Reinventing Demand Response

PRESENTED TO

CRRI – Rutgers University
32nd Annual Western Conference

PRESENTED BY

Mariko Geronimo Aydin
Prepared with Ahmad Faruqui and Ryan Hledik

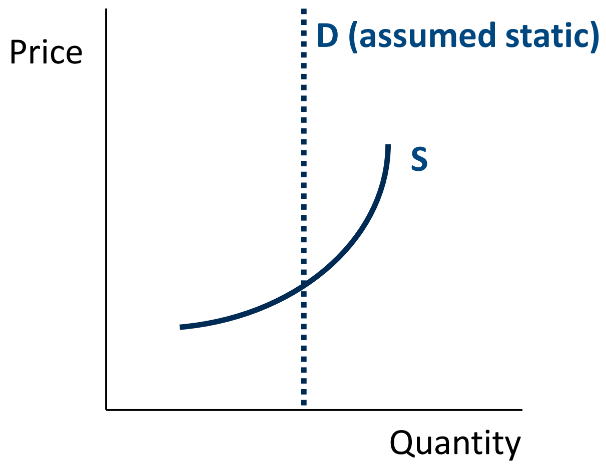
June 27, 2019

THE Brattle GROUP

Demand Response (DR)

What is the objective? —Essentially to identify and engage customers' demand flexibility

