

DOCKETED

Docket Number:	17-IEPR-12
Project Title:	Distributed Energy Resources
TN #:	220509
Document Title:	Moving Forward with Tariff Reforms A Global Survey
Description:	8.8.17 Presentation by Ahmad Faruqui of The Brattle Group
Filer:	Raquel Kravitz
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	8/2/2017 12:04:57 PM
Docketed Date:	8/2/2017

Moving Forward with Tariff Reforms: A Global Survey

PRESENTED TO

California Energy Commission
Sacramento, California

PRESENTED BY

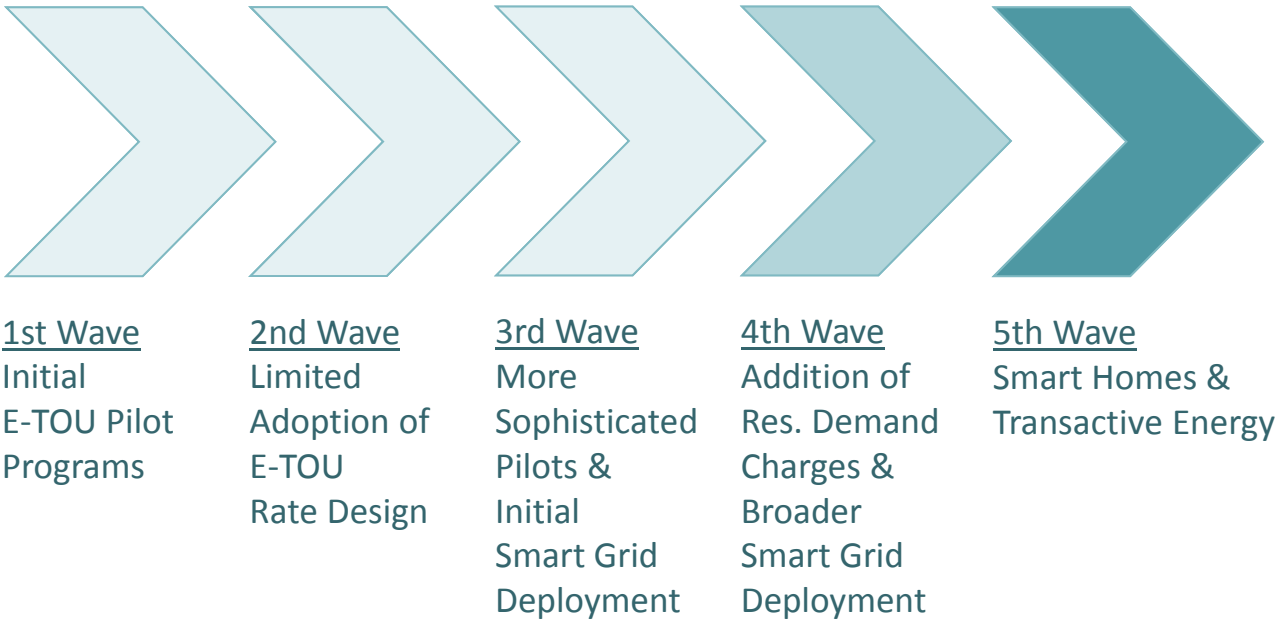
Ahmad Faruqi, Ph.D.

August 8, 2017



THE **Brattle** GROUP

The history of tariff reforms



The 1st wave

- ❖ Energy-only time-of-use tariffs (E-TOU) were tested in the late 1970s in twelve pilots funded by the Federal Energy Administration (later part of the US Department of Energy)
- ❖ Their experimental designs were of uneven quality
- ❖ The results were encouraging but not consistent
 - ❖ <http://www.sciencedirect.com/science/article/pii/036054428390052X>

