



NYSERDA R&D

Time-Sensitive Pricing Demonstration:

Advanced Metering, TOU Pricing and Technologies for Multifamily Buildings

Joseph S. Lopes
Applied Energy Group, Inc.

Herbert E. Hirschfeld, P.E.



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Multifamily Buildings Conference – Brooklyn, NY July 2008

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NYSERDA Initiatives

- **New R&D Initiative in 2002**
 - **Funding of studies that:**
 - “enhance customer choice and expand demand responsiveness in the retail electricity marketplace... and demonstrate and evaluate innovative time-sensitive electricity rates and technologies that facilitate their adoption.”
 - **Project Team for Contract #7572**
 - **Applied Energy Group, Inc. (Joseph S. Lopes)**
 - **H.E. Hirschfeld, P.E.,**
 - **Elemco Building Controls (Zach Stern)**
 - **American Metering & Planning Services (AMPS) (Bob Friess)**



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Project Design

- **Objectives:**
 - Demonstrate that multifamily apartment residents can understand and respond to time-sensitive rates
 - Demonstrate that demand response can be accomplished and benefit
 - apartment residents
 - the building
 - utility and society
 - Establish that the technology and systems to accomplish the price signals can be cost-effectively applied to a master-metered multifamily building
 - Measure the end user customer satisfaction with the program elements and effectiveness of the educational efforts



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Host Building: Clinton Hill Apartments



Brooklyn, NY coop apartment complex; built in 1940's; 1225 units in 12 buildings; 66% own, 34% rent; recent electrical upgrade; room A/C's

2002: Electrical upgrade, NYS Code requires metering; shareholders opt for submetering; meters installed in basement

2003-2004: Submetering installed and tested; implemented early 2004 (shareholders only); rental apt. owners await State (DHCR) approval before charging for electric

2004: NYSERDA Program for Time-Sensitive Pricing applied to submetered residents; shadow period June 2004 – March 2005; Use "3-2-1" TOU Pricing

2005: full-scale June 2005 for shareholders, November for rentals; TOU billing continues to present



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Time-Sensitive Pricing Rate Design

Monitor and implement three stage price signal:

Stage 1: Submetering

- Clinton Hill implemented early 2004, equipment installed on all apts. but only shareholders billed initially. Renters later.
- System enables 2-way communications, on-demand apartment meter readings, interval metering on master meter
- Project provides opportunity to use non-billed renters as control group to measure submetered vs. “non-submetered” at same time rather than pre-post analysis



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Time-Sensitive Rate Design

Stage 2: Time-Sensitive Pricing

- on-demand remote meter reads enable time-of-use reading/billing at little/no additional cost
- Typical Submetering bill based on flat rate (cents/kWh)
- Building master-metered utility bill more complex: peak period (demand) charges and base energy charge, so When you use energy MATTERS!

Stage 3: Demand Response

- **Critical Peak Pricing** option provides incentive and promote load shifting from utility grid and building critical peaks
- Critical peak days called when utility grid stressed, ISO system-wide supply constraints, supply prices high or building peak likely
- Building can get utility and ISO incentives for demand response measures



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Time-Sensitive Rate Design

Objectives

- High enough ratio of peak to off-peak and large enough absolute price difference for residents to notice and have incentive to shift
- Address different peaks:
 - Standard Utility peak – 2-6pm on all weekdays
 - Critical Utility Peak – 2-6pm on hot summer days for demand response
 - Building peak – Building charged for monthly peak demand based on one hour maximum – typically hot summer evenings (9pm)
- Simple!
 - Avoid complex time periods and too much information (too many prices)
 - Consistent message on what are “good” times and what are “bad” times to use electricity



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2. Time-Sensitive Rate Design



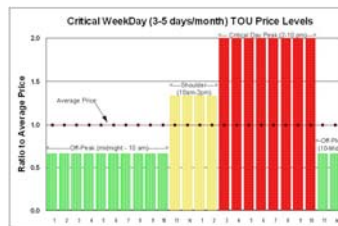
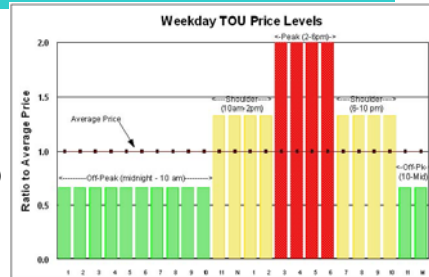
TRAFFIC LIGHT CONCEPT OF TOU

- RED: Stop! Peak = 3 x off-peak price
- YELLOW: Caution! Shoulder = 2 x off-peak price
- GREEN: Go! Off-Peak Price

Weekdays ----->
Peak Hours: 2-6 pm (red)
Shoulder 10am-2pm, 6-10pm (yellow)
Off-Peak 10pm-10am (green)



