Real-Time Pricing
Electricity Service for Urban Consumers

A Case Study in New York City

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Abstract

After two years of research, analysis and technology implementation, in October 2003, the cooperatively owned building at 322 Central Park West became the first apartment building in New York City, and perhaps the nation, to receive electricity service based on the wholesale electric market. The demonstration project was made possible by New York State's earlier move to unbundle utility electric services, establish an hourly wholesale electric market and create wholesale and retail competition.

This paper presents analysis before and after the 48-unit building enrolled in a real-time pricing program and implemented internal time-sensitive rate blocks for residents.[1] The process is iterative. Emerging findings triggered continuous adjustments to the building's internal rate schedule to enhance the rate responsiveness of its residents. There is initial indication of success. The building's electricity costs declined approximately 10 percent in the first full year of its new service; some individual residents saved much more. While a significant portion of savings can be attributed to a shift in discretionary electricity consumption and reductions in peak load demand, there may be contributing factors outside the scope of this study. Work continues to refine pricing mechanisms, measure resident response, quantify project benefits and introduce new enabling technology.

Introduction

Background

In 1996 New York State began to deregulate its electricity service industry to encourage electric competition that would help meet its growing needs. Over the next two years, the New York Public Service Commission (PSC) and the state's regulated electric utilities negotiated a series of agreements to unbundle services, separating the generated portion of electricity from distribution and transmission service and ushering retail competition into the state's electricity market.

Action was overdue in New York's critical load pockets downstate. By 1999 the local utilities, Consolidated Edison Company (Con Edison) in New York City and Westchester County, and the Long Island Power Authority[2] in Nassau and Suffolk Counties, had exceeded their forecasts for electricity demand -- *for 2003*. The situation was especially precarious in New York City, where the economy was booming, despite limited electric transmission capacity and a lack of new power plant construction for more than a quarter century (NYISO 2001).

In 2000 the PSC broached the possibility of time-sensitive pricing built on the emerging deregulated market, as a way to address the power supply crisis. The PSC directed electric utilities "to

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[1] We call our internal rate blocks time sensitive to distinguish them from utility time-of-use (TOU) pricing structures. Utility TOU pricing structures are generally broader than the internal time-sensitive blocks developed for 322 Central Park West.

[2] As a public authority, the Long Island Power Authority is not regulated by the PSC.

develop and offer tariff options that apply hourly market prices to actual hourly customer loads to provide improved incentives for utility customers to respond to price signals." It further ordered utilities to establish a series of demand response programs, specifying that "[a]t a minimum, [utility] programs shall include making available to customers voluntary real-time (hourly) pricing tariffs (PSC 2000,7)."

In 2001 the New York State Independent System Operator (NYISO), which manages the state's wholesale electricity market, echoed the PSC message. In its first annual *Power Alert* (2001) examining the state's power supply infrastructure, the NYISO warned that New York "must bring the supply and demand of electricity into greater balance, especially in the downstate region"(3). It stated: "To achieve the full benefits of electricity market deregulation, some customers need to be exposed to the true price (determined either in the day-ahead market or in real-time) of electricity. One of the many lessons learned from the recent California experience is that, in the presence of a capacity shortfall, when retail rates and wholesale prices are disconnected in time and space, the results can be disastrous (13)."

Despite the economic impact of the September 11 terrorist attack, the NYISO 2002 *Power Alert* found that the City's electric supply remained inadequate and again stressed the potential of demand response to effect electric reliability. The NYISO urged development of advanced meters that empower consumers, creation of real-time tariff schedules and broad educational efforts aimed at consumers (6).

Real-time pricing (RTP) in New York City's vast multifamily housing market is aimed at apartment buildings that purchase buildingwide electricity through a master meter. Master-metered buildings pass electric charges to residents through rent or maintenance fees, often as a standard monthly charge. To assure individual responsibility for electric usage, New York energy policy encourages master-metered apartment buildings to install submeters to bill individual apartments for their precise consumption. Other residential consumers receive electricity directly from the utility, and as small customers pay a higher price for their direct-metered service.

Con Edison responded to the PSC directive by setting a goal to "achieve voluntary load reduction periods of high wholesale market prices through voluntary customer actions in response to day-ahead signals" and "reduce system peak demand" (Con Edison 2001, A-6). The utility filed tariff amendments to permit RTP and proposed an interval meter program aimed at large customers, including residential buildings that receive bulk rate electric service through a master meter under Service Classification 8 (SC-8).

The deregulation of the electric market makes it possible for residential consumers in master-metered buildings to purchase full service electricity from a utility or purchase the generated portion of electricity from an alternative electric service provider or power marketer, which in New York is called an ESCO. Distribution and transmission services are provided solely by regulated utilities.

In 2001 the PSC authorized a new utility tariff, called Rider M, for customers who purchase electricity at real-time prices set on the ISO-administered day-ahead market (DAM).[3] ESCOs may establish a separate RTP tariff for the energy they provide. Both utilities and ESCOs may provide electricity based on day-ahead prices.

Scope

In 2001 we undertook the development of an RTP program at 322 Central Park West (CPW), a 1928 apartment building on Manhattan's Upper West Side. The multifamily building, which received electricity and cooking gas from Con Edison, was electrically submetered in the early 1980s with

[3] Rider M was originally open to customers with demands over 100 kW and was later extended to all demand-metered customers. Directly billed residential customers in apartments and single-family homes are not eligible for Rider M.

conventional mechanical metering technology.[4] The 48-unit upper-income cooperative is governed by an elected board of directors.

