period TOU tariffs are often targeted to EV drivers who charge at home

- They are designed to encourage charging late into the night

In a few cases, dynamic tariffs are being offered

- OGE has successfully deployed a variable-peak pricing tariff to its residential customers
- California offers a critical-peak pricing tariff paired with a TOU tariff to its residential customers

For C&I customers, time-varying tariffs are quite common

- TOU tariffs are often mandatory
- Georgia Power offers a real-time pricing tariff

How do you get started?

First, design TOU rates that are cost reflective ***and*** likely to appeal to customers

Second, conduct focus groups with customers and stakeholders to assess whether these rates would appeal to customers and how to elicit feedback on how best to offer these rates to customers

- Puget Sound Energy recently conducted five focus groups and three stakeholder meetings
- Nova Scotia Power conducted several stakeholder meetings

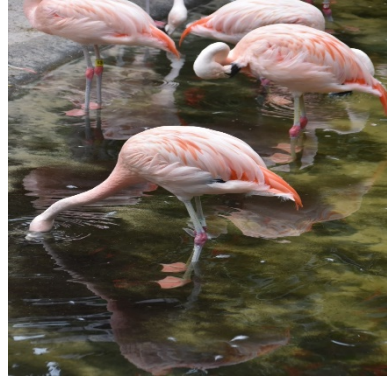
Third, conduct pilots to determine the likely magnitude of load shape changes that will be induced by these rates

- BGE, Pepco and Delmarva (Maryland) and Evergy (Missouri) have completed two-year pilots with TOU rates
- An alternative approach is to rely on the Arcturus database which contains a meta-analysis of the 401 pricing treatments that have been tested in prior pilots (see slide 7)

Fourth, decide on how you will offer these rates to customers: opt-in, opt-out, or mandatory basis

- Ideally, you would this decision prior to designing pilots so they can best simulate what would happen in a full-scale rollout

You will have to answer several additional questions prior to fielding the TOU rates

