Rate Design 3.0 and The Efficient Pricing Frontier

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Two-part rates are the norm for residential customers, but they are misaligned with the utility cost structure

Cost categories	Utility's Costs	Customer's Bill
Variable ($/kWh) - Fuel/gas supply - Operations & maintenance	Variable = $60	Variable = $115
Fixed ($/customer) - Metering & billing - Overhead	Fixed = $10	Fixed = $5
Size-related (demand) ($/kW) - Transmission capacity - Distribution capacity - Generation capacity	Demand = $50	

Three-part rates are the norm for commercial and industrial customers

They reflect the utility cost structure, unlike residential rates

Bonbright's principles of rate design apply to all classes

- All customers, regardless of class, are served by the same power plants and the same grid

Why have residential rates have been misaligned with the cost structure?

- The often cited reasons include lack of metering, customer distaste for demand charges and time-varying energy rates, and adverse impact on low and medium income customers

Smart meters are now deployed to 70 million residences and may be deployed nationwide in the next decade

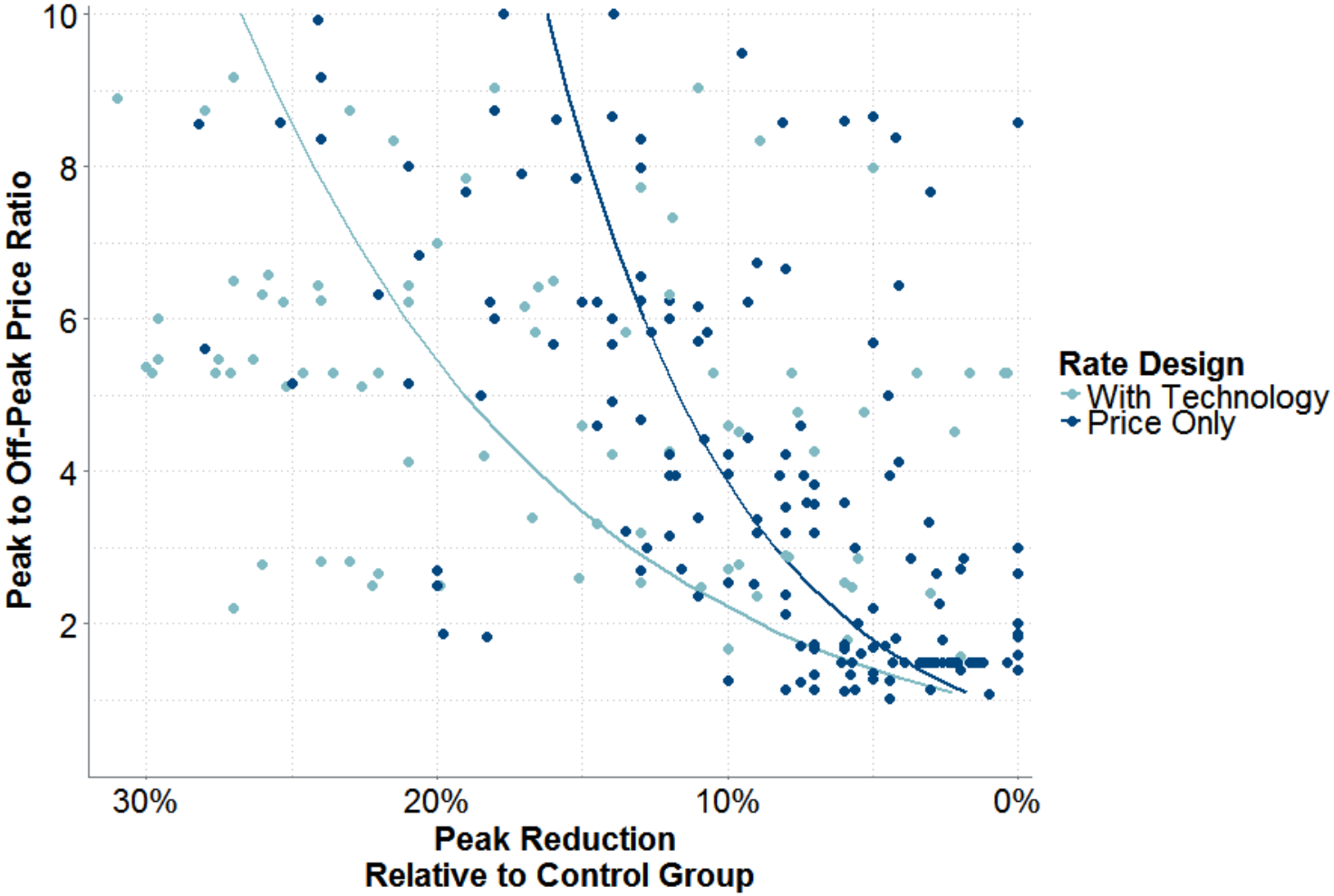
This has generated interest in new rate designs, which feature energy-only time-varying rates, sometimes coupled with a fixed charge; let's call them Rate Design 2.0