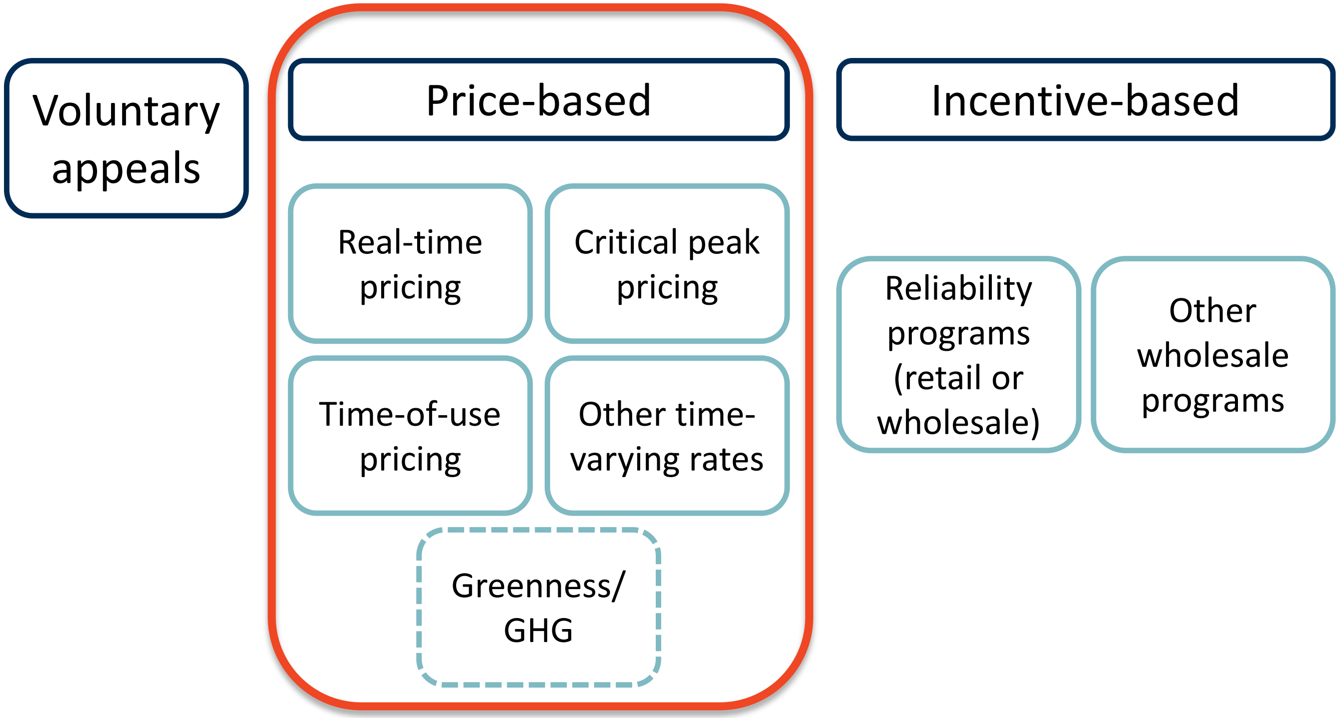
Unlocking the "Real" Demand Curve



- Hidden: system planning and operations mostly rely on best estimates of static/fixed demand
- With some proxies, e.g., VOLL
- Estimates anywhere from minute-to-minute to year-by-year
- A surprisingly large "resource" if it can be tapped (60 GW today): customers respond to price, instruction, and/or externalities (e.g., greenness)
- Provides cost savings and efficiency, at customer level and system level

Price (and Other) Signals for DR

Many ways to engage DR; this presentation focuses on price-based signaling residential customers via retail rates… but signaling for greenness is emerging



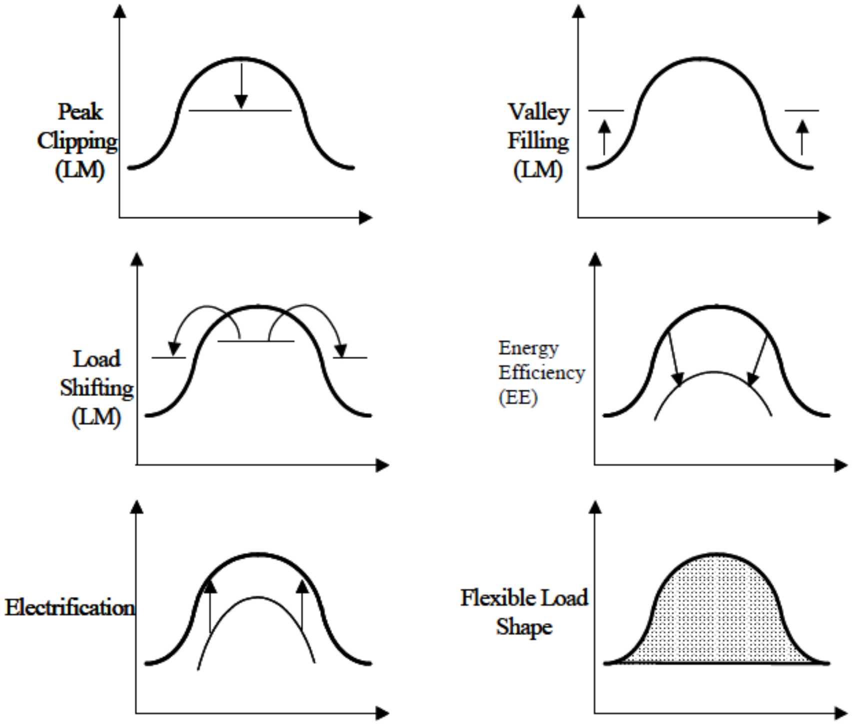
Why Does DR Need Reinvention?

Traditional DR programs, that assume none of the following exists, cannot fully engage customers to meet system and customer needs:

- **Customer appetites for green energy** are fundamentally changing the supply mix and how the system operates; flexibility in all aspects of the system is becoming increasingly important
- **Advanced meters, customer surveying techniques, and data analytics** are making it easier to observe the "true" demand curve and nuances in customer preferences
- **Smart home tech, smart appliances, EVs and storage** are creating new demand flexibility with residential customers
- **Communication technology, webware, and apps** are making it possible to engage customers on short notice and with complex shopping decisions

Demand Flexibility for Efficient Operations

Flexible Demand… Not a New Concept!

