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Witness:	Nicholas Bowden
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MISSOURI PUBLIC SERVICE COMMISSION

FILE NO. ER-2024-0319

SURREBUTTAL

And

TRUE-UP DIRECT TESTIMONY

OF

NICHOLAS BOWDEN

ON

BEHALF OF

UNION ELECTRIC COMPANY

D/B/A AMEREN MISSOURI

St. Louis, Missouri
February, 2025

TABLE OF CONTENTS

SURREBUTTAL and TRUE-UP DIRECT TESTIMONY

OF

NICHOLAS BOWDEN

FILE NO. ER-2024-0319

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Nicholas Bowden. My business address is One Ameren Plaza, 1901 Chouteau Ave., St. Louis, Missouri.

Q. Are you the same Nicholas Bowden that submitted direct and rebuttal testimony in this case?

A. Yes, I am.

II. PURPOSE OF TESTIMONY

Q. What is the purpose of your surrebuttal and true-up direct testimony in this proceeding?

A. This testimony responds to the rebuttal testimony of Staff related to the following three subjects.

1. Billing Units and Normal Revenue
2. Revenue Requirement Allocation
3. Rate Design

This testimony also provides the Company's billing units and normal revenue for the 12 months ending June 2024 with specific items trued-up through December 31, 2024.

Q. What specific billing unit and normal revenue issues are you responding to in this testimony?

A. I respond to two billing unit and normal revenue issues:

1. Weather Normalization (Staff Witness Michael Stahlman)

2. Solar Adjustment (Staff Witness Marina Stever)

Q. What specific revenue requirement allocation issues are you responding to in this testimony?

A. I respond to two revenue requirement allocation issues:

1. Revenue Neutral Reallocation (Staff Witness Sarah Lange)

2. Community Solar Generation Revenue Allocation (Staff Witness Sarah Lange)

Q. What specific rate design issues are you responding to in this testimony?

A. I respond to one rate design issue:

1. Non-residential Time-of-Day ("TOD") Adjustments (Staff Witness Sarah Lange)

III. BILLING UNITS AND NORMAL REVENUE

A. WEATHER-NORMALIZATION

Q. Can you summarize the weather normalization rebuttal testimony of Staff witness Stahlman?

A. Staff witness Stahlman recommends that the Commission use Staff's weather normalization results to determine normal revenues, claiming Staff's results are more precise than the Company's results.

Staff witness Stahlman organizes his rebuttal into two sections. In the first section, Staff witness Stahlman combines total kWh weather normalization and time-of-use ("TOU") kWh weather normalization. Staff recommends the Commission adopt its total kWh weather normalization simply because Staff produced TOU kWh weather normalization factors. In the second section, Staff witness Stahlman discusses block kWh weather normalization.

Q. Does Staff provide any evidence related to the precision of Staff's or the Company's weather normalization?

A. No, Staff provides no evidence related to the precision of Staff's or the Company's weather normalization procedures or results.

Q. Do you offer any evidence related to the precision of Staff's weather normalization in rebuttal?

Yes, I offer detailed evidence in my rebuttal testimony related to the imprecision of Staff's weather normalization procedures and results. I summarize three instances here. In one instance, I show that Staff's block kWh normalization model produces illogical results[1] and trace those results back to general and specific causes. Both causes are related to precision. The general cause is Staff's small sample size.[2] Small sample sizes are known to be in an issue in statistics. Small sample sizes are an issue because they produce imprecise results. The specific cause is the inclusion of outliers. The evidence clearly shows that Staff's inclusion of these outliers was unreasonable.[3] I show Staff's model and results vary significantly when the two outlier data points are excluded.[4] High variance

[1] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 5, ll. 19 - p. 6, ll. 11.
[2] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 7, ll. 15 - p. 9, ll. 7.
[3] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 9, ll. 15 - p. 13, ll. 3.
[4] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 13, ll. 4 - p. 16, ll. 12.

and imprecision are synonymous in statistics. In fact, I discuss the concepts of small sample size, high variance, and imprecision more generally in a comment concluding the discussion of this issue in my rebuttal testimony.[5] In a second instance, I discuss Staff's functional form selection in the context of block weather normalization. It appears Staff selects functional form based on R-squared.[6] Selecting functional forms based on R-squared or similar notions is a common pitfall in regression analysis and can lead to overfitting, which in the context of the bias-variance tradeoff, is synonymous with high variance, i.e. imprecision. In a third instance, I explain how the inclusion of a lagged dependent variable, yesterday's total kWh, in Staff's total-kWh-weather-normalization model causes imprecision in the estimate of the relationship between weather and total kWh.[7] The estimate of the relationship between weather on total kWh is the thing we need to know to remove the effect of abnormal weather from total kWh, i.e. to weather normalize total kWh. These instances provide evidence that Staff's weather normalization procedures and results are imprecise in ways that the Company's are not. Staff provides no such evidence of Company imprecision in its rebuttal testimony.

Q. Does Staff claim that the Company's total-weather-normalization results are unreasonable?

A. No. In fact, Staff states that it "does not have large concerns with the method used in those areas [total weather normalization], with the exception of TOU noted above."[8] Total weather normalization and TOU weather normalization are completely

[5] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 21, ll. 3 - 20.
[6] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 23, ll. 1 - p. 26 ll. 5 and p. 28, ll. 1 - p. 29, ll. 3.
[7] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 48, ll. 7 - p. 51, ll. 5.
[8] File No. ER-2024-0319, Rebuttal Testimony of Michael Stahlman p. 2, ll. 22-23.

separable, so Staff explicitly says that it does not have large concerns with the Company's total weather normalization. In fact, Staff does not express any concerns about the Company's total weather normalization, implicitly meaning Staff has no concerns about the Company's total weather normalization. The reason Staff has no concerns about the Company's total weather normalization is because the Company's total weather normalization is reasonable.

Q. On what basis does Staff recommend the Commission adopt Staff's total weather normalization?

A. Staff bases its recommendation on the fact that Staff developed independent TOU-weather-normalization factors for some TOU billing determinants for some classes.

Q. Is this a reasonable basis for their recommendation?

A. No, the TOU-weather-normalization factors are independent from and subordinate to the total-weather-normalization procedures and results produced by Staff. The fact that Staff merely produced additional TOU-weather-normalization factors is certainly not evidence that Staff's total-weather-normalization factors are superior to the Company's total-weather-normalization factors. It's not evidence that Staff's total-weather-normalization results are reasonable. I provide evidence in my rebuttal that Staff's TOU-weather-normalization and total-weather-normalization results are unreasonable in this case.

Q. Is there another claim Staff makes in route to its recommendation?

A. Yes. Staff claims that Staff and the Company use the same method to determine total weather normalization factors. The only exception Staff asserts is the

independent TOU-weather-normalization factors mentioned above.[9] This is an important step in Staff's rebuttal, because it asserts the equivalence of the Staff's and the Company's total weather normalization, and then links the Staff's total weather normalization with Staff's TOU weather normalization. This is the whole basis, the entire logic, of Staff's recommendation: Staff and the Company have equivalent total normalization results, but Staff has added TOU weather normalization, therefore Staff recommends the Commission adopt Staff's total weather normalization and TOU weather normalization.

Q. Do you agree with Staff's assertation that the Company and Staff use the same method to determine total weather normalization factors?

A. Yes and no. At a high level, our methodologies for developing total normalization factors are very similar. However, there are at least three substantive differences, which I outline in my rebuttal testimony.[10] The first two issues decrease the precision of Staff's total weather normalization and the third is just an unreasonable choice which appears to decrease the accuracy of total weather normalization.

Q. If we put those three total-weather-normalization differences aside, does Staff's TOU weather normalization represent an improvement relative to the Company's results?

A. In the case of the Small General Service ("SGS") TOU weather normalization, absolutely not. The evidence couldn't be any clearer and it is outlined in my rebuttal testimony.[11] Staff's SGS TOU-weather-normalization result, illustrated in

[9] File No. ER-2024-0319, Rebuttal Testimony of Michael Stahlman, p. 2, ll. 4 - 6.
[10] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 44, ll. 3 - p. 58, ll. 5.
[11] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 33, ll. 20 - p. 35, ll. 3 and p. 37, ll. 3 – pg. 40, ll. 14.