The building was an attractive candidate for RTP service. New York State Energy Research and Development Authority (NYSERDA) offers incentives for advanced metering equipment.[5] Residents are accustomed to seeing submetered electricity charges as part of their monthly maintenance. The board president at the time, Peter Funk, is an attorney specializing in regulated and deregulated energy markets whose experience and grasp of RTP benefits were factors in convincing the board to adopt RTP.

Despite their interest, board members requested assurance that an RTP program would cost the building no more than their current master-metered electric service. They were also concerned that no individual be unduly penalized by the change. Since RTP had never been implemented in a New York City apartment building, we would have to develop a methodology to assess the impact of a new time-sensitive paradigm on residential consumers.

A Residential RTP Case Study

There were several stages in the development of a viable RTP program at 322 CPW, beginning with the implementation of advanced electronic meters that recorded data in time increments and could be read from a remote site. The steps discussed here include analysis of prices of various electric service providers, a test of RTP's financial feasibility, creation of an internal time-responsive billing system reflecting RTP charges, monitoring price-responsive behavior and modifying the billing structure to achieve maximum benefits. Despite bureaucratic, technological and policy hurdles,[6] in October 2003, the apartment building became the first in the city to purchase electricity at real-time prices.

Pricing Mechanisms

In July 2002, the building installed an advanced interval master meter that recorded buildingwide time-sensitive data. In May 2003, NYSERDA's Residential Energy Affordability Program funded us to work with a specific ESCO to develop a multifamily building RTP structure based on DAM prices. The cooperative maintained its current SC-8 master-metered service through September 2003, while we collected interval data for testing purposes. This allowed the information and time to weigh actual charges for conventional master-metered service against utility and ESCO RTP service.

We evaluated pricing structures and components of three types of master-metered service (**Table 1)**: conventional full service from Con Edison (SC-8), the utility's Rider M RTP program and ESCO retail access service. Using the building's load profile, we modeled bills under the two utility tariffs and ESCO RTP rate.

- **Utility Full Service:** Con Edison supplies, transmits and distributes electric service to master-metered residential buildings under SC-8. This bulk rate tariff includes a supply charge for direct usage and a demand charge to cover the cost of keeping at the ready the maximum electrical capacity required for each customer. Market supply charges, transmission and distribution charges, monthly adjustments and taxes are included under consumption and demand. Demand charges pay for electric wires, current transformers and other electric

[4] A central oil-fueled boiler generates steam for space heating and hot water.

[5] NYSERDA programs are funded through System Benefit Charges, which investor-owned utilities collect as part of customer bills. NYSERDA sponsors research, technology and development, and financial incentives for energy improvements. NYSERDA awarded Energy Investment Systems two contracts toward the 322 CPW project.

[6] Utility coordination, equipment code compliance and rate cap regulations are the subject of an expanded study.

infrastructure needed to deliver energy to consumers. To determine demand, the utility identifies the 30-minute period in the month with the highest consumption and calculates those kilowatts at a much higher rate than consumption throughout the rest of the month.[7]

- **Utility RTP Service:** Under Rider M, an RTP charge replaces the energy market supply charge and related adjustments of standard SC-8 service. The RTP charge is the average rate per kilowatt hour (kWh) based on multiplying the building's hourly kWh by the corresponding DAM price.[8] Included is an eight percent charge for line loss.
- **Retail Access Tariff:** When an ESCO supplies the power, hourly time-of-day (TOD) energy charges based on the DAM replace utility market supply charges and adjustments for energy. A fixed monthly installed-capacity (ICAP) charge replaces utility demand charges for the commodity.[9] The ESCO sends a monthly bill for electricity consumption and service fees, while the utility submits a bill for remaining demand and energy delivery charges.

Table 1. Components of Master-Metered Electric Tariffs

		Utility Full Service	**Utility RTP Service**	**ESCO Retail Access**
Energy Charge	Market Supply Charge*	x		
	Utility RTP Charge		x	
	ESCO RTP (TOD) Charge*			x
	Monthly Adjustment Clause	x	x	x
	Transmission	x	x	x
	Distribution	x	x	x
	Systems Benefit Charge	x	x	x
Demand Charge	Market Supply Charge	x	x	
	ICAP Charge			x
	Monthly Adjustment Clause	x	x	x
	Transmission	x	x	x
	Distribution	x	x	x
Gross Receipts Tax		x	x	x
Sales Tax		x	x	x

* includes periodic adjustment charges

Table 2 and **Table 3** chart the component costs for these pricing structures in November 2002 and June 2003, two months with substantially different load profiles. Actual charges under current SC-8 utility service are recorded alongside projected RTP charges for the utility and the subject ESCO. We did not include projected savings through usage shifts in response to price signals.

Table 2. Component Costs for Alternative Services in November 2002

	ENERGY		**DEMAND**			
	MSC/RTP*	**MAC, T & D**	**MSC/ICAP**	**MAC, T & D**	**Taxes***	**TOTAL**
SC-8	$2,748	$759	$778	$1,579	$602	$6,467
Utility RTP	$2,941	$759	$778	$1,579	$622	$6,681
ESCO RTP	$3,809	$759	$905	$1,579	$236	$7,290

* ESCO includes gross receipt tax in RTP charge

[7] Standard demand meters for buildingwide service only register measure maximum demand and total consumption.
[8] Hourly energy cost equals the hourly kW usage multiplied by the hourly DAM price plus line loss.
[9] New York's utilities and ESCOs must procure enough installed capacity to meet their estimated portion of the area's peak load. Utilities recover costs in the market supply demand charge; the subject ESCO recovered costs in an ICAP charge.