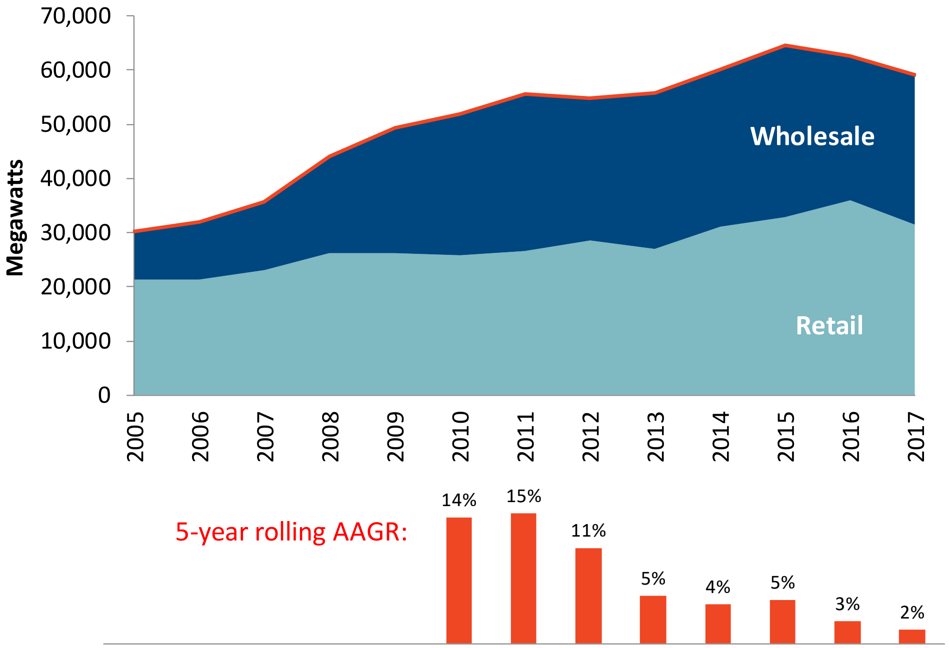


See, for example, Gellings, Clark W., Pradep C. Gupta, and Ahmad Faruqui, "Strategic Implications of Demand-Side Planning," Chapter 8 in Plummer, James L., Eugene N. Oatman, and Pradeep C. Gupta (eds), Strategic Management and Planning for Electric Utilities, Prentice-Hall, Englewood Cliffs, 1985, pp. 137–150. See also, Schweppe, Fred C., Richard D. Tabors, and James L. Kirtley, "Homeostatic Control: The Utility/Customer Marketplace for Electric Power," MIT Energy Laboratory Report MIT-EL 81-033, September 1981.

DR Peak Impacts: 2005–2017

Traditional DR capability doubled in 10 years, but more recently hit a saturation point

