Time-Variant Pricing (TVP) in New York

The REV agenda and residential time-variant pricing
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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 are the organic consumers?

- **Individuals that are passionate about controlling their energy use not only to save money but also to lower greenhouse gas emissions**

- **Unlike prior generations, they use smart consumer electronics to live the efficiency lifestyle *and* are willing to change their lifestyle**

- **They bring a child's curiosity to all things digital such as smart meters, smart thermostats, and in-home displays**

- **Among them we find the *prosumers*, who produce and consumer electricity**

The "house of the future" is about to enter the present

- **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

Nationally, we lose $10 billion each year due to FRP

There are more than 50 million households with smart meters today but less than 2 million of them are on TVP

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 assuming universal deployment, using price elasticities from Illinois's opt-in deployment

We found two major benefits

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

So why are so few customers on TVP?

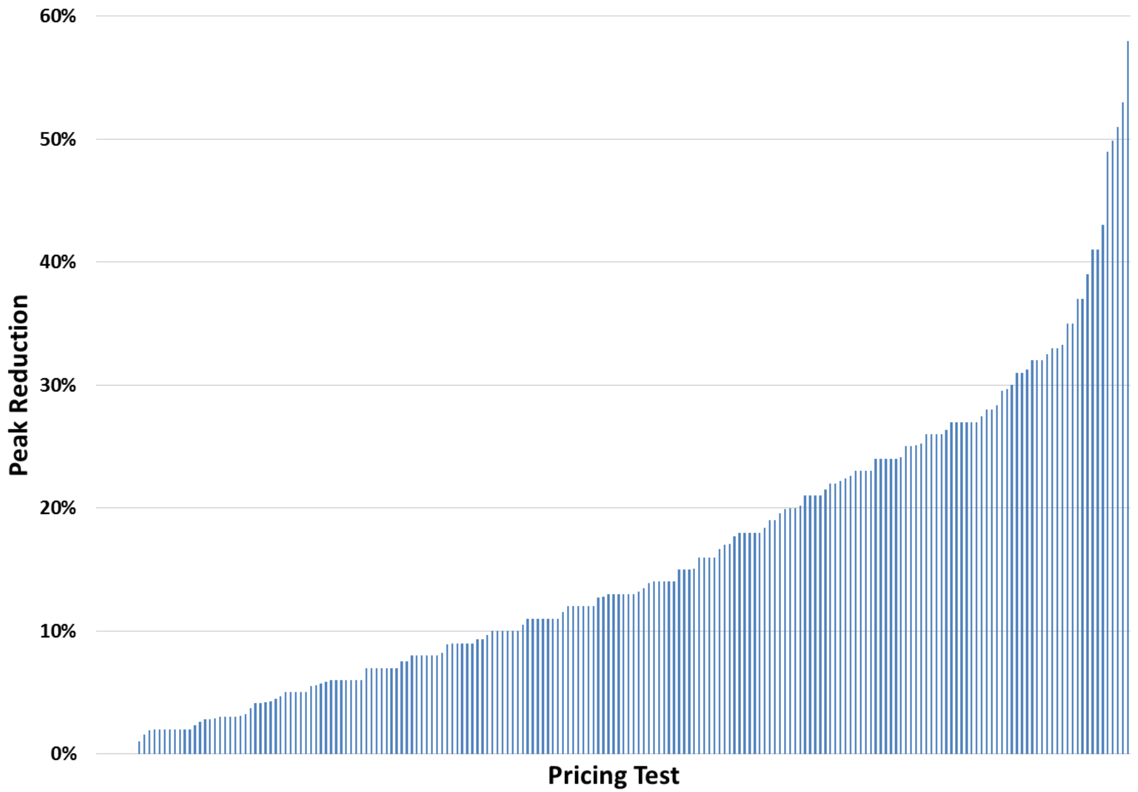
Over time, several concerns have been expressed about TVP by a variety of consumer organizations

Some are associated with the rollout of smart meters, which are a pre-requisite for TVP, while others are associated with how TVP would affect customer well-being

