Time-Variant Pricing (TVP) in New York

The REV agenda and residential time-variant pricing
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THE Brattle GROUP

New York’s initiative to reform its energy vision could not be more timely

“The future, though imminent, is obscure” – Winston Churchill

But several forces that will shape the future are already visible

- The emergence of a new generation of “organic consumers”
- Continued innovation in digital technologies
- Distributed energy resources
- Smart meters

Rate design, which has stagnated for a century, is about to undergo revolutionary change

The coming revolution in rate design

Flat rate pricing (FRP) has been ubiquitous in residential rate design, not just in the US but globally

FRP has persisted because of two reasons

- Lack of advanced metering
- A concern that residential customers won't understand either time-variant prices or demand charges

The industry has begun moving to a three part rate, comprised of a monthly service charge, a demand charge and TVP

- Such rates have a long history for commercial and industrial customers, backed up by a storied academic tradition dating back to Hopkinson and Wright

Who is the organic consumer?

- Individuals who are passionate about controlling their energy use not only to save money but also to lower greenhouse gas emissions and leave a better legacy behind
- Energy efficiency comes naturally to the organic consumer generation
- And unlike energy efficient folks from prior generations, they are armed with smart consumer electronics to live the efficiency lifestyle
- They bring a child's curiosity to all things digital such as smart meters, smart thermostats, and in-home displays

The house of the future

- **Digital technology will be commonplace**
  - Smart thermostats, smart appliances, smart light bulbs and smart plug loads
  - Home energy management systems will be pervasive
  - These will allow these households to manage their loads dynamically in real time
- **If prices fall in the middle of the day, as renewable energy resources kick in, customer loads will rise automatically**
- **As prices rise later in the evening, loads will fall automatically**

The organic consumer generation will facilitate the transition to TVP

- **They are likely to be cognizant of the opportunities presented by dynamic pricing to lower energy bills and reduce emissions**

- **Their views may allow state commissions to rollout dynamic pricing as the default or universal tariff**

- **Further support will come from the successful deployment of TVP as the default tariff to 4 million Ontarian households in and to all households in Italy**
  - Both regions feature retail choice

The case for TVP rests on two pillars

Economic efficiency

- The costs of supplying and delivering electricity vary by day
- Unless consumers see this time variation in prices, they will have no incentive to modify their usage patterns
- Excess capacity will have to be built and kept on reserve to meet peak loads during a few hundred hours of the year

Equity

- Customers who consume relatively less power during peak periods subsidize those who consumer relatively more power during peak periods

In the U.S., we lose $10 billion each year due to FRP

There are some 50 million smart meters in the US

But less than 2 million households are on time-variant pricing

That prevents us from harnessing the benefits of universal dynamic pricing

- $7B/year in lower energy costs
- $3B/year in reduced cross-subsidies

In New York, TVP could yield significant benefits to customers

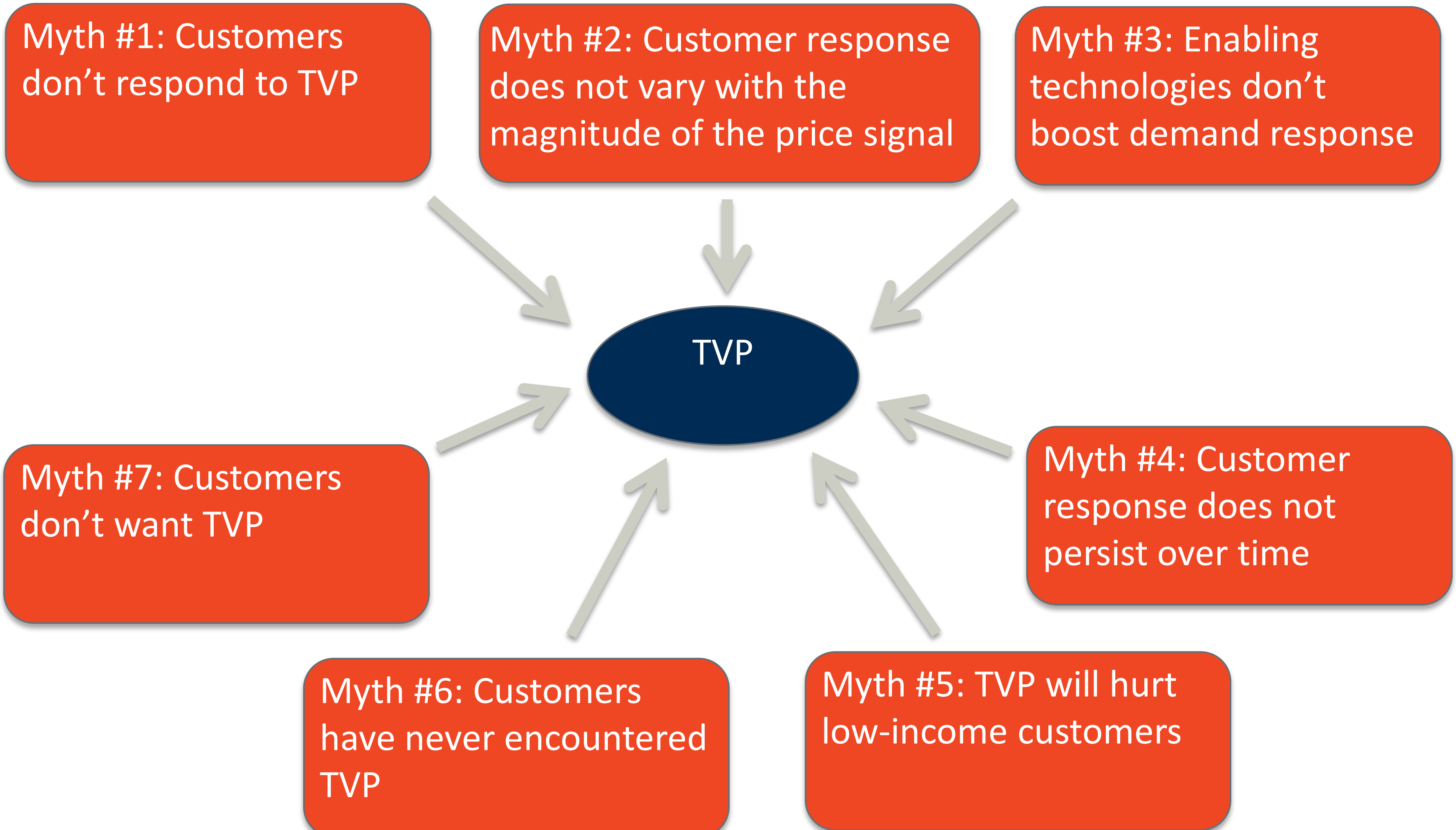
In 2009, we simulated the benefits of real time pricing in New York, using price elasticities from Illinois.

We found two major benefits

- *Demand Reduction*: Dynamic pricing could result in system peak demand reductions in the range of 10 to 14 percent, with a 13 to 16 percent reduction in New York City and an 11 to 14 percent reduction on Long Island.
- *Cost Reduction:* Total resource costs would decrease by 3-6 percent per year. Market-based customer costs would decrease by 2-5 percent.