Rate Design 2.0 does a better job of transmitting the time-varying costs of energy than uniform, volumetric structures (Rate Design 1.0)

- But it has not been an easy task to move from Rate Design 1.0 to Rate Design 2.0

After much hemming and hawing, quasi-academic deliberations on the "ethics of dynamic pricing," scientific trials and experiments, Rate Design 2.0 has begun to be deployed in several jurisdictions

349 experiments have shown that customers respond to price and smart technologies lead to higher elasticities



Source: Ahmad Faruqui, Sanem Sergici and Cody Warner, "Arcturus 2.0: A Meta-Analysis of Time-Varying Rates for Electricity," *The Electricity Journal* 30, no. 10 (2017): 64-72.

RD 2.0: Oklahoma has rolled out variable peak pricing (VPP)

OGE rolled out VPP coupled with a smart thermostat to its residential customers a few years ago

- "Smart Hours" features variable peak pricing, which has five levels of peak pricing

Some 130,000 customers (or 20% of the total) are on VPP; 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

RD 2.0: Maryland has rolled out peak-time rebates (PTR)

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 has just authorized new TOU pilots

RD 2.0: Ontario (Canada) has rolled out TOU rates to all residential and small commercial customers

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

- The TOU rates 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

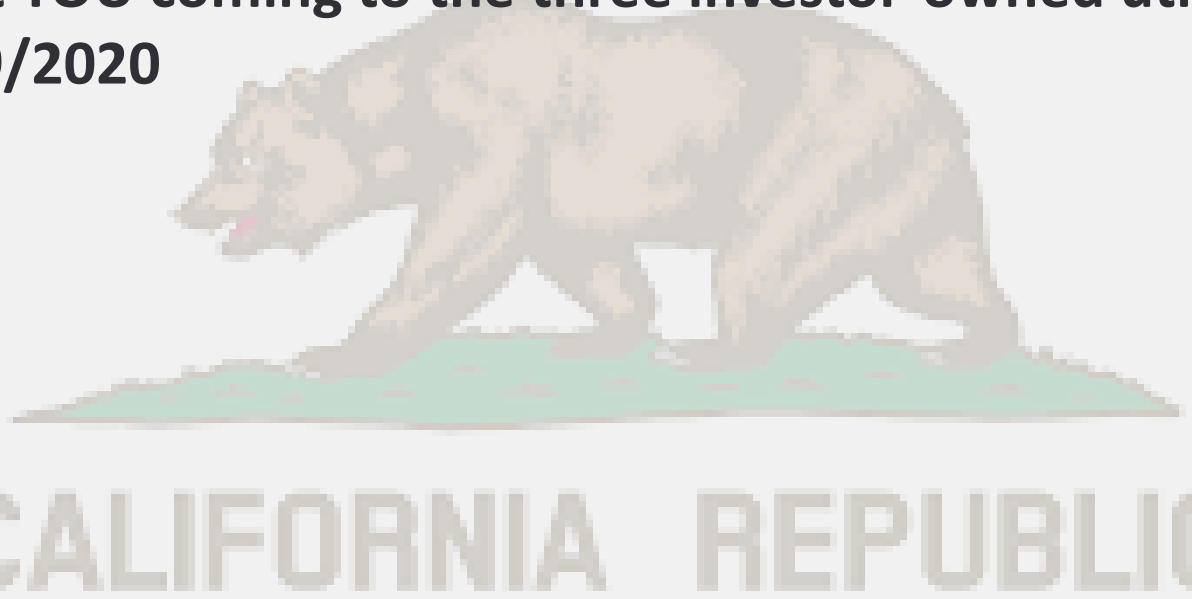
The OEB has ruled that distribution charges will be collected through a fixed monthly charge

