How Customers Adapt to RTP-based Default Electricity Service: Niagara Mohawk Case Study

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Overview of Presentation

- Why price responsive load is important to competitive electricity markets
- Why a case study of Niagara Mohawk's largest customers provides valuable lessons
- Key Findings from the Case Study

Why Is Price Responsive Demand Important for Electricity Markets?

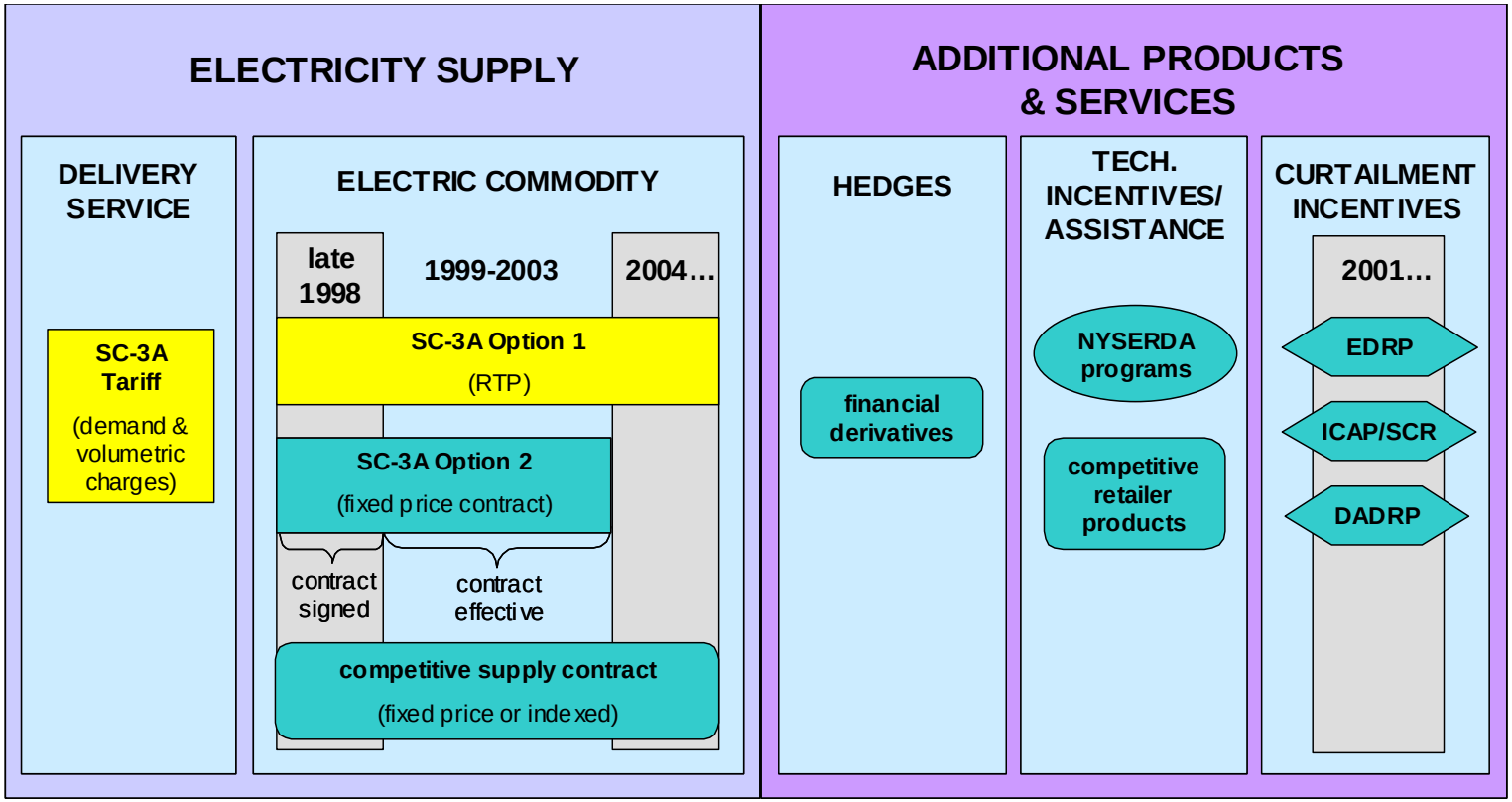
- **Current Situation Most Place: Wholesale electricity prices change hourly but most retail loads are not billed on their actual hourly usage and therefore have no incentive to respond to the hourly price:** *Leads to excess generating capacity and more frequent price spikes*
- FERC Standard Market Design NOPR: *"participation of demand in the market is critical for an effective wholesale market"*
- Vernon Smith on California Energy Crisis: *"Root cause of crisis in CA and high temporary spikes elsewhere has been failure in spot market design to encourage provision of strategic demand side bidding by wholesale buyers, …"*
- Cato Institute: Rethinking Electricity Restructuring: *"we should go backwards to a world of vertical integration and incentised rate regulation; a regulated system could introduce RTP for large C/I users"*
- **Energy Bill 2005**

Practical DR Considerations

- **Will customers actually respond to the hourly prices if they are billed based on their actual hourly usage?**
- **What is the most cost effective strategy to elicit demand response?**
- **How much price-responsive load do we need to reap most of the benefits of demand response?**
- **What type of customers should be targeted?**
- **How elastic is the true underlying demand curve for electricity at the retail level ?**

