



Demand Response for the Residential Multifamily Market in New York

*Presentation for AEE – New York Chapter
April 17, 2007*

by

Joseph S. Lopes



Applied Energy Group, Inc. - Hauppauge, NY
www.appliedenergygroup.com

Co-author: Herbert E. Hirschfeld, P.E.

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

1



Introduction

- **Demand Response history in NY**
 - **Industrial Customers:** Have Energy Managers, expertise, demand charges and time-of-use pricing (now real-time prices)
 - **Commercial Customers:** Some have head-office energy managers, demand charges, utility DSM programs, NYISO incentives
 - **Residential Single-family:** Utility DSM and load control programs, voluntary TOU programs, NYSERDA DSM programs

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

2

Introduction

- **Residential Multifamily: Underserved in utility DSM programs due to constraints:**
 - Logistics – access to apartment residents
 - Management – 3rd-party managers, Coop Boards, off-site owners
 - Size – apartments are low users; building typically central space and water heat
 - Apartment owner-occupancy issues
 - Who pays occupant electric charges?
 - Who buys/owns appliances?
 - Master-metered buildings with/without submetering
 - No direct utility/energy info access
 - Subsidized rentals

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

3

Demand Response Options

- **Objectives:**
 - In New York area, hot summer day afternoon is critical period
 - Critical peak hours are 1pm/2 pm to 6pm
 - Ongoing and/or critical day peak hours' load reduction
- **Strategies**
 - Load Control (Utility or Curtailment Service Provider-CSP): Turn off appliances such as room air conditioners, lighting
 - Price signals: time-of-use or critical peak pricing – higher prices when system costs are higher; typically summer afternoons

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

4

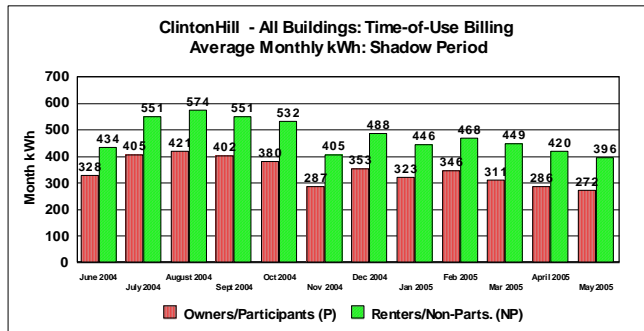
Multifamily Demand Response

- **Submetering in Master-metered buildings**
 - Provides price signal to individual residents, where none before – some residents think electricity is “free”
 - Transfers electric cost responsibility from building to user (coops); from owner to tenants (rentals) – incentive!
 - Proven success – 18-26% energy savings; slightly more for summer peaks
 - Main target is room A/C in unoccupied apartments
 - Submetering has been primary focus of NY Programs
 - NYSERDA Submetering Technology Demonstration Studies (1980's)
 - Con Ed Submetering program incentives (1991-1996)
 - NYSERDA Incentives and CEM Program (1997-now)

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

Submetering – Price Signal

- Under typical submetering plan (like SF), residents charged a flat rate in proportion to their use, allocating total building costs exc. common areas
- Submetering price signal is incentive for reducing waste and more efficient energy usage; Tenants respond by using less and investing in efficient appliances – provides demand response



Within the same building, submetered apts. Used 39% less than non-submetered apts. (renters)

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

Time-of-Use (TOU) – Price Signal

- **Submetering PLUS TOU!**
 - Building master-metered bill typically has complex rate – peak period (demand) charges for delivery (20-30% of bill)
 - **When you use energy MATTERS! Time-of-Use (TOU) pricing - Pay for When you use energy!**
 - Today's submetering systems typically provide two-way data communications (via PLC/wiring or wireless) between apartment (meter, devices) and host computer (can be linked to web)
 - Interval data collection enables TOU reading/billing at little/no additional cost
 - Potential for load control when linked to devices (A/C)

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

7

Multifamily Buildings & Demand Response

- **Multifamily buildings can be effective aggregators for demand response**
 - Concentration of apartments within one building under common management
 - Data Communications via powerline carrier or short-range wireless
 - Notifications within building already routine
 - Amortization of fixed cost over many apartments resolves problem of low use/apt.

