TRANSITIONING TO DYNAMIC PRICING

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January 27, 2009

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The Brattle Group

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With the advent of the smart grid, dynamic pricing is receiving increasing interest by state commissions throughout North America as a means of enhancing economic efficiency by reducing the need for expensive peaking capacity. But several barriers stand in the way of its rapid deployment.

As noted by MIT's Paul Joskow in a recent discussion of the economics of climate change, "On the demand side there are relatively low cost ways to reduce electricity consumption by increasing energy efficiency in building, lighting, heating, ventilating, air conditioning and other equipment. That's why getting the retail price signals right is important and why muting them with regulation based on traditional cost of service models is inconsistent with promoting adoption of economical energy efficiency opportunities."[2]

While the rate design process (in conjunction with the revenue requirements process) in principle results in utility recovery of all prudent costs, it provide sufficient incentives to utilities to pursue energy efficiency and demand response programs at a level commensurate with state and federal goals. A review of default rate designs across the continent reveals that prices paid by customers do not reflect the scarcity of capacity to produce energy at various times of day.

There is a lack of recognition that the default rates embody a hedging or risk premium which insulates customers from price volatility and eliminates any incentive that they would otherwise have for moving to dynamic pricing tariffs.

In addition, customers lack the information to become smart shoppers. Policy makers have bought into a viewpoint espoused by defenders of the status quo that customers are averse to being placed on dynamic pricing tariffs, since not only will they face price volatility but they may also pay higher bills. This is contradicted by evidence from fifteen recent pilots with dynamic pricing, which clearly showed that once customers experienced a dynamic tariff, not only did they understand and respond to the price signals, they also overwhelming preferred dynamic tariffs to their conventional hedged rate form.[3] The experiments also showed that a well-thought out customer education program is needed to sustain customer response.

In order to make a transition to dynamic pricing, a new framework is needed to develop innovative rate designs.

A New Framework

The fundamental premise is that that rate design should be driven by clearly articulated and feasible policy objectives. Several are noted below.

2 http://www.energypolicyblog.com/?p=457.
3 http://www.hks.harvard.edu/hepg/Papers/2009/The%20Power%20of%20Experimentation%20_01-11-09_.pdf

Rate Design to Achieve Simplicity

It is important to convey the price of electricity to customers. Long, complicated bills over laden with fine print and impenetrable prose pose a problem. A rate design that achieves this objective could simply be a flat volumetric charge, such as the one described in Figure 1.

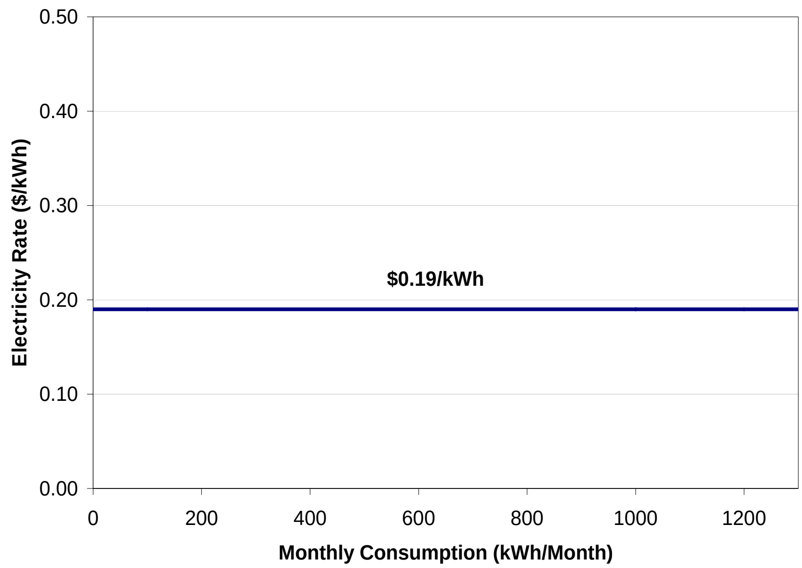

Figure 1: A Rate Design for Achieving Simplicity

Under this rate, a customer with 1,000 kWh of consumption per month would have a monthly bill of $190 dollars. The customer's bill is calculated as follows:

(1) 1,000 kWh x $0.19/kWh = $190

An even simpler pricing scheme is to charge the customer a flat fee per month of $190 plus a certain amount to capture the risk posed to utility earnings by month-to-month variation usage. However, completely decoupling electric costs from the rate of usage sends customers the wrong signal about the scarcity of the underling resources that are required to supply electricity.

