

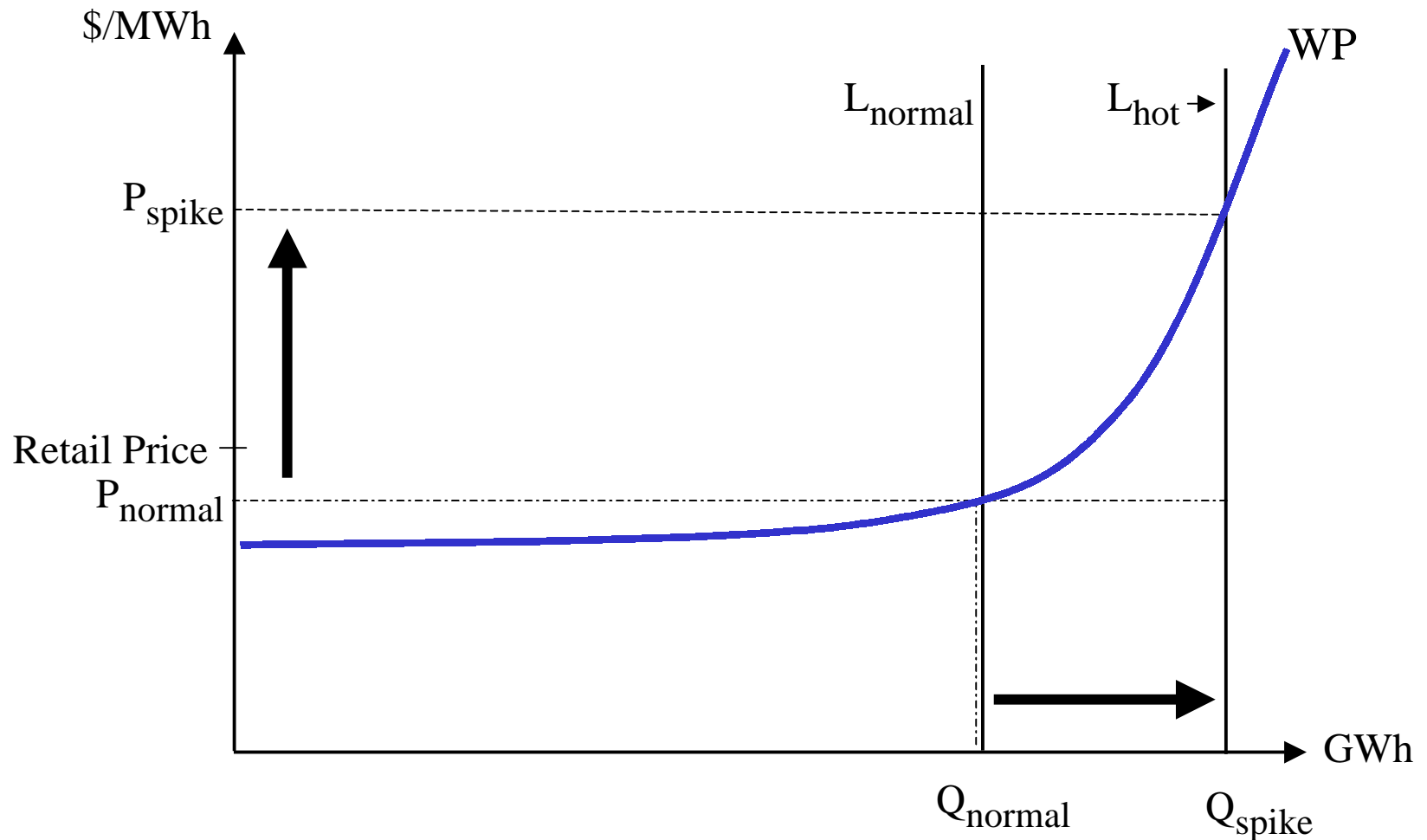
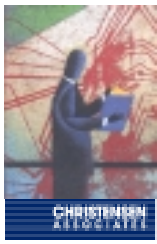


# Accounting for Price Response in RTP and Demand-Side Bidding Programs

*Energy Modeling Forum Conference:*  
**Retail Participation in Competitive Power Markets**

