# Exhibit No. 216

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Dr. Hari Poudel Testimony
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| *Exhibit No.:* | |
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# MISSOURI PUBLIC SERVICE COMMISSION

## INDUSTRY ANALYSIS DIVISION

## TARIFF/ RATE DESIGN DEPARTMENT

# DIRECT TESTIMONY

# OF

# HARI K. POUDEL, PhD

## UNION ELECTRIC COMPANY,
## d/b/a AMEREN MISSOURIMISSOURI

## Case No. EO-2023-0136

***Jefferson City, Missouri***
***March, 2024***

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**HARI K. POUDEL, PhD**

**UNION ELECTRIC COMPANY,**
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**DIRECT TESTIMONY**

**OF**

**HARI K. POUDEL, PhD**

# UNION ELECTRIC COMPANY, d/b/a AMEREN MISSOURIMISSOURI

**CASE NO. EO-2023-0136**

Q. Please state your name and business address.

A. My name is Hari K. Poudel, and my business address is P.O. Box 360, Jefferson City, Missouri, 65102.

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

A. I am employed by the Missouri Public Service Commission ("Commission") as an Economist in the Tariff/Rate Design Department in the Industrial Analysis Division.

Q. Please describe your educational and work background.

A. I received a Ph.D. in Public Policy and a master's degree in Public Health from University of Missouri, Columbia and another master's degree in Agricultural Economics from University of Hohenheim, Germany.

In January of 2020, I began working for the Missouri Department of Health and Senior Services as a research and data analyst. I was employed with the Division of Community and Public Health from January 2020 until October 2021. I started my career with the Commission as an economist in October 2021.

Q. Have you previously testified in proceedings before the Missouri Public Service Commission?

A. Yes. I have provided written testimonies and a deposition in multiple cases before the Missouri Public Service Commission. Please see Schedule HKP-1.

**EXECUTIVE SUMMARY**

Q. What is the purpose of your direct testimony?

A. The purpose of my direct testimony is to discuss the throughput disincentive, net margin rates, evaluation, measurement, and verification ("EM&V"), rebound effect, and rate case annualization in a Missouri Energy Efficiency Investment Act ("MEEIA") filing. My testimony explains the throughout disincentive and its components, that supports Staff Witness Sarah Lange who explains the basic interaction of the components of a MEEIA. If the Commission does authorize a fourth Ameren Missouri MEEIA Cycle, the Time-Of-Use ("TOU") rate structure may require separate net margin rates by rate code, by time period, and by measure, with the ability to account for the interactions of measures. The time of day that energy savings occur has different importance in block and TOU rate structures. Avoided marginal net revenue in a TOU rate structure is highly dependent on the timing of energy reductions. Consequently, this new complexity exists as a majority of Ameren Missouri residential customers are now served on TOU rate structures.

**THROUGHPUT DISINCENTIVE ("TD")**

Q. What is the throughput disincentive?

A. Utility rates are designed to recover more than the variable cost to the utility to acquire the energy required by its customers at wholesale. To the extent that a utility sells more energy at retail, the utility recovers more net revenue. To the extent that a utility sells less energy at retail, the utility recovers less net revenue. Absent some mechanism, utilities are financially disincentivized from facilitating demand-side programs that would reduce the utility's quantity of energy sold at retail, known as its "throughput."

As discussed by Staff Witness Sarah Lange, Ameren Missouri's MEEIA Cycles 2 and 3 included a Net Throughput Disincentive ("NTD") mechanism. The NTD mechanism was approved by the Commission as a component of a demand-side investment mechanism

("DSIM").[1] Avoided marginal revenues are a short-term problem that exists between rate cases, as reductions in throughput become recognized in normalized billing determinants in subsequent rate cases.[2]

Q. How was the NTD component calculated in MEEIA Cycles 2 and 3?

A. The NTD calculation includes the following mathematical equation:

NTD = MS x NMR x NTGF

MS refers to the monthly savings; NMR refers to the net margin revenue; and the NTGF refers to the Net-to-Gross Factor. I will explain each of these components further below.

Q. Where do the monthly savings values that are used in the above NTD calculation equation come from?

A. The monthly savings[3] values are the estimated values determined by Ameren Missouri. Ameren Missouri's Technical Resource Manual ("TRM") is the source of the initial savings values used in the NTD calculation. The accuracy of these estimates is dependent on the reliability of the TRM. The calculations are subject to after-the-fact adjustments pursuant to a process known as EM&V.

