

# Workshop on Pricing Reforms

## PRESENTED TO

Energy Networks Association  
Wellington, New Zealand

## PRESENTED BY

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October 17, 2017



# Agenda

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## The new frontiers of tariff design:

### Developments and evidence from around the world

- Tariff designs of the future
- International developments
- Empirical evidence on time varying tariffs
- Empirical evidence on demand charges

## Behavioral economics:

### Retail competition re-examined

- Introduction to behavioral economics
- Key concepts
- Behavioral economics and competition

## ENA pricing questions

# **A variety of new technologies have begun to appear in customers' premises**

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**Smart Wi-Fi enabled thermostats**

**Digital appliances that can talk to each other**

**Electric vehicles in the driveway**

**Battery storage in the garage**

**PV panels on the roof**

**Micro CHP**

# Customers are beginning to meet their own needs

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This has caught the industry off guard; some people are wondering if “distributed generation” may spell doom and gloom for the industry

Of course, self production (*i.e.*, distributed generation) has been around for a long time in other industries

- Back in 1980, the futurist, Alvin Toffler, coined the term *prosumers* in his book, *The Third Wave*

In the electric industry, co-generation, or combined heat and power (CHP), has been around for almost a century among large customers

# The time has come to move forward with tariff reform

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**But it is unclear whether customers (or boards) will accept the new tariffs**

- Tariff changes create winners and losers

**The industry has often imposed products and services on customers without assessing customer needs**

- *E.g.*, energy efficiency, demand response, time-varying rates ...
- Customers often can't grasp the language of tariffs

**The industry needs to understand the services that customers want**

# Rate designs of the future

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Guaranteed bill (regardless of usage and load shape)

Guaranteed bill with discounts for demand response

Simple energy-only (volumetric) tariffs with a modest customer charge

Time-of-use energy-only tariffs

Demand charges with and without time-of-use energy tariffs

Peak time rebates

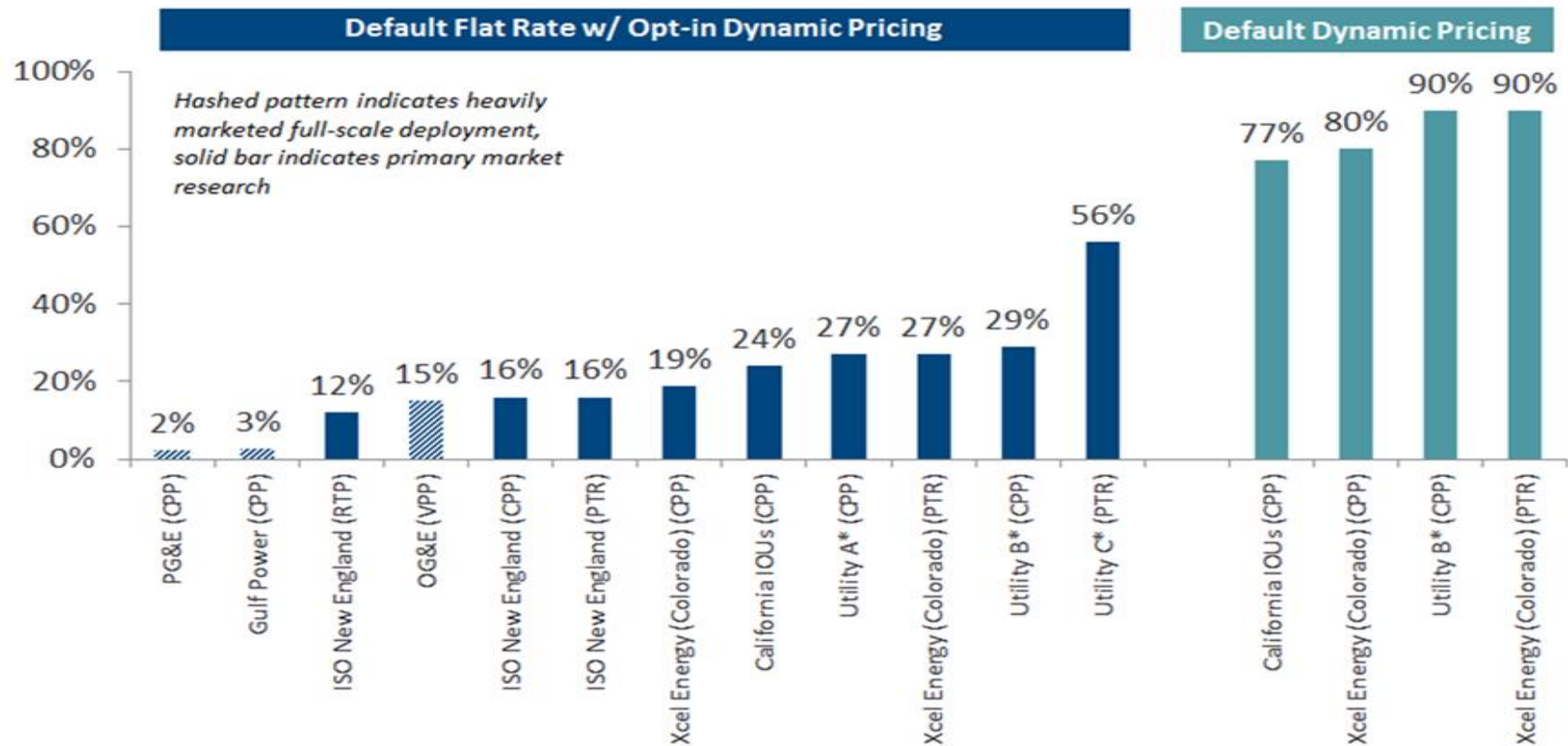
Critical peak pricing

Variable peak pricing (*e.g.*, at OGE)

Real-time pricing (half hourly or hourly)

Transactive energy (or peer-to-peer transactions)

# The number one predictor for enrollment in a tariff is whether it is the default or not



\*Utility identity is concealed because study results have not yet been made public  
Pepco and BGE have deployed a default residential PTR. Results forthcoming.