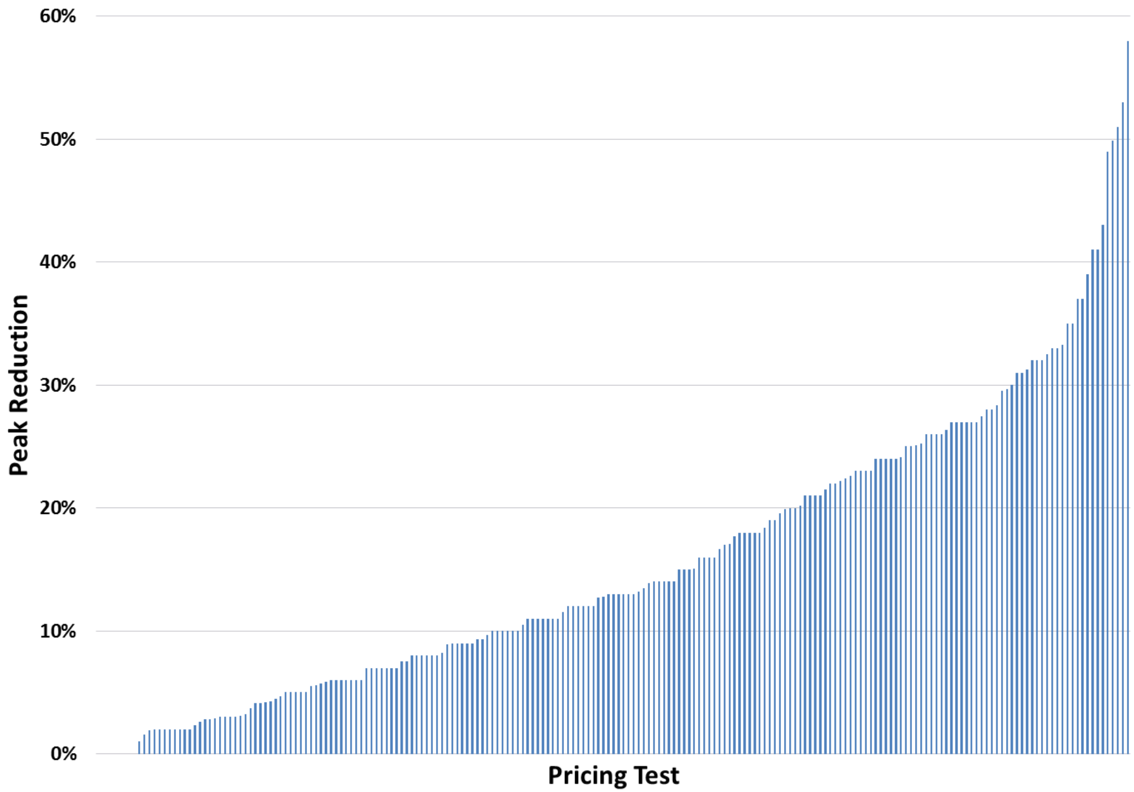
http://www.nyiso.com/public/webdocs/markets_operations/documents/Legal_and_Regulatory/NY_PSC_Filings/2009/Case_09M0074_NYISO_Supp_Cmmts_Report_12_17_09.pdf

The seven myths about TVP



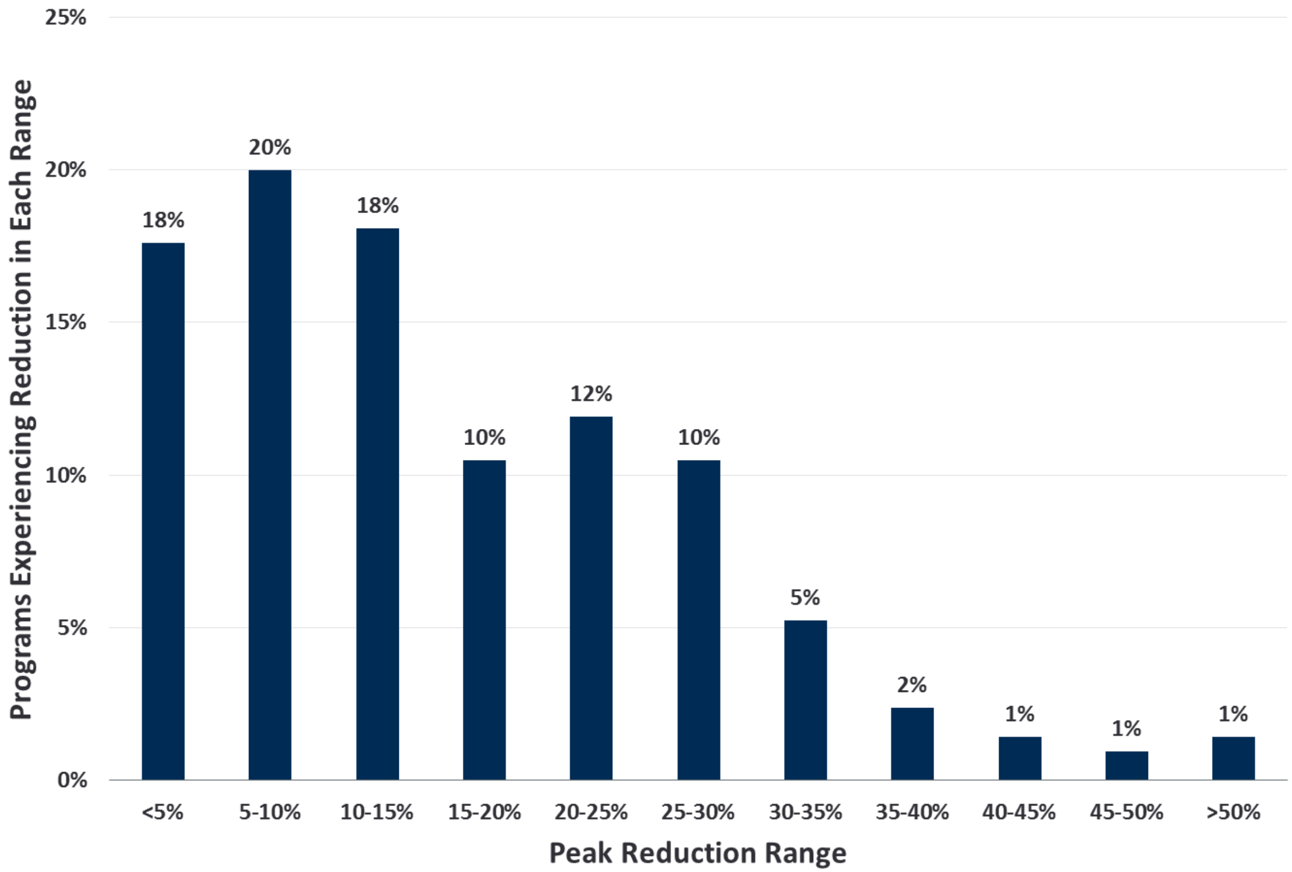
Myth #1: Customers don't respond

Because results vary widely, some conclude that we have learned nothing about customer response