Table 3. Component Costs for Alternative Services in June 2003

	ENERGY		DEMAND			
	MSC/RTP*	MAC, T & D	MSC/ICAP	MAC, T & D	Taxes*	TOTAL
Utility SC-8	$3,323	$961	$1,039	$2,023	$716	$8,065
Utility RTP	$3,269	$961	$1,039	$2,023	$712	$8,006
ESCO RTP	$4,205	$961	$1,144	$2,023	$354	$8,691

* ESCO includes gross receipt tax in RTP charge

Our breakdown of component charges showed the ESCO RTP charge to be higher than the utility market supply charge in both months, by 13 percent in November and nearly 8 percent in June as the cooling season got underway.

Table 4 summarizes charges in the two months. Utility RTP charges are lower than the ESCO RTP in both months. Utility RTP charges were slightly higher than SC-8 service in November, but lower in June. After reviewing our analysis, the building chose Con Edison to provide RTP service.

Table 4. Electric Bills under Alternative Services

	Utility SC-8	Utility RTP	ESCO RTP
Nov-02	$6,467	$6,681	$7,290
Jun-03	$8,065	$8,006	$8,691

Developing Internal Rate Tiers

In April 2003, we installed interval submeters for individual apartments. No cost-effective technology existed to communicate changing price signals to residents within their apartments, making it unrealistic to charge different rates by hour and day. Instead, we developed an internal pricing strategy that would reflect broad pricing patterns of the day-ahead market and help lower peak demand, which generally occurs at 322 CPW on weekdays between 7 P.M. and 9 P.M.

The start of buildingwide RTP service was delayed until the PSC's October 2003 reauthorization of the Con Edison Rider M tariff.[10] Between April and October, we developed and tested an internal pricing structure that would meet several criteria:

- Price signals should be easy for residents to understand.
- Residents should easily be able to assimilate price signals into everyday life.
- Differences between rate tiers should be sufficient to stimulate peak load reduction.
- No single resident should be especially hard hit.
- Billing must produce sufficient revenues to service the buildingwide RTP account with the utility.

We turned to Gulf Power in Pensacola, Florida, for assistance with the internal rate design for apartments. The utility in northeast Florida, Gulf Power operates a time-sensitive electricity program that is achieving 10-15 percent electric cost reductions for area homeowners. We worked with Gulf Power to develop a time-sensitive pricing strategy for the apartments at 322 CPW.

[10] The Con Edison RTP tariff was in effect on a pilot basis from October 2001 through September 2003. It required buildings to participate for at least 12 months, which meant that buildings had to initiate RTP by October 2002 to meet the one-year provision. The building was not equipped to participate by that date.

We created initial internal rate schedules for summer (**Table 5**) and winter (**Table 6**), with low, medium and high-priced rate tiers. We also created a "critical" rate that would correspond to electricity curtailment events called by the NYISO. The critical rate would not be put into effect, however, until price signals and load control mechanisms could be installed in each apartment to alert residents of pending power emergencies. Increases or decreases in utility costs due to market fluctuations would be addressed through a simple kWh rate adjustment independent of individual patterns of usage.

Table 5. 322 CPW Summer Rates

PRICE TIER	UNIT PRICE (¢/kWh)	SUMMER WEEKDAYS	SUMMER WEEKDAYS
LOW	11.389	10 P.M.-10 A.M.	10 P.M.-10 A.M.
MEDIUM	17.955	10 A.M.-3 P.M., 9-10 P.M.	10 A.M.-10 P.M.
HIGH	36.48	3-9 P.M.	N/A
CRITICAL	91.2	as called	as called

Table 6. 322 CPW Winter Rates

PRICE TIER	UNIT PRICE (¢/kWh)	WINTER WEEKDAYS	WINTER WEEKENDS
LOW	9.99	10 P.M.-10 A.M.	10 P.M.-10 A.M.
MEDIUM	15.75	10 A.M.-5 P.M., 9-10 P.M.	10 A.M.-10 P.M.
HIGH	32	5-9 P.M.	N/A
CRITICAL	86	as called	as called

Feedback from the board of directors was integral to the process of developing rates. Board members had invested in new metering equipment based on the assumption that prices would remain relatively neutral. They were concerned about the impact on individual residents. We used actual individual apartment load profiles to calculate prospective charges under the new system, without factoring in potential response to RTP price signals. We found that half of the apartments would save an average of $6 per month under the new program. Half would spend an average of $6 more per month.

The board reviewed our findings for each apartment. The maximum monthly increase would be $17.60; maximum savings would be $23.40. Satisfied that no one would see a severe price escalation, the board endorsed the implementation of the time-sensitive rates. We offered to prepare periodic bulletins to educate and update residents on the project.

Integrating Demand Charges. Demand charges are not reflected in the NYISO day-ahead market, which only pertains to the generated energy portion of electric service. Charges for the half-hour of peak demand often exceed $20 per kW, representing 25-40 percent of a typical bill. During summer months, demand charges in a master-metered multifamily building may exceed the cost of consumption.