Total U.S. Peak Reduction Capability from DR



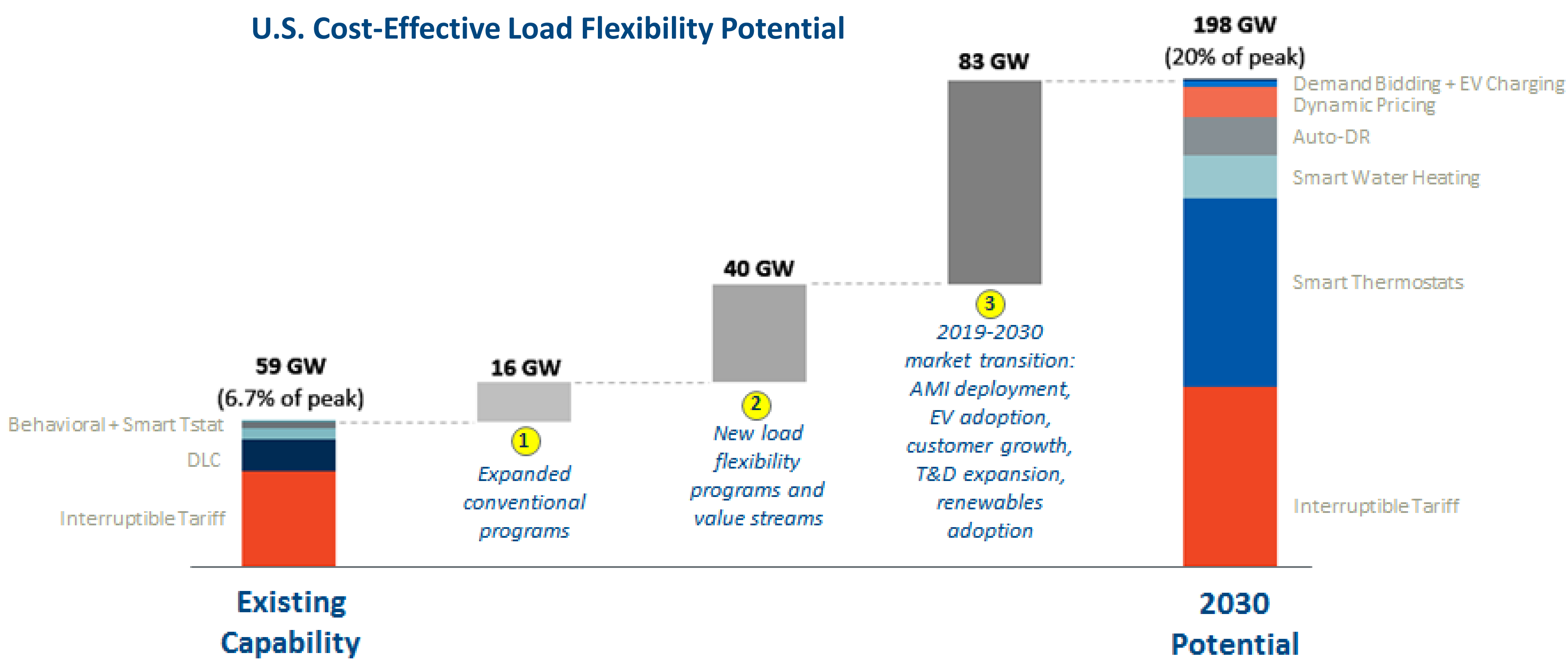
Contributing Factors

- Wholesale market refinements
- Low capacity and energy market prices
- Slowdown in load growth

Source: Brattle analysis of FERC Assessment of Demand Response and Advanced Metering reports (2006–2018) and EIA-861 Data (2005–2017). Post-2012 values are not modified to account for possible double-counting between wholesale and retail DR across data sources.