^ Weekends/Holidays (No Peak hours)
Shoulder 6-10pm (yellow)
Off-Peak 10pm-6pm (green)



← Critical Peak Wkday Option:
• a few “peak” days per month
• Peak Hours: 2-10 pm (red) (extended from 2-6 pm)



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Education Plan

- **Presentations to Management and Board**
- **Workshops for Residents**
 - Before TOU Shadow Billing Period (July 2004) – over 120 attendees, surveys administered
 - Before Shareholders began Actual TOU Billing (June 2005) – app. 50, surveys administered
- **Information Packet to Residents**
 - Description of “1-2-3”/traffic light rate structure
 - Tips on saving during peak and shifting strategies
- **“Top Ten Tips” Refrigerator Magnet**
- **Web site www.apartmentenergytips.com**
 - General tips on savings and TOU measures
 - Rate Structure description for Clinton Hill
 - Critical Day Notification
- **Critical Day Notification**
 - (Low-tech) sign posting in elevators and mailbox area
 - Email blast



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Billing System

- **Shadow Billing (Year 1)**
 - Standard Submeter Bill (flat rate) charged, with TOU bill amount provided for information
 - Algorithm applied to calculate 3:2:1 rate
 - Savings Incentive Fund distributed after Year 1 compensated residents for “savings” vs. standard submeter bill (85% received some \$)
 - Free Billing in Year 1
 - No incremental cost for TOU billing (NYSERDA funded software upgrade, used in subsequent sites)
- **TOU Billing**
 - Start Year 2 for shareholders
 - Start Year 3 for rentals
 - \$20 credit for “Top Ten Performers” each month with highest percentage savings from TOU rate



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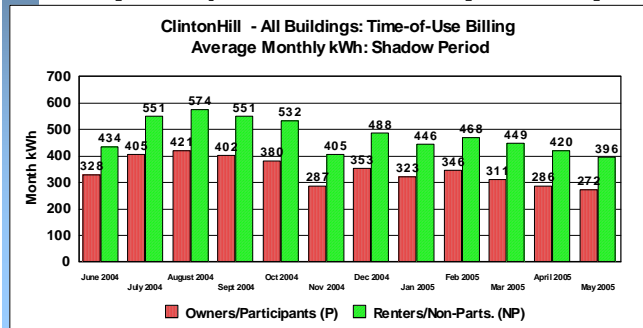
Analysis and Evaluation

- **Price Response Analysis**
 - **Submetering response: via comparison of billed shareholders vs. non-billed renters in Year 1 (pre-TOU)**
 - **TOU Response via comparison of:**
 - Shareholders Pre-vs.-post TOU pattern
 - Shareholders vs. Rentals TOU Pattern
 - **Critical Peak Pricing (CPP) Response**
 - Hourly Profiles of high participant (more shareholders) vs. low participant (more rentals) buildings



Submetering Price Response

- **Submetered apts. (owner/participants) used 28% less than non-submetered apts. (renters/non-participants)***



Avg. monthly kWh during TOU shadow period (June 2004 – May 2005):

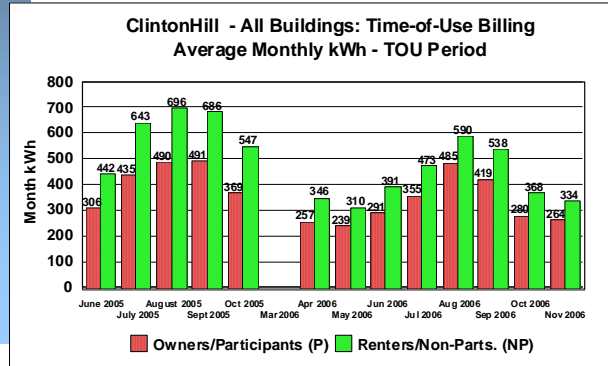
Submetered 342
Non-Submetered Rentals 477

* Mix of apartment sizes was comparable



TOU Price Response

- TOU/Submetered apts. (owner/participants) used 31% less than non-submetered apts (renters/non-participants)*



Additional 3% average monthly usage difference attributable to TOU-induced usage reduction during TOU Year 1 (June 2005 – Oct. 2005)

Difference declined to 23% in TOU Year 2 (April 2006 – Nov. 2006) as rentals began to be TOU and submetered billed

* Mix of apartment sizes was comparable



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TOU Price Response

- TOU/Submetered apts. reduced peak consumption from 13.8% to 11.6% and shoulder consumption from 33.0% to 30.5% of totals between shadow and TOU Year 1. Off-Peak increased from 53% to 57%.

