I. INTRODUCTION

In Kansas City Power & Light Company's (KCP&L or Company) 2014 rate case (ER-2014-0370), the Missouri Public Service Commission ("MPSC" or "Commission") ordered KCP&L to complete a study regarding residential and other special two-part time of day or real time pricing tariffs within two years of the effective date of its order.[1] These issues were specific to the evaluation of Residential Time of Use (TOU) rates.

The Company's response is organized as follows:

II. TOU STUDIES RESPONSIVE TO 2014 COMMISSION ORDER
III. TOU STUDIES RESPONSIVE TO 2014 COMMISSION ORDER (detailed scope and results)
IV. RATE DESIGN STUDY IN RESPONSE TO COMMISSION ORDERS (in progress)
V. CONCLUSION
VI. GLOSSARY

All of the studies described in this report explored TOU options, with distinct objectives, scopes, and assumptions utilized for purposes of meeting different goals. As such, at the time of consideration and utilization for purposes of TOU rate implementation, it may be necessary to revisit and refresh these analyses using the latest information available and consideration of all regulatory impacts to ensure feasibility and appropriateness.

II. TOU STUDIES PERFORMED RESPONSIVE TO 2014 COMMISSION ORDER

The 0370 Order coincided with Company efforts already underway or completed to study TOU rates. The Company, in partnership with the Electric Power Research Institute (EPRI), completed a series of progressive TOU and other Time Variant Rate (TVR) analysis. This analysis was undertaken in preparation of exploring newly designed, modern, TOU rates that provide proper pricing signals and incentives for customers to modify their electric usage patterns to the benefit of all KCP&L customers.

The Company completed four studies in partnership with EPRI that addressed TOU:

A. EPRI-Matching Electric Service Plans to KCP&L's Strategic Objectives (EPRI-ESP) – EPRI Supplemental Research Project,
B. KCP&L SmartGrid Residential Time-of-Use Pilot (SGDP-TOU) – a component of the KCP&L DOE SmartGrid Demonstration Project,
C. EPRI-KCP&L Residential Time-of-Use Impact Study (EPRI-TOU) – EPRI Smart Grid Demonstration Project Analysis,
D. EPRI-Measuring Customer Preferences for Alternative Electricity Service Plans (EPRI-ESP) – EPRI Supplemental Research Project, and
E. 2016 Market Potential Study. The Missouri Code of State Regulations require that the Company include a Market Potential Study[2] in its Electric Utility Resource Planning filing. This Market Potential Study may include identification of demand-side programs/portfolio and/or demand side rates for purposes of identifying energy

[1] Case No. ER-2014-0370, p. 92.
[2] 4 CSR 240-22-050 (2).

efficiency and/or demand response potential savings in the Company's service territory. A Market Potential Study was included in KCP&L's and KCP&L-Greater Missouri Operations Company's ("GMO") Integrated Resource Plan filings[3]. This Market Potential Study included analysis of TOU rates.

III. TOU STUDIES PERFORMED IN RESPONSE TO 2014 COMMISSION ORDER- detailed scope and results

Below is the detailed scope (s) and key findings of each TOU study performed[4].

A. *EPRI-Matching Electric Service Plans to KCP&L's Strategic Objectives (EPRI-ESP) – EPRI Supplemental Research Project*

KCP&L collaborated with EPRI on a Supplemental Research Project to evaluate alternative Electric Service Plan (ESP) offerings considering fundamental changes in electricity supply costs and the desire to diversify its ESP (tariff) offerings to provide customers more pricing options and engage the in managing their energy consumption.

Key Findings

The key takeaway findings of this study for the design of TVRs at KCP&L include:

1. The study identified 5 strategic goals for TVR or in the study term ESPs.

   - Promote energy efficiency
   - Reduce peak load
   - Promote load shifting
   - Promote customer satisfaction
   - Promote economic efficiency

2. The study identified an ESP portfolio of TVRs for further impact and benefit analysis.

   - TOU (Residential and Small General Service)
   - Peak Time Rebate (PTR) (Residential and Small General Service)

3. The study analyzed the potential impact that variability in program assumptions may have on the program response and benefits and found:

   - Changes in energy forecasts costs had minimal impact on TOU performance and benefits
   - As expected, projected TOU savings vary directly with the participation rate, but a large number of participants who are not very price responsive is not necessarily a good result.

[3] Case Nos. EO-2017-0229 and EO-2017-0230 2016.