# **In some jurisdictions, cost-based tariffs are the default tariff**

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**Spain offers real-time pricing as the default regulated supply option and about half of all customers have elected to stay on it**

**Ontario has made TOU tariffs the default supply option**

- The rates vary seasonally and feature three periods in each season
- Some 90% of customers are on that tariff

**California is planning to roll out TOU tariffs to all residential customers by 2019**

- A pilot to test default deployment will be implemented next year

# Developments in Ontario (Canada)

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**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, the Ontario Energy Board (OEB) has authorized 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

# Developments in Oklahoma

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**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

# Developments in Maryland

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**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**

**The Maryland Commission may authorize new pilots to be done with time-of-use rates**

# Developments in Australia

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**A distribution network in Victoria 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

# Developments in the UK

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**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**

# Developments in the UK (concluded)

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**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

**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**

# Developments in Hong Kong

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**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**

# Moving ahead with tariff reforms

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**Any improvement in tariffs to make them more cost-reflective will instantly benefit some customers and adversely affect other customers**

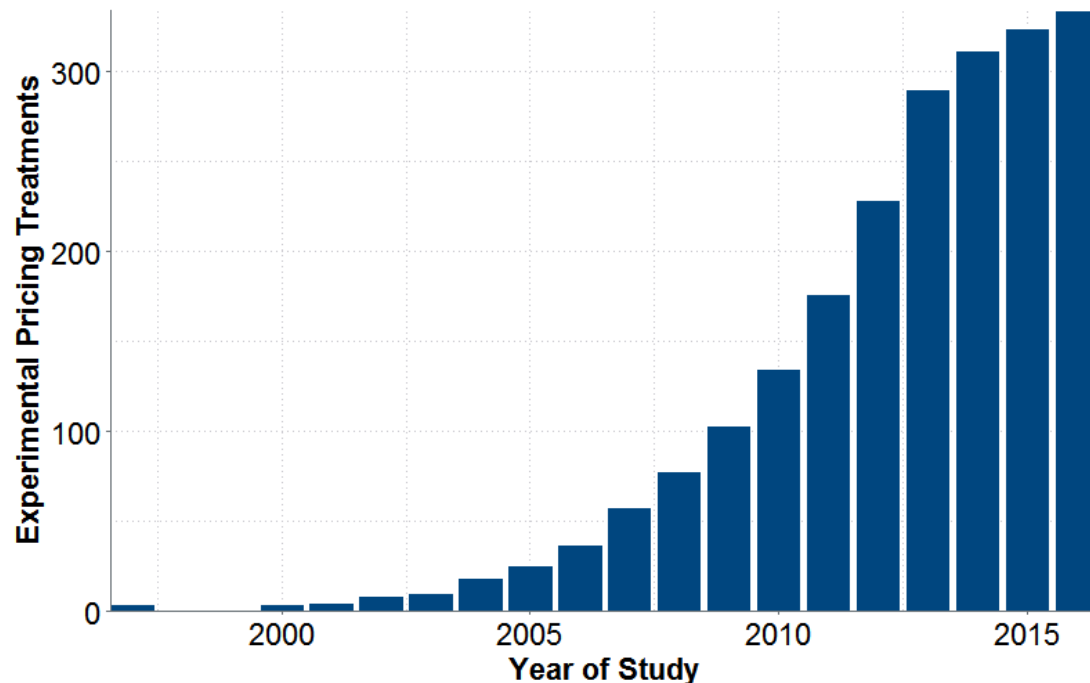
**There is a special concern among policy makers about the impact on low income customers and customers with disabilities**

**Bill protection has often been offered to such customers and it has also been suggested as a mechanism to protect all customers in the near term**

# Utilities have tested cost-based tariffs in pilots across the globe

Studies of time-varying rates have become increasingly popular

At least nine countries spanning four continents have piloted time-varying rates



Source: Ahmad Faruqui and Cody Warner, "Arcturus 2.0: International Evidence on Dynamic Pricing," (forthcoming).

# The impacts of customer load-shifting vary by price ratio and rate design

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## Pilots feature a combination of rate designs