I focus on the latter and address seven often-cited concerns

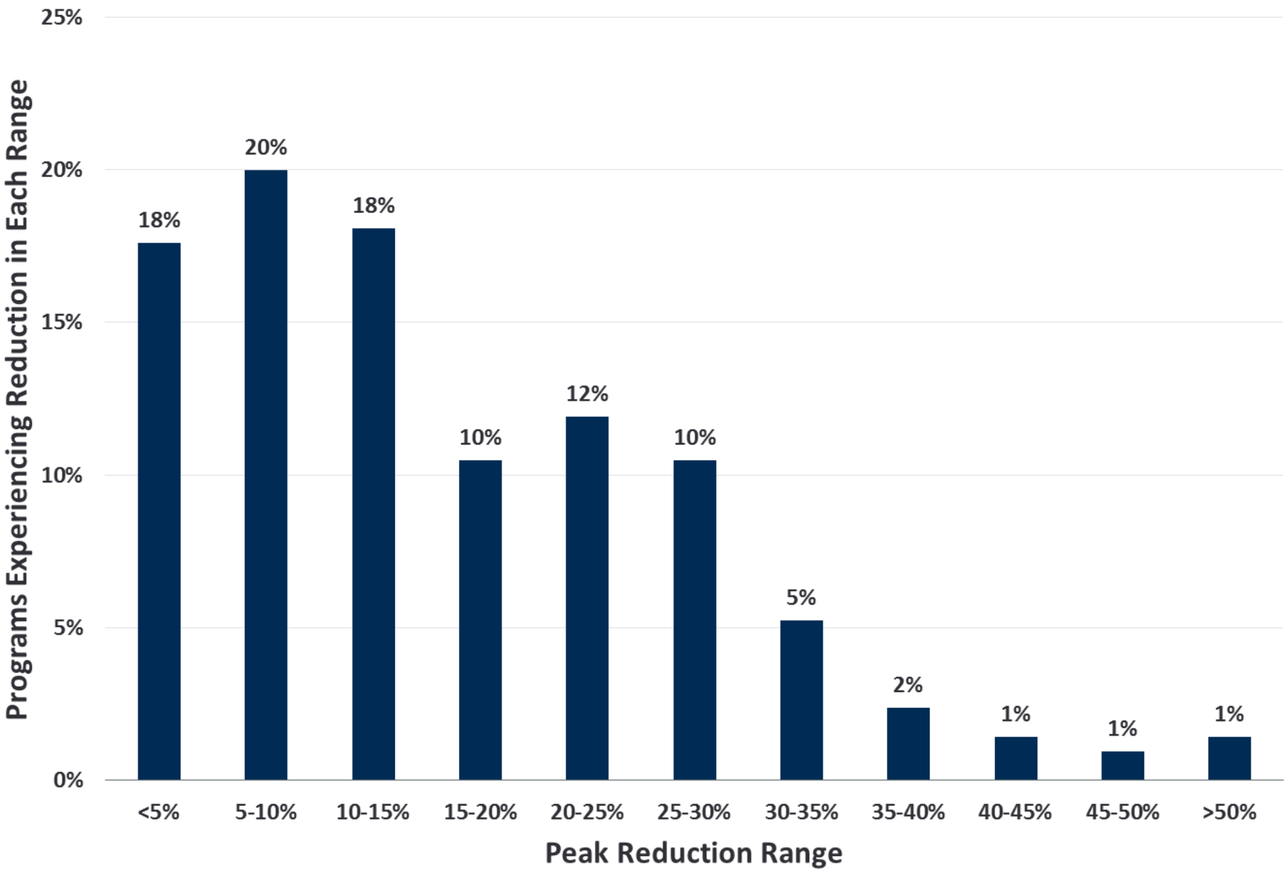
Concern #1: Customers won't respond to TVP

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



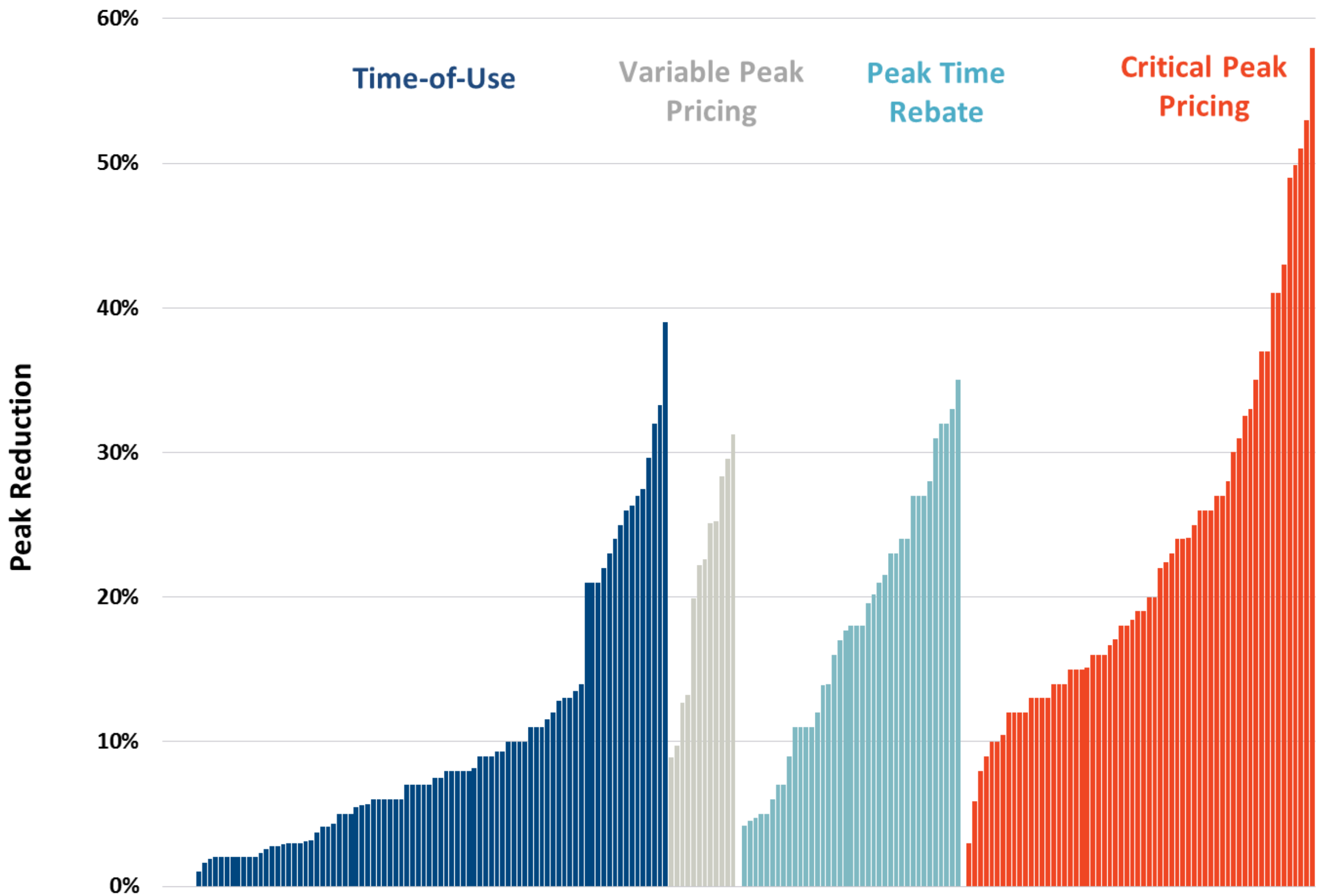
Source: Faruqui, Ahmad. "Arcturus." The Brattle Group.

