CHRISTENSEN
ASSOCIATES
ENERGY CONSULTING

Summary of the Rate Design Project for the Kansas Corporation Commission

Daniel G. Hansen
Michael T. O'Sheasy
Cara Lee Mahany Braithwait

April 11, 2012

Christensen Associates Energy Consulting, LLC
800 University Bay Drive, Suite 400
Madison, WI 53705-2299

Voice 608.231.2266 Fax 608.231.2108

Table of Contents

Tables

1. Introduction

In 2009, Christensen Associates Energy Consulting ("CA Energy Consulting") began working with the Kansas Corporation Commission ("KCC") to explore a comprehensive redesign of electric rate structures in Kansas. As stated in the Request for Proposals ("RFP"), the KCC had "recently established policy goals to encourage energy efficiency as a viable option to meet future energy needs in Kansas." The implementation of these goals includes consideration of the following factors:

- Rate structures that promote conservation;[1]
- Rate structures that contain a dynamic pricing component (in which the price paid varies with system conditions) to encourage efficient use of existing generating resources; and
- Customer education regarding energy use, energy efficiency, and rate structures.

Given the breadth of the scope of services contained in the RFP, our first step in the project was to work with the KCC Staff to define a specific project plan. The initial plan was based on our review of a document created by the KCC Staff titled “Staff Summary of Kansas Corporation Commission General Authority and Policy for Energy Efficiency Programs”, combined with our interpretation of the most effective means of addressing the key issues described therein.

Shortly following the creation of the initial project plan, we conducted meetings on January 11-12, 2010 with representatives from each stakeholder organization, including:

- KCC Staff;
- Westar Energy ("Westar");
- Kansas City Power and Light ("KCP&L");
- Midwest Energy ("Midwest");
- Citizens' Utility Ratepayer Board ("CURB"); and
- Each Commissioner, in separate meetings.

---

[1] In order for the KCC Energy Office (now Energy Division) to accept ARRA funds from the DOE funding opportunity DE-FOA-0000052, Governor Sebelius issued a signed assurance on April 24, 2009 providing written notice that Kansas will comply with and obtain the following assurances in accordance with Section 410 of the Recovery Act:

> (1) The applicable State regulatory authority will seek to implement, in appropriate proceedings for each electric and gas utility, under its ratemaking authority a general policy that ensures that utility financial incentives are aligned with helping their customers use energy more efficiently and that provide timely cost recovery and a timely earnings opportunity for utilities associated with cost-effective measurable and verifiable efficiency savings, in a way that sustains or enhances utility customers' incentives to use energy more efficiently.

Energy Efficiency and Energy Conservation is a policy sanctioned by the Commission. Rate design may have a direct impact on energy conservation. Historically, when electric utilities had excess capacity, rates were designed to encourage consumption through declining block rates and discounts for certain types of services. Today, the standard is that rates should be designed so that the customer pays the full cost of electricity consumed.

During these meetings, we discussed the objectives and concerns of each stakeholder regarding the modification of electric rate structures; obtained information about current rates and metering capabilities (some rate structures require advanced meters); solicited views regarding revenue recovery methods (e.g., revenue decoupling); and reviewed current customer education practices.

Based on the feedback obtained from these meetings, CA Energy Consulting worked with the KCC Staff to revise the project plan. The two primary components of the final project plan were to conduct workshops on the following topics:

- Rate design, which occurred on April 15, 2010; and
- Customer education, which occurred on May 18, 2010.

In addition, the plan called for a study of the effect of alternative rate designs on residential customers (i.e., expected bill impacts and usage changes) to be conducted following the rate design workshop. A follow-up workshop was conducted on February 24, 2011 to present the results of this study to the stakeholders.

Additional areas of interest were developed with the KCC Staff as the project continued, including:

- A rate study for commercial and industrial ("C&I") customers;
- A report describing the various issues associated with electric vehicles ("EV");
- Assistance to the KCC Staff with customer outreach (i.e., the marketing and processing of home energy audits);
- Assistance to the KCC Staff in describing a specific cost-of-service allocation method; and
- Assistance to the KCC Staff in switching from a Wright Rate (or "hours-of-use" rate) structure to a basic customer charge, demand charge, and energy charge structure.

The remainder of this report summarizes each of these project elements.[2] The three studies created as part of this project (the residential rate study, the C&I rate study, and the EV primer) are provided as appendices.

After this introductory section, Section 2 describes the rate design workshop, residential rate study, and subsequent study results workshop. Section 3 summarizes the C&I rate study. Section 4 describes the EV rate primer. Section 5 describes the four other areas of assistance provided to the KCC during the project. Section 6 provides a summary and conclusions.

[2] Opinions expressed in the reports are those of Christensen Associates Energy Consulting and do not necessarily reflect those of the Commission or its staff.

2. Rate Design Workshop and Residential Rate Study

2.1 Rate Design Workshop

On April 15, 2010, CA Energy Consulting conducted a workshop on electricity rate design alternatives. Participants in the workshop included utility representatives (from both electric and natural gas utilities), KCC Staff, the KCC Commissioners, and a variety of other stakeholder organizations (e.g., CURB, AARP, and Wal-Mart).

