STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION

THE CITIZENS UTILITY BOARD	**)**	
and	**)**	
THE ENVIRONMENTAL DEFENSE FUND	**)**	
	)	**Docket No. 15-____**
Proceeding to Investigate Adoption of a	**)**	
Utility Time of Use Tariff	**)**	

CUB/EDF Exhibit 1.0

Direct Testimony of Dr. James Fine

February 5, 2015

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INTRODUCTION

Q. Please state your name and business.

A. My name is James Fine. My business address is Environmental Defense Fund, 123 Mission Street, 28th Floor, San Francisco, California 94105.

Q. By whom are you employed and in what capacity?

A. I am employed as Director of Energy Research and Senior Economist, Clean Energy Program by the Environmental Defense Fund ("EDF").

Q. Please describe your educational background and work experience.

A. I received my B.S. in Economics from the University of Pennsylvania Wharton School in 1989, and my Ph.D. from the University of California Berkeley, Energy and Resources Group, in 2003. I have over 20 years of experience working in the fields of environmental and energy economics, with over the last three years spent primarily on clean energy issues. I consulted with M.Cubed and Envair from 1994 to 2007 and was an assistant and adjunct professor at the University of San Francisco. Since 2009, I have worked closely with the California Public Utilities Commission and with the California investor-owned utilities on many clean energy issues, including residential rate reforms focusing on time-variant tariffs, long term resource planning, demand response, renewable energy, on-bill repayment and smart grid deployment. I serve as lead economist in EDF's Clean Energy Program. Please see Exhibit 1.1 for my resume.

Q. What are your responsibilities as Director of Energy Research and Senior Economist at EDF's Clean Energy Program?

A. I am responsible for developing and supporting policies that appropriately value energy goods and services. EDF's clean energy program is endeavoring to spur industry paradigm change in pursuit of decarbonizing the electricity sector. Strategies include optimizing the electric grid's performance, rewarding customers for the full value of clean energy, and unleashing the potential of private capital.

Q. On whose behalf are you testifying today?

A. I'm testifying on behalf of the Citizens Utility Board ("CUB") and EDF.

Q. What is the purpose of your testimony?

A. I believe that Illinois electric utilities participating in the Energy Infrastructure Modernization Act ("EIMA") should offer residential customers an optional Time of Use ("TOU") rate tariff. A TOU rate, designed and deployed as I recommend here, can reduce costs to the grid, create jobs, lower energy costs for customers, and help Illinois achieve EIMA goals. A TOU rate can also help improve load shape, conserve energy, and move utilities closer to meeting goals for reducing greenhouse gas emissions ("GHGs"). As explained below, the value of a TOU rate is well substantiated. However, the design of TOU rates, along with a well-executed customer education and engagement campaign, is crucial to the adoption and success of the rate. Put differently, deployment is as critical to success as initial TOU rate design.

Q. What are you recommending the Illinois Commerce Commission do?

A. I recommend the Illinois Commerce Commission ("Commission" or "ICC") initiate an investigation into how a TOU rate can be designed and implemented, consistent with the best practices described herein. Following this investigation, the Commission should direct EIMA participating utilities to file tariffs implementing a TOU rate on an opt-in basis as a pilot program. The success of the TOU rate should be, consistent with prior Illinois practice in testing new rate designs, reviewed after four years. If the Commission concludes that a TOU rate has benefits for Illinois customers, the Commission should then make the TOU rate offering a permanent addition to the existing rates offered by Illinois utilities, Commonwealth Edison Company ("ComEd") and the Ameren Illinois Company ("Ameren"), the two utilities I understand are participating in the EIMA.

Q. How is your testimony organized?

A. My testimony is broadly organized to address the following: 1) the benefits a TOU rate can provide to consumers, the environment, and the overall functioning of the electric grid; 2) recommended design elements that should be considered by the utilities in crafting a TOU rate; and 3) recommendations related to TOU rate implementation and deployment in Illinois.

Q. Do you have any exhibit attachments to your testimony?

A. Yes, I have two exhibit attachments to my direct testimony,

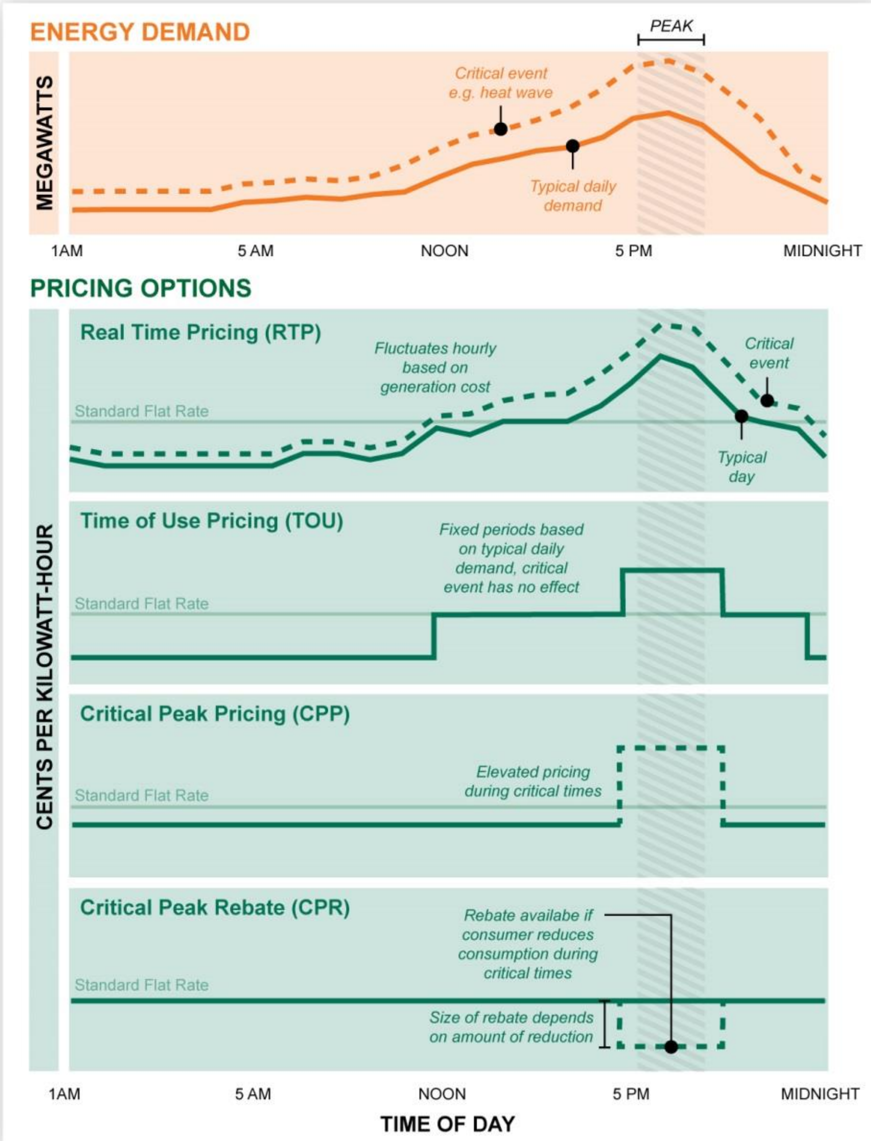
- CUB/EDF Exhibit 1.1, Resume of Dr. James Fine, which describes my work with EDF and past experience with the design and implementation of dynamic pricing programs, including TOU rates.

- CUB/EDF Exhibit 1.2, TOU Cost Savings Estimates for California and New York, which summarizes research done by EDF in respect to TOU pilots and potential benefits by utilities in those states.

I. THE VALUE OF TIME-OF-USE RATES FOR ILLINOIS

Q. Please explain what a TOU rate is and how it works?

A. In its simplest form, a TOU rate is one which charges a different price for electricity used at different times of day. A TOU rate recognizes the financial and societal costs of producing electricity are not constant but vary in predictable patterns. Wholesale electricity prices rise and fall based on supply and demand. A TOU rate transparently provides this information to consumers. While the specific design of a TOU pricing structure can vary, it typically divides the day into blocks of time, including on-peak hours (when electricity is more costly to produce, typically in the afternoon), off-peak hours (when electricity is less costly to produce, typically in the morning and evening), and super off-peak (when electricity is even less costly to produce). A TOU then prices electricity accordingly, with rates being higher during on-peak periods than in off-peak periods, and lowest in super off-peak periods. Such time blocks and prices can be adjusted regularly in order to reflect demand changes within the evolving grid, yet on-peak, off-peak, and super off-peak periods and prices should remain relatively stable over time so customers can become familiar with them and shift their electricity usage patterns from on-peak hours to the less expensive off-peak hours. The graphic below illustrates the general aspects of a TOU, and shows how it differs from Critical Peak Pricing ("CPP") and Peak Time Rebates ("PTR").