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.

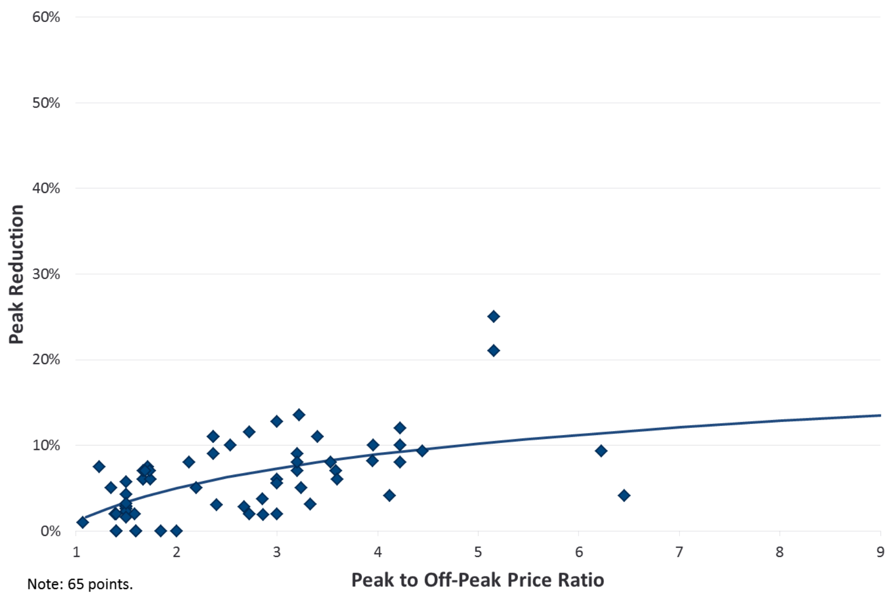
Concern #2: Customer response won't vary with price

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

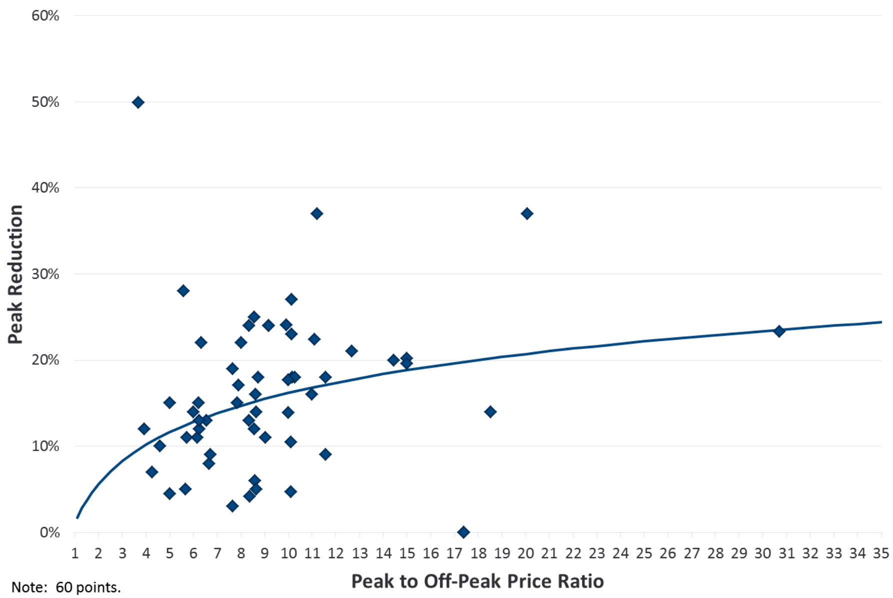
TOU Impacts (price only)



Note: 65 points.