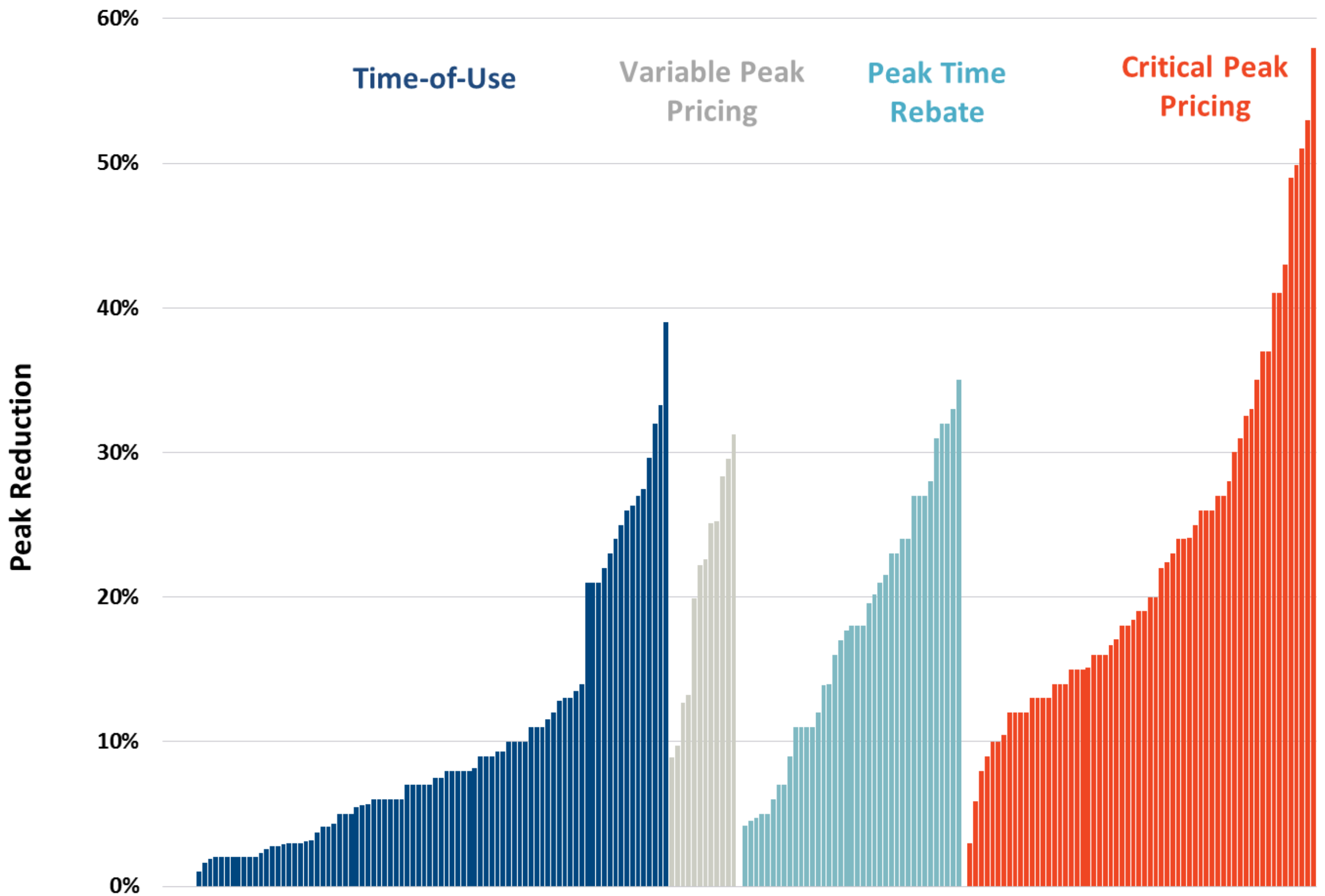
Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

60% of the tests have produced peak reductions of 10% or greater



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

Grouping results by tariff design helps explain some of the variation in impacts



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

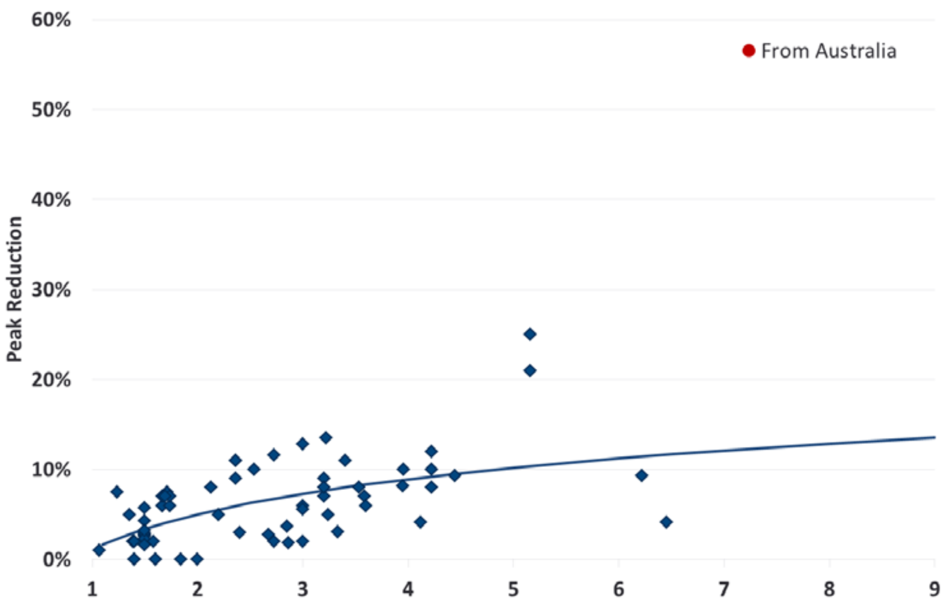
Myth #2: Customer response does not vary with the magnitude of the price signal

Not only do customers respond, but the magnitude of their response varies with the price incentive. The higher the incentive, the greater their demand response

To study this relationship between price incentive and peak energy reduction, we have estimated the Arc of Price Responsiveness. The Arc is based on 210 time-varying pricing treatments from around the world

We plot demand response against the peak to off-peak price ratio

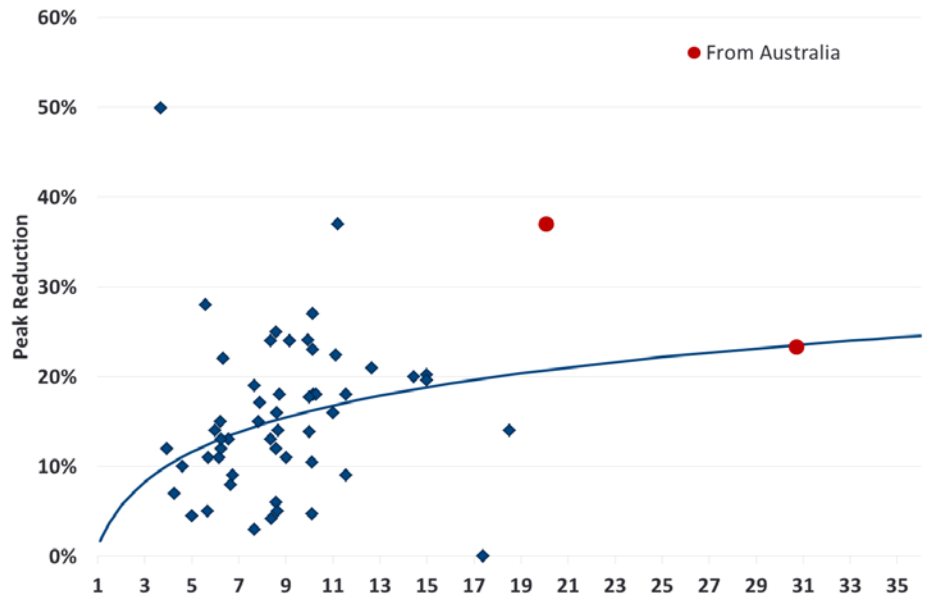
TOU Impacts (price only)



Note: 65 points.

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

Dynamic Pricing Impacts (price only)



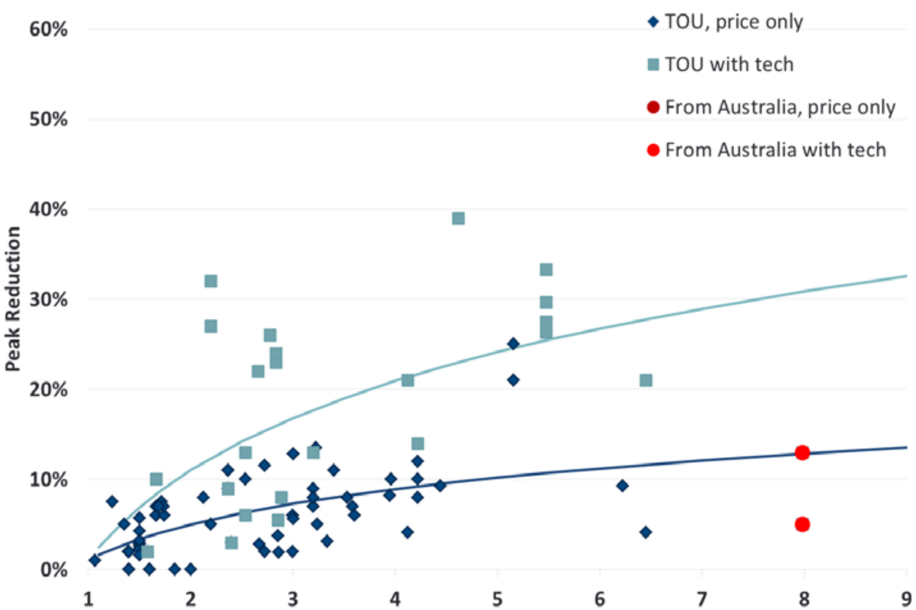
Note: 58 points.