The objective of this workshop was to provide participants with an introduction to the project as a whole and an overview of electricity rate design issues. The beginning of the workshop focused on developing rate design objectives, for which the "Bonbright Principles" are a common source. A discussion period followed the presentation, which allowed CA Energy Consulting to obtain feedback from the workshop participants regarding their objectives when considering the adoption of alternative rate structures.

CA Energy Consulting then described rate structures that have been used elsewhere and/or could be considered for use in Kansas. These included the following:

- Flat rates;
- Block rates;
- Demand and energy rates;
- Hours-of-use rates;
- Seasonal rates;
- Time-of-use ("TOU") rates;
- Straight-fixed variable ("SFV") rates;
- Day-type TOU rates;
- Critical peak pricing ("CPP") rates;
- Peak-time rebate ("PTR");
- Real-time pricing ("RTP"); and
- Interruptible/Curtailable rates.

The methods of evaluating each rate structure were then presented, which include: calculating customer bill impacts at current loads; simulating customer usage changes in response to the new price signals (which may then be used to calculate post-response bill impacts and utility benefits from demand response); and evaluating the implementation costs associated with each rate structure.[3]

The workshop concluded with a discussion of the rate structures presented earlier, and each participant was asked to complete a survey on their views of the rate structures. The results of these surveys assisted in the determination of the rate structures that were subsequently examined in the residential and C&I rate studies.

[3] For example, some rate structures, such as RTP, require meters that collect hourly usage data, whereas current meters may collect only total usage in between meter reads.

2.2 Residential Rate Study

The next step in the project was to conduct a study that evaluated a variety of alternate rate structures for residential customers at KCP&L, Westar, and Midwest using data provided by each utility. The rate structures included in the study are:

- Flat rate;
- Straight-fixed variable (SFV) rate;
- Inclining block rate (IBR);
- Time-of-use (TOU) rate; and
- Day-type TOU rate.

The flat rate is included primarily as a reference case, in which the price does not vary by time or with the level of customer use. SFV rates address the utility's incentive to promote conservation and energy efficiency by increasing the fixed monthly customer charge and reducing the throughput volumetric rate, thereby recovering all utility fixed costs through fixed charges rather than through volumetric rates. An IBR is intended to provide an incentive to conserve by increasing the rate a customer pays as its usage level increases. TOU rates are intended to provide efficient price signals by charging rates that are based on the average cost to serve customers. TOU rates therefore give customers an incentive to reduce usage during high-cost hours (e.g., summer afternoons) and increase usage during low-cost hours (e.g., overnight hours). Day-type TOU rates add a "dynamic" component to TOU rates that provides customers with a significant incentive to reduce usage on the hottest, most costly days to serve them.

Each of these rate structures affects customers differently depending on their usage levels and patterns. The relationship between bill impacts and customer usage levels is of interest because stakeholders often wish to avoid adverse bill impacts for low-income customers, and low-income customers are often believed to use less electricity than other customers. The advantages and disadvantages of each rate structure are described in the attached study report.

Research Approach

The following steps were used to evaluate the alternative rate structures of interest:

1) Design revenue-neutral alternative residential rates for each utility;
2) Estimate customer-level bill impacts for each rate structure at historical loads;
3) Evaluate the relationship between bill impacts and customer usage levels;
4) Simulate the changes in customer usage levels and patterns (i.e., "demand response") in response to the new rate structures; and
5) Estimate the potential for utility revenue loss (revenue attrition) due to mispricing the new rate options.

Design revenue-neutral alternative residential rates for each utility: Separate revenue-neutral rates were designed for each utility using utility-specific residential customer usage data and Southwest Power Pool (SPP) price data (to design the TOU and day-type TOU rates). The rates were designed so that they produced the same amount of total revenue as the current rate produces.

Estimate customer-level bill impacts for each rate structure at historical loads: Each customer's bill was calculated for both their current rate and each alternative rate structure using historical loads.

Evaluate the relationship between bill impacts and customer usage levels: To evaluate the relationship between bill impacts and customer usage levels, the bill impacts are displayed as scatter plots against each customer's average monthly usage (in kWh). This allows for an easy examination of how bill impacts vary with customer usage level.

Simulate customer demand response to each rate structure: Simulation was used to estimate the changes in load that could be expected from each rate structure. We used evidence from existing studies on customer price responsiveness to provide estimates of the potential magnitude of the load changes (which, depending on the rate, could be an overall increase, an overall reduction, or shifting from high- to low-cost hours) that might be expected from each rate structure.

Estimate the potential for utility revenue loss (revenue attrition) due to mispricing the new rate options: The final step was to examine the potential for utility *revenue attrition*, or lost revenues, due to self selection and demand response. Revenue attrition due to *customer self selection* can occur when the utility sets rates without accounting for the tendency of customers to select the rate that is most beneficial for them (i.e., gives them the lowest bill). Revenue attrition due to *customer demand response* can occur when the utility sets rates using historical load profiles but customers modify their usage patterns in response to the pricing signals of their new rate.

Research Implementation

We used utility-specific customer data to calculate bill impacts for each rate structure. KCP&L and Westar provided us with 2007 hourly data from their residential load research samples. Midwest did not have a load research sample, and instead provided us with 2009 monthly billing data for its residential customers.