Table 5 and Figure 12 of my rebuttal testimony[12], speaks for itself. Staff's SGS TOU normalization is unreasonable and produces an inaccuracy that is not present in the Company's SGS TOU weather normalization.

In the case of residential Evening-Morning Savers, it's a little less clear. The magnitude of the normalization in each month is small, but it moves in the same direction in every month.[13] This uniformity in the direction of result seems unlikely, but the novelty and complexity of Staff's TOU weather normalization is difficult to analyze from a mechanical methodological point of view. It's difficult to assess what Staff's assumptions do mechanically to impact the results from a theoretical mathematical perspective. Regardless, Staff's TOU shift, away from on-peak and towards off-peak, decreases the Company's normal revenue and would therefore increase the Company's revenue requirement request in this case. It is in the Company's financial interest to accept Staff's Evening-Morning Savers TOU proposal, but the merits do not warrant it. Furthermore, there are two specific Evening-Morning Savers results, that occur in two primary months which straddle the summer-winter rate boundary, which have small billing unit and revenue implications, but are unreasonable in principle. Those results are presented in my rebuttal testimony.[14]

Q. Can you summarize your surrebuttal of Staff's weather normalization rebuttal?

A. Staff presents no evidence that the Company's total weather normalization is unreasonable. Staff doesn't even claim the Company's total weather normalization is

[12] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 38, ll. 5-6 and p. 39, ll. 1-2.
[13] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 40, ll. 15 - p. 42, ll. 12.
[14] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 42, ll. 13 - p. 43, ll. 9.

unreasonable. Staff recommends the Commission adopt Staff's total-weather-normalization results, only because Staff has produced TOU-weather-normalization factors. Staff's TOU-weather-normalization factors are independent from and subordinate to Staff's total-weather-normalization procedure and results, and therefore provide no evidence related to the quality of the Staff's or the Company's total-weather-normalization factors. In my rebuttal, I provide evidence that Staff introduces imprecision into its total weather normalization in two ways and makes an unreasonable choice related to residential and SGS total weather normalization.

The mere existence of Staff's TOU-weather-normalization factors is not evidence of anything more than their mere existence. In fact, I provide evidence that Staff's SGS TOU-weather-normalization is unreasonable in my rebuttal and evidence that the accuracy of Staff's residential Evening-Morning Savers is unclear at best.

Q. Can you summarize Staff's block weather normalization rebuttal testimony?

A. Staff questions the Company's use of a logical constraint in the Company's block normalization procedure. Staff criticizes the Company's linear model and recommends that the Company use another functional form for its block-weather-normalization model. Staff recommends that the Commission adopt Staff's block-weather-normalization results.

Q. What is the additional logical constraint referenced by Staff?

A. The additional logical constraint is discussed in detail in my direct testimony.[15] The results of the total weather normalization and block normalization include

[15] File No. ER-2024-0319, Direct Testimony of Nicholas Bowden, p. 13, ll. 3 - p. 15, ll. 13.

both a direction and magnitude of kWh change in each month. The logical constraint binds, i.e., has an impact, when the magnitude of the block normalization is 'large' given the magnitude of the total weather normalization result. By large, I mean the kWh change required to reach the block normalization result would require a violation of the logic of weather normalization, i.e., both block changes should move in the same direction as the total weather normalization. A discussion of Staff's violation of the logic of weather normalization is discussed in my rebuttal testimony.[16]

Q. Do you agree with Staff characterization of the Company's application of its block normalization regression results and logical constraint?

A. Staff's characterization is a little unclear. Staff says, "Dr. Bowden did not apply the results of his regression analysis across all months, but limited its application to an additional logic constraint."[17] It would have been clearer if Staff said, "Dr. Bowden did apply the results of his regression analysis across all months, but constrained the magnitude of the results in some months." In my direct testimony, I gave an example of a result that was constrained. In January 2024 for Evening Morning Savers, the block normalization model results indicated a 5.85% decrease in proportion of total kWh that occur in block 1. In order to reach this proportion, given the total kWh decrease, block 1 kWh would have to increase. In order to avoid the illogical increase, the logical constraint modifies the decrease in proportion of total kWh that occur in block 1. The combined result of the regression analysis and logical constraint is a 4.65% decrease in proportion of total kWh that occur in block 1. In summary, the block-weather-normalization model indicates a decrease of 5.85%, but the logical constraint modifies the magnitude of the decrease to

[16] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 5, ll. 19 - p. 6, l. 11.
[17] File No. ER-2024-0319, Rebuttal Testimony of Michael Stahlman p. 3, ll. 4-5.

4.65%, so that an illogical increase in block 1 kWh is not allowed. This illustrates why Staff's characterization of the Company's block normalization process is unclear. The Company's block kWh regression analysis and logical constraint are compliments in the Company's block-weather-normalization procedure, not substitutes as Staff's characterization could be read to imply.

Q. Is the Company's use of a logical constraint a weakness of its weather normalization procedures?

A. No, it's a strength. The logical constraint allows the Company's independent total-weather-normalization and block-weather-normalization models to work together to produce reasonable weather normalization results.

Q. Did Staff allow the very same type of illogical outcomes that the Company's use of the logical constraint avoids to take place in its direct filing?

A. Yes. I reference this above and provide reference to the discussion in my rebuttal testimony.

Q. What does Staff recommend the Company do to address its perceived weakness in the Company's block weather normalization?

A. Staff recommends that the Company consider using a different functional form when it estimates its block normalization model.

Q. Is this a reasonable recommendation?

A. No. In fact, in my rebuttal testimony, I show how the relationship between the block usage and weather data used in the Company's model is clearly linear.[18] I do this to contrast the Company's model with Staff's, which does not include any weather data.

[18] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 31, ll. 3 - p. 32, ll. 2.

Q. Why is the rationale used by Staff to support this recommendation not convincing?

A. Staff takes a critique it makes about its own block normalization in direct, modifies it in a small but significant way, and then applies it to the Company's block-weather-normalization model where it is not applicable. In direct, Staff states the following about its own block-weather-normalization model, "This indicates that the rate block adjustment analysis is highly sensitive and could benefit from additional data points."[19] Again, this is Staff discussing its own model. A model of the relationship between usage-per-customer and block-usage. A model which does not include any weather data. In rebuttal Staff says this, "As discussed in my direct testimony, it seems that this analysis is overly sensitive to weather."[20] It's not clear what 'this' refers too in this statement, but the statement immediately follows Staff's recommendation to the Company and includes the word weather. Given this immediate antecedence of the recommendation and the fact that only the Company's model includes weather, one can only conclude that Staff is referring to the sensitivity of the Company's model to weather. The problem with that is that Staff has shown no evidence to support this idea and did not discuss any model's sensitivity to weather in direct. Staff was only discussing its own model sensitivity to functional form selection and its own issues resulting from its small sample size problem. This fact and the evidence of the linear relationship between weather and block usage shown in my rebuttal testimony make Staff's recommendation to the Company unreasonable, and do not support Staff's recommendation that the Commission adopt Staff's block weather normalization.

[19] File No. ER-2024-0319, Direct Testimony of Michael Stahlman, p. 7, ll. 1-2.
[20] File No. ER-2024-0319, Rebuttal Testimony of Michael Stahlman, p. 3, ll. 9-10.

Q. Can you summarize your surrebuttal of Staff's block weather normalization rebuttal?

A. The Company's logical constraint is a reasonable mathematical element of the Company's block-weather-normalization procedure. It ensures logical consistency between the Company's total-weather-normalization and block-weather-normalization results using information from both models. Staff's functional form and critique of the Company's block-weather-normalization model is not applicable. Staff cites a critique it makes of its own model in direct and Staff's application to the Company's model is a misrepresentation of that fact.

Q. Did you receive corrected block weather normalization workpapers from Staff after rebuttal testimony was filed?

A. Yes. I received two corrected workpapers from Staff after rebuttal testimony. The first workpaper includes Staff's estimates of its block-weather-normalization models. The second workpaper includes Staff's application of its block-weather-normalization models to block billing units.