**June 22, 2001**  
**Steven Braithwait**  
**Christensen Associates**

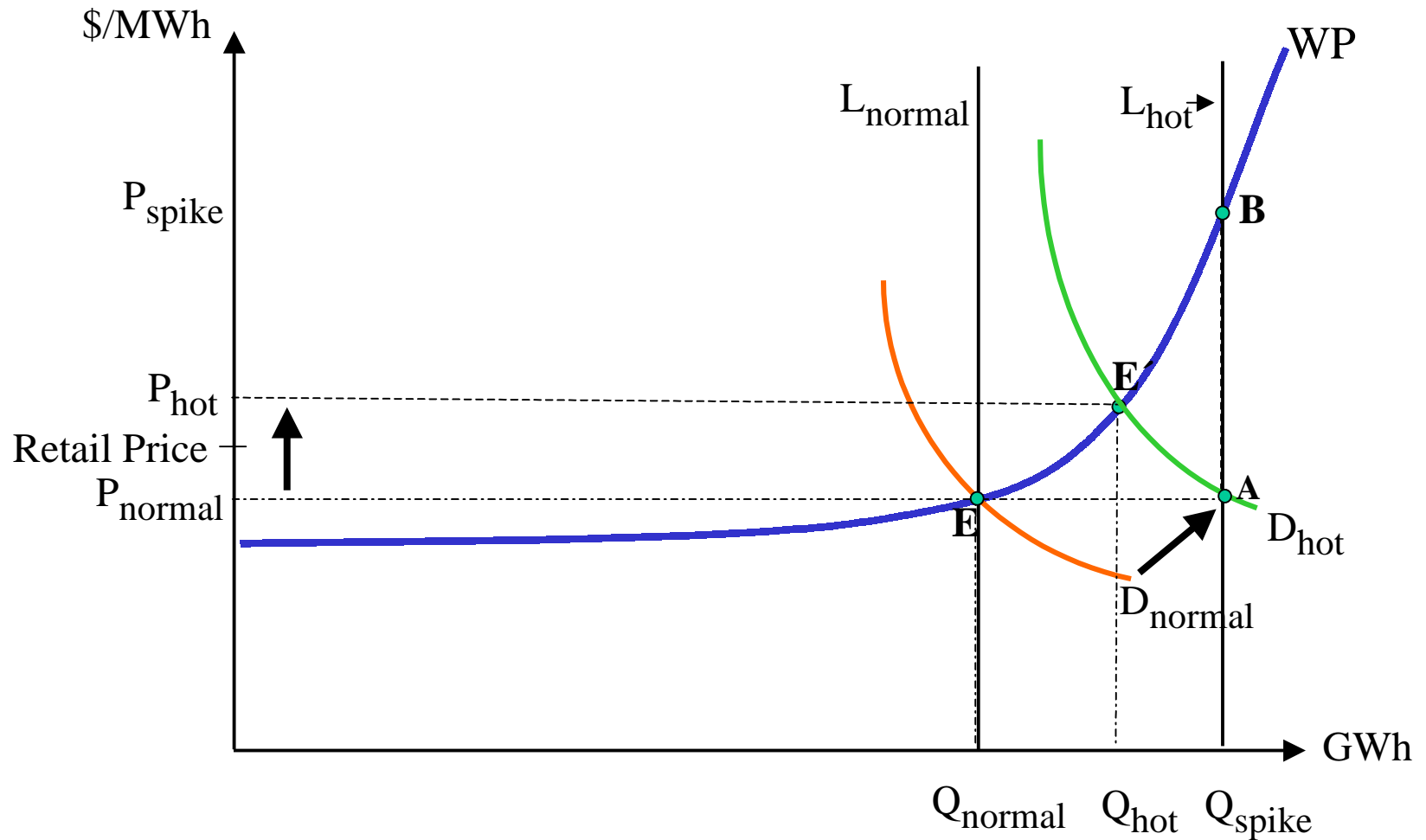
# “Disconnected” Electricity Markets: *Fixed retail price $\Rightarrow$ no demand response*





# 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
  - Load reductions available from bid; *verified later*
  
- ❑ Buy-back/interruptible
  - Load reduction from offer, or estimated relative to FPL; *verified later*
  
