

Energy Efficiency in California: An Examination of the Viability of Demand Response Customers and the Effects of Peak Day Pricing

I. Introduction: Energy in California

California faces significant challenges in its energy market, and part of these problems are currently addressed with a demand side strategy to alter consumption behavior. On peak energy days, the energy market faces higher than normal demand, which threatens to outstrip supply. This most often occurs on the hottest days of the year when energy demand rises due to higher use of air conditioning (HVAC) systems, among other uses. The result is an energy availability shortage in which energy providers are forced to either turn to higher polluting energy sources to increase supply, or face rolling blackouts or brownouts.

Strategies to encourage energy conservation represent efforts to combat this occurrence. This paper examines the role of demand response, which is one such strategy. I argue that while small and medium-sized businesses have the ability to reduce energy under demand response, they are not truly viable candidates for such programs. As PG&E transitions to Peak Day Pricing (PDP), this finding has significant implications for the equity of energy pricing in the California. Given that businesses that participate in demand response can choose to opt out of PDP, understanding which businesses are not eligible for demand response programs becomes increasingly crucial, in order to assess the degree to which businesses can influence their energy rates.

II. Demand Response

Demand response (DR) is a conservation tool used to reduce energy demand during peak energy periods, when the energy grid is in crisis and the state faces rolling blackouts or brownouts. According to the California Public Utilities Commission (CPUC),

“Demand response (DR) is the ability of a customer to reduce his electricity usage (or shift his usage to a different time of the day) in response to a trigger such as a price signal, an emergency alert or an environmental event like changes in temperature. The intent of traditional demand response programs is to reduce demand during the peak hours (approximately between the hours of 2 pm and 6 pm in the summer months) when it is very expensive for utilities to provide electricity” (May 2010 Report to the Governor and Legislature).

San Francisco Community Power (SFCP), the DR program analyzed in this paper, is a capacity bidding program that works in conjunction with the investor-owned utility Pacific Gas & Electric (PG&E) to reduce energy demand on peak energy days, referred to as Energy Alert Days. In capacity bidding programs, aggregators serve as third party intermediaries that work with the utility and the customer to nominate the customer for energy reductions during events, notify of event days and pay the customer for reductions achieved (Capacity Bidding Program). SFCP is the only nonprofit organization in California that runs such a program, and is unique in that it enrolls a wide variety of meter types,

from small (less than 200kW summer peak) to large (over 500kW summer peak). Other aggregators focus their efforts on enrolling large meters, such as agricultural producers, as this enables large reductions and profits to be achieved with fewer customers (Liotsakis).

In DR programs, customers reduce energy through either demand shedding or demand shifting. Demand shedding refers to an overall reduction of energy use by the consumer. This can be accomplished in a variety of ways, such as by turning off lights and unused banks of elevators, unplugging appliances, raising the temperature of air conditioning units and other similar strategies. With demand shifting, participants alter their energy use to avoid use at peak periods (Yin et al, 2010). Participants are often encouraged to “pre-cool” buildings, or lower the air conditioning temperature prior to an alert, for example, so that while energy use is higher than it otherwise would be in the morning, it is lower during the energy alert and the building remains at a somewhat cool temperature throughout the day. Another demand shifting strategy is to use printers, fax machines and non-essential appliances and machines before or after alerts, which transfers energy use away from alert hours. This enables DR customers to achieve an energy reduction during alert hours while maintaining business operations.

Demand response is generally perceived to be an effective mechanism for influencing the quantity of energy demanded (Coughlin et al., 2008; Spees and Lave, 2007; Albadi, 2007). DR customers benefit through lower energy bills and, in some cases, payment from the demand aggregator for participation in the program. The entire energy market benefits from this activity, as reduced participant demand eases the strain on supply of peak energy days. This reduces the occurrence of energy shortage, and the environmental consequences and rolling blackouts and brownouts that result from such shortage (Albadi, 2007). As a result of these benefits, the Energy Action Plan adopted by the California Public Utilities Commission encourages DR as a method of promoting energy efficiency (California Public Utilities Commission, 2008).

III. Peak Day Pricing

Historically, PG&E has used a tiered pricing strategy, under which the price per unit of energy increases as use increases beyond pre-established tiers. In other words, there is a marginal increase of rate as use increases, with the goal of reducing energy consumption due to price responsiveness (How Rates Are Set). As an investor-owned utility, the California Public Utilities Commission (CPUC) regulates PG&E, including its gas and energy rates (Regulatory Environment).