DR Future Impacts

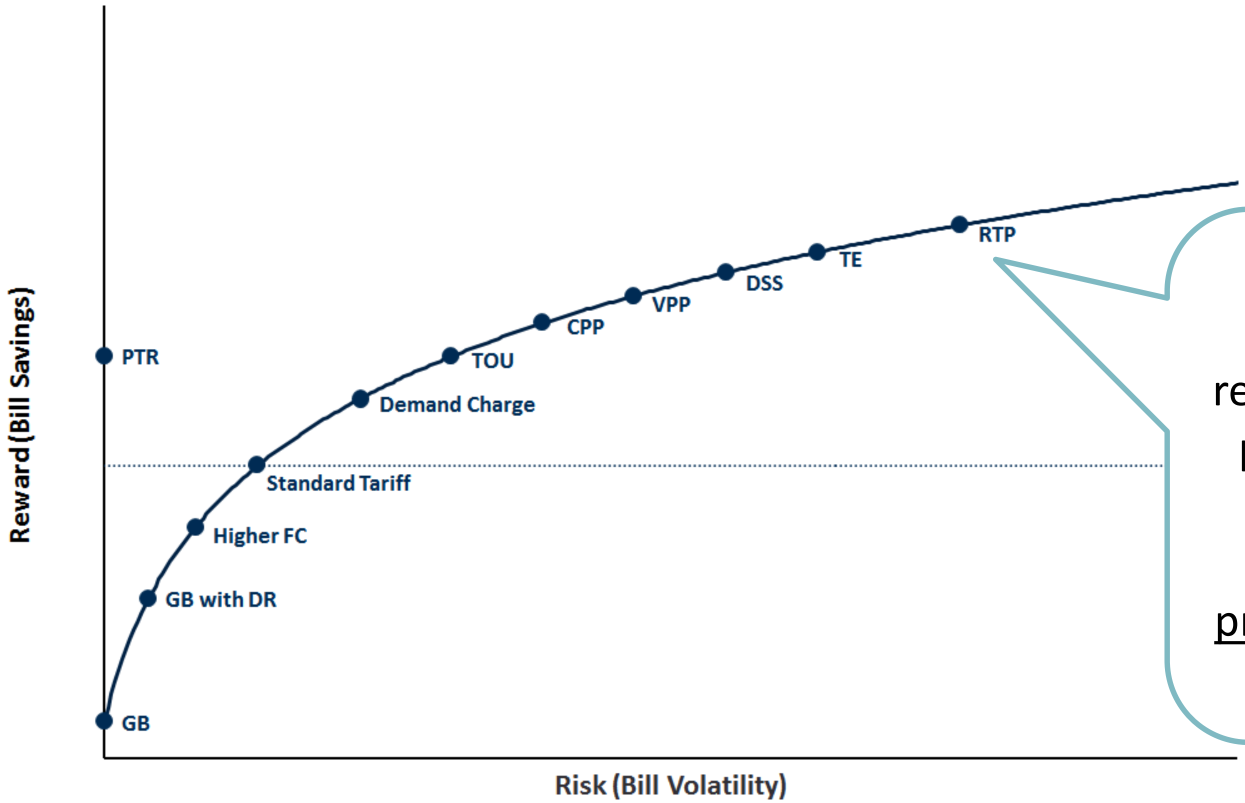
A new Brattle study shows that a portfolio of load flexibility programs could triple existing DR capability, approaching <u>200 GW</u> (20% of system peak) by 2030



Source: Hledik, Ryan, Ahmad Faruqui, Tony Lee, John Higham, "The National Potential for Load Flexibility: Value and Market Potential through 2030," June, 2019. Note existing DR capability does not account for impacts of retail pricing programs, as fewer than 1% of customers are currently enrolled in dynamic pricing rates and the impacts of long-standing TOU rates are already embedded in utility load forecasts.

DR Retail Pricing Methods

If achieved via dynamic pricing, depends on regulator and customer appetites for bill stability vs. cost saving opportunities