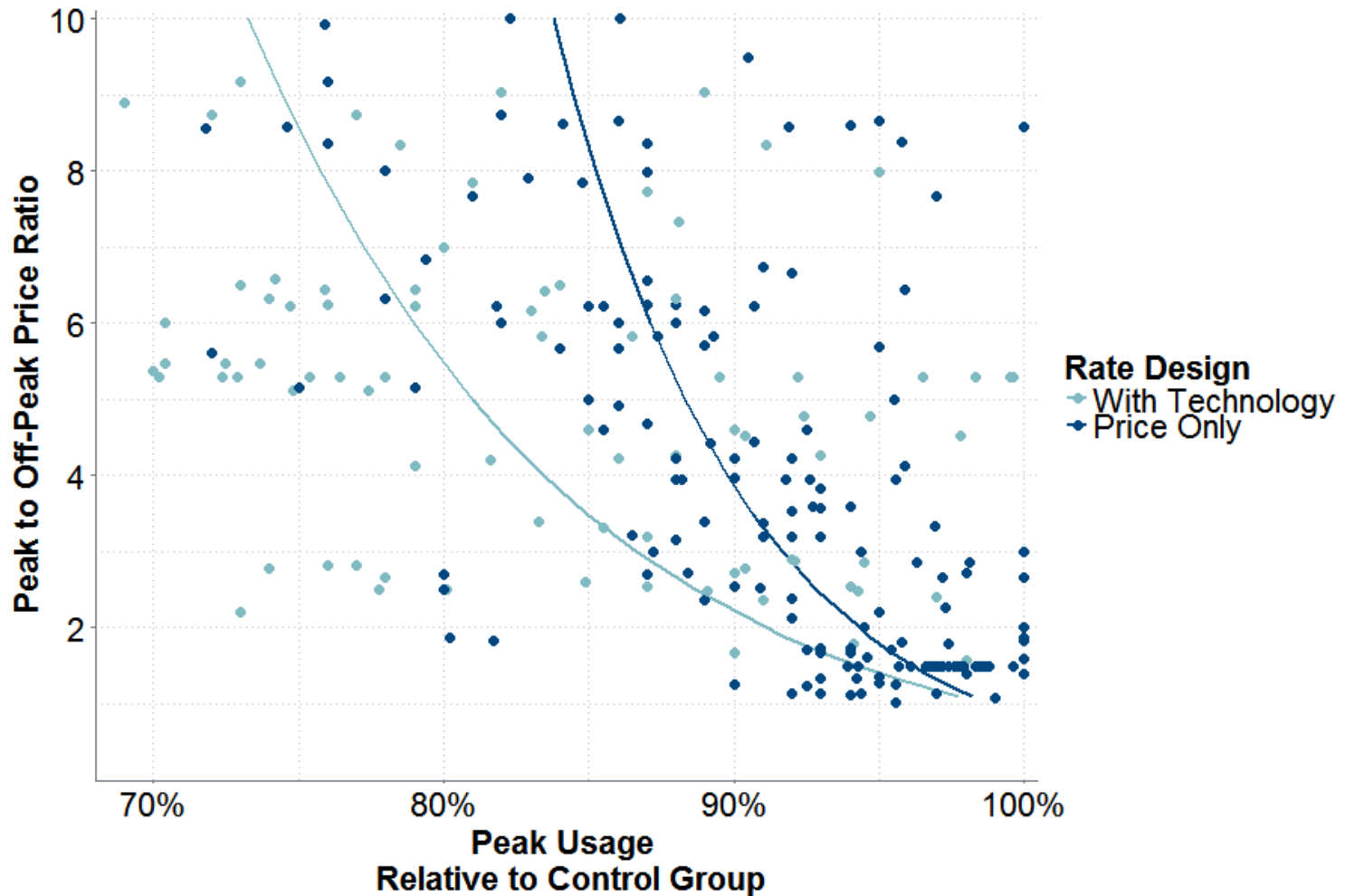
- Time-of-use, critical-peak pricing, peak-time rebates, and variable-peak pricing

**On average, residential customers reduce their on-peak usage by 6.5% for every 10% increase in the peak-to-off-peak price ratio**

**In the presence of enabling technology, such as smart thermostats, the effect is stronger**

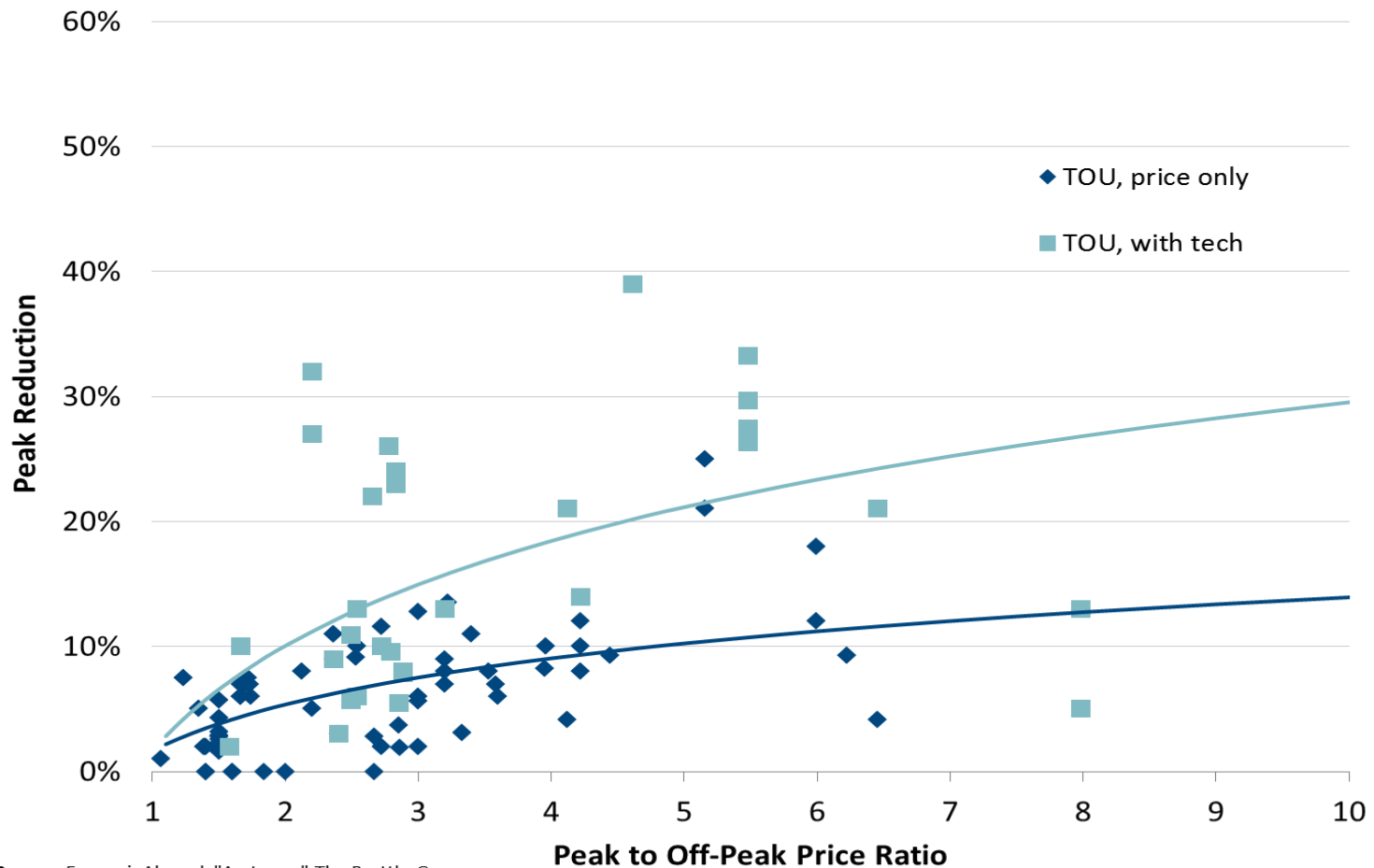
- On average, customers enrolled on time-varying rates that offer enabling technologies reduce peak usage by 11.1% for every 10% increase in the price ratio