Month	Pre-Shadow	Crit. Pk Days	Average kWh/Apt	Cooling Deg Days	Participants (submetered/billed)			Non-Participants (Non-Billed)		
					Peak	Shoulder	Off-Peak	Peak	Shoulder	Off-Peak
June 2004	Shadow		452	343	13.7%	34.1%	56.2%	12.2%	35.2%	52.6%
July 2004	Shadow		462	343	14.8%	33.6%	51.6%	16.0%	35.2%	48.8%
Aug 2004	Shadow	2	469	326	15.8%	32.2%	52.0%	17.0%	33.7%	49.4%
Sept 2004	Shadow		451	188	13.3%	32.7%	53.9%	15.1%	34.1%	50.8%
Oct 2004	Shadow		432	9	11.5%	32.2%	56.3%	12.1%	32.2%	55.7%
Nov 2004	Shadow		336	0	11.8%	33.9%	54.3%	12.9%	33.7%	53.4%
Dec 2004	Shadow		404	0	10.3%	32.6%	57.1%	11.4%	32.4%	56.2%
Jan 2005	Shadow		362	0	10.7%	32.8%	56.5%	11.9%	32.6%	55.6%
Feb 2005	Shadow		384	0	9.7%	32.0%	58.2%	10.9%	32.2%	56.9%
Mar 2005	Shadow		354	0	10.3%	32.4%	57.3%	11.4%	32.6%	56.0%
April 2005	Shadow		332	6	11.2%	33.0%	55.8%	12.1%	33.3%	54.6%
May 2005	Shadow		316	17	11.6%	32.1%	56.3%	12.2%	32.5%	55.3%
June 2005	TOU Billing		348	304	10.5%	31.9%	57.5%	11.5%	33.1%	55.4%
July 2005	TOU Billing	3	500	424	11.3%	31.9%	56.9%	12.4%	33.6%	54.0%
Aug 2005	TOU Billing	2	550	500	14.9%	27.6%	57.6%	15.3%	29.3%	54.8%
Sept 2005	TOU Billing		550	304	10.0%	29.4%	60.5%	11.7%	32.0%	56.3%
Oct 2005	TOU Billing		425	42	11.3%	31.7%	57.0%	13.2%	32.5%	54.3%
Nov 2005	TOU Billing		283	6	16.2%	32.2%	51.6%	16.5%	32.6%	50.8%
Dec 2005	TOU Billing		260	67	22.4%	29.2%	48.4%	22.5%	28.6%	48.9%
Jan 2006	TOU Billing		321	267	17.3%	27.9%	54.8%	15.5%	29.3%	52.2%
Feb 2006	TOU Billing	2	389	492	17.1%	28.7%	54.2%	15.0%	30.8%	54.2%
Mar 2006	TOU Billing	2	516	414	21.4%	25.4%	53.2%	21.0%	27.4%	51.5%
Apr 2006	TOU Billing		454	137	17.0%	29.2%	54.3%	15.1%	29.9%	50.9%
May 2006	TOU Billing		307	31	15.9%	29.2%	54.9%	15.9%	29.7%	54.3%
June 2006	TOU Billing		285	0	16.8%	29.8%	53.4%	16.8%	30.6%	52.6%
Shadow Summer					13.8%	33.0%	53.2%	15.1%	34.1%	50.8%
TOU Billing Year 1 Summer					11.6%	30.5%	57.9%	13.0%	32.1%	54.9%
TOU Billing Year 2 Summer					17.9%	27.9%	54.3%	17.3%	29.4%	53.2%

• TOU/Submetered Apts. TOU Peak % consistently 1.1% -1.2% lower than rentals in summer and winter months

• TOU/Submetered Apts. TOU Shoulder % consistently 1.5% lower than rentals in summer and winter months

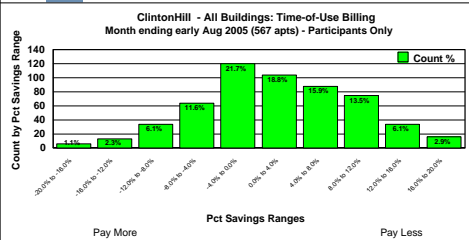
• TOU/Submetered Apts. TOU Off-Peak % consistently 2.6% - 3.2% higher than rentals in summer and 1% higher in winter months



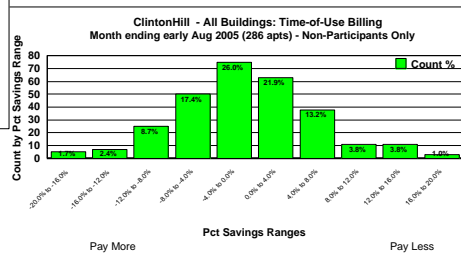
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TOU Price Response

- TOU/Submetered apts. had a higher percentage of savers under TOU rates than renters, typically 55-60% saved, vs. 35-50% of rentals.