Q. What are the Commission MEEIA rules about the monthly savings values used in the current NTD calculation?

A. According to the Commission MEEIA rules (20 CSR 4240-20.092),

> The demand-side program deemed savings is the sum of the deemed savings for all measures installed in a demand-side program. Deemed savings means the estimated measure-level annual energy savings and/or demand savings documented or calculated in the approved technical resource manual, multiplied by the documented measure count.

[1] 20 CSR 4240-20.093
[2] Staff Witness Sarah Lange has introduced a new method to replace the current TD method as "avoided revenues."
[3] The monthly savings include the sum of all energy efficient measures' estimated monthly savings in kWh.

Q. Which aspects are pivotal in establishing the reliability of savings estimates when calculating NTDs?

A. Controlling for independent variables and the interaction of measures is critical to the credibility of savings estimates and distinguishes properly quantified avoided energy sales values from a simple and unreliable comparison of energy use before and after the implementation of an energy efficiency measure. The changes in energy consumption are the result of changes in a variety of independent variables and influences, including the interaction of energy efficiency measures and the effect of the energy efficiency measures. To isolate the energy savings that result from energy efficiency measures, EM&V practitioners should control for each of these independent variables that are material to the savings determination.[4]

Q. The mechanics of Ameren Missouri's proposed NTD are similar to the mechanics of its MEEIA Cycle 3 NTD. However, the calculation of measured energy not in the Deemed Savings Table depends on Ameren Missouri's Program administrator. Does it affect the NTD calculation and how?

A. Yes. It is imperative that the amount of energy savings included in the calculation of NTD be accurate. The estimated measure-level annual energy savings is attributed to the reduction in revenues for the utility company to offset the revenue that the utility doesn't earn on sales it doesn't make. Ameren Missouri relies on the program administrator to provide an annual value of savings for those measures, which are not in the Deemed Savings Table.[5] The data provided by the program administrator might result in a biased estimate of the energy savings calculation.

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[4]https://www.epa.gov/sites/default/files/2019-06/documents/guidebook_for_energy_efficiency_evaluation_measurement_verification.pdf

[5] Ameren Missouri, JE-2013-0582, Current Tariff Sheet No. 91.18

Q. Another component of the NTD calculation you mentioned earlier is the net marginal rate. Please describe it briefly.

A. The marginal rate is the retail price of a unit of energy not sold due to Ameren Missouri's facilitation of customer-funded demand-side programs. The net marginal rate is the difference between the wholesale cost of the energy for a given kWh sold at retail and the marginal retail rate for that kWh of energy. Due to the operation of Ameren Missouri's FAC, it may be more appropriate to calculate the net marginal rate as the difference between the FAC base factor and the value of the marginal retail rate for that kWh. The calculation of NTD is dependent on the accuracy of the marginal rate calculation, which is dependent on the accuracy of the profile of the avoided sales estimate. Prior to the widespread use of time-based rates, avoided sales by class and by month were the key drivers of marginal rate calculations. With wide-spread time-based rate structures, it will be more important to isolate the profile of avoided energy sales to calculate marginal rates, which will vary by measure.

Q. Do net marginal rates vary based on the rate class?

A. Yes. In general, the customers are grouped into several classes, and each class purchases its electricity service under a different rate schedule. Ameren Missouri has multiple active rate schedules with different energy charges per kWh within each rate class. Generally speaking, blocked rate structures include distinct rates for energy based upon the level of billed energy usage, i.e., one rate for all usage up to 750 kWh and a second rate for usage exceeding 750 kWh. Ameren Missouri's current tariff includes several residential time-based rate schedules. Time-based, or TOU are rate structures in which customers pay different prices at different times of the day. On-peak prices are higher and off-peak prices are lower than they would be for a flat rate, based on season, day of week, and time of day.

Q. How are current MEEIA marginal rate calculations performed by Ameren Missouri?

A. The MEEIA marginal rate calculations to date have relied on the relationship between monthly customer usage and the block where the usage falls in a given month. For example, under a blocked rate structure, some customers (Customer type A) will be billed for the entirety of their usage at the first block rate, while others (Customer type B) will have a combination of first block and second block usage in a given month. The avoided revenue that occurs if Customer type A implements a demand-side measure and the avoided revenue that occurs if Customer type B implements the same measure will be different because the rate for first block usage differs from the rate for second block usage, typically by a few cents.