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

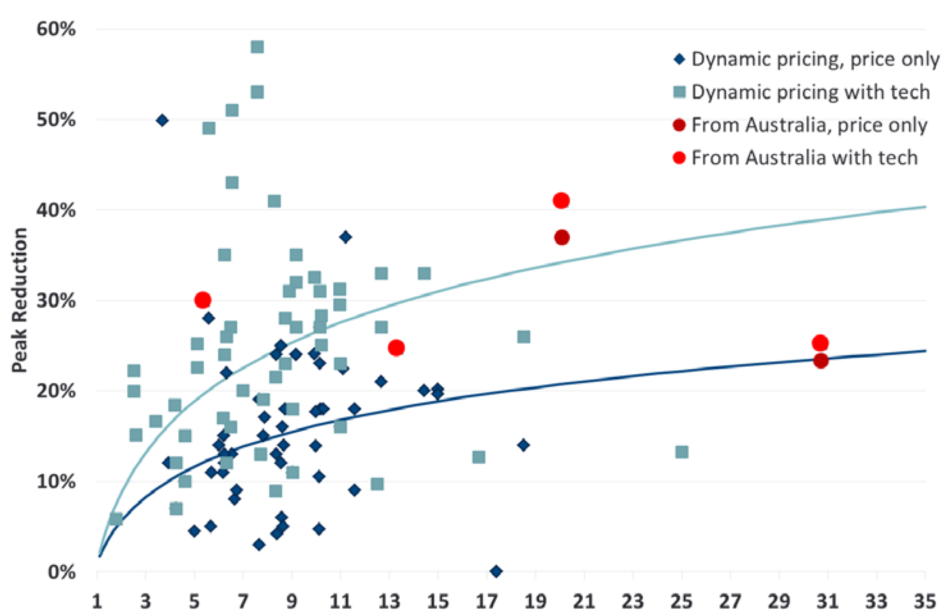
Myth #3: Enabling technologies don't boost demand response

The data shows that enabling technologies boost price responsiveness

TOU Impacts	Dynamic Pricing Impacts



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



Note: 118 points.
Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

Myth #4: Customer response does not persist over time

We observe that customer response has persisted in long-lived pilots

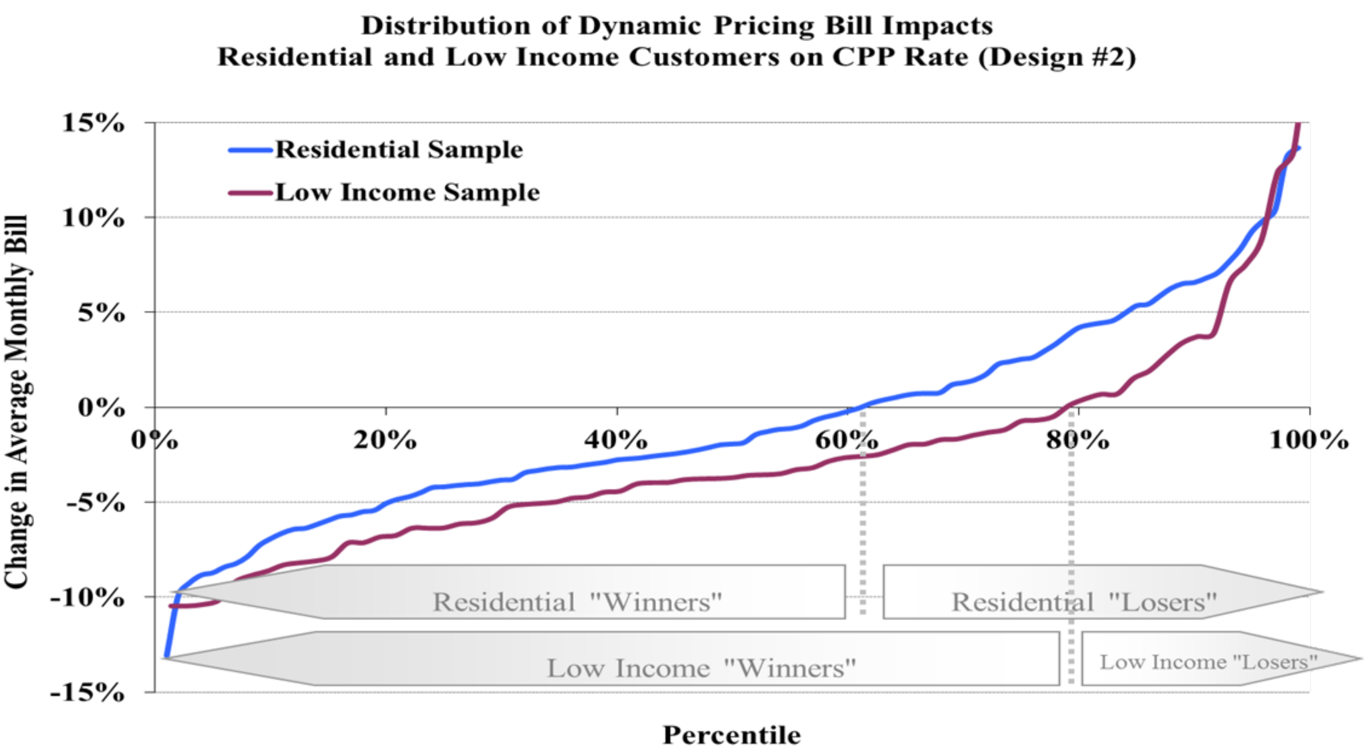
- California, Washington, D.C., Oklahoma for 2 years
- Maryland for 4 years

TOU programs have been in place for decades

- The French *tempo* tariff goes back to 1965
- Arizona’s TOU rates go back to 1980

Myth #5: Dynamic pricing will hurt low-income customers

Nearly 80% of *low income* customers are paying more under flat rates



Myth #6: Customers have never encountered TVP

Consumers experience TVP in everyday purchases

In the 1990s, Robert Cross highlighted the trend toward setting prices dynamically to maximize profit*

Today, TVP is used by a variety of capital-intensive industries such as airlines, hotels, rental car firms, and railroads

Since 2009, tickets for San Francisco Giants baseball games have varied according to the value of the game

*Source: Cross, Robert. *Revenue Management: Hard Core Tactics for Market Domination,* Broadway Books, 1997.

Myth #7: Customers don’t want TVP

In Connecticut Light and Power’s Plan-it Wise pilot, post-pilot surveys and focus groups were carried out to examine how customers felt about their participation in the pilot. Residential customers who participated in the survey had an overall satisfaction rating of 5.1 out of a possible 6, with 92 percent saying they would participate again

Customers showed similarly high levels of satisfaction with pilots at Consumers Energy, Baltimore Gas and Electric, Hydro One and California utilities

Customers are not inconvenienced by TVP

There is a notion that customers will have to get up at 2 am to do their laundry

In a recent survey of customers who participated in the Hydro One TOU pilot, only 4 percent found the changes in their daily activities to be inconvenient

Most customers value the opportunity to save money by making small adjustments in their energy consumption schedules

TVP is being practiced widely in the US

Arizona

- Over two decades, APS has enrolled 51% of its customers on an opt-in TOU rate and the SRP has enrolled about 30% of its customers on an opt-in TOU rate
- SRP has show that the TOU rate has yielded a significant reduction in system peak demand
- Both utilities offer rate choices to customers as they sign up for service
- In both cases, the TOU rate appeals to large consumers who avoid the upper tier of an inclining block rate by going with TOU

Illinois

- Both Ameren and ComEd have enrolled about 25,000 customers on RTP in Illinois and are planning to roll-out Flat+PTR