The rates within the alternative structures were set to produce the same total revenue as the existing base residential rate for the available sample customers. Therefore, the first step in the rate design process was to calculate the total revenue (accounting for the sample weights) from the base residential rate. The assumptions used when setting the rates were (a) all customers are on the rate (i.e., there is no customer selection issue), and (b) the historical load profiles are retained (i.e., we ignore the potential effect of demand response on customers' usage and bills).

For each of the rate structures, we calculated customer-level bills using the available customer-level load data, the "base" residential rates, and the newly designed rates. We then calculated "instant" bill impacts, which are the bill impacts before the customers modify their load profiles in response to the new price signals. For ease of analysis, scatter plots of bill impacts verses customer's average monthly usage were used. For some of the rate structures, such as IBR or SFV, the bill impacts are strongly related to customer size. For others, such as TOU, this is not the case.

Research Results

Bill Impacts

Tables 2.1 through 2.3 provide results that summarize the bill impact analyses. Four statistics are provided for each utility and rate structure:

- The share of customers that experienced a bill increase of 10% or more on the new rate structure;
- The share of customers that experienced a bill decrease of 10% or more on the new rate structure;
- The average percentage bill impact for customers who use an average of 500 kWh per month or less; and
- The average percentage bill impact for customers who use an average of 2,000 kWh per month or more.

These statistics are intended to facilitate comparisons of bill impacts across rate structures and utilities. Following are the key observations from these tables:

- The flat, TOU, and day-type TOU rates do not produce large percentage load impacts for very many customers (as shown in the "Greater than 10% column").
- The bill impacts for the flat, TOU, and day-type TOU rates are not strongly related to customer usage levels (as illustrated by the similarity of the average bill impacts in the "Low Use " and "High Use" columns).
- The high customer charge in the SFV rate leads to large bill increases for low-use customers (e.g., 27.4 percent for KCP&L's low-use customers). The percentage bill decreases for high-use customers on this rate structure are smaller in magnitude (e.g., 5.7 percent for KCP&L's high-use customers).
- Despite the fact that IBR and SFV have opposite effects by customer usage levels, combining the two rate structures is not enough to offset SFV's adverse bill impacts for low-use customers.

Table 2.1: Summary of Residential Bill Impacts by Rate Structure, *KCP&L*

Rate Structure	Share of Customers by Bill Impact Amount		Average Bill Impact by Customer Usage	
	Greater than 10%	Less than -10%	Low Use (<500 kWh/mo.)	High Use (>2,000 kWh/mo.)
Flat rate	1.3%	0.0%	0.1%	0.6%
SFV	15.1%	0.0%	27.4%	-5.7%
IBR	4.9%	0.0%	-6.6%	10.4%
IBR + SFV	3.9%	0.0%	21.2%	2.6%
TOU	0.3%	0.0%	-0.5%	-0.2%
Day-type TOU	0.3%	0.0%	-0.5%	-0.5%

Table 2.2: Summary of Residential Bill Impacts by Rate Structure, *Westar*

Rate Structure	Share of Customers by Bill Impact Amount		Average Bill Impact by Customer Usage	
	Greater than 10%	Less than -10%	Low Use (<500 kWh/mo.)	High Use (>2,000 kWh/mo.)
Flat rate	0.0%	0.0%	-0.1%	2.6%
SFV	35.9%	6.6%	46.6%	-10.1%
IBR	5.6%	0.0%	-1.5%	8.9%
IBR + SFV	28.8%	0.0%	42.2%	-4.8%
TOU	0.0%	0.0%	0.1%	1.9%
Day-type TOU	0.0%	0.0%	1.4%	1.5%

Table 2.3: Summary of Residential Bill Impacts by Rate Structure, *Midwest*

Rate Structure	Share of Customers by Bill Impact Amount		Average Bill Impact by Customer Usage	
	Greater than 10%	Less than -10%	Low Use (<500 kWh/mo.)	High Use (>2,000 kWh/mo.)
Flat rate	0.0%	0.0%	-2.2%	3.9%
SFV	19.5%	0.4%	20.7%	-8.8%
IBR	6.0%	0.0%	-7.3%	17.9%
IBR + SFV	13.7%	0.0%	16.7%	1.9%

The customer-level bill impacts shown above are those that occur before customers take actions to adapt to the new rate structures (e.g., by shifting or reducing load). Of course, the goal of most of these rate structures is to provide customers with incentives to change behavior. The primary incentive goal of each rate structure can be summarized as follows:

- **SFV:** Eliminates the utility's disincentive to encourage conservation and energy efficiency. As a side effect, SFV reduces the customer-level incentive to conserve because the volumetric rate has been reduced.
- **IBR:** Discourages increases in consumption levels, particularly for high-use customers who face the high tail-block price. Note that low-use customers may experience a *decrease* in their incentive to conserve because they face the relatively low initial block price.
- **TOU:** Encourages customers to shift intra-day load from peak to off-peak hours.
- **Day-type TOU:** Builds upon standard TOU by providing added incentives to reduce usage on high-cost days.

Demand Response

To evaluate the potential magnitude of the usage changes described above, we developed simple elasticity-based models to simulate the changes in usage for each of these rate structures. The results of these simulations show that SFV leads to small increases in overall usage; IBR leads to small decreases in overall usage; TOU leads to decreases in peak-period usage and increases in off-peak period usage; and day-type TOU produces larger shifts of usage from peak to off-peak periods on higher-priced days.