PG&E is slowly incorporating dynamic pricing, referred to as Peak Day Pricing, into its pricing structure. Beginning with commercial accounts using smart meters, PG&E is shifting pricing from tiered pricing to a model that charges based on demand. With Peak Day Pricing (PDP), PG&E implements a “Peak Pricing” model of dynamic pricing. In Ghatikar et al. (2010), dynamic pricing is defined “as electricity pricing in which the consumer does not know their electricity prices more than a day in advance.” The authors identify two such models: Real-Time Pricing, in which energy prices fluctuate throughout the day in accordance with a variety of factors, such as demand; and Peak Pricing, which

charges higher prices on certain high-demand days, identified to be Peak Days. With Peak Day Pricing, PG&E utilizes the latter demand-side strategy.

Peak Day Pricing (PDP) currently affects those customers with “an interval meter and three consecutive months of a demand greater than or equal to 200kW in the previous 12 months” (Facts). As of May 1, 2010, these large customers have already transitioned to PDP. The current program implementation schedule cites May 1, 2010 as the transition date for non-agricultural customers using 200kW or more in three consecutive months over the course of a year. For agricultural customers with the same threshold of use, the program implementation date was February 1, 2011; for small and medium businesses using up to 200kW, the transition date is November 1, 2011 (Facts). However, transition dates and the future of PDP remains in flux, as the California Public Utilities Commission has recently ordered PG&E to allow customers to opt out of SmartMeters, after widespread concern about meter inaccuracy, radiation and privacy (Baker). Without SmartMeters, PG&E would face difficulty in assessing real time energy use, making PDP implementation impossible.

PG&E rates will increase by either \$1.20 or \$1.00 per Kilowatt Hour (kWh) during these peak times, depending on the rate schedule in which the meter is enrolled (Facts). The intention is for the “critical peak price (to) represent the marginal cost of capacity used to meet peak energy needs plus the marginal cost of energy during the critical peak period (California Public Utilities Commission, 2006). There will be an estimated 12 Critical Peak Periods during the summer for large commercial meters, and an estimated 15 Critical Peak Periods for small commercial and residential meters. According to the new pricing schedule, prices on peak days will increase from 2pm to 6pm, or from 12pm to 6pm, also depending on meter enrollment. Given the rate structure, if an account is responsive to peak days and reduces energy consumption, their payments could decline. The CPUC emphasizes that by shifting toward dynamic pricing, it “gives customers greater control over their electricity bills” (July 2008 News Release). PDP will enable businesses that have the ability to alter their energy use during peak periods to lower their energy costs.

As a result of the potential to reduce energy costs, there is reason to believe that PDP will induce energy consumption in the state. Faruqui and George (2005) found that residential and small commercial and industrial customer energy use was responsive to changes in price in the California Statewide Pricing Pilot. However, for this to occur, these customers will have to be familiar with the price structure and aware of the different rate periods as they occur. Yin et al. found that “if participants want to benefit economically at all from the PDP program...they are *required* to drop and shift energy use away from these event days and times.” This implies that while PDP customers can reduce their energy costs from PDP, various factors become increasingly important to ensure price responsiveness, such as information, adaptability and personnel issues.

For businesses to reduce prices as a result of PDP, they must have nearly perfect information throughout the process in order to effectively respond to price changes. Businesses must have familiarity with the PDP program structure, awareness of higher rates and the ability to alter energy use quickly in order to adapt to price changes.

However, challenges arise with language barriers, small staffs that have a higher likelihood of being absent (and therefore unable to adjust consumption) on peak days, and other staffing issues. These complications can severely impact the ability of businesses to reduce use during peak periods, which could result in higher energy costs. Such issues are discussed in further depth using the example of San Francisco Community Power.

IV. Peak Day Pricing and Demand Response Customers

The effect of this pricing strategy on DR is undetermined so far. In their study of DR, Yin et al. found that “customers achieve little cost savings from the PDP rate coupled with the DR strategy,” but there were tangible benefits for the energy supplier, with reduced overall demand (2010). If this holds true, businesses will likely chose to enroll in either DR or PDP, but not both. In addition, according to PG&E, commercial businesses participating in a DR program will be exempt from the new rate structure, at least temporarily, meaning that there is a distinct incentive for enrollment in DR programs (Facts). In fact, such enrollment is encouraged to the extent that the PDP part of the PG&E website links directly to their DR program, encouraging customers to “choose to opt out” by clicking on a link (Peak Day Pricing). The CPUC has articulated that energy efficiency and DR are “the State’s preferred means for meeting growing energy needs” (Report to the Governor and Legislature, 2010).

In rolling out dynamic pricing, the California Public Utilities Commission highlights the increased control that consumers will have over their energy bills. “Dynamic pricing can enable customers to better manage their electricity usage and reduce their bills... Customers that can cut their electricity use during peak periods will be rewarded with a reduction in their bills” (2008 News Release). However, this overlooks the burden placed on businesses that cannot reduce their use past a certain point and are ineligible for demand response programs; these businesses cannot opt out of the pricing structure. For those that cannot reduce energy at such times, such as a restaurant operating during the lunch rush, PDP will dramatically and unavoidably raise energy rates. These businesses cannot shift use away from peak periods, and are not eligible for demand response programs, since they lack flexibility in use. Such businesses face a new pricing structure in which rates could increase dramatically during times of high-energy use (Liotsakis).