TVP in the US (continued)

Massachusetts

- The DPU has issued a “straw” proposal that calls for default CPP+TOU pricing; customers could opt instead for a Flat+PTR

Mid-Atlantic Region

- BGE and PHI are rolling out Flat+PTR to some 2 million customers in Delaware and Maryland
- PJM is allowing price-responsive demand to be bid into its multi-state capacity markets, as AMI and dynamic pricing are rolled out in its footprint of 60 million customers

TVP in the US (concluded)

Oklahoma

- In three years, OG&E has 100,000+ customers enrolled on variable peak pricing (VPP) and/or TOU pricing and the number is expected to reach 20 percent of its customer base fairly soon
- The program is called Smart Hours
- About 60 percent of the participants are on Smart Hours Plus where they get smart thermostats installed for them by OG&E
- The program is part of a portfolio of programs designed to eliminate the need for a 600 MW coal plant

TVP (for distribution networks) in Australia

The regulatory scene

- The Productivity Commission showed that TVP would lower costs for all customers
- The Australia Energy Market Commission recommended that TVP should be made mandatory for large customers, optional for vulnerable customers and default for everyone else
- The last annual conference of the Australian Energy Regulator featured two sessions on TVP

The businesses

- AusGrid (Sydney) has enrolled some 20 percent of its residential customers on TOU rates
- Distribution network service providers in Queensland and Victoria have completed pilots with TVP

TVP in Canada

The province of Ontario has deployed AMI to 4.5 million households and small businesses

- The regulated retail rate plan replaced a two-tier inclining block rate with a TOU rate with on peak, intermediate and off-peak periods
- About 90% of residential customers have chosen to receive service on the TOU rate plan and about 10% have chosen flat rates being offered by retailers

The results from the first two years of deployment are discussed later in the presentation

TVP in Europe

A couple of years ago, Italy rolled out AMI to all 29 million households along with default TOU pricing

- About 23 million residential and small-medium enterprises are on TOU pricing
- A recent analysis of Italy's default TOU concluded that more than half of customers have shifted consumption patterns in the first year
- The overall customer savings were € 2.54 million in the first year

France began rolling out its *tempo* tariff a couple of decades ago

- The tariff features on-peak and off-peak rates that vary across three types of days
- About a third of EDF's customers are on that tariff

TVP in Asia

Japan has been testing smart technologies and pricing in four cities

- Dr. Koichiro Ito of Boston University has evaluated these projects and concluded that customers *do* respond to hourly marginal prices
- Ito found that the various CPP treatments reduced peak demand by 11% on average

CLP Power in Hong Kong is running a two year pilot with PTR+TOU

- The first year results provided evidence of demand response

Residential dynamic pricing is transitioning to a new phase: full-scale deployment

Several utilities are achieving significant participation through aggressive *opt-in* programs

- Time-of-use (TOU) rates at APS and SRP in Arizona
- Variable peak pricing (VPP) at OG&E in Oklahoma

Others are rolling out *default* programs for the mass market

- Pepco in Delaware and Maryland
- BGE in Maryland
- Sacramento Municipal Utility District (SMUD) in California
- The Province of Ontario, Canada

Canadian Case Study: Ontario's Residential TOU Program

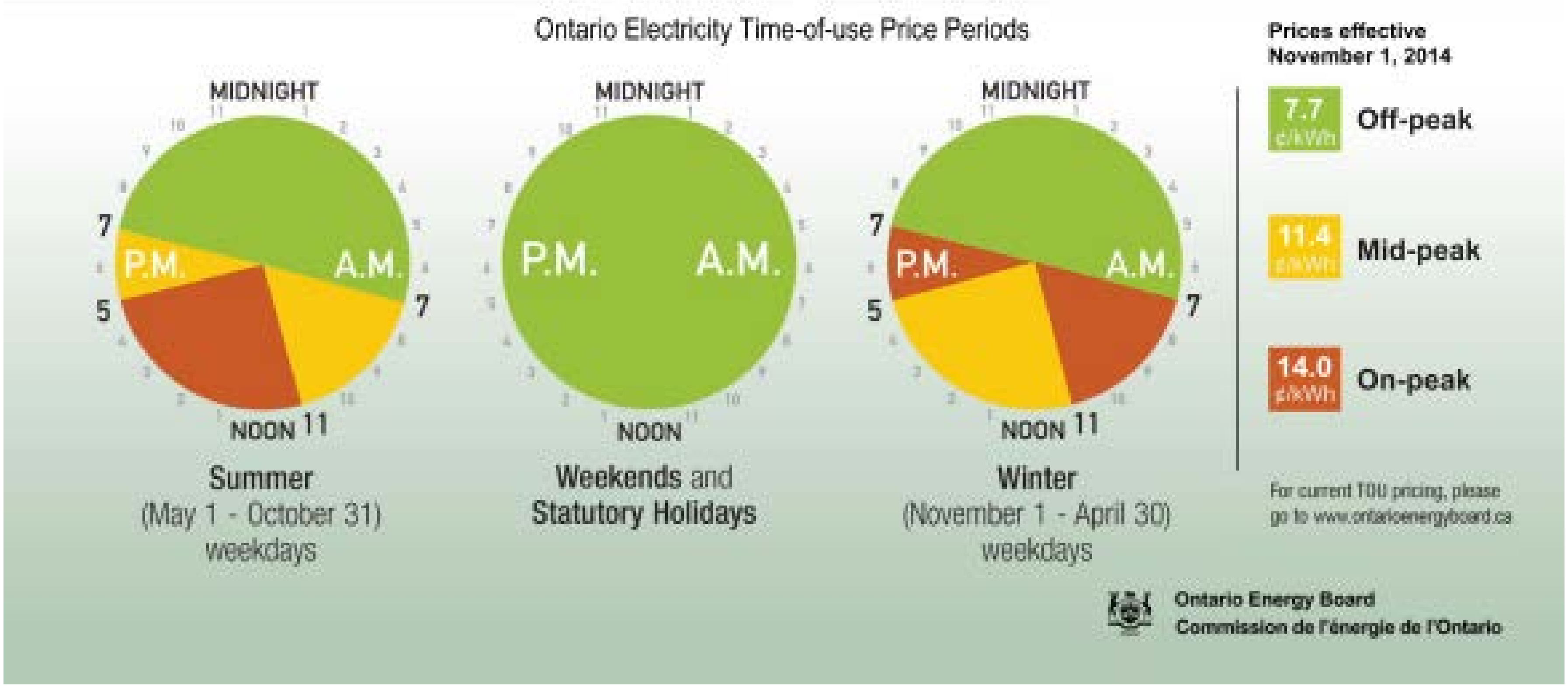
Besides Italy, Ontario is the only region in the world to deploy Time-of-Use (TOU) rates for generation charges to all customers who stay with regulated supply

TOU rates were deployed in Ontario to incentivize customers to curtail electricity usage during the peak period and possibly to reduce overall electricity usage

The Brattle Group was retained by Ontario Power Authority to undertake the impact evolution of the TOU program