Q. How does a TOU rate compare to how customers are charged today?

A. Typically, Ameren and Com Ed charge customers a "flat rate." That is, the customer pays the same price for using a kilowatt-hour ("kWh") at any time of the day, regardless of the cost to produce that power. Unlike a TOU rate (or any variant rate), a flat-rate structure inhibits a customer's ability to manage her electricity consumption and bill. Under a flat-rate structure, individuals wanting to lower their electricity bill have only two options: they can either (a) self-generate their own electricity, or (b) reduce their consumption by investing in more efficient appliances. The typical flat rate structure leads to unnecessary costs. A well-known 2012 meta-analysis published by the Brattle Group examined over 126 different pricing treatments in over 60 time-variant rate programs.[1] This study found that customers can and do respond to time-variant rate programs, and that responses can be enhanced enabling technologies. Another study by Brattle Group found that "each year American consumers are paying $7 billion more for electricity on flat rate pricing than they would be paying on time-variant rates."[2]

Q. How does TOU rate compare to an hourly pricing structure?

A. Under a TOU rate, consumers enjoy an extra method to reduce electricity bills: shifting electricity use to less expensive times. Put another way, TOUs enable households to shift between peak, off-peak, and super off-peak times, thereby reducing their monthly bills.[3]

Q. How do customers' electricity usage patterns change when they participate in a TOU rate program?

A. TOU rates have demonstrated in real-world applications that consumer demand for electricity is affected by price changes.[4] Customers can and do avoid higher prices

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[1] Ahmad Faruqui and Jenny Palmer, *The Discovery of Price Responsiveness – A Survey of Experiments Involving Dynamic Pricing of Electricity*. EDI Quarterly, March 12, 2012.

[2] Ahmad Faruqui, Ryan Hledik, and Neil Lessem, *Smart by Default; Time-Varying Rates From The Get-Go -- Not Just By Opt-In*. PUBLIC UTILITIES FORTNIGHTLY, August, 2014.

[3] P. Fox-Penner, *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities* 43 (2010); Herter Energy Res. Solutions, *SMUD's Residential Summer Solution* 4-5(Feb. 2012).

because electricity demand is elastic. This avoidance of high-priced electricity is what economists refer to as substitution. One example of such substitution would be a customer shifting his/her electricity demand to lower-priced times of day. Another would be a consumer investing in energy conservation and/or self-generation. All such actions tend to reduce energy use at times of peak prices. Dozens of electricity pricing studies have measured how price (and other factors) influences substitution elasticities.[5] It is possible to predict with a high level of confidence how much demand will change in response to a change in the peak and off-peak electricity prices, assuming the presence of other critical components, such as effective marketing and customer outreach.

Q. Has price substitution been observed in real world studies?

A. Yes. Pilot studies show that customers use electricity at lower-cost times of the day, and will invest in conservation and self-generation when the economics of doing so are favorable and obvious. As a result, the cost and energy savings from broad adoption of TOU rates are potentially substantial. A widely-cited 2005 study entitled *Impact Evaluation of the California Statewide Pricing Pilot* involved 2,500 residential customers and examined a traditional TOU rate with CPP events.[6] This study corroborates the earlier noted Brattle Group meta-analysis. As indicated in the table below, the study showed a 4.7-percent usage reduction due to TOU rates and 13.1-percent usage reduction during CPP events on average:

[4] Ahmad Faruqui, Ryan Hledik, and Neil Lessem, *Smart by Default; Time-Varying Rates From The Get-Go -- Not Just By Opt-In*. PUBLIC UTILITIES FORTNIGHTLY, August, 2014.

[5] *See* Ahmad Faruqui and Jenny Palmer, *The Discovery of Price Responsiveness – A Survey of Experiments Involving Dynamic Pricing of Electricity*. EDI Quarterly, March 12, 2012.

[6] The study uses the term “Critical-Peak-Fixed” (CPP-F) to refer to the TOU+CPP pricing scheme.

California Statewide Pricing Pilot: Dynamic Rate Pricing Scheme[7]

Pricing Plan	**Avg. Peak Price (¢/kWh)**	**Avg. Off-Peak Price (¢/kWh)**	**Avg. Daily Price (¢/kWh)**	**Avg. Usage Reduction**
Fixed-Rate	13	13	13	--
TOU Rate (normal weekday)	22	9	12	4.7%
CPP event (critical weekday)	59	9	23	13.1%

Q. Does Illinois have any experience with time variant rate design?

A. Yes. Illinois utilities already offer customers TOU rates that fluctuate by the hour, such as the residential real-time pricing rates. CUB and EDF propose a simpler version of these existing hourly rates. Like hourly pricing, CUB and EDF recommend that the utilities implement TOU rates which reflect temporal variations in the cost of service, but with less precision than hourly rates. This would represent a compromise between flat-rate and hourly pricing. It is a another step towards increasing customer familiarity with variant rate design, generally, and towards increased adoption of more dynamic pricing rates, such as an hourly pricing structure because customers become familiar with the idea of power price volatility.

Q. What are the benefits to customers of a TOU rate?

A. A well-designed and effectively implemented TOU rate would provide at least five concrete benefits to Illinois ratepayers.

[7] *Impact Evaluation of the California Statewide Pricing Pilot* (Charles River Associates International, March 2005), 11–7, https://www.smartgrid.gov/document/impact_evaluation_california_statewide_pricing_pilot.

1. By providing to consumers information that ties the cost of service to the timing of energy use, TOU rates give customers the opportunity to reduce their energy bills by using electricity when it is less costly.
2. System costs will be allocated more accurately and thus equitably to those who cause costs. As I explain in more detail in Section III below, utility distribution systems are built to meet the coincident system-wide peak demand. In a flat-rate pricing structure, those customers who contribute more than the average customer to peak demand are in effect being subsidized by those customers who do not.
3. TOU rates should reduce energy use at times of peak system cost, affecting a beneficial flattening of the load curve. A flatter load curve means that a customer's energy supplier needs to purchase less high-priced peak energy, as well as avoid the need to build more power-generation capacity to meet contingency reserves. In turn, higher capacity factors at existing generating plants means improved cost-effectiveness.
4. A reduction in system peak offers environmental benefit as less "peaker" generation plants, which tend to be the highest polluting units, are needed to serve customers who shift their use to off-peak periods. As less energy is transmitted during the peak periods, less is lost in transmission, and overall system energy efficiency is improved while pollution is reduced.
5. By signaling to customers when to use, and when to avoid using, electricity, TOU rates reduce the need for ramping resources and, therefore, increase the grid's ability to integrate greater quantities of variable renewable energy.

Q. Are these benefits limited to only those customer who choose to adopt a TOU rate?

A. No. The broad adoption of a TOU rate provides substantial benefits for all customers over both the short and long terms . The potential savings can be substantial. EDF's analysis, detailed in Exhibit 1.2, found that if just half of the ratepayers served by California's three largest investor-owned utilities adopted TOU rates, thirty three 100-megawatt ("MW") fossil fuel power plants could be avoided and total system costs would be reduced $500 million per year (approximately a 20% reduction). Likewise, under a similar set of assumptions for New York residents, utility Consolidated Edison could reduce its peak demand by 26 percent (650 MW), providing avoided and total system cost reductions of $190 million per year (approximately 20% reduction). Other studies also suggest TOU rates benefit diverse consumers. Brattle Group studies, for instance, have found TOU rate benefits extend to low-income consumers, findings that support broad adoption of TOU rates for residential customers.[8]

Q. What is the potential to avoid system costs if customers adopt TOU rates?

A. As stated above, EDF – using conservative assumptions – has estimated system-wide cost savings of approximately $500 million per year in California and $190 million per year Consolidated Edison's territory in New York. EDF's estimates are confirmed by other studies. A 2007 Brattle Group report, for instance, looked looking at the effects peak usage reduction in five Mid-Atlantic states and found that cutting peak demand by a mere three percent led to price reductions of five to eight percent and potential savings to customers of $73 million per year.[9] Such savings represent money that otherwise would be spent to build and operate expensive and polluting peak power plants and an over-sized distribution system. This represents absolute savings – not costs shifted between ratepayers. Studies by the Brattle Group also have found that 60 percent of time-variant pricing tests have produced peak reductions of 10 percent or greater. These findings are further supported by those found from California's Statewide Pricing Pilot, where the estimated average reduction in peak-period energy use on critical days was 13 percent. This reduction in peak usage has system benefits: less generation from the most expensive and often the most polluting sources of energy.

Q. What are the environmental benefits from TOU rates?

[8] *See* Ahmad Faruqui, Sanem Sergici, and Eric Shultz, *Meta-Analysis of Dynamic Pricing Studies- Some Initial Findings*, 2012 Brattle Group; *see* Ahmad Faruqui, *et. al.*, *The Impact of Dynamic Pricing on Low Income Customers*, Institute for Electric Efficiency, September 2010.

http://www.edisonfoundation.net/IEE/Documents/IEE_LowIncomeDynamicPricing_0910.pdf.