Revenue Attrition
Finally, the report examined the potential for utility revenue attrition (recovering less revenue than forecast) due to customer self selection and demand response. That is, when the utility sets the rates for an optional pricing program, it does not know which customers will select the rate, or how the customers who select the rate will modify their load profiles in response to the new price signals. Our analysis provided an indication of the scale of this potential problem by assuming that customers select the rate that provides them with the lowest bill (customer self selection); and by simulating customer demand response using a range of price responsiveness parameters (i.e., price elasticities). The results indicated that both types of revenue attrition (i.e., due to customer self selection and demand response) are more pronounced for SFV and IBR than they are for TOU and day-type TOU.

2.3 Residential Rate Study Results Workshop

On February 24, 2011, CA Energy Consulting conducted a workshop to present the residential rate study. The workshop provided a review of some material from the previous rate design workshop (to ensure that attendees understood the rate structures that were evaluated), and a description of the data, methods, and results from the rate study. During the final portion of the workshop, we proposed a C&I rate study that could be conducted using methods similar to those used in the residential rate study.

Participants were encouraged to provide feedback regarding the residential rate study, the proposed C&I rate study, and other areas of inquiry that interested them. Both KCP&L and Westar provided feedback following the meeting. The input we received encouraged us to proceed with the C&I rate study (discussed in Section 3) and to begin planning for an additional study addressing electric vehicle pricing issues (discussed in Section 4).

3. Commercial and Industrial Rate Study

The C&I rate study analyzed the effects associated with adopting time-of-use (TOU) and critical peak pricing (CPP) rates for Small and Medium General Service customers at KCP&L and Westar.[4] CPP programs provide customers with incentives to reduce usage during the hours of greatest need. This is accomplished by charging a high "critical" price on event days, which are called with day-ahead notice. Event days are typically hot summer days when a high level of customer demand increases the cost to serve customers. The resulting usage reductions can replace the need for additional peaking generation, allowing for the most efficient use of existing generating resources. TOU rates provide the foundation for the CPP program, serving as both the basis for the CPP rates on non-critical days and the alternative rate for customers who do not want to be exposed to critical prices.

The study used customer-level hourly usage data to examine the following criteria:

- The distribution of customer-level bill impacts;
- The expected magnitude of customer usage changes on CPP event days;

[4] Midwest Energy was not included in the study because they do not have hourly load data for their C&I customers, which are required in order to examine the effects of time-varying rates.

- The extent to which the utility can lose revenue (revenue attrition) because of customer self-selection (or the tendency for customers to select the rate that is best for them); and
- The extent to which the utility can lose revenue because of customer demand response (or customers modifying their load profiles in response to the price signals contained in the TOU and CPP rates).

The use of customer-level data provides a means of analyzing the outcomes that may occur under *default* CPP pricing, in which customers are automatically placed on the CPP rate, but allowed to switch to an alternative TOU rate instead.

Research Approach

The methods used in the C&I study were very similar to those used in the residential study. Specifically, the following steps were taken:

1) Design revenue-neutral alternative C&I rates for each utility and rate class (Small General Service, or SGS; and Medium General Service, or MGS);
2) Estimate customer-level bill impacts for each rate structure at historical loads;
3) Evaluate the relationship between bill impacts and customer usage levels;
4) Simulate the event-day demand response to CPP rates; and
5) Estimate the potential for utility revenue loss (revenue attrition) due to mispricing.

Design revenue-neutral alternative C&I rates for each utility and rate class: Separate TOU and CPP rates were designed for each utility and rate class. A difference from the residential study is that current C&I rates contain demand charges (i.e., a dollar-per-kW charge applied to the customer's maximum demand in the current month), whereas the residential rates do not. Because alternative rates could be designed to preserve, reduce or eliminate the demand charge, we examined a range of scenarios. Some scenarios eliminated the demand charge entirely, shifting a significant amount of revenue recovery to the energy prices. The results for these scenarios typically had the broadest range of bill impacts across customers. Other scenarios included the full demand charge (including the facilities charge) contained in the Small General Service ("SGS") and Medium General Service ("MGS") tariffs. For the KCP&L MGS customers, we were able to examine an intermediate scenario in which customers are charged only the facilities charge. In all cases, the proposed rates were designed to be revenue neutral at the class level (relative to the SGS and MGS rates). However, the bill impacts were allowed to vary within each customer class.

Estimate customer-level bill impacts for each rate structure at historical loads: For each customer, monthly bills were calculated for the current rate, TOU rate, and CPP rate. This step was conducted in the same fashion as the residential rate study.

Evaluate the relationship between bill impacts and customer usage levels: Scatter plots were used to illustrate the relationship between percentage bill impacts and customer usage levels.

Simulate the event-day demand response to CPP rates: Customer response to the CPP rates was simulated in two steps. In the first step, usage is shifted from expensive critical hours to lower-cost hours. This is based on an *elasticity of substitution* drawn from existing studies. In the second step, the overall load profile is shifted down to account for the increase in total expenditures on critical days. This is based on an *overall elasticity* value derived from previous research.