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

Dynamic Pricing Impacts (price only)



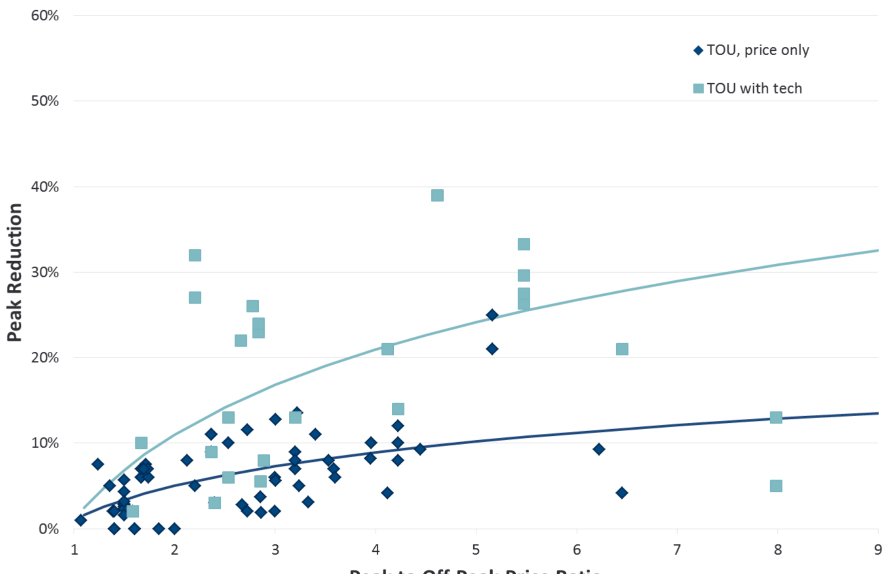
Note: 60 points.

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

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

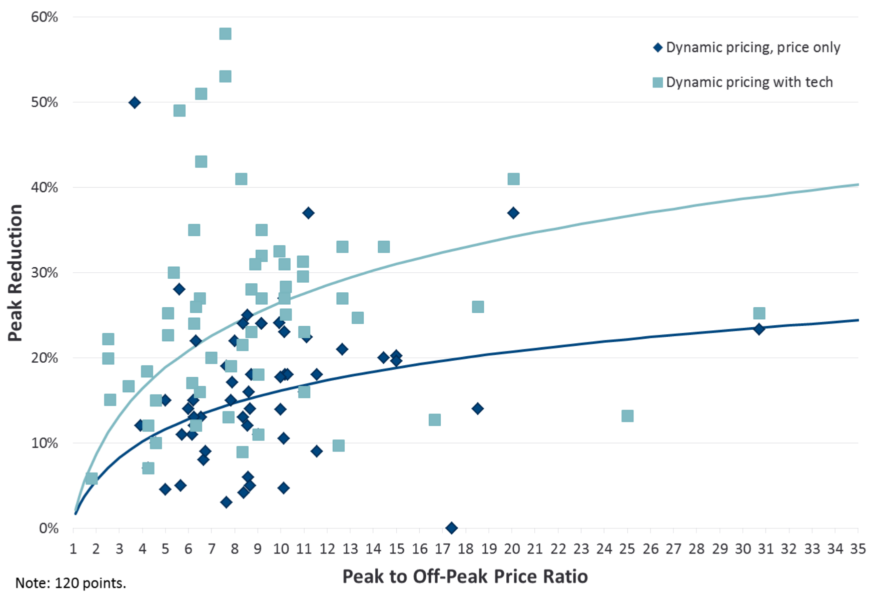
The data shows that enabling technologies boost price responsiveness

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.

Concern #4: Customer response won't persist

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

Concern #5: TVP is unethical

In 2011, Mark Toney of TURN argued that dynamic pricing will hurt low income customers at the Kellogg Alumni Club in San Francisco. https://vimeo.com/20206833

In 2010, an entire conference was devoted to the "ethics of dynamic pricing" at Rutgers University. It was videotaped and the key papers published in *The Electricity Journal* .

In 1971, Columbia's William Vickrey stated that people shared the medieval notion of a just price and regarded prices that varied with demand-supply imbalances as evil

Concern #6: Customers have never encountered TVP

While that may have been true of that charming TV character, Archie Bunker, today's consumers experience TVP in routine transactions every day, except when it comes to their purchase of electricity

In the modern economy, TVP is pervasive. It is to be found in a wide range of industries: airlines, bridge tolls, freeway lanes, groceries, hotels, railroads, rental cars, sporting events, and theaters

Even the ubiquitous parking meter displays a form of TVP

Concern #7: Customers don't want TVP

Customers have reported high levels of satisfaction with dozens of TVP pilots and programs in Australia, California, Canada, District of Columbia, Connecticut, Ireland, Japan, Michigan, Maryland, Oklahoma, just to name a few

No one has to get up at 2 am to do their laundry

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

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

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 successfully 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 very promising

