Exhibit No.:	204
Issue(s):	Smart Energy Plan/ Keeping Current/ Coal Power Plants/ CCOS/ Rate Design/ Customer Charge/ Pure Power RECs
Witness/Type of Exhibit:	Marke/Rebuttal
Sponsoring Party:	Public Counsel
Case No.:	ER-2019-0335

REBUTTAL TESTIMONY

OF

GEOFF MARKE

Submitted on Behalf of the Office of the Public Counsel

UNION ELECTRIC COMPANY
D/B/A AMEREN MISSOURI

FILE NO. ER-2019-0335

January 21, 2020

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF THE MISSOURI

In the Matter of the Union Electric Company d/b/a Ameren Missouri's Tariffs to Decrease Its Revenues for Electric Service	)))	File No. ER-2019-0335

AFFIDAVIT OF GEOFF MARKE

STATE OF MISSOURI)
) ss
COUNTY OF COLE)

Geoff Marke, of lawful age and being first duly sworn, deposes and states:

1. My name is Geoff Marke. I am a Regulatory Economist for the Office of the Public Counsel.

2. Attached hereto and made a part hereof for all purposes is my rebuttal testimony.

3. I hereby swear and affirm that my statements contained in the attached testimony are true and correct to the best of my knowledge and belief.

Geoff Marke
Chief Economist

Subscribed and sworn to me this 21st day of January 2020.

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI
JERENE A. BUCKMAN
My Commission Expires
August 23, 2021
Cole County
Commission #13764037

Jerene A. Buckman
Notary Public

My commission expires August 23, 2021.

TABLE OF CONTENTS

REBUTTAL TESTIMONY

OF

GEOFF MARKE

UNION ELECTRIC COMPANY

d/b/a Ameren Missouri

CASE NO. ER-2019-0335

I. INTRODUCTION

Q. Please state your name, title and business address.

A. Geoff Marke, PhD, Chief Economist, Office of the Public Counsel ("OPC" or "Public Counsel"), P.O. Box 2230, Jefferson City, Missouri 65102.

Q. Are you the same Geoff Marke that filed direct testimony?

A. Yes.

Q. What is the purpose of your rebuttal testimony?

A. My testimony responds to the direct testimony regarding:

Revenue Requirement:

- Smart Energy Plan: Customer Driven Focus
  - Ameren Missouri witness Warren Wood;
- Keeping Current
  - Consumers Council of Missouri ("CCM") witness Jaqueline A. Hutchinson
- Coal Power Plants
  - Sierra Club witness Avi Allison

Rate Design:

- Class-Cost-of-Service
  - Ameren Missouri witnesses: Thomas Hickman, Michael W. Harding, and Ryan P. Ryterski;
  - Staff witnesses: Robin Kliethermes and Sarah Lange;
  - Missouri Industrial Energy Consumers ("MIEC") witness Maurice Brubaker;
  - Midwest Energy Consumers Group ("MECG") witness Steve W. Chriss;

- Residential Rate Designs: Inclining Block, Time-of-Use, Three-Part Residential, and EV Charging Rates
    - Ameren Missouri witnesses: Steven M. Wills and Ahmad Faruqui, Ph.D.;
    - Staff witnesses: Robin Kliethermes and Sarah Lange;
    - Sierra Club witness Avi Allison; and
    - Missouri Division of Energy ("DE") witnesses Martin R. Hyman;
- Residential Customer Charge
    - Ameren Missouri witness: Steven M. Wills;
    - Staff witnesses: Robin Kliethermes and, Sarah Lange
    - Sierra Club witness Avi Allison; a
- Pure Power RECs
    - Staff witnesses: Robin Kliethermes and, Sarah Lange

My silence regarding any issue should not be construed as an endorsement of, agreement with, or consent to any other party's filed position.

II. REVENUE REQUIREMENT

Smart Energy Plan: Customer Driven Focus

Q. How is Ameren Missouri providing a "Customer Driven Focus?"

A. Ameren Missouri witness Warren Wood highlighted four ways including:

1. Laying the groundwork for the Smart Energy Plan;
2. A $1 million rate reduction;
3. Laying the groundwork for modern rate designs; and
4. A paperless billing incentive

Q. Did Mr. Wood expound on the specific aspects of the Smart Energy Plan?

A. Yes, again he highlighted three examples including:

1. More solar (community, distributed and non-wires alternatives)
2. Grid upgrades; and
3. AMI deployment

Q. Do you agree with Mr. Wood?

A. I would say that the term "customer driven focus" is value-neutral. Whether the pending investment actions articulated by Mr. Wood will result in a net positive outcome for customers or result in needless increases in rates is unknown at the moment. As it stands, I am skeptical.

Q. What causes you to be skeptical of Mr. Wood's testimony?

A. Putting aside the three highlighted future investments within the Smart Energy Plan for a moment.

First, it remains to be seen whether the outcome of this contested case will result in a $1 million reduction or not. Of course, that $1 million reduction (or whatever final number is ordered) should be tempered by the $5 billion addition in "customer driven focus" costs that follow this case.

Second, even under a best-case scenario in Ameren's plan, ratepayers are at least five years removed from experiencing full implementation of "modern rate designs." Customers do not have AMI in placed yet and it will be well after the planned Smart Energy Plan is done before all customers will have AMI. It is also important to note that I have yet to see any plan on how the Company intends on implementing and educating its customer base on modern rates. Instead, the Company suggests pilots with no details on what is to be learned. On this point, I will have more to say later in my testimony under Rate Design.