- Elasticity of Substitution (EoS)[5] has far greater impact on TOU peak load reduction than own-price elasticity[6], but results vary considerably and are dependent on design of rate, technologies and feedback options.

4. Overall, for ESP TOU and PTR rates, the study found:

   - A wide range of potential savings across all realistic cases of 10/20% participation and the range of expected price elasticities.
   - Overall the benefits from TOU are larger in magnitude than savings for PTR
   - The range of potential savings is so large (4x – 5x) that EPRI recommended that KCP&L consider additional market research to determine:
     - Likely acceptance rates (participation)
     - Likely EoS response rates (performance)

B. ***KCP&L SmartGrid Residential Time-of-Use Pilot (SGDP-TOU) – a component of the KCP&L DOE SmartGrid Demonstration Project[7]***

The KCP&L SmartGrid Demonstration Project (SGDP) was awarded a contract by the United States Department of Energy in August 2010. Over the 5-year project, the Company performed twenty-three operational demonstrations and tests of grid modernization systems and technologies in the several project components.

- Distribution Grid Management Infrastructure – with enhanced physical and cyber security
- SmartSubstation – a fully automated with next-generation monitoring and communications
- SmartDistribution – included feeder automation and outage restoration
- SmartDR/DER – with DR integrated with and dispatched for grid operations
- SmartGeneration – including rooftop solar and battery storage
- SmartMetering – including AMI and MDM systems
- SmartEnd-Use Programs – including TOU rates and customer energy portals

The analysis of these operational demonstrations was published in the 'KCP&L Green Impact Zone SmartGrid Demonstration Project Final Technical Report', version 2.0, dated May 22, 2015. These study results have been previously filed with the MO PSC as Appendix C of the Company's Integrated Resource Plan (IRP) 2016 Annual Update filings for KCP&L (Docket EO-2016-0232) and KCP&L-GMO (Docket EO-2016-0233).

The TOU rate developed and tested during the SGDP was a residential TOU rate structure designed to incent summer peak load shedding through higher costs on weekdays from 3:00 to 7:00 p.m. during the summer season. The following sections summarizes the findings of the of SGDP TOU rate test.

[5] The Elasticity of Substitution is defined as the percentage change in the ratio of electricity usage between time periods in response to a one percentage change in the ratio of those period's electricity prices.

[6] Own-price elasticity of electricity demand is defined as the percentage change in electricity usage in response to a one percentage change in the electricity price.

[7] *KCP&L Green Impact Zone SmartGrid Demonstration Project Final Technical Report*, version 2.0, dated May 22, 2015. Available at: https://www.smartgrid.gov/files/OE0000221_KCPL_FinalRep_2015_04.pdf

Key Findings

The key takeaway findings of this study for the design of TOU rates at KCP&L include:

Program design and communication are crucial to customer acceptance. The project team found that customers were receptive to an aggressive TOU pricing program (6x rate differential) if the program was simple to understand and customer risk exposure (On-Peak hrs.) was limited.

The main reason respondents gave for signing up for the TOU program was to save money (74%), followed secondarily by a desire to help the environment. Additionally, 49% said they regularly altered electricity usage in response to higher peak rates.

Many customers did save money on their electricity bills by shifting usage from On-Peak times to Off-Peak times. Customer savings varied widely.

The ability to leave the TOU program and the bill 'safety net' feature, while not often exercised by customers, were viewed as a positive aspect of the program.

On-Peak period and duration are key to customer acceptance. A 4-hour duration appears to be optimum. EPRI's analysis shows that the 4-hour TOU time period should be shifted to 4-8 p.m. to better align the residential peak usage time and minimize bounce-back demand impact, while still covering the typical 4-5 p.m. system peak hour.

C. *EPRI-KCP&L Residential Time-of-Use Impact Study (EPRI-TOU)– EPRI Smart Grid Demonstration Project Analysis*

EPRI's Smart Grid Demonstration Initiative (Program SG-D) was a seven-year collaborative research effort to design, deploy, and evaluate how to integrate DER into utility grid and market operations. Twenty-four collaborating and host utilities from Australia, Canada, France, Ireland, Japan and the United States participated in the Initiative and were supported by EPRI in the testing and evaluations of Smart Grid technologies.