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

Canadian Case Study: Ontario's Residential TOU Program

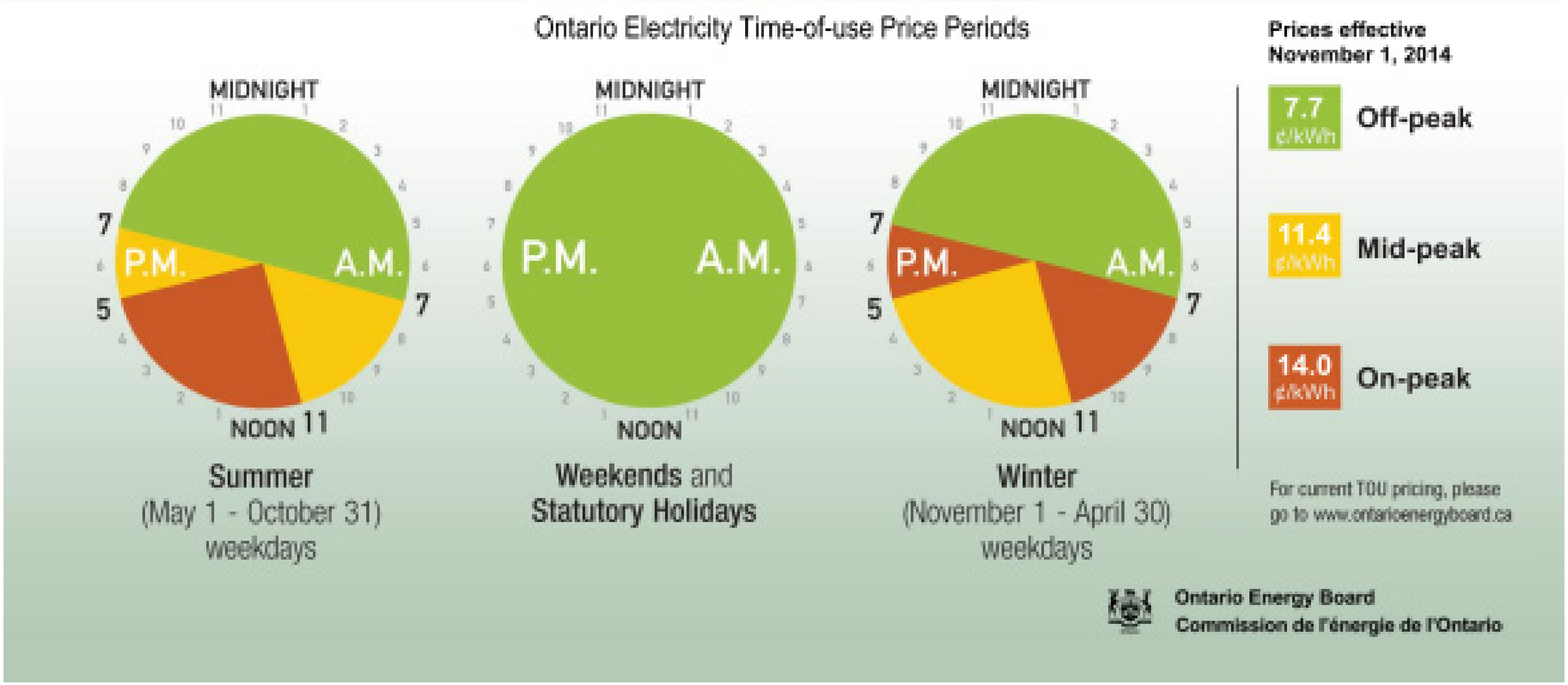
Besides Italy, Ontario is the only region in the world to deploy Time-of-Use (TOU) rates for generation charges to all customers who stay with regulated supply