Q. Does the first corrected workpaper, block-weather-normalization model estimates, include any substantive changes?

A. No. In my rebuttal testimony, I discuss how Staff estimates two block weather normalization models for the residential class. One for 'shoulder' months and one for 'winter' months. The 'shoulder' month model has a linear functional form and the 'winter' month model has a power functional form. In Staff's first corrected workpaper, Staff re-estimates the 'winter' model in logarithmic linear form using Excel's Data Analysis

Toolpack. In the original workpaper, Staff estimates their 'winter' model using the power function trendline functionality in Excel's Chart applications. In the second workpaper, Staff replaces formulas with the power function form with formulas with an exponentiation of the logarithmic linear results from the corrected workpaper. This is not a change. The re-estimation in the corrected workpaper uses the same data as the original workpaper and after exponentiation, the logarithmic linear formulas in the corrected workpaper are mathematically identical to the power function formulas in the original workpaper. The equality between the exponentiated logarithmic linear and power function forms of the model can be shown generally by use of the power rule of logarithms and the product rule of exponents. It is unclear why Staff provided an updated workpaper that results in a mathematically identical block normalization regression model to the model from its direct testimony workpaper.

Q. Does the second corrected workpaper, block normalization model application, include any substantive changes?

A. Yes. Staff eliminates the illogical results for the Anytime Users and Evening Morning Savers for the month of November. These illogical results and their sources were outlined in detail in my rebuttal.[21] Staff eliminates these illogical results by making two changes. First, Staff applies the 'winter' model rather than the 'shoulder' model to November block kWh. Second, Staff changes its 'replacement' mechanism with an 'adjustment' mechanism. In direct, Staff estimated the normal percentage-of-total-kWh-in-block-1 by inputting normal usage-per-customer from its total-weather-normalization model into its block normalization model and then simply replaced the actual percentage-of-total-kWh-

[21] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 5, ll. 19 - p. 16, ll. 12.

in-block-1 with this normal. In the corrected workpaper, Staff estimates the actual and normal percentage-of-total-kWh-in-block-1 using actual and normal usage-per-customer, takes the difference between the two percentages, and adds the difference to the actual percentage to calculate the normal percentage-of-total-kWh-in-block-1. The latter is different from the former because the estimate of the actual percentage-of-total-kWh-in-block-1 produced by the model is unlikely to be exactly equal to the observed actual percentage-of-total-kWh-in-block-1.

Q. Do these two corrections eliminate the specific criticisms of Staff's block normalization you presented in rebuttal?

A. Yes and no. These two corrections eliminate the illogical results in November, which was a specific criticism in my rebuttal. The use of an 'adjustment' mechanism rather than a 'replacement' mechanism is a methodological improvement, which addresses a criticism I offered in the context of TOU weather normalization, but was also applicable to Staff's block weather normalization.[22] All other specific criticisms of Staff's block weather normalization are still applicable.

Switching from the application of the 'shoulder' model to the application of the 'winter' model does not actually improve either of the models, it just changes the outcome for November. The new outcome is more sensible, but Staff doesn't address any of the

[22] The Company also uses an 'adjustment' rather than a 'replacement' mechanism to determine normal block kWh. In terms of the Company's model, a replacement mechanism would remove the effect of abnormal weather and other unobserved variation in the test year. The adjustment mechanism only removes the impact of abnormal weather. The latter is preferred because it is the definition of weather normalization. It is not possible to characterize Staff's model in the same terms because Staff doesn't actually include weather or any other causal variable in its block weather normalization model. Still the adjustment mechanism makes changes based on difference 'explained' by the model, whereas the replacement makes changes based on the differences explained by the model and other variation not explained by the model. Staff's model just estimates a relationship between usage-per-customer and block-usage. Nonetheless, an adjustment mechanism is still preferred because it only makes changes based on variation explained by the model rather than variation explained and unexplained by the model.

underlying issues with the 'shoulder' or 'winter' models outlined in my rebuttal testimony. The 'shoulder' model, inclusive of the outliers discussed and analyzed in my rebuttal still applies to the months of June and October. Outliers are also still impacting the 'winter' model and concerns about overfitting still apply. The more general criticisms related to small sample sizes and the absence of any weather data in a weather normalization model also still apply.

B. SOLAR ANNUALIZATION ADJUSTMENT

Q. Can you summarize Staff's rebuttal of the Company's solar annualization adjustment?

A. Staff recognizes that customer-owned solar generation installed behind the meter may (for all intents and purpose, it will) reduce the Company's billing units relative to those observed in the test year. However, Staff opposes the Company's solar annualization adjustment because it relies on an estimate of energy generated from known and measurable kW capacity installed in the test year. Staff notes that the Company uses an estimate of solar generation at the location of the Company's corporate office building. Staff shows the PVWatts® tool used by the Company has a disclaimer explaining how many variables will impact actual solar generator performance.[23] Staff claims that the Company's failure to account for the specific sources of variation across installations creates uncertainty in the accuracy of the estimate. Staff opposes the Company's adjustment on this basis. Staff offers a conceptual basis of an alternative adjustment it would not oppose. Staff suggests an adjustment based on customer-owned generation paid

[23] I could not locate the specific disclaimer cited by Staff at the location provided by Staff. I found a generally similar disclaimer, but could not independently confirm the specific language of the disclaimer provided by Staff.

'at the net-metering rate' or 'that exceeds customer-specific usage in a given month' because this energy production is 'measurable through the meter'.[24] Staff then recommends the Company retain this data for use in future cases.

Q. Why does Staff characterize the accuracy of the Company's adjustment as uncertain?

A. Staff cites a disclaimer from PVWatts® which explains how the specific characteristics of specific locations and systems will cause energy generation at solar installations to vary from the estimates provided by PVWatts®. I agree. Staff shows that the Company uses a single location, 1901 Chouteau Ave, St Louis, to produce an estimate of energy generated per unit of installed capacity. Staff's point is that the Company does not account for the variation in the specific characteristics of each installation when the Company produces its estimate of energy generated for all installations. I agree with that too.

Q. Does the Company need to account for all the specific variation in characteristics in order to produce an accurate estimate of energy generated from all customer-owned generation?

A. No. The Company must only produce an accurate estimate of the average energy generated per unit of capacity in order to produce an accurate estimate of the total energy generated from all customer-owned generation. This is exactly the kind of thing that PVWatts® is good for. It produces good estimates of average energy generated based

[24] File No. ER-2024-0319, Rebuttal Testimony of Marina Stever p. 4, ll. 10-16.

on high quality solar irradiance data.[25] In fact, the reliability of PVWatts® is recognized by the Commission. The only alternative to direct metering allowed by Commission rules for the determination Solar Renewable Energy Credits from behind-the-meter solar generation is estimation by PVWatts®.[26]

Q. Can you describe an alternative solar adjustment Staff asserts it would not oppose?

A. To some degree. Staff asserts that it would not oppose an adjustment based on customer-owned generation that is measured. Currently, as Staff correctly points out, some amount of customer-owned energy generated (a subset of all energy generated) is measured, because it exceeds a customer's contemporaneous energy consumption. Whenever a customer-owned generator is producing more energy than the customer is consuming at that moment, energy flows out from behind the customer's meter to the Company's distribution system. This subset of customer-owned energy generated is measured. The method for producing an adjustment from this data is unspecified. Ultimately, I conclude that Staff must imagine an annualization type adjustment, where the difference between annual measured energy generated and actual measured energy generated determines the adjustment. I reach this conclusion because 'removal of the energy production' measured by the customer meter by simple subtraction of these measured kWh would double count the test year actual reduction to billing units.[27]

[25] PVWatts relies on the data from the National Solar Radiation Database (NSRDB). The NSRDB data is derived from the Physical Solar Model. The Physical Solar Model combines known and measurable facts like the temperature of the sun, the distance between the sun and any location on the Earth at every point in time, and NASA GOES satellite measurements of clouds to calculate the amount of solar radiation (in kW) that hits the Earth at any location at any time of the year during a typical meteorological year.
[26] 20 CSR 4240-20.100(4)(K).
[27] File No. ER-2024-0319, Rebuttal Testimony of Marina Stever p. 4, ll. 10-16.