Rate Design to Achieve Energy Efficiency

While the previous example achieves simplicity, it is limited in its ability to achieve other objectives, such as promoting conservation and energy efficiency. One design to achieve this goal would charge customers a higher price the more they consumed. Consider the following rate illustrated in Figure 2.

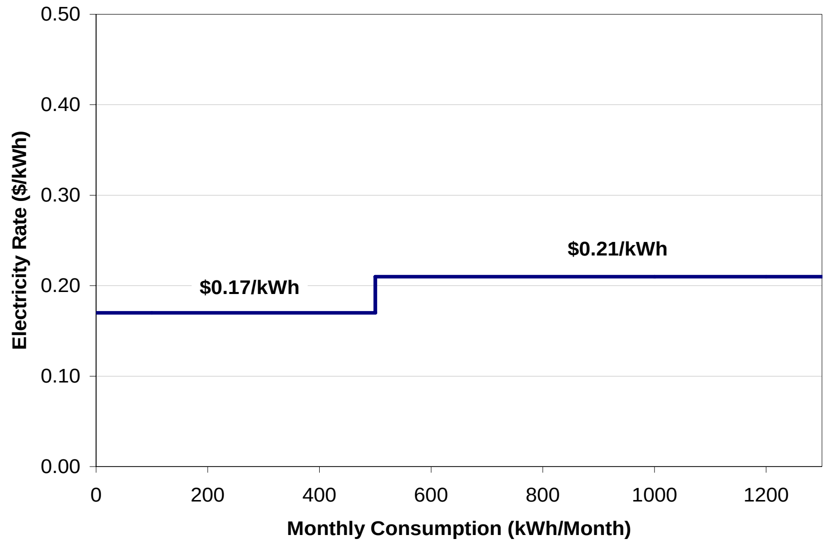

Figure 2: A Rate Design for Achieving Energy Efficiency

The higher rate charged to consumption beyond 500 kWh per month would encourage customers to reduce their electricity consumption. At the same time, the rate for consumption up to 500 kWh is lower than the flat rate described in the previous example. This gives the customers the opportunity to save on their electricity bill if they are able to cut back on usage.

Without any price elasticity, the same customer's bill would remain unchanged from the previous example:

(1) 500 kWh x $0.17/kWh + 500 kWh x $0.21/kWh = $190

However, several studies have shown that customers do exhibit small but significant price elasticities, so in this example the customer would likely reduce consumption and achieve bill savings.[4]

Rate Design to Achieve Daily Load Management (or Permanent Load Shifting)

While the previous example shows how rate design can encourage conservation, the design did not provide any means for encouraging reductions in consumption during the peak (expensive) time of day. When customers reduce consumption during the peak hours, this allows the utility to improve its load shape and reduce the need for lightly used, and therefore very expensive, capacity. At the same time, this would achieve some of the conservation-related benefits that would have also resulted from the previous example. Consider the following TOU rate design.

[4] Ahmad Faruqui, "Inclining toward efficiency," *Public Utilities Fortnightly*, August 2008.

Table 1: Example TOU Rate

Period	Total Rate	Surcharge/Credit
Peak	$0.31/kWh	+ $0.12/kWh
Off-Peak	$0.15/kWh	- $0.04/kWh

For a TOU rate like this, the peak period might last from 1 pm to 6 pm on weekdays, with all remaining hours being considered off-peak hours. Assuming that the average customer in our previous examples consumes 250 kWh during the peak period and the remainder (750 kWh) during the off-peak period, the average bill would be calculated as follows.

