COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC APPLICATION OF DUKE ENERGY	)	
KENTUCKY, INC. TO AMEND ITS DEMAND SIDE	)	Case No.
MANAGEMENT PROGRAMS	)	2019-00277

DIRECT TESTIMONY

OF

PAUL J. ALVAREZ

REGARDING THE PROPOSED PEAK-TIME REBATE PILOT

ON BEHALF OF THE

OFFICE OF THE ATTORNEY GENERAL

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December 6, 2019

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DIRECT TESTIMONY OF PAUL J. ALVAREZ

I. INTRODUCTION, QUALIFICATIONS, PURPOSE, AND PREVIEW

Q. Please state your name and business address.

A. My name is Paul Alvarez. My business address is Wired Group, PO Box 620756, Littleton, CO 80162.

Q. What is your occupation?

A. I am the President of the Wired Group, a consultancy specializing in the optimization of distribution utility businesses and operations as they relate to grid modernization (including smart meters), demand response, energy efficiency, and renewable generation.

Q. On whose behalf are you submitting testimony?

A. I am testifying on behalf of the Kentucky Office of the Attorney General (AG).

Q. Please describe your work experience and educational background.

A. My career began in 1984 in a series of finance and marketing roles of progressive responsibility for large corporations, including Motorola's Communications Division (now Android/Google), Baxter Healthcare, Searle Pharmaceuticals (now owned by Pfizer), and Option Care (now owned by Walgreens). My combined aptitude for finance and marketing were well suited for innovation and product development,

leading to my first job in the utility industry in 2001 with Xcel Energy, one of the largest investor-owned utilities in the U.S.

At Xcel Energy I served as product development manager, overseeing the development of new energy efficiency and demand response programs for residential, commercial, and industrial customers, as well as programs in support of voluntary renewable energy purchases and renewable portfolio standard compliance (including distributed solar incentive program design and metering policies). There I learned the economics of traditional monopoly ratemaking and associated utility economic incentives, as well as the impact of self-generation, energy efficiency, and demand response on utility shareholders and management decisions. I also learned a great deal about utility program impact measurement and verification (M & V).

I left Xcel Energy to lead the utility practice for sustainability consulting firm MetaVu in 2008. At MetaVu I employed my M & V experience to lead two comprehensive, unbiased evaluations of smart grid deployment performance. To my knowledge these are the only two comprehensive, unbiased evaluations of smart grid post-deployment performance completed to date. The results of both were part of regulatory proceedings in the public domain and include an evaluation of the SmartGridCity™ deployment in Boulder, Colorado for Xcel Energy in 2010,[1] and an

[1] Alvarez et al, MetaVu. "SmartGridCity™ Demonstration Project Evaluation Summary". Report submitted to the Colorado Public Utilities Commission in the testimony of Michael G. Lamb, Exhibit MGL-1, proceeding 11A-1001E. Report dated October 21, 2011; filed December 14, 2011.

evaluation of Duke Energy's Cincinnati-area deployment for the Public Utilities Commission of Ohio in 2011.[2]

In 2012 I started the Wired Group to focus exclusively on distribution utility businesses and operations as they relate to grid modernization, demand response, energy efficiency, and renewable generation. Wired Group clients include consumer, business, and environmental advocates, regulators, and industry associations. In addition, I serve as an adjunct professor at the University of Colorado's Global Energy Management Program, where I teach an elective graduate course on electric technologies, markets, and policy. I have also taught at Michigan State University's Institute for Public Utilities, where I've educated new regulators and staff on grid modernization and distribution utility performance measurement.

I am the author of Smart Grid Hype & Reality: A Systems Approach to Maximizing Customer Return on Utility Investment, a book that helps laypersons understand smart grid capabilities, optimum designs, and post-deployment performance optimization. I am also the developer of the Utility Evaluator, an Internet-based software application which benchmarks distribution utility financial and operating performance from publicly-available data sources. I received an undergraduate degree from Indiana University's Kelley School of Business in 1983, and a master's degree in Management from the Kellogg School at Northwestern University in 1991. Both degrees featured concentrations in Finance and Marketing.

Q. Have you appeared before the Kentucky Public Service Commission previously?

[2] Alvarez et al, MetaVu. "Duke Energy Ohio Smart Grid Audit and Assessment". Report to the Staff of the Public Utilities Commission of Ohio in proceeding 10-2326-GE-RDR. June 30, 2011.

A. Yes. I prepared testimony in Case No. 2016-00152, Duke Energy's Certificate of Public Convenience and Necessity (CPCN) for smart meters, on behalf of the AG. I also prepared testimony regarding smart meters in cases involving Kentucky Utilities/Louisville Gas & Electric, including Case Nos. 2016-00371/00372 and 2018-00005.

Q. What experience do you have before other state utility regulatory commissions?

A. I have testified in cases before state utility regulatory commissions on smart meters, associated rate designs, grid modernization, and distribution utility planning and performance measures in California, Indiana, Iowa, Kansas, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, North Carolina, North Dakota, Ohio, Pennsylvania, and Washington, and served clients participating in regulatory proceedings in Colorado, Hawaii, South Carolina, and Virginia. Brief descriptions of my testimony in various proceedings, and case numbers for each, are provided in the "Regulatory Appearances" section of my Curriculum Vitae, attached as Appendix A.

Q. What is the purpose of your testimony in this proceeding?

A. I provide testimony regarding the peak-time rebate pilot (Pilot) proposed by Duke Energy Kentucky (Duke) as part of the Company's demand-side management program application. I believe the Pilot's design can be substantially improved, making pilot results more relevant for future decisions regarding a broader roll-out of a peak-time rebate program for Duke customers with smart meters. My testimony is organized as described immediately below.

- The default application of an eventual permanent Peak-Time Rebate program as the standard for all Duke customers is a potential opportunity to maximize smart meter benefits and avoid capacity cost increases for customers.
- As proposed, the Pilot will not deliver the information the Commission will likely require to inform future decisions regarding peak-time rebate programs.
- Multiple design element modifications and information are required to ensure Pilot outcomes are useful for future decisions regarding peak-time rebate programs.

