

Real Time Pricing and the Real Live Firm

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ABSTRACT

Energy economists have long argued the benefits of real time pricing (RTP) of electricity. Their basis for modeling customers' response to short-term fluctuations in electricity prices are based on theories of rational firm behavior, where management strives to minimize operating costs and optimize profit, and labor, capital and energy are potential substitutes in the firm's production function. How well do private firms and public sector institutions' operating conditions, knowledge structures, decision-making practices, and external relationships comport with these assumptions and how might this impact price response? We discuss these issues on the basis of interviews with 29 large (over 2 MW) industrial, commercial, and institutional customers in the Niagara Mohawk Power Corporation service territory that have faced day-ahead electricity market prices since 1998. We look at stories interviewees told about why and how they respond to RTP, why some customers report that they can't, and why even if they can, they don't. Some firms respond as theorized, and we describe their load curtailment strategies. About half of our interviewees reported that they were unable to either shift or forego electricity consumption even when prices are high (\$0.50/kWh). Reasons customers gave for why they weren't price-responsive include implicit value placed on reliability, pricing structures, lack of flexibility in adjusting production inputs, just-in-time practices, perceived barriers to onsite generation, and insufficient time. We draw these observations into a framework that could help refine economic theory of dynamic pricing by providing real-world descriptions of how firms behave and why.

Introduction

Electricity restructuring, as scepter and fact, has yielded a considerable body of energy economics literature promoting dynamic or real time pricing of electricity (RTP) for retail customers as an essential link to achieving competitive wholesale markets, while offering a host of system benefits (Borenstein et al. 2002; O'Sheasy 2003). These system benefits accrue only if some customers are willing, able, and motivated to sufficiently adjust their load in response to time-varying prices. We will be concerned here only with the response of commercial, industrial, and institutional sectors. While some studies point to successful *aggregate* reductions, insofar as the RTP literature goes, knowledge about day-to-day practices of firms with respect to real time prices has not been extensively reported, in part because of confidentiality concerns and limited evaluation efforts (Barbose et al. 2004). When economists model customer demand for electricity, they typically assume that firms strive to minimize operating costs toward optimizing profit. Firms are assumed to first determine the amount of all inputs required (e.g., labor, capital, electricity aggregate) and then determine what quantity of peak and off-peak electricity to use to achieve that aggregate. Under such an ideal, firms find ways to shift or forego load in response to increases in electricity prices, as long as doing so saves more than it costs, considering the value

of lost production or service amenity as well as the transaction costs of responding.¹ But how many companies fit this ideal, or to put it another way, how would firms envision and act on these cost functions? Moreover, electricity customers have been collectively trained on and formed by a century of primarily flat, fixed rates, or otherwise predictably-priced power. Customer views on electricity service and pricing, as well as business practices, reflect this history. Given this long training, what would it take to get customers to respond to varying, hourly prices, how much change can be expected, and with what other effects?

How might particular operating conditions, knowledge structures, decision-making practices, expectations, and external relationships comport with assumptions used to model price-responsive load, and how might this impact price response? How does the electricity market look from the customer's point of view? We examine these questions on the basis on interviews with facility and energy managers from 29 large customers in the Niagara Mohawk Power Corporation (NMPC) service territory that have faced day-ahead electricity market prices since 1998. These customers, which span industrial, commercial, and public sectors, and are a subset of the approximately 130 New York businesses that were the first in the nation to face RTP as a *default* rather than voluntary tariff. Each of the interviewed customers had previously answered a questionnaire surveying firm characteristics, response capabilities, supply choices, etc. We used these responses as the starting point for interviews, during which we strove to understand the stories interviewees told about why and how they respond to RTP. As it turned out, about half of the survey respondents indicated that the firms they worked for could not curtail load. From a top-down perspective, the no-can-do comments represent customer inertia, but it is time to look closer at the realities of firm operations. Our interviews, backed with survey data earlier collected, provide a basis for turning the spotlight on firm-level issues and experiences.