Q. Does the time of day that energy savings occurs carry equal importance in both rate structures?

A. The time of day that energy savings occur has different importance in block and TOU rate structures. The introduction of larger quantities of customers being served under rate schedules with high rate differentials that occur during the course of a single day (and that vary by the day of the week) will affect the actual avoided marginal revenues more than those assumed in the block rate structure. Let's consider a hypothetical measure (Measure A) that is assumed to reduce 1 kWh of energy usage per hour of a device that is assumed to operate in all hours of all days throughout the year:

| Measure | Savings per Hour | Timing of Savings | Savings Per Month | Rate Plan Type | Average Rate | NTD Value |
|---|---|---|---|---|---|---|
| A | 1 | Every hour | 720 | Declining block rate structure | 9.34 ¢ | $67.25 |

However, if a measure (Measure B) avoids energy consumption every day at 6:00 PM, this calculation should look very different, as shown in the examples below:

| Measure | Savings per Hour | Timing of Savings | Savings Per Month | Rate Plan Type | Average Rate | NTD Value |
|---|---|---|---|---|---|---|
| B | 1 | 6:00 PM | 30 | Declining block rate structure | 9.34 ¢ | $2.80 |
| B | 1 | 6:00 PM | 30 | Residential Smart Saver Service on Peak Winter Option A[6] | 19.07 ¢ | $5.72 |

The tables above demonstrate that the timing of energy savings throughout the day is associated with varying NTD dollar values.

Q. Does the averaging of savings have the same impact on both sets of calculations?

A. No. Ameren Missouri calculates the average customer's marginal rate on a class-by-class basis and a month-by-month basis, but ignores the higher differential rate structure of the time-based rate. Ameren Missouri's current winter (October-May) rate has different energy charges per kWh. The first 750 kWh of consumption per customer per month are priced at one rate, and any additional kWhs are priced at a lower rate. The marginal rate is not constant under the declining block rates. The marginal usage, i.e., the last kWh purchased, for some customers occurs in the lower priced block, while the marginal usage for other customers occurs in the higher priced block. However, under a TOU rate structure, all customers are likely to use energy in time periods with different rates. Avoided marginal net revenue in a TOU rate structure is highly dependent on the timing of energy reductions. Consequently, this new complexity exists as a majority of Ameren Missouri residential customers are now served on time-based rate structures.

[6] Residential Smart Saver Service rate energy charge will vary by the time of day that the energy is used (On- Peak, Intermediate, Off-Peak), and the season (summer or winter). This rate has two options: year round service (Option A) and a summer seasonal service (Option B). Ameren Missouri, JE-2013-0582, Current Tariff Sheet No. 54.7.

Q. Does the current rate differential exist primarily based on the total usage in a given month?

A. With a TOU rate structure, the rate differential no longer occurs based primarily upon the total usage in a given month but rather the time of day that an individual customer uses energy. Furthermore, the rate differential between time periods can be far greater than the differential between blocked rates. As customer adoption of TOU rates increases, the need for more precise measurement of energy savings will also increase.

Q. Does both total usage and time of energy consumption need to be considered under the NTD design as used in MEEIA Cycles 2 and 3?

A. Yes. At this time, most Ameren Missouri residential customers are on a rate plan where total usage defines the majority of the energy charge, but a time-based overlay is also charged. Therefore, both total usage and time of energy consumption must be considered under the NTD design as used in MEEIA Cycles 2 and 3. Precision in measurement is crucial due to the impact on all ratepayers as the NTD is recovered through the Energy Efficiency Investment Charge ("EEIC"). The Commission requires energy metering to verify that consumers are billed accurately for the amount of energy ratepayers' use.

Q. Will the accuracy and granularity of assumed avoided energy sales profiles need to be improved to account for the higher differentials that occur intraday as opposed to monthly?

A. Yes. The complexity may require separate net margin rates by rate code, by time period, and by measure, with the ability to account for the interactions of measures. The kWh avoided energy sales profile by end-use category by rate class is the first input required for the current monthly NTD calculation based on a block rate structure. More granular avoided energy assumptions or estimates will be necessary in order to reasonably estimate the avoided revenue that occurs under TOU rate structures, if a mechanism like the NTD mechanism continues.