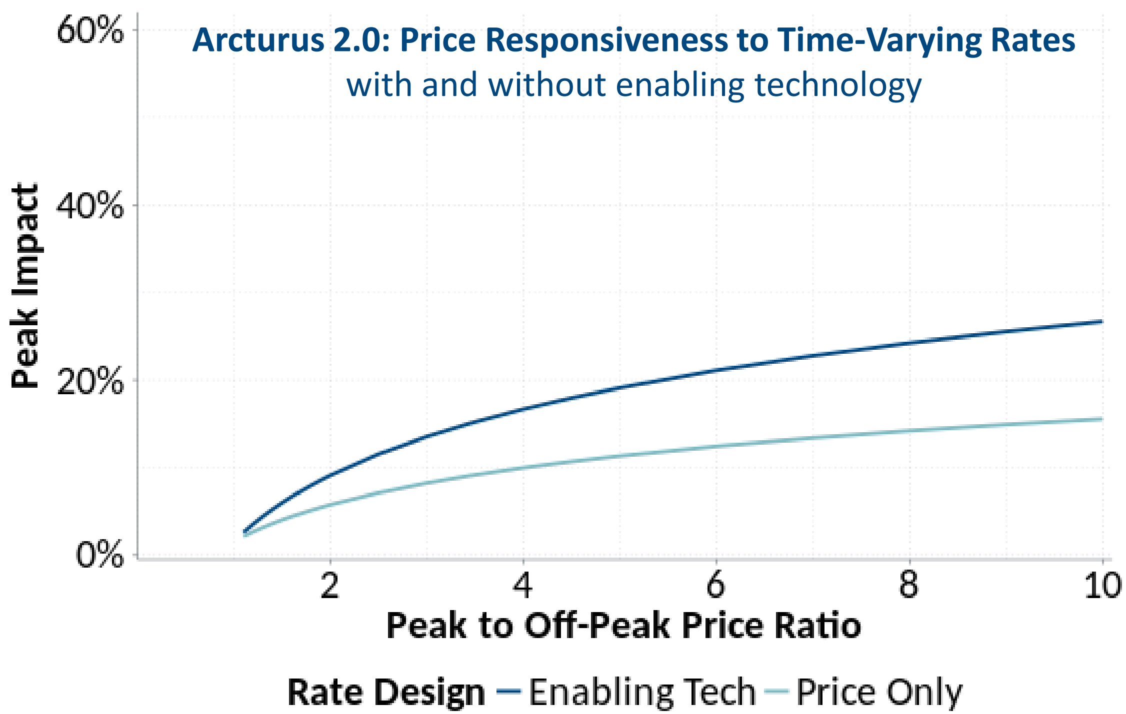


Do residential customers really respond to real-time prices? Oklahoma Gas and Electric found that 4% preferred RTP to the standard tariff.

Source: Ahmad Faruqui et al., The Brattle Group.

Responsiveness to Dynamic Pricing

Studies around the world have shown that some customers are responsive to dynamic pricing, and even more so with enabling tech



Source: : Faruqui, Ahmad, Sanem Sergici, and Cody Warner, "Arcturus 2.0: A Meta-analysis of Time-varying Rates for Electricity," The Electricity Journal, Volume 30, Issue 10, December 2017. Arcturus 2.0 is a database of 337 treatments from 63 pilots.

Retail Rate (Tariff) Modernization

- Nationally, about half of all meters are smart meters, but only 5% of customers are on advanced rates (FERC, 2018)

- Important to get the signal to customers "right"
  - Affects investment decisions and day-to-day behavior
  - Rate components/structure to better reflect cost of service (customer segmentation, fixed/demand/variable, time profile/dynamic pricing)
  - But balanced with other rate design objectives (*see* Bonbright, 1988)
  - Subsidies and incentive payments help to launch new technologies and programs, but will increasingly distort signals as DR resources grow
  - Customers increasingly interested in greenness signal, not just price

Example of Retail Pricing Options: Arizona Public Service

Residential Plan Comparison*

PLANS	BASIC SERVICE CHARGE (PER DAY)	ENERGY CHARGE (PER kWh)	OFF-PEAK PRICING	SUPER OFF-PEAK WINTER PRICING	ON-PEAK SUMMER PRICING	ON-PEAK WINTER PRICING	ON-PEAK SUMMER PEAK USAGE (DEMAND) CHARGE PER kW	ON-PEAK WINTER PEAK USAGE (DEMAND) CHARGE PER kW	OFF-PEAK HOURS	SUPER OFF-PEAK WINTER HOURS	ON-PEAK HOURS	ENERGY USE RESTRICTIONS (12-MONTH AVERAGE)	RENEWABLE ENERGY COMPATIBLE
Saver Choice	42.7¢	-	10.873¢	3.200¢	24.314¢	23.068¢	-	-	8 p.m.-3 p.m. weekdays, all weekend +10 holidays	10 a.m.-3 p.m. weekdays	3 p.m.-8 p.m. weekdays	-	Yes (with grid access charge)
Saver Choice Plus	42.7¢	-	7.798¢	-	13.160¢	11.017¢	$8.40	$8.40	8 p.m.-3 p.m. weekdays, all weekend +10 holidays	-	3 p.m.-8 p.m. weekdays	-	Yes
Saver Choice Max	42.7¢	-	5.230¢	-	8.683¢	6.376¢	$17.44	$12.24	8 p.m.-3 p.m. weekdays, all weekend +10 holidays	-	3 p.m.-8 p.m. weekdays	-	Yes
Lite Choice	32.9¢	11.672¢	-	-	-	-	-	-	-	-	-	Under 600 kWh per month	No
THE FOLLOWING PLAN IS AVAILABLE TO ELIGIBLE CUSTOMERS AFTER A TRIAL OF 90 DAYS ON ONE OF THE SAVER CHOICE PLANS.													
Premier Choice	49.3¢	12.393¢	-	-	-	-	-	-	-	-	-	601-999 kWh per month	No

Source: Arizona Public Service, Residential Plan Comparison, https://www.aps.com/library/rates/PlanComparison.pdf, accessed March 2019.