The 2nd wave

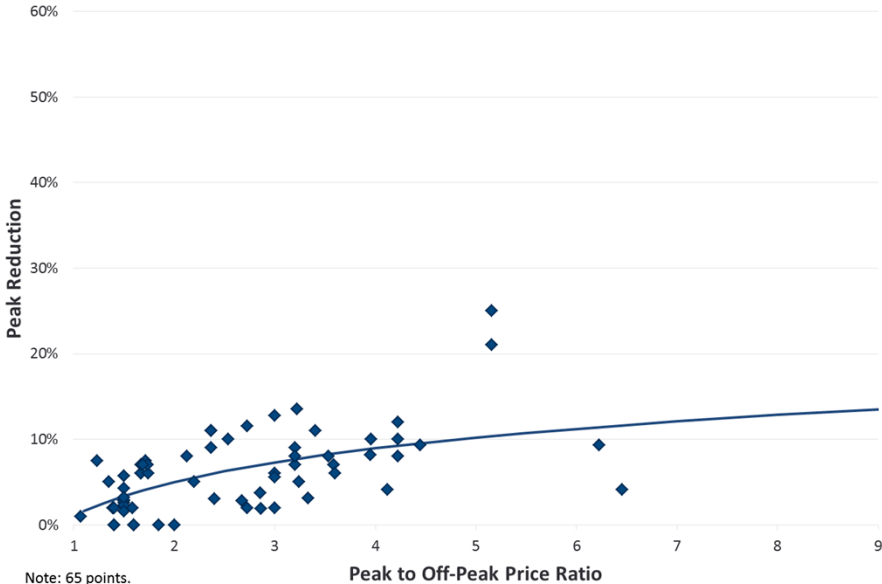
- ❖ In the mid 1980s, EPRI took the results from the top five pilots and found consistent evidence of consumer behavior
- ❖ Unfortunately, not much happened in the late 1980's and most of the 1990's because of the lack of smart metering and the onset of restructuring
- ❖ However, a few utilities did move ahead with mandatory E-TOU rates for large residential customers
- ❖ Virtually all utilities moved ahead with opt-in E-TOU rates but only a handful of customers were actually on those rates
 - ❖ <http://www.sciencedirect.com/science/article/pii/0304407684900174>

The 3rd wave

- ❖ The California energy crisis in 2000/01 gave impetus to the next wave of pilots featuring dynamic pricing, some with smart thermostats
- ❖ More than 40 pilots featuring more than 200 energy-only pricing treatments were carried out around the globe
- ❖ Today, 50 million households have smart meters but only a few million customers are on smart rates due to fears of bill volatility
 - ❖ <http://www.sciencedirect.com/science/article/pii/S1040619013001656>

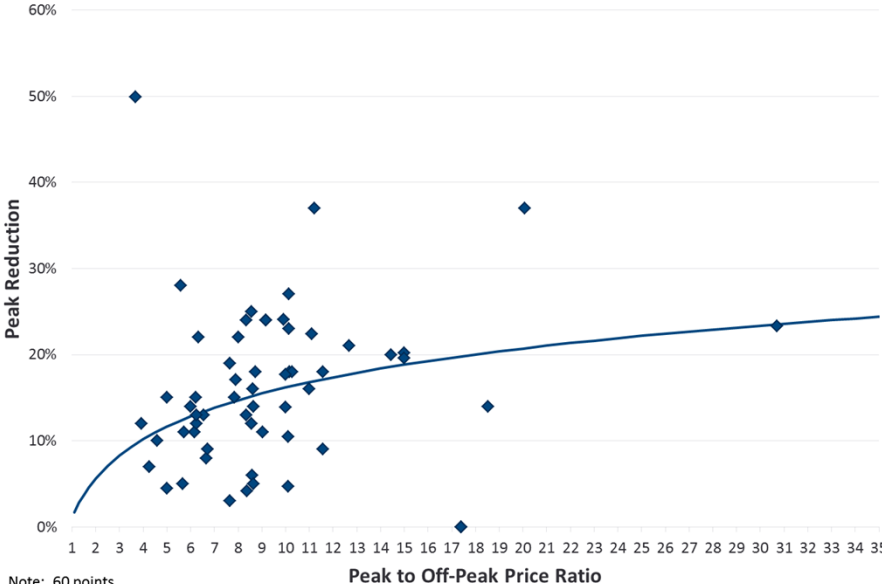
The magnitude of demand response rises with the peak to off-peak price ratio