Q. Do the high-differential TOU rates make the calculation of the net marginal rate more important?

A. Yes. High differential TOU adoption will undoubtedly pose challenges in the net marginal rate calculation. Furthermore, the complexity may require separate net margin rates by rate code by time period, with the ability to account for measurement installation type differences. The introduction of large rate differentials within a single day puts substantially more pressure on the accuracy of the avoided net marginal revenue included in the NTD, which is further complicated by the interaction of the FAC with actual avoided energy costs.[7]

Q. Is the availability of hourly load data necessary for large differential time-of-use rate structures?

A. Yes. There are several reasons. Differences between the prices for energy usage on one rate schedule can vary in a single day depending on the hour of usage.[8] The rate differentials are also variable across rate schedules with differing rate structures. Increasing the number of customers being served under rate schedules with high rate differentials that occur during the course of a single day (and that vary by the day of the week) requires granular data to generate net margin rates by rate code. The calculation of avoided revenues using an inaccurate net margin rate increases the likelihood of such revenues being underestimated or overestimated. Imprecise accounting for the timing of energy reductions potentially impacts the billing determinant adjustments made within the context of a general rate case as well.

[7] The interaction of MEEIA and the FAC is discussed in the direct testimony of Staff witness, J Luebbert.
[8] Lines 16-17, Page 7 of the rebuttal testimony of J Luebbert, EO-2024-0002.

Q. As discussed by Staff Witness Brad Fortson, Staff does not recommend that the Commission authorize a MEEIA Cycle 4 at this time. Would this recommendation account for the NTD discussed by Staff Witness Sarah Lange?

A. Yes. As discussed by Staff Witness Sarah Lange, if a MEEIA cycle 4 is authorized, a different avoided net revenue mechanism should be used than that used in the past. Ms. Lange explains that a different mechanism should be used, in part, because the NTD mechanism used in Ameren Missouri MEEIA Cycles 2 and 3 is unworkable today.

Q. Why is the NTD mechanism used in MEEIA Cycles 2 and 3 unworkable today?

A. To make the Cycles 2 and 3 NTD mechanism work today, reasonable and accurate avoided energy profiles are needed. These profiles are needed to calculate reasonable net margin rates, and to multiply against the net margin rates to calculate the revenue avoided on energy not sold. Reasonable EM&V is then needed to determine whether the EEIC rate appropriately charges customers for the actual energy not sold. That reasonable EM&V should then be used to inform subsequent avoided energy sales hourly profiles. Today, the Commission does not have the benefit of this iterative cycle at the level of hourly detail needed. Ameren Missouri has nearly completed its deployment of residential Advanced Metering Infrastructure ("AMI"). The larger the sample size, the higher the statistical confidence in the effects of individual energy efficiency measures when using customer AMI data. However, there are limits to the type and size of measures that can be discerned from an AMI data set.[9]

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[9]https://www.efficiencyvermont.com/Media/Default/docs/white-papers/What%20Are%20the%20Limits%20of%20AMI%20in%20Supporting%20Load%20Management.pdf

**EVALUATION, MEASUREMENT AND VERIFICAITON**

Q. What is EM&V?

A. EM&V is the assessment of savings associated with a demand-side program. Allowing utilities to recover the avoided revenues due to the implementation of efficiency programs necessitates an accurate evaluation of the programs. In order to prevent overcharging customers or undervaluing a utility's avoided revenues, it is crucial to get the savings right.

Q. What is the key element of EM&V?

A. A key element of an EM&V involves the estimation of net energy savings that account for freeridership[10] and spillover.[11] A meta-analysis of 120 studies from 2006 to 2018 indicates that a consistent, transparent, and reliable evaluation methodology to estimate free ridership and spillover effects based on randomized or quasi-experimental designs will not only improve accuracy but will also have better comparability for informed policy decisions regarding energy efficient program.[12] The wider discrepancies and inconsistencies in the evaluation methods adopted in practice make the net savings values less accurate.

Q. How does Ameren Missouri estimate net energy savings in its current MEEIA plan?

A. Ameren Missouri estimates net energy savings based on the application of a Net-To-Gross ("NTG") ratio. The NTG ratio is what establishes the amount of savings that are attributable to utility programs.