As such, understanding demand response, its challenges and related inequities becomes essential in conceptualizing the future of the energy market in California. In addition, determining what types of businesses participate in DR is crucial to predicting which businesses will be forced to adopt PDP without the option of DR. This paper indicates that there are certain types of businesses that are more desirable for DR aggregators. If this proves true, then the energy forecast for these businesses is bleak, as there are few options for these businesses to avoid drastically higher energy rates.

V. Demand Response, Small Consumers and San Francisco Community Power

As small and medium-sized businesses transition to dynamic pricing, they will be forced to contribute to a reduction in peak power demand in the state, or face much higher

energy rates. PG&E encourages participation in DR programs in order for businesses to contribute to reducing the amount of peak power demanded, and allows businesses to opt out of dynamic pricing if they are enrolled in a DR program. As such, it is essential to understand what types of businesses are enrolled and are desirable for enrollment in DR programs, as they can have the option of not being subject to PDP.

In order to assess business type viability, this paper analyzes the experience of San Francisco Community Power, a demand aggregator. Traditionally, DR programs enroll large businesses with commercial meters. However, the DR program of San Francisco Community Power (SFCP) is unique in that it includes a wide variety of commercial meters, from small businesses to large city pumps. The viability of this program came into question in the past year as a result of changes to PG&E's demand response program baseline calculation, as well as the challenges of maintaining a program with so many diverse customers and complicated logistics.

This section analyzes the viability of small and medium-sized businesses in demand response programs by using the experience of San Francisco Community Power. Here, viability is defined as the ability to participate in DR aggregator programs. This measure assesses the ability of these businesses to curtail their energy use when called upon, and if this reduction is significant enough such that any costs accrued to the program are outweighed by the benefits to such an extent that they are economically sustainable under demand response.

VI. Overview of Summer 2010 Program

Meters enrolled in DR programs are "nominated" for participation by the DR program to the utility. Nominations for the upcoming month are placed approximately one and a half weeks before the new month begins. As such, the program can vary widely between months, depending on the nominations. In addition, nominations for subsequent months must be made prior to the end of the current month. The nominations for San Francisco Community Power (SFCP) in the summer of 2010 are visible in Table 1, on the following page. As results became available to the organization, nonperforming meters were removed from participation in nominations for the subsequent months. In addition, as challenges arose from the 30-minute nomination process, the decision was made to no longer nominate under this system.

For the summer of 2010, SFCP enrolled customers in its aggregation program for June, July, August and September. The nominations were very similar for June and July, with over 400 meters nominated in two categories: approximately 30 meters in the 30-minute notification category and over 400 in the day-ahead category. Data returned for those months indicated that meters performed at lower-than-expected levels; as a result, fewer meters were nominated for August and September. This complicates analysis of the summer, since there was so much variation in meter nomination between the different months. This is displayed in Table 1, which shows the breakdown of the nominations for the duration of the program in 2010. As such, data analysis for this paper compares the August alerts against each other, which had similar meter composition.

Table 1: Summer 2010 Meter Nomination

	Meters Nominated in the Day-Ahead Alert Program	Meters Nominated in the Day-Of Alert Program
June	439	29
July	429	32
August	457	0
September	80	0

VII. Summer 2010 Performance

In general, meters nominated by SFCP underperformed for the 2010 program, which is visible in Chart 2, on the following page. This can partly be attributed to changes in the baseline calculation (discussed in the following section), delays in the processing of results from previous years and an unprecedented amount of alerts. Accurate data from previous alerts was not available for up to two months after an alert, meaning that nominations could not be altered according to performance until well beyond that. This meant that SFCP was unable to adequately react to meter underperformance in June until the September nomination period, which occurs at the end of August. Furthermore, the 2010 program was subject to nine alerts. Previous to 2010, one alert was called each year. This resulted in decreased program performance with each alert, as customers were less responsive after multiple alerts had been called with the span of a few months.

Charts 1 and 2 illustrate SFCP program performance over the years that the program has been in operation. Chart 1 demonstrates the increase in enrollment over the years of the program, as DR has increased in popularity and the program has gained traction. Since program inception, the amount of kW available for reduction has increased each year. Note that this is the peak of the meters enrolled in the program, from which reductions occur, demonstrating that the SFCP has grown significantly since 2007.