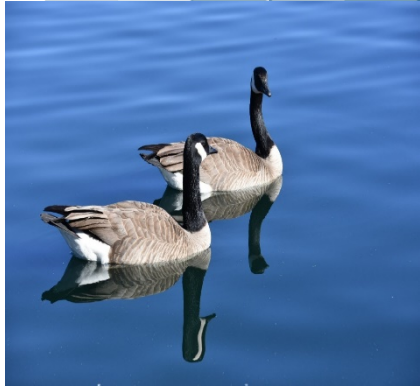


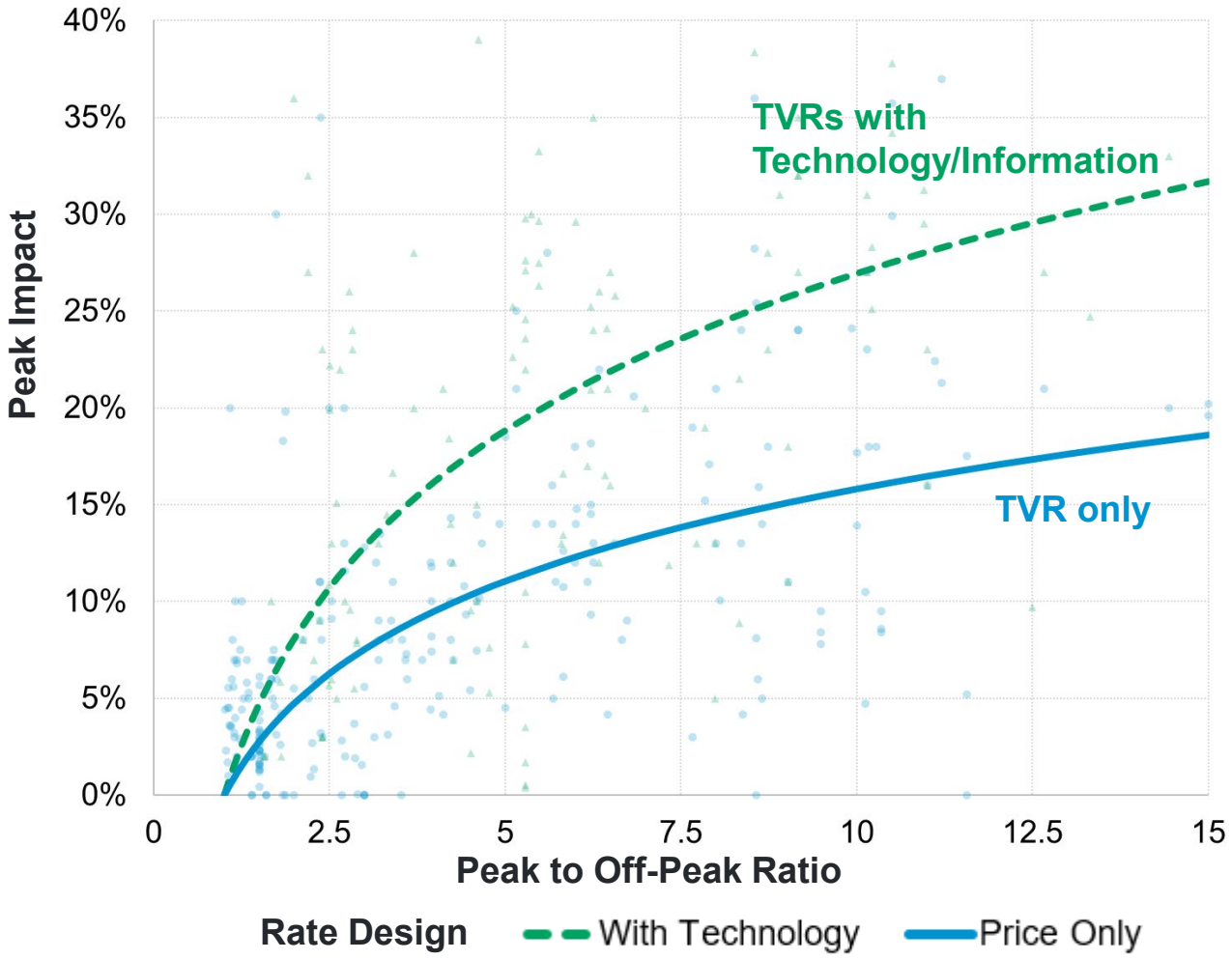
For example:

- What types of marketing collateral would be most effective in recruiting customers?
- To minimize customer risk, should bill protection or shadow bills be offered at the commencement of the rollout?
- Should enabling technologies be offered to customers on TOU rates to help them shift greater amounts of loads to enhance their bill savings?
- Should behavioral messaging be offered to facilitate load shifting?
- Should bill decomposition be provided, allowing customers to identify the key end uses that are contributing to peak load?
- Should a rate choice algorithm be provided to help customers chose the best rate for themselves?
- Should the website be updated to include tips on how to benefit from the rates?