(1) 250 kWh x $0.31/kWh + 750 kWh x $0.15/kWh = $190

This example again assumes no price elasticity. In reality, we would expect customers to reduce peak energy usage in response to the higher rate. They may also increase usage during off-peak periods because the price is relatively lower. Of course, some customers would respond more than others to the time-varying price signal, with some perhaps not responding at all. However, in the aggregate, we would expect substantial customer response to occur.

Through this progression of rate designs we have illustrated how various objectives can be met. However, the tradeoffs are also apparent. While the TOU rate is still a straightforward way of charging customers for electricity, it is not as simple or as easy to explain as the original flat rate. In the past, as rates were designed to accomplish an increasing number of objectives, they have tended to become more complex. It is important to keep this in mind when discussing the following ratemaking criteria, and particularly when discussing the strengths and weaknesses of alternative dynamic pricing rates.

The Bonbright Criteria

In addition to the rate design objectives described above, there are several other goals that a utility or policymaker might want to achieve through rates, from bill stability for customers to revenue stability for the utility. These were codified by Professor James Bonbright of Columbia University.[5]

Bonbright's Rate Design Criteria

After years of research, Bonbright formulated eight criteria for establishing the rate structure. The original list of eight was subsequently expanded to the following ten:

1. Effectiveness in yielding total revenue requirements under the fair-return standard without any socially undesirable expansion of the rate base or socially undesirable level of product quality and safety.
2. Revenue stability and predictability, with a minimum of unexpected changes that are seriously adverse to utility companies.

[5] The first edition of his canon, *Principles of Public Utility Rates*, was issued in 1961 and influenced the thinking of many generations of rate designers.

3. Stability and predictability of the rates themselves, with a minimum of unexpected changes that are seriously adverse to utility customers and that are intended to provide historical continuity.
4. Static efficiency, *i.e.*, discouraging wasteful use of electricity in the aggregate as well as by time of use.
5. Reflect all present and future private and social costs in the provision of electricity (*i.e.*, the internalization of all externalities.
6. Fairness in the allocation of costs among customers so that equals are treated equally.
7. Avoidance of undue discrimination in rate relationships so as to be, if possible, compensatory (free of subsidies).
8. Dynamic efficiency in promoting innovation and responding to changing demand-supply patterns.
9. Simplicity, certainty, convenience of payment, economy in collection, understandability, public acceptability, and feasibility of application.
10. Freedom from controversies as to proper interpretation.

These criteria have served as guiding principles in electricity ratemaking for the past half century. They are simple and comprehensive but somewhat duplicative and verbose. It is possible to collapse them into three broadly defined criteria without any loss of content: (1) efficiency, (2) equity, and (3) simplicity.

While the Bonbright criteria are a good starting point for designing today's rates, they are insufficient for meeting the changing needs of a smart grid world. The advent of advanced metering infrastructure, coupled with the introduction of in-home displays and price responsive appliances, are bringing about a revolution in how consumers approach electricity. It is necessary to update the criteria that we use for designing electric rates.

Next Generation of Rate Design

We believe it is possible to conceive innovative rate designs that meet the requirements of the smart grid world by conforming to the following four criteria:

1. *Promote economic efficiency*

The desire to achieve economic efficiency has been one of the key drivers underlying the increasing complexity of electricity pricing in the last two-to-three decades. When consumers pay prices that reflect the marginal cost of supply, societal resources are employed optimally in the economy; everybody wins. Increasing block rates are designed to reflect the fact that the marginal cost of electricity supply now exceeds the average cost, and time-varying prices reflect the time-varying nature of electricity supply costs.

