Harnessing Consumer Flexibility

A U.S. Perspective

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Locational pricing – how can it engage consumers
Round table on Future Power Market Platform
Berlin
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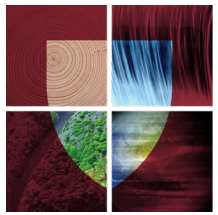
HARVARD Kennedy School



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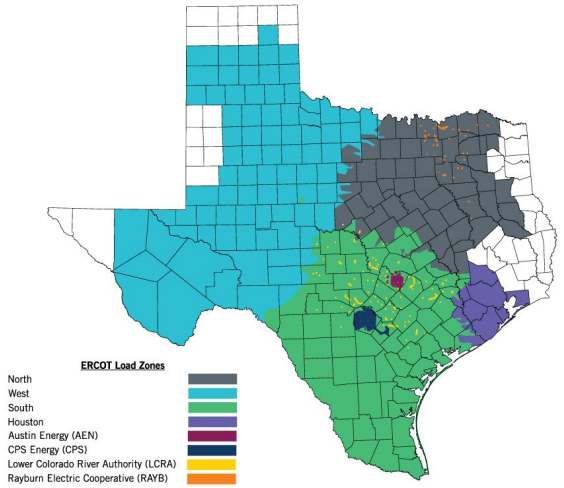
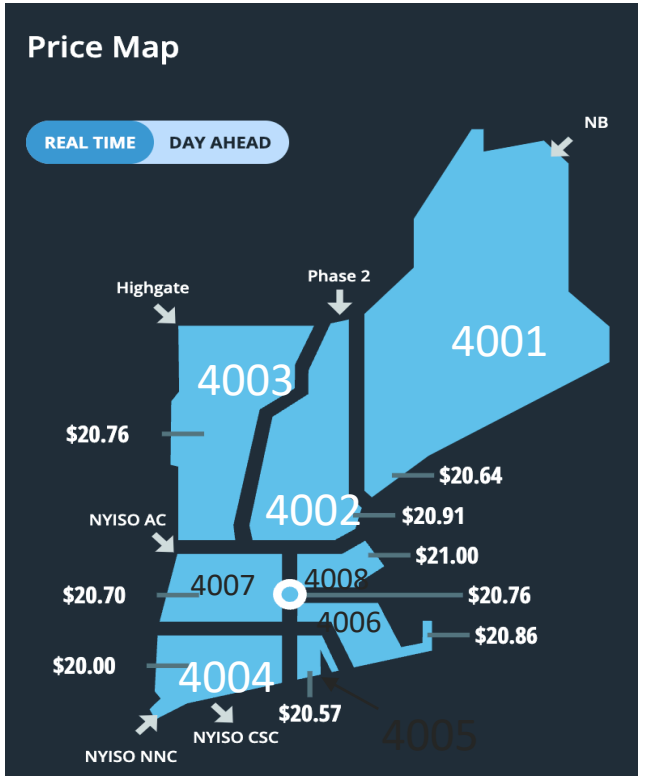
Locational demand signals