We have two objectives in this paper. First, we want to describe and interpret key results from our interviews, with the goal of exploring the above questions concerning what firms “think” and do when faced with RTP as their default service tariff. Second, we want to explore several methodological issues related to assessing the success and impacts of RTP. We highlight and assess our experiences with utilizing in-depth customer interviews as a complement to traditional methods of modeling customer demand for electricity. How can we use what customers say, both for the sake of building understanding, as well as for improving economic models and energy policy? The problem highlights the challenges of cross-disciplinary analysis. We provide a brief description of the study background and approach, leaving most details and accompanying study results (such as elasticity estimates) to other publications (Goldman et al. 2004). We then summarize and analyze interview results concerning basic customer characteristics, procurement choices and experiences, and price-responsiveness. Our results are more a beginning than an end, and conclusions explore methodological implications, and abstractly, some questions for policy.

¹ This statement intentionally leaves aside the allusion to many other complicating issues: the size of the signal, the nature of the response function relative to price signals, possible long-term effects, strategic responses, etc.

The Study

NMPC's SC-3A tariff represents the first large-scale application of RTP in a competitive retail market in the U.S.² NMPC is located in upstate New York. The SC-3A rate had been the utility's standard offering to their largest customers, those with metered peak demand greater than 2 MW. Since the early 1980s, it had been a time of use (TOU) rate. A revised SC-3A tariff was adopted in November 1998, at the time of the state's electricity industry restructuring. The tariff separated commodity costs from transmission, distribution, competitive transition, and other charges. In fall 1998, SC-3A customers could choose among several options offered by the regulated utility and/or competitive suppliers. The default service tariff was SC-3A Option 1, in which customers pay hourly prices indexed to NYISO's day-ahead market. Customers could also elect to nominate some or all of their load under Option 2, a fixed-rate take-or-pay contract. This was an alternative, hedged standard offer made available to customers on a one-time election basis, just prior to the advent of retail competition. On this option, customers nominated monthly peak and off-peak demand blocks for a period of up to five years. Customers could also take commodity service from competitive suppliers. Starting in 2001, NMPC's SC-3A customers were also eligible to enroll and participate in several demand response (DR) programs offered by the NYISO. The most popular DR program, in terms of enrolled customers in our sample, was the voluntary Emergency Demand Response Program (EDRP). EDRP pays customers the greater of \$500/MWh or the prevailing real-time market price for curtailments of at least four hours long when called by the NYISO. There are no penalties for participants that fail to curtail.³

Five years after the RTP default service began, Lawrence Berkeley National Laboratory (LBNL) and Neenan Associates had the opportunity to examine the results through a multi-dimensional study utilizing billing data, a customer survey, and customer interviews. The study utilizes three layers of representation: the population of SC-3A billing accounts, a subset of the population represented by survey respondents, and a subset of survey respondents with whom we were able to conduct interviews. These customer interviews, and the perspective they provide, are the foundation of this paper. NMPC provided billing information on 141 customer accounts, together representing 130 distinct organizations. We will call these organizations "firms," though they include public institutions as well as private ones. We invited each firm to participate in a written customer survey, which was administered primarily through a World Wide Web (WWW) form. NMPC provided contact information for individuals at each firm who appeared to be best able to complete the survey, and urged customers to participate and respond to the survey. The survey was administered over a six-week period in 2003 (August 1 through September 18). Fifty-three customers responded, accounting for 41% of the target population. The questionnaire asked for volunteers for follow-up interviews, and 29 of these volunteers were interviewed. All but three of these interviews were conducted by phone. Interviews were short, lasting an average of 20-25 minutes, though some lasted as long as an hour. From a sociological perspective, the effort is modest. But in the RTP literature, there appears to be no similar set of interviews.

A semi-structured approach was used, focusing primarily on understanding *why* particular customers responded, performed, and chose as they had indicated in their written survey response. While this provided supporting information for the survey results, it also

² The SC-3A default tariff (Option 1) is an hourly day-ahead market (DAM) pricing program; customers pay for their commodity usage based on the forecasted hourly DAM price.