# Customers' responses resemble a downward-sloping demand curve



Source: Ahmad Faruqui and Cody Warner, "Arcturus 2.0: International Evidence on Dynamic Pricing," (forthcoming).

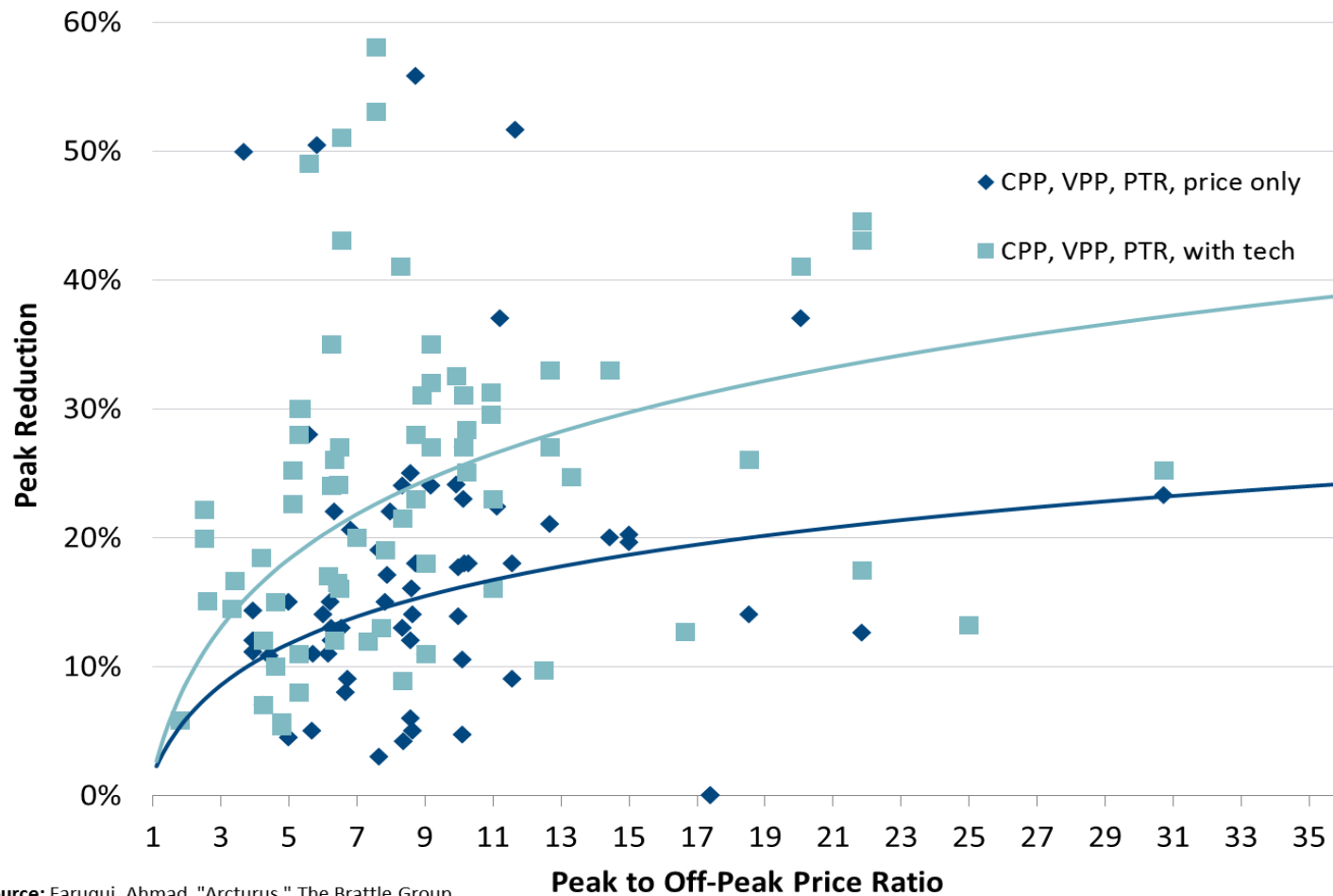
# Customer response to TOU increases with the peak to off-peak price ratio



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

Notes: Chart includes 67 data points from TOU pricing treatments without enabling technology and 30 data points with enabling technology.