RD 2.0: California, after piloting several time-varying rates, is preparing to deploy TOU on a default basis

Opt-in CPP has been offered for some time

Default TOU coming to SMUD in 2019

Default TOU coming to the three investor-owned utilities in 2019/2020



RD 2.0: The UK is piloting PTR and new TOU rates

UK Power Networks (London) is piloting PTR targeted specifically at low income customers

A couple of pilots have tested time-varying rates

13% of customers are on a TOU rate (Economy 7) designed for customers with thermal energy storage

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

RD 2.0: Ireland is preparing to deploy TOU rates

The Regulatory Commission (CRU) would like retail electricity suppliers to offer a generic, simple to understand TOU tariff

- The CRU will not specify the specific prices, just the structure

Retailers can also offer other TOU tariffs

Smart electricity meters will be rolled out starting in Q4 2019 on customer request.

- Once the meters are switched on, the suppliers will be obligated to provide the smart tariff within 14-16 months after the 'switch-on'

RD 2.0: Australia is beginning to experiment with PTR

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

RD 2.0: Hong Kong is moving ahead with 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

We are on the cusp of Rate Design 3.0

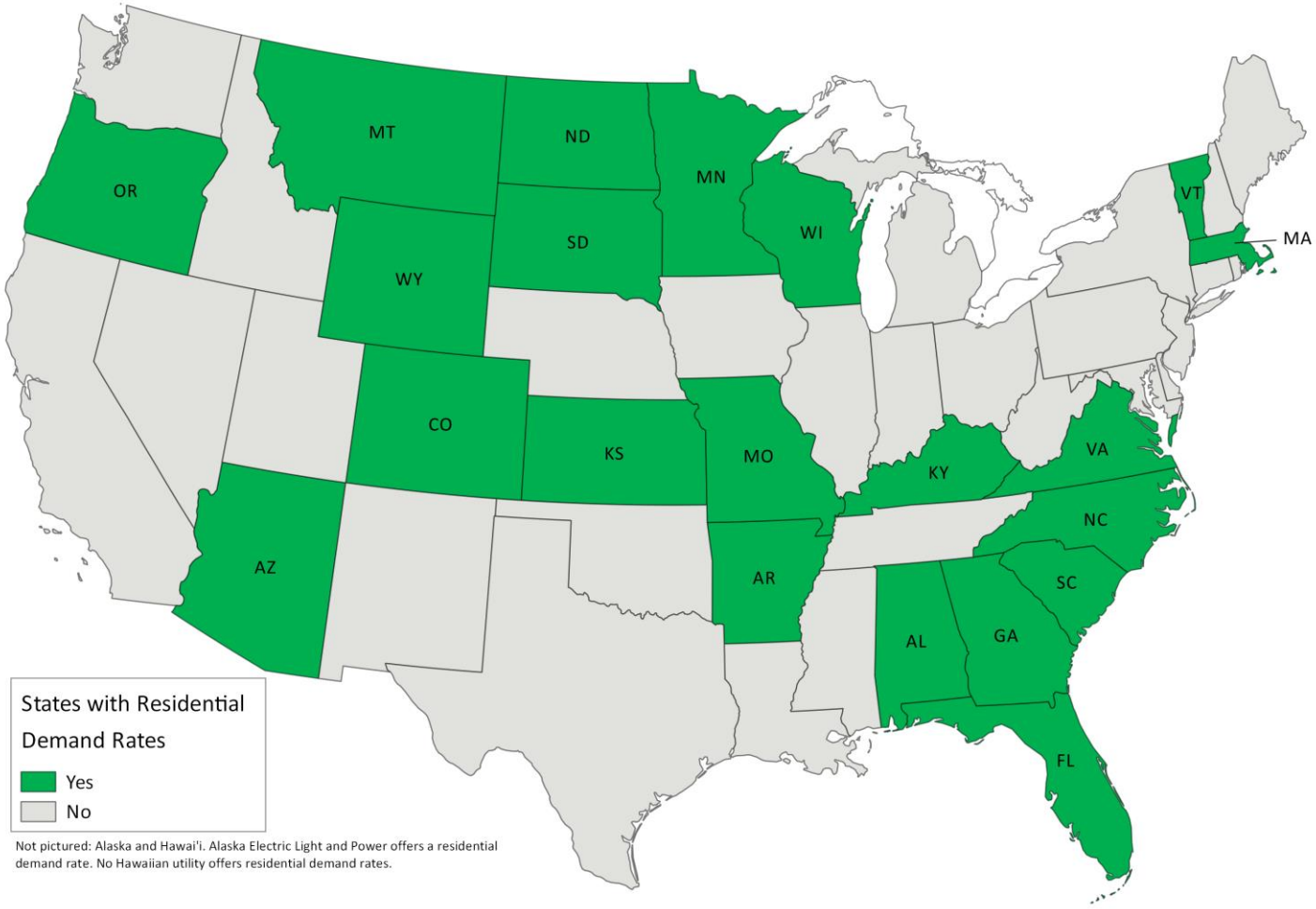
Capacity charges based on the size of the connection are mandatory for residential customers in France, Italy, and Spain