Niagara Mohawk Power Company (NMPC): Case Study of Default Service RTP Program

NMPC RTP Tariff: Market Situation

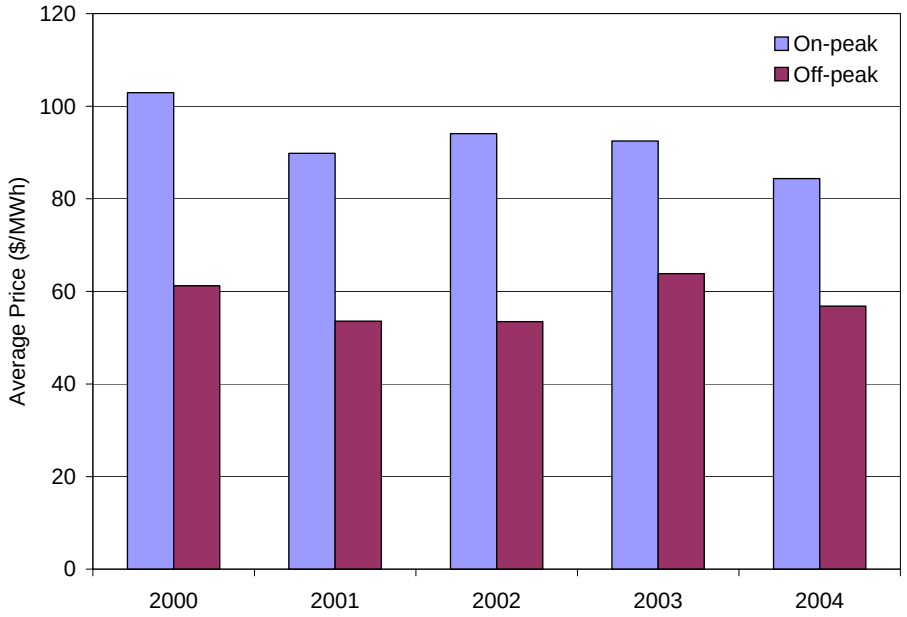


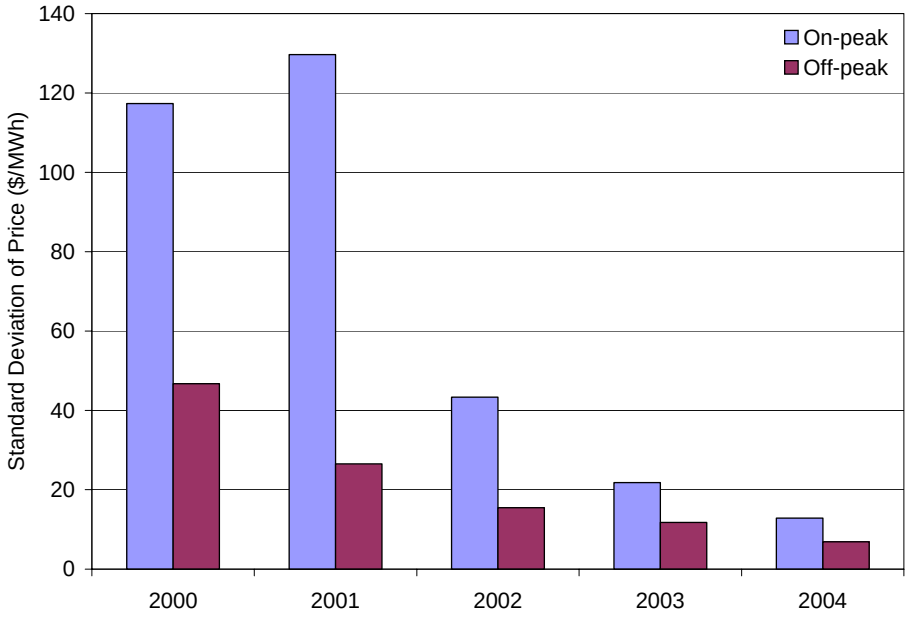
NMPC SC-3A Customers: Market Segments

Business Class	All SC-3A Customers		Customers Facing Hourly Prices		Survey Respondents
	# of Accounts	Peak Demand (MW)	# of Accounts	Peak Demand (MW)	# of Accounts
Commercial / Retail	17	55	17	49	11%
Gov't / Education	44	206	34	166	30%
Health Care	17	78	8	38	13%
Manufacturing	46	233	44	221	33%
Public Works	22	70	16	40	13%
Totals	146	642	119	514	76

- **NMPC billing system and customer surveys used to determine whether customers exposed to hourly varying prices**
- **119 (of 146) customers saw SC-3A or comparable hourly-varying prices at some point during the study period (Summers 2000 – 2004) – these were included in the demand modeling exercise**

Trends in Day-Ahead Market Prices: Summer, Eastern New York





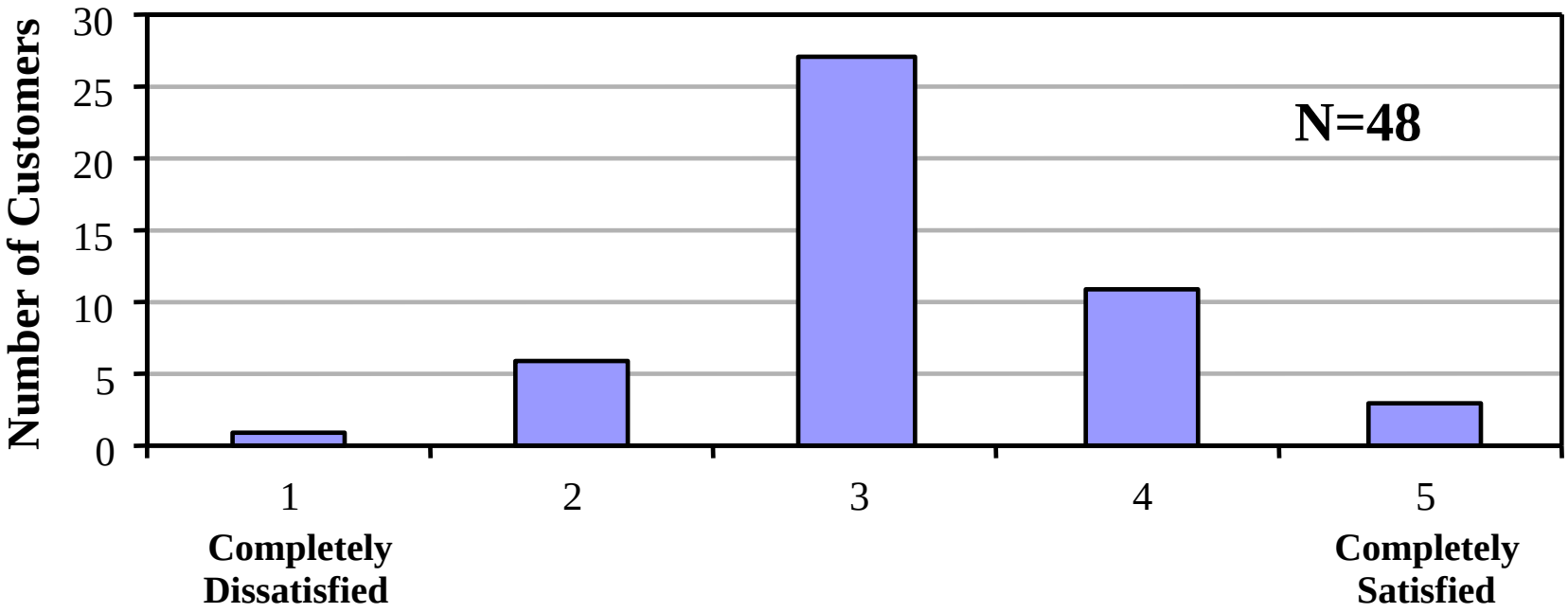
- **Less price volatility since 2002 compared to summers of 2000 and 2001**
- **Average hourly prices for summer period are relatively stable over 5 years**

*On-Peak defined as 2pm-5pm on weekdays

Key Policy Questions in Case Study

- **How satisfied are customers with the RTP as a default service tariff?**
  - Did they switch and are they hedged?
- **What do customers say about their price response?**
  - How often do customers monitor prices?
  - Do they shed or shift load ?
  - Why don't they respond to price ?
- **Does RTP deliver Demand Response?**
  - How elastic is demand?
  - Which customers respond most?
  - Do customers respond more when price levels are high ?
  - Do customers respond less when they operate close to their peak demand ?