TOU Impacts (price only)



Note: 65 points.
Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

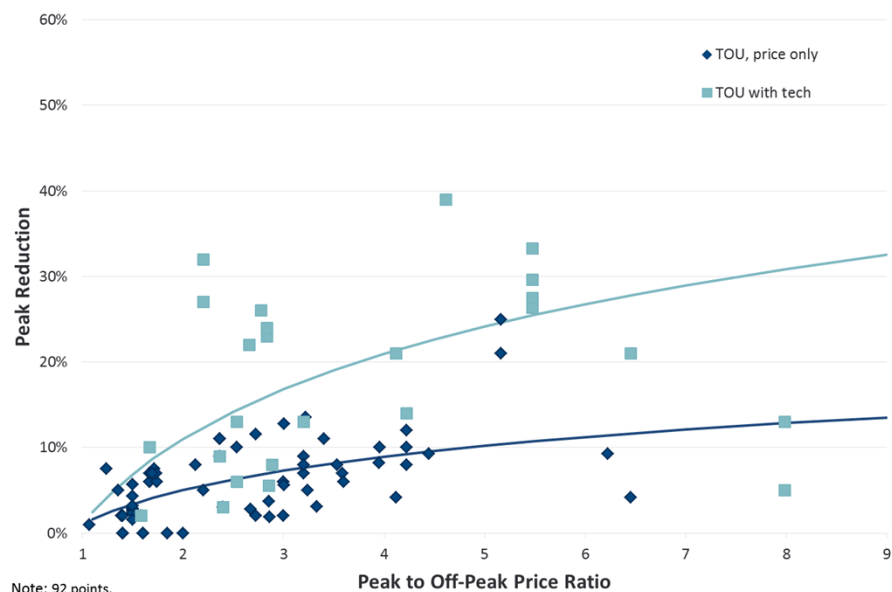
Dynamic Pricing Impacts (price only)



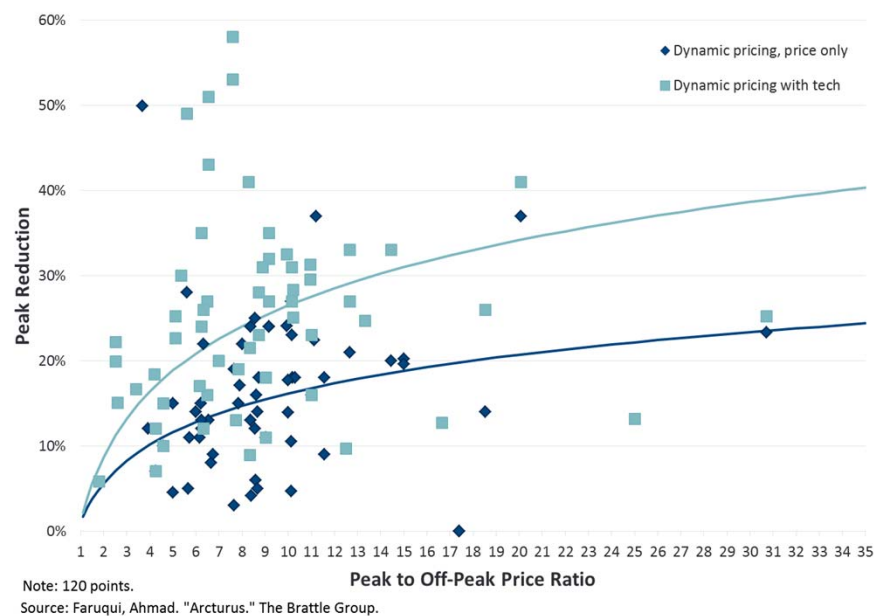
Note: 60 points.
Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