Through KCP&L's participation in the program, EPRI performed a study to determine the impact the KCP&L's SmartGrid Residential TOU rate had on customer usage. The study estimated residential-customer demand response (DR) achieved from the TOU rate. KCP&L SmartGrid Residential Time-of-Use Pilot, provides an overview of the design and implementation aspects of the SmartGrid TOU rate pilot.

The preliminary findings of EPRI's analysis are contained in KCP&L's SGDP Final Report[8] filed with the DOE and with the MO PSC as Appendix C of the Company's Integrated Resource Plan (IRP) 2016 Annual Update filings for KCP&L (Docket EO-2016-0232) and KCP&L-GMO (Docket EO-2016-0233). EPRI provided a revised final analysis and report[9] which is provided summarized in the following sections.

[8] *KCP&L Green Impact Zone SmartGrid Demonstration Project Final Technical Report,* version 2.0, dated May 22, 2015. Available at: https://www.smartgrid.gov/files/OE0000221_KCPL_FinalRep_2015_04.pdf

[9] *Residential Time-of-Use Impact Study*, EPRI and Christensen Associates Energy Consulting, 2015.

Key Findings

The key takeaway findings of this study for the design of TOU rates at KCP&L include:

- The results indicate a clear change in customer usage profiles in response to TOU pricing. The results are less clear with respect to changes in overall usage levels (i.e., whether off-peak period usage increases, decreases, or remains the same following TOU rate adoption). Still, the study provides evidence that customers exhibited significant response to TOU prices.

- Peak Load Reduction – Average TOU customer load profiles indicate that peak-period load reductions in the range of 0.33 to 0.44 kW (15-20%) which are at the high end of what other industry studies estimate

- Peak Usage Reduction – estimates are more consistent with respect to the relative usage changes in peak and off-peak pricing periods. On average, peak-period usage decreases by 0.35 kWh per hour (1.4 kWh over the four-hour peak period) more than off-peak period usage.

- TOU Time Period – Inspection of the average control and TOU customer load profile shows that a 4-hour TOU time period should be shifted to 4-8 p.m. to better align the residential peak usage time and minimize bounce-back demand impact, while still covering the typical 4-5 p.m. system peak hour.

- EoS Estimates – range from 0.133 to 0.165. By comparison, other TOU pilots without control technologies reported EoS estimates of 0.02-0.10. But, the estimated EoS values are within the EoS estimates for projects that deployed Programmable Communicating Thermostats (PCTs). These relatively high values may be explained by the high ratio of peak to off-peak prices (six to one) and relatively short peak period (four hours) and potentially a higher penetration of PCT due to KCP&L's thermostat DR program.

D. *EPRI-Measuring Customer Preferences for Alternative Electricity Service Plans (EPRI-ESP) – EPRI Supplemental Research Project*

KCP&L collaborated with EPRI on a supplemental research project to perform a survey methodology to gain insight into customer preferences for different types of ESPs (rates) and develop a tool a utility may use to gauge potential customer adoption rates for different types of ESPs.

EPRI published the results of the study in an EPRI research report[10] that is publicly available. The following section summarizes the findings of the EPRI analysis relevant to KCP&L regarding the development of TOU and other TVR rate offerings.

[10] *Measuring Customer Preferences for Alternative Electricity Service Plans - An Application of a Discrete Choice Experiment*, EPRI, 2015. Available at: https://www.epri.com/#/pages/product/000000003002005757/

Key Findings

The key takeaway findings of this study for the design of TOU rates at KCP&L include:

- Off-peak price was found to be far more important to the attribution of value to TOU service than the peak price. The off-peak price coefficient is almost seven times that of the 0n-peak coefficient. This key finding challenges accepted wisdom about how to design a TOU rate that is attractive to customers.

- The results indicate that demographics are more important drivers than TOU features for estimating preferences. All else being constant, the success of TOU depends on the characteristics of the customer it is offered to.

- One demographic variable is on Income. It is statically significant and positive for TOUs (0.002) but not for the Fixed Bill, indicating that individuals with higher incomes are more likely to select a TOU rate than individuals with a lower income.

- The results indicate that customers in the KCP&L service territory, for some unidentified factor, are less likely to select a TOU rate than individuals in the other surveyed utility service territories.

- The peak season variable of summer is negative, indicating that customers prefer having the rate available in both the summer and winter than in just the summer alone.