A tariff that incorporates both an increasing block structure and time-varying pricing can provide adequate price incentives for encouraging energy efficiency and demand response. On the other hand, challenges in implementing such economically efficient pricing have been a key driver in the use of incentives to promote economic efficiency and DR. Incentives for energy efficiency are designed to account for the market failure in setting correct electricity prices that incorporate social marginal costs. Incentives for DR options, such as direct load control, reflect the historical perception that load control technology is cheaper than time-of-use metering. They also reflect a perception that behavioral response to time-varying pricing is more unreliable than push-button technology options.

Designing economically efficient rates, even ones that incorporate the inherent uncertainty in supply conditions, is not hard. What is difficult is designing economically efficient rates that customers understand well, that overcome the political challenge of transitioning from longstanding cross-subsidies to more equitable and efficient cost allocation, and that can be implemented cost effectively. The interplay and tradeoffs between economic efficiency and the other criteria needs to be re-examined in future regulatory deliberations.

2. *Promote equity*

Equity in ratemaking can mean different things to different people. For some, it means preserving cross-subsidies and making sure that no one is made worse off relative to their existing situation. Of course, for this to be good for society, one has to assume that the existing situation was good to begin with. If the existing situation consists of significant cross-subsidies, it means that some individuals will be made worse off when those cross-subsidies are eliminated (even though all they are giving up are financial gains that were not theirs to begin with). Thus, the most conservative definition of optimality, due to the economist Vilfredo Pareto, rears its head and crimps forward progress.

A Pareto improvement is one in which at least one person is made better off by a change in policy while no one is made worse off. Adherence to only Pareto-optimal changes makes it impossible to move to a better allocation of resources through more efficient pricing, even if people agree that is ultimately the correct outcome. An alternative and less restrictive economic metric is the Hicks-Kaldor optimality criteria, which states that if as the result of a price change winners gain enough to be able to payoff losers, and still be ahead, then that constitutes a welfare improvement for a society as a whole, even if the winners are not required to make such compensation. Note that if the winners were required to make the compensation, we would be back to the Pareto Optimality criterion.

An alternative definition of equity means having lower rates for low-income consumers, as is the case with the California Alternative Rates for Energy (CARE) program that provides a discount of at least 20 percent for low income users. While rate options such as these are common throughout the industry, most economists would argue that they distort price signals and lead to excess electricity consumption.

A third definition of equity is accurate cost allocation—that is, setting prices so that they vary across customer classes or segments in accordance with variation in the cost of supply to those classes or segments. An example is having higher average prices for households with central air conditioning, or time-varying prices that incorporate the higher cost of supply associated with air conditioning loads during peak periods. Equity in this context focuses on eliminating cross-subsidies that are inherent in average cost pricing.

According to the second definition, lifeline rates (based on the theory that low income consumers are low users) and explicit discounts such as the CARE tariff are worthy of pursuit. Lifeline rates (sometimes called baseline rates) are designed to meet the critical or lifeline needs of all consumers by supplying power at subsidized rates for the first several hundred kWh of usage. They serve a laudable social goal but detract from the overriding goal of economic efficiency. The California Public Utility Commission should quantify the loss in economic efficiency created by such rates.

Suppose the full cost of power is 10¢/ kWh and customers pay 7¢/kWh on the first 300 kWh of usage that is designated lifeline usage. They are getting a price subsidy of 3¢/ kWh on 300 kWh, or $9. In the second step, the $9 subsidy would be converted into an income subsidy and the price on the first 300 kWh would be raised to its full marginal cost of 10¢/kWh. Most consumers would probably spend a good portion of the $9 income subsidy on higher value necessities such as food, clothing and transportation and conserve a certain amount of electricity by turning off lights in occupied rooms, perhaps installing compact fluorescent lamps, weatherizing their homes, or adjusting their thermostat settings and so on. The amount of electric usage may come down by a few percentage points, which would promote the state's goal of enhancing energy efficiency.

In addition, removal of the price subsidies would improve the financial position of the electric utility. The financial burden of subsidizing customers would be shifted back to the state (and federal) government, on whose shoulders it should ultimately rest.