Chart 1: Peak kW Enrollment by Year

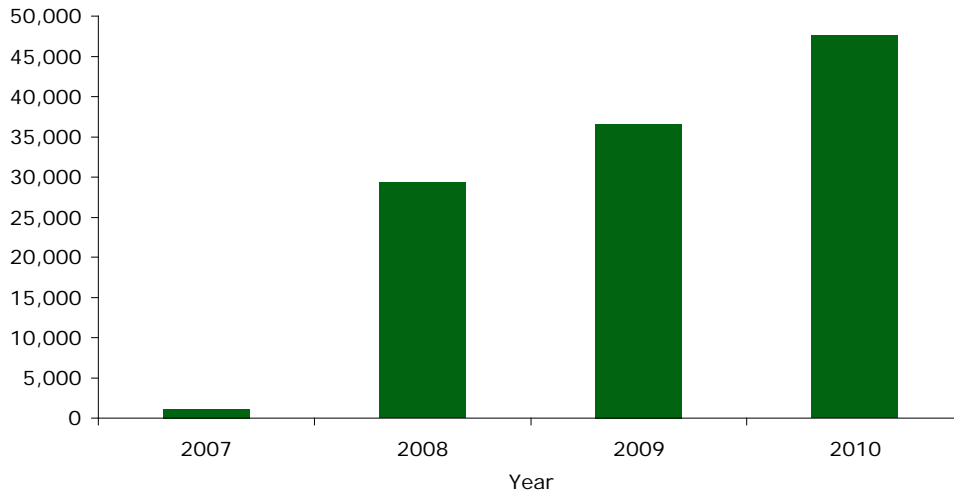


Chart 2, below, demonstrates that performance had drastically increased each year prior to 2010. For 2010, program performance varied drastically based on which baseline was used to judge performance. Under both baselines, performance dropped from 2009 to 2010, though this effect was much less under the 3-10 baseline than under the 10-10 baseline. I discuss the critical role of the baseline calculation in determining curtailment in the next section.

Chart 2: kW Curtailment Achieved by Year

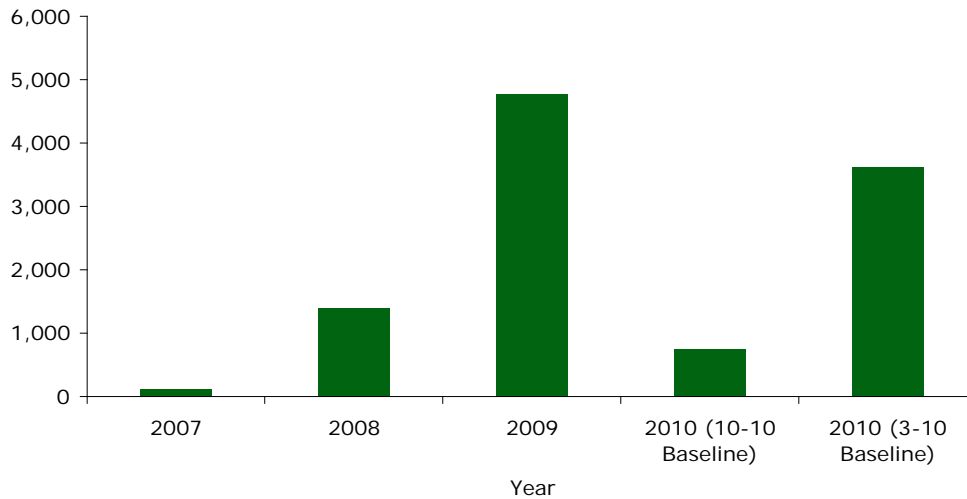
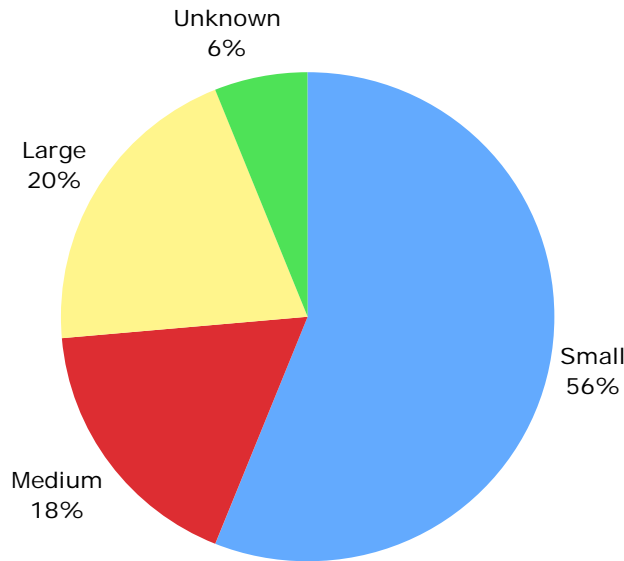


Chart 3, below, shows that small meters accounted for over half of curtailment for one event. This demonstrates the capability of small meters to curtail substantially when called upon during energy alerts. The aggregate efforts of such meters can amount to significant curtailments, as was the case for the August 16, 2010 Alert, illustrated below.