II. THE DEFAULT APPLICATION OF A PEAK-TIME REBATE PROGRAM AS THE STANDARD FOR ALL DUKE CUSTOMERS IS A POTENTIAL OPPORTUNITY TO MAXIMIZE SMART METER BENEFITS AND AVOID CAPACITY COST INCREASES FOR CUSTOMERS

Q. Please explain what a peak-time rebate program is.

A. Peak-time rebate programs are variants of time-of-use rate designs, which are generally intended to provide price signals to customers to indicate the relative scarcity or abundance of electric system capacity. By pricing electricity high during times of scarce capacity, and low during times of abundant capacity, time-of-use rates encourage customers to switch the operation of electric loads away from system peaks. By reducing use during system peaks, participating customers help avoid the addition of very costly peak capacity, thereby creating economic benefits for all customers.

Q. Please explain what "default application" of a peak-time rebate program means.

A. In the event the peak-time rebate Pilot results indicate that such a program would be beneficial in Kentucky, I recommend peak-time rebate be added as a routine, permanent component of Duke's standard Residential rate. By "default", I mean that the rebate opportunity should apply to every customer on a residential rate with a smart meter, without the need to take any special enrollment action.

Q. Are there critics of time-of-use rate designs?

A. Yes. Some time-of-use rate designs, such as "Free Saturdays", do nothing to alleviate system peaks (which invariably occur during weekdays). But the greatest critiques come from advocates for low-income customers. These advocates claim, with some justification, that low-income customers are less likely to own the types of electric appliances, such as air-conditioners, which can be turned down during times of high prices. The electric loads these customers do typically own, such as refrigerators or medical equipment, are characterized by usage which is difficult to modify in response to changing prices. Referred to by economists as price inelasticity, it means that low-income customers are more likely than others to be economically harmed by high-priced times, and less likely to take advantage of low-priced times, as their loads cannot readily be shifted away from system peak periods.

Q. How are peak-time rebate programs different?

A. Peak-time rebate programs feature the use of incentives, in the form of a rebate, to encourage shifts of electric usage away from system peak periods. While common time-of-use rate designs feature high prices as penalties to encourage such shifts, peak-

time rebate programs pay rebates to reward such behaviors. In a peak-time rebate program, those customers who are unwilling or unable to shift electric usage away from system peak periods are not penalized through higher rates, but simply pay the standard rate per kilowatt hour (kWh) for electricity used during these times. However, customers who are willing and able to shift electric usage away from such times are rewarded for their efforts in the form of a rebate on their electric bills. To simplify, peak-time rebate is referred to as a "carrot" approach to reducing system peak, whereas common time-of-use rates are referred to as "stick" approaches. Peak-time rebate programs, because they lack penalties for usage during system peaks, are considered more equitable for customers with less discretionary electric loads to shift. Moreover, the default application of peak-time rebate programs to all customers means that more customers will participate.

Q. Do other jurisdictions require peak-time rebate programs of utilities which have installed smart meters?

A. Yes. The Maryland Public Service Commission required its investor-owned utilities to include peak-time rebates as a part of standard residential rates in rate cases held since those utilities installed smart meters in the 2009-2013 time frame. I consider the approach employed in Maryland to be a best practice for utilities which have installed smart meters.

Q. How do peak-time rebate programs work in those jurisdictions?

A. In these jurisdictions, peak-time rebate programs are part of standard (default) rate design. The opportunity to earn a rebate is available to all customers with no required sign-ups (though sign-ups do permit customers to specify their preferred program notice delivery methods, either a recorded phone call, text message, or e-mail message). Up to six times a summer, each utility is authorized to call a critical peak event, or "CPE", by 8:00 p.m. local time the prior evening. CPEs are immediately communicated via mass media, social media, and up to two individual communication channels a customer may have selected. Any customer demonstrating a reduction in use during the peak hours specified for a CPE day, compared to the same period during recent non-CPE days with similar weather, is awarded a rebate. The size of the reduction compared to the baseline determines the size of the rebate, which is calculated at $1.25 per kWh reduced. Within a few business days of a CPE, a customer can check his or her account to determine the size of his or her CPE rebate, if earned. Rebates are clearly presented on rebate-earning customers' next monthly bills.[3]

Q. Do you recommend a default peak-time rebate program be deployed for Duke's Kentucky customers?

A. Yes, provided Pilot program results indicate such an approach would be of benefit. My research indicates that the application of time-of-use rates is among the largest potential sources of economic customer benefit for utilities which have installed smart

[3] The peak-time rebate program offered by PEPCO is typical of all such programs offered by IOUs in Maryland. A description is available on PEPCO's website at https://www.pepco.com/WaysToSave/ForYourHome/Pages/MD/AboutPeakEnergySavingsCredit.aspx

meters.[4] In addition, research indicates that default application of time-of-use rates (as opposed to individual enrollment) results in dramatically higher participation in such rates.[5] Finally, I agree that the peak-time rebate variant of time-of-use rates is the most equitable for customers less likely to have discretionary electric loads to shift. For all of these reasons, I recommend a default peak-time rebate program be deployed for Duke's Kentucky customers if the Pilot results are favorable.

Q. The Commission has already approved a settlement agreement between the AG and Duke in case 2016-00152.[6] The settlement agreement provided for the peak-time rebate pilot Duke is proposing in this case. Why is the design of the Pilot of such significant interest to the AG?

A. The design of the Pilot is critical to the AG for several reasons. First, the AG is highly interested in maximizing the benefits of Duke's smart meter deployment to customers. Not only is the maximization of smart meter benefits important to AG constituents served by Duke, it is important for the AG to pursue, and establish as appropriate, best practices for other Kentucky utilities interested in deploying smart meters to follow. Second, the AG strongly believes it is in constituents' best economic interest for Duke Energy to retain its status as a supplier of Fixed Resource Requirements in the PJM capacity market. Duke's status as a supplier of Fixed Resource Requirements alleviates the need for Duke to procure capacity in the PJM capacity market, likely at

[4] Alvarez P. Smart Grid Hype & Reality: A Systems Approach to Maximizing Customer Return on Utility Investment. Second Edition. Wired Group Publishing. June, 2018. Page 159.

