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# Implementation of Dynamic Pricing: Trends and Debates


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# The Smart Grid Opens Up a Number of Opportunities Involving the Customer

**The most important activity is the rollout of Advanced Metering Infrastructure (AMI)**

- This features “Smart” Meters which record and digitally communicate electricity consumption data on frequent intervals (*e.g.*, 15 minutes or hourly)

**AMI acts as a gateway to offering dynamic pricing and time-of-use rates which can foster more responsive customer demand, improve load factors and lower average cost for all customers**

# What is Dynamic Pricing?

**Simply put, it is "cost-reflective pricing"**

**Many 'flavors' exist**

- Time variant rates (or time-of-use rates, TOU)
- Critical-peak pricing (CPP)
- Peak-time rebates (PTR)
- Variable-peak pricing (VPP)
- Real-time pricing (RTP)

**These can be combined to yield hybrid forms of dynamic pricing.**

# Six Common Myths About Dynamic Pricing

**Customers have never heard of it**

- But they encounter it almost every day in their other lives

**Electricity is a necessity and consumers won't respond**

- The Arc of Price Responsiveness shows that they do respond

**Our prices are too low**

- But customers will be happier if they were even lower

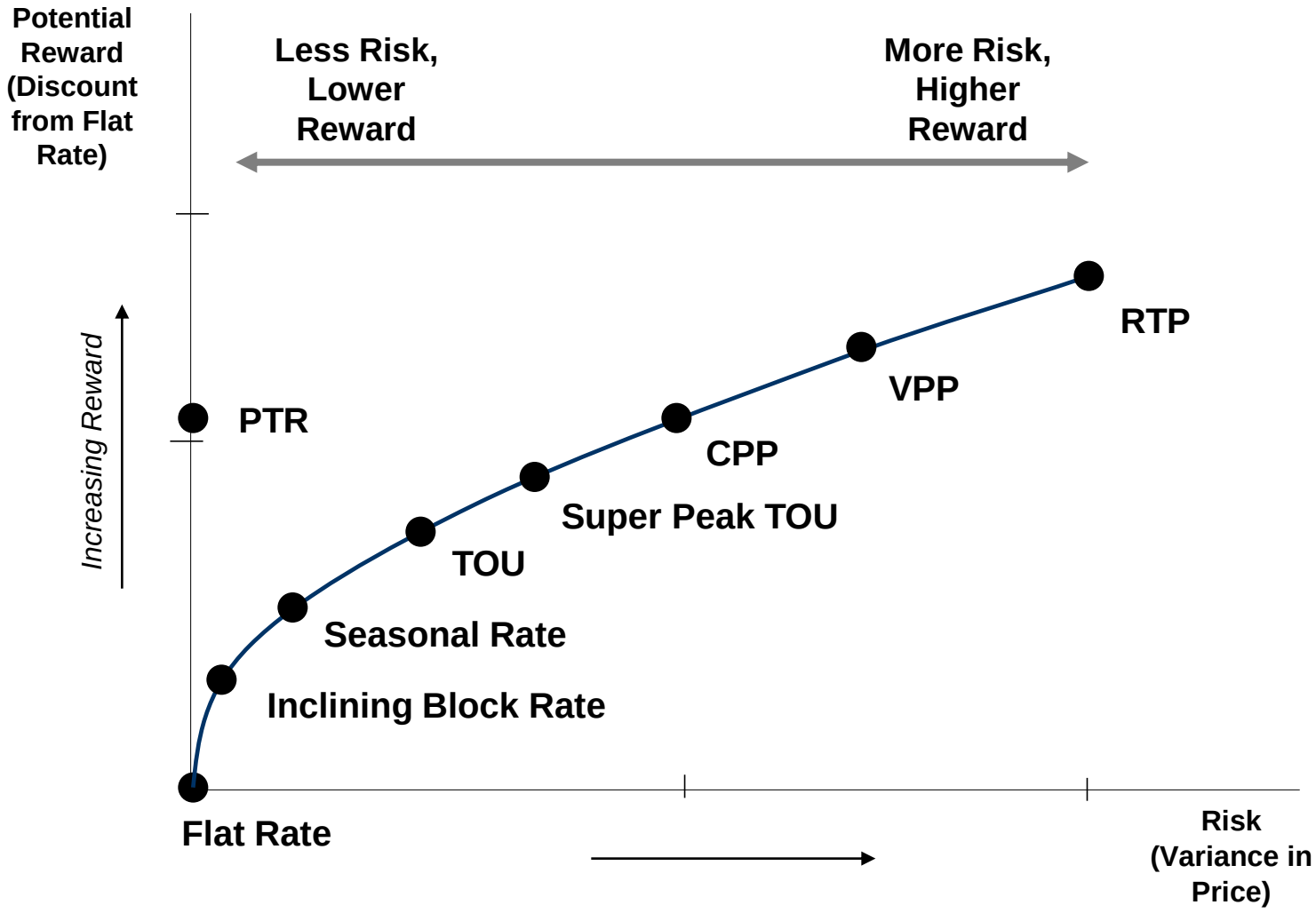
**Our prices are too high**

- Customers would be happier if they were lower

**It will harm low income consumers**

- Most low income consumers will see lower bills with dynamic pricing

# Dynamic Pricing Enables Customer Choice Among Competing Pricing Products



# Flat-Rate Pricing is Expensive

## Flat Rates are inefficient

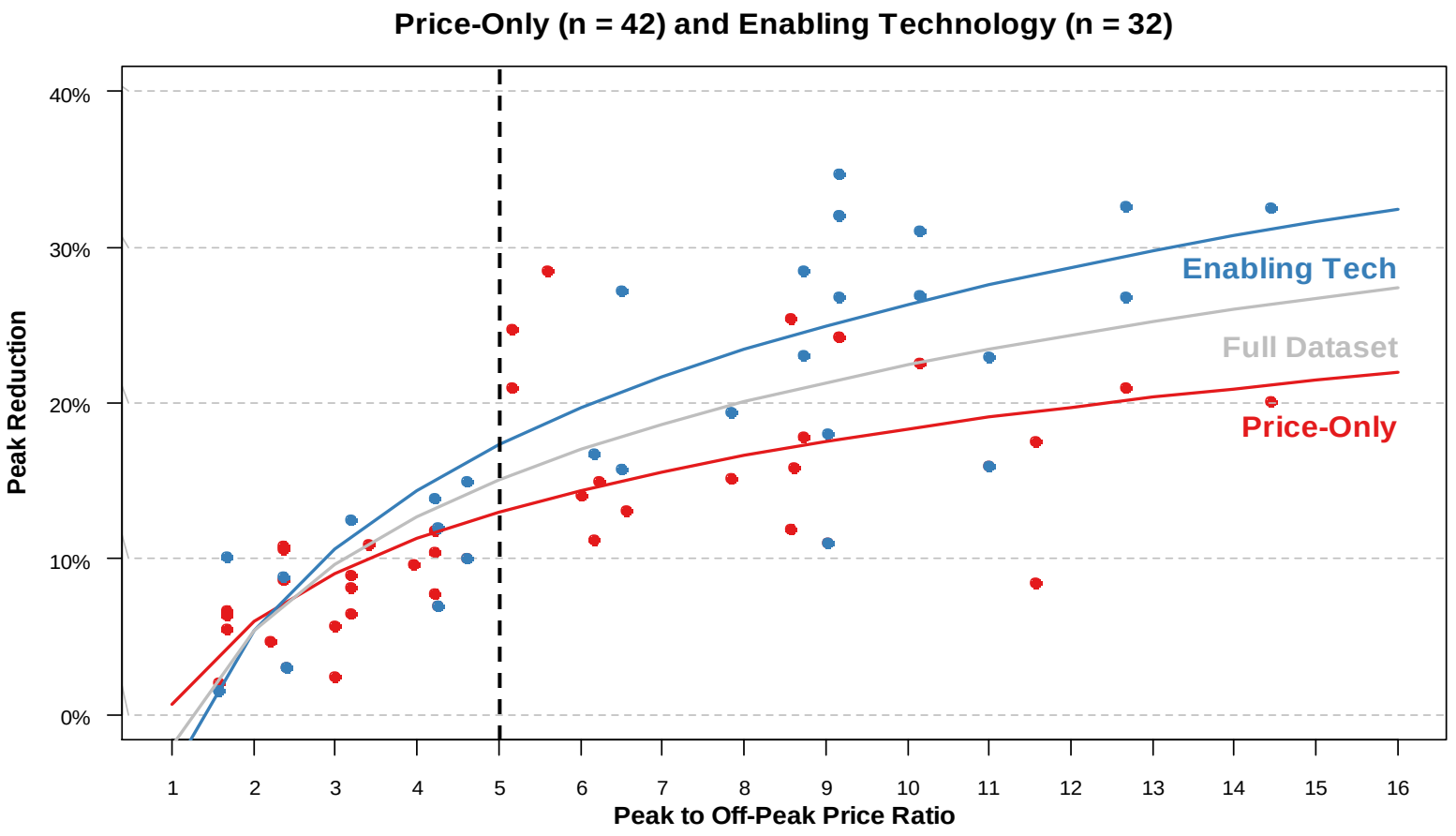
- They do not signal to consumers when electricity is expensive to consume
- In the US customers may be overpaying for electricity by about $7 billion/year
  - We take the FERC Staff estimate of 92 GW saved under universal dynamic pricing and value demand response at $75/kW-year.