This social goal could be achieved, without compromising the goal of basing prices on costs to achieve economic efficiency in the allocation of scarce resources, by expanding the federal government's Low Income Home Energy Assistance program (LIHEAP).

Commissions need to test hypotheses about the distributional impacts of various rate options on different customer segments rather than basing them on supposition and conjecture. For example, do low-use customers have flatter load shapes than high-use customers? If so, they are likely to be made better off with TOU pricing and not worse off, as is often contended by some consumer groups. Many myths and preconceptions have grown around equity issues. The only way to slay the myths is to subject the implicit hypotheses concerning which tariff will make which customer group worse off to rigorous empirical quantification and analysis.

Fortunately, this can be done since new databases now exist that quantify the response of customers to alternative rate designs. A good example is the individual customer data that has been generated by the dynamic pricing experiments that have been carried out across the continent. In most cases, published analyses focus on the behavior of the average customer. However, the databases are a fertile source of empirical information on customer response to rates that can be harnessed to test—and resolve— some of these distributional impacts that continue to be debated *ad nauseum*. The experimental data differ from the myriad datasets that are generated as part of ongoing load research activities such as cost-of-service studies, load forecasting, and direct access compliance. Those datasets include information on hourly (and half-hourly) load shapes on a representative sample of customers. They usually do not include information on customer characteristics (such as size and type of dwelling, saturation of end uses, and sociodemographic factors) nor do they include information on customer price responsiveness, both of which are richly represented in the experimental datasets.

3. *Facilitate customer choice*

One of the objectives of power market restructuring activities that were initiated in the mid-nineties was to provide more choices to customers. Initially, policy makers thought that the best way to accomplish this goal was by providing choice of power supplier. They hoped that competitive power suppliers would also provide choice of pricing products and services to customers. The former avenue has not found to work for mass market customers, at least not in California. Even in places such as Baltimore and the District of Columbia, customer switching rates for mass market customers are very low. Thus, a way has to be found for pursuing the latter through the incumbent utility provider. This is not as difficult as it seems. The incumbent provider can design and market a variety of pricing products for customers, as discussed in this paper. These would be differentiated along the risk-sharing spectrum and represent different ways of allocating risks between customers and suppliers. A middle-of-the-road option, such as critical-peak pricing, can be made the default option and customers would have the option to switch-over to any of the other options that better match their risk-taking preferences.

4. *Clearly and simply communicate prices and costs*

California's residential electricity tariffs, with their increasing block structure, subsidies and surcharges, and unbundled cost structure, are one of the most convoluted tariffs in the continent. That is before incorporating time-varying surcharges and credits and dynamic price variation as was done in California's landmark pricing experiment, the Statewide Pricing Pilot (SPP).[6]

Indeed, research done under the SPP indicated that many customers did not understand even the basic characteristics of their standard rates, let alone the nuances of how average and marginal prices move across rate tiers and time periods. On the other hand, the SPP showed that many customers did understand that prices were much higher during peak periods on critical days. The SPP also showed that time-varying prices can produce considerable peak demand reductions even in a world of significantly increasing block tariffs and rate complexity. In other words, the SPP showed that even complex rates can produce demand response. What the SPP did not show, however, is whether significantly greater reductions could be achieved if rates could be simplified. It also did not provide any insight into how best to achieve such simplification while reflecting sufficiently the key underlying economics of electricity supply.

There are many ways to make tariffs simpler than those that currently exist in California and to help customers better understand and respond to price signals. Just simplifying bill presentation by creating a simple summary sheet at the top of the bill and placing the large amount of extraneous information contained in current bills (e.g., all of the unbundled bill amounts) into a backup document would be a useful start. Of course, one could seek to simplify tariffs themselves. For example, a simpler dynamic rate is what some refer to as a ''pure critical-peak pricing (CPP)'' rate. This is a rate that preserves the dynamic nature of critical peak pricing without the burden and confusion of facing a time-varying rate every weekday. A pure CPP rate that has a high price on a limited number of ''emergency'' days, and a single low price on all other days with no increasing block structure, is a rate that would be fairly simple for customers to understand. On the other hand, it is a rate that focuses only on DR and not on energy efficiency. Alternatively, one could use a more complex, cost-reflective tariff that incorporates time variation and increasing block pricing, and rely on technology to automate response to price changes or to translate the complex tariff into more understandable information through, for example, in-house displays that report cumulative and incremental bill amounts.