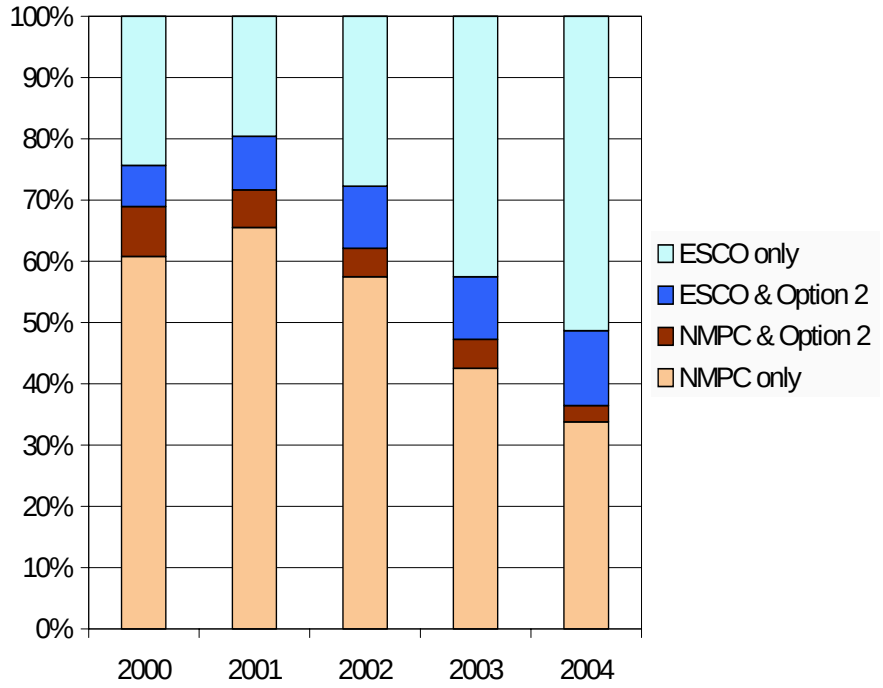
Customer Satisfaction with NMPC RTP Tariff



- **Customers are relatively satisfied**
- **Interviews reveal greater disappointment with limited offerings by competitive retailers**

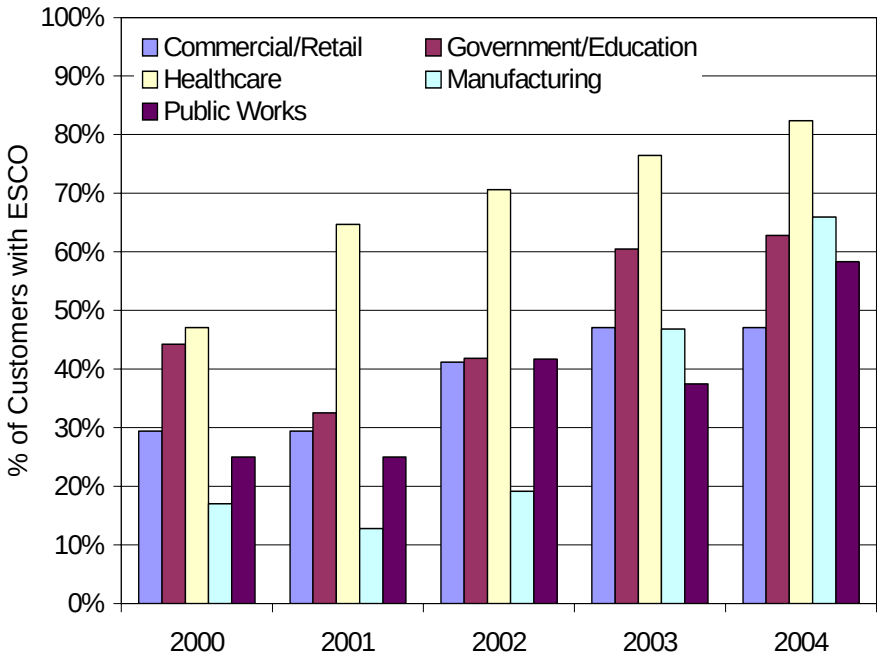
Trends in Customer Switching from NMPC to ESCO

- **Customer switching from NMPC to ESCO has accelerated since 2003**
  - **Number of customers with ESCOs more than doubled from 46 in 2000 to 94 in 2004**
- **Likely explanations**
  - **End of Option 2 tariff in 2003**
    - **In 2000, 45% of Option 2 customers were with ESCO; in 2004, it was 82%**
  - **Some customers watched retail market develop for a few years before deciding to switch along with more attractive contract options**
  - **Takes time for some customers to overcome internal procurement barriers**