## Flat Rates are unfair

- Under flat rate pricing, inter-customer subsidies may amount to $3 billion/year in the US
  - We scale up the results from a California rate design study that was sponsored by the Demand Response Research Center

# Dynamic Pricing With or Without Enabling Technology Can Lead to Major Peak Reductions

## The Arc of Price Responsiveness



# An Illustrative Case Study of Massachusetts

- The case study envisions that that AMI is rolled out in the state along with a representative portfolio of programs
  - Assumptions are made about AMI deployment rates, likely customer participation rates, likely impact on peak demand and energy consumption per customer
  - Aggregate impacts are then estimated as the product of the two preceding assumptions
  - Benefits are estimated by estimating avoided costs created by changes in load shapes
- The results from the case study are intended to be prospective and not prescriptive in any way

# We quantify the net benefits using the *iGrid* model

- The *iGrid* model measures three main categories of net benefits enabled by AMI
  - Demand response (DR)
  - Energy efficiency (EE)
  - Plug-in electric vehicles (PEV)
- In each category, we quantify the net benefits arising from avoided capacity costs, avoided energy costs, avoided carbon costs, and avoided gasoline costs
- *iGrid* was used recently to quantify the net societal benefits of AMI in Ameren's service area in Illinois and has been used for assessing net benefits in other states such as Colorado

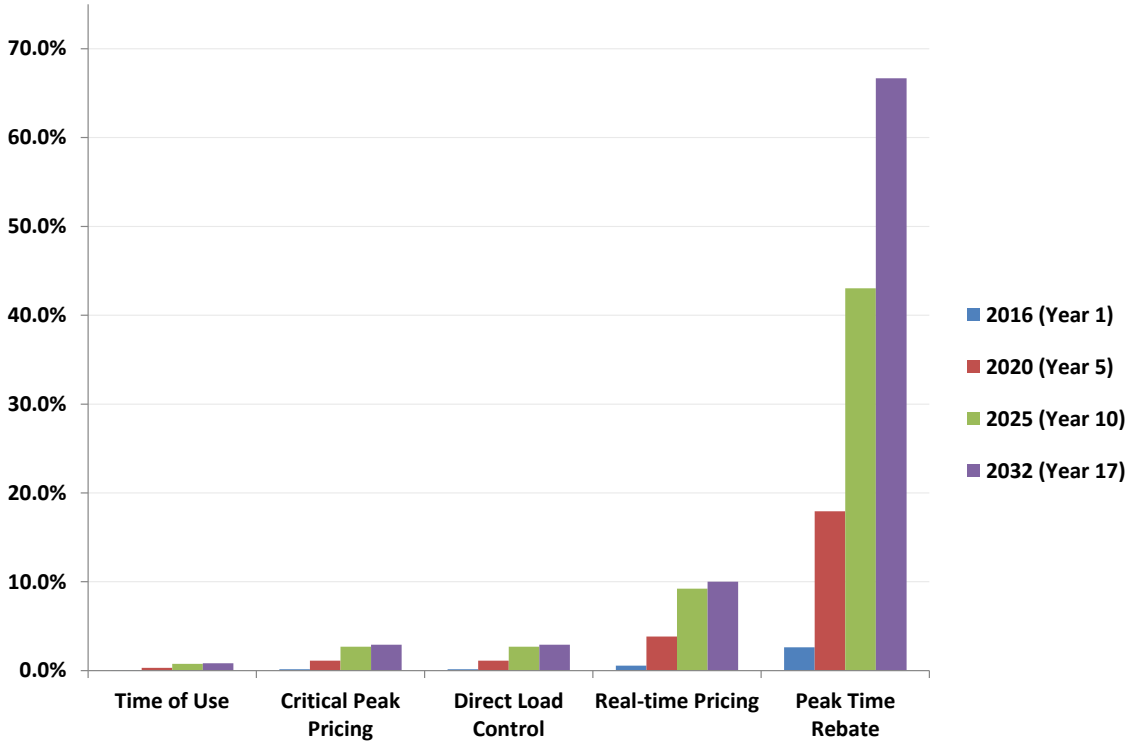
# Societal Costs of the Twenty-year AMI Rollout are Estimated per Customer