Chart 3: Percent Curtailment by Meter Size (August 16, 2010 Alert)



Role of the Baseline Calculation

In order to determine whether a meter used less energy on an alert day, it is first necessary to calculate an estimate of what energy use would be under a no-reduction scenario. This is accomplished by calculating a “baseline” from which to subtract the energy use on the alert day; the difference in the numbers is the amount reduced. Faruqui and Hledik argue that baseline calculations have a substantial effect on the potential for peak reduction (2007). Data collected and shown here (2010) confirms this assertion, based on San Francisco Community Power’s experience with the PG&E calculation change from a 3-10 baseline to a 10-10 baseline. Prior to the summer of 2010, baselines were calculated by averaging the three highest use days of the previous ten, excluding holidays, weekends and alert days. Baselines for the summer of 2010 used a 10-10 calculation, which averaged each of the 10 previous days, excluding holidays, weekends and alert days. This led to a much lower baseline from which to further reduce on alert days, as no outlier data points could be excluded from the calculation. This is apparent in Tables 2, 3 and 4, which show that the 10-10 baseline is much lower than the 3-10 baseline, and that this significantly hindered curtailment potential. In addition, by comparing the tables, it becomes apparent that this baseline effect occurred regardless of meter size.

Table 2: Baseline and Curtailment Calculation for one small meter:

	Using the 10-10 Baseline	Using the 3-10 Baseline
Baseline	52.8	57.1
August 24 Curtailment (in kW)	-22.6	-26.9
August 25 Curtailment (in kW)	-10.6	-14.9

*Note that the baselines for the August 24 and August 25 Alert are the same, as they are consecutive days and the baseline formula excludes alert days.

As a result of the lower baseline of the 10-10 calculation, shown in Table 2, curtailment for the August alerts was much lower than it would have been under the previous, 3-10 calculation. Table 3 demonstrates that both medium-sized and large meter users similarly witnesses challenges reducing under the new baseline calculation, which hindered overall curtailment by the SFCP program for duration of the 2010 program. Combining the effect this baseline over 400 meters had a significant effect on the overall curtailment potential of the program, which was previously displayed in Chart 2.

Table 3: Baseline and Curtailment Calculation for one medium-sized meter:

	Using the 10-10 Baseline	Using the 3-10 Baseline
Baseline*	283.7	313.4
August 24 Curtailment (in kW)	35.6	6.15
August 25 Curtailment (in kW)	35.6	24.1625

*Note that the baselines for the August 24 and August 25 Alert are the same, as they are consecutive days and the baseline formula excludes alert days.

Table 4: Baseline and Curtailment Calculation for one large meter:

	Using the 10-10 Baseline	Using the 3-10 Baseline
Baseline*	422.9	437.5
August 24 Curtailment (in kW)	12.9	-1.8
August 25 Curtailment (in kW)	23.9	7.7

*Note that the baselines for the August 24 and August 25 Alert are the same, as they are consecutive days and the baseline formula excludes alert days.

Indeed, the 10-10 baseline significantly reduced the curtailment potential of the program. For the alert days of June, July, August and September 2010, alert day energy usage was compared to days with dissimilar weather. This undermines the ability of businesses to demonstrate reductions according to the 10-10 calculation, as businesses must use less than they normally would on any given day, rather than less than they normally would on a similar, hot day. Under a 3-10 calculation scenario, a business could show an energy use reduction by using less air conditioning than would normally be used on a comparatively hot day, as energy alerts most often occur on the third or fourth consecutively hot day. Given that it is likely that there are at least three hot days within the previous ten, under a 3-10 calculation, alert day performances are generally compared against other hot, high usage days.

However, under the 10-10 calculation, all days are treated as equal, meaning that businesses must use less energy than on cool days, in which they may not even use air conditioning. Even if a business used drastically less energy than on a cool day, such as by

using no air conditioning at all, they would show little to no reduction. However, if they used more energy than during a cold day, as in setting the air conditioning at 78 degrees as opposed to off, they would show an energy increase, even if they increased the temperature of the air conditioning from 68 degrees. As such, it becomes very difficult to reduce energy use from the new baseline. This is particularly problematic in the Bay Area, which is notorious for brief heat waves in an otherwise cool summer climate. In the Bay Area, the 10 days previous to any alert day often include cool, foggy days, with significantly lower energy use.