- Peak Timing variables are positive (relative to 2-8pm) indicating that customers prefer shorter peak periods that reduces inconvenience.
  - The longest peak period, 6 hours, has the lowest potential market size (9%).
  - The shortest peak duration, 5:00 pm to 7:00 pm, does not predict the highest market size.
  - A dramatic drop in estimated market potential occurs with the combination of the six-hour peak period that spans the 5:00 to 7:00 pm time period. As expected the potential TOU market size decreases (29% to 10%) as on-peak price increases.

E. *KCP&L 2016 DSM MARKET POTENTIAL STUDY*[11]

KCP&L engaged the Applied Energy Group (AEG) Team to conduct this Demand Side Management (DSM) Market Potential Study in support of its IRP requirements. It evaluates various categories of electricity DSM resources in the residential, commercial, and industrial sectors of KCP&L's service territory in Kansas and Missouri for the years 2019-2037. The resource categories investigated are: Energy Efficiency, Demand Response, Demand-Side Rates, and Combined Heat & Power. Specifically, the DSM Potential Study included the following in the IRP:

- Primary market research of the residential and non-residential sectors

[11] *Kansas City Power & Light 2016 DSM Potential Study – Volume 3: Potential Analysis Final Report*, Applied Energy Group, Inc., 2017, Pg. iii.

- Four levels of measure-level DSM potential for 2019-2037: technical potential, economic potential, realistic achievable potential (RAP) and maximum achievable potential (MAP) energy efficiency potential
- Demand response and demand side rate RAP and MAP potential
- Combined heat and power (CHP) potential
- Four scenarios of DSM program-level potential

These study results have been filed with the MPSC, as part of the Company's Integrated Resource Plan Annual Update filings for KCP&L (Docket EO-2017-0229) and KCP&L-GMO (Docket EO-2017-0230).

Key Findings

The study evaluated several residential and commercial rates for their DSM savings potential. The study found the following rates passed the program cost effectiveness tests and if designed appropriately could be used to incentivize customers to reduce, shift, or modify their load:

- Residential IBR
- Residential TOU
- Residential TOU w/EV
- Residential Demand
- Residential Demand w/EV
- C&I RTP

These six demand-side rates are currently included in the Preferred Resource Plan[12] submitted in the 2017 IRP Annual Update and were modeled as commencing in 2019. These various rates contained specific assumptions with the primary objective of identifying DSM potential and limited consideration for implementation, customer impact, or IT constraints. Any future TOU proposals using this study in isolation would need to refresh assumptions using the latest information available.

IV. RATE DESIGN STUDY IN RESPONSE TO COMMISSION ORDERS (in progress)

Recently, KCP&L Greater Missouri Operations Company (GMO) was ordered to complete a rate design study evaluating TOU rates, as part of a Non-Unanimous Stipulation and Agreement that was approved in its 2016 rate case[13]. In 2017, the Commission ordered KCP&L to file TOU rates in its next rate case.[14]

In response to the Missouri Public Service Commission 2016 GMO rate case orders, the Company retained Burns & McDonnell to complete a comprehensive rate design study evaluating TOU rates. This latest study leverages much of the learnings from the prior EPRI studies, as well as, the recent 2016 Market

[12] The Company's IRP filing represents a plan, at a point in time and assumes perfect ratemaking. Many factors may impact assumptions/prices/costs included in a preferred plan that may necessitate a change to ensure operational/regulatory alignment. Additionally, any formal implementation of rate design changes would have to be made with the latest information available and full consideration of regulatory impacts.

[13] *Order Approving Stipulations and Agreements, Rejecting Tariffs, Cancelling True-Up Hearings, and Ordering Filing of Compliance Tariffs*, p. 7, Ordering ¶ 3, Case No. ER-2016-0156, dated September 28, 2016.

[14] *Report and Order*, p. 57, Case No. ER-2016-0285, dated May 3, 2017.

Potential Study and takes a fresh look at TOU rates that aligns with industry best practice, sound rate design principles, and the Company's corporate strategy.

Preliminary results reinforce prior study learnings about the need for customer options and the potential benefits of a properly designed TOU rate (e.g. peak load shift, increased customer satisfaction, and improved price signal), but also consider customer bill impacts, operational/technological limitations, class cost of service, and load analysis.