Apartment buildings typically peak later than the day-ahead market, which is driven by the load profile for the entire city. In summer months, New York City peaks between 3 P.M. and 7 P.M. when commercial and transportation sectors peak and residents return home to switch on their air conditioners. Residential use continues to climb, peaking from 7 P.M. to 9 P.M. **Figure 1** contrasts the 322 CPW load profile with price patterns of the NYISO day-ahead market on an average weekday in November 2002.

To signal residents to shift discretionary usage, we assigned the highest prices to the 3 P.M. to 9 P.M. tier, which encompasses the highest prices in the day-ahead market and is the period in which the building's demand typically peaks.

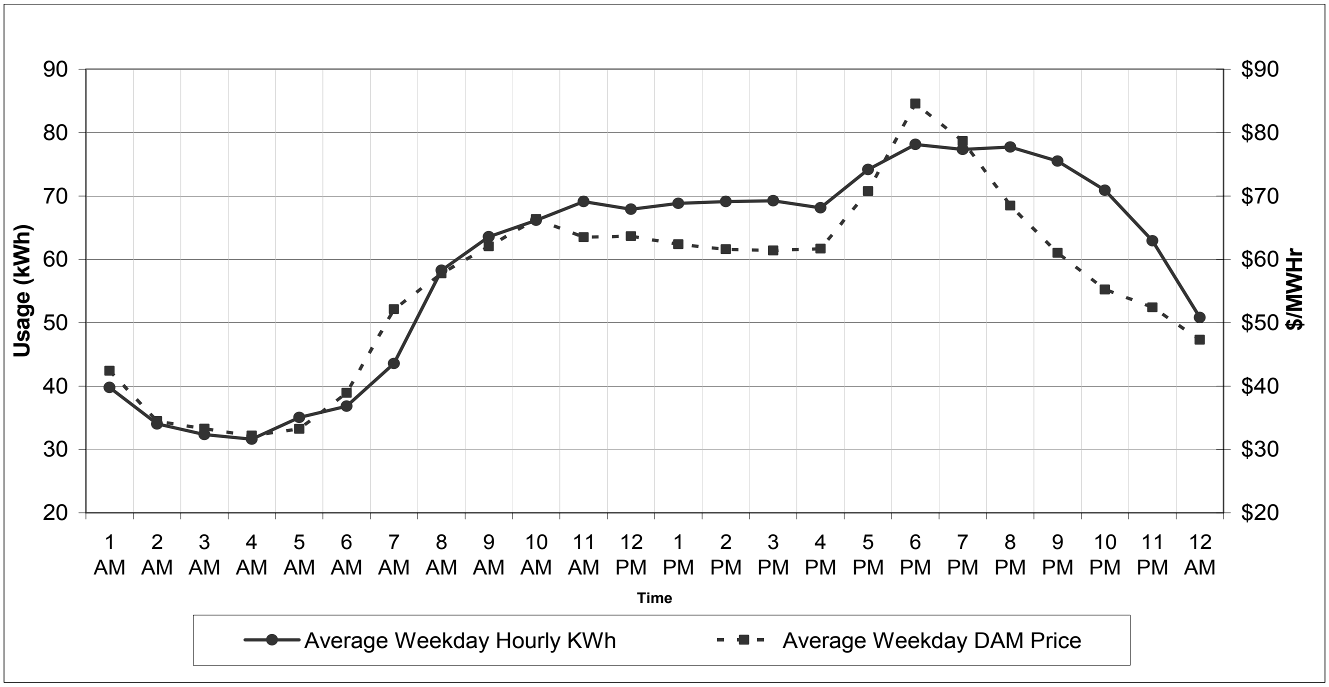

Figure 1. Average Weekday Usage (kWh) and DAM Prices in November 2002

A 9-10 P.M. Rate Oasis. In the original Gulf Power design for 322 CPW, the high-priced rate tier extended until 10 P.M., when low prices began. Upon review, we decided to roll back the high-priced period, which penalized residents with earlier bedtimes, especially families with school-age children who may not be able to delay some electricity-consuming activities. Instead, we instituted a one-hour moderate-priced "rate oasis" from 9 P.M to10 P.M. At half the cost per kWh of the high rate, the moderate rate was still a strong incentive to delay activities until 9 P.M. when demand charges are less likely and day-ahead energy prices are lower.

Weekend Rates. The high rate tier is omitted on weekends. A great deal of commercial activity ceases with the work week, keeping DAM prices low. Multifamily buildings rarely peak during weekends.

Implementing Internal Time-sensitive Rates

When we instituted the project in October 2003, we paid attention to any disproportionately high rates for individuals. Complaints might lead the board to halt the project. So far, RTP rates had been considerably lower than previous conventional rates. This was, however, the first time Con Edison had provided RTP service and we wanted to be sure the utility had not undercounted its charges.

We were cautious for the first three months. The amount that residents were billed according to rate tiers exceeded the actual buildingwide RTP. The building banked the surplus as a contingency reserve. This was fortuitous, since a bitter winter caused rates on the day-ahead market to soar. At the same time, Con Edison recalculated its bills back to October, at a higher, albeit anticipated, rate. The building was able to call on its reserve and, with only a slight adjustment of one bill, balance building costs with revenues collected from its internal rate schedule.