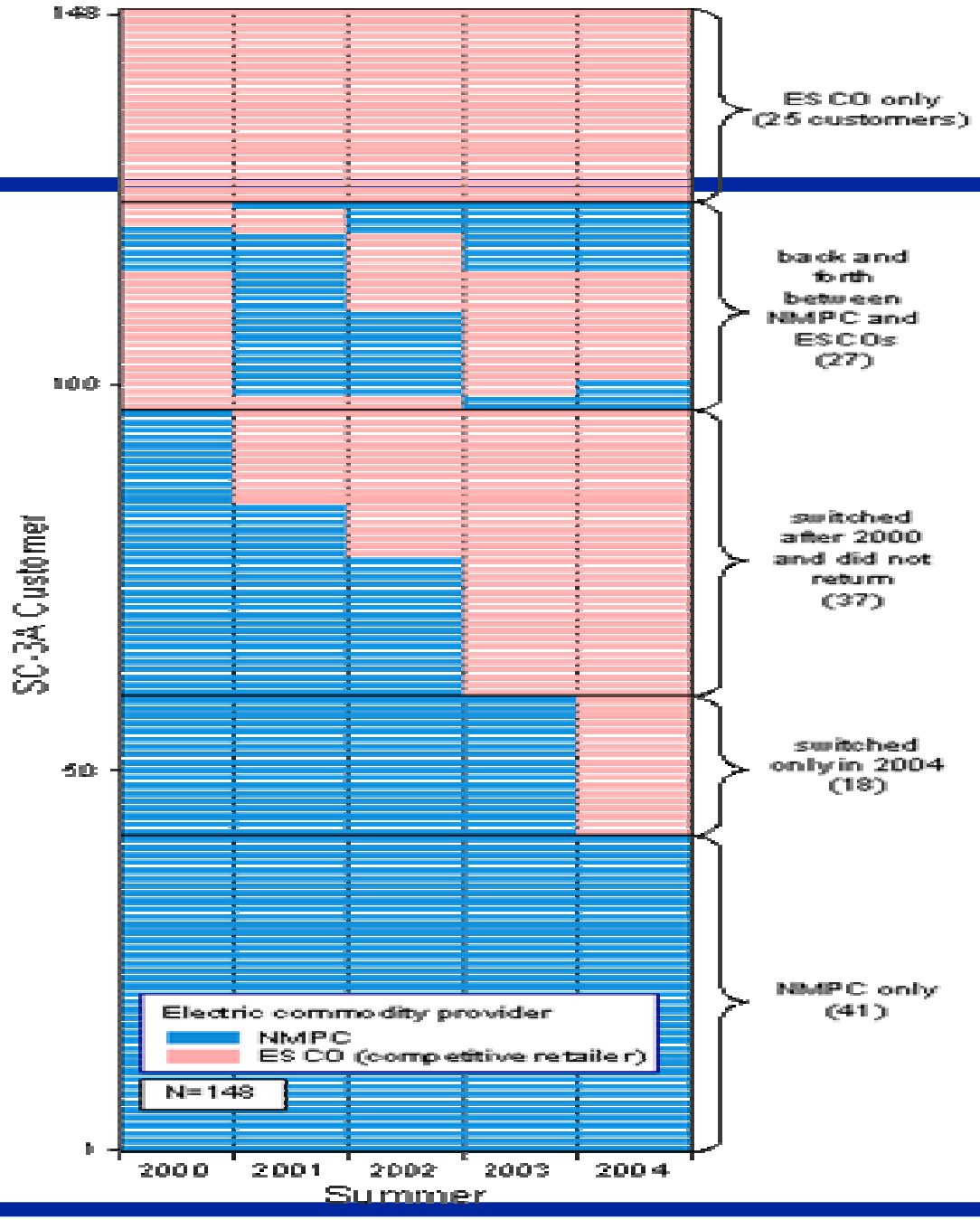


Trends in Customer Switching by Business Type

- **Healthcare customers most likely to switch to ESCO**
- **Switching rates increased significantly for manufacturing customers after 2001/2002**
- **Majority of the commercial/ retail and public works customers have preferred to stay with NMPC**

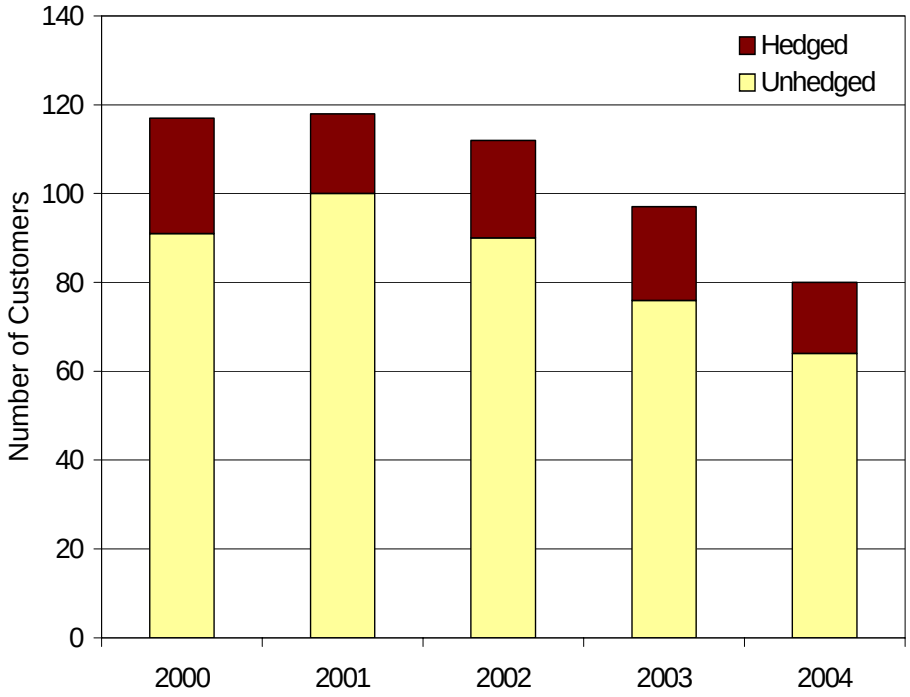


Service History- 119 Study Customers



Hedging Trends among SC-3A Customers

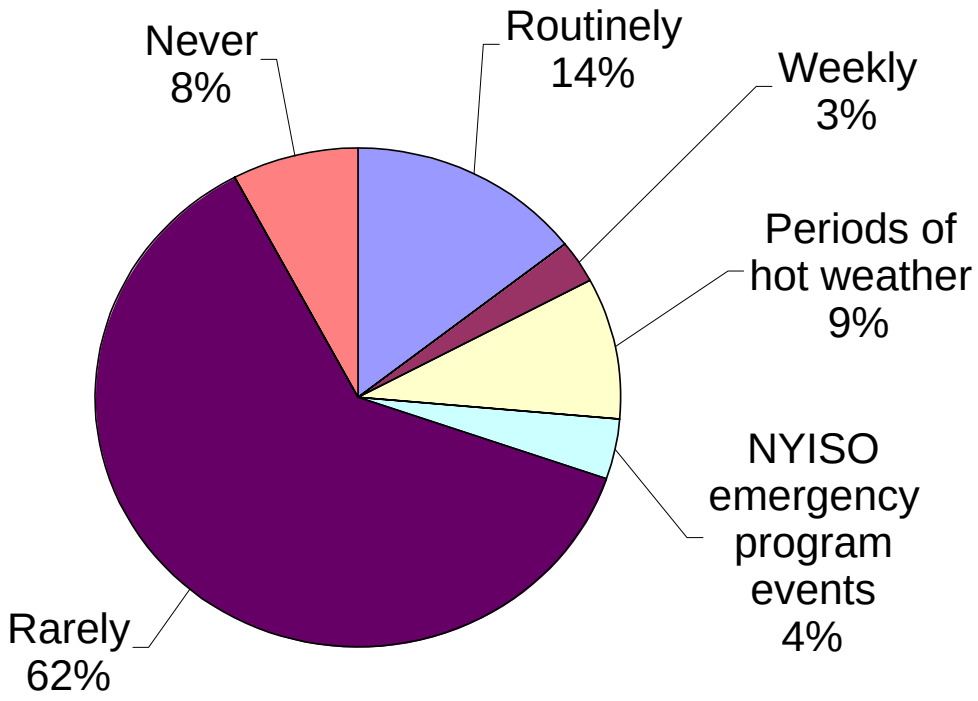
- **About 15-22% of customers are fully or partially hedged over the last five years**
  - **Relatively stable over time**
  - **But more uncertainty because more customers have switched in last 2 years**