Q. Do you have a general concern with Staff's proposed adjustment?

A. Yes. The adjustment Staff envisions fails to capture the phenomenon the Company's solar annualization adjustment is intended to capture. The Company's adjustment is intended to capture the entire impact customer-owned generation has on billing units. Staff's proposed adjustment is only intended to capture part of the impact on billing units – the subset of customer-owned energy generated that flows out through the meter. Staff's proposal excludes energy generated and consumed behind the meter which also reduces billing units.

The kWh of energy produced by customer-owned generation can be organized into three categories. First, energy netting behind the meter. These are kWh produced, but when generation is less than contemporaneous customer demand, so the customer consumes all energy generated directly and behind the meter. They are not metered but reduce billing units. Second, energy netting in front of the meter. These are kWh flowing out from behind the meter when generation is greater than contemporaneous customer demand. They are metered and reduce billing units. These kWh net in front of the meter so long as metered consumption from other intervals in the billing period exist. These kWh are the essence of net metering. They are not consumed directly by the customer owning the generation but are subtracted from the customer's metered consumption in the billing process as if the customer had consumed them directly. Third, kWh sold to the utility at an avoided cost rate. These are similar to the second category, but do not net in front of the meter, because they exceed the total kWh consumed by the customer in other intervals in the billing period. Table 1 provides an example of customer billing data for two hypothetical customers to illustrate the difference between the second and third category.

Table 1: Categories of Customer-Owned Energy Generation

	Customer 1	Customer 2
Total kWh	100	60
kWh to Utility	90	80
Net Billable kWh	10	0
Net Excess Generation	0	20

By its nature, the first category does not appear in billing data, because it is not measured. The first category is reducing Total kWh, but the magnitude of that impact is not metered. This unmetered energy generated is netting behind the meter. The second category is equal to kWh-to-Utility minus Net-Excess-Generation.[28] Total kWh will be netted down using kWh-to-Utility until zero is reached. This is netting in front of the meter, the essence of net metering, and is captured by Net-Billable-kWh. The third category is equal to Net-Excess-Generation. Once Total kWh is netted down to zero, kWh-to-Utility begin to go to Net-Excess-Generation. These kWh do not reduce billing units but are rather paid the avoided cost rate specified in the Company's net metering provisions.

Staff's proposal is most likely considering the second category, the difference between kWh-to-Utility and Net-Excess-Generation. It is rational to include these kWh in a solar adjustment, because they reduce billing units by netting in front of the meter. It is not rational to develop a solar adjustment based on Net-Excess-Generation because these kWh do not reduce billing units but are rather paid the avoided cost rate. These are the exact kWh the Company accounts for (removes from) its solar annualization adjustment through its avoided-cost-kWh offset. In my opinion, the problem with Staff's proposal is that it knowingly excludes all the kWh in the first category, those netting behind the meter,

[28] It is also equal to Total kWh – Net-Billable-kWh.

from a solar annualization adjustment. Staff knows these kWh will reduce billing units but wants to exclude their effect because they are not measured by customer meters.

Q. Does the Company already possess the data Staff proposes the Company retain?

A. Yes. Staff made a nearly identical rebuttal in the Company's last electric rate case, ER-2022-0337, and at the conclusion of that case the Company evaluated customer-level billing data from the test year and identified net-metered customers "excess energy production … measurable through the meter."[29] The Company has customer-level measurements of excess energy production measured by customer meters for the test year in this case in hand.

Q. Did the Company contemplate a solar annualization adjustment based on the portion of kWh measured by customer meters?

A. Yes. Staff likely envisions an annualization adjustment based on the test year actuals netting in front of the meter, because simply subtracting the test year actuals rather than annualizing them would double count the effect of these kWh. Figure 1 compares the test year actual customer-owned generation for the 12 months ending June 2024 for the residential class. The Company's actuals (netting behind and in front of meter) are based on known installed capacity and energy per unit of capacity estimates from PVWatts®. Measured energy generated envisioned by Staff's proposal (netting in front of meter) is the sum of kWh-to-Utility minus net-excess-generation from the Company's billing system. Test year actuals are lower for the adjustment envisioned by Staff, because it omits kWh generated but consumed behind the meter.

[29] File No. ER-2024-0319, Rebuttal Testimony of Marina Stever, p. 4, ll. 14-15.

Figure 1: Residential Test Year Actuals

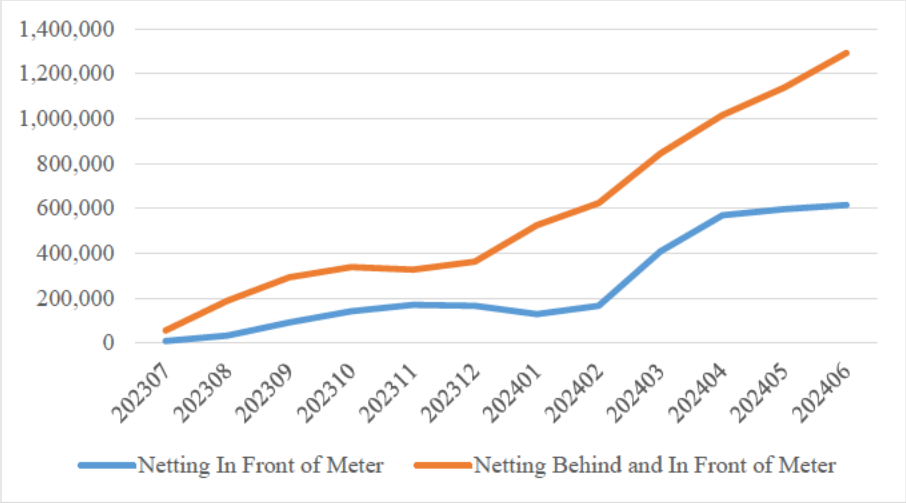


Figure 2 illustrates the annualization of test-year actuals using the Company's method and a possible method for annualizing the kWh Staff envisioned. The Company considered two possible methods for annualizing the measured energy generated that net in front of the meter. There is an observable difference in the shape of the two annualizations. The Company's method produces an annualization that follows average irradiance, highest in summer and lowest in winter. The Staff envisioned annualization is highest in spring and fall. This difference in shape is the result of the correlation between energy generated and customer demand, primarily in summer.

Figure 2: Residential Test Year Annuals

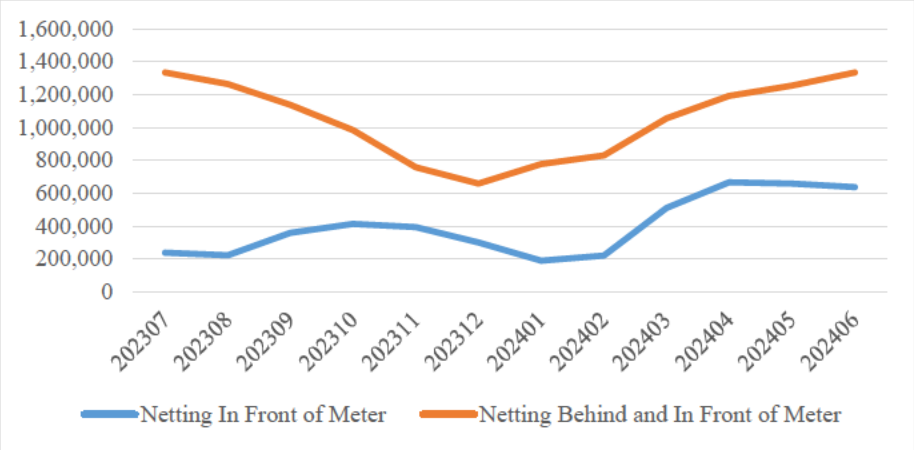


Figure 3 illustrates the test year actual, annual, and annualization adjustment based on the Company's method.