NTG Ratio = 1- Freeridership ratio + Spillover ratio

[10] A program participant who would have implemented the program measure or practice in the absence of the program.
[11] Spillover refers to additional reductions in energy consumption or demand due to program influences beyond those directly associated with program participation.
[12] https://www.energytrust.org/wp-content/uploads/2017/07/FR_Spillover_170206.pdf

Q. Explain the significance of the EM&V process in accurately estimating energy savings.

A. MEEIA rules require electric utilities to have program benefits measured and documented through EM&V reports.[13] Therefore, the EM&V plan should be transparent, with appropriate checks along the way, because this process assesses the performance of an energy efficiency program to measure the energy or demand savings and to verify the program is generating the expected level of savings.[14] The performance of an energy efficiency program is not limited to the amount of energy reductions, but also to the benefits achieved through program implementation. Staff Witnesses J Luebbert and Sarah Lange discuss the importance of cost avoidance and the requirement of programs to provide benefits to all customers within the class, regardless of whether all customers participate. However, until the sample size[15] is sufficient to represent all strata of the population, the inference of the statistical outcomes does not sufficiently speak to the robustness of the energy efficiency evaluation.

Ameren Missouri did not have enough sample size to represent entire electric consumers in the previous EM&V.

Q. What is the process for creating a reliable baseline scenario for estimating energy savings?

A. Let's first briefly discuss the baseline. Baseline is the act of measuring energy use at a determined level for the purpose of establishing a benchmark for future comparison to itself.[16] A fundamental and problematic issue in estimating free ridership is constructing a satisfactory baseline scenario, i.e., a counterfactual. In other words, to quantify the net cause-

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[13] 20 CSR 4240-20.092

[14] https://www.energy.gov/sites/prod/files/2014/05/f16/what_is_emv.pdf

[15] Representation of program population (households, business units, public service providers etc.). Central Limit Theorem strongly asserts that higher the sample size more robust estimate that resemble to the mean value of the population.

[16] https://www1.eere.energy.gov/manufacturing/resources/pdfs/leaderbaselinestepsguideline.pdf

and-effect relationship between program participation and energy savings, it is important to isolate those participants who would have implemented the particular energy efficiency measure even without any intervention.[17] Failure to account for such participants might overstate a program's effects. Similarly, failure to assess spillover effects might result in biased estimates of program impacts.[18] To design an evaluation that accounts for the presence of spillover effects, one needs to understand why and how these effects occur. This knowledge would help evaluators identify the subset of nonparticipants that are most likely to be indirectly affected by a particular treatment. Here, treatment refers to those customers who have installed the energy efficiency measure(s). For example, in the case of a smart thermostat used by a utility customer, evaluators have to know how customers become impacted (by being in contact with those who installed a smart thermostat) to understand which other customers are likely to benefit from the smart thermostat (relatives, friends, neighbors). Importantly, the evaluation must be carefully designed to account for spillover effects before the program is implemented. Spillover effects cannot be accurately detected ex post unless the design considers their existence from the start.[19] It is important to know the potential size of spillover effects for a given program or portfolio so appropriate policy decisions can be made by the Commission about energy efficiency investments.[20]

Q. Do the Commission's MEEIA rules state the filing requirements for empirical analysis?

A. Yes. 20 CSR 4240-20.094(D) states that

> Detailed description of each proposed demand-side program, including all workpapers with all models and spreadsheets provided as executable versions in native format with all links and formulas intact, to include at

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[17] https://www.energytrust.org/wp-content/uploads/2017/07/FR_Spillover_170206.pdf
[18] Angelucci, M., & Maro, V. D. (2015). Program evaluation and spillover effects. Retrieved from World Bank Group Policy Research Working Paper: http://documents.worldbank.org/curated/en/137731468171858310/pdf/WPS7243.pdf.
[19] *Ibid*.
[20] Estimating Net Savings: Common Practices, NREL, https://www.energy.gov/sites/prod/files/2015/01/f19/UMPChapter17-Estimating-Net-Savings.pdf; Page 6

> least: 1. Customers targeted; 2. Measures and services included; 3. Customer incentives ranges; 4. Proposed promotional techniques; 5. Specification of whether the demand-side program will be administered by the utility or a contractor; 6. Projected gross and net annual and lifetime energy savings; 7. Proposed energy savings targets; 8. Projected gross and net annual demand savings; 9. Proposed demand savings targets; 10. Net-to-gross factors; 11. Size of the potential market and projected penetration rates; 12. Any market transformation elements included in the demand-side program and an evaluation, measurement, and verification (EM&V) plan for estimating, measuring, and verifying the energy and demand savings that the market transformation efforts are expected to achieve; 13. EM&V plan including at least the proposed evaluation schedule and the proposed approach to achieving the evaluation goals pursuant to 4 CSR 240-20.093(7)."