Estimate the potential for utility revenue loss (revenue attrition) due to mispricing: The potential for utility revenue attrition was assessed by examining revenue loss under two scenarios: (a) Short-run where each customer selected the rate with the lowest bill; and (b) Long-run where customers have modified their usage level and profile in response to the CPP rate.

Research Implementation

The study used 2007 hourly usage data for 540 Small General Service ("SGS") and Medium General Service ("MGS") customers at KCP&L and Westar. The CPP and TOU rates were designed to be revenue neutral to the current rate at the class level. This was accomplished by calculating each customer's bill on the current rate using the historical load data, then setting the CPP and TOU rates to obtain the same level of total revenue, accounting for sample weights provided by the utilities. The assumptions used when setting the rates were (a) all customers are on the rate (i.e., there is no customer selection issue), and (b) the historical load profiles are retained (i.e., we ignore the potential effect of demand response on customers' usage and bills).

Research Results

Bill Impacts

Tables 3.1 and 3.2 summarize the bill impacts as customers move from their current rate to the TOU and CPP rates, respectively. Results are separated by rate class, utility, and the treatment of the demand charge.

The key bill impact findings may be summarized as follows:

- Low-use customers tend to experience bill decreases, while higher use customers tend to experience bill increases as they move from SGS or MGS to TOU or CPP (as shown in the "Average Bill Impact by Customer Usage" column). This is because the existing SGS and MGS tariffs tend to provide lower average rates to lower-use customers, and the rate structures that produce this effect are not carried over into the TOU and CPP rates.
- Bill impacts for TOU and CPP rates (as customers migrate from the SGS and MGS tariffs) are very similar and tend to be relatively small in magnitude. Even in the scenarios with the most dispersed load impacts, approximately half of the customers experience a bill change of less than 10 percent. An implication of this is that the introduction of critical days does not significantly affect customer bills.

Table 3.1: Summary of C&I Bill Impacts, *Current Tariff to TOU Rates*

Rate Class	Utility	Include Demand?	Share of Customers by Bill Impact Amount		Average Bill Impact by Customer Usage	
			Greater than 10%	Less than -10%	Low Use	High Use
SGS	KCP&L	No	24%	25%	-6%	10%
		Yes	24%	24%	-5%	10%
	Westar	No	0%	20%	-3%	2%
		Yes	0%	37%	-9%	0%
MGS	KCP&L	No	27%	16%	-17%	8%
		Yes	0%	3%	-4%	2%
		Facilities	3%	12%	-11%	5%
	Westar	No	29%	23%	-85%	11%
		Yes	0%	0%	0%	-1%

Table 3.2: Summary of C&I Bill Impacts, *Current Tariff to CPP Rates*

Rate Class	Utility	Include Demand?	Share of Customers by Bill Impact Amount		Average Bill Impact by Customer Usage	
			Greater than 10%	Less than -10%	Low Use	High Use
SGS	KCP&L	No	25%	24%	-7%	10%
		Yes	24%	24%	-5%	10%
	Westar	No	1%	20%	-4%	2%
		Yes	0%	36%	-10%	0%
MGS	KCP&L	No	29%	14%	-18%	8%
		Yes	0%	1%	-5%	2%
		Facilities	0%	12%	-11%	4%
	Westar	No	29%	25%	-85%	9%
		Yes	0%	0%	0%	-2%

Demand Response

Tables 3.3 and 3.4 show the percentage load changes by CPP pricing period using the simulation methods described above. These tables reflect the results assuming customer price responsiveness (i.e., elasticity values) from the California Statewide Pricing Pilot (CSPP), which is one of the only formal studies of C&I customer load response to CPP rates. As a sensitivity analysis, we simulated results based on elasticity values half as high as those of the CSPP.[5] The results showed that if the elasticities are reduced by half, the resulting load response percentages and revenue attrition amounts are also reduced by half.

Load reductions during critical hours range from 8.7 percent to 11.4 percent across the simulations (or 4.4 percent to 5.7 percent using the halved elasticity values).[6] In some

[5] A 2005 RAND study of commercial customer response to changes in overall prices (Mark A. Bernstein and James Griffin, "Regional Differences in the Price-Elasticity of Demand for Energy", 2005) found higher levels of price responsiveness in California's census region than in Kansas' census region. While these results are not directly relevant to CPP load response, they provide some motivation to examine cases in which the price elasticities are lower than those found in the CSPP.
[6] The critical price is $0.50 per kWh, except for the Westar scenarios that include a demand charge, in which case it is $0.30 per kWh.

cases (e.g., for KCP&L's MGS customers), customers *increase* usage during off-peak hours as they shift away from higher-cost time periods. In the cases in which off-peak usage goes down, the overall elasticity effect (due to the increase in overall expenditures because of the critical prices) leads customers to reduce overall usage enough to more than offset the load shifting into the off-peak hours.