Demand charges are being offered in the United States in increasing numbers but most of them do not combine them with TOU energy charges

- 52 demand charges (9 mandatory)
- 44 utilities (18 investor-owned)
- 22 states (see map)

In Arizona, two utilities already offer demand charges for capacity costs and TOU rates for energy costs

22 states are offering demand charges to residential customers



You can design your own Rate Design 3.0

Parts	Cost Category	Rate Design Category
1	Meter Line drop Transformer Billing Customer care	
2	Distribution capacity Transmission capacity Generation capacity	
3	Energy	

Here is one proposed design

Parts	Cost Category	Rate Design Category
1	Meter Line drop Transformer Billing Customer care	Monthly service charge
2	Distribution capacity	Non-coincident peak (NCP) demand charge
	Transmission capacity	Mix of NCP demand charge and coincident peak (CP) demand charge
	Generation capacity	CP demand charge and/or time-varying energy charge
3	Energy	Time-varying energy charge

Of course, customers have diverse preferences

Some want to save money and want the lowest price

- They are willing to be flexible in the manner in which they use electricity

Some want to lock in a guaranteed bill

- They are willing to pay a premium for peace-of-mind

Many others are in between these two bookends

- Some might want a guaranteed bill, but may be willing to lower it if rebates are offered for reducing demand during peak periods
- Others may wish to subscribe to a given level of demand

All customers want choice, but *they only want what they want*

These are a few of the rate designs that accommodate the diverse preferences of customers

A Guaranteed bill (GB)

B GB with discounts for demand response (DR)

C Standard tariff

D Increased fixed charge(|FC)

E Demand charge

F Time-of-Use (TOU)

G Critical peak pricing (CPP)

H Peak time rebates (PTR)