Enabling technologies boost demand response

TOU Impacts



Dynamic Pricing Impacts



The 4th wave

- ❖ More than 30 utilities today are offering demand charges, sometimes with energy-based dynamic pricing rates, to mitigate cross-subsidies caused by prosumers and by the slowdown in sales growth
- ❖ However, the only empirical evidence on customer response to demand charges comes from three older pilots
 - ❖ <http://www.sciencedirect.com/science/article/pii/S104061901400150X>

The 5th wave

- ❖ Customers subscribe to a “baseline” load shape, and sometimes to a given level of kW demand or monthly kWh energy consumption.
 - ❖ This directly addresses the bill volatility issue
- ❖ Customers buy or sell deviations from the baseline on the wholesale market.
 - ❖ Originally called demand subscription, this idea has morphed into “Transactive Energy”
 - ❖ A pilot funded by the CEC is being carried out with 200 customers in Thousand Oaks by SCE
- ❖ The idea has gained traction as Wi-Fi thermostats, digital appliances and home energy management systems have become ubiquitous
 - ❖ The millennials are really into “organic” conservation

Beyond default TOU– Ontario, Canada

- ❖ **For the past five years, some 90% of Ontario’s 4 million residential customers have been buying their energy through a regulated supply option which features a three-period TOU rate**
 - ❖ **They have reduced their peak demand by ~3% , based on a three-year analysis that we carried out for the IESO**
- ❖ **Knowing the limitations of TOU rates in the evolving energy market, the Ontario Energy Board (OEB) has authorized a series of dynamic pricing pilots that would allow those rates to be offered as supplements to the TOU rates**
- ❖ **The OEB has ruled that distribution charges will be collected through a fixed charge**
 - ❖ **The Texas PUC is watching the developments with interest**

Beyond TOU – Dynamic Pricing in Oklahoma

- ❖ **OGE rolled out a dynamic pricing rate coupled with a smart thermostat to its residential customers a few years ago**
 - ❖ **“Smart Hours” features variable peak pricing, or five levels of peak pricing depending on what day type it happens to be**

- ❖ **Some 130,000 customers are on that rate today; they control their thermostat setting, not OGE**
 - ❖ Average peak load has dropped by ~40%
 - ❖ Average bill savings amount to ~20% of the customer’s bill

Beyond TOU – Peak time rebates in Maryland

- ❖ Both BGE and PHI offer dynamic pricing rebates of \$1.25/kWh to their customers in Maryland (~ 2 million households), and bid in the load reductions into the PJM market
- ❖ At BGE, about 80% of its customers have taken advantage of the rebates and saved \$40 million in utility bills since the program began in 2013
- ❖ In 2015, BGE's PTR customers showed an average demand reduction of 16.2%, up from 14.5% in 2014 and 13.7% in 2013

Beyond TOU – the case of Australia

- ❖ **Customers already pay fixed charges for distribution that are a larger part of the total bill than in the US**
- ❖ **The distribution utilities are seeking to move their customers to fixed charges and demand charges to recover grid costs**
 - ❖ However the smart meter network is not yet in place
 - ❖ Retail providers may not pass on cost reflective prices
- ❖ **One distribution network is offering significant rebates for dynamic demand curtailment during peak times (~ \$5/kWh curtailed)**
 - ❖ Avoiding costly upgrade on low load factor feeder
 - ❖ Electricity rules say networks must consult alternative resources before building

Beyond TOU – United Kingdom

- ❖ **UK Power Networks (London) is piloting a peak time rebate targeted specifically at low income customers**
- ❖ **A couple of pilots have tested 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 looking at new ways to increase the role of price responsive demand, including the possible introduction of firms like Amazon and Google into the marketplace**

TOU rates in the UK

- ❖ **13% of customers are on a TOU rate (Economy 7) designed for customers with thermal energy storage**
 - ❖ The rate has been offered for many years, is based on old technology, and the number of participants is in decline
- ❖ **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 in an attempt to alleviate local distribution system constraints due to net excess solar generation**

Beyond TOU – CLP Hong Kong deploys PTR

Pilot with ~2,000 customers on PTR was carried out a few years ago

- It showed a peak reduction in the 15-20% range attributable to the dynamic rebate