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6 Ahmad Faruqui and Stephen S. George, "Quantifying customer response to dynamic pricing," *The Electricity Journal*, May 2007.

None of the above examples, however, address the most fundamental challenge of electricity pricing, namely, the fact that no matter how simple the tariff customers don't know what a kilowatt-hour is or how much it costs them to do a load of laundry or dishes or to run their refrigerator for a day. That is, customers don't know whether the simplest tariff, say 10¢/kWh, means that it costs 5¢, 25¢, or 50¢ to wash a load of dishes, or that a 5-degree change in a thermostat translates into a $1 savings on a typical summer day or a $2 savings on a really hot summer day. Consequently, there is a need to explore the extent to which service level pricing, that is, pricing based on the end-use services consumed, is feasible.

Would an ''outside-the-box'' pricing strategy such as this improve consumer decision-making and could one be designed to accurately reflect the underlying economics of electricity supply? An example might be 10¢ for a load of wash done after 8 p.m. at night, but 30¢ for the same load done between noon and 8 p.m. during summer weekdays. While there are many practical challenges to implementing such an approach, the potential benefits could be huge from what might be the only sure way to significantly improve customer decision-making.

Completing the Transition

Any move to default dynamic pricing rates is bound to create some anxieties because it will make some customers better off and some other customers worse off. Of course, all customers will have the opportunity to become better off by lowering peak demands, especially on critical days, but they may be unwilling to try this out unless their concerns are addressed.

In order to ease the transition, it may be useful to undertake one or more off the following steps.

- **Creating customer buy in.** Customers need to be educated on why a century-old practice of ratemaking is being changed. They have to be shown how dynamic pricing can lower energy costs for society as a whole, help them lower their monthly utility bill, prevent another energy crisis from occurring, improve system reliability, and lead to a cleaner environment.

- **Offering tools.** These tools should allow customers to get the most out of dynamic pricing. At the simplest level, they should be equipped with information on how much of their utility bill comes from various end-uses such as lighting, laundry and air conditioning and what actions will have the largest response on their bill. At the next level, they could be provided real-time in-home displays which disaggregate their power consumption and tell them how much they are paying by the hour. Finally, they could be provided enabling technologies such as programmable communicating thermostats. Similar examples can be constructed for commercial and industrial customers.

- **Designing two-part rates.** The first part would allow them to buy a predetermined amount of power at a known rate (analogous to how they buy all their consumption today) and the second part would give them access to dynamic pricing and allow them to manage their energy costs by modifying the timing of their consumption. They could be allowed to pick their predetermined amount or it could be based on consumption during a baseline period.

- **Providing bill protection.** This would ensure that their utility bill would be no higher than what it would have been on the otherwise applicable tariff but would not preclude it from being lower based on the dynamic pricing tariff. Customers would simply pay the lower of the two amounts. In later years, the bill protection could be phased out. For example, in year one, their bill would be fully protected and would be no higher than it would have been otherwise; in year two, it would be no higher than five percent; in year three, no higher than ten percent; in year four, no higher than fifteen percent and in year five, no higher than twenty percent. In the sixth year and beyond, bill protection would be provided for a fee.

- **Crediting customers for the hedging premium.** Existing fixed price rates are very costly for suppliers to service since they transfer all price and volume risk from the customers to the suppliers. In addition, the supplier takes all volume risk. In order to stay in business, the supplier has to hedge against the price and volume risk embodied in such as open-ended fixed price contract. The supplier can do so by estimating the magnitude of the risk and charging customers for it through an insurance premium. The risk depends on the volatility of wholesale prices, the volatility of customer loads, and the correlation between the two. Theoretical simulations and empirical work suggest that this risk premium ranges between five-to-thirty percent of the cost of a fixed rate; being higher when the existing rate is fixed and time-invariant, and smaller when the existing rate is time-varying or partly dynamic. So customers who move to dynamic pricing rates should be credited for the insurance premium.