The next step was to assess the building's overall response to the price signals embodied in the tiered rates. Had rate tiers caused residents to change their electric-consuming habits in favor of lower-cost time periods? There had been no resident complaints and no direct feedback from the building's board of directors or property manager, but we were not able to tell whether that was due to acceptance or apathy. Perhaps an upper-income demographic was impervious to changeable electricity prices. We conducted additional analysis to evaluate resident demand response.

Demand Peaks Before and After RTP. Demand is a vital component in the price of power to multifamily buildings. It is not, however, a simple concept for consumers to understand. **Figure 2** was distributed as part of our efforts to explain and underscore the importance of peak demand reduction to residents. It compares monthly peaks for October 2002 through January 2003 before RTP with the same months a year later, after the adoption of RTP and internal time-sensitive rates. The post-RTP decrease in demand was significant.

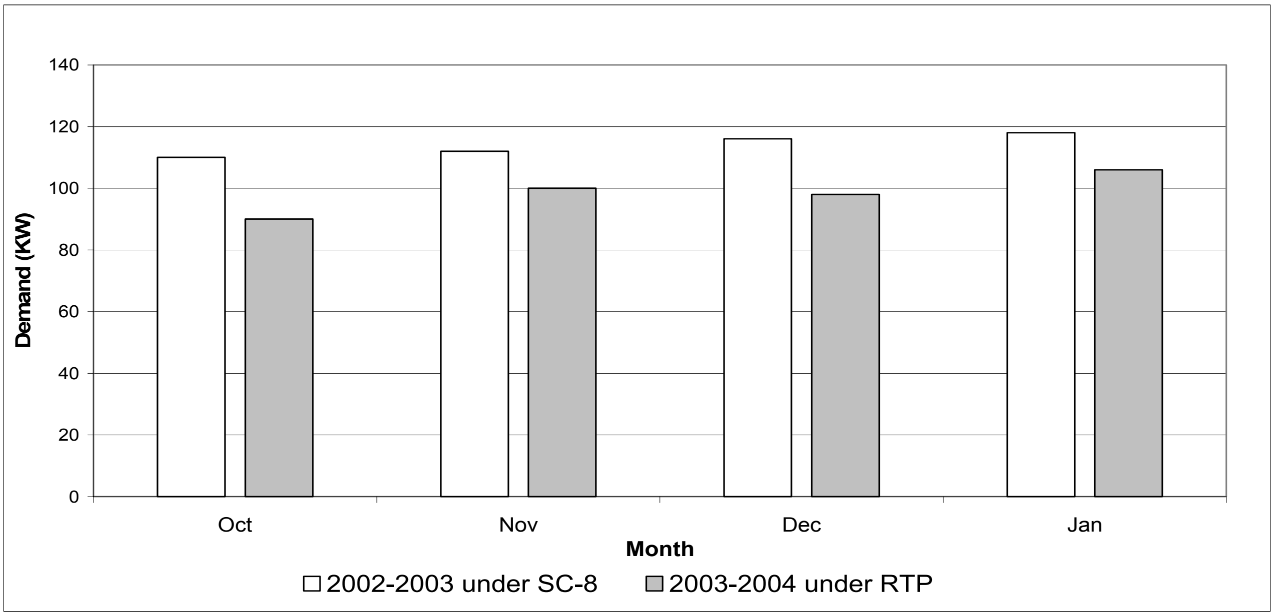

Figure 2. 322 CPW Demand (kW) Before and After RTP

Demand/Consumption Ratios. By shifting usage and "flattening" the peak, a building can pay less for equivalent electric consumption. A lower ratio of demand to consumption determines the aggregate price and is a contributing factor for overall lower electric charges. **Table 7** divides kWh consumption by demand for the same four months, before and after RTP. In each of the first four months of RTP, the ratio of demand to consumption improved markedly over the previous year.

Table7. Demand/Consumption Ratio Before and After RTP

	2002-2003 SC-8 Electric Bill				2003-2004 RTP Electric Bill			
Month	**Demand (kW)**	**Use (kWh)**	**Bill ($)**	**kW/kWh**	**Demand (kW)**	**Use (kWh)**	**Bill ($)**	**kW/kWh**
Oct	110	41,000	7,160	0.00268	90	37,680	5,489	0.00239
Nov	112	46,940	7,500	0.00239	100	47,280	6,582	0.00212
Dec	116	43,150	7,248	0.00269	98	44,640	6,640	0.00220
Jan	118	49,670	6,992	0.00238	106	46,080	8,740	0.00230

Time-Sensitive Usage. In July 2002 the building installed an advanced interval master meter that allowed us to record buildingwide time-of-use data in advance of the implementation of time-sensitive pricing. We compared data for the same four pre-RTP months, October 2002 through January 2003, with usage under the time-sensitive pricing plan a year later. **Table 8** indicates the percent of kWh consumed during each rate category before and after RTP; **Table 9** shows the percentage of change in each rate tier.

Table 8. Percentage of Consumption by Rate Tier Before and After RTP

Month	Low	Med	High
Oct-02	40.99	36.26	22.75
Oct-03	40.46	36.50	23.04
Nov-02	39.35	44.81	15.84
Nov-03	39.36	44.62	16.02
Dec-02	40.19	43.55	16.26
Dec-03	40.24	44.97	14.79
Jan-03	40.25	44.07	15.68
Jan-04	40.29	43.74	15.97

Table 9. Percentage of Change by Rate Tier under RTP

Month	Low	Med	High	Total
Oct	-1.30	0.66	1.28	0.22
Nov	0.02	-0.43	1.15	0.25
Dec	0.14	3.25	-9.05	-1.89
Jan	0.10	-0.75	1.83	0.40

There was no significant change between usage in low, medium and high tiers before and after implementation of time-sensitive rates during the first four months of RTP billing.