[9] Brattle Group, *Quantifying Demand Response Benefits in PJM.* PJM and MADRI, 2007.

A. TOU rate adoption can flatten load profiles and avoid some of the worst environmental impacts of power production, particularly the use of last-in-the-supply-line peaker plants that tend to run on polluting fossil fuels. TOU rates also can support larger quantities of distributed generation and renewable resources. Because TOU prices reflect more accurately the current cost of service, resources such as photovoltaics ("PV") compensated through net metering will be more appropriately valued and reflect higher peak rates. [10]

Q. Do TOU rates encourage overall system efficiency?

A. Yes. TOU rates cause more costly electricity to be priced higher than less costly electricity, thereby changing consumer behavior.[11] The substitution effect discussed above implies that since the consumer faces a cheaper electricity price off-peak, she will substitute peak demand in favor of using energy at off-peak times. This behavior carried out by many consumers at once helps to flatten the system-wide coincident peak load, saving the need to invest in and operate expensive and polluting peaker units. To the extent there is a "rebound effect," – increased consumption because of lower prices during off-peak hours – the overall effect is likely to be non-existent or low since consumers are shifting rather than increasing demand. As an example, consider that

[10] One study has evaluated the impact of all residential NEM customers moving to TOU rates to find a small positive system impact relative to IBP when the current 5% NEM cap is reached, This indicates that the current TOU rate provides a smaller financial compensation to NEM customers than IBP. *See infra* FN 3.

[11] W. Nicholson, *Microeconomic Theory: Basic Principles and Extensions* 245 (7th ed. 1998) at 133.

consumers enjoying TOU rates may run their dishwashers at less expensive times of the day, but they won't have more dirty dishes to wash.[12]

Q. Can TOU rates be used in conjunction with other types of programs like critical peak pricing and peak time rebates?

A. Yes. Both CPP and PTR encourage customers to reduce usage during a small number of critical peak hours when electricity demand (and price) is at its highest – typically during the hottest summer days. To motivate reductions during these hours, a PTR offers rebates to participating customers who reduce consumption, while CPP works in the inverse, applying higher prices when electricity is most costly to produce. Because a TOU rate necessarily increases customer awareness of time-variant price fluctuations, it reinforces the message to respond to CPP and PTR incentives.

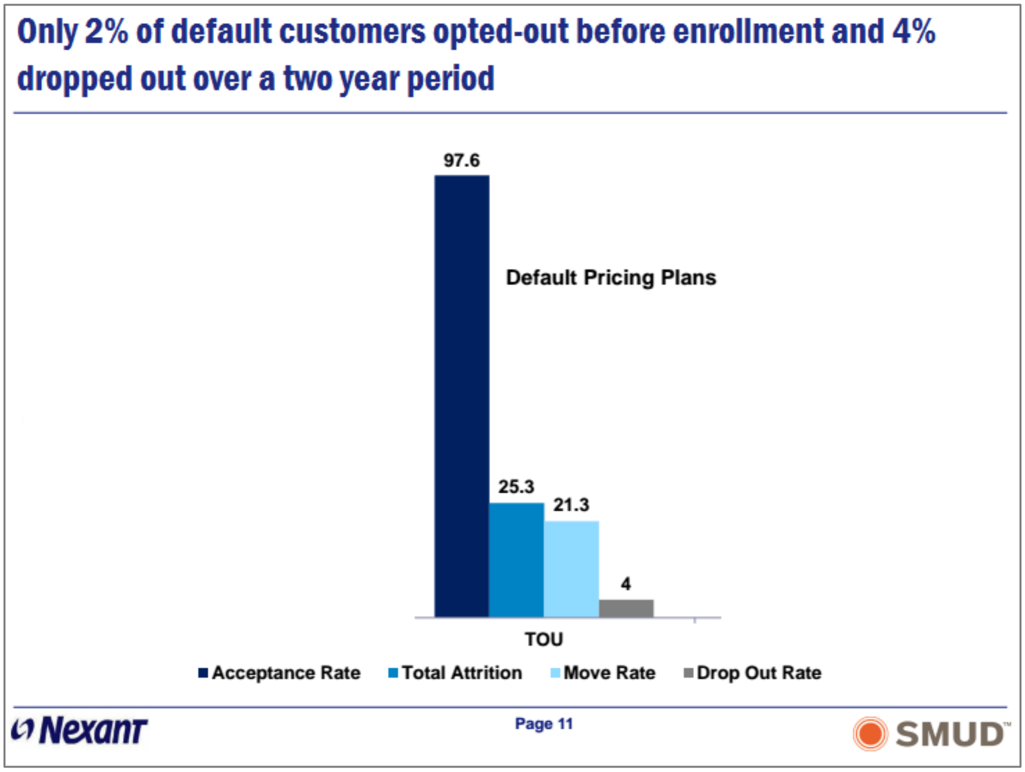
Q. How do customers respond to TOU rates?

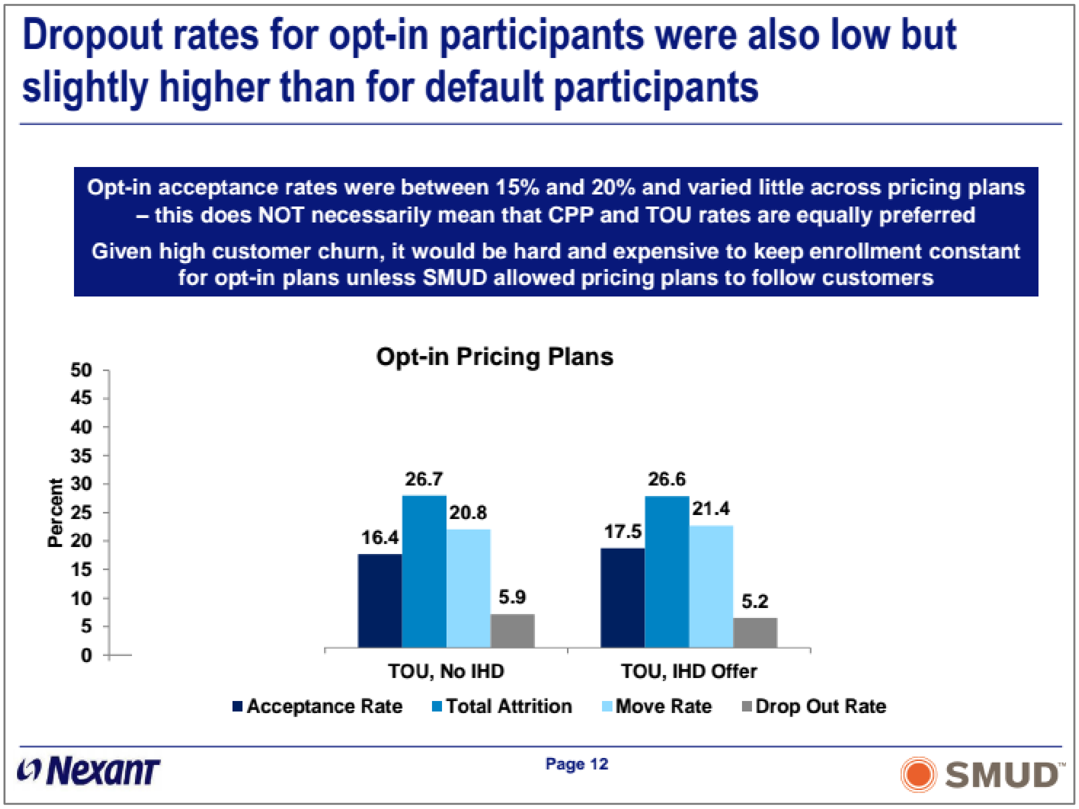
A. Numerous pilots have shown that customers respond favorably to TOU rates. For example, a 2013 study of programs at Sacramento Municipal Utility District ("SMUD") found that only four percent of opt-out customers and five to six percent of opt-in customers dropped their TOU rate plans over the span of two years.[13] Customer reactions to TOU rates depend upon a variety of factors, including the price of electricity, the low- and high-priced time blocks associated with the rate, and, perhaps most significant, the effectiveness of outreach, marketing and technology enablement

[12] Kenneth Gillingham, Matthew J. Kotchen, David S. Rapson & Gernot Wagner, *Energy policy: The rebound effect is overplayed*, 493 *Nature* at 475-76 (2013).