Figure 3: Company Adjustment

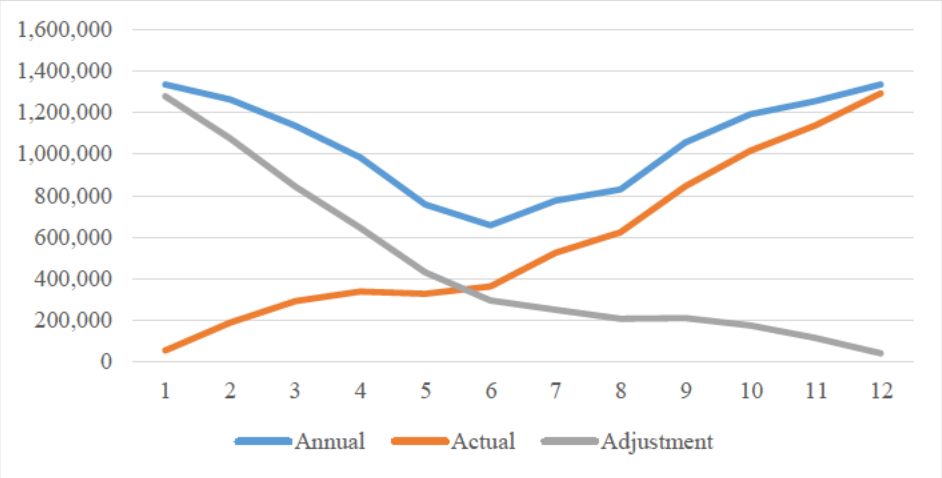
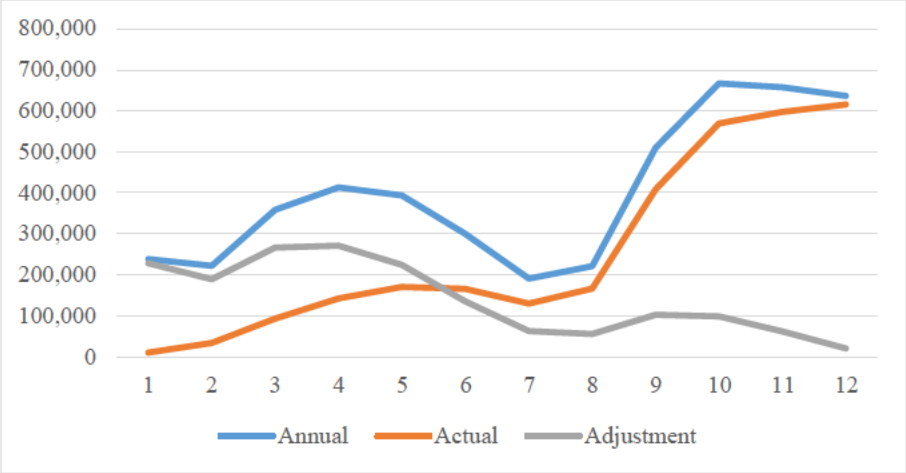


Figure 4 illustrates the test year actual, annual, and annualization adjustment envisioned in Staff's testimony.

Figure 4: Netting In Front of Meter Adjustment



Q. Is the Company's True Up proposing a solar annualization adjustment based on measured kWh concept envisioned by Staff?

A. No.

Q. Why not?

A. The need to estimate annual test year kWh netting in front of the meter creates a challenge to implementing Staff's envisioned adjustment. The annualization of total behind the meter generation, the phenomenon the Company is trying to capture, is relatively simple since the average solar irradiance hitting any specific latitude is predictable. An annualization of the portion of total customer-owned energy generated that nets in front of the meter is more complicated. First and foremost, the annual energy generated and netting in front of the meter needed for an annualization adjustment must be estimated. This, in it of itself, undermines Staff's criticism that the Company's adjustment is uncertain. There is more uncertainty in the annualization implied by Staff's proposal. The annualization of energy generated netting in front of the meter must explicitly or implicitly model customer-owned energy generated, total customer consumption, and the correlation between the two.

Q. Can you summarize your surrebuttal of Staff's solar annualization adjustment rebuttal?

A. Staff objects to the Company's solar annualization adjustment because of uncertainty in the estimation of customer-owned energy generated. I show there is also uncertainty included in an annualization adjustment based on the portion of energy generated that is measured by the customer's meter. There is certainty in the actuals, but there are more sources of uncertainty in the annuals relative to the Company's proposal. At the higher level, Staff's envisioned adjustment only intends to capture a portion of the phenomenon that is actually reducing the Company's billing units.

IV. REVENUE REQUIREMENT ALLOCATION

A. REVENUE NEUTRAL REALLOCATION

Q. Can you summarize Staff's rebuttal of the Company's revenue requirement allocations?

A. Staff opposes the Company's revenue requirement allocations because Staff's class cost-of-service study does not support the revenue neutral shift away from small primary service ("SPS") and large primary service ("LPS") customers and towards residential customers. Staff also opposes the differential impact this shift has on large general service ("LGS") and SPS customers. Staff cites the general alignment in these classes' rates and the ability for customers to switch between these classes as the rationale for opposing the Company's proposal.[30]

[30] File No. ER-2024-0319, Rebuttal Testimony of Sarah L.K. Lange, p. 43, ll. 23 - p. 45, ll. 12.

Q. What is your response to Staff's cost-of-service based opposition to the Company's revenue requirement allocation proposal?

A. My response is the same as in my rebuttal.[31] Staff's class cost-of-service study is flawed in ways illustrated by Company witnesses Hickman, Wills, and Phillips.

Q. What is your response to Staff's alignment of LGS and SPS rates and switching argument for opposing the Company's proposal?

A. It is important to understand that switching from the LGS to the SPS class is not free for the customer. A customer must purchase and install a transformer and associated equipment and take an outage to change their service arrangement before they can switch from the LGS to the SPS class. A customer's rational decision to switch would be based on the potential bill savings benefits associated with switching and the cost associated with the transformer investment and outage. In the past three cases, I have not observed a single LGS customer switching to SPS.

Furthermore, LGS and SPS rates are not designed to prevent or incent switching between the two classes, which is a decision a customer makes based on their marginal cost and benefit of switching. LGS and SPS rates are designed to reflect the differences in the embedded costs of serving the two customer classes. The primary difference is the embedded costs of transformation and distribution assets associated with secondary service.

The potential bill savings associated with a LGS customer switching to SPS at current rates, under rates proposed by the Company, and an equal percentage increase in revenue requirement responsibility exist along a spectrum, because LGS customers exist

[31] File No. ER-2024-0319, Rebuttal Testimony of Nicholas Bowden, p. 61, ll. 21 - p. 62, ll. 3.

along a spectrum. A complete analysis of the bills impacts of the Company's proposal relative to an equal percentage increase is possible, but even that complete analysis won't directly answer any question about potential switching. There are a few facts which we can establish at relatively low cost. If the average LGS customer switched to SPS, their bill would increase at current rates, under the Company's proposal, and with an equal percentage increase in all classes' revenue requirement allocation. Therefore, the average LGS customer would not rationally switch under any of the three rate scenarios, because they would incur additional cost to switch and subsequently incur higher bills. Staff's observation is more relevant knowing there are some LGS customers who are significantly larger than the average LGS customer. Approximately 0.7% of LGS customers have billed demand greater than the average SPS customer. For an LGS customer as large as the average SPS customer, the potential bill savings associated with switching from LGS to SPS is approximately $13,500 annually under current rates. Given annual total bills of approximately $394,000, that is about 3.4% savings. These customers have been on the Company's system for years and have not chosen to switch rate classes. An equal percentage increase to class revenue requirement allocations would increase the annual potential savings to approximately $15,500. Given the equal percentage increase nature of this proposal, the annual savings is still 3.4%. The Company's proposal would increase the annual potential savings to approximately $17,500, or an annual savings of 3.9%. The differential impact of the Company's proposal is approximately $2,000 annually for this extreme case, the few very large LGS customers.[32]

[32] The $2,000 is the difference because it is 0.5% of the approximate $400,000 annual bill for this size of customer.

Given the history – or lack of a history - of switching, the analysis of the average and extreme bill impact cases for LGS customers, and the costs associated with switching, I do not find Staff's argument related to switching risk compelling. The Company's rationale for the revenue requirement allocation based on the reasonable recognition of current and historical imbalance in rates is far more compelling in this case.

