Exhibit No.:
Issue(s): *Throughput Disincentive, Rebound Effect, Rate Case Annualization*
Witness: *Hari K. Poudel, PhD*
Sponsoring Party: *MoPSC Staff*
Type of Exhibit: *Direct Testimony*
Case Nos.: *EO-2023-0369 and EO-2023-0370*
Date Testimony Prepared: *May 24, 2024*

MISSOURI PUBLIC SERVICE COMMISSION

INDUSTRY ANALYSIS DIVISION

TARIFF/RATE DESIGN DEPARTMENT

DIRECT TESTIMONY

OF

HARI K. POUDEL, PhD

EVERGY METRO, INC.
d/b/a Evergy Missouri Metro
CASE NO. EO-2023-0369

EVERGY MISSOURI WEST, INC.
d/b/a Evergy Missouri West
CASE NO. EO-2023-0370

Jefferson City, Missouri
May 2024

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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, MO 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 PhD 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-d1.

Executive Summary

Q. What is the purpose of your direct testimony?

A. The purpose of my direct testimony is to discuss the net throughput disincentive ("NTD"), rebound effect, and rate case annualization in a Missouri Energy Efficiency Investment Act ("MEEIA") filing. If the Commission does authorize a fourth MEEIA Cycle, the Time-of-Use ("ToU") rate structure may require separate net margin rates ("NMRs") 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 ToU rate structures. Consequently, this new complexity impacts a majority of Evergy Missouri Metro and Evergy Missouri West residential customers served on ToU rate structures, with a relatively large portion of residential customers being served on high-differential ToU rate structures.

Net Throughput Disincentive

Q. What is the net 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."

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

A. No. 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 higher differential rates increases, the need for more precise measurement of energy savings will also increase.

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[1] by rate code, by time period, and by measure, with the ability to account for the interactions of measures. The kilowatt hour ("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 NMR vary based on the various rate codes?

A. Yes. In general, the customers are grouped into several classes, with each class purchasing its electricity service under a different rate schedule. Evergy Missouri has multiple active rate schedules with different energy charges per kWh within each rate class. On-peak are higher prices and super off-peak prices are lower than they would be for a flat rate, based on season, day of week, and time of day. Additionally, 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 is time-variant.

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

[1] The marginal rate is the retail price of a unit of energy not sold due to Evergy 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.

A. Yes. High differential ToU adoption (between 15-20%) has undoubtedly posed challenges in the NMR calculation. In addition, the remaining 80-85%[2] of residential customers that are in the default reclassification of a peak adjustment rate schedule appear to have some difference in rates during peak periods. The current rate structures is complex in nature. The complexity may require separate NMR 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.

Q. Is there a need to change the existing NTD mechanism in the context of the ToU rate structures?

A. Absolutely.

Q. Why do you think that it is necessary to change the existing NTD calculation mechanism?

A. It is important to consider how ToU rate differentials will impact the NTD calculation mechanism. Evergy Missouri West and Evergy Missouri Metro residential customers are on a rate plan where their usages are dependent on the time of the day. Therefore, using the historical NTD along with time-variant rate structures is unlikely to be either precise or accurate. Consequently, it is necessary to change the existing NTD calculation mechanism.

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

[2] EO-2023-0369/0370 Direct Testimony of Leigh Anne Jones Page 5 lines 10-12.

offset by increased consumption of energy services.[3] For example, 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 energy savings than would be expected by simply multiplying the change in energy efficiency by the energy use prior to the change.[4] 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[5] - 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.[6] 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. 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 contributions that energy

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

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

[5] 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.

[6] 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

efficiency can realistically make. An assessment of the state of knowledge in this area would make a valuable contribution to contemporary MEEIA program evaluation.

Q. Does existing literature support including the rebound effect in energy efficiency effectiveness studies?

A. Yes.

Q. Please discuss existing literature supporting the rebound effect in the energy efficiency effectiveness studies.

A. Energy consumers tend to use more energy due to economic benefits from efficiency improvements; thus, the actual energy savings will be smaller than expected. There is a general perception that energy efficiency improvements are associated with lower energy consumption. Stanley Jevons[7] introduced the concept of energy rebound more than 150 years ago, stating that anticipated energy efficiency savings may be "taken back" by behavioral responses. Jevons's concern has been reinforced by a growing body of literature that estimates the size of the rebound effect in residential and industrial sectors. The following studies provide strong support for including the rebound effect in the energy efficiency effectiveness studies:[8]

- Messenger et al. (2010)[9] recommended including the rebound effect in the evaluation, measurement, and verification approaches because the current evaluation, measurement, and verification approaches are incomplete and thus inaccurate for modeling energy efficiency savings. The authors have made this recommendation based on information on energy efficiency evaluation practices and issues from 14 selected states and a regional energy efficiency organization.