What do customers say about their price response or lack of price response ?

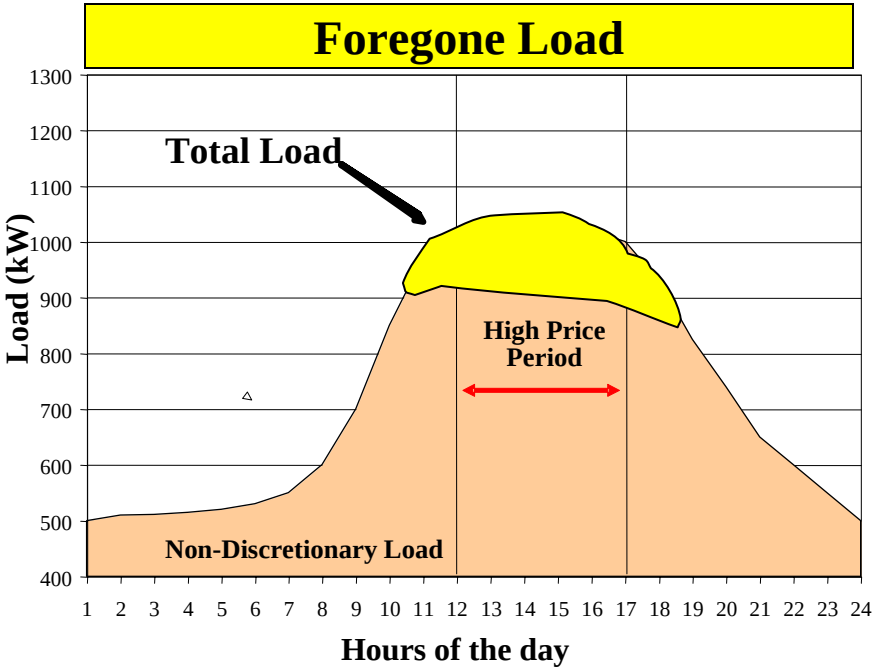
How Often Do Customer's Monitor the Next Day's Hourly Prices?

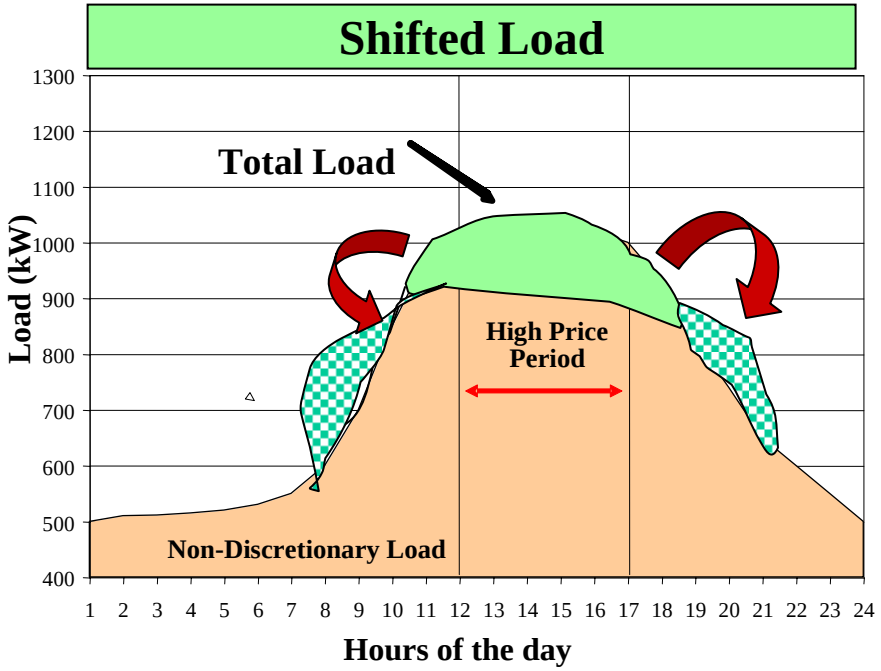
N = 76



- **~30% of customers monitor day-ahead hourly prices routinely or during hot weather/system emergencies**
- **~70% rarely or never monitor prices**