- ❑ RTP
  - 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

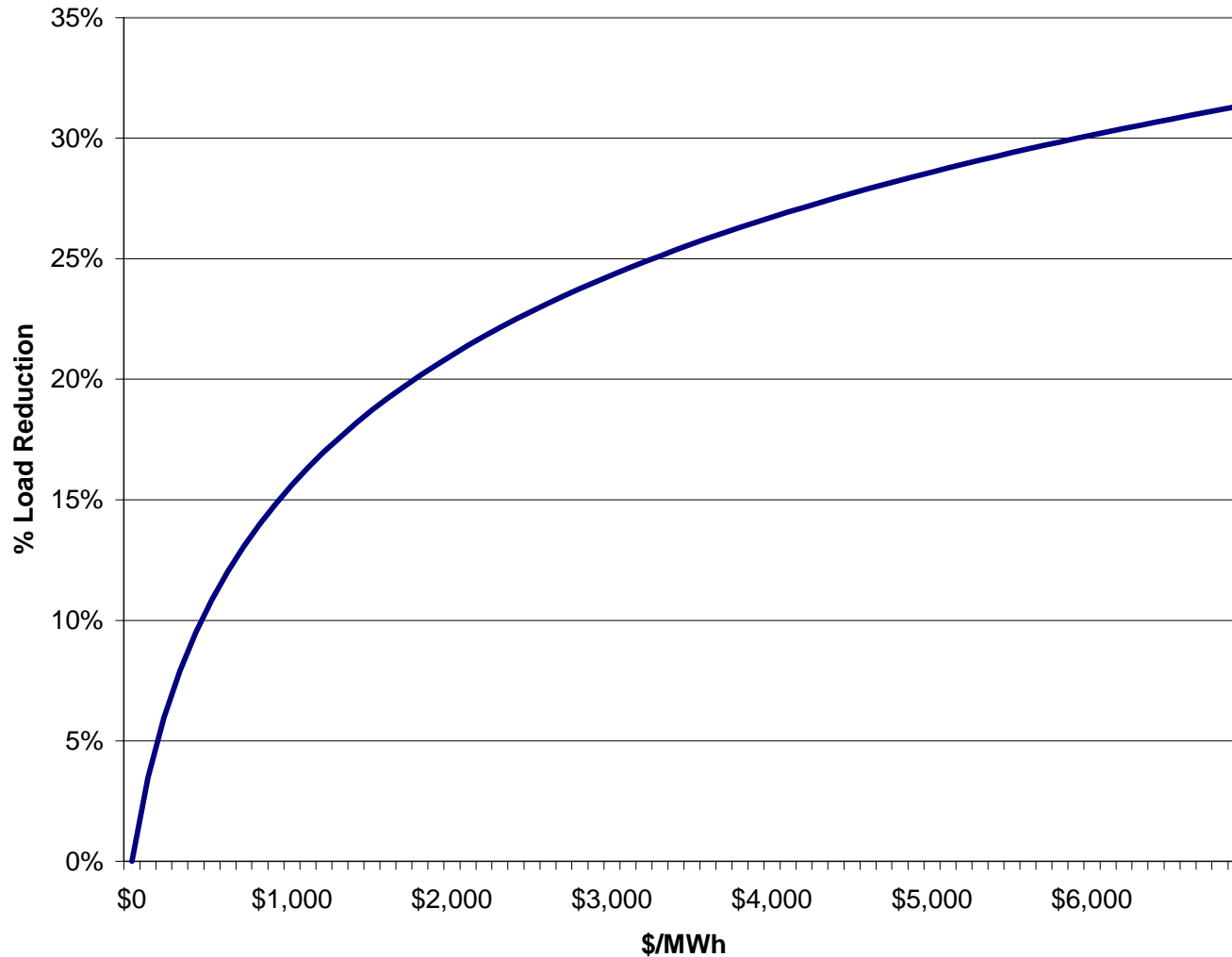
- ❑ Use data on hourly loads, prices, and weather for period of interest (*e.g.*, summer months)
  - **Individual customers**
  - **Aggregate by customer type (*e.g.*, by UDC, commercial/industrial)**
  - **Total load**
  
- ❑ Estimate price response parameters from econometric model of customer demand
  - **$\text{Ln}(\text{Load}_h) = \text{B1} * \text{Ln}(\text{Price}_h) + \text{B2} * \text{Ln}(\text{CDD}_h)$**