| Per-customer Technology Costs in 2012 (Residential & Small C&I) | |
|---|---|
| AMI | $200 |
| Display | $50 |
| Display + PCT | $150 |
| DLC | $150 |
| HEMS | $400 |
| HEMS + PCT | $550 |

(1) The cost of installation is included in these price estimates
(2) We assume a PEV cost premium of $9,500 in 2012
(3) AMI cost is net of operational savings; this cost is assumed to be a one-time cost for all customers
(4) In the first ten years of the forecast, nominal technology costs (apart from AMI) decrease at a rate of 16% per year; in the next ten years, the costs decrease at a rate of 8% per year.
(5) Display is in-home display, PCT is programmable communicating thermostat, DLC is direct load control and HEMS is home energy management system

# Our Illustrative Scenario Assumes Full AMI Deployment and Opt-Out Dynamic Pricing in Massachusetts

## Residential Participation by Program

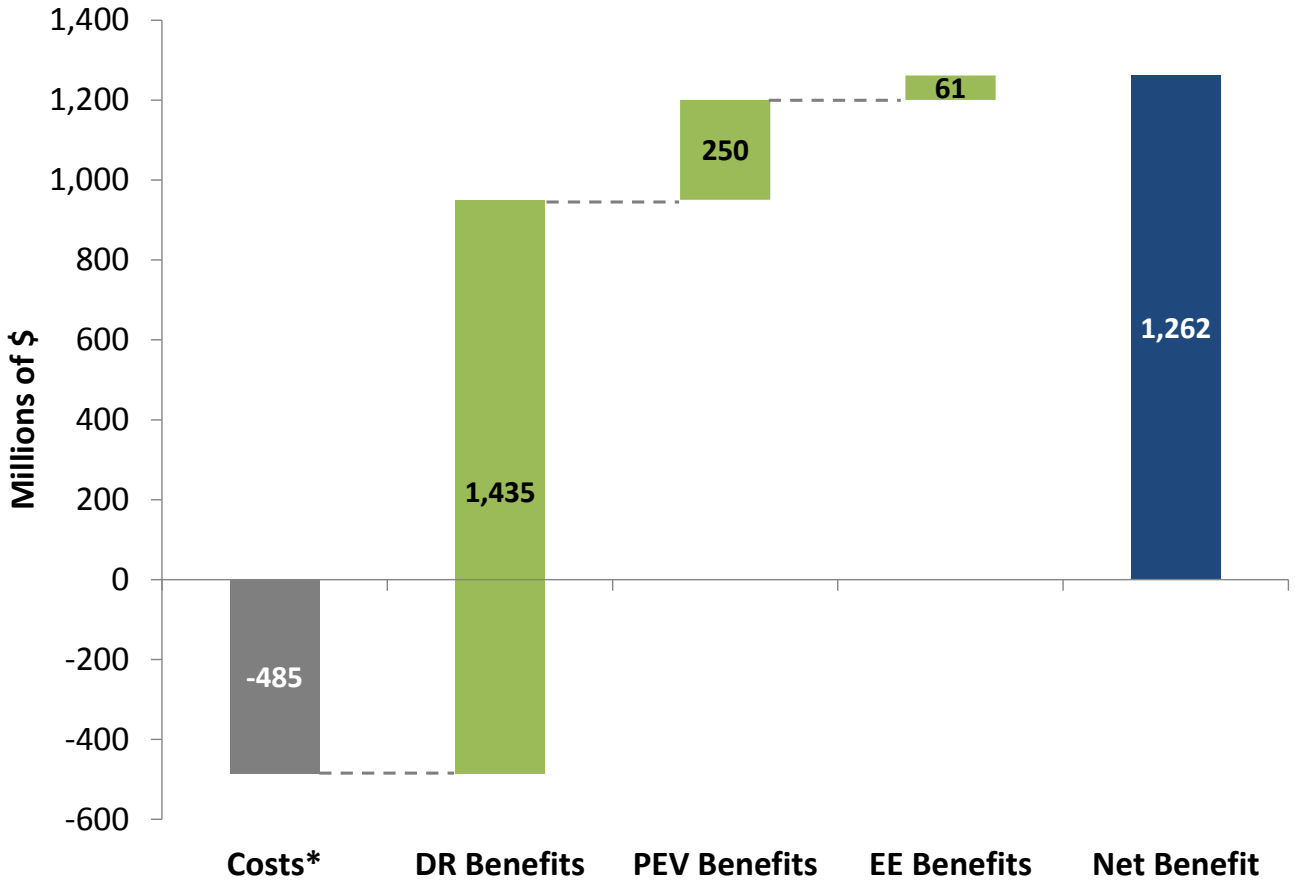



## Key Assumptions (Illustrative)

- 100% AMI deployment reached over 15 years
- PTR is assumed to be offered on an opt-out basis, reaching nearly 70% enrollment by 2032
- Some customers who opt out of the PTR enroll in a variety of other pricing and non-pricing programs (17% choose not to enroll in any DR option)
- A portion of participants in pricing programs are assumed to be equipped with "enabling technologies"
- Similar assumptions are used for C&I customers
- The AMI rollout is also assumed to encourage an incremental increase in PEV adoption

# A Full AMI Rollout with Opt-Out Dynamic Pricing Can Potentially Yield Over $1.2 Billion in Net Societal Benefits

## Net Present Value of AMI Deployment over 20 years




** AMI costs are assumed to be net of operational savings*

# Developments in the United States

## Arizona

- Over two decades, Arizona Public Service has enrolled 51% of its customers on a voluntary TOU rate and the Salt River Project has enrolled about 30% of its customers on a voluntary TOU rate