# Likewise for dynamic prices



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

Notes: Chart includes 68 data points from dynamic pricing treatments without enabling technology and 70 data points with enabling technology.

# Demand charges

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**Capacity charges based on the size of the connection are mandatory for residential customers in France, Italy, and Spain**

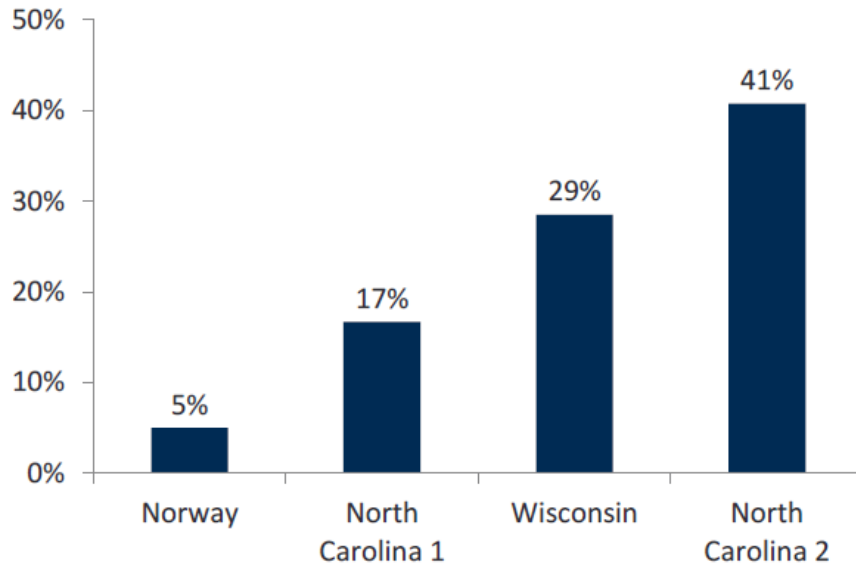
**Demand charges are being offered by more than 30 utilities in the U.S. as an optional tariff**

**Utilities such as Arizona Public Service, NV Energy, and Westar Energy have filed applications to make them a mandatory tariff for customers with PVs on their roof**

- Salt River Project in Arizona, a municipally owned system, has instituted a mandatory tariff for DG customers
- The Kansas Corporation Commission has ordered that DG customers be considered a separate class and be offered three-part rates, among other options

# Three experimental pilots have detected significant response to demand charges

## Average Reduction in Max Demand



*Note: North Carolina was analyzed through two separate studies using different methodologies; both results are presented here*

## However...

- Two of the pilots are old and the third is from a unique climate
- The impact estimates vary widely
- Findings are based on small sample sizes
- New research is needed

# Conclusions

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**Tariff reform has evolved through five waves since the late 1970s**

**300+ pilots have shown that customers respond to time-varying energy-based rates so doing more pilots with such rates should not be a top priority**

**The rural cooperatives have been among the industry leaders when it comes to introducing demand charges**

**Whenever possible, we should design and rollout new pilots featuring three-part rates with demand charges and time-varying energy rates**

**At some point, it would also be useful to design pilots designed to test customer acceptance and response to transactive energy**

# Introduction to behavioral economics and competition

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**Much of the literature on electricity pricing is driven by economic theory and doesn't consider:**

- Evidence from network industries that operate competitively
- Actual consumer behavior or attitudes
- How network prices are passed on to consumers by retailers
- Evidence from different jurisdictions

**In this presentation we will**

- Examine the evolution of cost structures and prices for mobile wireless networks in New Zealand— a competitive network industry
- Examine how behavioral economics influences our conclusions on retail competition and how customers respond to prices
- Outline next steps with regards to:
  - Evidence from different jurisdictions around the world

# Many policy prescriptions are based on the *theoretical* assumptions underlying neoclassical economics

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## Neoclassical economics assumes that:

- People hold rational preferences
- Individuals maximize utility, firms maximize profits
- People act independently on the basis of full and relevant information

## Behavioral economics, on the other hand:

- Uses insights from psychology and experimental economics to explain actual consumer behavior
- Explains why consumers in certain contexts act in a way that does not follow from the traditional economics framework

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## ENA pricing questions

# The way information is presented can affect consumer preferences

- The evaluation of probabilities and outcomes may be different when the same problem is framed in different ways (Tversky and Kahneman 1981)

Public Health Programs

Problem 1

Program A: 200 lives will be saved.

Program B: 1/3 probability of saving 600 lives, and 2/3 probability of saving no lives.

Problem 2:

Program C: 400 people will die.

Program D: 1/3 probability that no one will die; 2/3 probability that 600 people will die.