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

8

Case Studies in MF Demand Response

Waterside Plaza



New York City rental apartment complex; master-metered; built early 1970's; 1470 units, all-electric with heat pumps in each apt.

Clinton Hill Apartments



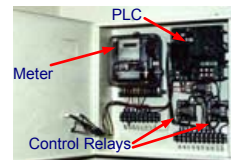
Brooklyn, NY coop apartment complex; master-metered; built in 1940's; 1225 units; 66% owner-occupied, 34% renter; recent electrical upgrade; room A/C's

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

9

Case Study: Waterside Plaza

- **All-electric rental apartment complex: electric costs a major concern**
- **Dual System installed (1997)**
 - 2 functions enabled with shared PLC communications system: submetering and energy management system (EMS)
 - Designed to satisfy both owners and tenants:
 - ✓ Housing agency (HPD) wanted EMS with resident override feature (no rent reduction issues);
 - ✓ Owner wanted electrical submetering (requires rent reduction process)
 - ✓ Incentive \$ (Con Ed) for both EMS and Submetering



Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

10

Case Study: Waterside Plaza

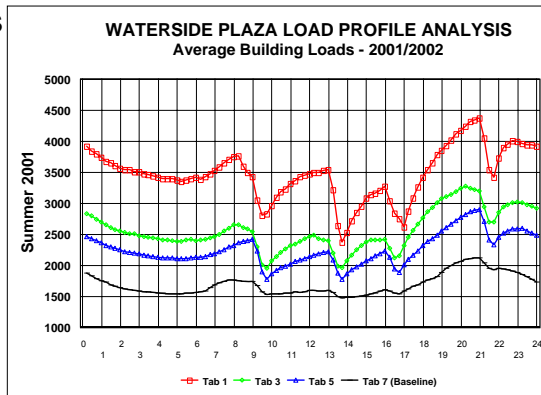
Chronology of System Implementation

- 1997-2000: EMS shuts off (sweeps) heat pump units at scheduled times for energy/cost savings
- 2000-2004: After Privatization, Submetering for opt-in units (EMS optional); higher rents for opt-out units (EMS mandatory)
- 2004 on: Price-responsive load management
 - NYSERDA R&D Program incentives for equip. upgrade
 - Incentives from NY ISO for load control, coordinated through Curtailment Service Provider (Consumer Powerline)
 - Voluntary participation by tenants; incentives shared

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

Waterside Plaza 1997-2002

- Apt. heat pumps controlled 4x/day
- Graph shows impact at several temperature levels
- Tab 1=Max 102 d
- Tab 3=Max 88 d
- Tab 5=Max 83 d
- Tab 7=baseline



Total Building Load: 4500kW

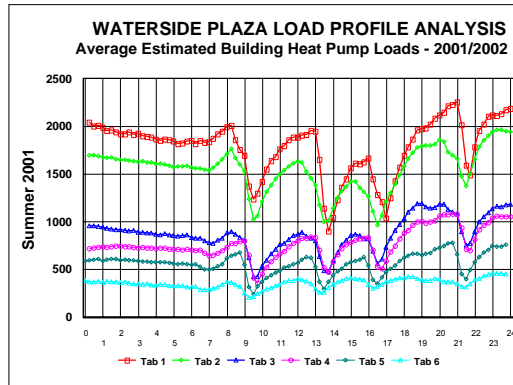
Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

Waterside Plaza 1997-2002

- Central control of heat pumps (A/C)
- Residents can override without penalty

Impacts:

9 am: 700 kW
 1 pm: 1051 kW
 4 pm: 630 kW
 9 pm: 430 kW



Est. Peak A/C Load 2200 kW

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

13

Waterside Plaza – 2006/07

- **Savings Analysis/Cost Avoidance Study**
 - Conducted by H. E. Hirschfeld, P.E., Waterside's Energy Consultant
 - Compared 2006 with baseline year (1996)
 - Cost reduction of 47% in the apartment sectors when adjusted for both utility cost and weather variations – approx. components:
 - EMS alone (pre-submetering): 10-15%
 - Dual System operation: Submetering 20 - 25% plus EMS 5 - 10%
 - Additional with opt-in, ISO incentives and heat pump unit upgrades 10%-15%

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

14

Waterside Plaza Case Study

- Post-submetering, residents have incentive to welcome control to save money
- Control System upgrade to make overrides require phone-in (documented)
- Control designed to reduce billing demand kW peak (instead of kWh energy) 6-9 pm
- Target July billing peak reduction of 250 kW (5%)
- Participation in ISO and Utility incentives on critical days
- Target critical day peak reduction of 500 kW 2-6pm

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

15

Clinton Hill Case Study

Chronology of System

- Pre-2001: Master-metered, insufficient electric service (A/C)
- 2002: Electrical upgrade, NYS Code requires metering; shareholders opt for submetering (meters in basement)
- 2003-2004: Submetering installed/tested; implemented early 2004 (shareholders only); rental apt. owners await DHCR approval before charging for electric
- 2004: NYSERDA Program for Time-Sensitive Pricing applied to submetered residents; shadow bills June–Mar 2005; full-scale April 2005; electric costs allocated to each apartment based on TOU period usage allocation
- November 2005: DHCR approval, submetering and TOU rate expanded to renters



Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

16

Clinton Hill Case Study

NYSERDA 2004 Pilot Program: Submetered TOU Pricing

- **3 time block periods: Peak, Shoulder, Off-Peak**
 - Peak matches Utility System Peak Period: (2-6pm) on Weekdays
 - Algorithm computes fixed ratio of 3:2:1 for peak/shoulder/off-peak periods based on building TOU usage breakdown
- **“Critical” Peak extends Peak Period through the evening hours**
 - Call “Critical” Peaks when system grid conditions are most severe (hot summer days) – 3-5 days/month
 - Posted signs in building and note on web site
 - Matches likely Customer/building peak (6-10pm on Critical Day)
- **Technical assistance at no cost**
 - Workshops, Information, analysis, surveys
 - web site www.apartmentenergytips.com

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

17

NYSERDA Time-Sensitive Pricing Pilot



Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

18

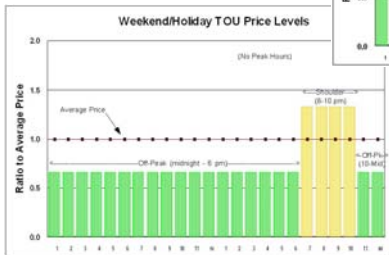
NYSERDA Time-Sensitive Pricing Pilot



TRAFFIC LIGHT GUIDE TO TOU

RED: Stop; YELLOW: Caution; GREEN: Go!

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)

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

NYSERDA Time-Sensitive Pricing Pilot

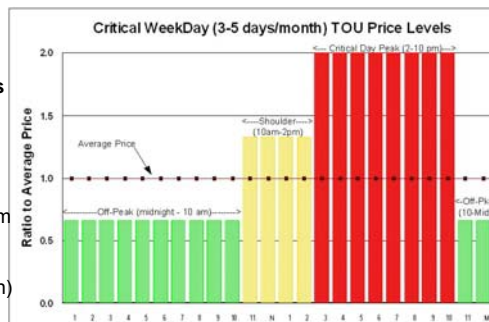
Critical Days: Coincide with utility system stress and/or building peak billing demand (30%+ of bill\$)

Critical Day (3-5 peak days per month) ----->

Peak Hours: 2-10 pm (red)
 (extended from 2-6 pm)

Shoulder 10am-2pm, 6-10pm
 (yellow)

Off-Peak 10pm-10am (green)