# RTP Load Response Curve for Georgia Power

*(Load Response as a Percent of Total RTP Load)*



# Demand Response -- the Bottom Line

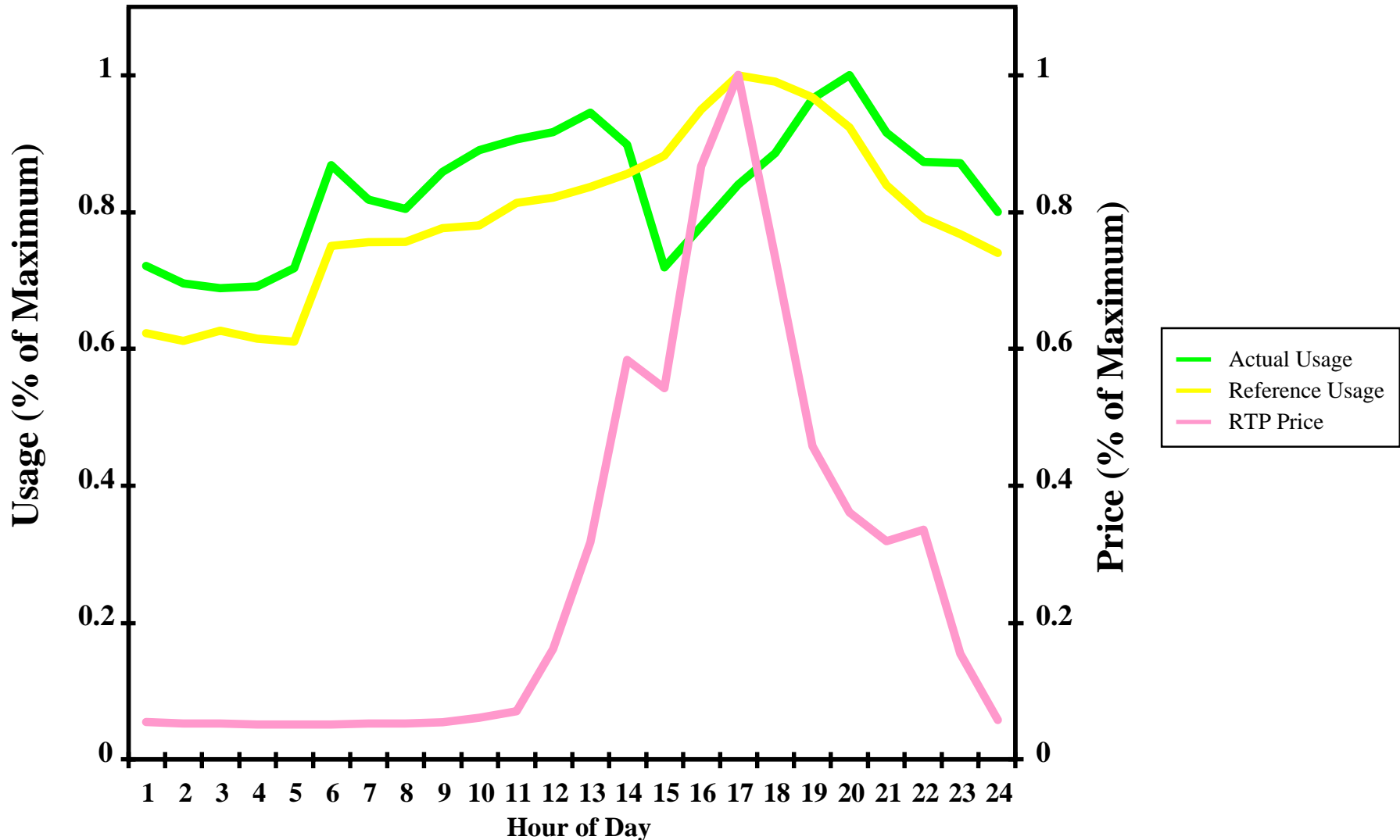


- ❑ Do customers respond to hourly market prices?
  - Yes, in aggregate; considerable range across customers
- ❑ How much?
  - 10 to 50% load reductions
- ❑ Can you count on it?
  - Yes; consistently larger response at higher prices
- ❑ What evidence?
  - Georgia Power, Duke Power, GPU Energy
- ❑ Implications?
  - Lower wholesale prices; higher reliability; market efficiency



