Accounting for Price Response in RTP and Demand-Side Bidding Programs

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“Disconnected” Electricity Markets:
*Fixed retail price ⇒ no demand response*
Connected Markets:
Demand Response Yields Lower Wholesale Prices
Types of Demand Response Programs

- **Demand-side bidding** – customers bid load reductions into the wholesale market

- "**Buy-back,**” or pay-for-performance interruptible
  - Suppliers buy load reductions, *relative to baseline*, at price tied to market price

- **Real-time (hourly) pricing**
  - Full-time
  - Whenever prices exceed specified level
Accounting for Load Response in Operations and Billing

- Demand bidding
- Buy-back/interruptible
- RTP

- Load reductions available from bid; verified later
- Load reduction from offer, or estimated relative to FPL; verified later
- Price-sensitive load levels estimated by service provider or ISO; no need to verify
How to Calculate Load Response?

- Cannot “measure” load reductions by metering
- Can estimate by subtracting *actual* load from *reference* load

*Reference load* = the load that would have occurred had prices remained “normal”

- How to estimate *reference load*?
Sources of *Reference Load* in Estimating Load Response

- Historical load on same day-type (*e.g.*, summer Tuesday, with “hot” weather)
- Rolling average of loads on “non-event” days (*e.g.*, previous 10 weekdays)
- Average load in previous hours (*e.g.*, previous 3 hours)
- Predicted load from *econometric demand model* based on usage during period of interest

*Key objective – avoid “gaming” possibilities*
Measuring Customer Response to RTP

- Use data on hourly loads, prices, and weather for period of interest (e.g., summer months)
  - Individual customers
  - Aggregate by customer type (e.g., by UDC, commercial/industrial)
  - Total load

- Estimate price response parameters from econometric model of customer demand
  - \( \ln(\text{Load}_h) = B1 \times \ln(\text{Price}_h) + B2 \times \ln(\text{CDD}_h) \)
RTP Load Response Curve for Georgia Power
(*Load Response as a Percent of Total RTP Load*)
Demand Response -- the Bottom Line

- Do customers respond to hourly market prices?
  - Yes, in aggregate; considerable range across customers

- How much?
  - 10 to 50% load reductions

- Can you count on it?
  - Yes; consistently larger response at higher prices

- What evidence?
  - Georgia Power, Duke Power, GPU Energy

- Implications?
  - Lower wholesale prices; higher reliability; market efficiency
Example: Measuring RTP Load Response

Moderately Flexible, Weather Sensitive Customer (.06)
Recent Evidence of Demand Response

- Georgia Power *Real-Time Pricing (RTP)*
  - 1,600 large C & I customers; 5,000 MW of load
  - 8 years of load response experience

- Duke Power *Hourly Pricing*
  - 100 large industrial customers; 1,000 MW

- GPU Energy *“Critical price” Residential TOU*
  - 1997 pilot residential program

- Demand response parameters available in EPRI *StatsBank* database
GP RTP Load Response (DA): Moderate Prices
(Load response = 230 MW; 8% of reference load)
GP RTP Load Response (DA): Very High-Price
(Load response = 500 MW; 20% of reference load)
Duke Power Demand Response Experience (per Tom Taylor, Rates and Regulation)

- 100 industrial customers; 1,000 MW

- Aggregate load response when Price > $.25/kWh
  - 200 MW, or 20% of expected load

- 20 customers reduced load by > 5%

- Significant price elasticities for 25% of customers
GPU “Critical-price” TOU Pilot Rate

- Three-tier TOU rate, plus critical price ($0.50/kWh)

- Interactive communication system
  - customers select thermostat settings and circuit priority at different price triggers
  - utility can send critical price signal

- Treatment and control groups (200 in each)
“Critical-price” TOU Rate Design

Critical price

Standard Rate

Rate 6173

Rate 9122
Load Response – *Critical Price Day* (Maximum reduction nearly 50%)
Conclusions

- Methods for accounting for demand response differ for bidding and interruptible programs, vs. RTP

- RTP load response curves for California may be developed based on existing evidence exists
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