³ NYISO also offers a Day-Ahead Demand Response Program (DADRP), and a capacity call program, Installed Capacity Special Case Resources (ICAP/SCR) program.

provided the opportunity to explore customers' responses and choices with respect to RTP, framed when possible in their own terms. Herein lies a critical challenge. The underlying assumptions and customer decision-making framework that drive results obtained from customer demand models are often not easy to combine or reconcile with the ethnological approach embodied in interviews. The perspectives, methods, and frameworks of the economic and ethnological approaches do not naturally align. However, one may be able to find ways to translate findings between one field and the other. Doing so is slow work, but we begin it.⁴

In each interview, customer commentary was elicited, as captured in quotations and stories concerning issues central to the implementation of RTP. The strength of such story-centered descriptions is their ability to highlight path dependencies and causal or at least functional relationships, often distinguishing themselves from normative models. That is, stories are often told because they illustrate a point that needs illustration, in distinction from what would be otherwise assumed. Overall, there was enormous diversity and variety of customer experiences as represented by their "stories," emphasizing their distinctive and sometime unique situation, and away from simple notions of normativity. Presenting, using, and learning from these stories is not easy. First, interesting stories are often closely linked to particular characteristics of a customer (e.g., load response capability may be influenced by the specifics of industrial processes, load shapes, or labor inputs). Because of the need to protect customer confidentiality, however, such details cannot be revealed. Many stories thus lose the essential drivers to their plots. In sum, almost every customer has a special situation; we just can't say what it is. Even so, stories in generic, summarized form are included. A second trouble spot is the reputation and normal fate of anecdotes in analytical literature, in the energy as well as other policy fields. In the energy field, from time to time one hears interesting anecdotes, sometimes the same theme over and over again, yet in general such anecdotes have little analytical import. In part this is because anecdotes have no conventional basis for substantiation or representation. Moreover, it is the nature of much customer commentary to be expansive ("consider this..."), critical, or contrarian. Politics are such that this also renders certain commentary vulnerable to dismissal or to being viewed as attack, rather than a tool for reconstructing or elaborating on models, or suggesting directional shifts. Third, customers may provide answers that are "strategic" in the sense that they support their perceived interests or concerns in the regulatory process (e.g., customers may say that they can't shift load if they believe that the regulators may institute a tariff that mandates them to do so). This issue is dealt with by reporting what customers say, rather than to assess these comments as objective facts. Fourth, much of the import of interviews comes not from what is said directly, but from implication — especially, trying to visualize the interviewee point of view rather than to pick out only what can be easily translated. In writing this paper, we try to make it clear which of our statements are relatively speculative or impressionistic.

Results

Firm and Interviewee Basics

Table 1 summarizes the distribution of business types comprising the SC-3A billing accounts that are the target population, and for the subset of customers with whom interviews

⁴ Asad (1994) and Flyvbjerg (2002) provide particularly useful philosophical discussions as to the balance of quantitative and qualitative approaches in policy fields.

were conducted. Manufacturing firms, generally considered to be the business type with the best potential for price-responsiveness, constitute 32% of the target population and the population's combined load. Among the 53 respondents to the survey, 21% were manufacturing firms for which batch processes were a substantial part of the load — batch processing being a firm characteristic thought to be favorable condition for price-responsiveness. Relative to the population, the subset interviewed had a higher proportion of educational customers and a lower proportion of institutional customers.⁵ As to job titles of the 29 interviewees, about 17% of survey respondents were energy managers, 33% were facility managers, with the remaining 50% other engineering or management titles.

Table 1. Business Types in the SC-3A Population

<i>Firm Type</i>	<i>Percentage of SC-3A Tariff Population (by billing account, n = 149)</i>	<i>Percentage of Interviewees (n=29)</i>
Manufacturing	32%	34%
Commercial	23%	17%
Education	16%	28%
Institutional	32%	21%

When asked how much time each spent on energy procurement and energy management, the answer was often “not much.” Though it approaches a tautology, one might say that the more important energy is to a firm, the more likely they will have somebody dedicated to attending to it. Certainly some interviewees were intimately involved. But plenty of firms on RTP rates said they looked at their bill at the end of the month, and rarely if ever examined the next day's posted RTP prices; some referred to RTP simply as a TOU rate for general electric service. Nor, as some of our interviewees reminded us, is all the control necessarily in one set of hands — as to procurement, for example, there may be boards, approvals, time constraints, and budgets to plan around, especially for the public sector. When asked about their energy costs over the past years, nearly all interviewees reported that costs had gone up. Most cited price increases as the reason. For quite a few firms, there had also been substantial expansions or reductions in operations over the past five years. That is, businesses can change considerably over just a few years. Such changes confuse the internal issue of tracing energy costs or accounting for savings, and certainly affect the decision environment with respect to long-term energy-related plans. Incidentally, many interviewees mentioned concerns with rising, and increasingly volatile, natural gas prices in New York.⁶