Initial Results/Adjusting the Schedule

The analysis of the first four months under RTP was inconclusive. Despite actual price savings, we were not sure why they occurred. Residents had not objected and the board had not complained. Industry reports on the price elasticity of demand warn that it takes time for consumers to respond to price signals. Impatient to see results, in February 2004, we decided to increase the price differential between categories (**Table 10**).

Table 10. Adjusted Weekday Rate Schedule

	Old Rates		New Rates	
Tier	**Cost (¢/kWh)**	**Time Period**	**Cost (¢/kWh)**	**Time Period**
Low	.0994	10 A.M.-10 P.M. (12 hours)	.09	10 P.M.-1 P.M. (15 hours)
Medium	.1575	10 A.M.-5 P.M. 9-10 P.M. (8 hours)	.14	1-5 P.M. 9-10 P.M. (5 hours)
High	.32	5-9 P.M. (4 hours)	.4350	5-9 P.M. (4 hours)

Although the new rates would be neutral if residents maintained their existing usage patterns, they provided stronger incentives for residents to adjust their usage to off-peak hours. Low and moderate rates were reduced slightly. The low period was extended three hours, from 10 A.M. to 1 P.M., providing residents more time to perform household tasks like laundry, vacuuming and ironing at considerable savings. To capture the attention of residents, the high rate was increased 35 percent, making it four-and-a-half times the low rate and three times the medium rate.

Findings of One Year on Real-Time Pricing

In October 2004 we undertook a 12-month assessment of RTP at 322 CPW. Our evaluation is limited in several respects. The relatively small number of units and lack of a moderate-income control building prevent a meaningful elasticity analysis. Because this is the first multifamily RTP program anywhere, we cannot place our experience alongside those of other buildings. In addition, it is beyond the scope of this project to factor in variables such as climate, economy and demographics.

Figure 3 depicts the actual buildingwide rates paid in the building's first year of Con Edison RTP service. They are charted against rates for prior conventional SC-8 service and SC-1 rates for direct-metered apartments. The electric rate for the building's RTP service was lower than the other rates in all but January and August, when high heating and cooling demand forced DAM prices to rise.

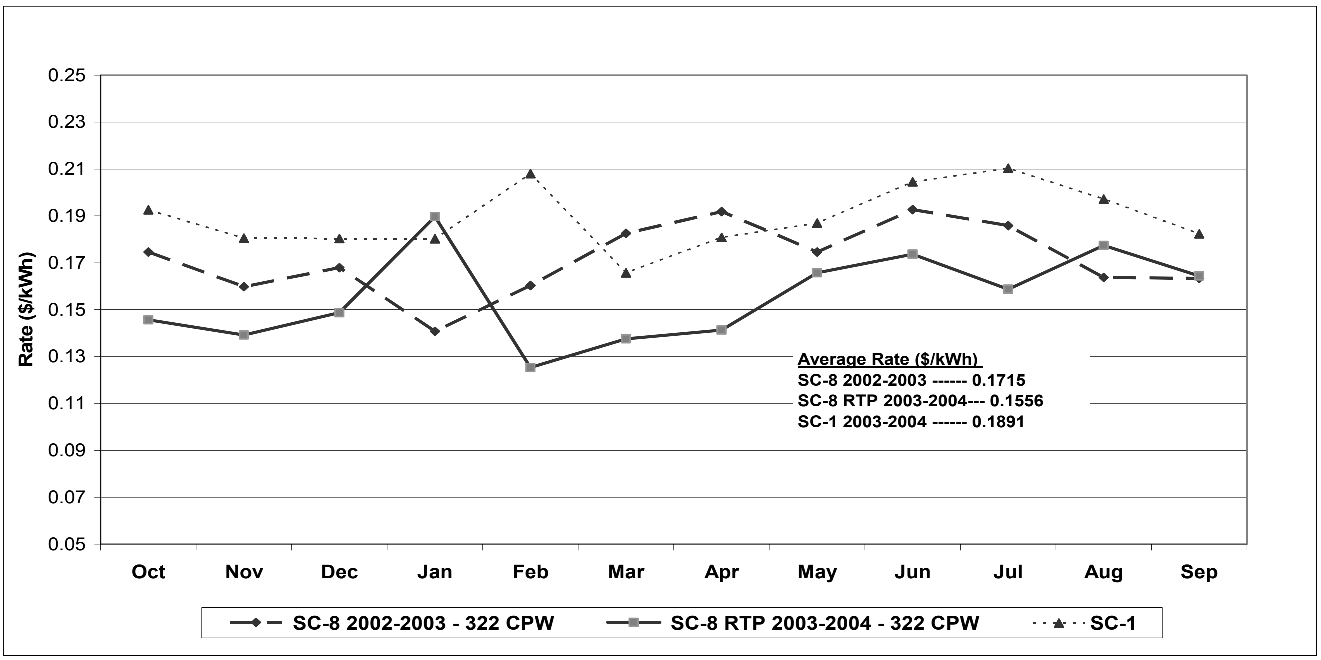

Figure 3. 12- Month Electricity Rate Comparison for RTP, SC-8 and SC-1

Among our key findings:

- The average RTP rate was 15.56¢/kWh, 9.27 percent lower than the previous year.
- No resident paid more than the direct-metered SC-1 rate, as mandated by the PSC's submetering regulation
- When adjusted for usage, the building saved more than $10,000, including $3,000 on public spaces.
- Almost half the residents saved more than $100 during the year and almost a quarter saved more than $200.
- Only four apartments of forty-eight apartments paid a slightly higher rate than the previous year, with the highest annual increase only $10.

