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Moving Forward with Tariff Reform: A Global Survey

PRESENTED TO

California Energy Commission
Sacramento, California

PRESENTED BY

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THE Brattle GROUP

The history of tariff reform

1st Wave
Initial E-TOU Pilot Programs

2nd Wave
Limited Adoption of E-TOU Rate Design

3rd Wave
More Sophisticated Pilots & Initial Smart Grid Deployment

4th Wave
Addition of Res. Demand Charges & Broader Smart Grid Deployment

5th Wave
Smart Homes & Transactive Energy

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

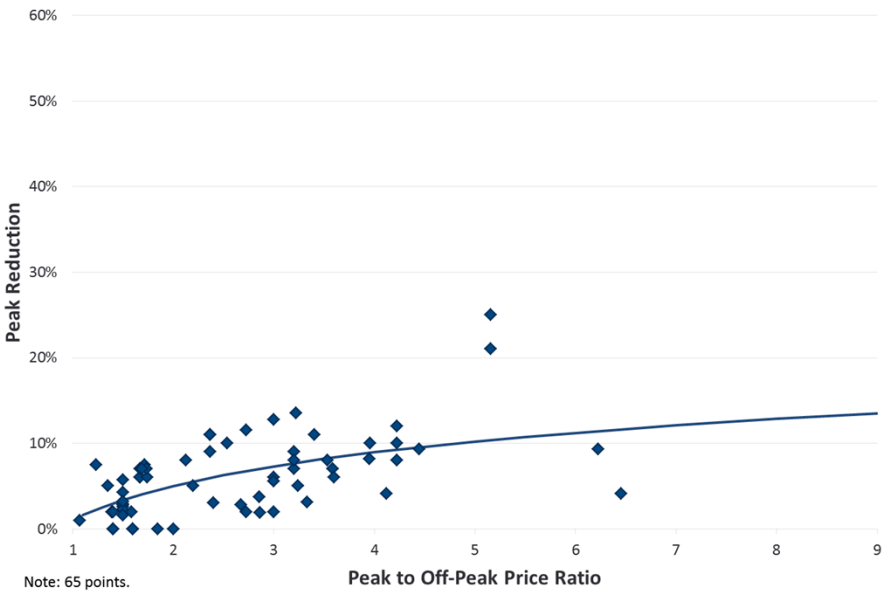
- In the mid 1980s, EPRI took the results from the top five pilots and found consistent evidence of consumer behavior
- Unfortunately, not much happened in the late 1980's and most of the 1990's because of the lack of smart metering and the onset of restructuring
- However, a few utilities did move ahead 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

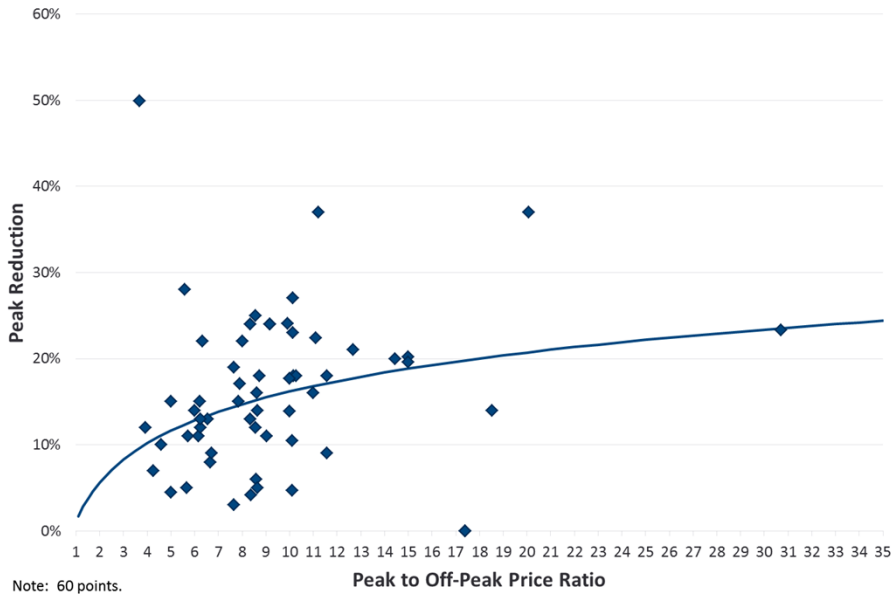
TOU Impacts (price only)



Note: 65 points.

Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

Dynamic Pricing Impacts (price only)

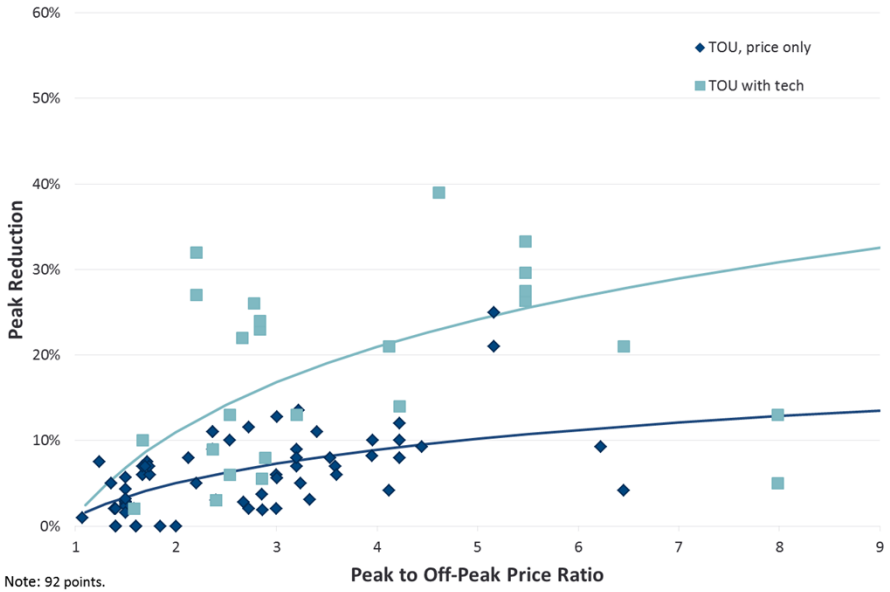


Note: 60 points.

Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

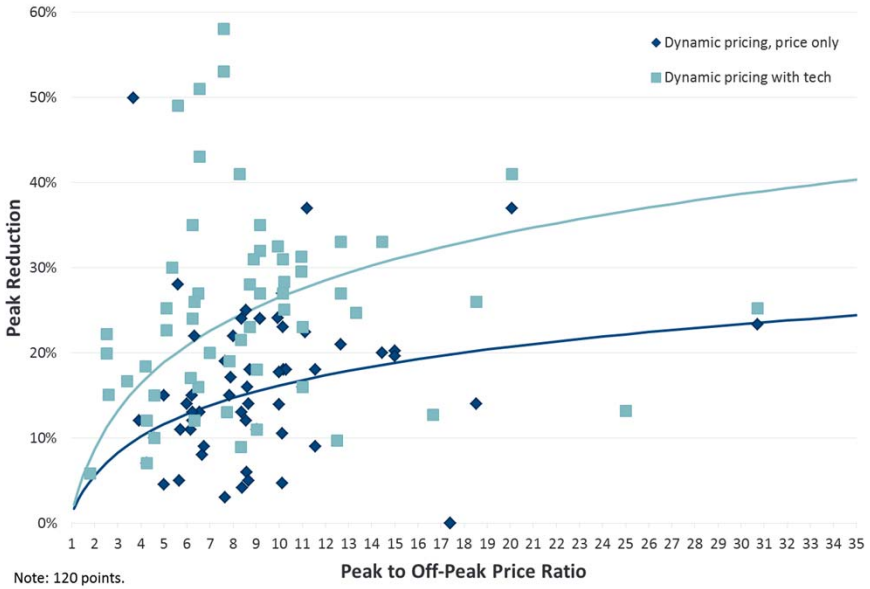
Enabling technologies boost demand response

TOU Impacts



Note: 92 points.
Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

Dynamic Pricing Impacts



Note: 120 points.
Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

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 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

- In the same year, PHI's companies reported savings of 12.3% (Delmarva) and 16.5% (Maryland)

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 reform – 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 reform – 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 reform – 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
- But there are 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

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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.

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