There is one more general consideration worth bearing in mind. Interviewees may have been more interested in or dedicated to energy management than those who didn't return the survey or volunteer for an interview. However, containing energy costs is probably rarely the paramount element of the firm's activities. We heard it stated point-blank from several interviewees: “You've got to understand. We make widgets. That is what we do” and “We're in the education business, not the energy business,” and “We turn off chillers and lights sometimes,

⁵ Since we are not drawing statistical conclusions from the interview data, the differences in representation do not create particular problems for interpretation.

⁶ For a few, the natural gas situation appeared to be the most pressing energy management concern, not only for its potential impacts on electricity prices, but also from the standpoint of managing near-term and future gas commodity costs.

when we need to curtail. But when we get too many complaints from the workers, we turn them back on.”

Customer Choice and Market Offerings

Through the interviews, we explored customer’s decision-making processes and experiences with retail suppliers since 1998, focusing on their preferred types of supply arrangements, the choices that they have been offered, and their overall assessment and satisfaction with the competitive retail market. As to initial choices, 18% of survey respondents chose to contract for some load on Option 2. One of our interviewees, representing a manufacturing firm, commented: “It’s a one-man show for the whole facility. It was just easier to take that and not to worry.” Another, explaining why his company did not choose Option 2, said, “We didn’t understand it, and at the time, we were too busy to have time to look into it.” We have the impression that Option 1 was probably often less an active choice than a default that was either attractive or did not look unattractive enough to avoid — in order to have the freedom to take advantage of what the newly-opening competitive market might provide, or because of familiarity with NMPC as the regulated utility. Several customers likened electricity restructuring to the breakup of AT&T. One (a customer that had been quite creative) stressed the importance of trust: “People want something nice and reliable for their electricity. I don’t know suppliers.” We certainly heard a few competitive-supplier horror stories referenced. One bad experience with an energy service company (ESCO) might result in substantial skittishness.⁷

About 45% of the interviewees seemed satisfied with their retail experience. The most satisfied companies tended to be larger industrial companies with relatively flat loads or institutional sector customers that had successfully aggregated their loads among several facilities. In addition, about 15% of interviewees mentioned that they were particularly satisfied with NMPC rates that they had elected (e.g., Option 2). However, nine interviewees mentioned that they were dissatisfied with either the type or pricing of supply offers, while six interviewees indicated that they had received few or no supply offers from retail suppliers. Some had actively sought suppliers but said that, despite considerable effort, they had been able to get only few or even no offers (due to relatively small load or to unfavorable load shape, for example); two had ESCO contracts but were dropped without warning. One thing the interviews made clear was that this could be an emotional topic. Several interviewees voiced frustration or resignation: “nobody is interested in our load,” and “there is no competitive market.” Such customers saw, or felt, no choice. Two mentioned that they wanted an ESCO who would provide creative (as opposed to routine) efficiency or energy management services, but could not find one.

Customers also cited other reasons for not taking service with a competitive supplier, or that made taking service relatively difficult. Some institutional customers had to pass their supply decisions through a multi-stage approval practice. For example, one interviewee from a government institution said that contract approval would take a year — perhaps not impossible but not well suited to the pace of supply offers. One private company mentioned another form of risk: to take a competitive supplier, which involves an active choice rather than accepting the default, was to expose oneself to criticism from those who pay costs. Savings may not be visible on their own, but costs are. For a few companies, supply decisions were made elsewhere, for example at headquarters located out of state. In sum, such comments — no suitable offers available, administrative issues that make contracting difficult or time-consuming, risk-aversion

⁷ In New York, retail energy service providers are referred to as ESCOs.

— may explain why many customers that are unhedged also indicate that they are not capable or interested in adjusting load in response to price.