Q. Is there any concern about reporting the monthly savings values?

A. Yes. Highly precise and updated savings data are necessary to determine more realistic net impacts. The lack of precise savings data is more likely to be attributed to inappropriate adjustments for any significant changes that would impact the savings estimate. For example, energy savings from the retirement and recycling of inefficient but operational refrigerators and freezers are based on the 2010 Cadmus report.[21] Does a decade old saving reference point still represent a valid baseline for energy savings? This baseline is used by Ameren Missouri to measure the net impacts of an energy efficiency measure. In this case, baseline would produce estimated net savings that are biased because they are outdated.

Q. Is it justifiable to shift the entire burden of non-performance in energy efficiency from implementers, contractors, or utilities to ratepayers?

A. No. When the results of energy efficiency measures are different from what was expected, the utility company should not incentivize their implementers or contractors based on the targeted number of projects or measures. The non-performance in energy efficiency could overestimate energy savings, which could lead to increased costs for ratepayers or decreased cost-effectiveness. Using standardized research designs and

[21] Ameren Missouri TRM - Vol 3: Residential Measures Revision 7.1 Page 5.

econometric models can minimize the risk of non-performance from implementers or contractors to ratepayers.[22] Therefore, energy savings resulting from MEEIA programs must be evaluated both prior to and after the energy efficiency intervention. The pre- and post-evaluation provide immediate feedback to contractors and implementers and allow programs to be modified, improved, and optimized on a regular basis.

Q. Does the expected cost-effectiveness of demand-side programs rely heavily on estimated net savings calculated by Ameren Missouri?

A. Yes. The expected cost-effectiveness of a demand-side program relies heavily on estimated net savings calculated by Ameren Missouri itself. Ameren Missouri's estimates of net savings suffer from a variety of biases, the most serious of which is selection bias: the possibility that MEEIA program participants will make energy efficiency investments regardless.[23] For example, some participants that install energy efficient lighting with the aid of a program subsidy will eventually do so in any case, whether or not a utility offers a MEEIA program.

**REBOUND EFFECT**

Q. What is the rebound effect?

A. The rebound effect is generally understood as a response to improved energy efficiency in which potential energy savings from efficiency improvements are partially offset by increased consumption of energy services.[24] Buy a more fuel-efficient car and drive more. This is perhaps the simplest illustration of what has come to be known as the "rebound-effect"- the phenomenon that an increase in energy efficiency may lead to less

[22] Horowitz, M. J. (2011). Measuring the savings from energy efficiency policies: a step beyond program evaluation. Energy Efficiency, 4(1), 43-56.

[23] Loughran, D. S., & Kulick, J. (2004). Demand-Side Management and Energy Efficiency in the United States. Energy Journal, 25(1), 19–43. https://doi.org/10.5547/ISSN0195-6574-EJ-Vol25-No1-2

[24] Azevedo, I.M. (2014) Consumer end-use energy efficiency and rebound effects. Annual Review of Environment and Resources, 39, 393–418.

energy savings than would be expected by simply multiplying the change in energy efficiency by the energy use prior to the change.[25] To illustrate, consider an air conditioner with an annual electricity use of 100 kWh/yr. Suppose a more efficient air conditioner shaved 10 kWh/yr off this total before accounting for any consumer and market responses. If these responses increased electricity use by 1 kWh/yr, then the rebound effect would be equal to 10 percent[26] - i.e., 1 of the 10 kWh/yr in expected energy savings would be "taken back" due to the consumer and market responses.

Q. Does the rebound effect constitute a component of human behavior?

A. Yes. Research indicates that TOU customers may experience higher behavioral changes compared to non-TOU customers.[27] Such behavioral responses have come to be known as the energy efficiency rebound effect.

Q. How do investor-owned utility companies evaluate the potential consequences of rebound effects in their consideration of energy efficiency?

A. In general, rebound effects have been neglected when assessing the potential impact of energy efficiency policies.[28] The existence of the rebound effect has been clear for a long time. The existing literature demonstrates that the failure to take account of rebound effects could contribute to shortfalls in the assessment of the contribution that energy efficiency can realistically make. An assessment of the state of knowledge in this area should therefore make a valuable contribution to contemporary MEEIA program evaluation.

Q. What are the consequences of the rebound effect for energy efficiency policy?

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[25] https://resources.environment.yale.edu/gillingham/GillinghamRapsonWagner_Rebound.pdf

[26] Rebound effects are normally expressed as a percentage of the expected energy savings from an energy efficiency improvements, so a rebound effect of 10% means that only 90% of the expected energy savings are achieved. Rebound effects of 100% means that the expected energy savings are entirely offset, leading to zero net savings.