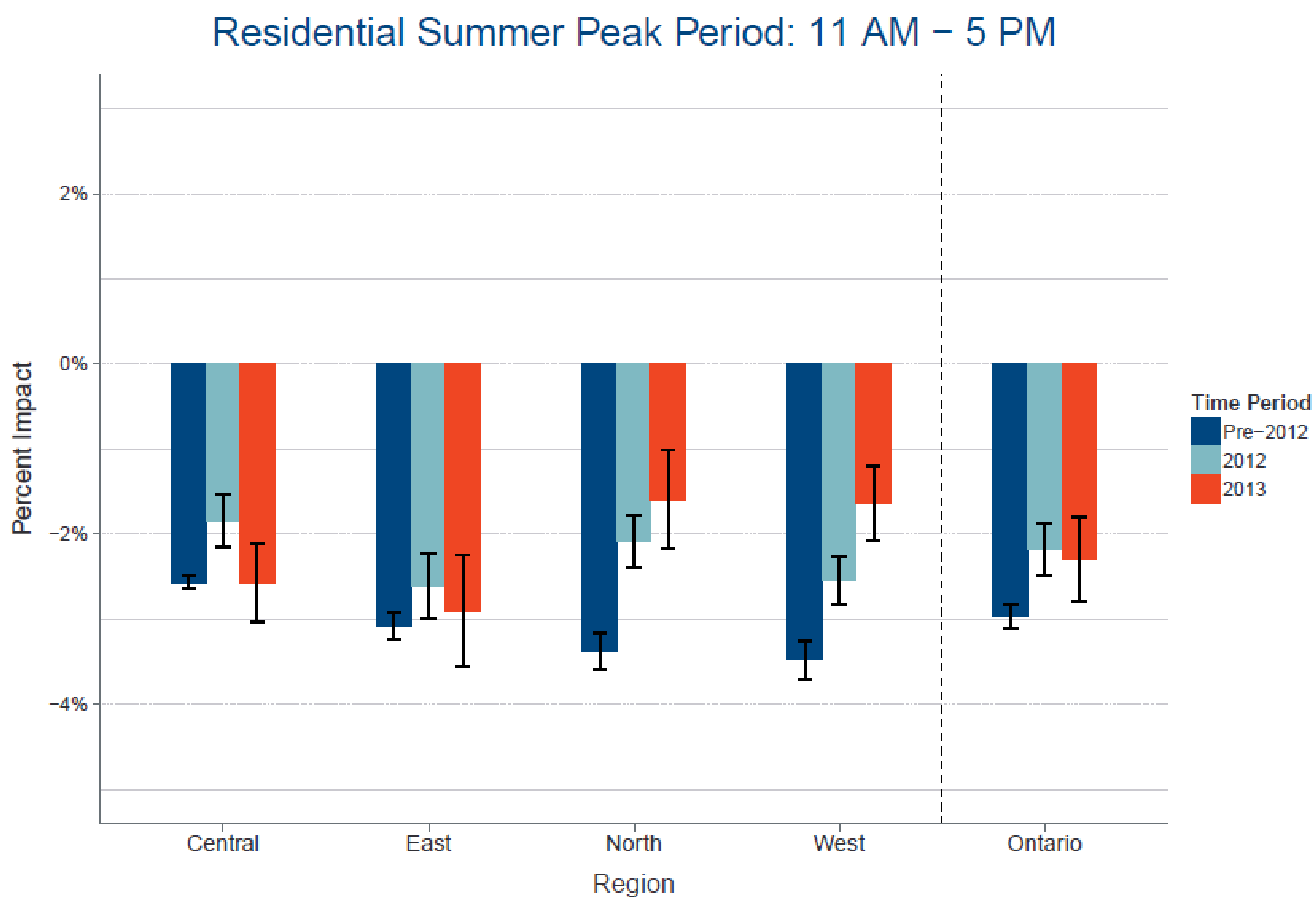
- Three year assignment; the 1st Year Impact Evaluation results are presented here, the 2nd year study is underway

TOU Seasons and Peak Periods



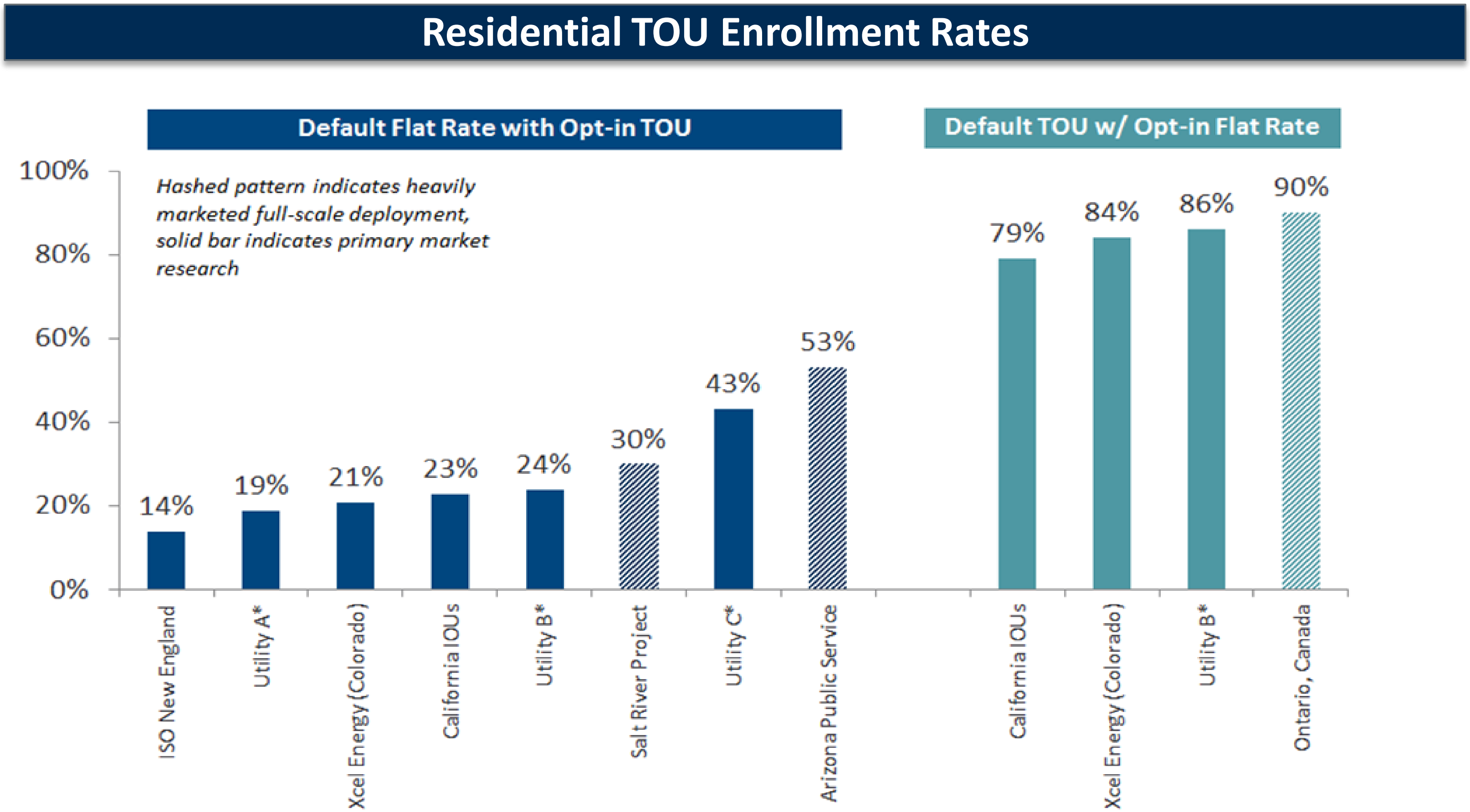
Note: The prices above are commodity only, this study uses the all-in prices that customers actually face