B. COMMUNITY SOLAR GENERATION REVENUE ALLOCATION

Q. What does Staff say about the allocation of Community Solar Generation revenue in rebuttal?

A. Staff identifies the pages in my direct testimony which clearly outline how Community Solar Generation revenue factors into revenue requirement allocations. Staff contrasts the Company's allocation method with its own. Staff removes Community Solar Generation revenue from retail rate revenue and uses it to offset generation costs within its cost-of-service. Staff claims that the results of these two methods produce parallel or near-parallel results, but could produce differing results based on the specific wording of the Commission order. Staff recommends that the Commission specify the approach to be taken in its Order and recommends the Commission adopt Staffs approach. Staff claims its method is more reasonable than the Company's.[33]

Q. How do you respond to Staff's recommendation related to the allocation of the Community Solar Generation revenue?

A. Staff's revenue requirement allocation does not appear to include any explicit allocation of the Community Solar Generation revenue. As Staff states, it handles the allocation in its cost-of-service, but Staff's revenue requirement proposal doesn't

[33] File No. ER-2024-0319, Rebuttal Testimony of Sarah L.K. Lange, p. 44, ll. 4 - 22.

precisely follow its cost-of-service, so it is not clear how, or even if, Staff's cost-of-service treatment of the Community Solar Generation revenue impacts Staff's recommended revenue requirement allocations. Staff's direct testimony includes a table outlining its calculation of actual revenues, cost-of-service revenues, and a proposed revenue requirement allocation. A footnote states that the table includes an adjustment related to Community Solar revenue, but nothing about the actual mechanics of the adjustment.[34] In the accompanying Staff workpaper, you can see the exact Community Solar Revenue coming out of actual current retail revenue, but that revenue does not explicitly come back into the revenue requirement allocation proposed by Staff. It's probably baked into the cost-of-service row of the table, but there is no precise relationship between that Community Solar Generation revenue, the cost-of-service, and Staff's recommended revenue requirement allocations. Staff claims that its method is more reasonable but does not provide a rationale for its claim. Implicitly, Staff's claim confirms that the Company's method is reasonable. Furthermore, the Company's method is explicit. The Company's method removes the actual Community Solar Generation revenue from the classes that produce it in one step and allocates it to all the classes in a second step.[35] The steps are simple and transparent and flow through to the calculation of rates. The steps for allocating the Community Solar Generation Revenue are clearly outlined in my direct testimony and shown explicitly in schedule NSB-D2 attached to my direct testimony. Staff's method is not transparent, and in my opinion, has not explicitly reallocated those Community Solar

[34] File No. ER-2024-0319, Direct Testimony of Sarah L.K. Lange, p. 2, ll. 12 - 14.
[35] The Community Solar Generation revenue is allocated to all classes because the costs of the Community Solar Resources are included in the Company's revenue requirement paid by all the classes. This allocation is the mechanism through which customers who voluntarily subscribed to Community Solar offset the costs that are in the revenue requirement and without the allocation would be paid by customers who did not volunteer to pay these costs.

Generation revenues in its revenue requirement allocation. The fact that Staff tacitly acknowledges that the Company's method is reasonable and roughly equivalent to Staff's purported result is reason enough to adopt the Company's proposal. The fact that Staff's method is not clearly outlined in testimony nor transparent in workpapers makes it unreasonable for the Commission to adopt it.

V. RATE DESIGN

Q. Can you summarize Staff's rebuttal of the Company's non-residential Time-of-Day ("TOD") adjustment rate design proposal?

A. Staff characterizes the proposed TOD adjustments as not optimal. Staff then goes on to conditionally accept the proposed TOD adjustments. Staff states that the TOD adjustments are not unreasonable because the adjustments, in combination with the block rates for these classes, do not result in kWh sales made at a loss. Staff indicates that the TOD adjustments would be unreasonable if they resulted in energy sold at a loss. If block energy rates are not increased uniformly, then Staff indicates that unreasonable results could occur.

Q. How do you respond to Staff's assertion that the TOD adjustments proposed by the Company are not optimal?

A. I'm not sure what Staff's definition of optimal is, but it is fair to believe that the TOD adjustments are not perfect reflections of prices that produce strict economic efficiency. I'm pretty sure I've never seen optimal retail rates that meet this standard, and I've done my fair share of looking. Regardless, the proposed changes to the TOD adjustments were not intended to produce optimal time-of-use adjustments but were proposed as improvements to the current TOD adjustments. The measure of improvement

is revenue neutrality of the standard rate schedule and the legacy TOD rate schedule for the three applicable classes. This is what the proposal intends to achieve, and it does just that.

Q. How do you respond to Staff's concern that proposed TOD adjustments could cause the Company to sell energy at a loss?

A. In principle, the concern makes sense. However, it doesn't appear to be a practical concern. The legacy TOD rates are modifications to the standard rate. Customers on the legacy TOD rates are still billed based on the standard rate, and the TOD adjustments are billed 'on top' of those rates. The TOD adjustments are an on-peak adder and an off-peak subtractor. This adder and subtractor TOD rate design allows the TOD adjustments to be billed on top of the standard rate without modification of the standard rate. The TOD adder and subtractor are small, and the adjustments proposed in this case are tiny. Table 2 shows the TOD adjustments and the proposed changes to the adjustments in dollars per kWh.

Table 2: Current and Proposed TOD Adjustments

	LGS			SPS			LPS		
	Current	Proposed	Change	Current	Proposed	Change	Current	Proposed	Change
Summer On Peak	0.0114	0.0114		0.0084	0.0084		0.0064	0.0064	
Summer Off Peak	-0.0065	-0.0079	-0.0014	-0.0048	-0.0055	-0.0007	-0.0035	-0.0037	-0.0002
Winter On Peak	0.0035	0.0035		0.0031	0.0031		0.0029	0.0029	
Winter Off Peak	-0.0019	-0.0022	-0.0003	-0.0018	-0.0019	-0.0001	-0.0018	-0.0017	0.0001

Staff's concern only appears applicable to the off-peak adjustments, the subtractors, which effectively decrease the standard block rates. The largest 'increase' in a proposed subtractor happens in the LGS class and the increase is 0.14 cents per kWh. One of the

changes is a 0.01 cents per kWh decrease. The combined effect of the Company's TOD adjustment proposal (specifically the subtractor effect) and the Company's base rate proposal is an increase of approximately 0.5 to 1.5 cents per kWh across all block rates across all classes. Even if you apply the proposed TOD adjustments to current rates, Staff's principled concern does not appear to be practically relevant. The lowest rate based on application of the proposed TOD adjustment to current rates are 3.86, 3.75, and 3.16 for the LGS, SPS, and LPS classes.

VI. TRUE UP BILLING UNITS AND NORMAL REVENUE

Q. What is the true-up date for this case?

A. The true-up date is December 31, 2024.

Q. Please provide the billing units and normalized revenue through the true-up date.

A. The normalized test year billing units through the true-up date are detailed in Schedule NSB-S1. The Company's normalized revenue through the true-up date in this case is $2,853,865,508. The Company's true-up test year revenue, total revenue adjustments, and normalized revenue are summarized by customer class in Table 3.

Table 3: Normalized Revenue By Class

Customer Class	Actual Revenues (in Dollars)	Total Adjustments (in Dollars)	Normalized Revenue (in Dollars)
1M	1,428,235,781	17,780,934	1,446,016,715
2M	326,300,996	2,913,159	329,214,155
3M	586,267,505	-2,830,406	583,437,099
4M	246,555,650	-5,856,620	240,699,030
11M	218,642,126	-6,354,273	212,287,853
Lighting	42,082,251	42,414	42,124,664
MSD	85,897	95	85,992
*Total	2,848,170,205	5,695,303	2,853,865,508
**Total may differ from sum of rows due to rounding.*			

Q. What adjustments are the Company making to normalize billing units through true-up?

A. The Company is making the same five types of adjustments to normalize billing units and revenues as I described in direct testimony. The Company is also making the same three types of adjustments that do not impact billing units but do impact revenue as I described in my direct testimony. The five billing unit adjustments are as follows:

1. A weather normalization adjustment;
2. A days adjustment;
3. An energy efficiency adjustment;
4. A customer-owned solar adjustment; and
5. A growth adjustment.

The three direct revenue adjustments are as follows:

1. A rate annualization adjustment;
2. An economic development incentive adjustment; and
3. A Community Solar adjustment.

The revenue value of each billing unit adjustment is shown in Table 4 by customer class.