[5] Todd, A., P. Cappers, and C. Goldman. 2013. *Residential Customer Enrollment in Time-based Rate and Enabling Technology Programs*. Lawrence Berkeley National Laboratory, LBNL-6247. Page xxiii.

[6] Kentucky PSC Case No. 2016-00152. Order dated May 25, 2017. Page 15.

much higher costs than through the use of Duke's rate-based generating plants and bi-lateral purchased capacity contracts. However, Duke has advised the Commission that its "actual operating capacity position in PJM is razor thin at best."[7] The Commission recognized the potentially costly ramifications of Duke's precarious capacity position in its Order in that case.[8] Thus, the AG deems the Pilot design to be of critical importance in securing accurate results, so that the results may be used by the Commission and stakeholders regarding the application of peak-time rebate programs in Kentucky.

Q. What is the relevance of these observations to the design of the PTR pilot?

A. Duke is motivated by capital bias to build new generating capacity, and by the throughput incentive to sell more kWh between rate cases. As an effective peak-time rebate program is likely to avoid new plant investment and may reduce kWh sales volumes,[9] I am concerned that Duke would prefer not to offer a peak-time rebate program on a default basis to its Kentucky customers. As a poor result from the Pilot would reduce the likelihood the Commission will order this, I believe the interests of Duke's customers are best served by a well-designed Pilot with carefully considered features and details. In my review of information Duke provided on the proposed Pilot, I have identified features and details which will limit the value of Pilot results in informing a potential broader roll-out of peak-time rebate programs. Pilot features and

[7] Kentucky PSC Case No. 2017-00427. Direct testimony of John A. Verderame. Page 25 at line 1.

[8] Kentucky PSC Case No. 2017-00427. Order dated September 13, 2018. Page 9.

[9] King C and Delurey, D. *Efficiency and Demand Response: Twins, Siblings, or Cousins?* Public Utilities Fortnightly. March, 2005.

details should be defined in advance such that results will be useful in informing future Commission decisions regarding peak-time rebate programs. In my opinion, the Commission has an opportunity to play a leadership role in smart meter optimization research by overseeing a well-designed peak-time rebate Pilot.

III. AS PROPOSED, THE PILOT WILL NOT DELIVER THE INFORMATION THE COMMISSION WILL LIKELY REQUIRE TO INFORM FUTURE DECISIONS REGARDING PEAK-TIME REBATE PROGRAMS

Q. Why do you believe the Pilot Duke proposes will not deliver the information the Commission will likely require to inform future decisions regarding peak-time rebate programs?

A. In order to inform future decisions regarding peak-time rebate programs, I believe the Pilot should be designed, to as great a degree as possible, to mimic the design of a broader roll-out of peak-time rebate programs. Pilot features and details, to the extent they do not mimic the design of a broader roll-out, should be modified. In particular, the Pilot must be designed to provide answers to specific questions needed for future decisions regarding peak-time rebate programs. The Pilot sample size must be determined in advance such that answers to the questions are likely to be statistically significant. Finally, the Pilot must be designed to encourage customer participation and response. In all of these areas, and a few more, I find the Pilot as proposed to be deficient. Unless these deficiencies are remedied, I fear the Pilot will not provide information useful for future decisions regarding peak-time rebate programs.

Q. Can you offer specific examples?

A. Yes. Regarding peak-time rebate design, one of the most critical features is the rebate rate per kWh of reduction during CPEs. I believe the rebate rate Duke has proposed, at $0.33 per kWh, to dramatically under-estimate the value of conservation during system peak periods. I do not believe this figure accurately represents the value of energy avoided during system peaks. As such, it represents a departure from what a full peak-time rebate amount might be in a full roll-out, and makes the Pilot less likely to produce results useful in future decisions regarding peak-time rebate programs. Furthermore, I recognize peak-time rebate program success is dependent on customer learning and achievement. In my experience developing demand-side management programs, and in published research, feedback which is prompt, either positive or negative, enhances learning and achievement.[10] Yet Duke's Pilot proposal provides no feedback to participants for as long as two billing cycles. As other utilities' PTR programs feature both higher rewards ($1.25 per kWh) and prompt feedback,[11] I believe these deficiencies must be remedied if the Pilot is to deliver meaningful results of value in future decisions regarding peak-time rebate programs.

Q. Are there other examples?

A. Yes. Duke's Pilot proposal appears to take a narrow view of learning objectives, or questions the Pilot will answer. In discovery, Duke provided six questions to serve as

[10] Hattie J and Timperley H. *The Power of Feedback*. Review of Educational Research. March 2007, Vol. 77, No. 1, pp. 81-112

[11] Description of a typical peak-time rebate program is available on PEPCO's website at https://www.pepco.com/WaysToSave/ForYourHome/Pages/MD/AboutPeakEnergySavingsCredit.aspx

Pilot learning objectives.[12] Not only are some Pilot learning objectives I believe to be critical missing, Duke provides no details on how it will attempt to secure answers to the questions. For example, Duke has yet to design marketing materials or participant survey instruments[13] which could retard or advance peak-time rebate impacts and/or the achievement of Pilot learning objectives.

Q. Please address the issue of sample size.

A. A clear understanding of Pilot learning objectives is critical to the determination of sample size. In my experience, sample size must be determined in advance if statistically significant answers to Pilot questions are to be obtained. The sample size required is based on an estimate of the ranges of Pilot outcomes for specific questions to be answered. For example, in the "difference of differences" study approach Duke has chosen for the PTR Pilot, the smaller the expected difference between test and control groups, the larger the sample size required for statistically significant answers. Yet Duke appears to make no such determinations of sample size in advance, responding in discovery that an optional "Power Analysis" proposed by its Pilot evaluation vendor might be employed once participants begin to enroll in the Pilot.[14] This is inadequate assurance that the Pilot sample size will be large enough to deliver statistically significant answers to Pilot questions, jeopardizing the Pilot's value for future decisions regarding peak-time rebate programs.