Before and After Real-Time Pricing During Summer Months

The impact of RTP signals at 322 CPW is best assessed by comparing pre- and post-RTP consumption during the cooling season, when electricity in New York City is most scarce and expensive. We compared July and August 2003 consumption, before RTP implementation, with RTP consumption in July and August 2004.

Overall consumption decreased 5.22 percent from July 2003 to July 2004 after the new rates were in effect. Usage declined in all categories, but consumption in the high and medium-priced rate periods declined at more than three times the rate of the low period (**Table 11**).

Table 11. Usage (kWh) at 322 CPW in July 2003 and July 2004

Month	Low	Med	High	Total
July 2003	31,903	17,021	10,702	59,627
July 2004	31,098	15,536	9,880	56,513
Difference	-806	-1,486	-822	-3,113
% Change	-2.52	-8.73	-7.68	-5.22

In July 2004, consumption in moderate and high-priced periods made up smaller percentages of total consumption (**Table 12**).

Table 12. Percentage of Consumption by Price Tier

Month	Low	Med	High
July 2003	53.50	28.55	17.95
July 2004	55.03	27.49	17.48
Difference	0.015	-0.011	-0.005
% Change	2.85	-3.70	-2.60

The gap between pre- and post-RTP consumption widened in August (**Table 13**). August 2004 consumption decreased by more than 13 percent and consumption in the high-priced hours decreased nearly a third more than in low- and medium-priced hours.

Table 13. Usage (kW) at 322 CPW in August 2003 and August 2004

Month	Low	Med	High	Total
Aug 2003	29,609	14,301	10,484	54,394
Aug 2004	25,902	12,500	8,800	47,202
Difference	-3,707	-1,801	-1,683	-7,192
% Change	-12.52	-12.59	-16.06	-13.22

As a consequence, consumption in the high-priced period in August 2004 shrank 3.2 percent to comprise a smaller percentage of total consumption than in August 2003 (**Table 14**). We acknowledge that heightened energy awareness leading to the use of more efficient appliances and lighting may be an additional contributing factor to the decrease.

Table 14. Percentage of Consumption by Price Tier

Month	Low	Med	High
Aug 2003	54.43	26.29	19.27
Aug 2004	54.87	26.48	18.64
Difference	0.004	0.002	-0.006
% Change	0.81	0.73	-3.27

These early results show that buildingwide consumption patterns are changing in line with the internal rate tiers instituted through the building's RTP program. Subsequent analyses subtracted public space usage to determine the extent to which residents had changed discretionary usage patterns within individual apartments. They revealed a similar pattern of reduced usage in medium- and high-priced rate periods, indicating that individuals are gradually adapting consumption patterns to price signals.

Sharpening Price Signals and Gauging Response

Encouraged by initial price response, we set about providing residents more information about their consumption. Previous maintenance bills summarized electricity costs on a single line indicating kWh used and total cost. In July 2004 we proposed a four-line RTP-based insert to show residents what they were paying in each rate tier (**Figure 4**). It was designed to reiterate price signals at a glance.

Tier	Usage (kWh)		Rate	Cost
Low	363	x	$0.09	$32.67
Medium	156	x	0.14	21.84
High	68	x	0.44	29.58
Total	587			$84.09

Figure 4. Sample RTP Electric Bill

Management software could not, however, accommodate the information. Instead, management offered to insert a separate page for electricity charges. This allowed us to create a more informative module that includes the percentage of kWh consumed and costs attributable to each rate tier. Thus, our sample bill could be expanded to note that the high period accounts for 12 percent of usage but a full 35 percent of costs. We added a graphic (**Figure 5**) to reiterate current rates .