[27] Liang, J., Qiu, Y., & Xing, B. (2021). Social Versus Private Benefits of Energy Efficiency Under Time-of-Use and Increasing Block Pricing. Environmental & Resource Economics, 78(1), 43–75. https://doi.org/10.1007/s10640-020-00524-y

[28] *Ibid*.

A. The existing literature suggests that rebound effects need to be factored into policy assessments.[29] The rebound effect may reduce the size of the energy savings. For household heating and cooling, the rebound effect is likely to be less than 30%, and this effect is likely to decline in the future as demand saturates. However, rebound effects may be expected to be larger where demand for energy services is far from saturated. My testimony clarifies what the rebound effect is, and tries to draw the attention of commissioners and utility industries to its existence. The rebound effect has clear energy efficiency policy implications in the long run. The application or subsequent approval should include a requirement that the energy efficiency impact evaluation be well planned and evaluate the effects on energy savings accounted for in the upfront estimated energy savings and evaluated energy savings.

## RATE CASE ANNUALIZATION

Q. What is an annualization adjustment?

A. An annualization adjustment spreads revenues or costs that affect only a portion of the test year but are of a continuing nature (or non-continuing).[30]

Q. What is the objective of the energy efficiency adjustment?

A. The goal of the energy efficiency adjustment is to account for the annualized impact of energy efficiency measures installed during the test year. The adjustment of the revenue or expenses in the test year is an attempt to smooth variable annual data. The annualization adjustment attempts to account for the drop in billing units[31] and related

[29] Kahouli, S., & Pautrel, X. (2023). Residential and Industrial Energy Efficiency Improvements: A Dynamic General Equilibrium Analysis of the Rebound Effect. Energy Journal, 44(3), 23–63. https://doi.org/10.5547/01956574.44.2.skah

[30] https://pubs.naruc.org/pub/538106A2-2354-D714-51AF-35D76FEB3C5C

[31] The sales of energy must be removed from the appropriate billing determinants.

revenue that the utility companies experienced as a direct result of the implementation of end-use savings measures.[32]

Q. How have energy efficiency adjustments been implemented in recent rate cases?

A. The energy efficiency adjustment is based on the number of energy-efficient end-use measures installed during the test year. The first input required for the analysis is the kWh savings by end-use category by rate class. The total deemed savings are calculated from these end-use measures installed in each category of saving and the low-income deemed savings of the test year. For the energy efficiency adjustment, a half-month convention was used to estimate the energy savings in each month of the installation. A half-month convention assumes that all energy-efficient capacity was installed halfway between the beginning and end of the month, which is mathematically equal to assuming that investments were made consistently throughout the month. The second input data is the installed savings, also called calculated savings, for each calendar month. The calculated savings are the values that would have been realized for each calendar month of the test year. The difference between the calculated monthly energy efficiency savings realized and the annualized energy efficiency savings for each end-use measure category and rate class is the calendar month energy efficiency annualization adjustment. For each end-use measure, the applicable monthly load shape is multiplied. The load shape reflects the seasonality of the savings. The energy efficiency adjustment is applied in general rate case annualization in an attempt to reflect the effect of the energy efficiency adjustment on the utility company's revenue. As discussed in the EM&V section, this process will also require both energy usage and time of energy consumption data to perform energy efficiency adjustment calculations.

[32] Hari Poudel, Direct Testimony ER-2022-0337.

**RECOMMENDATION AND CONCLUSION**

Q. As discussed by Staff Witness Sarah Lange, if a MEEIA cycle 4 is authorized, a different avoided net revenue mechanism should be used than that used in the past. Ms. Lange explains that a different mechanism should be used, in part because the NTD mechanism used in MEEIA Cycles 2 and 3 is unworkable today. Do you have any recommendations if the net throughout disincentive continues as used in MEEIA Cycles 2 and 3?

A. Yes. I would recommend that both the total energy usage and time of energy consumption be considered under the NTD design as used in MEEIA Cycles 2 and 3. Most Ameren Missouri residential customers are on a rate plan where total usage defines the majority of the energy charge, but a time-based overlay is also charged.

Q. Do you have any recommendations for how the MEEIA programs should be evaluated that would mitigate some of your concerns?

A. Yes. I would recommend that any evaluation be required to compare a year of weather-normalized hourly usage prior to the adoption of a measure with a year of weather-normalized hourly usage after the adoption of usage separately for a sample of participants and non-participants. The use of non-participants would help in establishing a baseline, whereas hourly usage would provide more information to accurately account for which hours are affected by energy savings measures.