Table 3.3: TOU to CPP Usage Changes, *KCP&L*

Customer Group	Include Demand Charge?	Pricing Period		
		Critical	Peak	Off-peak
SGS	No	-8.7%	-2.3%	-0.2%
	Yes	-8.7%	-2.3%	-0.2%
MGS	No	-9.1%	-1.5%	0.4%
	Yes	-10.1%	-1.0%	0.2%
	Facilities Only	-9.5%	-1.3%	0.3%

Table 3.4: TOU to CPP Usage Changes, *Westar*

Customer Group	Include Demand Charge?	Pricing Period		
		Critical	Peak	Off-peak
SGS	No	-10.0%	-0.5%	0.6%
	Yes	-8.7%	-1.0%	0.7%
MGS	No	-11.4%	-0.7%	0.5%
	Yes	-10.8%	-0.9%	0.6%

Revenue Attrition

Tables 3.5 and 3.6 show the results of the analysis of the potential for utility revenue loss due to customer self selection and demand response.[7] These scenarios were set up as "worst-case" scenarios, in which every customer selects the rate that provides the lowest bill (in the case of customer self-selection) and the utility does not set prices accounting for demand response. Even so, only the demand response analysis for KCP&L's SGS customers produces an estimate of revenue loss in excess of 1 percent. Note further that these revenue losses can be almost entirely mitigated by having a rate case to reset rates based on the observed customer participation and billing determinants after the new rates have been made available.

[7] The revenue attrition in dollars is calculated using class-level revenues from each utility's most recent rate case. The revenue values in millions of dollars are: KCP&L SGS = $36.5; KCP&L MGS = $66.0; Westar SGS = $233.8; Westar MGS = $188.2.

Table 3.5: Revenue Attrition Due to Customer Self-Selection

Rate Class	Utility	Include Demand?	% Revenue Attrition	Revenue Attrition ($000)
SGS	KCP&L	No	0.46%	$168
		Yes	0.46%	$168
	Westar	No	0.95%	$2,221
		Yes	0.53%	$1,239
MGS	KCP&L	No	0.45%	$297
		Yes	0.49%	$324
		Facilities	0.47%	$310
	Westar	No	0.89%	$1,675
		Yes	0.53%	$997

Table 3.6: Revenue Attrition Due to Customer Demand Response

Rate Class	Utility	Include Demand?	% Revenue Attrition	Revenue Attrition ($000)
SGS	KCP&L	No	1.26%	$460
		Yes	1.25%	$457
	Westar	No	0.67%	$1,566
		Yes	0.36%	$842
MGS	KCP&L	No	0.79%	$522
		Yes	0.72%	$475
		Facilities	0.75%	$495
	Westar	No	0.73%	$1,374
		Yes	0.38%	$715

The results have shown the benefit of introducing CPP rates, in the form of approximately 5 to 10 percent usage reductions during critical hours, depending on the assumed level of customer price responsiveness. The largest portion of the bill impact associated with introducing CPP rates is due to removing incentives to grow (and/or flatten) loads in the existing SGS and MGS rates. The critical prices themselves do not have a large effect on customer bills. In addition, utility revenue attrition does not appear to be a significant barrier to the adoption of CPP.

4. Electric Vehicle Rate Primer

Based on interest expressed by the KCC Staff and Westar, CA Energy Consulting prepared a report that addresses issues that the proliferation of electric vehicles may raise for electric utilities.

EVs have considerably lower fuel costs per mile and emissions per mile than do conventional gasoline-fired vehicles. Virtually all of the major automobile manufacturers are now producing, or will soon produce, EVs. The prospect of many millions of EVs reaching the road over the next two decades has the electric power industry considering the logistical issues that need to be addressed to accommodate the repetitive charging of EV batteries. Among these issues are questions concerning how utilities can best set rates that will recover the costs of producing and delivering electricity for EVs.

The EV study provided a brief overview of the electricity ratemaking issues raised by EVs and methods by which U.S. utilities are presently setting EV rates. The topic areas addressed in the study include:

- Key EV ratemaking issues;
- An overview of current utility EV ratemaking practices; and
- Observations relevant to EVs in the context of Kansas' electricity market.

The report adopts a question and answer format, where the question posed in each sub-section addresses a potentially important EV topic. Below is a summary of some of the key questions addressed in the primer.

4.1 Key EV Ratemaking Issues

Why do EVs warrant special rate treatment?

For any individual utility, the pricing of the electricity used by EVs should generally adhere to the same rate-treatment agreements as have been reached for other electricity uses. Nonetheless, special treatment of EV electricity usage may be warranted by differences in the costs of serving EVs relative to other electricity uses.

First, the time pattern of electricity consumption by EVs is likely to be different from that of most other electricity uses. Ideally, electricity prices for all types of electricity use would vary by hour in accordance with hourly variations in the marginal costs (or market prices) of electrical energy production and generation operating reserves.

Second, EV charging by many households or businesses in a particular neighborhood or other area may require upgrades in the distribution systems (and, less probably, in the transmission systems) that serve that area. For the purposes of fairness and discouragement of high local peak loads, prices of service to EV customers should arguably reflect these prospective or actual upgrade costs.

Third, electricity offers externality benefits relative to other transportation fuels. In principle, it would be best if the costs of the air pollution, water pollution, and national defense, for example, were incorporated into fuel costs through mitigation requirements, taxes, and cap-and-trade schemes applicable to the relevant pollutants and fuels. Incorporation of these externalities into fuel costs would allow consumers to see, in relative fuel prices, the full benefits of EV relative to other transportation choices. In practice, however, the incorporation of these externalities into fuel costs – through SO_x and NO_x markets, for example – is only partial.