[12] Kentucky PSC Case No. 2019-00277. Duke response to AG DR 01-008.

[13] Kentucky PSC Case No. 2019-00277. Duke response to AG DR 01-011

[14] Kentucky PSC Case No. 2019-00277. Duke response to AG DR 01-011(e).

IV. MULTIPLE DESIGN ELEMENT MODIFICATIONS AND INFORMATION ARE REQUIRED TO ENSURE PILOT OUTCOMES ARE USEFUL FOR FUTURE DECISIONS REGARDING PEAK-TIME REBATE PROGRAMS.

Q. What Pilot design modifications do you recommend?

A. First, I recommend that a definitive list of questions the Pilot should be designed to answer be developed. In addition to the general list Duke provided in discovery, I would add the following specific questions as Pilot learning objectives, at a minimum:

- What is the average kWh reduction (and estimated kW reduction) per participant, per event, broken down by summer events and winter events?
- What is the average kWh reduction (and estimated kW reduction) per participant earning a rebate, broken down by summer events and winter events?
- On average, how many/what percent of participants earned a rebate, broken down by summer events and winter events?
- Among participants who earned a rebate, what was the average rebate per participant per summer event? Per winter event?
- How do differences in participant characteristics impact the size of kWh reductions per summer event? Per winter event?
- What are the most common actions participants took to reduce usage during summer events? During winter events?
- What are the most common reasons participants gave for not reducing usage during summer events? During winter events?
- How satisfied are participants with the peak-time rebate program?

- What are the participants' most frequently identified program improvement recommendations?

The advance determination of highly specific questions to be answered by the Pilot is one of the two most critical actions the Commission can take to ensure the Pilot delivers information of value in making future decisions regarding PTR. Without a clear understanding of the Pilot's learning objectives, the Pilot is unlikely to be designed in a way that delivers value. The other most critical action the Commission can take to ensure the Pilot delivers information of value in making future decisions regarding PTR is to ensure the Pilot sample size is adequate to deliver answers to the questions which are statistically significant.

Q. How can the Commission ensure the Pilot sample size is adequate to deliver answers to the questions which are statistically significant?

A. I recommend the list of learning objectives/questions to be answered be subjected to the selected Pilot evaluation vendor's Power Analysis in advance, prior to the start of the Pilot program. A Power Analysis is generally conducted as part of Pilot design to determine the minimum sample size required to deliver statistically significant answers. A Power Analysis considers the questions to be answered, as well as the variation expected in the outcomes data, to determine the appropriate sample size. Then, I recommend Duke be required to design an enrollment program and marketing efforts consistent with fulfillment of the sample size targeted for the Pilot by the Power Analysis. Depending on the questions the Pilot is intended to answer, and the variation

expected in responses, a Pilot sample size much larger than the 1,000 Duke anticipates in its proposal may be required.

Q. Are you aware that the Settlement Agreement the Commission approved in Case No. 2016-00152 specifies that the Pilot be limited to 1,000 participants?

A. Yes, but to my knowledge, the selection of Pilot size was arbitrary. With a better understanding of the Pilot design Duke presents in this Case, such as the use of the "difference of differences" approach, the measurement of winter as well as summer CPE impacts, and the measurement of impacts of "day before" CPE notices against the impacts of "same day" CPE notices, the potential insufficiency of the 1,000 participant Pilot size becomes more apparent. The opportunity to use a third party Pilot evaluation firm to complete a Power Analysis to objectively determine the appropriate Pilot sample size is also new information. The AG suggests the concern that the Pilot will deliver statistically significant answers to Pilot questions be prioritized over the adherence to the arbitrary cap of 1,000 Pilot participants called for in the stipulation in Case No. 2016-00152.

While Pilot cost may be a concern for some, I believe the cost of conducting a valid pilot to be much less than the potential value of a well-designed PTR program. Furthermore, spending ratepayer funds on a pilot which does not deliver information useful to future decisions regarding PTR is the most costly type of pilot, as it would require a second pilot to correct the deficiencies of the first. The reality of pilots, and of impact measurement, is that the issues of learning objectives and sample size are related. The more objectives to be satisfied, and the lower the expected variance in

impacts, the greater the sample size must be to deliver statistically significant answers. Learning objectives must therefore be highly specific and prioritized. It may be necessary to eliminate some learning objectives if they require too large a sample size. For example, the measurement of summer CPE impact merits a higher priority than the measurement of winter CPE impact, and the measurement of CPEs called with adequate notice (evening before) merits a higher priority than the measurement of CPEs called with as little as one-hour's notice.

Q. Do you have recommendations regarding the features and details of the Pilot?

A. I have several, regarding rebate size, CPE notifications, participant- and event-specific feedback and rebate calculations, and CPE limitations.

Q. Please provide your recommendation regarding rebate size.

A. In its Pilot proposal, Duke recommends a rebate amount of $0.33 per kWh. I believe this amount to be far below the actual economic value of energy and capacity at peak, particularly in summer months. As indicated earlier, low rebates per kWh will reduce customers' motivation to reduce usage during CPEs, and likely result in lower observed impacts in the Pilot. I recommend a summer rebate amount three or four times higher than the amount proposed by Duke in its Pilot proposal.

PJM reports locational marginal price history on its website.[15] By way of example, on July 1, 2019 at 5:00 p.m., the marginal price for energy at Duke's three local pricing nodes (DEOK, EKPC-DEOK, and DEK) reached $0.36 per kWh, and

[15] Hourly history available at https://www.pjm.com/markets-and-operations/energy/lmp-model-info.aspx

that is just for energy. Duke's proposed $0.33 rebate per kWh is therefore not even enough to cover the energy value during some system peaks. As the Commission is well aware, there is also a capacity value which rebate amounts should take into consideration. In discovery, Duke provided information on its avoided capacity costs for July, 2019, which it estimated at $70.10 per KW-year for generation and $49.65 per KW-year for transmission/distribution, for a total of almost $120 per KW-year.[16] As the average central air conditioning unit uses 3 to 5 KW of power, and the average electric clothes dryer uses 3 KW of power,[17] even small customer behavior changes/usage reductions can deliver significant capacity value. If Duke's KW values are accurate, a 20% reduction in a 3 KW load would therefore be worth $72 a year if delivered for each CPE ($120 per KW-year x 3 kW x 20%). Certainly, the summer month energy and capacity value combined from a PTR program is worth more than just $0.33 per kWh.