[13] Lupe R. Jimenez, *et al.*, *SmartPricing Options Interim Evaluation*: *An interim evaluation of the pilot design, implementation, and evaluation of the Sacramento Municipal Utility District's Consumer Behavior Study* (Oct. 23, 2013), https://www.smartgrid.gov/sites/default/files/MASTER_SMUD%20CBS%20Interim%20Evaluation_Final_SUBMITTED%20TO%20TAG%2020131023.pdf.

programs. That's one reason I recommend specific best practices for implementation of a TOU rate, described in more detail below. With thoughtful deployment, such as in the case of the SMUD program, customer response has been found to be overwhelmingly positive as summarized in the graphs below:





Q. What has been the customer reaction to the TOU rate offerings in other states?

A. TOU rates have also been well received in a number of other states. More than half of residential customers have voluntary chosen such tariffs in the Arizona Public Service ("APS") and Salt River Project ("SRP") service territories. In another example, residential customers in Connecticut Light and Power's dynamic pricing pilot reported a satisfaction rate of 92 percent; commercial and industrial customers had an average satisfaction rating of 4.1 out of 6, with 73.5 percent indicating they would participate again. Focus groups found that consumers most liked how the program allowed them to save money. Pilots at other utilities – including Consumers Energy, Baltimore Gas & Electric, and Hydro One – have seen similarly high levels of satisfaction. For instance, nearly 100 percent of Hydro One's customers on a pilot TOU rate were interested in returning to a dynamic pricing structure post-pilot and only 4 percent of participants found changes in daily activities to be inconvenient. Closer to Illinois, in Michigan, 78 percent of customers in Consumers Energy's TOU pilot reported satisfaction with the rate, with 92 percent reporting they were likely to participate again. In the aforementioned California SMUD pricing pilot, over 75% of opt-in and over half of customers defaulted to a TOU rate said they wanted to stay on that rate.

Q. What can Illinois learn from its own real-time pricing efforts?

A. Over the last seven years, ComEd's hourly pricing initiative, known as the Residential Real-Time Pricing Program ("RRTP"), has saved 9,500 participating households $13.7 million on their electric bills, or about 28 percent. Similarly, Ameren's hourly pricing program, known as Power Smart Pricing, saved 13,500 participating households $9.4 million, or about 26 percent.[14] The success of these programs, which require more from customers in terms of time and education than TOU rates, indicate Illinois could benefit substantially from a TOU rate that involves the participation of many more customers. The state's success with hourly pricing, moreover, suggests a TOU rate could serve as a first step for customers who could, after increased familiarity with time-variant pricing, eventually switch to an hourly pricing rate.

Q. How can customers enhance their response to a TOU rate?

A. A variety of enabling technologies, such as programmable control thermostats ("PCTs") or other "smart" user-feedback devices, can enhance a customer's response to TOU rates. Many technologies and smart devices are designed with the specific goal in mind of enabling customers to shift their usage to off-peak times. However, if customers are not

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[14] Becker, David, *The Smart Grid is Coming: Why Hourly Pricing is Key*. Elevate Energy (2014).

able to see time-variant price fluctuations, they are unable to fully enjoy the benefits of many of these technologies and are less incentivized to use them. The implementation of a TOU rate greatly encourages customers to adopt these smart devices and supports their development of a robust market in Illinois.

Q. How do smart devices work and what are some examples?

A. The range of smart devices available to customers varies greatly and is expanding as new technologies and behavioral insights are developed. While specifics can vary somewhat depending on the type of technology, in general smart devices are those that enable customers to change the amount and/or the time of day in which their homes are using electricity. The following are common smart devices but are by no means an exhaustive list:

- <u>Energy Information Displays (also known as In-home displays or "IHDs"):</u> Provide customers with real-time energy consumption updated regularly (commonly in less than one-minute increments). Some in-home displays may be capable of setting alerts and providing estimated price.
- <u>Programmable communicating thermostats ("PCTs"):</u> Allow customers to program and control cooling and heating temperatures in their homes. Some programmable communicating thermostats allow control of temperature settings remotely (e.g., via the internet or a smartphone), and may also display usage data in real-time. Some PCTs, such as the popular Nest Learning Thermostat, "learn" the usage patterns and preferences of customers, and can have settings updated remotely to, for example, prepare for seasonal changes in both rates and energy usage needs. Likewise, some PTCs are also capable of receiving energy management alerts or messages to customers.
- <u>Plug load controllers:</u> These devices are plugged into a standard wall outlet and can measure the energy usage of a connected electrical appliance. Many load controllers allow for customers to view the usage of connected appliances in real-time and allow for remote control of such appliances (e.g., via the internet or a smartphone).
- <u>Gateways:</u> Communicate with smart meters to provide electricity usage information via a web portal, or through an in-home display. Multiple devices

can be connected to a gateway so it can transmit data to and from each connected device.

- <u>Smartphone applications:</u> Many smartphone applications work in conjunction many with smart devices and allow customers to view and control their electricity usage.

Q. How does a TOU rate affect the value proposition for investing in smart devices and distributed energy resources?

A. Given the capabilities of these and many other smart devices, a TOU rate that allows customers to take advantage of time-variant pricing naturally enhances the incentive to use these technologies, thereby saving electricity and money. Because TOU rates reward customers for shifting their usage to lower cost times, they enhance the value proposition for enabling "set-it-and-forget-it" automation technology, such as programmable thermostats. TOU rates thus help integrate and complement smart devices – an objective previously stated by the Commission.[15] TOU rates also help to integrate other distributed energy resources, such as energy efficiency, demand response, storage, solar energy, and self-generation. As noted above, TOU rates can address 'ramping needs' that emerge when electrical output varies predictably with some renewable resources. For example, solar output regularly increases during the morning hours, decreases in the afternoon, and drops during nighttime hours. To ensure the grid is able to integrate this renewable energy source, which is only available during certain times, resources and technology able to match supply and demand become all the more important. Any time-variant tariff, inclusive of a TOU rate, would provide this function – motivating customers to use electricity when it is cheap and plentiful (such as when solar power output is high). This

[15] *See* Final Order, ICC Docket No. 13-0498, at 78-79 (Jan. 28, 2014); Final Order, ICC Docket No. 13-0498 at 80 (Jan. 28, 2014).

is a foreseeable issue in Illinois: the load forecasts for Spring 2016 for both ComEd and Ameren show the need for significant ramping resources to serve load in the mornings and evenings.[16]

Q. Has the Commission previously considered the benefits of smart devices?

A. Yes. It's my understanding that both ComEd and Ameren are currently exploring programs to distribute "smart devices" to customers as part of their energy efficiency programs. Like any time-variant rate, a TOU rate would complement those initiatives. The Commission has recognized the benefits of smart devices in both the ComEd and Ameren service territories. In its Final Order in Docket No. 13-0498 concerning the adoption of Ameren's 2014-2016 Energy Efficiency and Demand Response Plan, the Commission describes the benefits of smart devices and the need to maximize their benefits for customers:

> *The Commission is dedicated to providing consumers with all available tools to take control of their energy use, maximize savings and encourage conservation. This approach includes leveraging the investments of smart grid that are well underway. In PY9 alone, AIC will be deploying roughly 400,000 smart meters in its territory. At the same time, private market innovation with home devices is moving at a rapid pace. Customers are adopting new technologies that provide interoperability between devices so they can have greater control over their energy needs.*
>
> *Many of these devices may be unable to communicate with AIC's smart meters. It appears that this lack of interoperability is not due to technological constraints; rather, the roadblock appears to be a lack of standards and coordination among AIC and manufacturers. Furthermore, customers would have no way of knowing what devices can and cannot communicate with their smart meter.*
>
> *AIC's smart meters could provide effective tools for greater energy reduction and management if they are paired correctly with smart home devices. The Commission believes that ELPC's smart devices program could provide a mechanism to unlock additional savings previously unattainable if*

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[16] Illinois Power Agency, 2015 Electricity Procurement Plan, ICC Docket No. 14-0588, at 22 and 27 (Sept. 29, 2014).

interoperability standards are developed and consumers can make choices knowing which devices are compatible with their meters and which are not.[17]

Similarly, in its Final Order in Docket No. 13-0495 concerning the adoption of ComEd's 2014-2016 Energy Efficiency and Demand Response Plan, the Commission recognized the benefits of smart devices in light of the utility's large investment in Advanced Metering Infrastructure ("AMI"):

The Commission agrees with ELPC that nothing precludes consideration of Smart Devices in the context of a Section 8-103 EE plan. In fact, ignoring the potential benefits of such a program would be to deny the inherent link between AMI deployment and the energy efficiency potential that it brings.

As ELPC points out, the Illinois Energy Infrastructure Modernization Act requires ComEd to invest over $2.6 billion on AMI deployment, Smart Grid technologies, and grid modernization over the next 10 years. ComEd plans to deploy more than 1.2 million smart meters and the associated two-way communications by PY9 and over 4 million meters by the end of 2021. ComEd's smart meter deployment has the potential to enable significant energy efficiency and demand reduction by customers. The Commission believes it is important that ComEd take steps to integrate its smart meter deployment with additional measures that produce energy efficiency savings for customers.[18]

Q. How can a TOU rate assist the efforts of the Illinois Power Agency ("IPA") to fulfill its mission of obtaining "adequate, reliable, affordable, efficient, and environmentally sustainable electric service at the lowest total cost over time" for ComEd and Ameren customers?[19]

A. It can help by complementing efforts of the IPA to procure distributed energy resources such as rooftop solar. It is my understanding that the IPA is conducting a one-time series of auctions for solar renewable energy credits ("SRECs"), aimed at stimulating the

[17] *In Re Ameren Illinois Company*, Final Order, ICC Docket No. 13-0498, at 78-79 (Jan. 28, 2014).