Table 4: Billing Unit Revenue Adjustments

Customer Class	Weather Adjustment (in Dollars)	Days Adjustment (in Dollars)	Energy Efficiency Adjustment (in Dollars)	Solar Adjustment (in Dollars)	Growth Adjustment (in Dollars)
1M	10,517,747	-5,232,596	-6,153,712	-1,417,295	11,386,282
2M	2,324,885	70,394	-2,231,849	-277,673	1,494,500
3M	2,394,112	-1,053,040	-4,281,572	-457,048	-333,525
4M	-664,646	-652,455	-1,504,708	0	-2,450,761
11M	-787,103	-349,675	-114,736	0	1,819,393
Lighting	0	0	0	0	37,047
MSD	0	0	0	0	0
*Total	13,784,995	-7,217,373	-14,286,577	-2,152,016	11,952,936

*Total may differ from sum of rows due to rounding.

The value of each direct revenue adjustment is shown in Table 5 by customer class.

Table 5: Non-Billing Unit Revenue Adjustments

Customer Class	Rate Annualization Adjustment (in Dollars)	Economic Development Adjustment (in Dollars)	Community Solar Adjustment (in Dollars)
1M	7,128,441	0	1,552,067
2M	1,463,085	0	69,818
3M	2,784,926	-1,884,259	0
4M	922,577	-1,506,626	0
11M	220,898	-7,143,050	0
Lighting	5,366	0	0
MSD	95	0	0
*Total	12,525,388	-10,533,935	1,621,885
*Total may differ from sum of rows due to rounding.			

The above-values were used by Company witness Stephen Hipkiss to derive the Company's revenue deficiency (i.e., the annual increase in revenues sought for approval in this case) as of the true-up date in this case.

Q. Does this conclude your surrebuttal testimony?

A. Yes, it does.

Residential - Anytime Users	Billing Units	Current Rates	Current Revenue
Customer Charge			
Total Bills	2,499,828	9.00	22,498,452
Low Income Charge	2,499,828	0.14	349,976
Energy Charge			
Summer kWh	939,381,380	0.1372	128,883,125
Winter kWh			
First 750 kWh	1,053,414,983	0.0934	98,388,959
Over 750 kWh	847,858,989	0.0627	53,160,759
Total Anytime Users kWh	2,840,655,352		
Total Anytime Users Revenue			303,281,271

Residential - Anytime TOD	Billing Units	Current Rates	Current Revenue
Customer Charge			
Total Bills	12	9.00	108
Low Income Charge	12	0.14	2
Energy Charge			
Summer kWh			
Off Peak	9,691	0.0828	802
On Peak	1,982	0.353	700
Winter kWh			
First 750 kWh	15,883	0.0934	1,483
Over 750 kWh	13,406	0.0627	841
Total kWh	40,962		
Total Anytime TOD Revenue			3,936

Residential - Evening Morning Savers	Billing Units	Current Rates	Current Revenue
Customer Charge			
Total Bills	10,619,580	9.00	95,576,220
Low Income Charge	10,619,580	0.14	1,486,741
Energy Charge			

Summer kWh	3,699,350,691	0.134	495,712,993
Summer Peak kWh	2,232,144,813	0.005	11,160,724
Winter kWh			
First 750 kWh	3,818,141,329	0.0919	350,887,188
Over 750 kWh	2,757,550,294	0.0616	169,865,098
Winter Peak kWh	3,442,643,708	0.0025	8,606,609
Total kWh	10,275,042,314		
Total Anytime TOD Revenue			1,133,295,573

Residential - Overnight Savers			
	Billing Units	**Current Rates**	**Current Revenue**
Customer Charge			
Total Bills	35,064	9.00	315,576
Low Income Charge	35,064	0.14	4,909
Energy Charge			
Summer kWh			
Off Peak	3,968,183	0.0644	255,551
On Peak	8,441,427	0.1617	1,364,979
Winter kWh			
Off Peak	7,158,127	0.0555	397,276
On Peak	13,341,490	0.091	1,214,076
First 750 kWh	808,748	0.0934	75,537
Over 750 kWh	539,457	0.0627	33,824
Total kWh	34,257,431		
Total R-TOU2 Revenue			3,661,727

Residential - Smart Savers			
	Billing Units	**Current Rates**	**Current Revenue**
Customer Charge			
Total Bills	22,464	9.00	202,176
Low Income Charge	22,464	0.14	3,145
Energy Charge			
Summer kWh			
Off Peak	2,486,636	0.0674	167,599
Intermediate Peak	4,186,708	0.1069	447,559
On Peak	924,296	0.3562	329,234
Winter kWh			
Off Peak	3,642,229	0.0558	203,236

Intermediate Peak	6,222,216	0.0684	425,600
On Peak	1,252,658	0.1907	238,882
First 750 kWh	1,009,048	0.0934	94,245
Over 750 kWh	759,639	0.0627	47,629
Total kWh	20,483,430		
Total R-SmartSavers Revenue			2,159,306

Residential - Ultimate Savers			
	Billing Units	**Current Rates**	**Current Revenue**
Customer Charge			
Total Bills	18,108	9.00	162,972
Low Income Charge	18,108	0.14	2,535
Energy Charge			
Summer kWh			
Off Peak	6,399,949	0.0508	325,117
On Peak	902,560	0.3001	270,858
Winter kWh			
Off Peak	11,752,577	0.0449	527,691
On Peak	1,426,441	0.1632	232,795
Demand Charge			
Summer Demand	37,452	8.16	305,609
Winter Demand	69,809	3.37	235,257
Total kWh	20,481,528		
Total kW	107,261		
Total R-SmartSavers Revenue			2,062,834

Community Solar Revenue	128,058	12.12	1,552,067
Total Residential Revenue			1,446,016,715

Small General Service Class			
	Billing Units	**Current Rates**	**Current Revenue**
Customer Charge			
One-phase	1,168,895	11.96	13,979,990
Three-phase	469,706	22.87	10,742,168
Limited Unmetered Service	87,850	6.34	556,969
TOD Bills			
One-phase	17,537	22.91	401,768

Three-phase	2,081	44.74	93,122
Overnight Bills			
One-phase	218	11.96	2,613
Three-phase	60	22.87	1,375
Low Income Charge	1,746,348	0.20	349,270
Total Bills	1,746,348		
Energy Charge			
Summer			
Summer kWh	1,081,456,785	0.1197	129,450,377
Off Peak	27,379,801	0.0726	1,987,774
On Peak	15,915,753	0.1779	2,831,412
Overnight Off Peak	15,710	0.0791	1,243
Overnight On Peak	40,331	0.1324	5,340
Winter			
Base	1,532,446,737	0.0894	137,000,738
Seasonal	482,918,413	0.0516	24,918,590
Off Peak	56,065,017	0.0535	2,999,478
On Peak	31,157,681	0.1172	3,651,680
Overnight Off Peak	213,310	0.0563	12,009
Overnight On Peak	492,965	0.0883	43,529
CellNet kWh	2,222,258	0.0517	114,891
Total kWh	3,230,324,762		
Total Revenue			329,144,337

Community Solar Revenue	6,273	11.13	69,818
Total SGS Revenue			329,214,155

Large General Service			
	Billing Units	**Current Rates**	**Current Revenue**
Customer Charge			
Standard Bills	128,292	108.44	13,911,984
TOD Bills	711	21.08	14,988
Low Income Charge	128,292	2.11	270,696
Demand Charge (kW)			
Summer	7,989,966	6.19	49,457,891

Winter	14,597,594	2.30	33,574,467
Energy Charge			
Summer kWh			
First 150HU	1,024,053,378	0.1112	113,874,736
Next 200HU	1,104,399,907	0.0836	92,327,832
Over 350HU	444,914,422	0.0563	25,048,682
Off Peak	14,243,556	-0.0065	-92,583
On Peak	8,012,927	0.0114	91,347
Winter kWh			
Base Energy Charge			
First 150HU	1,674,976,432	0.0698	116,913,355
Next 200HU	1,789,949,197	0.0519	92,898,363
Over 350HU	783,291,477	0.0409	32,036,621
Seasonal Energy	367,466,094	0.0408	14,992,617
Off Peak	25,523,072	-0.0019	-48,494
On Peak	13,958,718	0.0035	48,856
Total kWh	7,250,789,180		
Total EDI Discount			-1,884,259
Total Revenue			583,437,099

