

Lessons Learned and Evaluation of 2-way Central A/C Thermostat Control System:

Demand Response via Thermostat Control

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Introduction

- **Deregulation has had mixed success**
 - Volatile electric commodity prices
 - Regulated utilities no longer control supply prices
 - Summer system peak critical periods are the most volatile
- **New York State is a typical example**
 - New York State Regulators, NYSEERDA and NYISO have instituted incentive programs for demand reduction:
 - Initiatives for Demand Response Programs
 - Funding for innovative technology
 - Utility incentives
 - e.g. Con Edison “Distribution Load Relief”

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Background

- **Con Edison**
 - 3 million customers in New York City and Westchester County (north of NYC)
 - Annual Peak over 10,000 MW



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Background

- **NYPSC Order in 2000** required each utility to identify load reductions achievable in the near future
- **Air conditioning** considered the primary target for demand response:
 - Coincident with Summer Peak
 - Somewhat discretionary
 - Growing in saturation, especially in new residential home developments
- **May 2001: PSC directed Con Edison to implement direct load control program for central air conditioners**
 - Residential Pilot in 2001, full-scale in 2002
 - Commercial Pilot approved 2003, launched 2004

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Program Design

- **Design Objective:**
 - Cost-effective load reduction
 - Significant participation levels
 - Acceptable to customers (including overrides)
 - Adequately verifiable
- **Quantitative Objectives**
 - Measure connected load and maximum load (power factor)
 - Determine summer peak kW load reduction
 - Determine level of overrides expected

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Program Design

- **Qualitative Objectives**
 - Evaluate marketing strategies
 - Evaluate customer understanding of program parameters and willingness to participate
 - Customer satisfaction with equipment and installation
 - Determine barriers to participation
 - Determine size and type of business most suitable for participation

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Program Technology

- **Historically, implemented with one-way switches on central A/C systems**
- **Con Edison assessed options and chose Carrier Comfort Choice® Thermostat**
 - **Switches: unpopular, communications problems**
 - **One-way systems would require sample loggers or metering to verify/estimate impacts**
 - **Carrier thermostat provided more benefits to customer and were well-received**
 - **Energy Star-rated, programmable (7days x 4 periods), digital, low-power, independent fan operation**

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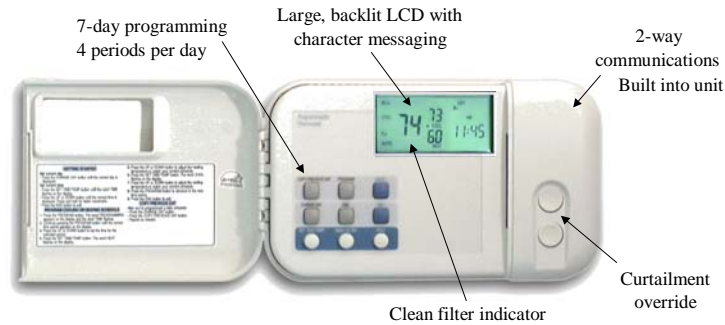
Program Technology

- **Carrier Comfort Choice® Thermostats:**
 - **Two-way pager communications, which ensures verification, remote access via Internet (customer and utility)**
 - **Interval data (runtime and temperature) available for virtually all sites, stores 7 days of hourly runtime and temperature data**
 - **Customer overrides can be tracked**
 - **Capable of duty cycle control (e.g. 50%: 30 minutes on/ 30 minutes off) or temperature control (raise setpoint “x” degrees)**

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Controllable Carrier Thermostat



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Program Features

- **Residential and Commercial Features are similar:**
 - Customers offered free thermostat and one-time incentive (\$25 residential, \$25 - \$75 for commercial)
 - Multiple thermostats permitted
 - Control operated only during NYISO or Con Edison emergencies, typically 1-6pm on hot summer days, historically up to 3 per year
 - No pre-specified limit to control events
 - 50% duty cycle control, with “refreshed” signal every two hours an option
 - Participants have internet access to program thermostat
 - Can override without penalty, but only on site