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

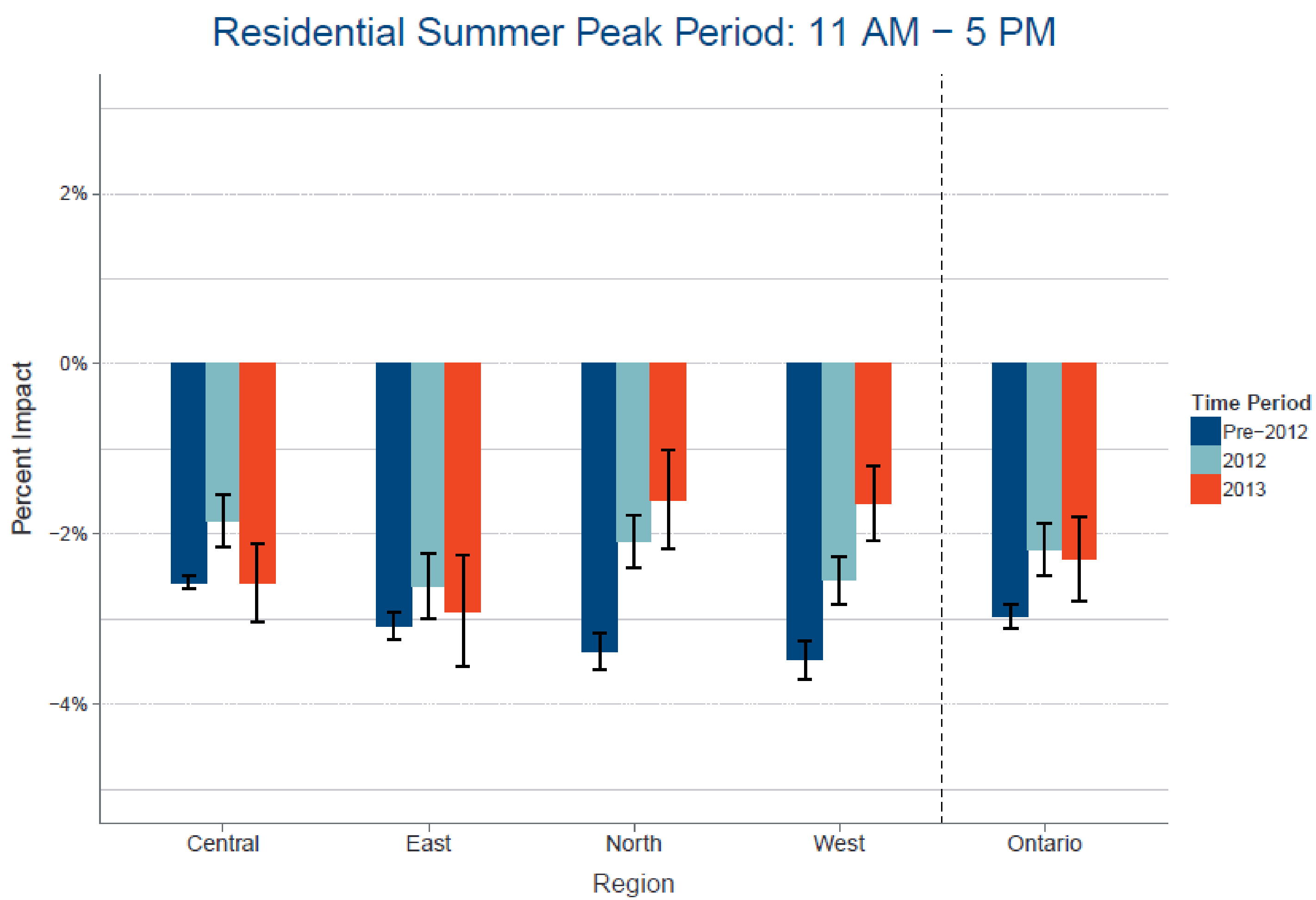
- Three year assignment; the 1st Year Impact Evaluation results are presented here, the 2nd year study is underway

TOU Seasons and Peak Periods



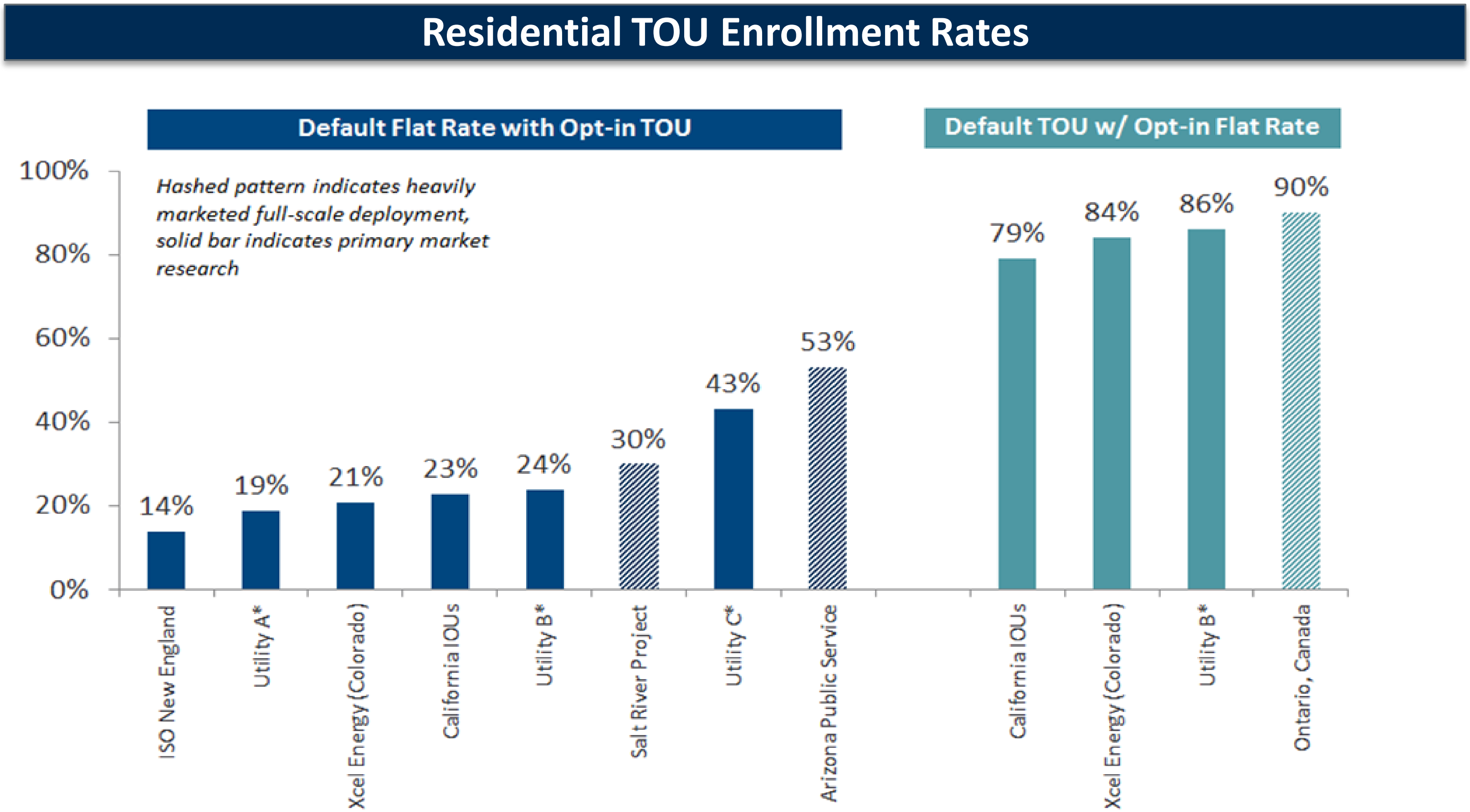
Note: The prices above are commodity only, this study uses the all-in prices that customers actually face