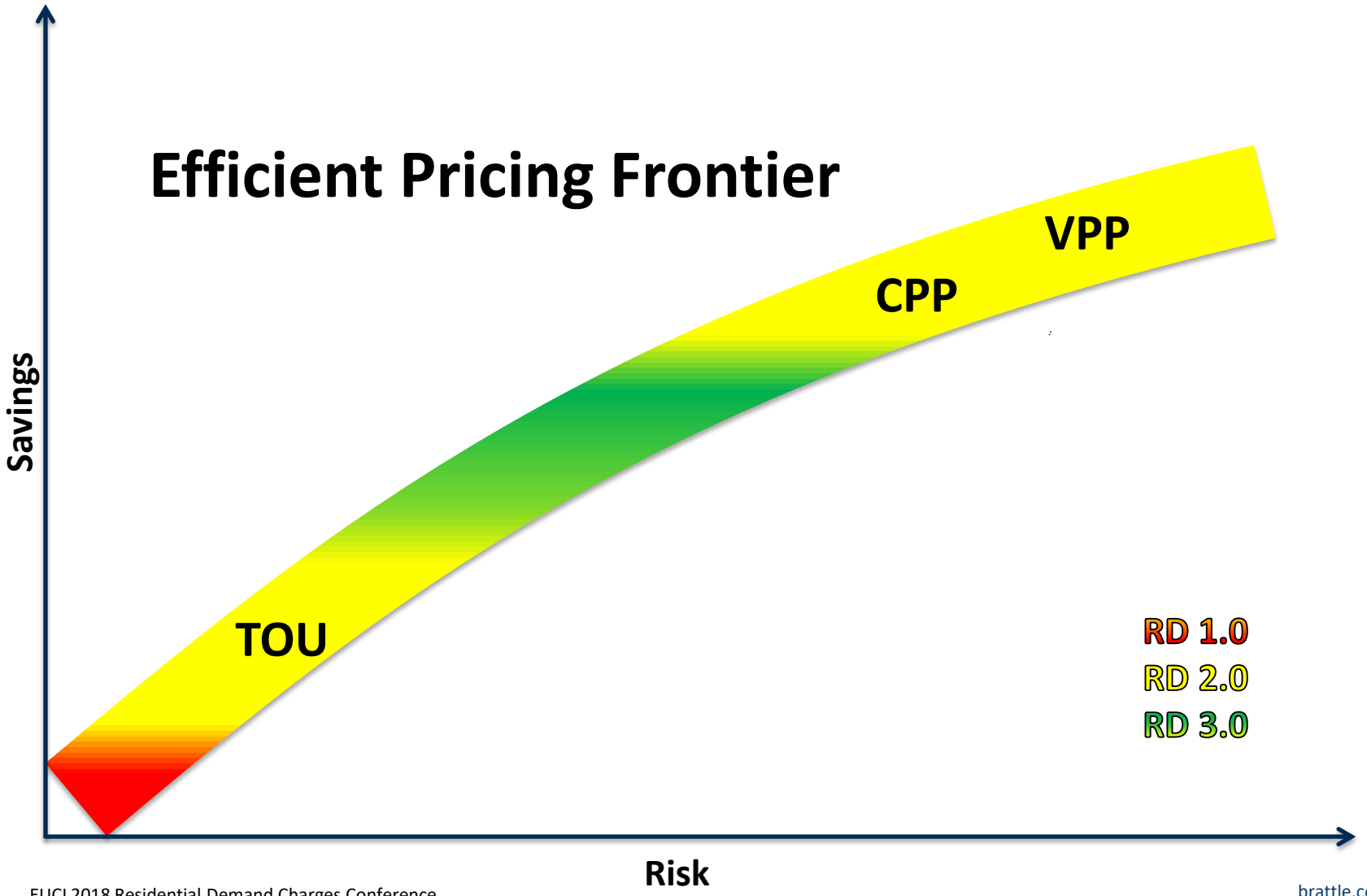
I Variable peak pricing (VPP)

J Demand subscription service (DSS)

K Transactive energy (TE)

L Real-time pricing (RTP)

These rate choices span the savings-risk space, generating an "efficient pricing frontier"



Utilities can modernize their rates in five easy simple steps

Step One: Identify customer needs and preferences through interviews, focus groups and surveys

Step Two: Develop new cost-based rates by leveraging or updating your cost-of-service studies

Step Three: Engage in a broad-scale customer outreach program and educate them about the new rate choices

Step Four: Make it clear that Rate Design 3.0 will become the default rate in the near future, but it will be accompanied by other rate choices

Step Five: Assist customers in picking the rate they want

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