Though morning adjustment was only used for approximately 30 meters during June and July (see Table 1, Morning-Of meters), research has shown that this adjustment can improve meter performance during energy alerts. According to Coughlin et al., “the morning adjustment factor substantially improves the performance of each (of their tested) baseline model(s); both in terms of reduced bias and improved accuracy” (2008). If this is correct, SFCP can improve upon its summer 2010 performance by opting into the morning adjustment for all meters. However, Coughlin et. al note that for buildings that only pre-cool on event days and for those buildings that take awhile to “unload,” or that need to begin reducing load hours prior to an energy event, the morning adjustment artificially lowers alert performance. This occurs as a result of abnormal morning use, and results in a morning ratio that distorts the baseline calculation. Given the different outcomes of adding the morning-of adjustment, programs that enroll a large number of meters of varying types, such as SFCP, face an additionally complex nomination process. Such programs face the challenge of assessing the characteristics of approximately 400 meters, and ensuring that each meter is nominated properly and that the data adequately reflects the difference in program type. This burdens the program with significantly more time-consuming labor.

Analysis of Summer 2010 Program

Findings from the SFCP 2010 program indicate that small and medium-sized businesses are capable of reducing their energy load during peak times. This reduction can aggregate to the megawatt level when assessed on a large scale. For SFCP, small meters amounted to over 30 percent of reduction in each of the three August alerts, meaning that they constituted a significant part of total SFCP performance. In terms of reduction alone, this data implies that small and medium-sized businesses can effectively participate in demand response programs.

However, for assessment of program viability of these meters, as previously defined, there is more to consider than performance alone. The amount of small and medium-sized businesses that are required to make any aggregation program economically sustainable is significant. SFCP, a nonprofit, has over 400 small and medium-sized meters, and less than 20 performing large meters, yet large meters accounted for between 20 and 50 percent of reductions. Large meters can reduce more kilowatts while requiring the same amount of labor per meter, meaning that a program with substantially fewer, but larger meters can outperform a program model such as SFCP. Thus, there is greater incentive to enroll larger

meters as opposed to smaller meters, as a program can provide a higher curtailment level while requiring significantly less time.

With such a large number of meters comes tremendous work throughout the process. The outreach required to sustain a program of so many customers is substantial. Before the program starts, each business must be contacted to ensure that they are still interested in participating. With the type of business mix, there is a high amount of business turnover, which means that each new program year requires outreach to determine which businesses remain in existence. In order maintain enrollment and to make up for those businesses that have closed, SFCP must constantly work to sign new customers.

Within the remaining businesses, personnel turnover presents an additional complication. In order to combat this, SFCP must ascertain the status of all existing contacts, and establish new contacts when necessary. New contacts must be informed about program logistics. In addition, each contact within the organization must be reminded about their curtailment agreement, such as loads to be reduced, and by how much. During the months of the program, outreach continues, and in the event of an energy alert, each must be contacted. In addition, with each alert performance drops, so in the event of a multiple-alert year (such as 2010), outreach becomes more critical and complicated as more alerts occur. Outreach is a cumbersome process, as there are numerous obstacles that arise on alert days, such as the unavailability of primary contacts, turnover of contacts and other such challenges.

For larger businesses, outreach is often easier. Large buildings and businesses such as hotels often have multiple personnel or a department designated to building operations. However, for smaller businesses, this is rarely the case. Rather, there are often just one or two people with knowledge of building operations that can serve as the contacts for SFCP, and such operations represent just a portion of the tasks required of these individuals. In such cases, performance often varies based on whether those contacts are unavailable on the alert day; for larger businesses, a designated department or more contacts means that these organizations are predisposed to better respond to alerts. In the case that the contact person of a small business is unavailable during an alert, SFCP staff must train other personnel to respond to an alert as the event occurs. This effort is often unsuccessful and requires a substantial time commitment during an otherwise busy time for staff members.

In addition, many small businesses in the SFCP program face language barriers to performance, especially when the designated contact person is unavailable. In one such instance, SFCP staff faced significant challenges when attempting to reach the contact person for a San Francisco-based market. The direct line for the contact person went straight to a message, and efforts to reach this person through the store line were complicated, as employees of the market could not understand staff directions to power down the facility. Indeed, much of the language used to advise people as to how to reduce energy use is very technical, and therefore a high level of fluency is required to overcome language barriers. While SFCP eventually reached the contact person, it was only after multiple outreach efforts were made and there was significant time and cost involved in

outreach efforts, including fax, phone and email system messages. This time could otherwise be spent ensuring that many businesses respond to an alert, rather than just one.

As a result of these factors, I conclude that small businesses are not economically viable under the 10-10 baseline. The process of managing a large number of small businesses is significantly more cumbersome than that of fewer, larger businesses, as a result of the previously discussed factors. With such a large number of small businesses, the aggregator faces increased overhead, as more staff time is required to manage the more complex program. While individually, small businesses have proven successful in reducing energy use when called upon to do so, aggregator programs such as SFCP must enroll at least hundreds of such meters to demonstrate significant alert day reductions.