Residential Summer TOU Peak Period Impacts



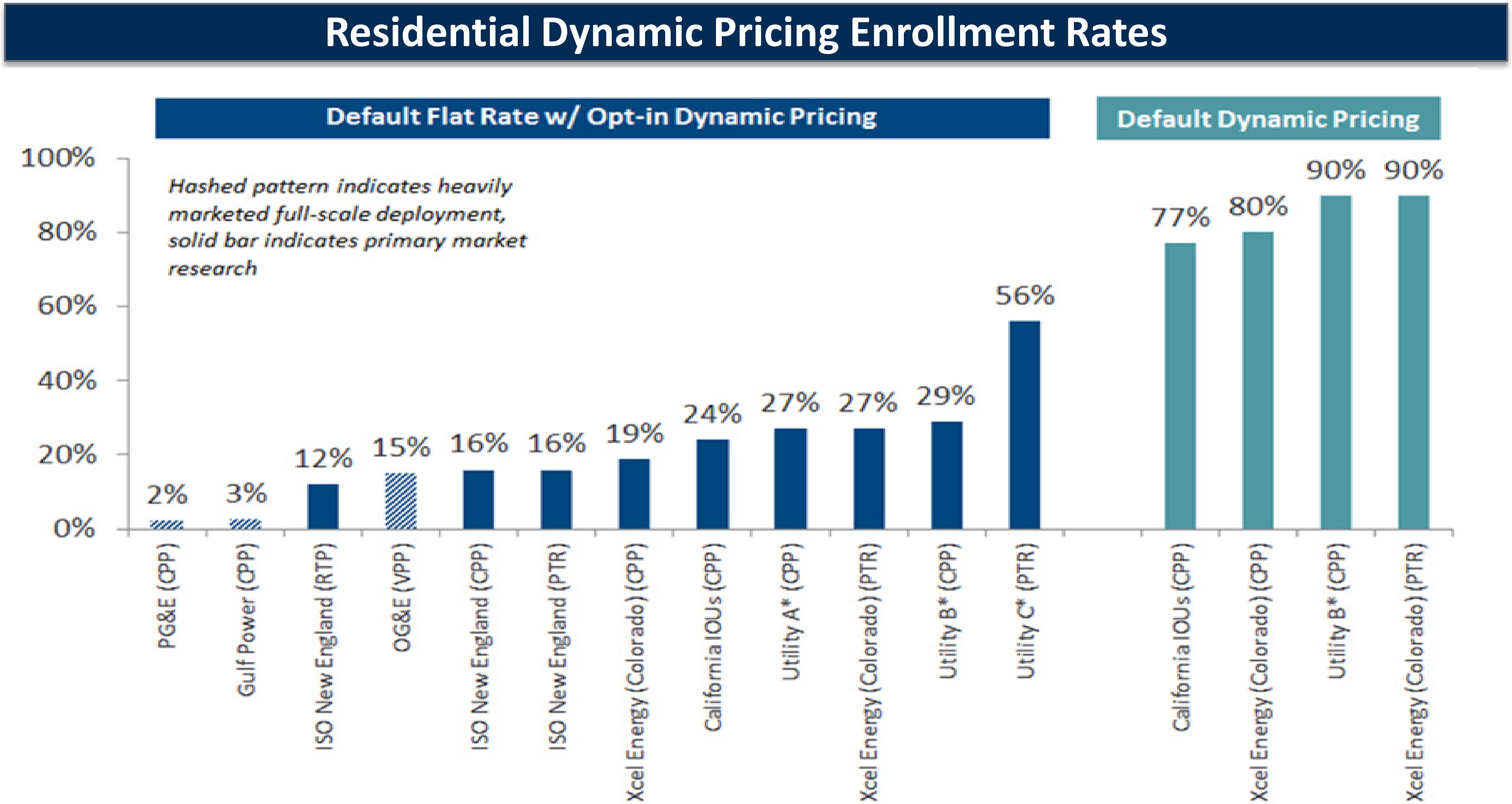
Note: Black bars indicate 95% confidence intervals for the impact

Should TOU rates be rolled out as the default tariff?