# Example: Measuring RTP Load Response

## *Moderately Flexible, Weather Sensitive Customer (.06)*





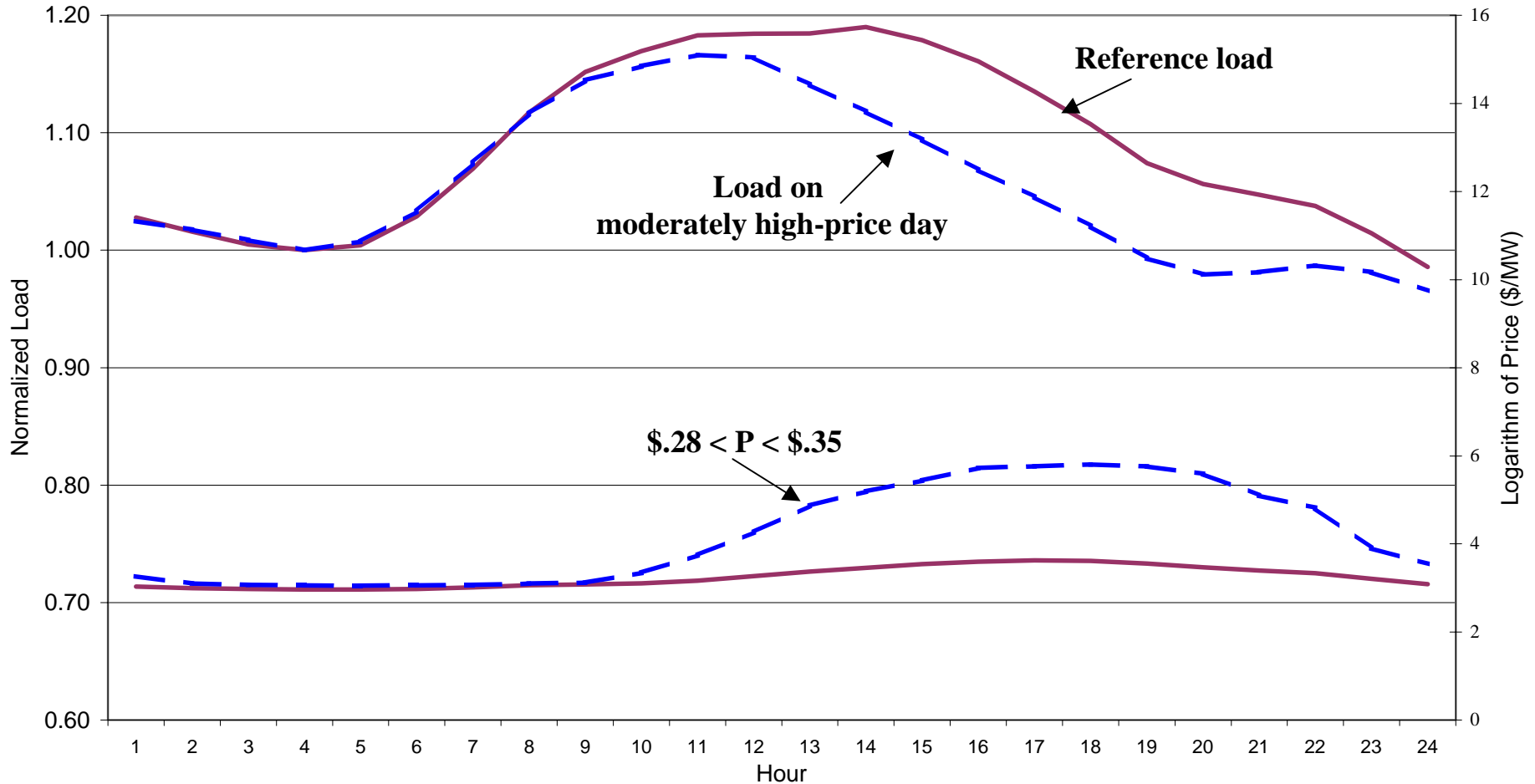