The rollout of PTR is being expanded to some 27,000 customers

Beyond simple dynamic pricing of energy

- ❖ **The increasing penetration of rooftop solar technology, coupled in the future with battery storage, will make it difficult to equitably the costs of the grid with energy-only rates**
- ❖ **Customers will need to pay for being connected 24/7 to the grid**
- ❖ **That is why fixed charges and demand charges are being proposed by utilities throughout the globe**

Toward three-part tariffs

- ❖ Ideally, utilities will begin offering them to residential customers, just like have been doing for decades for commercial and industrial customers
 - ❖ Monthly service charge for revenue cycle services (meter, line drop, customer care)
 - ❖ Demand charge either for recovering grid capacity costs (either based on connected load or peak-coincident demand or a combination of both)
 - ❖ Dynamic energy charge (or rebate)

There are several barriers to tariff reform – Part I

- ❖ **Fear of the unknown**
 - ❖ This is equally pervasive among customers, utilities and regulators
- ❖ **Bills will rise for some customers who might complain**
 - ❖ Even though bills will fall for other customers, they will remain silent
- ❖ **The new rates would not be understood by customers and sow confusion and distrust of the utilities**
- ❖ **Low income customers and small users will be harmed by the new rates**

There are several barriers to tariff reforms – Part II

- ❖ **Customers with disabilities will be harmed by the new rates**
- ❖ **Customers will not respond to the new rates**
- ❖ **The rates will fail to promote economic efficiency or equity**
- ❖ **The rates will require new meters and billing systems**
- ❖ **The rates will impose an extra load on customer service staff**
- ❖ **Revenue volatility will rise**

Moving ahead with tariff reforms – I

- ❖ Understand how customer bills will change if the new rates are implemented immediately
 - ❖ Identify how much bills will rise for small users
 - ❖ Find ways to mitigate these bill impacts
- ❖ Simulate the impact of the rates to study the likely customer response
 - ❖ Models are available for carrying out such simulations
- ❖ Engage in a customer outreach program to explain why tariffs are being changed
 - ❖ Make sure the new rates use clear and understandable language
 - ❖ Enlist neutral parties to endorse the change
 - ❖ Use social media to spread the word

Moving ahead with tariff reforms – II

- ❖ **Change the rates gradually over a three-to-five year period or provide bill protection that is gradually phased out**
- ❖ **For the first few years, make the rates optional for low income, small users and disabled customers**
 - ❖ **Or provide financial assistance for a limited period of time**
- ❖ **Consider a subscription concept in which customers “buy” their historical usage and the historical price and buy or sell deviations from that usage at the new tariffs (transactive energy)**
- ❖ **Conduct pilots to test customer acceptance and load response to the new rates, not just to simple TOU energy-only rates**

Conclusions

- ❖ **Tariff reform has evolved through five waves since the late 1970s**
- ❖ **While many pilots have shown that customers respond to time-varying rates, there is a reluctance among policy makers, regulators and utilities to move ahead with new tariffs because of strongly-held misperceptions about how they will affect customers**
- ❖ **We have explored several ways in which the transition to new tariffs can be carried out without triggering a social revolt**
- ❖ **It may be helpful to test the newer tariffs of the 4th and 5th waves through well-designed scientific experiments**

Selected Papers

Primary

Faruqui, Ahmad and Mariko Geronimo, "Moving Forward with Tariff Reform," *Regulation*, forthcoming, 2017.

Secondary

1. "The Impact of Time-of-Use Rates in Ontario," with Neil Lessem, Sanem Sergici, and Dean Mountain, *Public Utilities Fortnightly*, February 2017.

<https://www.fortnightly.com/fortnightly/2017/02/impact-time-use-rates-ontario>

2. "Dynamic pricing works in a hot, humid climate: evidence from Florida," with Neil Lessem and Sanem Sergici, *Public Utilities Fortnightly*, May 2017

<https://www.fortnightly.com/fortnightly/2017/05/dynamic-pricing-works-hot-humid-climate>

3. "Curating the Future of Rate Design for Residential Customers." With Wade Davis, Josephine Duh, and Cody Warner. *Electricity Daily*, 2016.