Furthermore, under the new, 10-10 baseline, attaining large energy use reductions has become significantly more difficult. The alternative to the SFCP model is to either combine these small meters with many large meters that can reduce upwards of 500kW, to automate all of the meters so that the push of a button will turn off the loads automatically, or to enroll only large meters that are economically viable, so as to make reductions significant enough to yield profit. For aggregator programs, then, there is little incentive to enroll small meters as opposed to large meters, which present a higher payoff at a lower opportunity cost.

In accordance with this analysis, San Francisco Community Power has concluded that the only means of ensuring that the program performs to expectations on alert days under the current model is to use automated technologies. With automation, SFCP would firm its load for alert days by automatically turning off the loads of customers during alert times. While customers would have the ability to override the automation, to do so would undermine their curtailment, and jeopardize their enrollment in the program. As such, SFCP would not be assured that of its curtailment with certainty, but would significantly increase the likelihood that its load reduction goals would be met. Without automation, SFCP will continue to face curtailment uncertainty and risk underperformance.

Energy and Equity

As PG&E continues to transition more businesses to PDP, the only option for many businesses to avoid this new pricing structure is enrollment in a DR program. As previously established, significant factors deter DR programs from enrolling small businesses, as they are less cost-efficient than enrollment of large businesses. PDP then becomes the only option for small businesses that are excluded from DR programs. While PG&E does offer demand response programs, the only option for non-large businesses is the SmartAC program, which does not alter energy rates (SmartAC Program).

For some businesses, PDP is expected to reduce energy costs, as these businesses will shift their energy consumption away from peak times. Under PDP, as previously stated, energy costs will be lower during off-peak times, so that there is real potential for energy savings, if the business has great flexibility in energy use and can adapt to changes in price. However, this can only really succeed in a scenario of near-perfect information and

responsiveness; for the business to reduce consumption as a result of higher prices, it must first know that higher prices will be charged during this time. As previously established, buildings with a facilities manager and low turnover of staff are more likely to be responsive to changes in energy prices, because they have employees for whom this is a primary job task, and who know to look for such events. In addition, larger businesses can better adapt to this structure, as they are more likely to have a larger staff to be able to accommodate situations in which contact personnel are not available to respond to an alert.

Under this new system of either transitioning to PDP or enrolling in a DR program, the businesses that are most negatively affected are those that cannot shift their energy load away from peak times. For example, a restaurant would have difficulty reducing its energy load during the lunch rush, or shifting its usage away from that time. For these businesses, the best option is to run off of a generator or other power source during this time. However, generators are notoriously bad for the environment, increasing pollution on days that often coincide with "Spare the Air" days, and high levels of dangerous pollutants in the air.

The alternative to a generator is to rely on another energy source. Powergetics, an energy company, is in the early stages of producing a battery that is intended to function under real time pricing. The battery draws energy from the grid at low prices, but runs off the battery source when energy prices are high. It is too early to tell how much this technology would cost, if anything. This would allow businesses to continue to operate normally during peak energy times (Althoff and Glauthier).

However, until that technology becomes widely available and without the high up-front costs of a generator, businesses have no choice but to either reduce energy consumption during peak periods or to face substantially higher energy prices under PDP. This disproportionately hurts those businesses that rely on peak energy use for essential operations. For small businesses, it is too early to tell precisely how they will be affected by PDP, as they have not yet transitioned to PDP and there is little data available to make predictions.

For those businesses that cannot shift their energy use away from peak periods, the introduction of PDP will dramatically increase energy costs. For Wareham Development, a company with multiple buildings, including laboratories that must remain at a fixed, cool temperature for scientific experimental purposes, PDP has already significantly increased energy costs. Wareham Development transitioned to PDP in May 2010 but is currently being refunded for the payment differences. This is a practice that PG&E adopted for all new participants to PDP, to ease their transitions to the new rate structure. Wareham Development has witnessed a drastic increase in their energy rates from PDP. According to the company, there is little flexibility for reducing energy use during this time, which also leaves them as ineligible for demand response programs. Other buildings owned by the company are DR participants and can easily adjust because they have front desk staff at the buildings to alert occupants of alert days, distribute information, and the businesses have the flexibility to alter their energy use. However, for laboratory buildings such as those of

Wareham Development, PDP will drastically increase energy costs that are already in the “millions” for the company. This will dramatically alter the business model of the company (Bosco).