Finally, though some customers saw an abundance of competitive suppliers in the earlier years, the activity seems to have slowed and the type of offers narrowed. Though not necessarily representative, the interviews suggested that recently negotiated offers tended to be rates that were indexed to DAM prices or SC-3A rates, where the main attraction to the customer were bill savings due to customer service backout credit and avoidance of certain local gross receipts taxes, which provide a discount that ESCOs typically share with customers that switch. One customer noted that, given observed volatility and future uncertainty, suppliers were clearly more skittish about offering fixed rate pricing for long terms, with the skittishness manifested by offers featuring relatively higher prices and shorter terms.

Price-Responsiveness

When asked what best characterized their company's ability to curtail load, about half of survey respondents said that they were unable to either shift or forego load.⁸ Many reported prices at which they might begin curtailment capabilities. However, the interviews suggest that in some cases this was a "theoretical" response rather than actual practice. Setting aside pricing aspects of the emergency response program (EDRP), five of our 29 interviewees appeared to be price-responsive based on their interview responses. We discuss these cases below. But first, why did so many customers who reported having little interest or ability in adjusting load in response to price remain on RTP rates?⁹ And why do they say that they can't respond?

Part of the answer to why customers remain on RTP rates or pricing stems from the findings of the supplier choice discussion above: some could not find an attractive alternative deal from a competitive supplier, or finding a supplier involved overcoming significant institutional hurdles. However, the question of "why don't you respond?" is in general a question that is very much from the perspective of policy-makers. For customers, the question may be, "why *should* we respond?" An abstract notion of possibly cost-effective curtailment on the margin is not necessarily a motivation in the real world. For some customers, the SC-3A Option 1 prices are just the price of electricity. These customers don't interpret time-varying rates as an implicit call to adjust their usage accordingly — even if they thought they could. As noted above, several mentioned they review their bill only at the end of the month and rarely if ever regarding price-variation. While in some cases the costs of price-responsiveness can be calculated, in many cases, lack of interest in response is probably based on an intuitive, informal, assessment of potential benefits as opposed to costs, rendered in complex judgment rather than translated to dollar figures.

Whether they were exposed to RTP-indexed rates or not, we asked customers who said they could not or would not curtail in response to prices to tell us their reasoning. We grouped their responses into four general categories, as follows:

⁸ About 35% said they were able to forego, and 15% said they could shift.

⁹ Sixteen said they couldn't respond, weren't on Option 2, and had never taken competitive supply — e.g., NMPC RTP. However, what about others on indexed rates? In fact, about 30% of survey respondents reported being on NMPC RTP rates but reported being unable to curtail load.

Schedules are not adjustable:

- Our industrial processes cannot be adjusted on short order, because of the nature of the processes, supply-chain considerations, or production obligations (e.g., industrial customers that utilize time-sensitive inputs or tightly scheduled delivery promises with little storage capability).
- Providing reliable and consistent service to our customers is our utmost priority (e.g., utilities, landlords, and some retail institutions).
- We cannot adjust labor inputs on short-order without paying a penalty (e.g., terms of union contracts).
- We can curtail, but not at the time when prices are likely to be high.

Savings would be insufficient:

- The adjustable portion of our load, and/or the importance of the commodity portion of our electric bill relative to total electricity costs, is too low to make the benefit worth the costs.
- Worker complaints render regular exercise of curtailments of lighting, cooling, etc. loads unattractive.

No time, no interest, skepticism, and frustration:

- We don't have staff available to attend to monitoring prices or to managing daily load when prices would dictate that we do so.
- We want to focus on our core business, not on energy management.
- Even if we figured out a way to reduce costs, a new charge or other change would erase these savings. We don't trust this situation.
- We're frustrated by regulations that prevent us from making other business decisions where we could save money, such as using onsite generation.¹⁰

Interest, but insufficiently prepared:

- We would like to be responsive, but we have not figured out how.

Reportedly Price-Responsive: How and Why?

Five of the 29 interviewees indicated that they are price-responsive and described their decision-making criteria and/or approach. Of these, two facilities were educational institutions and three were industrial customers. The facility managers at the educational institutions indicated that they had flexibility to control and manage usage, particularly during holiday and summer breaks or slow periods, because many buildings were nearly unoccupied and were thus easy targets for shedding load through centrally coordinated measures. The willingness to experiment and try new approaches to managing energy use (a perspective consistent with the academic "culture" of their educational institution) combined with support from budget-

¹⁰ This theme is an example of a response that might be considered relatively strategic on the part of the customer.

conscious senior management also was evident in the thinking of these energy managers. In a Duke Power study on a voluntary RTP rate, a university had by far the highest estimated elasticity among the 110 customers analyzed (Schwarz et al. 2002). Though educational institutions do not fit the conventional model of a firm best suited to price-response (e.g., a profit-oriented industrial with interruptible batch processes), they may sometimes be able to provide considerable price-response.