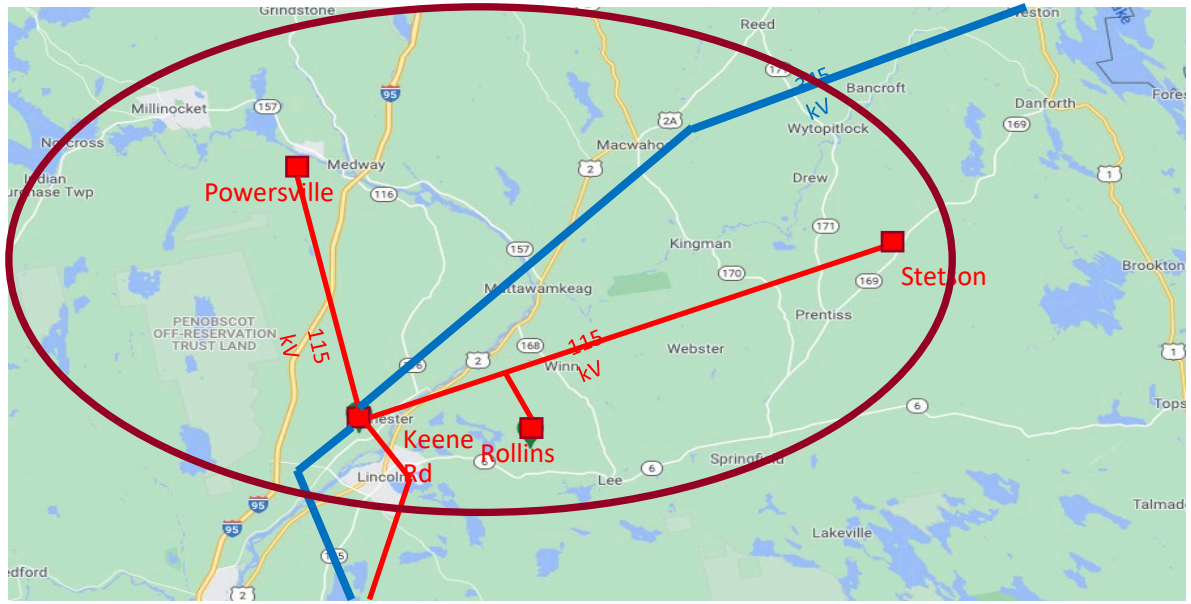
- Organized short-run markets in U.S. are primarily nodal
  - Locational marginal price (LMP) seen by producers and consumers at wholesale level
- But load does not always settle at LMP
  - ISO New England: 8 "load zones" across 6 states
  - ERCOT (Texas): 8 "load zones"





Perverse incentive: Congestion can decrease zonal prices

- ISO-NE: Top 10 nodes with negative prices are all behind the Keene Rd Constraint
- High wind output and congestion is leading to lower, not higher prices
- 7 homes with air-water heat pump with storage in Millinocket Maine
- Heaters exhibited a 50% increase in load during wind curtailment events when using nodal vs zonal prices
  - Annual wholesale energy costs reduced by 20-40% with 2020-3 data



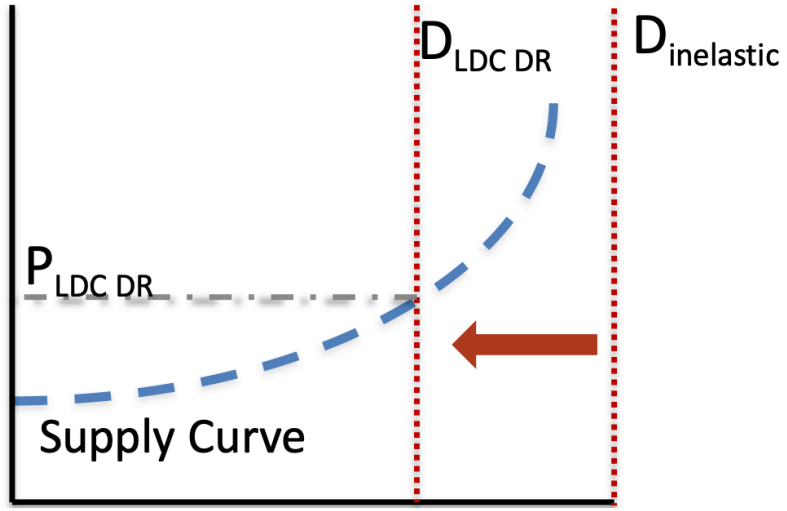
Consumer flexibility potential

- Est. 200 GW (20% peak) of load flexibility by 2030, avoiding $15 billion in costs (Brattle, 2019)
  - 40% via existing pathways
  - 60% via new pathways, inc. accessing electrified building load
- **Demand response (DR)**: payments/incentives for reducing energy usage
  - Commercial, industrial sector dominant (~70%)
  - Demand response (DR) participation in energy, reserve markets but largely in capacity markets (ISO-NE, PJM, NYISO, CAISO)
    - Performance issues (e.g., CAISO DRAM discontinued)
    - Capacity = zonal product