New DR Services

Future DR growth will also depend on expanded definitions of the type and method of services provided

1 Extend DR value streams →

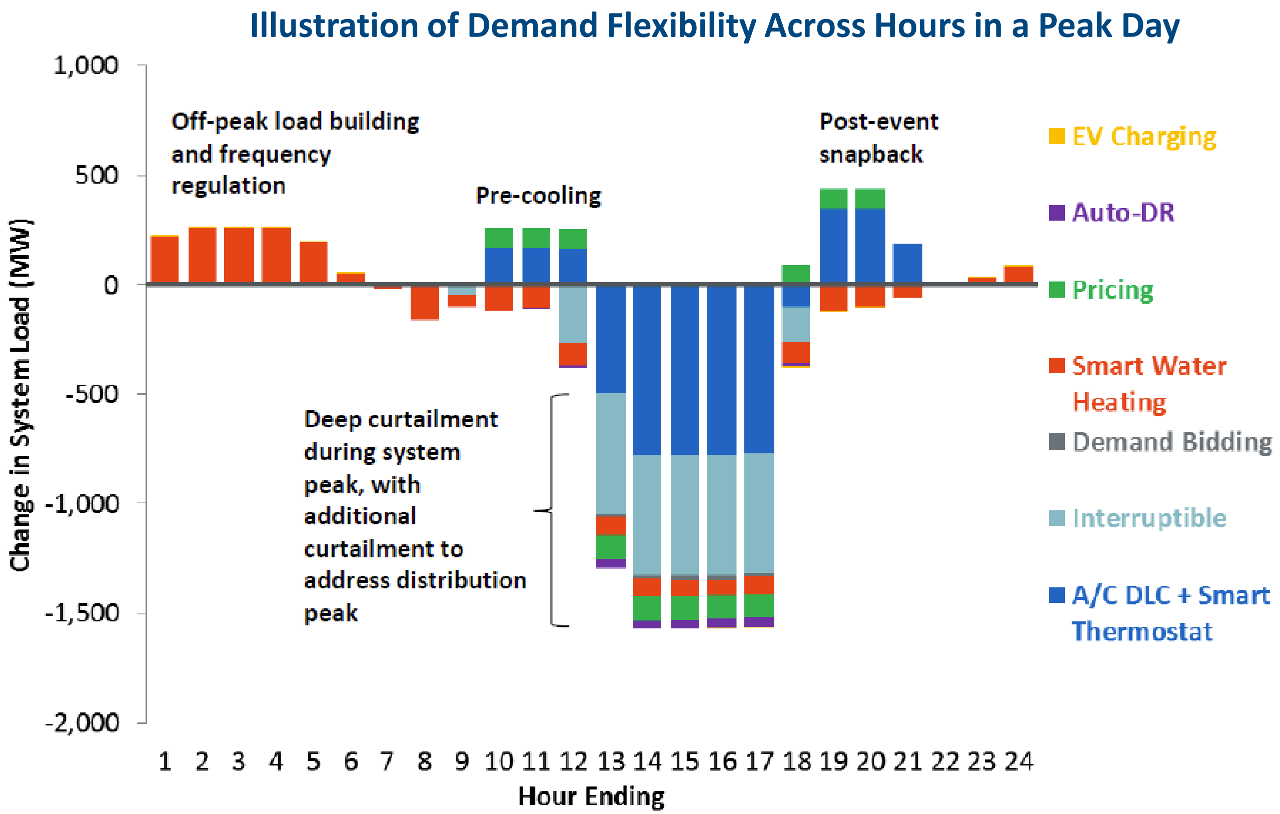
2 Broaden definition of DR ↓

	Generation capacity avoidance	Reduced peak energy costs	System peak related T&D deferral	Targeted T&D capacity deferral	Load shifting/ building	Ancillary services
Direct load control	X	X	X	X		
Interruptible tariff	X	X	X			
Demand bidding	X	X	X		X	
Time-of-use (TOU) rates	X	X	X			
Dynamic pricing	X	X	X			
Behavioral DR	X	X	X			
EV managed charging	X	X	X	X	X	X
Smart water heating	X	X	X		X	X
Timed water heating	X	X	X		X	
Smart thermostat	X	X	X	X		
Ice-based thermal storage	X	X	X	X	X	
C&I Auto-DR	X	X	X	X	X	X

Source: Hledik, Ryan, Ahmad Faruqui, Tony Lee, John Higham, “The National Potential for Load Flexibility: Value and Market Potential through 2030,” June, 2019.

Example: DR Impacts on a Peak Demand Day

New demand response could provide flexibility throughout the day



Notes: Shown for cost-effective programs identified in 2030, accounting for portfolio overlap.

Source: Ryan Hledik et al, The Brattle Group.

PRESENTED BY

Mariko Geronimo Aydin

Senior Associate, San Francisco
+1.415.217.1015
Mariko.Geronimo@Brattle.com

Ms. Mariko Geronimo Aydin, a Senior Associate in The Brattle Group's San Francisco office, has almost fifteen years of experience in analyzing the policies and economics of electricity system planning, regulation and de-regulation of electricity supply, and wholesale electricity markets across the U.S. Her more recent work has focused on finding sustainable and creative ways to adapt traditional planning processes and analytical tools to an industry rapidly shifting towards cleaner and more scalable supply technologies. Today's electricity industry still has untapped potential to meet goals of clean energy, cost-effectiveness, and operational and planning flexibility through greater electricity customer engagement, cutting-edge data analysis, and new technologies. To reach this potential with a robust and modern grid, Mariko works with clients to explore options for evolving utility business models, customer choice, and wholesale market refinements that can make the best use of distributed and customer-driven power supply resources, in synergy with more traditional resources.