One of the industrial customers had a batch process type operation. This customer indicated that they were sensitive to prices over a 24 hour period (rather than just 1-2 hours) and that they would curtail and/or shift usage for a sustained period of time (several hours to days) if prices went over their price threshold. Another industrial customer reported that they were willing to adjust office loads in response to time-varying prices. They also indicated that they also curtailed process loads in response to an ISO DR system event (e.g., EDRP), but that they were not interested in curtailing process loads in response to RTP, given the fact that any curtailment resulted in foregone production. The third industrial customer operated their facility using hourly electricity prices as an important consideration in their scheduling and operations. They indicated that they tried to have inventory stored, to cover variations in production schedule and product demand. This customer had significant flexibility as to the timing of production and could shift load to off-peak hours. However, they noted that if demand for their product was high or they had a tight delivery deadline to meet, they would not reduce electricity consumption no matter what the price.

Emergency Response, but not RTP

About 40% of interviewees indicated that they were enrolled in the NYISO emergency DR programs – primarily EDRP. Others indicated that they sometimes curtail when asked, even though they are not enrolled in DR programs.¹¹ Either way, such emergency-linked responses suggest that many firms can and do curtail load on short notice. A number of interviewees provided insights as to why facilities that are willing to curtail load in response to declared emergencies would not be willing to do so in response to RTP signals.

- “We’ll respond when asked, otherwise we’re not watching.”
- “We respond because it benefits the community, as well as having some advantage to our financial bottom line.”
- “EDRP payments make it worth our while, so we do it when we can, but RTP prices are not high enough.”
- “We can adjust our load from time to time, based on special arrangements between management and facilities, or between one plant and another, or based on the goodwill of workers who understand the short-term need to conserve in order to prevent blackouts, but we’re not interested in making a regular, profit-oriented, practice out of it.”

These responses suggest that an additional share of the customer base is willing to curtail load relatively infrequently, in situations where they are reacting to an emergency situation that is defined by a grid operator or governmental entity and for which they are paid higher prices (e.g., \$500/MWh floor payments). During the study period, EDRP floor prices were higher than

¹¹ The state government issued public appeals to minimize electricity use in conjunction with NYISO emergency DR program events.

the SC-3A RTP prices during high price periods (e.g., \$\$250-300/MWh). While EDRP carries no penalty for not responding (even while not all interviewees were aware of this), whatever the RTP price, customers on RTP rates must pay it. However, it was clear from the interviews that there was a considerable “good citizen” component to emergency-related curtailments. We surmise that there are at least two varieties of good citizenship: (1) public reputation — companies want to look good; (2) stewardship — doing one’s part to prevent power outages, for the good of the community as well as out of self-interest. Another consideration is the impact of load curtailment on the goodwill of employees, and the extent to which employee reaction depends on the reasons for the curtailment. According to our surveys, by far the most common strategies for load curtailment were asking employees to reduce usage, turning off or dimming lights, and reducing or halting air conditioning. Employees may cooperate with such requests and tolerate reduced air conditioning and lighting when doing so is at least implicitly for the common good. The extent to which “the common good” extends beyond tending the grid and into controlling company costs is an open question. In any case, as some of our interviewees made clear, when employees don’t buy in to motivations for curtailments that cause them discomfort, they complain. Employee complaints, or the fear of them, may effectively detract from routine deployment of reduction of comfort-related discretionary loads.

Prospects

As mentioned above, about half of all survey respondents reported being unable to curtail. Based on our discussions, we estimate that about half of the interviewees had thought about the question a lot; most of these were educational facilities, public works, or manufacturers. Some of the manufacturers had made moderately formal calculations concerning tradeoffs between profit and cost, an exercise clearly mostly relevant to manufacturers. In some interviews, we probed the question of what might make the firm more price-responsive, or instead, what would make SC-3A work better for them. Surely the question of “what would make you price responsive” is a difficult one, and many of the interviewees had already laid out why they could not or would not respond to short-term price signals (other than through increased efficiency, buying hedging products, etc., where possible). This section discusses some of the themes that did emerge.