For the purposes of environmental benefit and efficiency, it may therefore be reasonably argued that EV owners should be subsidized to the extent that the value of externalities is not incorporated into relative fuel prices. Such subsidies would accrue to EV owners in the forms of reduced electricity prices or payments for part of their charging equipment capital costs; and utilities would recover the costs of these subsidies through higher prices paid by all other electricity customers. Of course, placing monetary values on externalities is difficult and often controversial; so legislatures and regulators almost always implement pro-environmental policies with arbitrary rules that are not supported by any explicit valuation of externalities.[8]

What types of time-variant rates should be offered to EV owners?

There are two basic choices of time-variant rates. First, EV electricity rates could change hourly to reflect day-ahead marginal costs or market prices of electricity. This approach would give the most accurate price signal. Second, EV electricity rates could change on a time-of-day and seasonal basis to reflect marginal costs or market prices of electricity as forecast before the beginning of each rate year. This time-of-use rate could be the same as applies to the customers' non-EV loads, or it could be specially tailored for EV loads.

Should utilities build, own, and operate public charging infrastructure?

Utilities certainly need to build, own, and operate the distribution systems that support the public charging infrastructure. If the distribution system costs incurred to provide such support is significant, these costs should be borne by the beneficiaries of these systems. This implies that either: (a) EV rates should vary by location; or (b) there need to be special tariffs for public charging stations that would allow utilities to recover the costs of their distribution system support.

Whether utilities need to build, own, and operate the public charging stations themselves is a very different issue. Such a need could arise only if there are some "economies of scope" that would give utilities greater expertise or lower costs in running public charging stations than could be expected of unaffiliated enterprises running such stations. We are not aware of any reason that such economies of scope might exist. On the contrary, it seems that the expertise needed to run public charging stations is quite different than that needed to run a power system, and that allowing public charging stations to be run by non-utility enterprises would encourage competition that would provide customers with consumer-responsive charging services at least cost.

4.2 Overview of Current Utility EV Ratemaking Practice

We have identified eleven utilities in five states that have tariff schedules that are specifically designed for electric vehicle charging.[9] Table 4.1 lists these utilities and their tariffs. Most of these tariffs apply to residential customers only. The few tariffs that apply to non-residential general service (GS) customers usually limit their applicability to customers with peak demands of 500 kW or less. While most of the tariffs are permanent, nearly half are experimental. The Exp column indicates, with a "yes" or a number, whether tariffs are experimental: where the tariff specifies a maximum number of customers who may participate in the experimental rate, the number in the Exp column indicates that maximum.

In addition to the utilities identified in the table, we have found two utilities – Portland General Electric in Oregon and Progress Energy in Florida, North Carolina, and South Carolina – who specifically say that their customers take EV charging service through their standard non-EV rates, and that EV customers have the option of requesting the time-of-

[8] Present Kansas Corporation Commission policy does not incorporate externalities into pricing.
[9] We do not claim that these are the only EV tariffs that are presently being offered in the U.S.

use rate applicable to their customer class. In addition, some utilities, like Consumers Energy in Michigan, offer EV rates but nonetheless allow customers to take EV charging service through their standard non-EV rates.

Table 4.1: Electric Vehicle Utility Tariffs

State	Utility	Schedule	Class	Exp
Alabama	Alabama Power	BEVT	GS	
California	Pacific Gas and Electric	E-9A	Res	yes
		E-9B	Res	yes
	Sacramento Municipal Utility District	GS-TOU2	GS	
		RTEV	Res	
	San Diego Gas & Electric	EPEV-X	Res	1,000
		EPEV-Y	Res	1,000
		EPEV-Z	Res	1,000
		EV-TOU	Res	
		EV-TOU-2	Res	
	Southern California Edison	TOU-D-TEV	Res	
		TOU-EV-1	Res	
		TOU-EV-3	GS	
Georgia	Georgia Power	TOU-PEV-1	Res	
Michigan	Consumers Energy	REV-1	Res	yes
		REV-2	Res	yes
		REV-3	Res	250
	Detroit Edison	D1.7	Res	
		D1.7	GS	
		D1.9-1	Res	2,500
		D1.9-2	Res	yes
	Indiana Michigan Power	RS-OPES/PEV	Res	yes
Nevada	Nevada Power	GSHEVRR–TOU	GS	
		RHEVRR–TOU	Res	
	Sierra Pacific Power	OD-RHEVRR–TOU	Res	
		OGS-HEVRR	GS	

4.3 Observations about Kansas

The final section of the EV report contains observations on Kansas, including a description of EV-related efforts undertaken to date, data on EV adoption rates, and an examination of recent Southwest Power Pool data to illustrate the typical ratio of peak to off-peak TOU rates that may be used in an EV rate. A TOU rate (in which prices vary by time of day and perhaps by season) may be used to reflect the cost to serve EV customers, who may be likely to charge their vehicle during lower-cost, overnight hours.

5. Other Assistance

In addition to the major areas of effort described in the previous sections, CA Energy Consulting assisted KCC Staff in four additional areas during the course of the project, as described below.