[18] *In Re Commonwealth Edison Company*, Final Order, ICC Docket No. 13-0495, at 80 (Jan. 28, 2014).

[19] 20 ILCS 3855/1-5.

rooftop solar market in Illinois. While the sale of SRECs is an important incentive for potential solar investors, it is not the only method of monetizing a rooftop installation. A growing number of residents and businesses also receive on-bill net metering credits for periods when the amount of electricity their on-site solar installation generated exceeded the amount that they used, and that excess electricity was available for the distribution grid to deliver elsewhere. With a TOU rate, those customers would have the potential to reap even greater rewards, as the value of the excess energy they generated would be higher. This would create additional financial incentive for consumers to invest in rooftop solar technology.

Q. Can a TOU rate support other policy initiatives important to Illinois?

A. Yes. As a demand-side resource, TOU rates can reduce greenhouse-gas ("GHG") emissions and add to compliance options for the Environmental Protection Agency's ("EPA") proposed Clean Power Plan. According to the EPA timeline, states will be required to submit plans implementing the standards in compliance with guidelines by June 30, 2016. EPA officials say their framework will be flexible and accommodate the successful deployment of renewable energy, distributed generation, and demand-side resources, including demand response resources created by time-variant tariffs. With clear foresight that new rules for GHG emissions are on the horizon, it is imperative for Illinois to utilize all available cost-effective clean energy resources now, and to encourage them to achieve scales of significance. Future compliance costs for the state's utilities associated with the *Clean Power Plan* can be mitigated by now adopting strong, scalable clean energy policies, including robust TOU tariffs.

Q. Will a TOU rate benefit all customers in Illinois, including low-income households?

A. Yes. TOU rate pricing provides an extra path to reduce electricity bills. Since low-income households expend a greater proportion of their income on energy than do higher-income households,[20] they are more *willing* to shift load and conserve, even if they are less *able* to do so. TOU rates offer a pathway for such willing households without requiring an upfront cost investment. Likewise, my work with families located near power plants – who tend to be lower-income – suggests TOU rates can reduce air emissions in disadvantaged communities by relieving pressures on highly polluting "peaker" generation resources. This motivation may be reflected in relatively high adoption levels for low-income households in other jurisdictions, such as PG&E's SmartRate tariff.[21]

Q. Have the impacts of TOU rates on low-income customers been documented?

A. Yes. Analysis has demonstrated TOU and other time-variant rates can result in cost and energy savings to low-income households. For example, in 2008, Connecticut Light & Power conducted its "Plan-it Wise Energy" program, a pilot with 1,251 customers. This program tested three dynamic rates, including two TOU rates with different price levels (high and low). Researchers found no statistical difference in the response of low-income and non-low-income customers who were switched to TOU rates. Low-income customers saved an average of $8.07 over the course of three months:

[20] Stephen Morris, Nancy Devlin, & David Parkin, *Economic Analysis in Health Care* 153 (2007).

[21] 2012 Rate Design Window Application of Pac. Gas & Elec., A. 12-02-020 App. A Vol. 1 at 46 (E-Filing Cal. P.U.C. Feb. 29, 2012)(application of Pac. Gas & Elec.), https://www.pge.com/regulation/RateDesignWindow2012/Testimony/PGE/2012/RateDesignWindow2012_Test_PGE_20120229_230078.pdf.

Connecticut Pilot, TOU Rate Impacts on Low-Income Customers[22]

<table>
<tr><th>Pricing Plan</th><th>Peak Price (per kWh)</th><th>Off-Peak Price (per kWh)</th><th>Avg. Low-income Usage Reduction</th><th>Avg. Low-income Bill Savings (Jun 1-Aug 31)[23]</th></tr>
<tr><td>High TOU</td><td>34¢</td><td>14¢</td><td>4%</td><td rowspan="2">$8.07</td></tr>
<tr><td>Low TOU</td><td>27¢</td><td>17¢</td><td>2%</td></tr>
</table>

In Maryland, researchers tested a variety of dynamic rates and technologies with 1,375 residential customers as part of Baltimore Gas & Electric's Smart Energy Pricing Pilot. That study used a "dynamic peak pricing tariff" ("DPP") - a TOU rate with CPP events. As shown in the table below, the pilot found no statistical difference between low-income and high-income customers in their response to the rates.

Maryland Pricing Pilot "DPP" (TOU + CPP) Pricing Scheme[24]

Pricing Plan	**Peak Price (per kWh)**	**Off-Peak Price (per kWh)**	**Avg. Low-income Usage Reduction**
Fixed-Rate	15¢	15¢	--
TOU	14¢	9¢	20%
CPP event	$1.30	9¢	20%

It is important to note that these cost savings do not require turning off air conditioning on hot days or being cold on frigid ones. Rather, customers can use programmable thermostats to precool or pre-heat the house and can simply avoid unnecessary electricity

[22] Faruqui, Ahmad and Sanem Sergici, *Impact Evaluation of NU's Plan-It Wise Energy Program: Final Results*, November 2, 2009.

[23] Docket No. 05-10-03RE01, *Results of CL&P Plan-It Wise Energy Pilot*, CL&P Compliance Filing (Order No. 4), 4.

[24] Ahmad Faruqui, Sanem Sergici, and Jennifer Palmer, *The Impact of Dynamic Pricing on Low Income Customers (Updated* September 2010*)*, 16.

use during peak-price times. Low-income households have less ability to make upfront investments in clean energy improvements, such as installing solar panels or weatherization due to split incentives and diminished access to credit or capital. This is why I recommend a TOU rate be deployed on an opt-in basis and in conjunction with existing Illinois efforts to deploy smart devices to customers.

Q. Can the Commission see TOU rates as related to grid modernization?

A. Wider adoption of TOU rates should be seen as a fundamental part of the evolution of the grid as it becomes more customer-centric and flexible. TOU rates can enliven energy management services and third-party providers to help manage the electricity system, akin to supply side participants. As climate change demands new resiliency and adaptability, TOU rates can adapt to changing loads, costs and grid conditions, inviting ratepayers to play a beneficial role in rebalancing the grid and reducing its associated environmental impacts.

Q. Why are you recommending that only utilities participating in the EIMA be directed to offer a TOU rate?

A. A TOU rate depends on having interval metering, that is, the ability to record electricity usage at specific times of day. Thus, a necessary condition is advanced metering like that which ComEd and Ameren are deploying as part of their participation in the EIMA. It's my understanding that this deployment means that they are eligible to "participate" in the EIMA by having their rates set through an annual, performance-based rate rather than a traditional test year.

II. DESIGNING A TIME OF USE RATE FOR ILLINOIS

Q. How should a TOU rate be designed to provide the benefits described in the section above?

A. A utility is well positioned to create the precise design of a TOU rate, and the rate itself should adjust as energy supply and demand changes over the course of time. Yet several significant "elements" are common to any well designed TOU rate. One good example is the "Smart Home Rate" designed in partnership with a broad range of stakeholders, including San Diego Gas & Electric, Sunverge, Rocky Mountain Institute, and Google. Designed to "enable new technologies and practices and to reveal their costs and benefits to the grid,"[25] this rate is founded upon a structure that ensures fair compensation to "customers, the utility, and third-party participants for the full range of services they provide." It uses a day-ahead hourly price signal ("$/kWh") that allows customers to utilize technologies to avoid periods of high costs/high demand and to benefit from utilizing energy during negative pricing events that occur when loads are low and renewable supplies are high.[26] \This vision is similarly articulated in a Rocky Mountain Institute ("RMI") white paper that identifies three dimensions – i.e. design elements - by which smart rates might be differentiated: [27]

- Attribute unbundling – break down energy, capacity, ancillary services, and other components and price them explicitly;
- Temporal granularity – shift from flat or block rates to pricing that differentiates time-based value of generation and consumption; and

[25] Rocky Mountain Institute's eLab at www.rmi.org/eLab.

[26] *Id.*

[27] Devi Glick, *et al.*, *Rate Design for the Distribution Edge: Electricity Pricing for a Distributed Resource Future*, Rocky Mountain Institute Electricity Innovation Lab (Aug. 2014).

- Locational granularity – offer pricing that provides geographically differentiated incentives for distributed energy resources.