Customer Response Strategies: Forego Usage vs. Load Shift

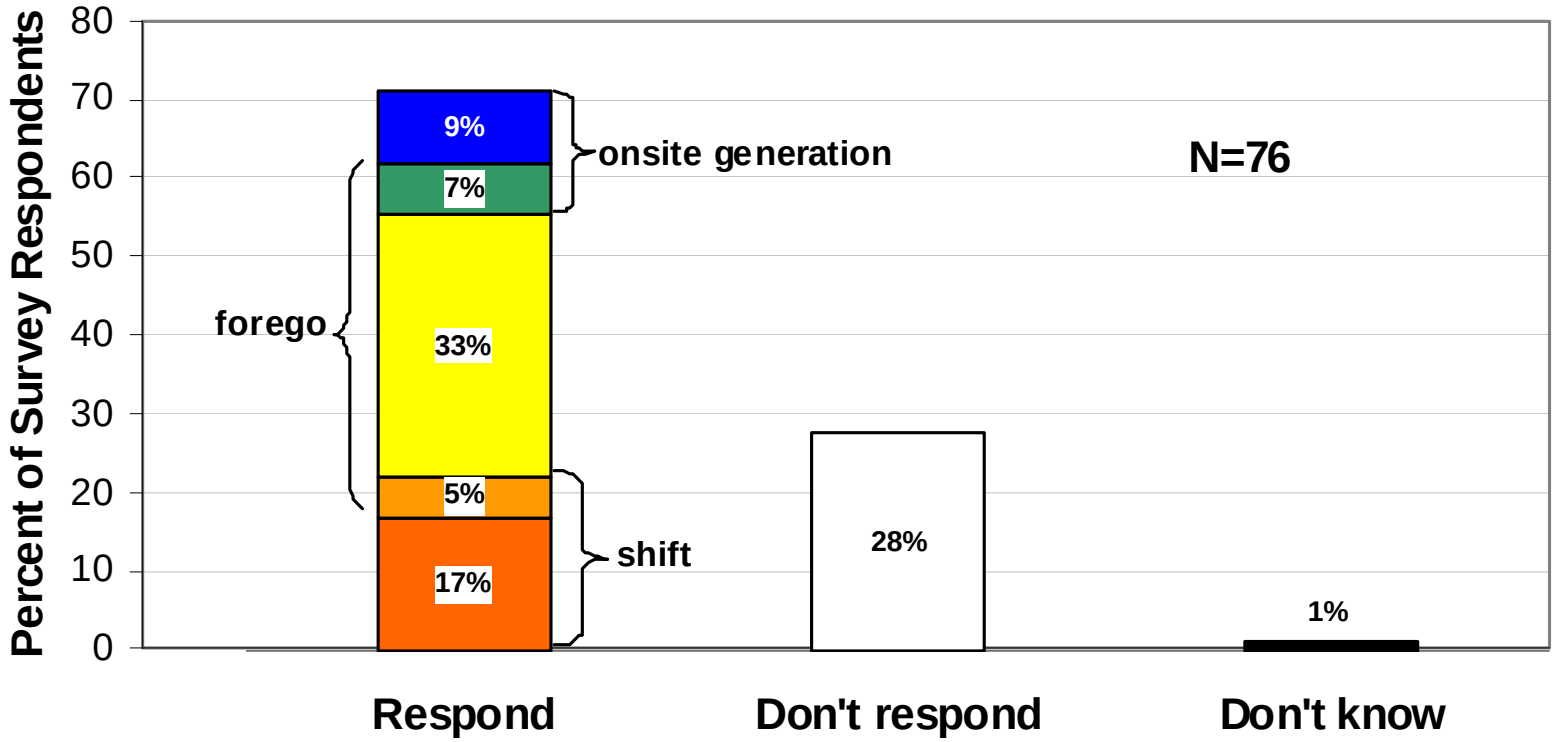




Customers' assess their DR potential: discretionary vs. non-discretionary usage

- **Some customers shift load from the peak, and make it up off-peak**
- **Some customer's maximum load curtailment is often limited to discretionary loads; unwilling to curtail more even if prices rise**

Self-Reported Price Response Capability: What Customers Told Us



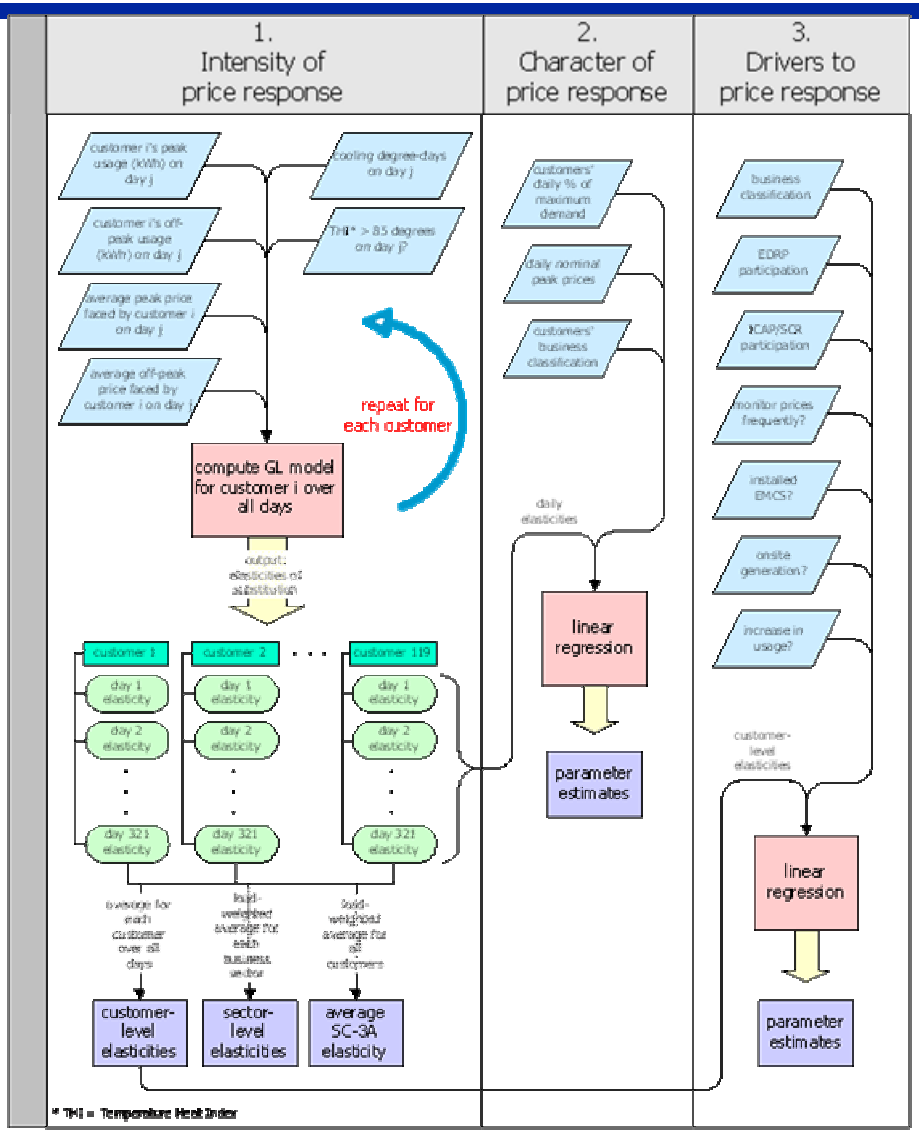
- **~30% of customers say they are unable to curtail load**
- **~70% can either forego or shift load or utilize onsite generation**
  - Government/education customers forego usage as their curtailment strategy
  - Manufacturing customers can shift or forego load, or both

Customer Barriers to Responding to High Hourly Electricity Prices: Survey Results

(N=76)	Frequency
No Barriers Encountered	9
Barriers	
Organization/Business Practices	
• Insufficient time or resources to pay attention to hourly prices	39
• Institutional barriers in my organization make responding difficult	23
• Inflexible labor schedule	16
Inadequate Incentives	
• Managing electricity use is not a priority	17
• The cost/inconvenience of responding outweighs the savings	17
Risk Averse/Hedged	
• My organization's management views these efforts as too risky	10
• Flat-rate or time-of-use contract makes responding unimportant	9

Does RTP Deliver Price-Mitigating Load Changes?