5.1 Customer Education Workshop

In addition to rate design issues, customer education regarding energy use was an area of interest for the KCC and the stakeholders. On May 18, 2010, CA Energy Consulting coordinated a workshop in which a variety of experts in the field presented information on a variety of relevant issues. The presenters and topics included the following:

- Dan York of the American Council for an Energy-Efficient Economy ("ACEEE") described the state of social marketing efforts in the area of energy efficiency and demand response;
- Bruce Ceniceros of the Sacramento Municipal Utility District ("SMUD") described the energy efficiency programs in place at his utility;
- Anthony Star of the Illinois Commerce Commission (formerly of the Center for Neighborhood Technology, or "CNT") described residential programs, such as RTP, that have been fielded by CNT;
- Hunt Alcott of New York University presented a study he conducted of the effect of social comparisons on customer usage. Specifically, he studied the effect of electricity usage comparisons that a company called OPOWER provided to residential customers in various markets; and
- Jane Peters of Research Into Action discussed methods for evaluating community education programs.

The workshop concluded with group discussions regarding what the workshop participants want community-based programs to accomplish and the types of programs that participants thought should be offered. Suggestions included offering home energy displays, realtor education programs, home weatherization programs, and smart thermostat deployment.

5.2 Customer Outreach Assistance

In July 2010, Cara Lee Mahany Braithwait of CA Energy Consulting assisted KCC Staff with the processing and marketing of home energy audits. Shortly after the award of the multi-million dollar grant to Efficiency Kansas, Ms. Braithwait was asked to come to the KCC Energy Office and help jump start the project. This included an assessment and recommendation regarding an organizational structure that would be needed to provide timely and efficient assistance in rolling the program out. Specifically, she inventoried staff resources—including technical, marketing and staff support, existing process plans, private business and utility connections/resources—and mapped these resources to necessary tasks. She also identified areas that needed to be immediately changed to allow for program monitoring and evaluation. She worked with staff to develop an action plan for staffing, what, if any, software they needed, website presence, and advised a strong push to let the private market take the lead in moving the program forward. She also provided milestones to help them identify when they had outgrown the initial roll-out campaign.

5.3 Education on a Cost-of-Service Allocation Factor

In October 2011, at Staff's request, Michael O'Sheasy of CA Energy Consulting presented a description and explanation of the Base Intermediate Peak (BIP) allocation factor used in utility cost-of-service studies. The BIP allocator was utilized in a recent KCP&L rate case, creating a need for KCC Staff to improve their understanding of the method.

5.4 Education on the Transition from a Wright Rate to a Conventional Rate

At the request of the KCC Staff, Michael O'Sheasy of CA Energy Consulting provided a spreadsheet and PowerPoint presentation explaining how to transition from a customer rate based on hours-of-use (i.e., a "Wright rate", in which the customer's energy rate is tied to its non-coincident peak demand) to a conventional customer rate with a customer charge, demand charge, and an energy charge. KCC Staff was able to use this technique in the Empire Rate Case (Docket No. 11-EPDE-856-RTS) to transition from a Wright Rate to the conventional customer rate structure.

6. Summary and Conclusions

This project was intended to provide Kansas with information required to meet a potential need for electricity conservation and demand response. The motivation for pursuing these goals can vary across stakeholders. Conservation may be desirable because of concerns about the environmental effects associated with generating electricity, or in order to minimize electricity fixed costs (and therefore customer bills) by reducing the need to add new generating capacity. Similarly, demand response can delay or prevent the need for adding expensive peaking generation and reduce short-term wholesale energy costs by reducing the demand for electricity during the most constrained hours.

At the current time in Kansas, the need for rate structures that encourage conservation and/or demand response is mitigated by two factors:

1. A surplus of generating capacity in the region, and the resulting low wholesale electricity prices; and
2. A lack of metering equipment in place to implement dynamic rate structures (i.e., those for which retail prices vary with system conditions).

Because of these factors, we encountered little urgency to implement the rate structures studied as part of the project. However, this project has provided Kansas with information to assist it in addressing issues that may arise in the future. For example, an economic recovery may reduce or eliminate the surplus generating capacity, creating a need for rates that reflect market costs in real time. In addition, advanced metering may be deployed by utilities to reduce metering costs and improve their ability to monitor and resolve system outages. These meters may allow the utilities to implement dynamic or other time-varying rates at low costs compared to current levels.

Some of the recommendations that have emerged from our research serve as a conclusion to this study:

- If the need for demand response increases (e.g., because of an increase in peak-period usage relative to generating capacity), day-type TOU rates (for residential customers) and critical peak pricing rates (for C&I customers) can be used to turn customers into "virtual generators". By providing customers with incentives to reduce usage during the highest-cost hours, these rate structures can reduce electricity costs for all users and forestall the need to add peaking generating capacity.

- If straight-fixed variable ("SFV") rates are proposed as a means of mitigating utility cost recovery issues in the face of conservation (whether it was mandated or initiated by consumers), stakeholders should be aware of the adverse load impacts that would be incurred by low-use customers. To the extent that low-use customers are also low-income customers, concerns may be raised regarding the distributional effect of using SFV rates.[10]
- We recommend that Kansas offer electric vehicle tariff rates (if the demand for electric vehicles is sufficient to warrant them) that are differentiated by time of day, and perhaps by time of year, in rough correspondence with forecast time variations in SPP energy prices.

[10] The relationship between usage and bill impacts could be mitigated by "tiering" the customer charge, such that lower use customers pay lower customer charges. However, this method should be implemented in a manner that prevents customers from frequently changing tiers (and thus being exposed to variations in the monthly customer charge).