- Where consumers are required to make a choice along a spectrum, they can be heavily influenced by anchoring effects
  - Ariely, Loewenstein, and Prelec (2006) asked MIT students to bid on items using the last two digits of their social security numbers as an anchor. They found that people with higher social security numbers paid up to 346 percent more than those with low numbers

## More options increases the desire to delay decision-making, to choose the default option or rely on heuristics (rules of thumb)

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- Iyengar and Lepper (2000) showed that people are more likely to purchase gourmet jams or chocolates or to undertake optional class essay assignments when offered a limited array of 6 choices rather than a more extensive array of 24 or 30 choices. Moreover, participants actually reported greater subsequent satisfaction with their selections with a limited selection of choices

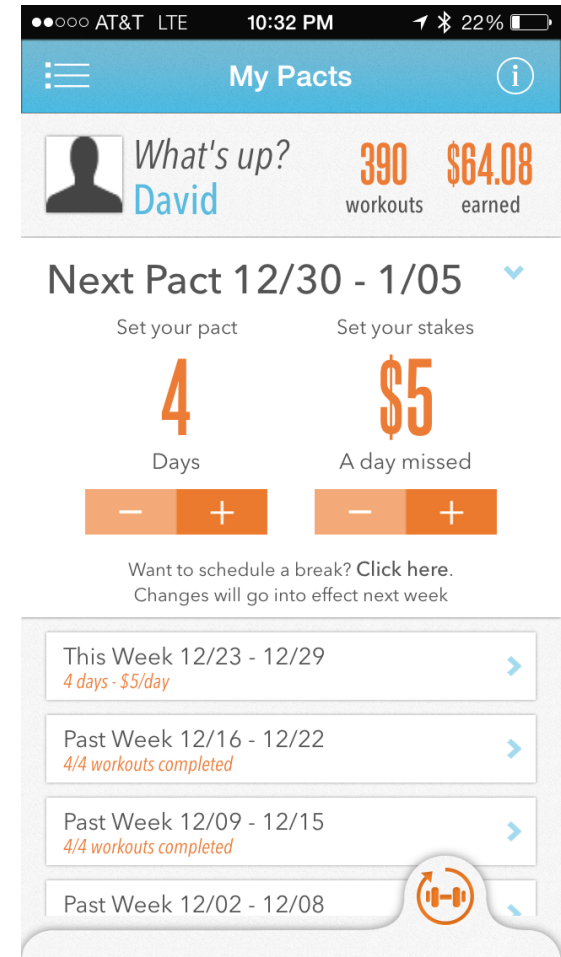
# Research shows that consumers place more emphasis on the present and heavily discount the future

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- Laibson (1997) used the decisions of a time-inconsistent consumer to explain a model that accounts for self-control problems where agents have difficulty sticking to their long-term goals
- Loewenstein and Prelec (1992) showed that people are not always time consistent and proposed a framework to analyze discounted utility anomalies
- A 2004 U.K. BIT experiment of 600,000 credit card holders showed that the study subjects were 13% more likely to accept a low introductory offer for a short period even though they would have been better off with the slightly higher interest rate lasting for a longer period of time

# Consumers tend to over-estimate their abilities, motivation, and knowledge

- A familiar empirical example is consumers signing up for gym membership and then not using it
- This could be explained by both overconfidence and hyperbolic discounting of future pay-offs
- Compared to naïve consumers, who exhibit time-inconsistent behavior, sophisticated consumers, who realize their bias and try to anticipate future performance, can bind themselves to contracts to achieve their goals
  - Apps and websites (e.g. Pact and StickK, respectively) use monetary rewards/fines to influence users' future behavior



Source: January 2013 review of GymPact on iMedicalApps

# Neoclassical economics assumes that large numbers of buyers and sellers are sufficient for competition

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**Competition among firms pushes the price down to long run marginal cost**

- Productive and allocative efficiency

**Firms do not have market power**

- Cannot set price above long run marginal costs

**No need to look at demand side, just supply**

# Neoclassical economic model implies that retailer will pass through network costs

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**Competitive market for commodity**

**Retailers have no market power**

**Customers either pay network costs directly or a premium to avoid them**

- Consumers have different risk/reward preferences with respect to their exposure to cost reflective tariffs
- The cheapest bundles will pass network costs directly through to customers
- Alternative pricing increases the risk to the retailer and they will need to charge a premium above long-run marginal cost

# Behavioral economics raises the prospect that retailer prices may not be cost reflective

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## Behavioral biases may undermine competition

- Even if there are a large number of buyers and sellers

## Electricity customers may:

- Find it hard to assess available information and compare across similar products/services
- Overestimate future use, underestimate cost, and overweigh the present
- Resort to heuristics, or rules of thumb, when faced with too many options
- Defer decisions/actions indefinitely

## Retailers may have an incentive to use biases to increase market power:

- Retailers may introduce search and switching costs through pricing frames and complexity to lessen price competition
- Retailers may use pricing frames to influence consumer behavior

# Competitiveness of retail markets around the world is being challenged...

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## In the UK a two year review of retail markets was undertaken by the Competition Market Authority (CMA)

- “We would expect competition in a well-functioning retail market to be largely on price”
- “[T]here is a wide variation in the prices that different domestic customers pay for energy, which is particularly striking since electricity and gas are entirely homogenous products”
- “[O]ver the period Quarter 1 (Q1) 2012 to Quarter 2 (Q2) 2015, most customers of the Six Large Energy Firms could have made considerable savings from switching”
- “Some suppliers have a position of unilateral market power, arising from the extent of customer lack of engagement in the market, and that these suppliers have the ability to exploit such a position, for example, through price discrimination by pricing their standard variable tariffs materially above a level that can be justified by cost differences”