While Wareham development provides an example of a larger company that will be negatively affected by PDP, there are many types of smaller businesses that will be similarly affected financially. Specifically, businesses that depend on high energy use during the middle of the day, such as restaurants, food service businesses and manufacturing, reducing energy use undermines the ability of these businesses to generate revenue during crucial business hours. Depending on the amount that energy costs will increase under PDP and the individual business, it can be expected that many of these businesses will lose substantial revenue under the PDP model. Furthermore, without the ability to enroll in demand response, there is no alternative for these businesses, meaning that they will disproportionately be affected by the introduction of Peak Day Pricing into the energy landscape in Northern California.

Greater Economic Implications

There are many ways to define business size, such as by revenue, number of employees, mechanisms for capital supply or extent of the operations (Scott and Bruce). Previously I defined business size by peak energy use, which is the relevant characteristic for demand response. However, when assessing the impact of small businesses in the economy, relevant data considers business size by the number of persons employed by a business. Given that North American Industry Classification System Codes (NAICS) data is based on employee number, that is the relevant determination of size in this context. While the difference in definition means that not all of the previously identified small businesses are considered as such under NAICS codes, I will assume that there is a strong enough correlation between the two definitions to give the NAICS data meaning in this context.

According to the U.S. Small Business Administration classifications, the smallest employee-based business size standard matched to the NAICS data is 50 employees. Other NAICS matched classifications define small businesses as those with fewer than 100 employees, or those with fewer than 100 employees (U.S. Small Business Association). I will take the most conservative definition, which is to consider any business establishment with fewer than 50 employees as a small business.

Data shows that most businesses are small businesses. At the time of the 2008 County Business Patterns, San Francisco County had 30,605 total business establishments. Approximately 94 percent of these, or 28,849 businesses, had fewer than 50 employees. Indeed, most businesses in San Francisco County are very small: nearly 85 percent of all establishments had less than 20 employees in the 2008 County Business Patterns, and 53 percent had less than five employees. This is true throughout California, as approximately 95 percent of total establishments had fewer than 50 employees, and 55 percent had fewer than five employees (2008 County Business Patterns). Indeed, the San Francisco data mirrors national rates of small businesses, as approximately fifty percent of all employer

firms nationwide had fewer than five employees, and 89 percent had fewer than 20 employees (Employers and Nonemployers).¹

Of these small businesses, a large number can be considered as unable to reduce significant portions of their energy load during peak periods, such as supermarkets (with high levels of essential refrigeration). In the County data, San Francisco had 661 food and beverage stores facing such energy reduction challenges, or approximately 2 percent of total business establishments. There were nearly 3000 health care establishments with similar challenges, which is nearly 10 percent of total business establishments. Health care facilities, for example, cannot reduce use beyond a certain, high threshold without affecting patient care and related health outcomes. In addition, there are 1,370 manufacturing businesses in the San Francisco County; many of these are likely at financial risk in the event of an energy alert. That is to say that these businesses, they would either have to reduce energy at the expense of business output, or be completely vulnerable to higher energy rates. Such businesses, like the Wareham Development example, would likely be forced to jeopardize their financial model to drastically reduce energy when called upon.

Given that small firms dominate business type, the findings that demand response will disproportionately affect these businesses is significant. In addition, of these small businesses, a large number face structural challenges to responding to energy prices as a result of their financial model. According to these results, there are a significant number of firms that will be critically affected by PDP, and either not eligible for demand response, or undesirable for demand aggregators. For these firms, energy rates are likely to increase dramatically. At best, this will reduce their profit margin, but for some businesses, it could require a change in their financial model.

Conclusion

It is too early to definitively determine how PDP will alter the energy landscape. It is very likely that there will be losers from the rate change, but there will likely also be some winners. The extent to which the new pricing model generates losers is dependent on how PDP is implemented and the price responsiveness of affected businesses. There is the potential for many businesses to enroll in DR programs to avoid PDP, which raises crucial questions relating to which businesses are eligible for and viable under such programs. Undoubtedly, certain customers will be disproportionately affected by the new pricing model, as such businesses are either too small to be viable under demand response aggregator programs, or cannot shift energy use away from peak periods without significantly affecting business operations.

The extent to which these businesses will be affected remains to be seen, but it is clear that understanding demand response enrollment is an essential prerequisite to determining the impacts of these programs on small and medium-sized businesses.

¹ The U.S. Census Bureau data on business size does not distinguish between firms with 20 to 50 employees and those with 50 to 99 employees. Therefore, it is not possible to directly compare the number of firms with fewer than 50 employees nationally to the number of firms with fewer than 50 in San Francisco County.

Changes to demand response program implementation, such as baseline calculations, can critically alter program success and the viability of small and medium-sized businesses in demand response programs. Further, it is critical to know which types of businesses cannot reduce energy use during such periods without jeopardizing revenue, in order to determine the extent to which PDP will increase energy and operating costs. Finally, as small businesses at particular risk are a substantial portion of total businesses, the findings of this paper have far-reaching implications for economic welfare and equity.

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