Residential Summer TOU Peak Period Impacts



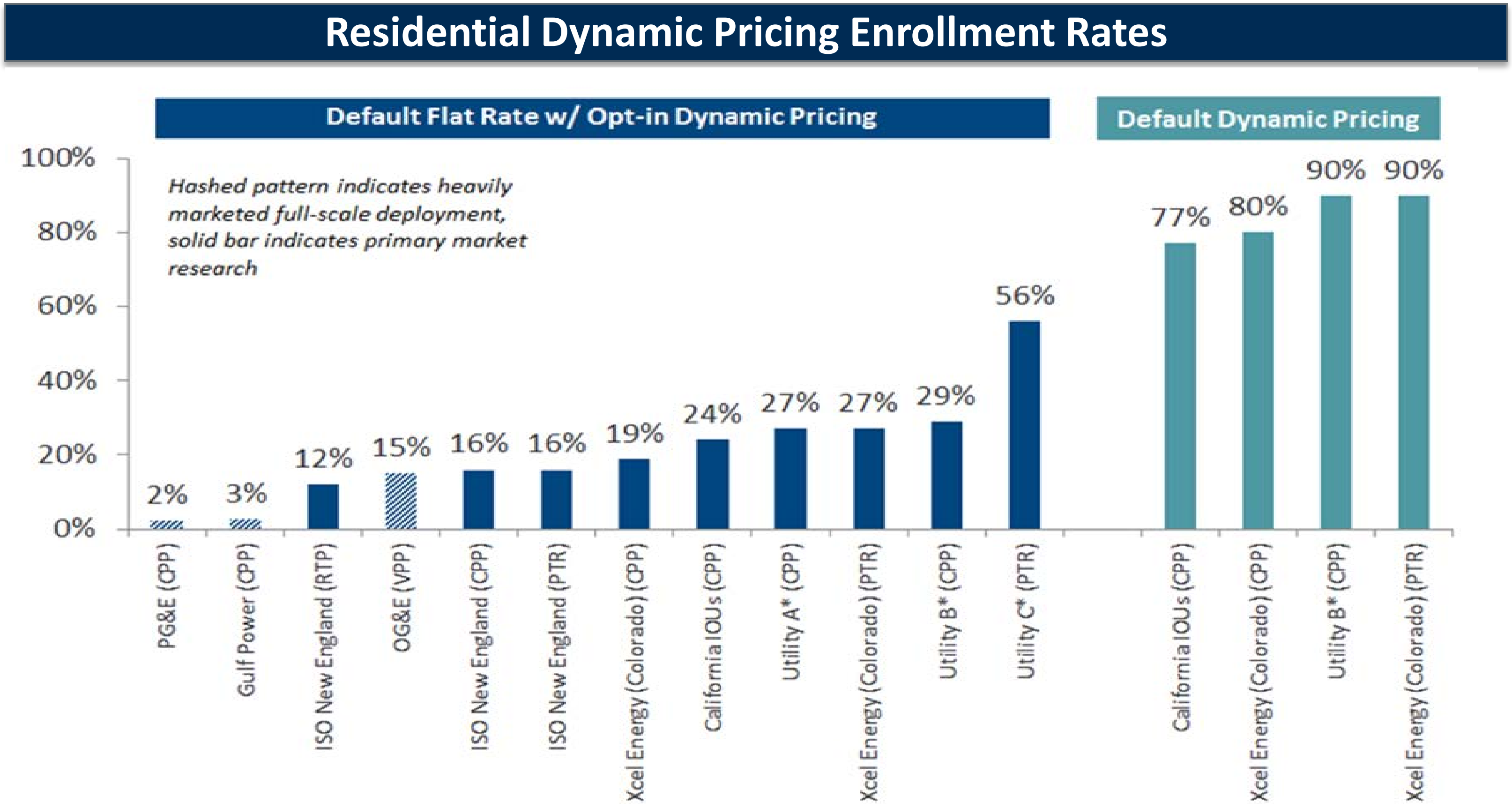
Note: Black bars indicate 95% confidence intervals for the impact

Should TOU rates be rolled out as the default tariff?



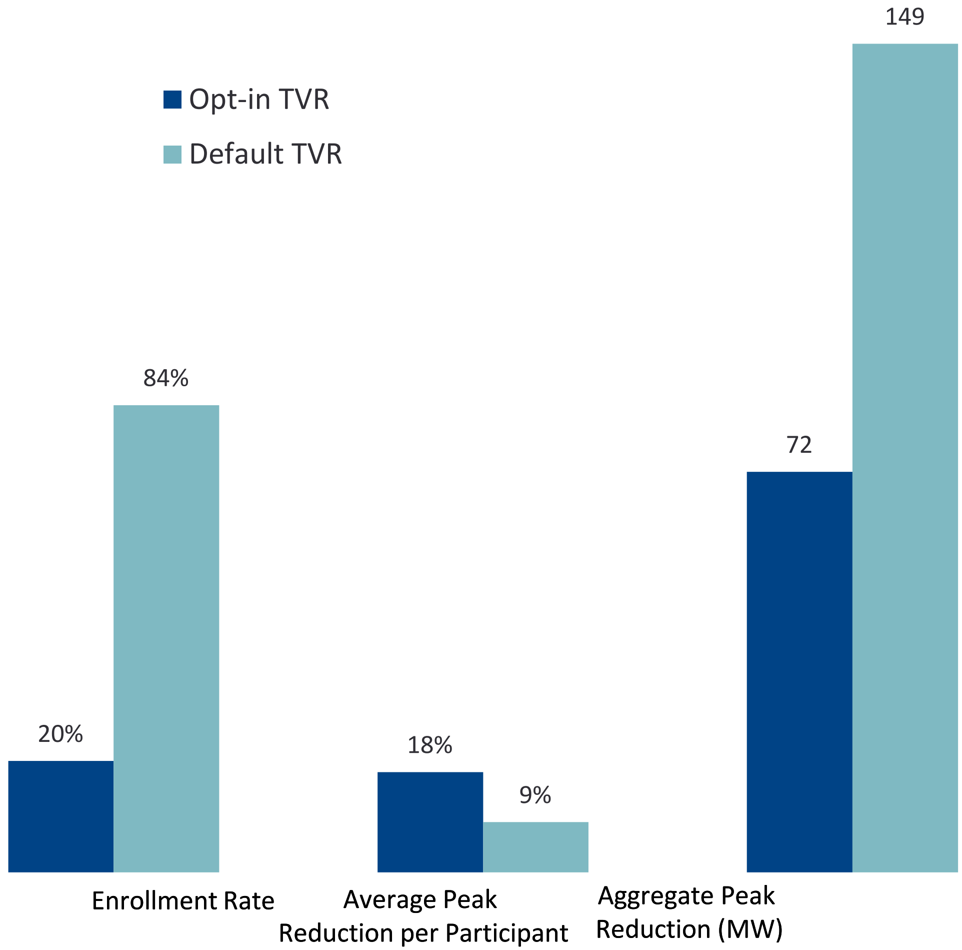
The average TOU enrollment level is 28% under default flat rates. When TOUs are the default, the average enrollment rate rises to 85%

The dynamic pricing enrollment levels are similar to those of the TOU offerings



The average dynamic pricing enrollment is 20% under default flat rates and 84% when dynamic prices are the default

Default time-variant rates (TVR) dominates opt-in TVR



Aggregate peak reduction impacts (MW) are calculated for a hypothetical utility with one million residential customers and a coincident residential peak demand of 2,000 MW

Making the transition

Any change in rate design will create winners and losers, and the key to success will lie in gradualism