# Recent Evidence of Demand Response

- ❑ 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



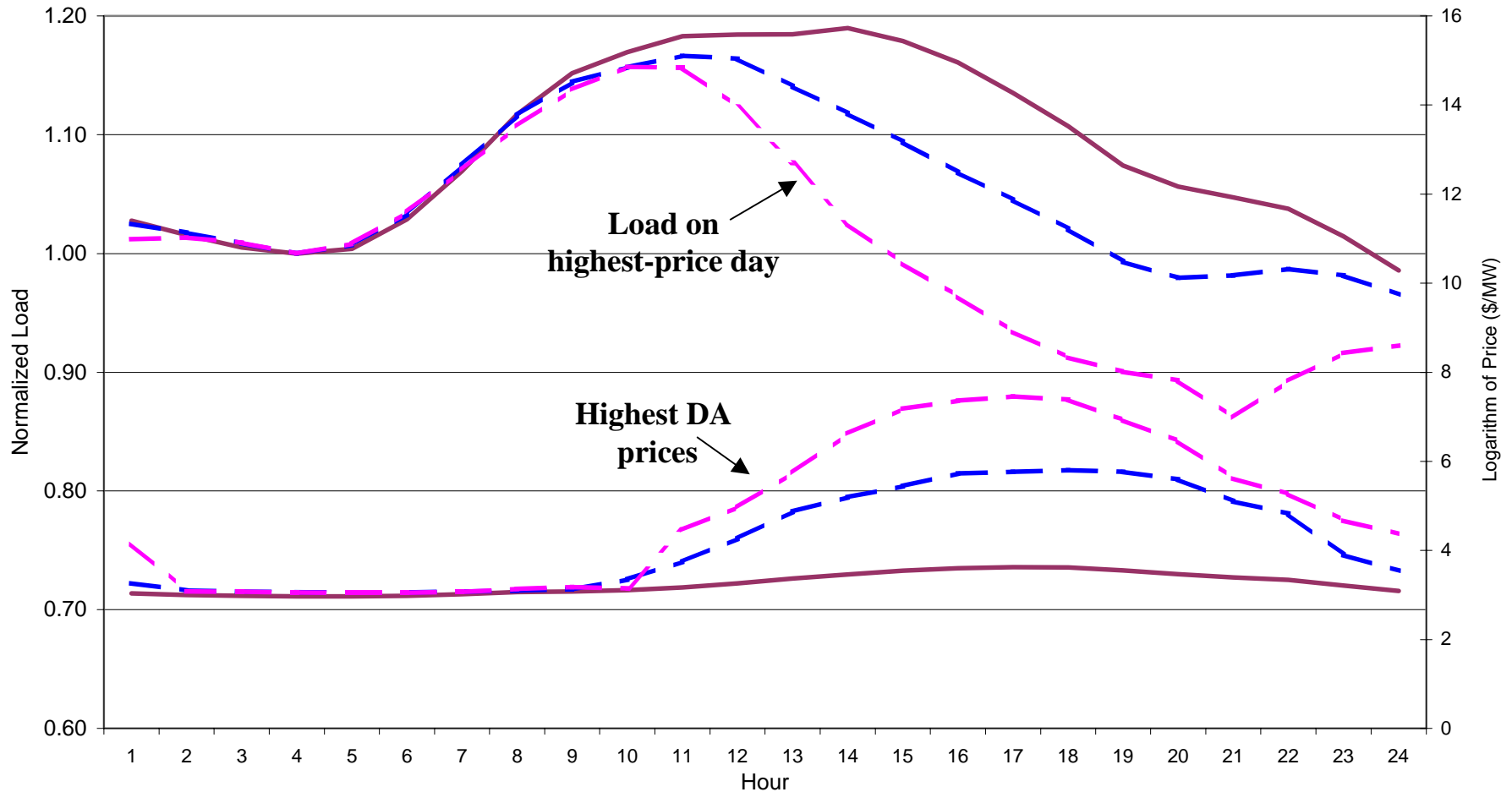
# GP RTP Load Response (DA): Moderate Prices