Q. How do these dimensions relate to the design of a TOU rate?

A. A TOU rate should be designed to encourage broad adoption by consumers, while at the same time taking into account the transparency in pricing "smart rates" like those discussed by RMI. This can be achieved with a number of different structures, ranging from opt-out TOU rates to opt-in TOU rates (the latter, as noted above, has been successful in Arizona, where utilities offered an opt-in TOU tariff that over 50 percent of residential customers have chosen to join).[28]

Q. Please describe the best practices and principles for designing a TOU rate.

A. TOU rates must give necessary price signals and actionable solutions for customers to save money and for the electric system to shift demand to non-peak and lower-priced times. The theory and evidence provided above indicate that (1) consumers want and are able to act as empowered decision makers, (2) a well-structured TOU rate can protect customers and provide system benefits, and (3) it is desirable to facilitate more transparency in pricing goods and services on the grid. Thus, any TOU rate adopted must be designed to allow for these results. To that end, there are some basic principles that should be kept in mind when a TOU tariff is designed:

- Rates should provide transparent and actionable price signals;
- Rates should be based on marginal cost;
- Rates should encourage conservation and energy efficiency;

[28] Leland Snook, *APS's Time-of-Use Rates & What's Next for Arizona?* California Public Utilities Commission Residential Rate Rulemaking Workshop: Best Practices and Lessons Learned in Time Variant Pricing, R. 12-06-013, http://www.cpuc.ca.gov/PUC/energy/Electric+Rates/Time+Variant+Pricing_TVP.htm.

- Rates should encourage reduction of both coincident and non-coincident peak demand;
- Rates should be stable and understandable and provide customer choice; and
- Rates should encourage economically efficient decision making.[29]

Q. Why are price signals important in electric rate design?

A. Customers need transparent information about products and services – particularly about prices – to make rational purchasing decisions.[30] Electricity is no different. Customers need the same clear information about their energy use as they do for any other purchase, such as how they plan their meal purchases at the grocery store. Nobel Prize winning economist William Vickrey compared flat-rate electricity pricing that most consumers experience to a supermarket charging the same price for ground beef and filet mignon, and a resultant shortage of filet mignon. An electricity customer should be given a similar opportunity to determine their consumption based on price. Given the social and environmental consequences of energy production, pricing that reflects economic, social, and environmental costs is especially important if consumers are to be enabled to make fully informed choices.[31]

Q. How are price signals most effective in motivating a response?

A. For prices to be most effective in motivating good decisions, they must be readily transparent. Information must be clear in terms of the cost per kWh at a given point in time and how much electricity is needed for a given household task. Transparent electricity pricing requires that, to the extent possible, consumers know the price of each

[29] Regulatory Assistance Project, *Designing Distributed Generation Tariffs Well: Fair Compensation in a Time of Transition*, 2013, available at www.raponline.org/document/download/id/6898.

[30] Andreu Mas-Colell, Michael D. Whinston & Jerry Green. *Microeconomic Theory* 20 (1995).

[31] T. H. Tietenberg, *Environmental and Natural Resource Economics* 67 (5th ed. 1999).

kWh unit of electricity they use.[32] They should also have access to basic information about what the kWh usage is of basic appliances and tasks, for example like air conditioning.

Q. Is there evidence that consumers are likely to act on transparent electricity pricing?

A. Yes. As noted in Section I above, consumers consistently seize on opportunities to save money, and many are motivated additionally to reduce their environmental footprints. They will make rational purchasing decisions when given the opportunity, and electricity is no exception. For example, consumers have embraced the rapid penetration of fluorescent light bulb technology, full subscription in solar incentive programs, and initiatives, such as California's FlexAlert, that obtain quick reductions in electricity use when needed to avoid outages. The evidence says that customers not only can, but want the opportunity to, act on more transparent energy prices. A recent survey of nearly 5,000 customers by PG&E and So Cal Edison found that 75 percent have tried shifting their energy use already – even though they receive no financial rewards to do so. As well, 70% said they would be willing to risk higher bills for the chance to realize bill decreases.[33] This willingness, combined with thoughtful policies – such as bill protection that prohibits bill shocks for up to one year after a customer changes rate plans, and the ability to opt-out – strongly suggests that ratepayers (and their service providers) will take advantage of information and capabilities of digital electricity meters and automated "set-it-and-forget-it" learning thermostats, to employ best practices and to be a part of a cleaner, more efficient energy system while reducing their own energy bills.

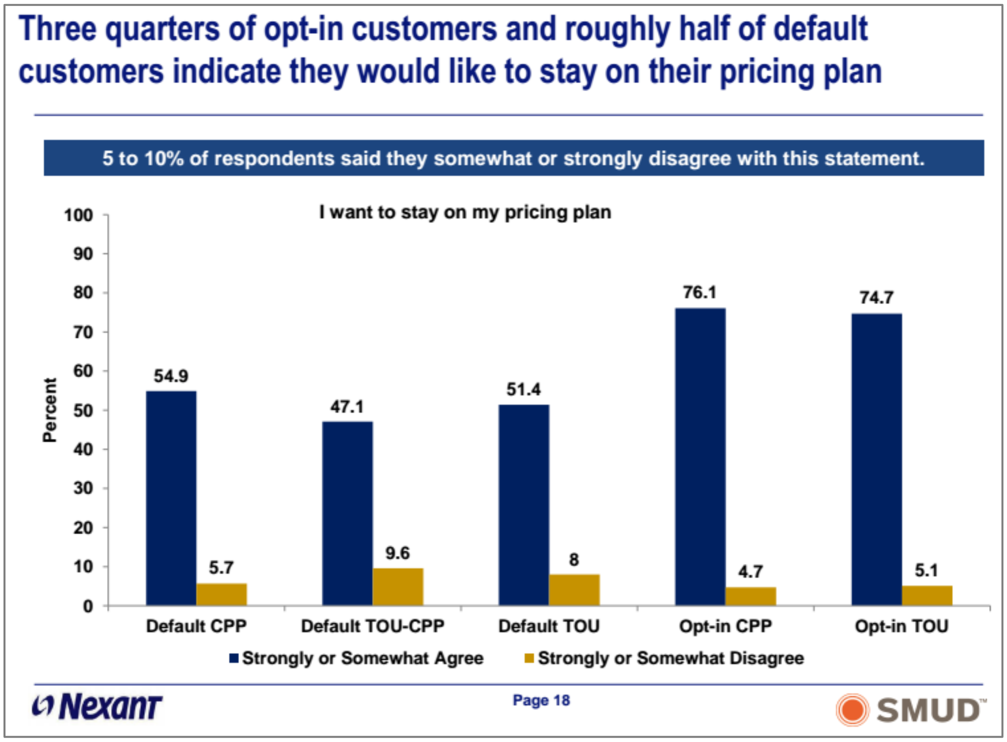
[32] W. Nicholson, *Microeconomic Theory: Basic Principles and Extensions* 245 (7th ed. 1998).

[33] Hiner & Partners, Pac. Gas & Elec., S. Cal. Edison , & San Diego Gas & Elec., *RROIR Customer Survey Key Findings* 11, 43 (April 16, 2013).

Q. Does real-world evidence exist that indicates that customers who participate in a TOU rate actually like the experience?

A. Yes. When customer bills change in understandable, predictable, and actionable ways – particularly when paired with education and attractive, accessible technology – customer satisfaction improves.[34] At the same time, experience validates the common sense understanding that energy users don't like bill surprises, but will change their behavior, or adopt new technology, if presented with the right incentives, or reasons, to do so. The aforementioned SMUD program supports these findings, showing that consumers prefer a well-designed TOU rate, as illustrated in the graph below:

[34] This technology could include but is not limited to: advanced automatic load control devices, colorful signals that remind ratepayers to shift their load to take advantage of lower cost periods, and devices and practices that will not be fully developed until the right pricing structures are in place, such as precooling on peak demand afternoons paired with intensive weatherization and rooftop PV generation, and financing mechanisms that front load benefits for customers and remove the need for them to dynamically respond (e.g., set it and forget it).



Q. How does the length of the time periods impact a TOU rate's effectiveness?

A. The structure of a TOU rate impacts its value proposition for customers. This means it impacts how many customers shift their usage and by what percent that usage is shifted. For example, when the peak period is short (i.e. less hours) or the ratio of peak to off-peak prices is shallow (i.e. price differentials between prices are small), shifting of electricity consumption has less of an impact on monthly energy bills. Conversely, with a longer peak period, there is greater risk of using energy during that period, but also more value from shifting away from peak time usage. As an example, if the peak price is twice the off-peak price (i.e., ratio equals two), under a four-hour peak window, 30 percent shifting results in almost twice as much bill reduction (relative to no shifting behavior) as under a two-hour peak window. A household's ability to shift between time periods decreases as the peak window increases. Thus, load shifting behavior is less likely under a four-hour peak window than under a two-hour peak window.