4. "Efficient Tariff Structures for Distribution Network Services," With Toby Brown and Lea Grausz, *Economic Analysis and Policy*, 2015.

Selected papers II

5. “Smart By Default,” with Ryan Hledik and Neil Lessem, *Public Utilities Fortnightly*, August 2014.

<http://www.fortnightly.com/fortnightly/2014/08/smart-default?page=0%2C0&authkey=e5b59c3e26805e2c6b9e469cb9c1855a9b0f18c67bbe7d8d4ca08a8abd39c54d>

6. “Dynamic Pricing in a Moderate Climate: The Evidence from Connecticut,” with Sanem Sergici and Lamine Akaba, *Energy Journal*, 35:1, pp. 137-160, January 2014.

7. “Arcturus: International Evidence on Dynamic Pricing,” with Sanem Sergici, *The Electricity Journal*, 26:7, August/September 2013, pp. 55-65.

<http://www.sciencedirect.com/science/article/pii/S1040619013001656>

8. “Dynamic Pricing of Electricity for Residential Customers: The Evidence from Michigan,” with Sanem Sergici and Lamine Akaba, *Energy Efficiency*, 6:3, August 2013, pp. 571–584.

9. *Time-Varying and Dynamic Rate Design*. With Ryan Hledik, and Jennifer Palmer. Global Power Best Practice Series, The Regulatory Assistance Project (RAP), 2012.

Selected papers III

10. “Dynamic Pricing of Electricity and its Discontents” with Jennifer Palmer, *Regulation*, Volume 34, Number 3, Fall 2011, pp. 16-22.

<http://www.cato.org/pubs/regulation/regv34n3/regv34n3-5.pdf>

11. “Dynamic pricing of electricity in the mid-Atlantic region: econometric results from the Baltimore gas and electric company experiment,” with Sanem Sergici, *Journal of Regulatory Economics*, 40:1, August 2011, pp. 82-109.

12. “California: Mandating Demand Response,” with Jackalyne Pfannenstiel, *Public Utilities Fortnightly*, January 2008, pp. 48-53.

http://www.fortnightly.com/display_pdf.cfm?id=01012008_MandatingDemandResponse.pdf

13. “Quantifying Customer Response to Dynamic Pricing,” with Stephen S. George, *Electricity Journal*, May 2005.

Selected Papers IV

14. "2003 Manifesto on the California Electricity Crisis," with William D. Bandt, Tom Campbell, Carl Danner, Harold Demsetz, Paul R. Kleindorfer, Robert Z. Lawrence, David Levine, Phil McLeod, Robert Michaels, Shmuel S. Oren, Jim Ratliff, John G. Riley, Richard Rumelt, Vernon L. Smith, Pablo Spiller, James Sweeney, David Teece, Philip Verleger, Mitch Wilk, and Oliver Williamson. May 2003.

<http://www.aei-brookings.org/publications/abstract.php?pid=341>

15. "Analyzing California's Power Crisis." With Hung-po Chao, Vic Niemeyer, Jeremy Platt, and Karl Stahlkopf. *The Energy Journal* 22, no. 4 (2001): 29–52

16. "Residential Demand for Electricity by Time-of-Use: A Survey of Twelve Experiments with Peak Load Pricing." With J. Robert Malko, *Energy* 8, no. 10 (1983): 781–795.

Presenter Information



AHMAD FARUQUI, PH.D.

Principal | San Francisco, CA

Ahmad.Faruqui@brattle.com

+1.415.217.1026

Ahmad Faruqui's consulting practice is focused on the efficient use of energy. His areas of expertise include rate design, 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. These include electric and gas utilities, state and federal commissions, independent system operators, government agencies, trade associations, research institutes, and manufacturing 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, 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. His research has 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 holds BA and MA degrees from the University of Karachi, an MA in agricultural economics and Ph. D. in economics from The University of California at Davis.

The views expressed in this presentation are strictly those of the presenter(s) and do not necessarily state or reflect the views of The Brattle Group.