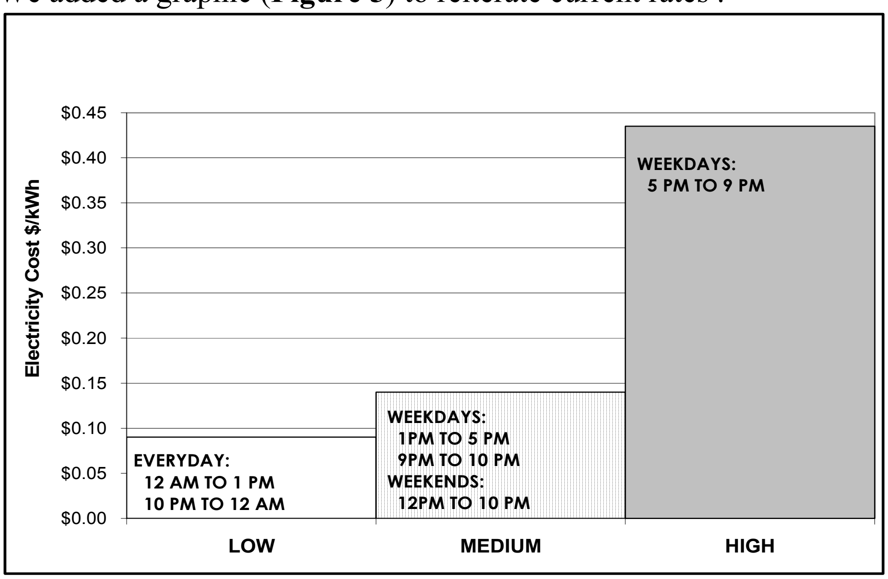

Figure 5. Winter Rate Schedule October 2003-May 2004

In June 2004, we introduced residents to a new summer rate schedule through their monthly bill. Prices were increased slightly to reflect higher summer wholesale prices. The gap between high rates and low and medium rates was widened. We recalibrated the high-priced tier to start at 3 P.M. rather than 5 P.M., two hours earlier than in winter, to help offset earlier system peaks due to commercial air conditioning use. We eliminated the high rate on Friday nights in the summer when many residents are away for the weekends and peaks do not occur.

In March 2005, we added a new tool, the Kwit Evaluation Index^SM (KEI^SM) to help residents gauge how much they are saving from month to month and in comparison with the building as a whole. The KEI^SM rating, which ranges from 2 to 10, is determined by the pattern of electric usage. The higher the KEI^SM rating, the greater the savings. The KEI^SM rating is figured through a simple formula. Kilowatt hours consumed during the low-priced period are multiplied by 10, kWh consumed in medium-priced hours by 7, and usage in high-priced hours by 2. Total points are divided by total monthly kWh. **Table 15** calculates the KEI^SM rating for an apartment using 851 KWH in February 2005. **Table 16** figures the average apartment KEI^SM rating for the month.

Table 15. Sample Apartment KEI^SM Rating

Price Period	Points		KWH Used		
Low Usage	10	x	540	=	5,400
Medium Usage	7	x	222	=	1,554
High Usage	2	x	89	=	178
					7,132 ÷ 851 kWh = 8.38 KEI^SM Rating

Table 16. Building Average KEI^SM Rating

Price Period	Points		KWH Used (all apts.)		
Low Usage	10	x	16,850	=	168,850
Medium Usage	7	x	9,994	=	69,958
High Usage	2	x	3,358	=	7,076
					245,884÷30,382 kWh = 8.09 Ave KEI^SM Rating

Patent protection is being pursued for the Kwit Evaluation Index^SM.

Conclusion

The 322 CPW RTP project has demonstrated positive results for nearly all residents. More than half appear to have seized the opportunity to save by adjusting consumption patterns according to price signals. A significant number saved over $200 in the first year. Furthermore, by lowering demand in the summer months, residents are helping meet the PSC to meet its energy objectives for the state.[11]

Yet despite early positive results, we cannot guarantee the level of savings that would induce most buildings to make the investment required for RTP. There are risks associated with real-time prices if market rates soar during heat waves and resident response is insufficient. The summers of 2003 and 2004 were unseasonably cool. The effect of prolonged higher real-time prices has yet to be felt. How 322 CPW would react and its residents collectively respond to a heat wave would help subsequent candidates determine if RTP electric service is feasible for them.

More comprehensive assessment is also needed to determine long-term impact. We will monitor results at 322 CPW as we continue to refine the RTP structure and communications. At the same time,

[11] We acknowledge that a growing sense of social responsibility among residents to help reduce blackouts and pollution may be a contributing factor in changing electric consumption patterns.

we are expanding our study to buildings with different demographics, which will help place the building's results into a broader context.

In the meantime, we continue to assist residents at 322 CPW to assimilate price signals and maximize savings by modifying billing structures, adding additional user-friendly ways for residents to assess their performance and identifying ways to signal apartments directly about prices. We are investigating technology to provide residents with price signals and more immediate feedback than the monthly bill permits. Under consideration are an orb that glows a different color during each price period, a digital display panel with data and colored lights, and online access to individual electricity and cost information. We also plan to implement an automatic response capability to respond to ISO curtailment events.

Despite the societal benefits of RTP, including increased electric reliability and reduced usage of inefficient power plants, robust government support for equipment and analysis is needed if a time-sensitive electric paradigm is to achieve widespread acceptance in the multifamily housing sector. We will continue to participate in an alliance of housing, industry, government and financial sectors to unite resources in this effort.

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Many people contributed time and effort to the 322 CPW project. The PSC assisted us each step of the way, beginning with Paul Powers who led New York's effort to institute retail competition and require utilities to make RTP available to consumers. Jim Gallagher continues to facilitate meaningful RTP and load shedding demonstrations statewide. Harvey Arnett and Steve van Cook assisted our rate analysis; Bill Saxonis lent his diligence, patience and professionalism to the preparation of this paper.

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The EIS team never wavered in commitment, creativity and persistence, with Jack Woolams providing institutional and technical expertise, Cristina Villegas conducting the extensive rate analysis and rate modeling, Dick Lam addressing policy issues, and George Masters and Lani Kennedy helping to pull the results into a coherent case study.

The cooperative board of directors looked beyond parochial financial concerns to grasp the potential benefits of RTP for the building and society. The leadership of Peter Funk, plus his energy, expertise and exuberance, were essential.

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