On-Site Generation

The most common interviewee response to the question of what would best allow their company to be more price-responsive was a version of “create more favorable conditions for use of CHP or other on-site generation.” Until recently, NMPC customers with onsite generation paid standby charges on that capacity (Rule 12), which may have hampered some on-site generation (NYSERDA 2002: 5-10—5-11). That on-site generation is strongly associated with perceived ability to respond is no surprise. High or volatile prices, as well as or system reliability concerns, tend to increase customer interest in on-site generation and improve its economics. In Duke Power’s voluntary RTP program, for example, seven of the 12 top responders in the program used on-site generation (Schwarz et al. 2002).¹² For some interviewees, on-site

¹² On the other hand, customers with on-site generation capabilities might be the most likely to join emergency or capacity DR programs.

generation was an emotional topic, little doubt both because of environmental regulations as well as heightened reliability concerns in the wake of August 2003 Northeast Blackouts.

Technology, Information, Knowledge

With respect to enabling technology, some customers mentioned that they didn't much use the energy management technology and software they had, while several commented that they had successfully diagnosed inefficiencies, rather than considered their systems suitable for price-responsive load management. Not surprisingly, few customers mentioned technology as a stumbling block to responsiveness. This does not mean that the right technology would not greatly help responsiveness in some cases, especially in combination with a champion. "Better technology" is hardly a satisfying answer on its own, knowing as we do, for example, that energy management control systems often do not work, or are not used, as designed (Piette et al. 1999). Some interviewees did suggest, directly or indirectly, that more information — assistance on developing load curtailment plans, determining optimal strategies to curtail or shift certain loads, or data products that made the time-varying costs (not just price) of electricity clearer — could increase their price-responsiveness. These comments suggest a potential role for information products (e.g., load curtailment plans, strategies/methods to optimize load response for specific end uses) as enablers of demand response. Savings and discounts received from ESCOs through supply contracts or payments for EDRP response, render themselves visible, as line items on a statement, for example, and may be perceived quite differently from "savings" from price-responsive curtailments, which are not apparent unless one undertakes to make them so. Making savings visible may work either way of course: depending on the situation, estimated savings might be too small to justify curtailment.

Energy Efficiency as Hedge

RTP pushes some customers to examine the patterns of their electricity use more closely, based on interviewee comments. Sometimes, in examining load more closely, it becomes clear that some equipment may not have to be running at all, or that improved controls and/or scheduling of equipment can enhance production needs, whatever the price of electricity. This phenomenon was especially striking in a case in which the interviewee considered his company to have virtually no ability to shift processes or otherwise curtail. Given their uncertainty as to future rates and rate structures, energy efficiency presented a solidly attractive option. As part of the in-depth interviews, we explored customers' reasons for and the decision-making process behind their investments in energy efficiency and load management equipment and systems made since 1998. About 50% of these customers indicated that they had made significant investments in energy-efficient lighting, HVAC systems, or motors, and about a third reported that they were working with NYSERDA on projects that leveraged public benefit funds. In response to probing questions about whether their energy-efficiency investments were linked to real-time prices, most customers indicated that they were not. A typical comment was "we have been quite successful in reducing overall load working with the State, but not to respond to real time prices." Two customers, who recently reverted to default RTP service after extended periods on fixed rates, indicated that the combination of RTP and concerns about future electricity prices motivated them to look for ways to adjust load shape or reduce overall load. These customers described reviewing various plant practices in detail and found ways to reduce

load through changes in system operations (e.g. pump operations) and energy-efficiency investments in variable speed drives. In arguing for the implementation of RTP, Costello comments on what he calls “consumer inertia”: as for any good, consumers may resist RTP in electricity prices because it increases their transaction costs: “most people do not give much thought to how they consume electricity, and that is the way they want it” (Costello 2004: 23). Whether or not customers faced with RTP eventually develop price-responsive capabilities, it seems quite apparent that the prospect of RTP, especially along with observed price variability might cause them to pay closer attention to electricity consumption at any hour of the day. Overall efficiency improvements may result, benefiting the firm but not producing the short-term load response that dynamic pricing seeks.