- In both cases, the TOU rate appeals to large consumers who avoid the upper tier of an inclining block rate by going with TOU

## California

- PG&E has enrolled 80,000 customers on CPP
- SDG&E is offering PTR on an opt-out basis to 2 million customers
- SCE is offering PTR on an opt-in basis and more than 2 million customers have signed on

# US Developments (continued)

## Illinois

- Both the investor-owned utilities, ComEd and Ameren, have enrolled about 25,000 customers on RTP in Illinois
- A new state law calls for opt-in PTR to be offered statewide

## Mid-Atlantic Region

- BGE and PHI will be offering PTR to 2 million customers over the next few years in Delaware, Maryland and the District of Columbia
- PJM is allowing price-responsive demand to be bid into its multi-state markets, as AMI and dynamic pricing are rolled out in its footprint of 51 million customers

## Oklahoma

- OG&E has begun rolling out VPP and hopes to sign up 20% of its customers over the next 3 years
- By so doing, it hopes to avoid building a medium-sized power plant

# International Developments

## Australia

- The Federal Government recently announced its support for a national rollout of smart meters in order to lower power bills
- The federal energy minister supports dynamic pricing
- A three-tier solution is being proposed by the Australia Energy Market Commission for dynamic pricing applied to transmission and distribution rates
  - Mandatory for customers that use twice as much as the average residential customer
  - Opt-in for low income and other vulnerable customers
  - Opt-out for everyone else