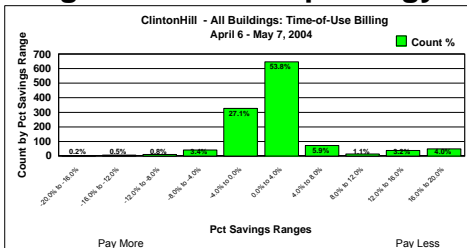


Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

NYSERDA Time-Sensitive Pricing Pilot

BENEFITS:

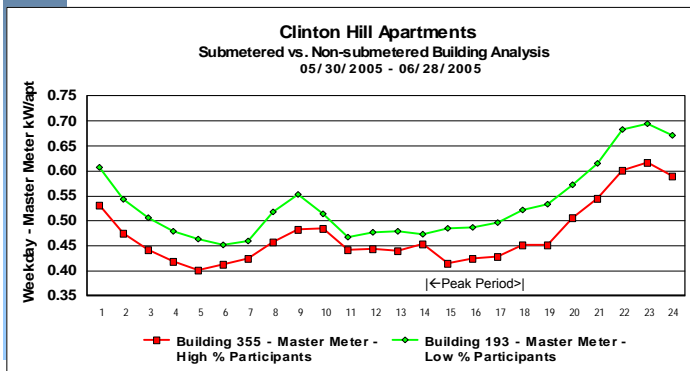
- Energy Costs are allocated more fairly and in line with building's true costs
- Residents have the opportunity to \$ave by reducing energy, shifting and can recoup energy investments
- Under TOU rate, nearly all residents' bills would be within 4% of non-TOU bill without changing their usage patterns →



Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

Submetered TOU Pilot Results

Compare Buildings: High Percentage vs. Low Percentage of Participants
– On average weekday, Building with more “participants” (pay their electric bill) has lower overall use and lower kW peak



PRELIMINARY

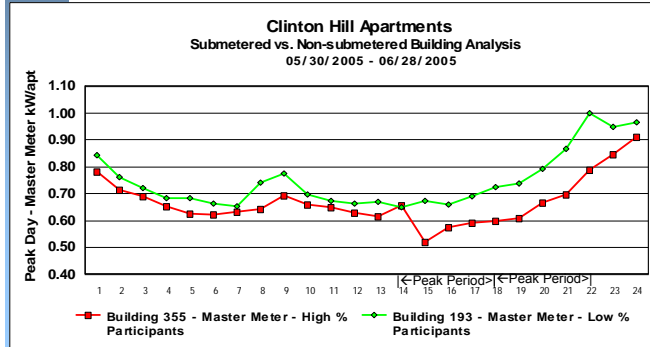
← Average Weekday load profile dips for high participant building at 2pm start of peak period

- Additional 0.04 kW/apt (8%)

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

Submetered TOU Pilot Results

Compare Buildings: High Percentage vs. Low Percentage of Participants
 – On 2005 Critical Peak Day, Bldg with more participants has lower overall use and much lower kW demands during peak and evening



PRELIMINARY

← Reduction in usage more significant on Peak Day than Average Weekday

← Peak Day load profile dips for high participant building at 2pm start of peak period: Additional 0.08 - 0.12 kW/apartment (13-20%, or = 2-3x average weekday)

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

MF Demand Response: Lessons Learned

- **Building advanced metering systems (e.g. submetering) facilitate aggregation of loads for demand response purposes**
 - Submetering alone can provide significant across-the-board load reduction and bill savings, benefiting both utility system and building
 - Addition of Energy Management System with A/C load control to advanced metering system (e.g. Waterside Dual System) provides many options for significant energy savings and demand response
 - Aggregation of Demand response enables participation in ISO incentive programs, which have a minimum load reduction requirement

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

MF Demand Response: Lessons Learned

Multifamily Advanced Metering Aggregation (Con't)

- **Addition of Time-of-Use (TOU) and Critical Peak Pricing (CPP) adds a valuable price signal that can affect both energy and demand**
- **TOU Price Demand Response addresses both utility peak (2-6pm) and building peak (8-10pm)**
- **Critical Peak Day Pricing element (6-10pm on selected days) provides additional bill savings benefits for multifamily buildings with demand charges**
- **Simple Pricing plan with high peak to off-peak ratio (3:1) and well-defined periods can be understood and responded to by residential apartment residents**