(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



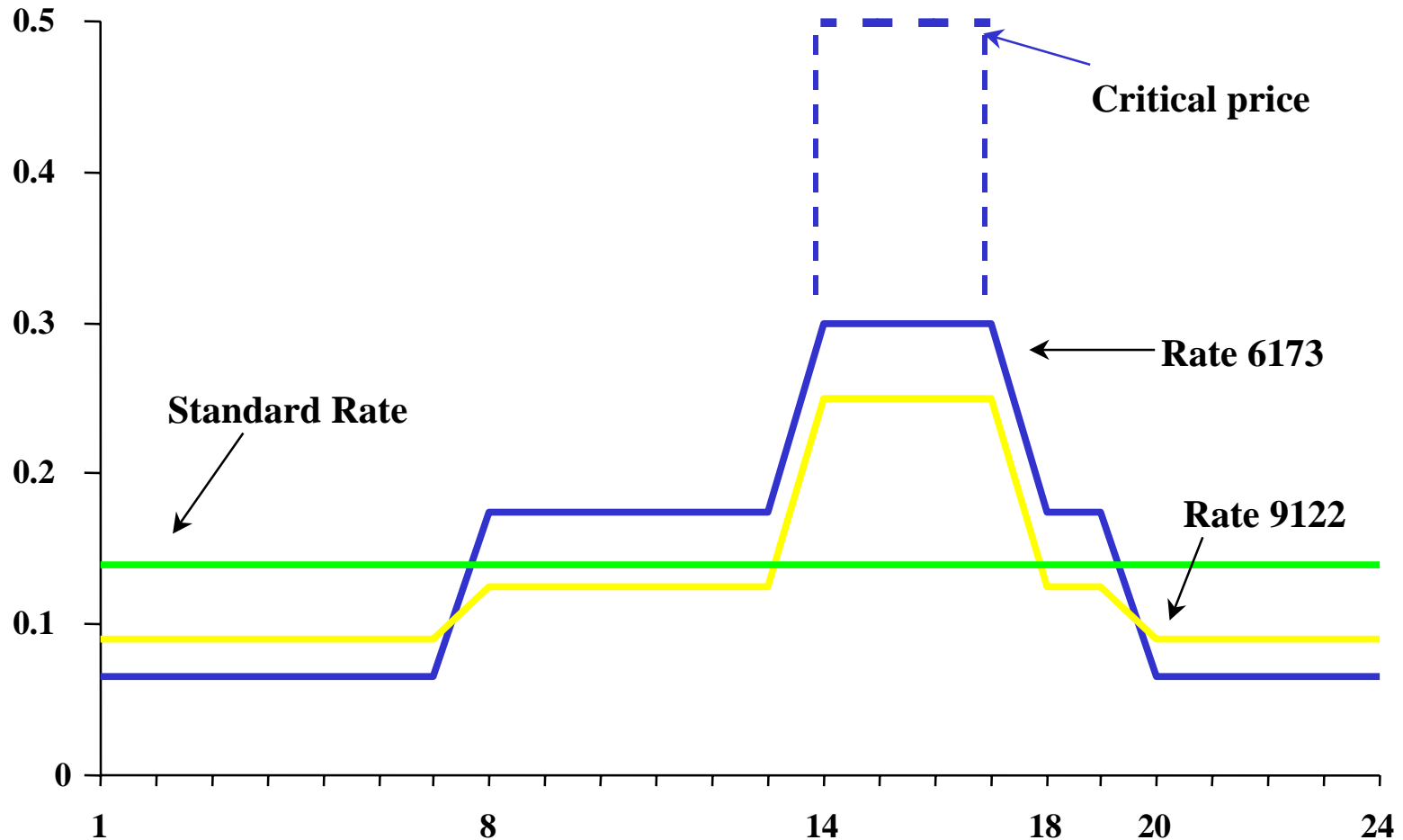
# GPU “*Critical-price*” TOU Pilot Rate

- ❑ Three-tier TOU rate, plus *critical price* (\$.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)