# International Developments (continued)

## Canada (Ontario)

- 4.2 million (90%) residential and small business customers are on TOU rates under a regulated retail pricing plan (October 2012)
- All customers have the option of switching over to retail providers
- Significant consumer education at the grassroots level
- Recent survey by Smart Grid Canada found that 72% of people in Ontario said they had changed their behavior because of TOU

## China

- Beijing: 62% of the population was on TOU rates by the end of 2003
- Hebei: 40,000 customers (about half of all sales) are on TOU rates Additionally, Hebei has instituted a mild CPP rate
- Jiangsu: Voluntary residential TOU since 2003
- Shanghai: TOU rate with a 4.5-to-1 peak to off-peak price ratio

# International Developments (continued)

## France

- Électricité de France has offered residential customers CPP across France through the tempo tariff since 1996
- Roughly 400,000 customers have enrolled in the rate

## Great Britain

- Consumer Focus found ~75% of consumers on TOU tariff are satisfied
- Most popular TOU tariff is the Economy 7 tariff, where consumers are charged a lower price for seven consecutive hours overnight

# International Developments (concluded)

## Ireland

- The Commission for Energy Regulation is currently assessing the pros and cons of mandating TOU tariffs and intends to publish its findings by the end of this year
- Stakeholder engagement will follow in 2013

## Italy

- Currently, 28.8 million customers are on a TOU program
  - 18.8 million are Residential Customers
  - ~91% of these residential customers have defaulted to the TOU tariff

# Pathways to the Future

## Opt-in

- Makes sense but only if the dynamic pricing rate is net of the hedging premium in flat rates and if dynamic pricing rates are simple and easy for customers to understand
  - The rates should offer customers significant savings potential and also be offered in a way that appeals to other customer needs besides just saving money.

## Opt-out

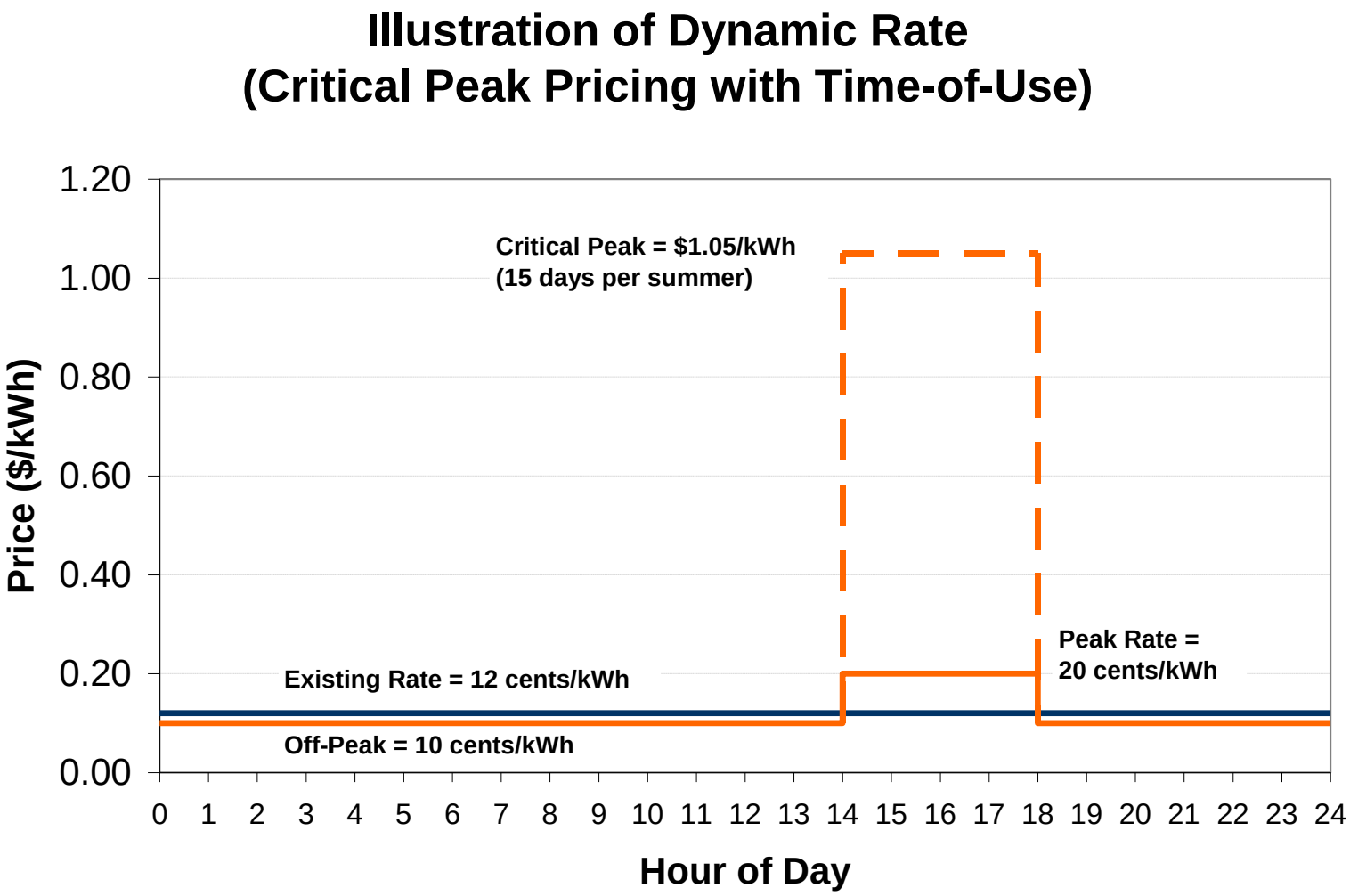
- Best to offer it with full bill protection for the first year and to phase this out over the next two to three years
  - An alternative is to offer two-part rates
  - Another alternative is to offer peak-time rebates