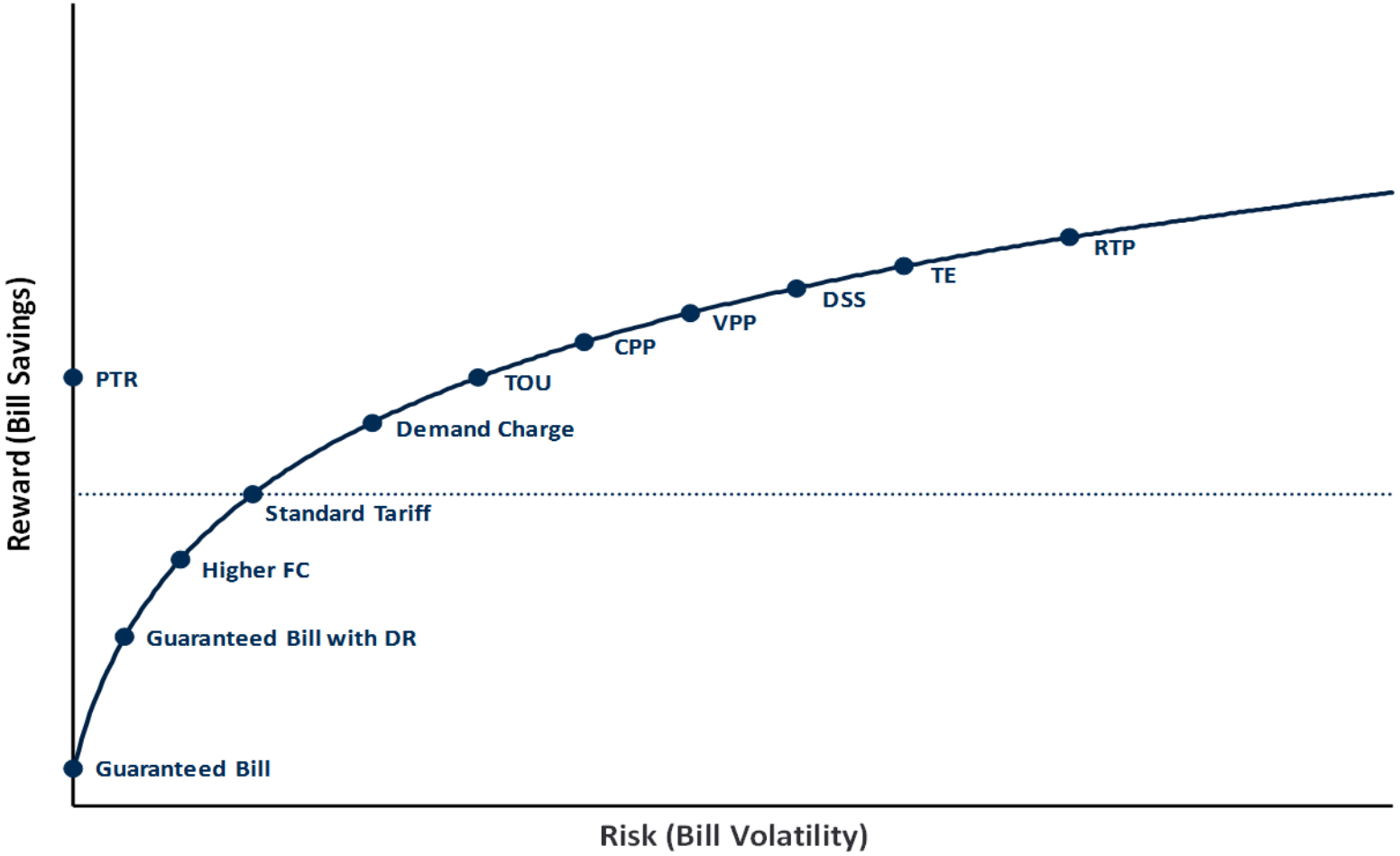
Once you have fielded the TOU rates, you should track customer acceptance and customer response and modify the rate designs based on “learning by doing,” more formally known as ***Bayesian*** updating

Will customers respond to price signals? Yes!





Consider offering customers a *choice of tariffs*



Encourage EV customers to adopt TOU rates

EV's can add raise home energy consumption by a significant amount

- Level 1 charging at 110 volts draws 1.4 kW of power but takes very long
- Level 2 charging at 220 volts draws 6.2-7.6 kW of power and takes less time

EV's can place a large load on distribution circuits if all drivers charge them simultaneously

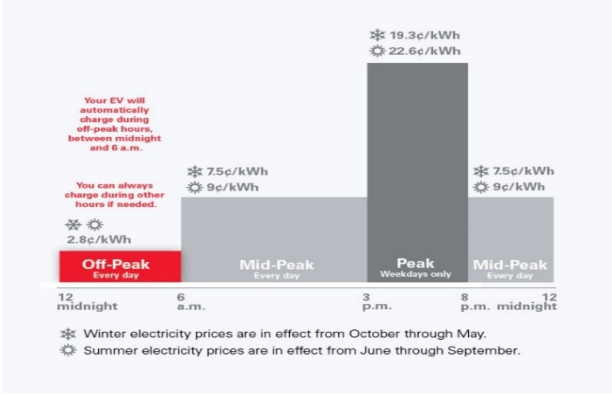
That's where TOU rates come into the picture