# Competitiveness of retail markets around the world is being challenged...

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**Numerous reviews of retail competition are currently underway in Australia, including a recent report by the Grattan institute:**

- “[T]he average household on its incumbent retailer’s market offer could have saved between \$94 and \$164 a year if it had signed up to the lowest available offer.”
- “Many electricity plans are advertised with a focus on the discount that applies rather than a dollar amount. Which raises the question: a discount from what? Consumers who think they will get a reduction if they switch retailer may be sorely disappointed...The monthly bill for a typical household is similar for most of [a selection of electricity] retailers. Yet the advertised discounts vary from zero to 33 per cent. Consumers can pay less with the retailer that advertises no discount than with another that advertises a 30 per cent discount.”

**Previous inquiry by the AEMC**

**Current inquiries by ACCC and Victoria DELWP**

# Competitiveness of retail markets around the world is being challenged...

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## United States

- Texas Coalition for affordable power (TCAP) says rates higher than regulated jurisdictions
- But there has been convergence
- Possibly more innovation than other markets

## Canada

- Fewer than 10% of customers in Ontario on retail rates (despite TOU)
- Retailers targeted customers with low electricity literacy

## New Zealand?

- “Just over half of all consumers have switched electricity supplier once or more in the last five years and this proportion is increasing in about half of all regions.”
- 70% of customers have smart meters (innovation)

# This is supported by a new but growing academic literature

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## **Gabaix and Laibson (2009)**

- Bad behavior not necessarily driven out by competition
  - If market can segment

## **Spiegler (2011)**

- Customers extrapolate from small amounts of information
- Firms have incentive to obfuscate pricing to make extrapolation less accurate
  - Change prices overtime, or introduce complex-multi-dimensional prices

## **De Roos (2015)**

- Price obfuscation can be used to sustain collusion

# **We conclude that cost reflective network prices alone may not result in efficient retail tariffs**

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**The competitiveness of retail electricity markets is being questioned in a number of jurisdictions**

**A growing academic literature says that in the presence of behavioral biases, prices can be used to create market power**

- Neoclassical model assumes price competition

**Retail market reforms that address behavioral biases could make markets more competitive**

- Resulting in efficient retail tariffs

**Focusing on tariffs that benefit or bypass retailers may be necessary**

# **Peak time rebates have emerged as a very popular option in several jurisdictions**

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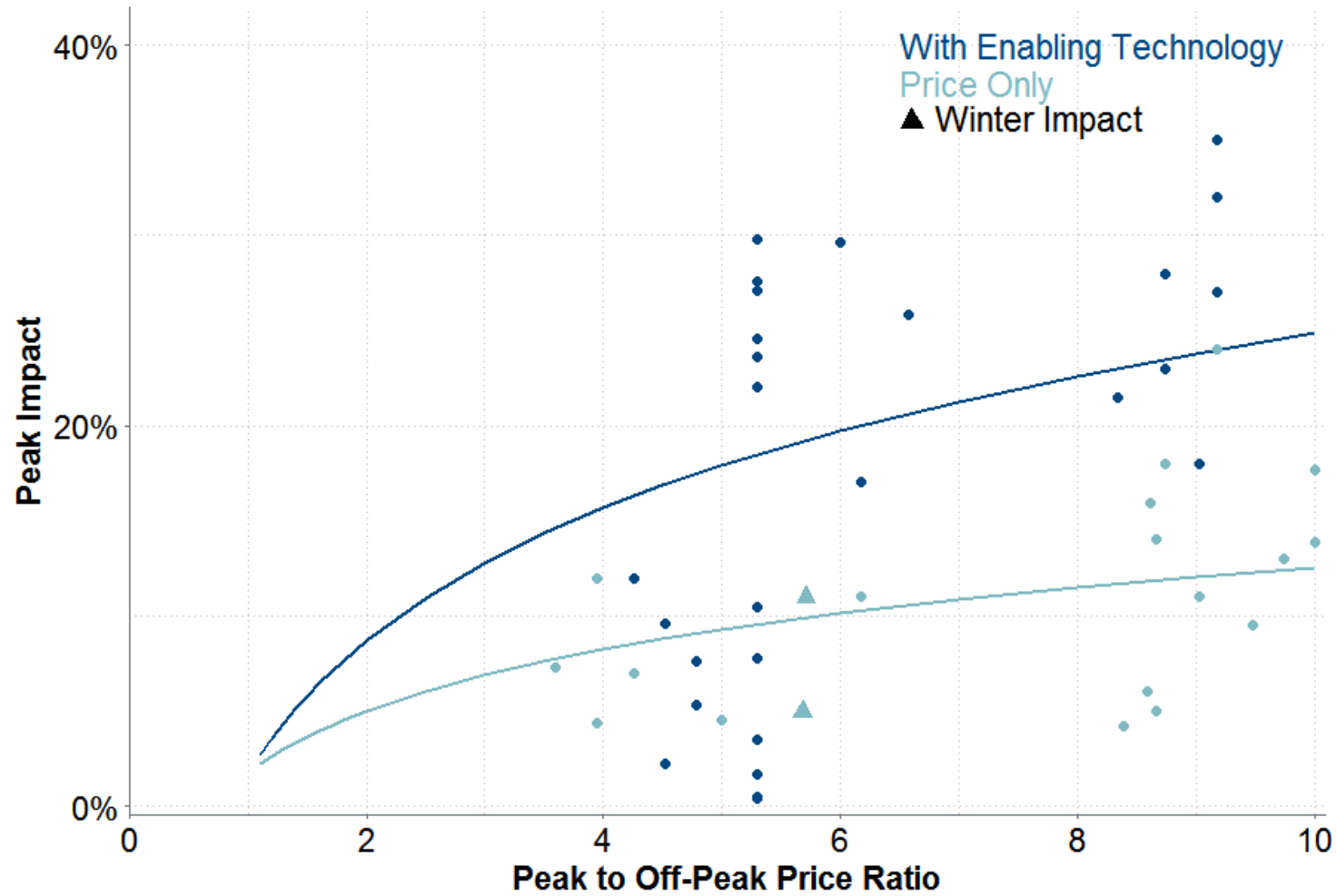
**They are seen as having no downside for any customer**