Q. What else impacts a customer's response to a TOU rate?

A. In addition to the length of a TOU rate's price windows, the amount of shifting that would occur under a TOU rate schedule depends on the customer's awareness and the household's ability to change its behavior. Utilities can significantly influence such behavior by increasing education and helping individuals adopt set-it-and-forget-it technologies.

Q. Would a TOU rate be consistent with previous ICC guidance on rate design principles regarding cost causation?

A. Yes. In docket No. 10-0467, the Commission noted the importance to "design rates that reflect cost causation."[35] TOU pricing, as noted above, reflects marginal costs with more precision than flat rate pricing, and extensive evidence demonstrates that electricity service costs vary over the course of a day, week, and season. The following graph shows how PG&E incorporates such varying costs when it calculates the value of distributed energy resources.[36]

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[35] *In Re Commonwealth Edison Co.*, Final Order, ICC Docket No. 10-0467, at 232 (May 24, 2011).

[36] Pac. Gas & Elec., *Time Dependent Valuation (TDV) Economics Methodology* 8 fig. 1 (2002), http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/tdv/TDV_ECON_METHOD_EXTRACT.PDF.

Extract of March 18, 2002 Report

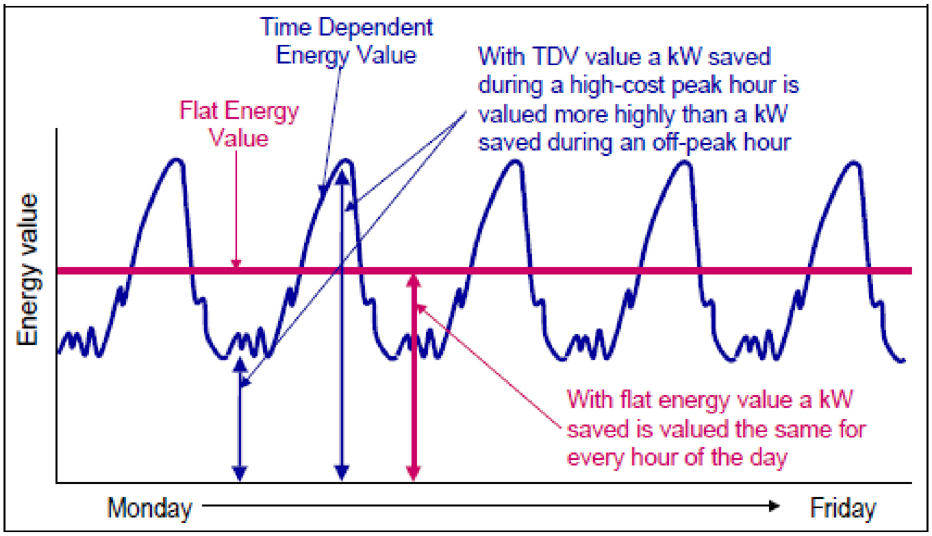

Figure 1 - TDV Costing Compared to Flat Costing – summer weekday

Q. Would a TOU rate be consistent with previous ICC guidance on rate design principles pertaining to cost allocation?

A. Yes. In ICC Docket No. 13-0387, the Commission concluded it was

> "not reasonable or consistent with public policy to structure rates so that the poor, the frugal and the energy efficient are required to subsidize those who are not, when a more equitable method of allocation exists. A more reasonable policy allocates the same aggregate costs so that individual customer costs are reasonably proportionate to the costs that their use places on the system."[37]

As TOU rates are closer to marginal cost-based pricing than flat or tiered rates, they better satisfy economic efficiency for both consumers and producers, while meeting conservation and consumer goals.

Q. Would a TOU rate be consistent with the Commission's interest in an open access data framework?

[37] *In Re Commonwealth Edison Company*, Final Order, ICC Docket No. 13-0387, at 75 (Dec. 18, 2013).

A. Yes. Customers can be empowered to manage their energy usage if they have both access to their usage data as well as access to market signals that highlight the actual costs of generating and delivering electricity. The Commission's ongoing efforts associated with an open access data framework complement the adoption of TOU rates.

Q. Is there a particular TOU rate design that you recommend the Commission consider?

A. Yes. Because the greatest value of a TOU rate lies in its ability to encourage customers to shift their usage away from expensive periods which rely on the most polluting sources, I recommend the Commission direct the utilities to offer a TOU rate which would have three blocks: on-peak for highest demand times; off-peak for periods of less demand; and super off-peak for when demand is minimal. The time periods could be in a 1:3:2 ratio – e.g. 4 hours of peak time, 12 hours of off-peak time and 8 hours of super off-peak time – with prices in each period reflecting the marginal rates in those periods.

<u>III. RECOMMENDATIONS FOR DEPLOYING A TOU RATE</u>

Q. Have other TOU programs delivered the benefits discussed in Section I?

A. Yes. As discussed in Section I, substantial empirical evidence shows the benefits possible through a TOU rate. Well-designed, well-implemented variant rates have consistently lowered peak load and received high marks in customer satisfaction.

Q. Are there specific elements of the TOU rates you or others have reviewed that influence peak load reduction and customer satisfaction?

A. Yes. A higher peak to off-peak price ratio results in a higher peak load reduction.[38] Generally, enrollment is much higher when customers are defaulted into TOU rates when compare to opt-in programs; this is partly a function of "choice architecture" whereby most consumers can't be troubled to either opt-in or opt-out, so the status quo dominates.

Q. Do you have any recommendations for how a TOU rate could be successfully implemented and deployed in Illinois?

A. Yes. A TOU program must be implemented with the right amount and type of consumer education, outreach, and enablement. Factors that should be considered include:

- *Communicate with consumers early and often, through multiple means and channels*. Thoughtful, consistent, diversely-conveyed messages about the new rates and their benefits should be launched well in advance of their implementation, and continue through the transition period.
- *Adopt integrated approaches using multiple tactics*. Every Commission-funded, utility-sponsored ratepayer "touch" should include mention of the new rate opportunities and support services, with the web of tactics carefully mapped to ensure that overlapping strategies complement one another.
- *Segment the market, implementing tailored approaches for particular customer groups.* Utilities should continue to build on the significant progress they've made in segmenting the residential class into synergistic groups – by income, race, ethnicity, use patterns, and location, among other variables – and harness those segments as part of effective education strategies.
- *Shape tactics to local contexts.* The utilities should restructure their marketing and outreach efforts as needed so that they are nested alongside their distribution planning boundaries and defining community characteristics.
- *Demonstrate tangible and immediate benefits rather than "general awareness" messaging*. Highlighting early adopters who have achieved significant bill savings as a result of TOU rate structures is an example of demonstrable benefits. Showing clear examples is preferable to generalized messaging.
- *Strive for consistent messaging, to ensure accuracy of information, repetition of key concepts, and cohesion across the multiple messengers*. The messenger and messaging can and should change. Utilities should foster an ability to

[38] *See* Faruqui *et al., Arcturus: International Evidence on Dynamic Pricing,* The Brattle Group, July 1, 2013.

monitor communication efforts by diverse parties where they meet the customer in order to maintain quality.

- *An emphasis on customer service and satisfaction is critical*. The communication effort should not be one-way. Messengers and customers should be encouraged to provide early feedback on tariffs and associated programs so that real and perceived issues can be effectively addressed.

Q. Why should Illinois utilities begin by offering a TOU rate as an opt-in program?

A. It is important that a TOU rate be one of several time-variant rate offerings from ComEd and Ameren, and it's my understanding that all of the current offerings are ones where customers opt into the pricing program. There are strategies by which a utility could default new customers onto a TOU rate, such as enrolling customers who open new accounts. While the majority of customers will be structural winners (i.e., without any load shifting or conservation practices, they will enjoy a bill reduction when moved from a flat to a TOU rate), it is important to determine what education and enablement is needed to assist non-structural winners in managing their bills before they are moved to a TOU rate.

Q. What are elements of a successful customer engagement program to encourage TOU rate participation and satisfaction?

A. The aforementioned SMUD, PowerCents D.C, and APS[39] experiences, as well as the study summary findings by Faruqui et al,[40] lead to some basic principles:

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[39] *See generally* Jennifer Potter, *SMUD's SmartPricing Options Marketing Strategy,* California Public Utilities Commission Residential Rate Rulemaking Workshop: Best Practices and Lessons Learned in Time Variant Pricing, R. 12-06-013, http://www.cpuc.ca.gov/PUC/energy/Electric+Rates/Time+Variant+Pricing_TVP.htm;

Leland Snook, *APS's Time-of-Use Rates & What's Next for Arizona?* California Public Utilities Commission Residential Rate Rulemaking Workshop: Best Practices and Lessons Learned in Time Variant Pricing, R. 12-06-013, http://www.cpuc.ca.gov/PUC/energy/Electric+Rates/Time+Variant+Pricing_TVP.htm.