Small Primary Service			
	Billing Units	**Current Rates**	**Current Revenue**
Customer Charge			
Standard Bills	7,896	371.39	2,932,495
TOD Bills	244	21.08	5,144
Low Income Charge	7,896	2.11	16,661
Demand Charge (kW)			
Summer	2,801,289	5.34	14,958,882
Winter	5,019,777	1.94	9,738,366
Energy Charge			
Summer kWh			
First 150HU	401,926,284	0.1079	43,367,846
Next 200HU	485,577,294	0.0811	39,380,319
Over 350HU	338,420,179	0.0545	18,443,900
Off Peak	30,103,928	-0.0048	-144,499
On Peak	14,723,200	0.0084	123,675
Winter kWh			

Base Energy Charge			
First 150HU	655,991,011	0.0679	44,541,790
Next 200HU	786,037,665	0.0505	39,694,902
Over 350HU	574,675,110	0.0394	22,642,199
Seasonal Energy	178,024,694	0.0395	7,031,975
Off Peak	52,089,358	-0.0018	-93,761
On Peak	27,939,871	0.0031	86,614
Reactive Power (kvar)	1,179,618	0.40	471,847
Rider B 34.5/69 kV Discount	794,212	-1.24	-984,823
Rider B 138 kV Discount	5,358	-1.47	-7,876
Total kWh	3,545,508,595		
Total EDI Discount			-1,506,626
Total Revenue			240,699,030

Large Primary Service			
	Billing Units	**Current Rates**	**Current Revenue**
Customer Charge			
Standard Bills	804	371.39	298,598
TOD	60	21.08	1,265
Low Income Charge	804	223.99	180,088
Demand Charge (kW)			
Summer	2,486,283	21.45	53,330,778
Winter	4,414,917	9.53	42,074,159
Energy Charge			
Summer kWh			
Energy	1,329,834,867	0.0364	48,405,989
Off Peak	80,987,171	-0.0035	-283,455
On Peak	38,711,644	0.0064	247,755
Winter kWh			
Energy	2,356,006,152	0.0333	78,455,005
Off Peak	149,622,292	-0.0018	-269,320
On Peak	73,826,123	0.0029	214,096
Reactive Power (kvar)	285,401	0.4	114,160
Rider B 34.5/69 kV Discount	1,977,767	-1.24	-2,452,431
Rider B 138 kV Discount	602,573	-1.47	-885,782

Total kWh	3,685,841,019	
Total EDI Discount		-7,143,050
Total Revenue		212,287,853

Company Owned Lighting 5M			
	Billing Units	**Current Rates**	**Current Revenue**
100000 MH Direct	284	74.44	253,692
11000 MV Open Btm	58	10.59	7,371
140000 HPS Direct	4	75.06	3,603
20000 MV Direct	161	22.89	44,223
20000 MV Enclosed	1,410	17.43	294,916
25500 HPS Direct	1,815	23.81	518,582
25500 HPS Enclosed	3,340	18.33	734,666
27500 HP Enclosed	84	18.33	18,477
3300 MV Open Btm	852	10.57	108,068
3300 MV Post Top	46	23.45	12,944
34000 MH Direct	445	22.93	122,446
34200 HPS Direct	3	23.81	857
36000 MH Direct	1,580	22.93	434,753
47000 HPS Direct	66	37.67	29,835
50000 HPS Direct	1,652	37.67	746,770
50000 HPS Enclosed	832	33.12	330,670
54000 MV Direct	8	33.97	3,261
54000 MV Enclosed	40	29.42	14,122
5800 HPS Open Btm	35	10.92	4,586
6800 MV Enclosed	2,219	12.73	338,974
6800 MV Open Btm	4,439	11.11	591,807
6800 MV Post Top	4,674	24.36	1,366,304
9500 HPS Enclosed	2,914	13.26	463,676
9500 HPS Open Btm	8,035	11.64	1,122,329
9500 HPS Post Top	24,852	24.9	7,425,778
LED 100 W EQ Bracket	86,101	10.71	11,065,701
LED 250 W EQ Bracket	13,448	17.27	2,786,964
LED 400 W EQ Bracket	2,272	31.75	865,632
LED Direct-Large	572	71.89	493,453
LED Direct-Medium	4,485	36.06	1,940,749
LED Direct-Small	3,810	22.49	1,028,243
LED Post Top - All	27,040	23.77	7,712,890
Municipal Discount		-0.0382	-1,563,488
Total Revenue			39,322,851

Customer Owned Lighting 6M

	Billing Units	Current Rates	Current Revenue
100W LED Energy Only	46	1.75	966
11000 MV Energy Only	50	4.93	2,958
11000 MV Enrg&Maint	0	7.49	0
12900 MH Enrg&Maint	0	7.45	0
162W LED Energy Only	8	2.84	273
180W LED Energy Only	47	3.15	1,777
196W LED Energy Only	28	3.43	1,152
20000 MV Energy Only	126	7.6	11,491
20000 MV Enrg&Maint	0	9.84	0
23W LED Energy Only	25	0.4	120
25500 HPS Enrg&Maint	24	7.38	2,125
25500 HPS Enrgy Only	387	5.14	23,870
25W LED Energy Only	2	0.44	11
26W LED Energy Only	29	0.46	160
27W LED Energy Only	10	0.47	56
3300 MV Enrg&Maint	2	4.3	103
3300 MV Enrgy Only	84	2.13	2,147
36W LED Energy Only	62	0.63	469
40W LED Energy Only	25	0.7	210
44W LED Energy Only	1	0.77	9
45W LED Energy Only	47	0.79	446
48W LED Energy Only	48	0.84	484
50000 HPS Enrg&Maint	2	10.59	254
50000 HPS Enrgy Only	55	8.07	5,326
54000 MV Energy Only	15	18.11	3,260
54000 MV Enrg&Maint	0	20.88	0
54W LED Energy Only	33	0.95	376
5500 MH Enrg&Maint	0	6.29	0
57W LED Energy Only	7	1	84
60W LED Energy Only	4	1.05	50
6800 MV Enrg&Maint	678	5.54	45,073
6800 MV Enrgy Only	287	3.46	11,916
6M Ltd LED 100 W EQ	12,219	3.24	475,075
6M Ltd LED 250 W EQ	117	4.2	5,897
6M Ltd LED 400 W EQ	13	7.41	1,156
70W LED Energy Only	13	1.23	192
72W LED Energy Only	19	1.26	287
75W LED Energy Only	183	1.31	2,877
80W LED Energy Only	249	1.4	4,183
85W LED Energy Only	64	1.49	1,144
9500 HPS Enrg&Maint	4,262	4.3	219,919
9500 HPS Enrgy Only	2,290	2	54,960

96W LED Energy Only	5	1.68	101
Fixture Revenue			880,959
Municipal Discount		-0.0382	-33,688
Total Revenue			847,271

Customer Owned Lighting 6M Metered			
	Billing Units	**Current Rates**	**Current Revenue**
Bills	20,097	8.15	163,791
Energy	36,987,436	0.0517	1,912,250
Billed Revenue			2,076,041
Municipal Discount		-0.0585	-121,499
Total Revenue			1,954,542

Total Lighting Revenue	42,124,664

MSD Horsepower Service		
Billing Units	**Current Rates**	**Current Revenue**
36,900	0.1942	85,992

Total Revenue	2,853,865,508

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Union Electric Company d/b/a Ameren Missouri's Tariffs to Adjust Its Revenues for Electric Service.	)))	Case No. ER-2024-0319

AFFIDAVIT OF NICHOLAS BOWDEN, Ph.D.

STATE OF MISSOURI)
) ss
CITY OF ST. LOUIS)

Nicholas Bowden, being first duly sworn states:

My name is Nicholas Bowden, and on my oath declare that I am of sound mind and lawful age; that I have prepared the foregoing *Surrebuttal and True-Up Direct Testimony*; and further, under the penalty of perjury, that the same is true and correct to the best of my knowledge and belief.

/s/ Nicholas Bowden
Nicholas Bowden

Sworn to me this 13th day of February, 2025.