- **Giving customers a choice.** Dynamic pricing rates, even with all the items mentioned above, may still be too risky for some customers. Thus, they should have the option of migrating to other time-varying rates perhaps with varying lengths of the peak period and with varying numbers of pricing periods. If the critical-peak pricing rate (combined with a time-of-use rate) becomes the default rate, risk-averse customers should have the opportunity to migrate to a fixed time-of-use rate and risk-taking customers should have the opportunity to migrate to a one-part or two-part real-time pricing rate.

Conclusions

The benefits of dynamic pricing are well established and increasingly within reach as advanced metering infrastructure and other smart grid technologies are deployed throughout the continent. What stands in the way of progress is a misplaced concern about price volatility and a fear of dealing with the push back that might come from those who would lose the subsidies that they have been enjoying under existing rates. This article has discussed several ways to make the transition to dynamic pricing. Commissions and utilities can be use these methods individually or jointly to ease the transition. Unless the transition is accomplished, society as a whole will continue to suffer from the well-known inefficiencies of uniform, static pricing.

SIDEBAR

Getting the Subsidies out of the way

Existing rate designs are often encumbered with subsidies that not create inequities among customers but also muffle the incentive for energy efficiency and demand response that are often part of the government's energy policy. In California, which is moving toward default dynamic pricing and which already has inclining block rates, the rate designs are encumbered with two subsides: (a) those associated with the low-income discount plan known as CARE and (b) the rate freeze on the first two tiers imposed by Assembly Bill 1X (AB 1X). Ideally, the subsidies would be converted into an income payment and phased out over time. But even if they need to be preserved for social policy reasons, there are ways to reformulate the electric bill that makes them more transparent and less of a barrier to economic efficiency.

First, consider a hypothetical residential electricity bill in California in Figure 3.

Monthly Electricity Bill

Charges								
Total Usage:	533.00	kWh						
Electric Charges								
Baseline Quantity:	362.50	kWh						
Baseline Usage:	362.50	kWh	@	$0.08316	per kWh	=	$30.15
101-130% of Baseline:	108.75	kWh	@	$0.09563	per kWh	=	$10.40
131-200% of Baseline:	61.75	kWh	@	$0.09563	per kWh	=	$5.91
Net Charges							$46.45
Taxes and Other							
Energy Commission Tax							$0.12
TOTAL CHARGES							**$46.57**

Figure 3: Simplified Version of AB 1X-Compliant Bill with CARE Subsidy

In this example bill, the electricity rates are more than 30 percent below the standard tariff to account for the CARE subsidy. In addition, the rates do not vary with the time of day during which the electricity is being consumed due to AB 1X restrictions. How could this bill be modified to add transparency to the embedded CARE and AB 1X subsidies? Two simple suggestions with illustrations are presented below.

CARE

In Figure 3, the rates that are being charged to the hypothetical customer are more than 30 percent below the standard tariff to account for the CARE subsidy. A more transparent version of the bill would expose customers to the full electricity rate and provide the CARE subsidy as a separate line. The first step in doing this is to simply compute the bill as if the CARE subsidy did not exist. The intent is to convey the true economic cost of electricity to the customer. In the second step, the CARE subsidy should be computed and shown as a line item on the bill. The customer should be informed that this is a legal requirement that it is designed to make electricity more affordable to them. Over time, a dialogue should be initiated with the legislature to convert the CARE subsidy into an income payment that would be provided to customers as a credit on their state income taxes. In other words, it would be funded through the general revenue of the state rather than through the ratemaking process.

An example of a bill with a more transparent CARE subsidy is illustrated in Figure 4.