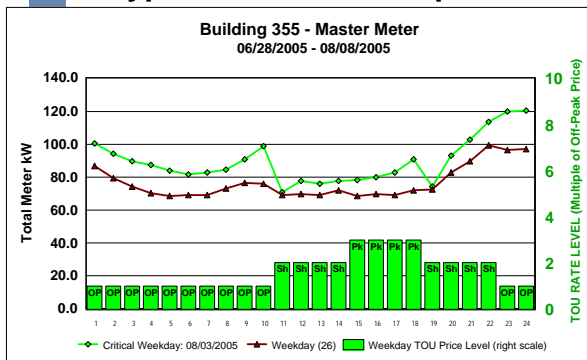
← 57% of TOU participants saved, averaging \$5.50 in August 2005



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TOU/Critical Price Response

- Hourly load profiles were significantly affected by both TOU participation and Critical Peak Price alerts
- Typical summer load profile results



← High-participant building (87% TOU participants) summer load profile illustrates resident response to TOU on weekdays and dramatic response on critical days

← 25% initial kW drop at 10am, 15% drop at 6pm for Critical day

← Evening building peak not significantly affected by shifting from peak (weather-normalized)

Note that peak extends to the evening shoulder hours on critical days (5 during this period)

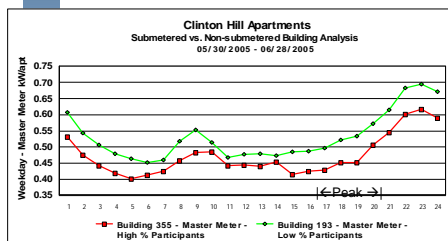


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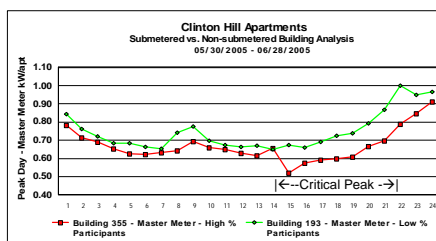
TOU/Critical Price Response

Compare Building with High Percentage (87%) of Submetered/TOU-billed Participants (Red) vs. Building with Low Percentage (57%) of Submetered/TOU-billed Participants (Green)

➤ Building with more participants has lower overall use and lower kW peak



^ Average Weekday load profile dips for high participant building at 2pm start of peak period



^ Critical Peak Weekday load profile dips for high participant building at 2pm start of peak period and maintains higher impacts through 10 pm peak period end.



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Survey Results

- **2005 Pre-TOU Billing Workshop (28 resp.)**
 - Program Education
 - 74% - Traffic Light concept considered helpful
 - 78% - Info Packet helpful
 - 70% - Brochure/Tip Sheet and Top Ten Tips Magnet
 - 76% - Web Site Not Useful
 - 80% familiar with TOU period definitions
 - TOU Response
 - 65% expected to shift **SOME** energy to off-peak
 - Actions taken: 82% turned off lights, 71% turned off TV/computer; 68% fan instead of A/C
 - 46% indicated TOU had “some” influence on usage



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Survey Results

- **2006 Post-TOU Billing Survey (51 resp.)**
 - **TOU Response**
 - 71% shifted **SOME** energy to off-peak
 - 14% unable to shift
 - **Actions taken: 75% turned off lights, 63% turned off TV/computer; 47% fan instead of A/C,**
 - **Shift/Defer:**
 - 33% A/C, 35% dishwasher, 14% cooking
 - 65% indicated TOU had “strong” (20%) or “some” 45% influence on usage pattern
 - 30% noticed reduction in electric charges from TOU
 - 47% plan Energy Star purchases, 20% efficient appliances
 - 64% felt program materials excellent or very good, only 9% rated it poor



SUMMARY RESULTS

- **Submetering provides an essential price signal to apartment residents – worth 20% or more in energy and peak savings**
 - Clinton Hill annual kWh reduction of 28%
- **Time-sensitive Pricing (TOU and CPP) adds a valuable additional price signal that can affect both energy and demand, though to a lesser extent than submetering**
 - Clinton Hill annual kWh reduction 3%
 - Summer utility peak (2-6pm) reduction 8-10%
 - Summer Critical Peak Day utility peak reduction app. 15%-20%
 - Summer Building peak not significantly affected by shifting
- **TOU/CPP can be done at a small incremental cost (mostly administrative) since most advanced submetering systems already have on-demand meter-reading capability.**



CONCLUSIONS

- **Time-Sensitive Pricing provides significant energy and demand savings for master-metered multifamily buildings over and above submetering**
- **Submetering plus demand response (via TOU/critical peak pricing and load curtailment) can qualify building and residents for incentives, including utility and state ISO curtailment programs**
- **Submetering and TOU/Critical Peak Pricing, encourage conservation, efficiency and investment in more efficient appliances, lighting and timers**



Acknowledgements

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- **Bob Friess – American Metering & Planning Services (AMPS)**
- **Clinton Hill Apartments Management and Board of Directors**