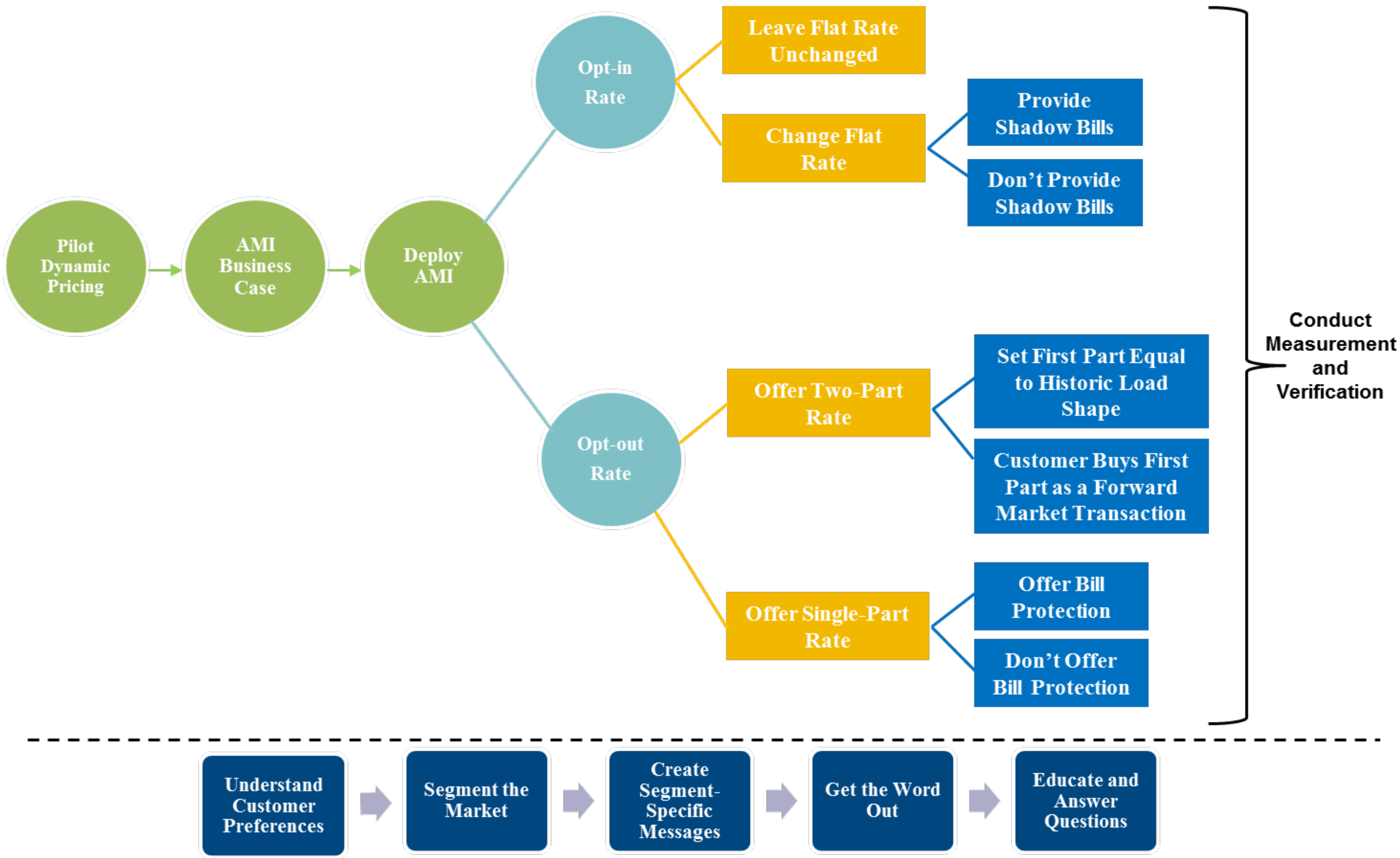
Choices in rate design should be offered, including a fully hedged flat rate

Other options would include

- Temporary bill protection
- Provision of shadow bills
- Excluding low income customers

A more radical solution would involve the provision of energy stamps, akin to food stamps

A roadmap for making the transition



Challenges to implementing TVP in NY

Lack of smart meters

- Simply a matter of time

Restructured market place

- That has not stopped other regions from offering TVP

1990’s legislation prohibiting mandatory RTP

- Does not prohibit opt-in or default RTP or TVP more broadly speaking

Source material – I

- **Brown, Toby and Ahmad Faruqui, "Structure of Electricity Distribution Network Tariffs: Recovery of Residual Costs," Australian Energy Market Commission, August 2014.** **http://brattle.com/system/publications/pdfs/000/005/076/original/The_Structure_of_Electricity_Distribution_Network_Tariffs_and_Residual_Costs.pdf?1422374425**
- **Faruqui, Ahmad, "Residential Dynamic Pricing and Energy Stamps," Regulation, Winter 2010-11.**
- **Faruqui, Ahmad, Sanem Sergici and Lamine Akaba, "Dynamic Pricing in a Moderate Climate: The Evidence from Connecticut," *Energy Journal*, 35:1, pp. 137-160, January 2014.**
- **Faruqui, Ahmad, Sanem Sergici and Lamine Akaba, "Dynamic Pricing of Electricity for Residential Customers: The Evidence from Michigan," *Energy Efficiency*, 6:3, August 2013, pp. 571–584.**

Source material -- II

- Faruqui, Ahmad and Jennifer Palmer, "The Discovery of Price Responsiveness –A Survey of Experiments involving Dynamic Pricing of Electricity," Energy Delta Institute, Vol. 4, No. 1, April 2002.
- Faruqui, Ahmad, and Jennifer Palmer. "Dynamic Pricing and its Discontents." *Regulation*, Fall 2011.
- Faruqui, Ahmad and Sanem Sergici, "Dynamic pricing of electricity in the mid-Atlantic region: econometric results from the Baltimore gas and electric company experiment," Journal of Regulatory Economics, 40:1, August 2011, pp. 82-109.
- Faruqui, Ahmad and Sanem Sergici, "Household response to dynamic pricing of electricity—a survey of 15 experiments," Journal of Regulatory Economics, 2010, 38: 193-225.

Source material –III

- **Faruqui, Ahmad, Dan Harris and Ryan Hledik, "Unlocking the €53 billion savings from smart meters in the EU: How increasing the adoption of dynamic tariffs could make or break the EU's smart grid investment," *Energy Policy*, Volume 38, Issue 10, October 2010, pp. 6222-6231.**
- **Faruqui, Ahmad and Sanem Sergici, "Arcturus: International Evidence on Dynamic Pricing," *The Electricity Journal*, August-September, 2013.**
- **Faruqui, Ahmad, Ryan Hledik, and Neil Lessem. "Smart by Default," *Public Utilities Fortnightly*, August, 2014.** http://www.fortnightly.com/fortnightly/2014/08/smart-default?page=0%2C0&authkey=e5b59c3e26805e2c6b9e469cb9c1855a9b0f18c67bbe7d8d4ca08a8abd39c54d
- **Faruqui, Ahmad, Ryan Hledik, and John Tsoukalis, "The Power of Dynamic Pricing," *The Electricity Journal*, April 2009.**
- **Faruqui, Ahmad, Ryan Hledik and Wade Davis, "The paradox of inclining block rates," *Public Utilities Fortnightly*, April 2015, forthcoming.**

Source material (concluded)

- Faruqui, Ahmad, Ryan Hledik, Sam Newell and Hannes Pfeifenberger, "The Power of Five Percent," *The Electricity Journal*, October 2007.
- Faruqui, Ahmad et al. "Year Two Analysis of Ontario's Full Scale Rollout of TOU Rates," December 16, 2014.
  http://www.brattle.com/system/news/pdfs/000/000/777/original/Year_Two_Analysis_of_Ontario's_Full_Scale_Roll-out_of_TOU_Rates.pdf?1420755179
- Hledik, Ryan. "Rediscovering Residential Demand Charges," *The Electricity Journal*, Volume 27, Issue 7, August–September 2014, Pages 82–96.

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Dr. Faruqui leads the firm's practice in understanding and managing the changing needs of energy consumers. This work encompasses rate design, distributed generation, energy efficiency, demand response, demand forecasting and cost-benefit analysis of emerging technologies. During his career, he has worked for more than 125 clients, including utilities, system operators, and regulatory commissions, in the US and in Australia, Canada, Egypt, Hong Kong, Jamaica, Philippines, Saudi Arabia and Thailand. He has filed testimony or appeared before state commissions, government agencies, or legislative bodies in Alberta (Canada), Arizona, Arkansas, California, District of Columbia, Illinois, Indiana, Kansas, Maryland, Michigan and Ontario (Canada). He has spoken at conferences in Australia, Bahrain, Brazil, Egypt, France, Germany, Ireland, Jamaica, and the United Kingdom. His work has been cited in publications such as *The Economist*, *The New York Times*, *USA Today*, *The Wall Street Journal* and *the Washington Post*. He has appeared on Fox Business News and National Public Radio. The author, co-author or editor of four books and more than 150 articles on energy economics, he holds bachelors and masters degrees from the University of Karachi and masters and doctoral degrees from the University of California, Davis.