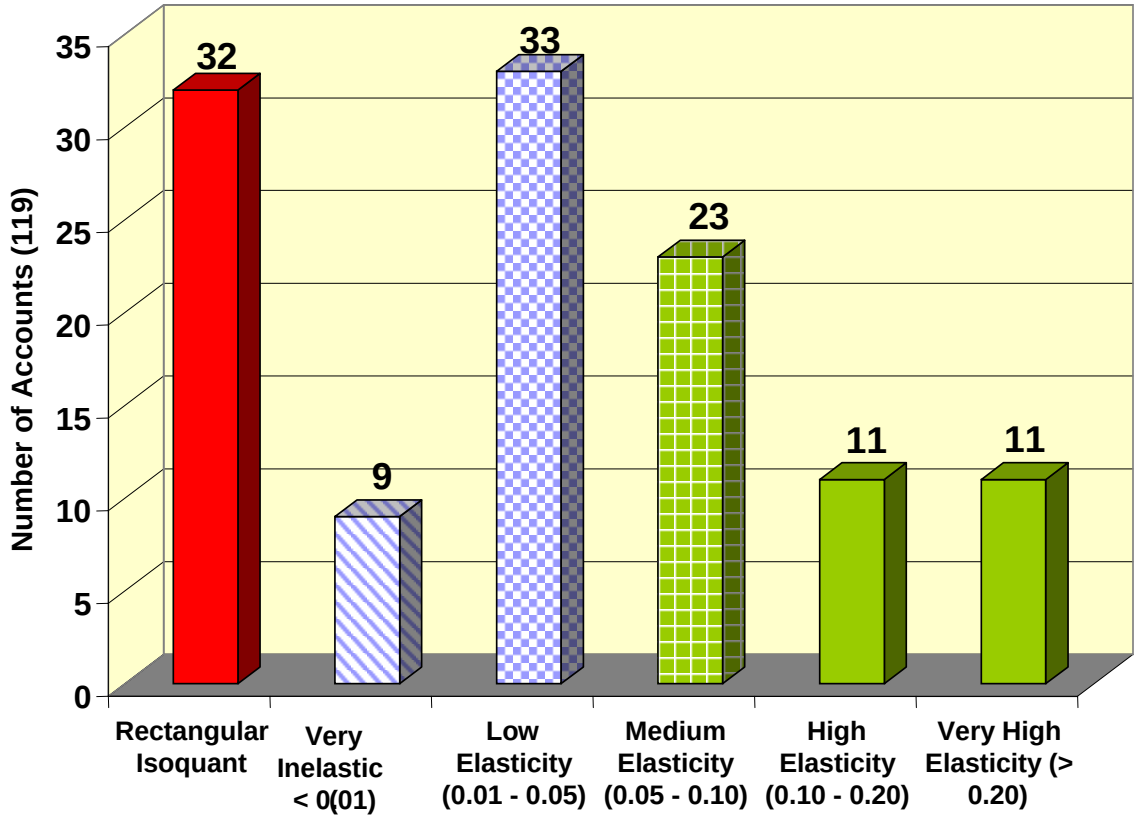
Modeling Price Response



Approach

- **Estimate a demand model to explain how customers adjust usage in response to price changes**
  - **Divide day into peak (2:00 – 5:00 p.m.) and off-peak periods**
  - **Quantify how customers substitute off-peak usage for peak usage when the peak to off-peak ratio increases**
  - **Estimate substitution elasticities for each customer, and then develop pooled segment estimates**
- **Data and Models**
  - **Hourly price and usage data for 119 customers for 2000-2004**
  - **Estimated model for summer months**
  - **Employed the Generalized Leontif demand model**
    - **Places no restrictions on character of response, unlike the Constant Elasticity of Substitution model**

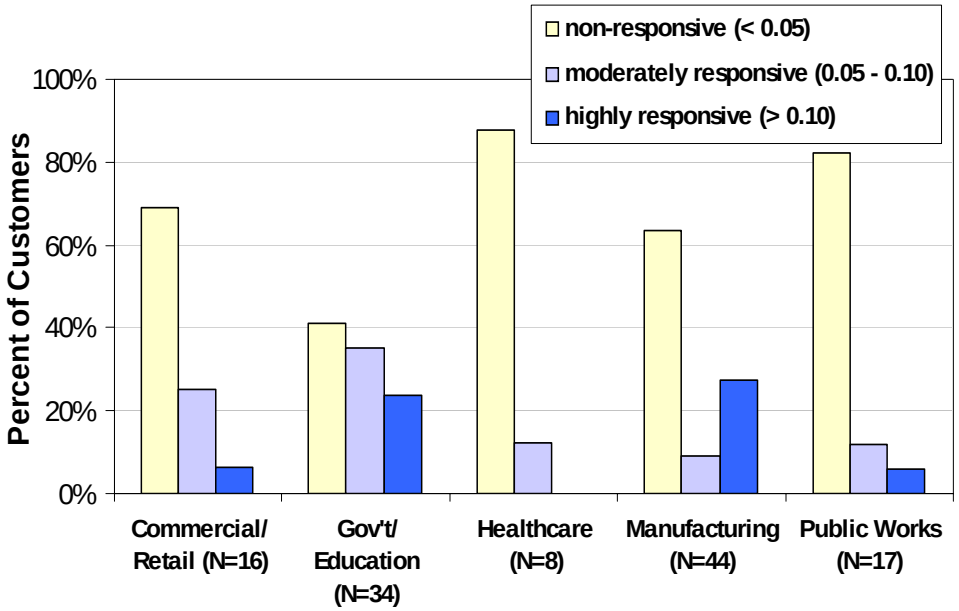
Distribution of Elasticities: Customers



- About ¼ of customers exhibit fixed proportion elect use, Elast. = 0.
- About 16% show Elast. > .10