Q. Does this conclude your testimony?

A. Yes. It does.

**BEFORE THE PUBLIC SERVICE COMMISSION**

**OF THE STATE OF MISSOURI**

| | | |
|---|---|---|
| In the Matter of Union Electric Company d/b/a Ameren Missouri's 4th Filing to Implement Regulatory Changes in Furtherance of Energy Efficiency as Allowed by MEEIA | ) | Case No. EO-2023-0136 |

**AFFIDAVIT OF HARI K. POUDEL, PhD**

STATE OF MISSOURI )
) ss.
COUNTY OF COLE )

**COMES NOW HARI K. POUDEL, PhD,** and on his oath declares that he is of sound mind and lawful age; that he contributed to the foregoing *Direct Testimony of Hari K. Poudel, PhD*; and that the same is true and correct according to his best knowledge and belief.

Further the Affiant sayeth not.

**HARI K. POUDEL, PhD**

**JURAT**

Subscribed and sworn before me, a duly constituted and authorized Notary Public, in and for the County of Cole, State of Missouri, at my office in Jefferson City, on this 27th day of February 2024.

DIANNA L. VAUGHT
Notary Public - Notary Seal
State of Missouri
Commissioned for Cole County
My Commission Expires: July 18, 2027
Commission Number: 15207377

Dianna L. Vaught
Notary Public

# Hari K. Poudel

## Present Position

Currently, I work for the Missouri Public Service Commission ("Commission") as a Regulatory Economist in the Tariff/Rate Department of the Industry Analysis Division. The Department of Tariff and Rate Design takes part in and offers advice on matters filed with the Commission, such as rate, complaint, application, territorial agreements, sale, and merger. The department also handles rate design, weather variables, and weather normalization tasks and offers technical assistance. I am responsible for using quantitative economic techniques and statistical analysis to address energy-related challenges that have an effect on utility ratemaking. I am also responsible of recommendations for the Commission based on a rigorous economic analyses of the problems relating to energy.

## Educational Credentials and Work Experience

I received a Doctor of Philosophy in Public Policy from the University of Missouri, Columbia, Missouri in May 2020. I graduated with a Master's in Public Health from the University of Missouri, Columbia in May 2019. Inn 2008, I received a Master's in Agricultural Economics degree from Hohenheim University in Germany.

I've been employed with the Missouri Public Service Commission since October 25, 2021, in the Tariff/Rate Department of the Industry Analysis Division as a Regulatory Economist. Prior to joining the Commission, I was a Research/Data Analyst for the Missouri Department of Health and Senior Services. I analyzed public health data that directly affects Missourians in my capacity as an analyst.

**Testimonies/Memorandum**

| SN | Case Number | Company Name | Issue |
|---|---|---|---|
| 1. | GR-2021-0320 | Liberty Utilities | Tariff Compliance |
| 2. | GR-2022-0235 | Spire Missouri, Inc. | Weather Normalization Adjustment Rider (WNAR) |
| 3. | ER-2022-0146 | Ameren Missouri | Rider Energy Efficient Investment Charge (EEIC) |
| 4. | GT-2022-0233 | Liberty Utilities | Weather Normalization Adjustment Rider (WNAR) |
| 5. | ER-2022-0129 & ER-2022-0130 | Evergy Metro, Inc. & Evergy Missouri West, Inc. | General Rate Case |
| 6. | ER-2022-0337 | Ameren Missouri | 365-Day Adjustment, Weather Variables, Weather Normalization, Hourly Load Requirement Energy Efficiency Adjustment |
| 7. | GO-2023-0002 | Spire | Weather Normalization Adjustment Rider (WNAR) |
| 8. | GT-2023-0088 | Liberty Utilities | Weather Normalization Adjustment Rider (WNAR) |
| 9. | GT-2023-0274 | Liberty Utilities | Weather Normalization Adjustment Rider (WNAR) |
| 10. | EA-2023-0286 | Ameren Missouri | Economic Feasibility |
| 11. | GT-2024-0054 | Liberty Utilities (Midstates Natural Gas) | Weather Normalization Adjustment Rider (WNAR) |
| 12. | GT-2024-0055 | The Empire District Gas Company | Weather Normalization Adjustment Rider (WNAR) |
| 13. | GR-2024-0107 | Ameren Missouri | Weather Normalization Adjustment Rider (WNAR) |