These facts, combined with the fact that PTR programs in climates similar to those in Kentucky (Maryland) have been paying a rebate of $1.25 per kWh for years,[18] lead me to recommend that the rate per kWh for the Duke Pilot be established at between $1.00 and $1.33 per kWh. This level of rebate should serve as both a better estimate of the true value of conservation on summer CPE days, and as a more accurate

[16] Kentucky PSC Case No. 2019-00277. Attachment to Duke response to AG DR 02-010, worksheet cells D10 and D11.
[17] Accessed via Internet at www.energyusecalculator.com on November 29, 2019.
[18] See, for example, the Baltimore Gas & Electric "Energy Savings Days" webpage at: https://www.bge.com/WaystoSave/ForYourHome/Pages/EnergySavingsDays.aspx, or the Pepco "Peak Energy Savings Credit" webpage at: https://www.pepco.com/WaysToSave/ForYourHome/Pages/MD/PeakEnergySavingsCredit.aspx.

approximation of the rate to be used in any future permanent PTR program the Commission might require Duke to offer.

Q. What about the rebate rate for winter CPEs?

A. I have no basis for a recommendation for winter CPE rebate rates. I admit that it might also be rational, if not preferable, for a different rebate level to be used in winter months. As with my recommendation for a higher rebate in summer months, the winter rebate amount should be based on market prices for energy during peaks, as well as avoided capacity values. As with my recommendation for a higher rebate in summer months, the winter CPE rebate rate should be set so as to mimic the likely rate for any winter peak-time rebate program Duke might eventually establish. However, as Duke is a summer-peaking utility, and as PJM is a summer-peaking market, the Pilot should prioritize the measurement of summer CPE impacts over the measurement of winter CPE impacts.

Q. Please provide your recommendations regarding CPE notification.

A. Duke's proposal for the PTE pilot allows Duke to provide notice of CPEs as little as one hour in advance. Duke appears to justify CPE notifications as short as one hour in advance through the fact that PJM can issue emergency capacity notices as short as 1 hour in advance.[19] However, emergency capacity relief is not the primary goal of PTR programs, and PJM events need not be the driver of CPEs in Duke's Kentucky service territory. I am concerned that the use of CPE notifications for anything other

[19] Kentucky PSC Case No. 2019-00277. Duke response to AG DR 01-009(b).

than evening-before notifications (the standard in other PTR programs)[20] will negatively impact the amount of impact observed in the Pilot. In the case of such short-notice CPEs, many program participants will not be able to shift loads away from peak, either because they are not home or do not have a thermostat they can control remotely via smart phone.

I recommend Duke be prohibited from calling CPEs if notice cannot be given by 9:00 p.m. the evening before. If the Commission deems impacts from short-notice CPEs to be an important outcome of the Pilot, then Duke should be required to express this intention formally, in the form of a question to be answered by the Pilot. The number of short-notice CPEs should be defined in advance, and the Pilot participant sample size adjusted as needed to ensure a statistically significant answer given the defined number of short-notice events to be called. I also recommend that in the event the Commission allows short-notice CPEs despite my recommendation, the impacts of CPEs called with adequate notice (i.e., evening before) be calculated separately from CPEs called on short notice.

Q. Please provide your recommendations regarding participant- and event-specific feedback and rebate calculations.

A. Duke's Pilot proposal does not provide for participant- and event-specific feedback and rebate calculations.[21] Instead, Duke proposes to calculate and apply rebate credits

[20] See, for example, the Baltimore Gas & Electric "Energy Savings Days" webpage at: https://www.bge.com/WaystoSave/ForYourHome/Pages/EnergySavingsDays.aspx, or the Pepco "Peak Energy Savings Credit" webpage at: https://www.pepco.com/WaysToSave/ForYourHome/Pages/MD/PeakEnergySavingsCredit.aspx

[21] Kentucky PSC Case No. 2019-00277. Duke response to AG DR-01-010(f).

to customers' bills "no later than the second billing month following the CPE(s)."[22] This means that feedback on the actions a participating customer might take on June 15th might not be available to that customer until August, when the customer receives his or her July bill. By this time, several additional CPEs will have been called without a customer knowing if his or her conservation actions were adequate to deliver a rebate. Further, Duke describes the bill credit as a single line item on a customer's bill.[23] This level of detail will be insufficient for participating customers to know to which CPE a bill credit applies, further reducing the customer's understanding of which conservation actions were adequate to deliver rebates, and which were not. As I indicated earlier, prompt and accurate feedback is important for individual learning, and I believe prompt and accurate feedback should therefore figure prominently in any future PTR program. As prompt and accurate feedback should be part of any future permanent PTR program, it should also be part of the Pilot if the Pilot is to deliver information valuable for future decisions regarding PTR.

I recommend each participating customer receive a notice no later than 3 business days after a CPE as to either the amount of the rebate earned, or as to the fact that any actions the customer may have taken were insufficient to earn a rebate.[24] I recommend such notice be provided through the same channels the customer selected for CPE notices to be communicated to him or her. I also recommend that bills reflect rebates per CPE, with CPE dates noted for each rebate/CPE.