Price Responsiveness by Business Category

Business Category	N	Average Elasticity
Government/Education	34	0.10
Public Works	17	0.02
Commercial/Retail	16	0.06
Healthcare	8	0.04
Manufacturing	44	0.16

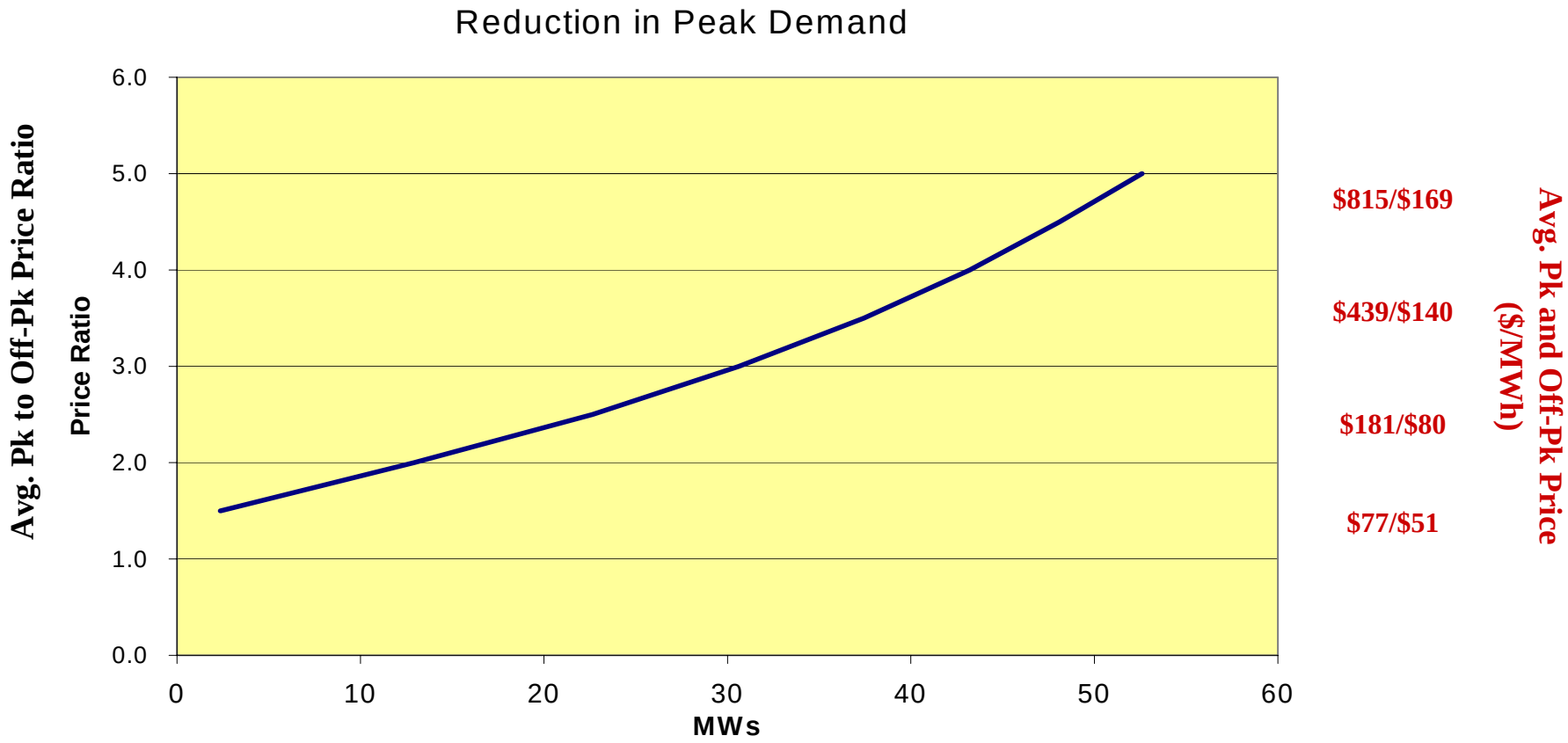


- Manufacturing customers have the highest average substitution elasticity followed by govt/edu customers
- Relative price responsiveness also varies substantially within each business sector
  - Manufacturing: 27% are highly responsive; but 63% have low elasticities
  - Government: Greater fraction of customers show price responsive behavior (24% are highly responsive and ~35% are moderately responsive)
  - Healthcare, Commercial/Retail, and Public Works: >70-80% have low elasticities ((<0.05)

Aggregate Demand Response Curve

Peak 2 PM – 5 PM

For the 119 SC-3A customers, 50 MWs, or 11%, of peak demand would be reduced if the peak to off-peak price ratio was 5, the maximum observed between 2000 - 2004



Character and Texture of Price Response Characteristics and Circumstances

A secondary equation was estimated to quantify the impact on price elasticity of:

- **The nominal level of price. Some firms may be more price responsive at higher price levels than at lower price levels**
  - They respond by turning on a DG unit that can carry only some of the facility load, so the price must be high enough to compensate for foregone usage.
  - Indivisibilities associated with processes or activates require that prices exceed a threshold in order to justify curtailment, analogous to generation units that factor in start-up costs in setting bid prices.
- **The customer's relative usage level. Some firms may be more willing to respond more at higher prices, while others respond less**

Impact of Price Level and Usage Relative to Customer's Max. Demand

	Increase in price Ratio	Usage Relative to Max kW
Com/Retail	14.5%	1.2%
Gov't/Ed	13.4%	-3.2%
Health	-8.01%	0.0%
Manufacturing	-1.4%	-0.3%
Public Works	-9.5%	-0.2%
	Change in the price ratio from 2:1 to 3:1	Change in usage from .6 to .7 of Max kW

- Com/Retail and Gov't Ed are more responsive (13 to 14%) at higher nominal prices, Public Works and Health are less responsive (- 8 to - 9%).
- Only Com/Retail is more responsive (1.2%) as peak demand is approached. Response for Gov't Ed declines (-3.2%) noticeable as peak usage is approached

Summary of Key Findings

- **NMPC large customers are generally satisfied with day-ahead, hourly pricing as default service RTP**
- **Price response is modest overall (0.11)**
  - Manuf and gov't/ed are most responsive
  - 20% of customers account for 80% of price response
  - Aggregate DR potential is 11% of customer's summer peak demand at historic prices
    - **Comm/Retail and Gov't/Ed customers are more responsive at higher prices**
- **Large diversity of response, both between and within business sectors**
  - Elasticities vary substantially
  - Diverse types of load response – foregoing, shifting, DG