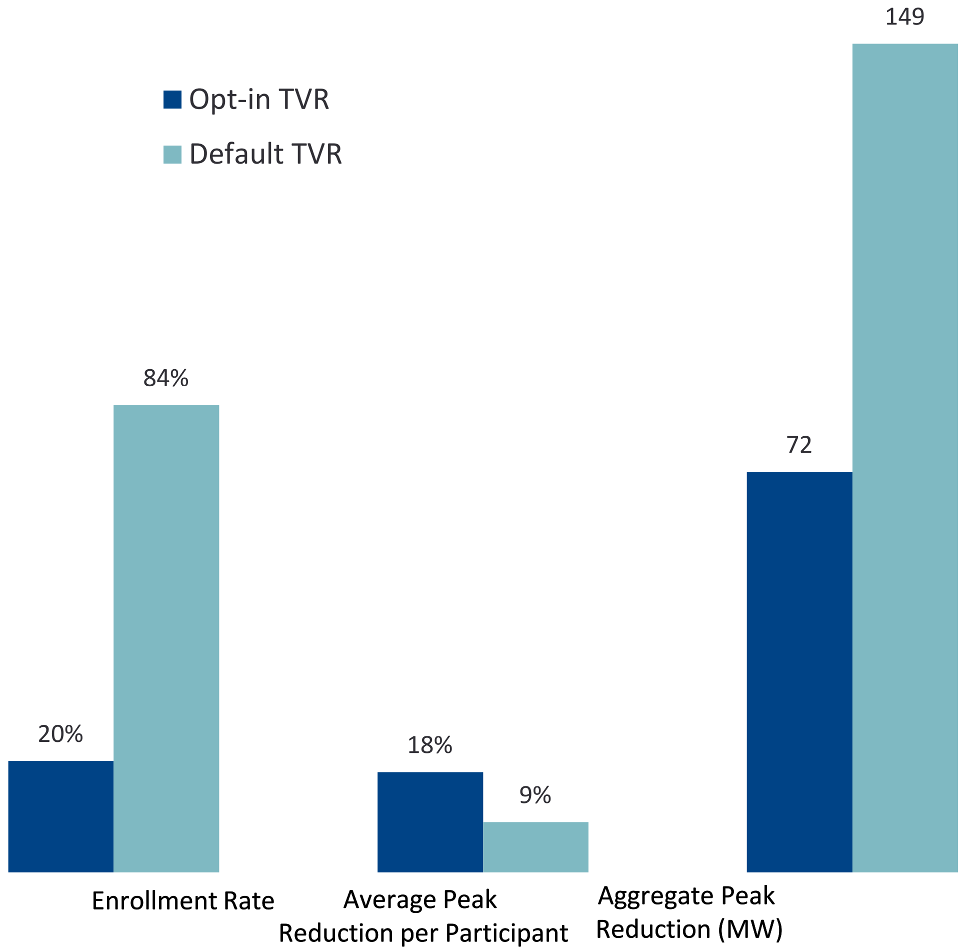
The average TOU enrollment level is 28% under default flat rates. When TOUs are the default, the average enrollment rate rises to 85%

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

No one said it would be easy

In 1939, the British economist Bolton wrote that changes in tariffs were guaranteed to be an unfailing source of argumentation

- *There is general agreement that appropriate tariffs are essential to any rapid development of electricity supply*
- *Ad there is complete disagreement as to what constitutes an appropriate tariff*

Ways to ease the pain

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
- Two-part rates
- Exempting vulnerable customers or providing them "energy stamps"
-

Challenges to implementing TVP in NY

Lack of smart meters

- Simply a matter of time

Restructured market place

- As noted earlier, other restructured regions are doing so

The Manhattan skyline is dominated by apartments

- Hong Kong has successfully tested peak-time rebates
- Technologies for controlling room a/c's are commercially available

1990's legislation prohibits mandatory RTP

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

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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.

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

Appendix

Back to the future 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 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	• Laid out his famous Ten Principles of Public Utility Rates

Back to the future (concluded)

Year	Author	Contribution
1971	William Vickrey	• Fathered 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*
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

James Bonbright's *Ten Commandments*

1. Effectiveness in yielding total revenue requirements under the fair-return standard
2. Revenue stability and predictability
3. Stability and predictability of the rates themselves
4. Static efficiency*, i.e.,* discouraging wasteful use of electricity in the aggregate as well as by time of use
5. Reflect all present and future private and social costs in the provision of electricity (*i.e.,* the internalization of all externalities)
6. Fairness in the allocation of costs among customers so that equals are treated equally
7. Avoidance of undue discrimination in rate relationships so as to be, if possible, compensatory (free of subsidies)
8. Dynamic efficiency in promoting innovation and responding to changing demand-supply patterns
9. Simplicity, certainty, convenience of payment, economy in collection, understandability, public acceptability, and feasibility of application
10. Freedom from controversies as to proper interpretation

Bonbright Reloaded for the 21st century

The ideal rate design should promote economic efficiency, preserve inter-customer equity, promote the financial health of the utility, promote transparency to customers and enable customer choice.