[22] Kentucky PSC Case No. 2019-00277. Application dated August 15, 2019. Page 10.
[23] Kentucky PSC Case No. 2019-00277. Duke response to AG DR-01-010(g).
[24] See, for example, the Baltimore Gas & Electric "Energy Savings Days" webpage at: https://www.bge.com/WaystoSave/ForYourHome/Pages/EnergySavingsDays.aspx, or the Pepco "Peak Energy Savings Credit" webpage at: https://www.pepco.com/WaysToSave/ForYourHome/Pages/MD/PeakEnergySavingsCredit.aspx

Q. Might it be difficult for Duke to comply with this requirement?

The methodology Duke provided for calculating rebates appears relatively straightforward to me.[25] It involves selecting data from customers' meter data history according to certain rules, which are designed to ensure that the days used to establish a baseline are comparable to days on which a CPE is called. From this data, Duke proposes to establish customer-specific usage baselines for comparison to usage during a CPE, and then to calculate rebates from any demonstrated reductions from the baseline. The process does not appear to me to be overly complex, and I believe standard MS Excel or MS Access software will be adequate for executing the process for each CPE. As the process appears straightforward, the tools standard, and the participants to likely number only a few thousand, I estimate that 2 business days post-CPE will be adequate to complete the rebate calculation process and run some checks for accuracy, with an additional day allowed for loading rebate amounts (or lack thereof) into outbound notification processes (text, e-mail, etc.) to deliver feedback. I do not believe compliance with this feedback requirement to be particularly difficult or onerous relative to the feedback's contribution as a Pilot design element which more closely mimics how a permanent, full PTR program should operate.

Q. Do you have other recommendations regarding CPE notices?

[25] Kentucky PSC Case No. 2019-00277. Duke response to AG DR-01-010(a).

A. Yes. Duke indicates that it may send participating customers a reminder of the event just prior to the event start for some CPEs. I recommend such reminders be sent for every participant for every CPE between 7:00 a.m. and 8:00 a.m. the day of a CPE. Such a reminder is likely to catch a significant number of program participants before they leave for work on a CPE day.

Q. Please provide your recommendations regarding CPE limitations.

A. As indicated earlier, I believe no CPE should be called if notifications cannot be delivered to participants by 9:00 p.m. the evening before. But in addition, I believe limits should be placed on the number of events called in a year or in a season.

Duke proposes to call 16-25 CPEs in a year in its Pilot proposal.[26] I consider this to be too frequent, and believe it may lead to participant dissatisfaction, fatigue, and/or reduced impact persistence. Again, I look to existing PTR programs for guidance. In Maryland, CPEs are limited to ten per summer (and none in winter).[27] I believe ten planned CPEs per season to be an appropriate limitation, and recommend Duke establish its daily CPE process (whether or not to call a CPE for the next day) such that it targets no more than ten CPEs per season. Should the Commission allow Duke to call "emergency" CPEs (those with notice periods as little as one hour in advance) as part of the Pilot, I believe such CPEs should be limited to one or two instances as part of the maximum of ten per season. In addition, whatever the

[26] Kentucky PSC Case No. 2019-00277. Duke response to AG DR-01-009 (a).
[27] See, for example, the Baltimore Gas & Electric "Energy Savings Days" webpage at: https://www.bge.com/WaystoSave/ForYourHome/Pages/EnergySavingsDays.aspx, or the Pepco "Peak Energy Savings Credit" webpage at: https://www.pepco.com/WaysToSave/ForYourHome/Pages/MD/PeakEnergySavingsCredit.aspx

Commission decides on this issue, and as I've mentioned multiple times in this testimony, the Pilot sample size must take into account the number of CPEs to be called. The fewer the CPEs (with evening-before notice) called, the larger the sample size will need to be.

Q. Do you have any other general observations or recommendations regarding PTR programs you wish to describe to the Commission?

A. Yes. Several Duke responses to discovery seem to imply that a PTR program must comply with PJM requirements for Price-Responsive Demand programs to deliver value, and that PTR programs should be designed in compliance with such requirements. I do not agree with this implication, intentional or otherwise, and recommend the Commission resist agreeing to such design requirements. If a PTR program or pilot delivers conservation and peak period capacity reductions, such a program or pilot should be deemed to be valuable irrespective of PJM Price-Responsive Demand program requirement compliance. From one-hour notice periods to CPE event frequency, I recommend PTR programs be designed in a way that creates value for Kentucky customers, and not limited to designs which meet PJM specifications. Of course, to the extent PJM requirements can be accommodated without harming PTR impact, compliance with such requirements is not a bad idea. I am simply suggesting that compliance with PJM Price-Response Demand program requirements be a secondary, rather than primary, consideration.

V. REVIEW AND RECOMMENDATIONS

Q. Please review your testimony

A. My testimony provided information in support of the following points:

- The default application of an eventual permanent Peak-Time Rebate program as the standard for all Duke customers is a potential opportunity to maximize smart meter benefits and avoid capacity cost increases for customers.
- As proposed, the Pilot will not deliver the information the Commission will likely require to inform future decisions regarding peak-time rebate programs.
- Multiple design element modifications and information are required to ensure Pilot outcomes are useful for future decisions regarding eventual permanent peak-time rebate programs.

Q. Please provide recommendations to the Commission which your testimony supports.

A. I recommend the Commission should only approve Duke's Pilot proposal if the changes to the Pilot I describe in this testimony are made. These include:

- Defining questions the Pilot must answer in advance, to include, at a minimum, the questions I provided;
- Completing a Power Analysis to determine, in advance, the minimum Pilot sample size required to answer the questions in a statistically significant manner;
- Increasing the summer rebate amount to between $1.00 and $1.33 per kWh;
- Prohibiting the calling of CPEs unless participant notification can be accomplished by 9:00 p.m. the evening prior;

- Providing feedback as to rebate award/size within three business days of a CPE, and providing bill credit details which identify each credit by CPE date;
- Providing reminder notices to each program participant between 7:00 and 8:00 a.m. the day of a CPE, for each and every CPE;
- Limiting the number of CPE's to six per season (six summer, six winter);
- Considering PJM Price-Responsive Demand program requirements as a secondary, rather than primary, objective of Pilot design.