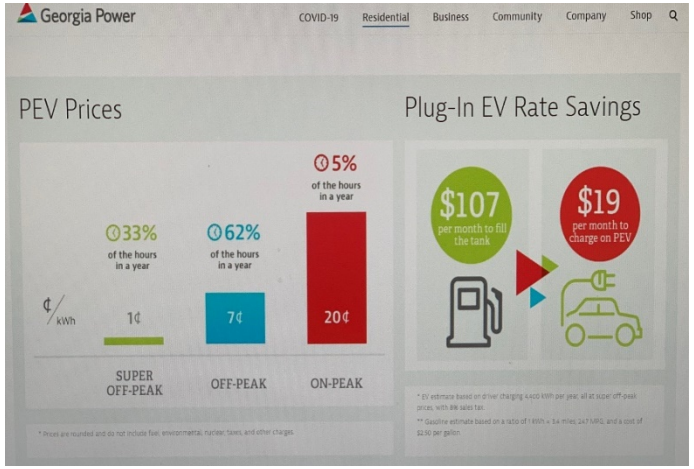
- They typically have three pricing periods
- They will encourage EV drivers to charge late into the night, when the super off-peak period begins
- Most EVs come with programmable charging capability

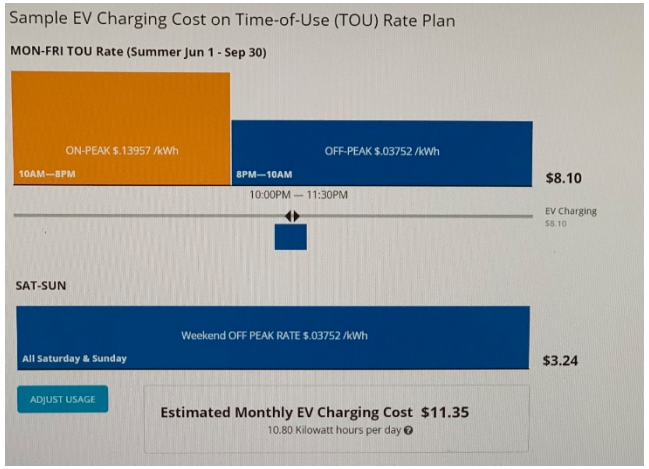
Down the road, you many want to consider

- TOU rates only for EVs
- Managed charging
- V2H and V2G

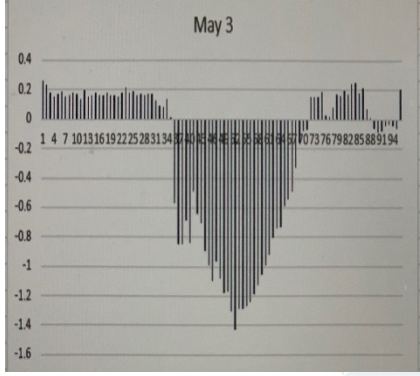
Here are some examples of TOU rates for EV drivers

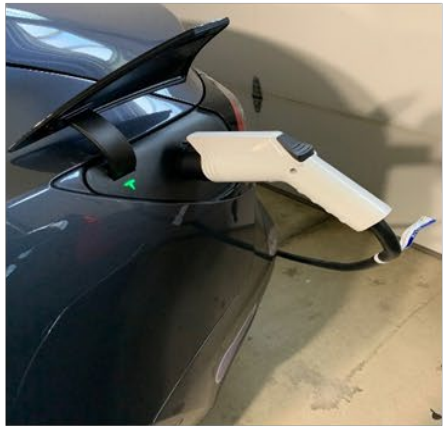


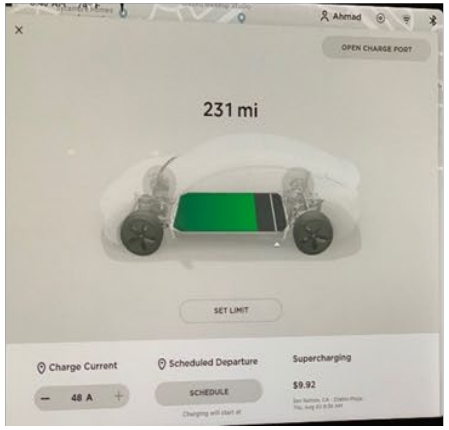




More and more customers are installing solar panels and pairing them with batteries







Should you reform tariffs for customers with rooftop solar panels?