Consumer flexibility and price formation

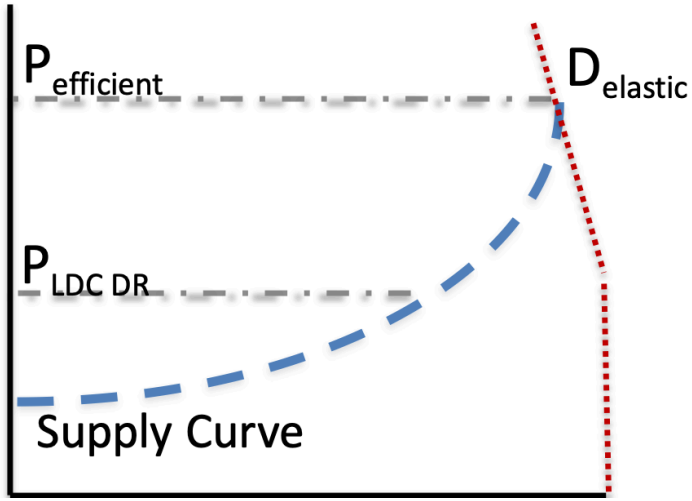
- FERC Order 745: Pay DR the LMP (like supply resource) even if *imputed DR*
  - Behind-the-meter resource: LMP + retail avoided cost
  - In-front-of-the-meter resource: LMP
- DR should inform price formation in energy market

Poor Price Formation



Utility DR program not coordinated with wholesale market
ISO sees missed load forecast

Property Scarcity Pricing



ISO sees willingness to pay of consumers

Source: Klein (2021)

Unrealized residential flexibility potential

- **Price-responsive demand (PRD)**: consume less (more) based on LMP
  - At retail level: requires dynamic rates, advanced metering infrastructure
    - <2% residential consumers enrolled in time-of-use rates (Faruqui et al. 2019)
    - "Smart meters," "dumb rates"
    - No intermediary: Griddy in ERCOT passd through RT wholesale prices to residential ← Disaster in Winter Storm Uri
- Incomplete incentives for active demand-side (Kavulla 2023)
  - Monopoly utilities: No exposure to marginal incentives with "trackers"/"adjustment clauses"; want bigger capital investments
  - Competitive retailers: Focus on supply; No role for billing, network charges

Participation models aligned with utility incentives

- VPP capacity: 30-60 GW (DOE 2023)

Google's Nest Renew, OhmConnect combine with goal of managing 50 GW of residential demand by 2030

The new entity, Renew Home, says it is "North America's largest residential virtual power plant" and can help to support the electric grid and manage home energy costs.

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UTILITY DIVE

  - OhmConnect provides DR to utilities owning generation assets in CA, NY + Texas retail competition

The Business Journals

Southern Company partners with WeaveGrid to simplify EV charging in homes

Southern Company's goal is to limit stress on the electric grid.

- Actively manage and shift EV charging with respect to grid conditions and distribution constraints

Thanks for your attention

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- A. Klein, "FERC Order 745 Ten Years On: Improve Incentives by Better Integrating Demand Response and Energy Price Formation," 2021 IEEE PES General Meeting, Jul. 2021
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- DOE https://liftoff.energy.gov/wp-content/uploads/2023/09/20230911-Pathways-to-Commercial-Liftoff-Virtual-Power-Plants_update.pdf

Appendix

+ Types of DR

- **Real-time Pricing Demand Response**. Consumers are paying the applicable LMP for their marginal consumption.
- **Explicit Contract Demand Response**. Consumers purchase a fixed quantity of electricity but consume less than the purchased amount and sell back the difference.
- **Imputed Demand Response**. Consumers have an estimated consumption baseline and the difference between actual consumption and the baseline is the imputed demand response.

Source: Hogan (2010)