Q. Does this conclude your testimony?

A. Yes, it does.

APPENDIX A: CURRICULUM VITAE OF PAUL ALVAREZ

Curriculum Vitae -- Paul J. Alvarez MM, NPDP

Wired Group, 6483 Big Horn Trail, Littleton, CO 80125. palvarez@wiredgroup.net 303-997-0317

Profile

After 15 years in Fortune 500 product development and product management, including P&L responsibility, Mr. Alvarez entered the utility industry by way of demand-side management rate and program development, marketing, and impact measurement for Xcel Energy in 2001. He has since designed renewable portfolio standard compliance and distributed generation rates and incentive programs. These experiences led to unique projects involving the measurement of grid modernization costs and benefits (energy, capacity, operating savings, revenue capture, reliability, environmental, and customer experience), which revealed the limitations of current utility regulatory and governance models. Mr. Alvarez currently serves as the President of the Wired Group, a boutique consultancy serving consumer and environmental advocates, regulators, associations, and suppliers.

Appearances and Research Projects in Regulatory Proceedings

Critique of Smart Meter Benefits Claimed by Puget Sound Energy. Testimony before the Washington Utility and Telecom Commission recommending rejection of cost recovery pending demonstration of benefits in excess of costs. UE-190529 and UG-190530. November 22, 2019.

Critique of Smart Meter Benefits Claimed by Rockland Electric Company. Testimony before the New Jersey Board of Public Utilities on behalf of the Division of Consumer Advocate recommending rejection of cost recovery pending demonstration of benefits in excess of costs. ER19050552. October 11, 2019.

Critique of Grid Improvement Plan Proposed by Indianapolis Power and Light. Testimony before the Indiana Utility Regulatory Commission recommending reductions in the size of the plan ($1.2 billion) based on benefit-cost analyses of plan components. Cause 45264. October 7, 2019.

Investigation into Distribution Planning Processes. Comments to the Michigan Public Service Commission recommending a transparent, stakeholder-engaged distribution planning process. U-20147. September 11, 2019.

Investigation into Grid Modernization. Comments to the New Hampshire Public Utilities Commission recommending a transparent, stakeholder-engaged distribution planning process. IR 15-296. September 6, 2019.

Arguments to Reduce and Re-prioritize Grid Modernization Investments Proposed by Pacific Gas & Electric. Testimony before the California Public Utilities Commission. A.18-12-009. July 26, 2019.

Evaluation of Xcel Energy's Request for an Advance Determination of Prudence Regarding Natural Gas Generation Plant Purchase. Testimony before the North Dakota Public Service Commission. PU-18-403. May 28, 2019.

Critique of Smart Meter Replacement Program Implied by Proposed Duke Energy Ohio Global Settlement Agreement. Testimony before the Public Utilities Commission of Ohio on behalf of the Office of Consumer Counsel. Numerous cases including 17-0032-EL-AIR. June 25, 2018.

Support for Considering Duke Energy Grid Modernization Investments in a Distinct Proceeding. Testimony before the North Carolina Utilities Commission on behalf of the Environmental Defense Fund. E-2 Sub 1142, October 18, 2017 and E-7 Sub 1146, January 19, 2018.

Evaluation of Southern California Edison's Request to Invest $2.3 Billion in its Grid to Accommodate Distributed Energy Resources. Testimony before the California Public Utilities Commission on behalf of The Utility Reform Network. A16-09-001. May 2, 2017.

Evaluation of Kentucky Utilities/Louisville Gas & Electric Smart Meter Deployment Plan. Testimony before the Kentucky Public Service Commission on behalf of the Kentucky Attorney General in 2016-00370/2016-00371. March 3, 2017. Also in 2018-00005 May 18, 2018

Evaluation of National Grid's Massachusetts Smart Meter Deployment Plan. Testimony before the Massachusetts Department of Public Utilities on behalf of the Massachusetts Attorney General in 15-120. March 10, 2017.

Evaluation of Pacific Gas & Electric's Request to Invest $100 Million in Its Grid to Accommodate Distributed Energy Resources. Testimony before the California Public Utilities Commission on behalf of The Utility Reform Network, A15-09-001. April 29, 2016

Recommendations on Metropolitan Edison's Grid Modernization Plan. Testimony before the Pennsylvania Public Utilities Commission on behalf of the Environmental Defense Fund in R-2016-2547449. July 21, 2016.

Arguments to Consider Duke Energy's Smart Meter CPCN in the Context of a Rate Case. Testimony before the Kentucky Public Service Commission on behalf of the Attorney General in 2016-00152. July 18, 2016.

Evaluation of Westar Energy's Proposal To Mandate a Rate Specific to Distributed Generation-Owning Customers. Testimony before the Kansas Corporation Commission on Behalf of the Environmental Defense Fund, case 15-WSEE-115-RTS. July 9, 2015.

Regulatory Reform Proposal to Base a Significant Portion of Utility Compensation on Performance in the Public Interest. Testimony before the Maryland PSC on behalf of the Coalition for Utility Reform, case 9361. December 8, 2014.

Duke Energy Ohio Smart Grid Audit and Assessment. Primary research and report prepared for the Public Utilities Commission of Ohio case 10-2326-GE. June 30, 2011.

SmartGridCity™ Demonstration Project Evaluation Summary. Primary research and report prepared for Xcel Energy. Colorado Public Utilities Commission case 11A-1001E. October 21, 2011.

Books

Smart Grid Hype & Reality: A Systems Approach to Maximizing Customer Return on Utility Investment. Second edition. ISBN 978-0-615-88795-1. Wired Group Publishing. 360 pages. 2018.

Noteworthy Publications

The Rush to Modernize: An Editorial on Distribution Planning and Performance Measurement. With Sean Ericson and Dennis Stephens. Public Utilities Fortnightly. July 8, 2019. Pages 116+

Modernizing the Grid in the Public Interest: Getting a Smarter Grid at the Least Cost for South Carolina Customers. Whitepaper co-authored with Dennis Stephens for GridLab. January 31, 2019

Modernizing the Grid in the Public Interest: A Guide for Virginia Stakeholders. Whitepaper co-authored with Dennis Stephens for GridLab. October 5, 2018.

Measuring Distribution Performance? Benchmarking Warrants Your Attention. With Sean Ericson. Electricity Journal. Volume 31 (April, 2018), pages 1-6.

Busting Myths: Investor-Owned Utility Performance Can be Credibly Benchmarked. With Joel Leonard. Electricity Journal. Volume 30 (October, 2017), pages 45-48.