Conclusions

The most striking result of our interviews was the attention they called to the remarkable variety of customer experience and conditions: there are myriad ways that firms and markets don’t fit theoretical ideals or assumptions embedded in customer demand models, even if in basic and important ways, they do. This in turn raises the question of whether and how customer demand theory should be modified to account for this variety, and for what ends. For example, would more elaborate market segmentation be enough and if so, what good does this do? Or if we are to view the situation from a top-down “barriers” standpoint, what barriers do we expect we can permanently change and with what result? Herein, in such questions, lies a methodological tension. Highlighting the variety of experience is what ethnographic methods tend to do; a good ethnographic analysis will pull out patterns and identify similar stories amidst all this variety, toward answering “why.” On the other hand, customer demand models are apposite at characterizing central tendencies of customer samples, which are then extrapolated to broader populations as to the implications of particular policy issues. In our case, these questions have to do with the observed average elasticity of substitution for customer market segments, adjusted to account for revealed behavioral nuances, which are then extrapolated to produce estimates of estimated reductions in system peak load at various price thresholds.

At the level of practice, we see several dimensions to pursue. First, much remains to be understood about how companies manage electricity with respect to electricity costs. Second, if one’s goal is to increase responsiveness, there is little doubt that technological and informational improvements could facilitate more response for at least some customers. These improvements might be as straightforward as providing information products that make costs and potential savings clear, provided the results of such a presentation would be compelling. Third, some customers that participate in ISO emergency DR programs don’t see themselves as “price-responsive”; rather, they are willing to curtail loads in response to an ISO call and to preserve system reliability. Finally, at the same time, a significant number of the customers who say they can respond little or not at all may be right, short of dramatic increases in electricity price levels or volatility or major changes in business configurations. Such changes in business configuration may partly depend on technological and informational changes, but they may take many years to evolve.

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References

- Asad, T. 1994. "Ethnographic Representation, Statistics and Modern Power" *Social Research* 61: 55-88.
- Barbose, G., C. Goldman and B. Neenan. 2004. *A Survey of Utility Experience with Real Time Pricing*. LBNL-54238. Berkeley, CA.: Lawrence Berkeley National Laboratory.
- Borenstein, S; M. Jaske, and A. Rosenfeld. 2002. *Dynamic Pricing, Advanced Metering, and Demand Response in Electricity Markets*. Working Paper CSEMWP-105. Berkeley, CA.: Center for the Study of Energy Markets, University of California, Berkeley.
- Costello, Ken. 2004. "An observation on real-time pricing: Why practice lags theory." *The Electricity Journal*.17(1): 21-25.
- Flyvbjerg, Bent. 2002. *Making social science matter. Why social inquiry fails and how it can succeed again*. Cambridge, U.K.: Cambridge University Press.
- Goldman, C., N. Hopper, O. Sezgen, M. Moezzi, R. Bhavirkar, B. Neenan, R. Boisvert, P. Cappers, D. Pratt. 2004. *Customer Response to Day-ahead Wholesale Market Electricity Prices: Case Study of RTP Program Experience in New York*. LBNL-54761. Berkeley, CA.: Lawrence Berkeley National Laboratory.
- New York State Energy Research and Development Authority (NYSERDA). 2002. *Combined Heat and Power Market Potential for the State of New York*. Report 02-12.
- O'Sheasy, M. 2003. "Demand response: not just rhetoric, it can truly be the silver bullet." *The Electricity Journal*. 16(10): 48-61.
- Piette, Mary Ann, Sat Kartar Khalsa, Philip Haves, Peter Rumsey, Kristopher L. Kinney, Eng Lock Lee, Anthony Sebal, Kumar Chellapilla, Christine Shockman. 1999. *Performance Assessment and Adoption Processes of an Information Monitoring and Diagnostic System Prototype*. LBNL-44453. Berkeley, CA.: Lawrence Berkeley National Laboratory.
- Schwarz, Peter M., Thomas N. Taylor, Matthew Birmingham, and Shana L. Dardan. 2002. "Industrial response to electricity real-time prices: short run and long run." *Economic Inquiry* 40(4): 597-610.