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

25

MF Demand Response: Lessons Learned

Multifamily Advanced Metering Aggregation (Con't)

- **Risks and benefits are shared fairly:**
 - **Cost of Advanced Metering System is minor when allocated over all building residents**
 - **Benefits of reduced building electric costs are allocated proportionally (fairly) to residents who respond most**
 - **Benefits of incentives for demand response (ISO, Con Ed) accrue to residents based on their participation and response**

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

26

Other Demand Response Case Studies

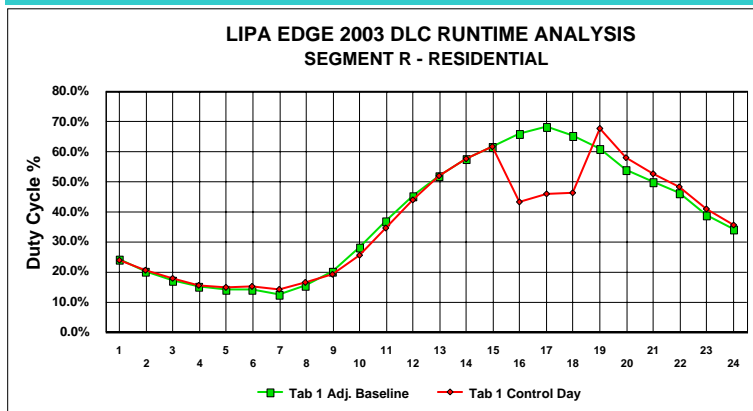
Two-way programmable thermostats

- Con Edison
- Long Island Power Authority (LIPA)
 - Since 2001, Central A/C units in over 21,000 residential, 5,000 small commercial
- Colorado Springs Utilities
 - Since 2005, Residential A/C Units in 500 sites; both temperature and A/C Control
- Southern California Edison
 - Pilot for 5,000 Commercial Sites, temperature control
- Aquila: Gas Heat and Central A/C – 100 sites

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

27

Duty Cycle Control Case

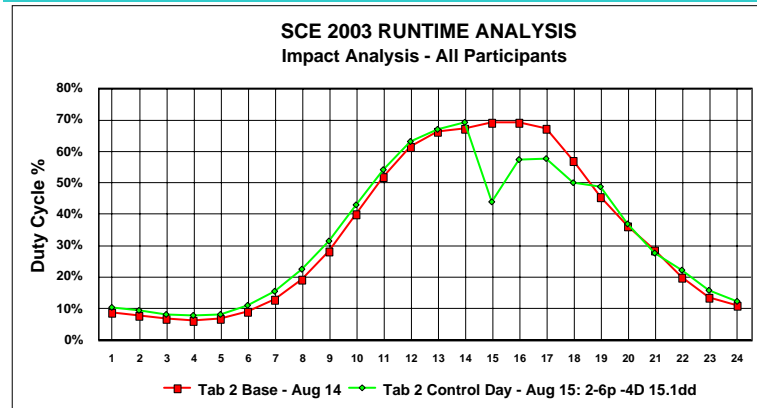


Control 3-6 pm; Some “payback” after control ends

Demand Response for the Residential Multifamily Market in NY
 J. Lopes; AEG for AEE-NYC; April 2007

28

Setpoint Temperature Control Cases



98° max day; 4° setpoint change 2-6pm, no payback

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

29

Acknowledgements

- **NYSERDA – Peter Douglas**
- **Waterside Plaza and Clinton Hill Management**
- **Herbert E. Hirschfeld, P.E. (Designer of Dual System and Waterside’s Energy Consultant)**
- **Zach Stern – Elemco Building Controls**
- **Bob Friess – American Metering and Planning**
- **LIPA/KeySpan – LIPA Edge Staff**
- **Southern California Edison (Mark Martinez)**

Demand Response for the Residential Multifamily Market in NY
J. Lopes; AEG for AEE-NYC; April 2007

30