Monthly Electricity Bill							
Full Charges							
Total Usage:	533.00	kWh					
Electric Charges							
Baseline Quantity:	362.50	kWh					
Baseline Usage:	362.50	kWh	@	$0.11550	per kWh	=	$41.87
101-130% of Baseline:	108.75	kWh	@	$0.13131	per kWh	=	$14.28
131-200% of Baseline:	61.75	kWh	@	$0.24725	per kWh	=	$15.27
Net Charges							$71.42
CARE Subsidy							
					CARE discount applied to net charges	=	($24.97)
					Total	=	$46.45
Taxes and Other							
Energy Commission Tax							$0.12
TOTAL CHARGES							**$46.57**

Figure 4: Sample Bill with Transparent CARE Subsidy

AB 1X

While it is difficult to determine exactly how much of California's electric usage falls within the purview of AB 1X, conversations with utility rate experts indicate that about half of all residential customers never go past the second tier and, of those that do go past it, about a third to half of their usage resides in the first two tiers. This suggests that about two-thirds to three-quarters of electricity usage falls within the rate freeze imposed by AB 1X. This has represented a serious barrier to offering dynamic pricing as a default rate.

This barrier is being dealt with today by the offering of peak-time rebates (PTR) to all customers. As discussed elsewhere in this whitepaper, PTR can approximate the impact of dynamic pricing rates such as critical-peak pricing (CPP). Indeed, it is also possible to create an hourly version of PTR that would approximate the effects of real-time pricing (RTP). However, this approximation comes at a price, which is posed by the statistical and billing challenge of estimating baselines for ten million customers on an ongoing basis. In addition, there is the strong possibility that rebates would be paid out to several hundred thousand customers. This would not be a result of consciously lowering their peak usage but because they happened to either have higher usage during the baseline period and/or have lower consumption during the critical-period for lifestyle reasons unrelated to the rebate.

If legal restrictions were not present, it would be best to offer the true price signal to customers rather than an approximate signal through a rebate. How should this be done?

As in the case for the CARE subsidy, the first step is to simply compute the bill with the dynamic pricing tariff as if the AB 1X protection of electricity consumed during the first two tiers did not exist. The intent is to convey the true economic cost of electricity to the customer and to provide an economic incentive for reducing consumption during peak and critical-peak periods. The customer should see clearly that consumption during the peak period is much more expensive than during the off-peak periods and that consumption during the critical-peak period is substantially more expensive. In the second step, the AB 1X subsidy should be computed and shown as a line item on the bill. The customer should be informed that this is a legal requirement that is designed to protect the price they pay for their first two tiers but they still have a strong incentive in the time-varying nature of the dynamic pricing tariff to modify their usage pattern and lower their bill. In order to accomplish this transition, a dialogue should be initiated with the legislature to modify the language of AB 1X.

An example of an electricity bill with more transparent price signals, as well as the transparent CARE subsidy, is illustrated in Figure 5.

Monthly Electric Bill

Critical Peak Pricing Charges

Total Usage:	533	kWh				
Off-peak Usage:	281	kWh	@	$0.10000	=	$28.10
On-peak Usage:	246	kWh	@	$0.20000	=	$49.20
Critical Peak Usage:	6	kWh	@	$0.75000	=	$4.50
				Total	=	$81.80

Baseline Consumption Discounts and High Consumption Surcharges

Baseline Quantity:	362.5	kWh				
Baseline discount	362.50	kWh	@	($0.03000)	=	($10.88)
101-130% of Baseline discount:	108.75	kWh	@	($0.02000)	=	($2.18)
131-200% of Baseline surcharge:	61.75	kWh	@	$0.04318	=	$2.67
				Total	=	($10.38)

CARE Subsidy

CARE discount applied to net charges = ($24.97)

Taxes and Other

Energy Commission Tax 0.12

TOTAL CHARGES **$46.57**

Figure 5: Sample Bill with Transparent Price Signals and CARE Subsidy