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Recruitment

- **Recruitment for Residential and Commercial were similar:**
 - Web Site set up linked to Con Edison Main site
 - Direct mailing for Pilots (most effective residential method); billing analysis filter used to target likely A/C users
 - Local Publication / Community Newspaper ads
 - Residential Lead Sources: 35% telemarketing followups; 25% direct mail response; 11% Con Edison web/bill stuffers; 10% Community Newspapers
- **Commercial pilot targeted Brooklyn and Queens only, under 50 kW demand**
 - Door-to-door with bilingual marketing reps (57% of leads); direct mail (23%); telemarketing (20%)

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Participation

- **Residential (since 2001)**
 - 22,000 leads, over 14,000 participants through Sept 2004
- **Commercial Pilot (2004)**
 - 2,500 participant target; over 2200 achieved
 - Restaurants (23%), Hard-Goods Retailers (22%), Food Retail (10%), Personal Services (8%), Financial Offices (8%)
- **Some “technical” turn-downs**
 - Damper systems (incompatible), lack of access, wiring constraints, unit operational problems, lack of two-way signal (minor)

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Program Evaluation

- **Surveys**
 - **Customer Surveys during installation**
 - **“Technical turndown” customers**
 - **Annual Post-Season Satisfaction**
 - **Mailed up to 3,000, with about 50% response**
 - **Satisfaction with equipment and installation**
 - **Ease and use of thermostat (programming, internet access, overrides)**
 - **Use/Satisfaction with Information Line, after-hours service and overall satisfaction**

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Program Evaluation

- **Runtime Data Collection/Analysis**
 - **Recover over 90% of all site data on verified two-way communications test**
 - **Unbiased, virtually 100% “sample”**
 - **Runtime duty cycle combined with maximum load draw (based on connected load adjusted by results of watt meter study: 15% reduction from connected load)**
 - **Comparison day(s) analysis between control day and comparable baseline day(s) - minor adjustments where necessary**

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Program Survey Results

- **Residential Survey Analysis (2002)**
 - Virtually 100% (4.99 / 5.0 rating) of “technical turndowns” were satisfied
 - 73% “very satisfied” with quality of equipment/installation; 21% “somewhat satisfied”
 - 82% used programming features; 80% rated “easy”
 - 27% used overrides at some point
 - Web Site used by 12%; 89% rated it user-friendly
 - 11% used the info line; 88% rated it responsive
 - Overall satisfaction (2003) was 92%, including 56% “very satisfied”

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Program Survey Results

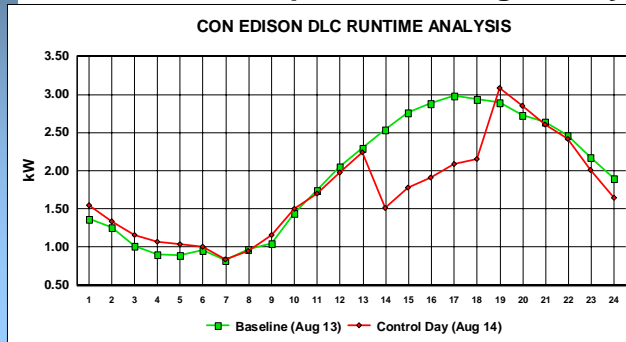
- **Commercial Pilot Survey Analysis (2004)**
 - Overall, 90% were satisfied with the overall program and quality of thermostats
 - 67% said main reason for participation was to conserve energy vs. 18% for free thermostat
 - 61% used programmable features; 80% indicated those features were important to them
 - 84% stated the programming was easy
 - 14% use internet features; 80% of those indicated it was an important feature
 - 11% used Program infoline; 70% said it was helpful
 - 26% were aware of test curtailment; 62% had used override feature

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Program Load Impact Results

- Residential (August 14, 2002 1-6 pm) 50% Duty Cycle Curtailment achieved 1.1 kW per thermostat impact on 96 degree day



- Baseline Day matched well
- Minimal “payback” after control period
- App. 14% of stats were off all day (free riders)
- App. 47% of units ran flat out on baseline day

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Conclusions

- Program considered a success
 - Significant load reduction without adverse impact on participants
 - Significant total impact (nearly 20 MW so far)
 - Customer features of thermostat (inc. internet access) considered a key element in recruitment
 - Residential Program considered cost-effective and full-scale effort will be continued through at least 2007
 - Commercial Program considered cost-effective – cost similar to residential - expected to be expanded to full-scale, with larger sites included
 - Door-to-door was most effective strategy for Commercial recruiting

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