# Appendix

# A Glossary of Dynamic Pricing

| Rate | Description |
|---|---|
| **Time-of-Use (TOU)** | Charges a higher price during all weekday peak hours and a discounted price during off-peak and weekend hours |
| **Super Peak TOU** | Similar to the TOU with the exception that the peak window is shorter in duration (often four hours), leading to a stronger price signal |
| **Inclining Block Rate (IBR)** | Customer usage is divided into tiers and usage is charged at higher rates in the higher tiers; meant to encourage conservation |
| **Critical Peak Pricing (CPP)** | Customers are charged a higher price during a few hours and a discounted during the remaining hours |
| **Variable Peak Pricing (VPP)** | Critical Peak Pricing rate with added variability |
| **CPP-TOU Combination** | A TOU rate in which a moderate peak price applies during most peak hours of the year, but a higher peak price applies on limited event days |
| **Peak Time Rebate (PTR)** | Customers can earn a discount by reducing usage during critical hours |
| **Real Time Pricing (RTP)** | A rate with hourly variation that follows LMPs, but with capacity costs allocated equally across all hours of the year |
| **Critical Peak RTP** | A rate with hourly variation based on LMPs and with a capacity cost adder focused only during event hours |

# Dynamic Pricing Means Lower Rates for Thousands of Hours a Year and Higher Prices During a Few Hundred



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Ahmad Faruqui is a principal with *The Brattle Group* who specializes in the analysis, design and evaluation of smart grid strategies involving the consumer. He has consulted with more than 50 utilities and transmission system operators around the globe and testified or appeared before a dozen state and provincial commissions and legislative bodies in the United States and Canada.

He has also advised the Alberta Utilities Commission, the Edison Electric Institute, the Electric Power Research Institute, the Federal Energy Regulatory Commission, the Institute for Electric Efficiency, the Ontario Energy Board, the Saudi Electricity and Co-Generation Regulatory Authority, and the World Bank.

Dr. Faruqui has managed the design and evaluation of large-scale dynamic pricing experiments in California, Connecticut, Florida, Illinois, Maryland and Michigan. This work involved the estimation of a variety of econometric models for estimating customer response to prices that varied by time of day.

His work has been cited in publications such as The Economist, The New York Times, and USA Today and he has appeared on Fox News and National Public Radio. The author, co-author or editor of four books and more than 150 articles, papers and reports on efficient energy use, he holds a Ph.D. in economics and an M.A. in agricultural economics from The University of California at Davis, where he was a Regents Fellow, and B.A. and M.A. degrees in economics from The University of Karachi with the highest honors.

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