**They also have a significant upside for those who chose to lower their demand during dynamically-called peak periods**

**They have been shown to reduce peak loads dynamically consistently**

**They benefit retailers and can be enacted on top of existing retail rates**

# The impact of peak time rebates on peak demand can be quite significant



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# RIGHT GOAL ?

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**Q: Most pricing reform options here and overseas seem oriented toward reducing consumption or demand/load. Do you think this is really the right goal for pricing reform for Distributors? What else do you think the focus of reform should be?**

- Conservation is a goal since electricity prices do not encapsulate the full cost of producing energy.
  - In New Zealand where 80% of generation is renewable, this may be less pressing.
- Peak or demand management however has many objectives, such as reducing unintended subsidies, encouraging efficient consumer investments and behavior, discouraging uneconomic grid bypass and avoiding or deferring network investment and high energy costs.
- Another goal would be **flexibility** - prices should encourage consumers to invest in flexible equipment that can adapt to the varying nature of price signals emanating from a rapidly changing grid.

# OPTIONS OVERLOAD:

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**Q: It's clear from research that too many options can just push people toward cognitive biases like sticking with default options. How many options do you think is *optimal* to help customers make decisions or to encourage change?**

- Possibly more about how options are communicated than necessarily the number of options.
- For example, standards on retail advertising can reduce the dimensionality of the problem, while recommendation engines, powered by smart data, can limit choices to those options that are most relevant.
- The key is having the right data available and the right rules and incentives in place.

# SEGMENTATION VS AGGREGATION:

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**Q: Insights from Brattle and CSIRO research (among others) highlight that customers are not homogenous in terms of either their willingness or capability to change, e.g. renter's vs owners, high vs low income, housing infrastructure, etc. Yet most reform targets residential consumers as a single group. What role do you see for greater segmentation in the future of pricing reform (i.e. beyond obvious segments like solar / distributed generation)?**

- Again, reducing the dimensionality will enable customers to make meaningful choices.
- I think more options are good as long as they are not used to confuse consumers into inaction or bad choices.

# THEORY VS PRACTICE OF BEHAVIOURAL ECONOMICS:

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**Q: Quite a bit of available research on customers likelihood to take up pricing options designed through a behavioural economics lens still seems to show that they don't out-perform 'control' options. Even though they may outperform non behavioural economics options, customers overwhelmingly seem to still prefer the default / current option.**

- Customers definitely have a default bias, but I think that is independent of dynamic prices. Some customers will like control some won't.
- For example 130,000 OGE customers (16%) opted in to a dynamic rate

**Q: What do you think is missing between the theory and the practical application of behavioural economics in electricity pricing? What else would generate better results against control benchmarks?**

- Setting defaults, creating the right incentives for retailers, creating tariffs that are meaningful and understandable by customers through experimentation and testing

# TARGETTING RIGHT AUDIENCE IN VALUE CHAIN:

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**Q: Current reform trials primarily directly target the end consumer to effect change. What are your thoughts on whether targeting others in the electricity value chain would generate more change in end demand and consumption? E.g. appliance manufacturers, appliance retailers, builders, electricians, electricity retailers (who do the billing in nz), etc. In other words who is the right audience to effect change?**

- To some extent customers create demand for services, but to another there are economies of scale and behavioral biases that inhibit customers.
- Builders etc. can really impact conservation. Device standards are essential in creating an internet of things type grid.
- Retailers need to face the correct incentives to promote efficient pricing.
- But once the field is nicely laid out, it is up to consumers. (i.e. all of the above have a role to play).

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# Presenter Information

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Neil Lessem is an expert on consumer behavior and energy markets. He has assisted clients around the world on issues such as wholesale market design, regulated tariffs and cost allocation, innovative customer and pricing programs, and policy impact measurement.

He has worked with more than 50 clients across North America, Asia-Pacific and the Middle-East. His clients include regulators, policy makers, utilities, system operators, consumer representatives, tech startups and infrastructure owners. He has published in peer-reviewed journals such as the *Journal of Economics and Environmental Management and Business and Society*; and trade journals such as *The Electricity Journal* and the *Public Utilities Fortnightly*. He has presented on pressing energy topics to audiences in Brazil, Hong Kong, the United States, Canada, Malaysia and Hong Kong. In his graduate studies, Neil Lessem conducted extensive research examining consumer adoption of environmentally-friendly products and conservation behaviors, utilizing both field experiments and utility data.

He holds a Ph.D. and M.A. in Economics from the University of California, Los Angeles and an honours degree in Business, Economics and History from the University of Cape Town.

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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.

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