In Australia and Hawaii, about a third of customers have installed solar panels

- In California, the number is one out of ten, representing 50% of the US population

Utilities are concerned that their business model is being turned upside down when customers install solar panels and in several instances, pair them with battery energy storage systems

Several states are seeking to reform net energy metering (NEM) and replace it with successor tariffs that reduce the cost-shift that occurs when prosumers reduce their usage drastically

Progress toward successor tariffs is gradually beginning to occur in jurisdictions with a high percentage of prosumers

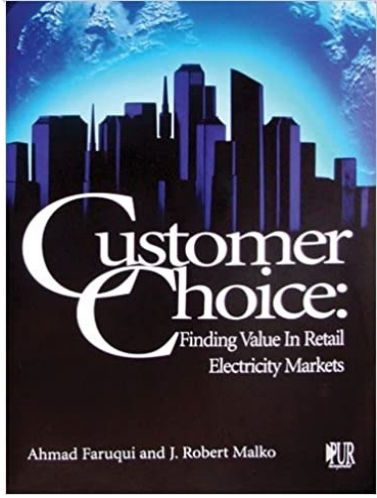
The options being implemented include minimum monthly bills, higher fixed charges, time-of-use rates, and lower prices for exporting power to the grid

The most recent example of success comes from Duke Energy in South Carolina

APPENDIX A

ADDITIONAL READINGS

Selected papers on pricing and customer-centricity



"Refocusing on the consumer," *Regulation*, Spring 2020.

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

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

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

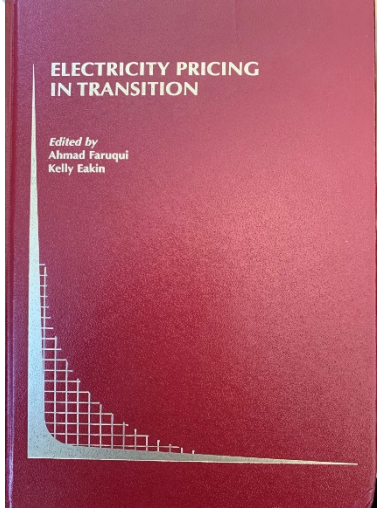
"Rate Design 3.0 – Future of Rate Design," *Public Utilities Fortnightly*, May 2018.

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

APPENDIX B

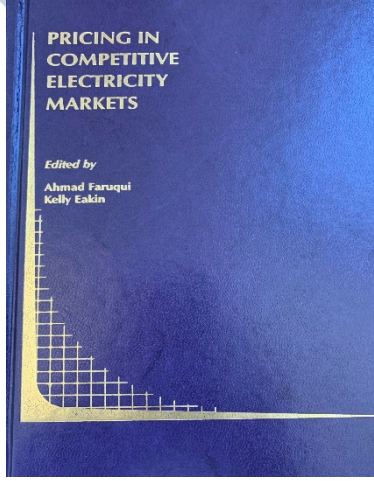
A POCKET HISTORY OF RATE DESIGN

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

Presenter Information

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Dr. Faruqui provides expert advice and testimony on rate design, load flexibility, energy efficiency, demand response, distributed energy resources, demand forecasting, decarbonization, and electrification. He has worked for over 150 clients on five continents and appeared before regulatory bodies, governments, and legislative councils.

He has authored or coauthored more than 100 papers in peer-reviewed and trade journals and co-edited books on industrial structural change, customer choice, and electricity pricing. His work has been cited in *Bloomberg, Business Week, The Economist*, and *Forbes*, in addition to *The New York Times* and the *Washington Post*, and he has appeared on NPR and Fox Business News.

Dr. Faruqui has taught economics at San Jose State, UC Davis and the University of Karachi and delivered guest lectures at Carnegie Mellon, Harvard, Idaho, MIT, New York, Northwestern, Rutgers, Stanford, and UC Berkeley. He obtained an MA in Agriculture Economics and a PhD in Economics from UC Davis, and a BA and an MA in Economics from the University of Karachi.