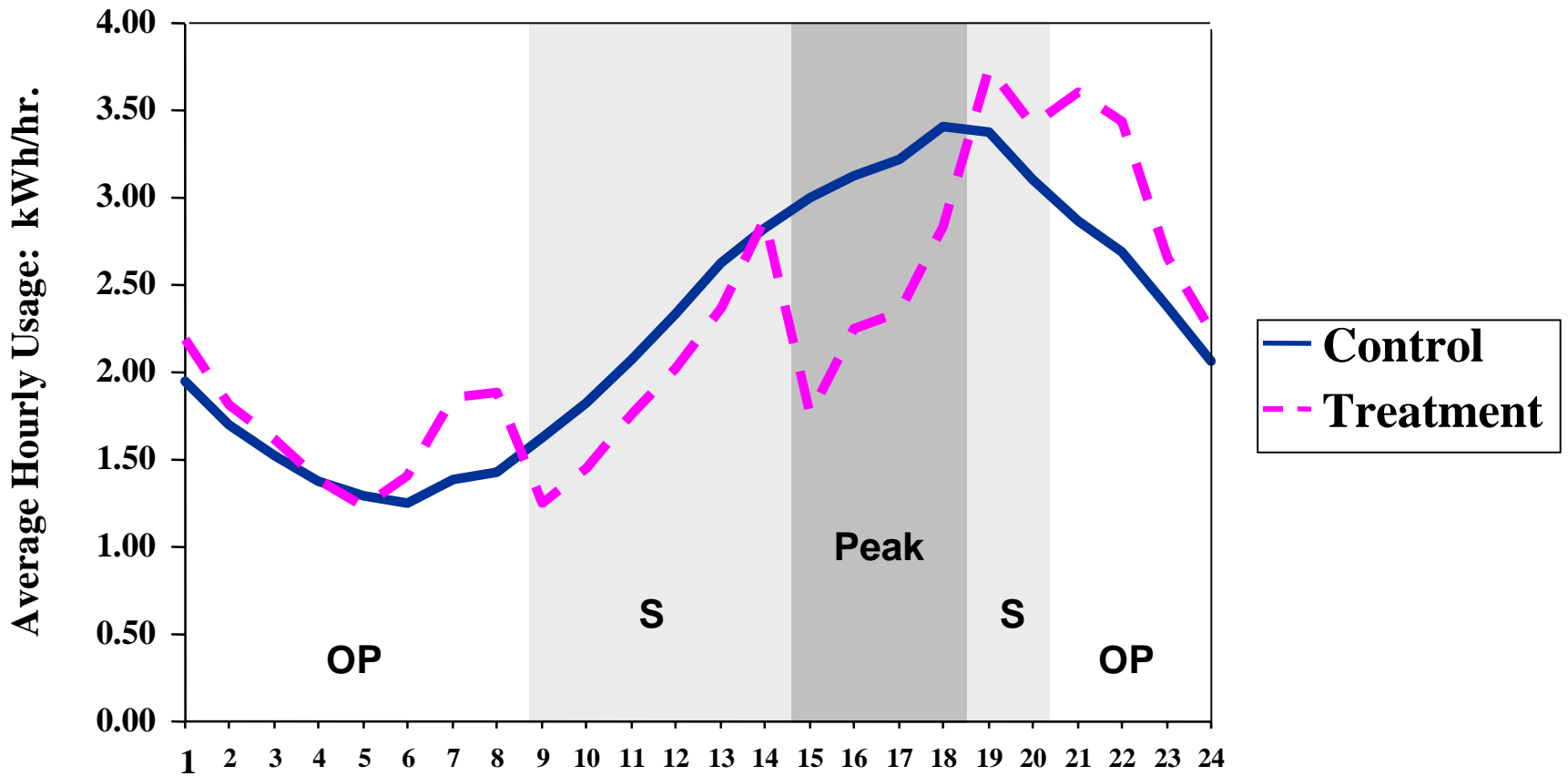


# “Critical-price” TOU Rate Design



# 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



## For Additional Information:

- ❑ Customer Response to Market Prices – *How Much Can You Expect When You Need it Most?*, Steven Braithwait and Michael O’Sheasy, EPRI Pricing Conference, July 2000.
- ❑ Residential TOU Response in the Presence of Interactive Communication Equipment, Steven Braithwait, in *Pricing in Competitive Electricity Markets*, Ahmad Faruqui, Ed.
- ❑ Demand Response – *The Ignored Solution to California’s Energy Crisis*, Steven Braithwait and Ahmad Faruqui, in *Public Utilities Fortnightly*, March 15, 2001.
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