Mariko holds a B.S. in Economics and an M.A. in Applied Economics from Northeastern University in Boston, Massachusetts.

About Brattle

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governments around the world. We aim for the highest level of client service and quality in our industry.

OUR SERVICES

Research and Consulting

Litigation Support

Expert Testimony

OUR PEOPLE

Renowned Experts

Global Teams

Intellectual Rigor

OUR INSIGHTS

Thoughtful Analysis

Exceptional Quality

Clear Communication

Our Practices and Industries

ENERGY & UTILITIES

- Competition & Market Manipulation
- Distributed Energy Resources
- Electric Transmission
- Electricity Market Modeling & Resource Planning
- Electrification & Growth Opportunities
- Energy Litigation
- Energy Storage
- Environmental Policy, Planning and Compliance
- Finance and Ratemaking
- Gas/Electric Coordination
- Market Design
- Natural Gas & Petroleum
- Nuclear
- Renewable & Alternative Energy

LITIGATION

- Accounting
- Analysis of Market Manipulation
- Antitrust/Competition
- Bankruptcy & Restructuring
- Big Data & Document Analytics
- Commercial Damages
- Environmental Litigation & Regulation
- Intellectual Property
- International Arbitration
- International Trade
- Labor & Employment
- Mergers & Acquisitions Litigation
- Product Liability
- Securities & Finance
- Tax Controversy & Transfer Pricing
- Valuation
- White Collar Investigations & Litigation

INDUSTRIES

- Electric Power
- Financial Institutions
- Infrastructure
- Natural Gas & Petroleum
- Pharmaceuticals & Medical Devices
- Telecommunications, Internet, and Media
- Transportation
- Water

Our Offices

BOSTON

NEW YORK

SAN FRANCISCO

WASHINGTON

TORONTO

LONDON

MADRID

ROME

SYDNEY

THE POWER OF **ECONOMICS**

brattle.com

THE Brattle GROUP