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[7] Jevons, W. S. (1866). The coal question; an inquiry concerning the progress of the nation and the probable exhaustion of our coal-mines. Macmillan.

[8] Fourteen states include California, Connecticut, Florida, Idaho, Illinois, Iowa, Maine, Massachusetts, Minnesota, New York, Oregon, Pennsylvania, Texas, and Wisconsin. The organization is Northwest Energy Efficiency Alliance.

[9] Messenger et al. (2010). Review of Evaluation, Measurement and Verification Approaches Used to Estimate the Load Impacts and Effectiveness of Energy Efficiency Programs (osti.gov).

- Berkhout et al.'s (2000)[10] empirical evidence shows that the rebound effect is between 0 and 15%. Similarly, Nadel (2012)[11] also provides evidence of the impact of the rebound effects, which are generally about 20%. The remaining 80% of the savings from energy efficiency programs are attributed to the reduced energy use. All of the above studies have found that there is a rebound effect from the energy efficiency measures. This is an important issue today.

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

A. The existing literature suggests that rebound effects need to be factored into policy assessments.[12] 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. The rebound effect has clear energy efficiency policy implications in the long run. A MEEIA 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).[13]

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

[10] Berkhout, P. H., Muskens, J. C., & Velthuijsen, J. W. (2000). Defining the rebound effect. Energy Policy, 28(6-7), 425–432. https://www.sciencedirect.com/science/article/abs/pii/S0301421500000227.
[11] Nadel, S. (2012). The Rebound Effect: Large or Small? An ACEEE White Paper. https://www.aceee.org/files/pdf/white-paper/rebound-large-and-small.pdf.
[12] 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
[13] https://pubs.naruc.org/pub/538106A2-2354-D714-51AF-35D76FEB3C5C

A. The goal of the energy efficiency adjustment is to account for the annualized impact of energy efficiency measures installed during the test year. Adjusting 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[14] and related revenue that the utility companies experienced as a direct result of the implementation of end-use savings measures.[15]

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

[14] The sales of energy must be removed from the appropriate billing determinants.
[15] Hari Poudel, Direct Testimony ER-2022-0337.

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 NTD section, this process will also require both energy usage and time of energy consumption data to perform energy efficiency adjustment calculations.

Recommendation and Conclusion

Q. Do you have any recommendations if the NTD continues as used in the previous MEEIA cycles?

A. Yes. I would recommend that both the total energy usage and time of energy usage be considered under the NTD design as used in the previous MEEIA cycles. The current NTD calculation mechanism assumes that all customers in a class take service under the same (or essentially the same) rate plan, and that the time of energy consumption is irrelevant to the revenue recovery experienced by the utility. Therefore, the current NTD as applied to customers with rate options and time-variant rates will produce results that are neither precise nor accurate.

Q. Do you have any recommendations for how a MEEIA program should account for the rebound effect?

A. Since the rebound effect is typically measured as a percentage of the potential energy savings, Staff recommends using an appropriate percentage of the reduction in energy savings estimations in the Technical Reference Manual ("TRM"). Reducing energy consumption due to energy efficiency has been discussed in the existing literature in the form of the rebound effect. The 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.

Q. Does this conclude your testimony?

A. Yes. It does.

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the Matter of Evergy Metro, Inc. d/b/a Evergy Missouri Metro's Notice of Intent to File an Application for Authority to Establish a Demand-Side Programs Investment Mechanism	)	Case No. EO-2023-0369
n the Matter of Evergy Missouri West, Inc. d/b/a Evergy Missouri West's Notice of Intent to File an Application for Authority to Establish a Demand-Side Programs Investment Mechanism	)	Case No. EO-2023-0370

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 21st day of May 2024.

D. SUZIE MANKIN
Notary Public - Notary Seal
State of Missouri
Commissioned for Cole County
My Commission Expires: April 04, 2025
Commission Number: 12412070

Notary Public

Hari K. Poudel, PhD

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/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. In 2008, I received a Master's in Agricultural Economics degree from Hohenheim University in Germany. I currently am pursuing a Graduate Certificate degree in Public Utility Regulation and Economics at New Mexico State University.

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.	GT-2024-0054	Liberty Utilities (Midstates Natural Gas)	Weather Normalization Adjustment Rider (WNAR)
11.	GT-2024-0055	The Empire District Gas Company	Weather Normalization Adjustment Rider (WNAR)
12.	GR-2024-0107	Ameren Missouri	Weather Normalization Adjustment Rider (WNAR)