Price Cap Electric Ratemaking: Does it Merit Consideration? With Bill Steele. Electricity Journal. Volume 30, (October, 2017), pages 1-7.

Integrated Distribution Planning: An Idea Whose Time has Come. Public Utilities Fortnightly. November, 2014; also International Confederation of Energy Regulators Chronicle, 3rd Ed, March, 2015

Smart Grid Economic and Environmental Benefits: A Review and Synthesis of Research on Smart Grid Benefits and Costs. Secondary research report prepared for the Smart Grid Consumer Collaborative. October 8, 2013. Companion piece: Smart Grid Technical and Economic Concepts for Consumers.

Is This the Future? Simple Methods for Smart Grid Regulation. Smart Grid News. October 2, 2014.

A Better Way to Recover Smart Grid Costs. Smart Grid News. September 3, 2014.

Why Should We Switch to Performance-based Compensation? Smart Grid News. August 15, 2014.

The True Cost of Smart Grid Capabilities. Intelligent Utility. June 30, 2014.

Maximizing Customer Benefits: Performance Measurement and Action Steps for Smart Grid Investments. Public Utilities Fortnightly. January, 2012.

Buying Into Solar: Rewards, Challenges, and Options for Rate-Based Investments. Public Utilities Fortnightly. December, 2009.

Notable Presentations

NASUCA Annual Meeting. *Reinventing Distribution Planning in New Hampshire.* With D. Maurice Kreis, Executive Director, Office of Consumer Advocate. San Antonio, TX. November 19, 2019.

National Council on Electricity Policy Annual Meeting. Trainer on the economics of distribution grid interoperability and standard compliance; Presentation on communication network economics. Austin, TX. Sept 10-12, 2019.

NASUCA Annual Meeting. *Grid Modernization: Basic Technical Challenges Advocates Should Assert.* Orlando, FL. November 13, 2018.

Illinois Commerce Commission, NextGrid Working Group 7. *Using Peer Comparisons in Distributor Performance Evaluation.* Workshop 3 Presentation. Chicago, IL. July 30, 2018.

NARUC Committee on Electricity. *Using Peer Comparisons in Distributor Performance Evaluation.* Smart Money in Grid Modernization Panel Presentation. Scottsdale, AZ. July 16, 2018.

Public Utilities Commission of Ohio, Power Forward Proceeding Phase 2. *Getting a Smart Grid for FREE.* Columbus, Ohio. July 26, 2017.

NASUCA Mid-Year Meeting. *Using Performance Benchmarking to Gain Leverage in an "Infrastructure Oriented" Environment.* Denver, CO. June 6, 2017.

NARUC Committee on Energy Resources and the Environment. *How big data can lead to better decisions for utilities, customers, and regulators***.** Washington DC. February 15, 2016.

National Conference of Regulatory Attorneys 2014 Annual Meeting. *Smart Grid Hype & Reality.* Columbus, Ohio. June 16, 2014.

NASUCA 2013 Annual Conference. *A Review and Synthesis of Research on Smart Grid Benefits and Costs.* Orlando, FL. November 18, 2013.

NARUC Subcommittee on Energy Resources and the Environment. *The Distributed Generation (R)Evolution.* Orlando, FL. November 17, 2013.

IEEE Power and Energy Society, ISGT 2013. *Distribution Performance Measures that Drive Customer Benefits.* Washington DC. February 26, 2013.

Great Lakes Smart Grid Symposium. *What Smart Grid Deployment Evaluations are Telling Us*. Chicago. September 26, 2012.

Mid-Atlantic Distributed Resource Initiative. *Smart Grid Deployment Evaluations: Findings and Implications for Regulators and Utilities.* Philadelphia. April 20, 2012

DistribuTECH 2012. *Lessons Learned: Utility and Regulator Perspectives.* Panel Moderator. January 25.

DistribuTECH 2012. *Optimizing the Value of Smart Grid Investments.* Half-day course. January 23.

NARUC Subcommittee on Electricity. *Maximizing Smart Grid Customer Benefits: Measurement and Other Implications for Investor-Owned Utilities and Regulators*. St. Louis, MO. November 13, 2011.

Canadian Electric Institute 2013 Annual Distribution Conference. *The (Smart Grid) Story So Far: Costs, Benefits, Risks, Best Practices, and Missed Opportunities.* Toronto, Canada. January 23, 2011.

Teaching

Post-graduate Adjunct Professor. University of Colorado, Global Energy Management Program. Course: Renewable Energy Commercialization -- Electric Technologies, Markets, and Policy.

Guest Lecturer. Michigan State University, Institute for Public Utilities. Courses: Performance Measurement of Distribution Utility Businesses; Introduction to Grid Modernization.

Education

Master's Degree in Management, 1991, Kellogg School of Management, Northwestern University. Concentrations: Finance, Accounting, Information Systems, and International Business.

Bachelor's Degree in Business Administration, 1984, Kelley School of Business, Indiana University. Concentrations: Finance, Marketing.

Certifications

New Product Development Professional. Product Development and Management Association. 2007.

COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC APPLICATION OF DUKE ENERGY KENTUCKY, INC. TO AMEND ITS DEMAND SIDE MANAGEMENT PROGRAMS	)))	CASE NO. 2019-00277

AFFIDAVIT OF Paul Alvarez

State of Colorado)
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Paul Alvarez, being first duly sworn, states the following: The prepared Pre-Filed Direct Testimony and the Schedules attached thereto constitute the direct testimony of Affiant in the above-styled cases. Affiant states that he would give the answers set forth in the Pre-Filed Direct Testimony if asked the questions propounded therein. Affiant further states that, to the best of his knowledge, his statements made are true and correct. Further affiant saith not.

Paul Alvarez

SUBSCRIBED AND SWORN to before me this 5th day of December, 2019.

Tess M Creger
NOTARY PUBLIC

My Commission Expires: 01/12/2021

TESS M CREGER
NOTARY PUBLIC - STATE OF COLORADO
NOTARY ID 19964020083
MY COMMISSION EXPIRES JAN 12, 2021