- Work with thought leaders in communities and a diversity of marketing and outreach avenues;
- Be open to third parties capable of more effectively and efficiently engaging customers and reaching “hard to reach” customers; and
- Identify customers with load profiles that indicate the need for energy management (due to either very high total use or high peak use) and treat these customers as intelligent beings with smart technologies capable of shifting and reducing load in response to signals.

Q. Are there specific strategies Illinois should consider during the testing of a TOU rate?

A. Yes. Several strategies should be considered:

- Use best practices for outreach and marketing TOU tariffs and associated programs as learned from other TOU programs.
- Use “shadow” billing, where customers are given information on what they would have paid under a flat rate as compared to the TOU rate. Shadow bills can help customers understand the opportunities and risks presented by time-variant rate structures with respect to their individual use patterns and potential to changes to those patterns. Providing shadow bills for several months or years will help customers plan for and adjust to the potential for bill volatility. These bills need not be presented in paper form as part of bill inserts, but rather be easily accessible through web or mobile interfaces. This “*Try-it-Before-You-Buy-It*” approach and associated education could be provided along with directed customer energy management assistance. Likewise, in addition to bill limit protection, customers could be allowed to switch to alternative rates if they choose to do so.
- Ensure low-income customers are provided with every opportunity to benefit from TOU rates. These opportunities include increased access to newer, energy efficient appliances that enhance readiness to adopt strategies beneficial for customers on TOU rates.
- Provide a period of bill protection after the switch to TOU rates, particularly if shadow billing suggests a customer may experience a bill increase.
- Provide customers who voluntarily enroll in TOU rates with set-it-and-forget technologies. Recent analyses, including in the Sacramento Municipal Utility District’s service territory, indicate that the provision of advanced thermostats – user-friendly thermostats that enable customers to program precooling and offsets for daily TOU peak load shifting, and display real-time electricity rates

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[40] Ahmad Faruqui and Jenny Palmer. *The Discovery of Price Responsiveness – A Survey of Experiments Involving Dynamic Pricing of Electricity*. EDI Quarterly, March 12, 2012.

and home energy data – can significantly increase energy users' ability to respond to price signals.[41] It's my understanding the Commission has already directed ComEd and Ameren to make the piloting of in-home devices a part of the utility energy efficiency programs. Such programs could be coupled with efforts aimed at enrolling those customers the utilities identify as most likely to save money on a TOU rate.

Q. When should customers be approached to enroll in a TOU rate?

A. Perhaps the most convenient time to enroll customers in TOU rates and associated programs is when they sign up for electric service. APS and SRP have used these opportunities to drive enrollment in their pricing programs, helping these utilities achieve high participation rates of 50 percent and 22 percent, respectively. APS presents all pricing plans as equal and helps customers identify which rates best suits them, rather than leading with their basic service plan and promoting other plans only as alternatives to this lead offer. Given APS's high customer turnover, this acquisition strategy has been instrumental in achieving high enrollment, with the majority of program participants enrolling during the electricity sign-up process. APS' success suggests that customers are not inherently opposed to pricing programs and can be enrolled in large numbers.[42]

Q. How can the Commission ensure low-income customers benefit from a TOU rate?

A. To ensure diverse constituencies benefit from TOU rates, the Commission should ensure:

- *Appropriate education and outreach*: Targeted outreach that meets the needs of non-English, disabled, and other consumers.
- *Access to Enabling Technologies*: Ensure customers have access to enabling devices, such as thermostats, before enrollment in TOU rates.
- *Air Conditioning:* AC is the single most important driver of success under TOU rates during summer peaks – and a well-designed approach is critical to maintaining the well-being of consumers. Strategies might include saturating

[41] Herter Energy Res. Solutions, *SMUD's Residential Summer Solution* (Feb. 2012).

[42] *Id.* at 25.

certain regions and household types with enabling devices capable, perhaps with financing for more efficient air conditioners.

- *Access to Energy Improvement Programs:* Because of the financial barriers some customers face, there is an untapped reservoir of energy and cost savings in households, including plug load dominated by older, inefficient, devices. These households could benefit from increased financing of energy improvements by leveraging existing energy efficiency and appliance replacement programs and supporting access to distributed generation options.

Q. How will the Commission know that a TOU rate is actually resulting in benefits to Illinois customers?

A. As discussed earlier, a TOU rate should be designed to meet specific goals, and success can be based upon whether those rates are meeting explicit metrics. The Commission should plan for the collection of data that enables utilities, the Commission, and other stakeholders to evaluate the efficacy of rate structures and to modify policies and programs. The refinement of TOU rates should be an ongoing, adaptive process with specific, measurable, time-specified objectives, appropriate metrics to evaluate progress, and a clear game plan for adjustments. Thoughtful tracking, evaluation and adaptation will be especially significant for particularly vulnerable customer classes.

Q. Do you have specific recommendations on what would inform the Commission, and all stakeholders, that a TOU rate is in fact providing benefits to Illinois customers?

A. Yes. The Commission should adopt robust metrics and associated performance indicators that accompany the transition to TOU rates. CUB, EDF and ComEd have already put in place metrics associated with metrics requiring reporting of customers on TOU rate, HAN penetration, use of utility web-based portals, authorizations to share information with third parties, smart meter related consumer complaints, consumers enrolled in electric vehicle tariffs, and various aspects of consumer-owned distributed generation.[43] These metrics should be expanded to include consumer education and load flexibility resource needs in order to inform specific aspects of the TOU rate policy and refine it over time. The environmental benefits of time variant rates can be tracked by determining:

- Changes in load shapes and bills, along with underlying household characteristics;
- Changes in generation mix emissions intensity; and
- Changes in the quality and level of services and technologies that aid in conservation and shifting.

These metrics should be carefully tracked, tied to a utility's performance-based compensation, and used to continually improve upon the policies, programs, and tariffs recommended in this proceeding. For that reason I think a TOU rate is best implemented as a multi-year pilot, the approach that I understand was done with the other time-variant rates offered by ComEd and Ameren.

Q. What kind of tracking should the utilities do as part of this pilot?

A. Utilities should monitor ongoing research that evaluates the impacts of TOU rates on energy usage, customer investment in distributed energy resources, customer bills, and environmental outcomes (such as avoided GHG pollution). This means measuring the impacts of specific interventions, such as those technologies noted earlier and educational programs. Identifying interventions that help control bill impacts and improve conservation and shifting will result in more cost reductions by eliminating costly

[43] *In Re Commonwealth Edison Company,* Final Order, ICC Docket No. 12-0298, at 19 (June 22, 2012).

programs or interventions that do not help achieve desired outcomes while promoting those that do.

Q. Why is ongoing monitoring and research important?

A. Some households will better adapt to a new TOU rate than others – particularly given different characteristics such as income, location, appliance mix, access to information, and other factors. Understanding which households benefit most from TOU rates, and identifying ways to maximize savings across different types of households, is essential to achieving the full benefits of energy pricing. Likewise, new rate structures may be regularly introduced over the next decade, as the grid evolves towards a new equilibrium, creating the need for constant evaluation, feedback loops, and adaptive management.

Q. How can the utilities inform the Commission of the impacts of a TOU rate?

A. Energy consumption data should be gathered from a sample of households and matched with a census of household characteristics. This information can be used to document changes in customer segment and marketplace behavior, enabling policymakers and utilities to continually hone their efforts to develop effective rate structures, financing programs, and targeted distributed energy resources initiatives. A variety of different household characteristics and outcomes of interest are listed in the table below.

Table 1: Household Characteristics and Outcomes of Interest

Household Characteristics	Outcomes of Interest
Demographics (income, race, location)	Investments in energy efficiency, appliances, self-generation, weatherization
Opt-in vs. Default TOU	Shifting in household energy consumption from peak to off-peak

Household Characteristics	Outcomes of Interest
Appliances and HVAC (other than electricity generators and vehicles)	Market segmentation and valuation of efficiency, and communication capabilities (e.g., Wifi enabled, programmable, clock)
Vulnerable Customers	Bill Impacts (Change in bill before and implementation)
High vs. Low Energy Users	Gradual transition from high to low energy use
Peaky vs. Flat Load Energy Users	Shifting from peak to off peak for flatter diurnal usage patterns (aka, flattening load factor)
Solar PV	Net present value and rate on investment; Utility cost recovery
Electric Vehicles	Super off peak charging, obtain value out of demand response, storage and ancillary services
Storage	Obtain value out of demand response, storage and ancillary services

Q. What is your final recommendation?

A. I recommend the Commission direct the utilities to offer a TOU rate that would have three blocks: on-peak for highest demand times; off-peak for periods of less demand; and super off-peak for when demand is minimal. The time periods could be in a 1:3:2 ratio – e.g. 4 hours of peak time, 12 hours of off-peak time and 8 hours of super off-peak time – with prices in each period reflecting the marginal costs of service in those periods. This tariff should be offered on an opt-in basis, and implemented with an emphasis on customer education and engagement.

Q. Does this conclude your direct testimony?

A. Yes.