V. CONCLUSION

The Company appreciates the opportunity to review TOU rates and has learned much from its Smart-Grid Pilot, EPRI studies, and the 2016 Market Potential Study. These learnings include, residential customer interest in TOU rate offerings, customer responsiveness to certain price signals, and the market potential possible for certain demand side rate offerings, when coupled with Energy Efficiency and Demand Response programs, etc. The Company believes that the EPRI studies, collectively and Market Potential Study, provided a solid foundation as to the costs/benefits of TOU rates. The GMO Rate design studies responsive to the 2016/2017 MPSC Commission orders are in progress. The TOU portion of the GMO rate design studies will help fine tune our understanding of TOU rate design possibilities learned in prior studies, in a manner that will allow for proposal of a formal tariff in the KCP&L and GMO jurisdictions.

VI. GLOSSARY

- Electric Service Plan (ESP) – An ESP is defined as an electricity rate structure and/or an enabling technology option that a customer may choose.

- Time Variant Rates (TVR) – TVR refers to a number of energy pricing options; each provides the ability to reflect a variety of goals, such as cost causation, load shifting, or demand response. Generally, a TVR design charges customers a higher price during peak hours and a lower price during off-peak hours. The TVR construct may be implemented as the volumetric portion of a 2-part rate, as the volumetric portion of a multi-part rate structure, or as an overlay option or rider to another rate.

- Time-of-Use (TOU) – A TOU rate charges the customer different energy prices per a pre-determined schedule of on-peak, off-peak, and super off-peak hours and prices. The TOU pricing typically varies by season. Traditionally residential TOU rates have required specialized metering, but with the advent of AMI technologies, TOU rates can be implemented on a broader scale with standard AMI meters.

- Peak Time Rebate (PTR) – A PTR rate is a behavioral demand response option that works in conjunction with a traditional energy only (flat or TOU) rate. When the utility initiates a demand response event, a variable PTR is credited to the customer based on the amount they reduce usage below a predefined, customer specific baseline level. The customer still pays the standard rate for the energy they do use. The PTR rate requires the utility have a mechanism to calculate the customer specific predicted baseline usage profile and communicate PTR events to the customer. The PTR rate requires the use AMI or other legacy interval metering technologies.

- Critical Peak Pricing (CPP) – A CPP rate is a more dynamic pricing option, as it charges the customer a pre-established price during pre-established blocks of hours. Unlike the TOU, the utility may revise the dynamic pricing schedule and price level based on market conditions. CPP plans are often implemented as an optional rider to a TOU rate, allowing the utility to invoke higher CPP pricing on peak loading days. The CCP rate requires the utility have a bill calculation mechanism that can apply the CPP rate for the customer's usage during the prescribed CPP period. The utility must also to communicate the CPP schedule to the customer. The CPP rate requires the use AMI or other legacy interval metering technologies.

- Own Price Elasticity – Own price elasticity of electric demand, or simply price elasticity, serves as a measure of how price changes influence electricity use. Own price electricity is defined as the percentage change in electricity usage in response to a one percentage change in the electricity price.

- Elasticity of Substitution (EoS) – EoS serves as a measure of the degree to which shifting of usage is induced by the price differentials of TOU and other TVRs. The EoS is defined as the percentage change in the ratio of electricity usage between time periods in response to a one percentage change in the ratio of those period's electricity prices.

- Demand Response (DR) – DR is the change in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity, or to incentive payments designed to induce lower electricity use at times of high system usage. DR can be used as a resource by utilities, grid operators, and customers to balance supply and demand. Although traditionally viewed as a peak reduction resource, DR can be used to increase consumption when there is excess generation, or more regularly to avoid dispatching of more costly generation resources and enhance the efficiency of the grid.

- DSM Market Potential Study – The DSM Market Potential Study refers to the 2017 Demand Side Management (DSM) Market Potential Study performed by Applied Energy Group (AEG) for KCP&L pursuant to the Demand-Side Resource Analysis rule in 4 CSR 240-22.050. The study evaluated various categories of electricity DSM resources in the residential, commercial, and industrial sectors of KCP&L's service territory in Kansas and Missouri for the years 2019-2037. The resource categories investigated are: Energy Efficiency, Demand Response, Demand-Side Rates, and Combined Heat & Power.

- Peak – is the highest loading or demand placed on an installation or a system over a specified time period.

- System Peak – is the hourly period of highest customer electric consumption, expressed in kilowatts (kW), that occurs annually.

- On-Peak – or peak period is a pre-defined daily time-period in which system loads are generally highest.
- Super Off-Peak – or Late Night period is a pre-defined daily time-period in which system loads are generally lowest.

- Off-Peak – are those periods of the day that are not considered On-Peak or Super Off-Peak.