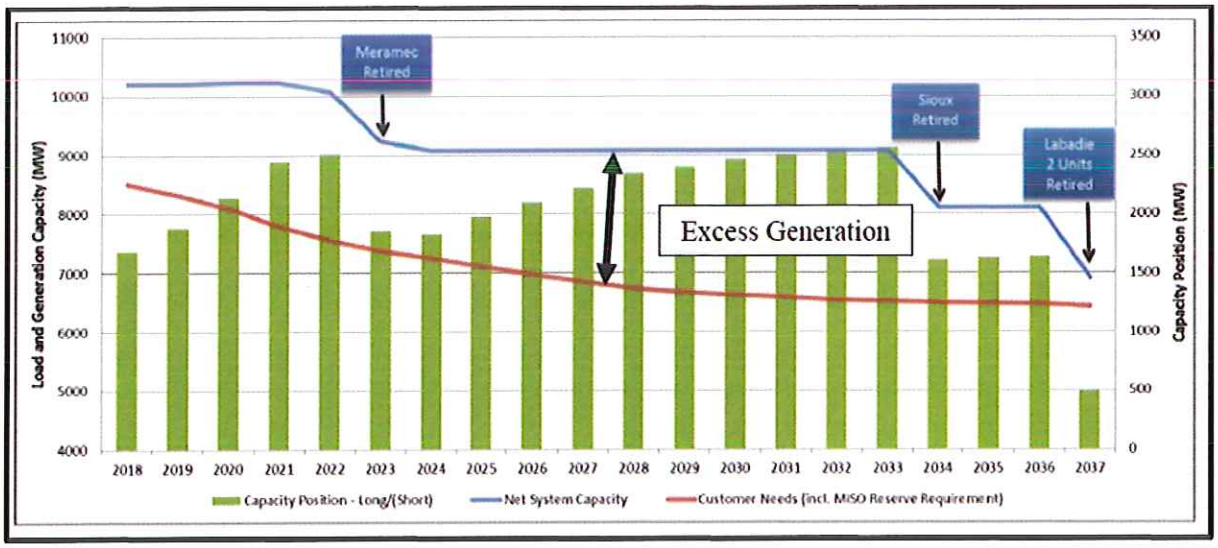
Third, customers can request paperless billing already today. More than 17% of all of Ameren's customers already do. Highlighting an existing option to pay the Company is not a benefit.

Q. What is your response to Mr. Wood highlighting future solar investment as a customer-driven focus within Ameren Missouri's Smart Energy Plan?

A. To state the obvious, Ameren Missouri is very long on capacity. They have zero need to build out more supply-side investment beyond what is required by statute. This can be seen by looking at the delta between customer needs (including Midcontinent Independent

System Operator (MISO) reserve requirement) represented by the lower red line with the Company's net capacity position represented by the higher blue line in Figure 1.

Figure 1: Net Capacity Position—No New Resources (Baseline)[1]



Q. Is there anything about that graph the Commission should be aware of?

A. Yes. The Commission should be aware that the delta between the lines will be even more pronounced in the near future because the graph does not include the 700 MW of wind that the Company is planning and/or in the process of building presently. Nor does it account for the "up to 250 MW" of generation associated with Ameren Missouri's Green Tariff or the 1 MW Community Solar program. All of those investments have Commission-approved Certificates of Convenience and Necessity ("CCNs").

Ameren Missouri needs to address the elephant in the room, namely the Rush Island and Labadie Power Plants. It was Ameren Missouri's managerial decision to not invest in environmental scrubbers and it was the US District Court, Eastern District of Missouri's opinion that because of that managerial decision the Company was in violation of the Clean Air Act's New Source Review Program. Until Ameren Missouri deals with all of their

[1] EO-2018-0038 Chapter 9, Integrated Resource Plan and Risk Analysis p. 3.

investments transparently and holistically, it makes very little sense to continue to build out rate base even further for energy that is not needed to serve its customers or meet capacity reserve requirements.

As to the specific solar investments, Mr. Wood references the community solar and non-wires solar alternative; the former is already in place and predates the Smart Energy Plan and the latter is before the Commission as a separate contested case.[2] I have no frame of reference for the "neighborhood solar" other than the Company has put forward that it is willing to put solar on roofs of customers voluntarily and with their consent.[3] I do know that, to date, there has been no appetite for moving forward with solar investments specifically advocated by OPC such as the low-income commercial non-profit solar option I outlined in EW-2019-0002.[4]

Q. What is your response to Mr. Wood highlighting future grid upgrades as a customer-driven focus within Ameren Missouri's Smart Energy Plan?

A. What are the quantified benefits? Where are the cost-benefit ratios and analysis? What are the performance measures? Where is the risk-informed distribution project evaluation or prioritization?

To date, there has not been a single performance measure offered. No reliability metrics, no O&M savings, no demand response savings, nothing. Instead, the Commission was given a filing that contained a list of projects and a seven-page "report" without any historic or accountable metrics.

I have not seen one cost-benefit analysis on any of the projects. I would, for example, be very interested in how Ameren Missouri has determined it is cost-effective to underground over 300 miles of its distribution system after its most recent IRP said:

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[2] Interested readers are directed to the rebuttal testimony of Geoff Marke in Case No: EA-2019-0371 for further information.

[3] Ameren Missouri (2019) Neighborhood Solar Program: Growing Solar Power across Missouri. https://www.ameren.com/missouri/business/clean-energy-customer-programs/solar/neighborhood-solar?wt.mc_id=neighborhood-solar-Press-Release

[4] See GM-1 for a copy of the memorandum.

> 22% of the [distribution system] lines are underground which provide a more aesthetically pleasing experience and are less susceptible to weather **but cost significantly more and take longer to fix.**[5] (emphasis added)

Or how 4kV substation replacement programs will deliver positive benefit-cost ratios or why the Plan omits any Conservation Voltage Reduction when Ameren Illinois estimated a 1.5% drop in energy use from their investment.[6]

Q. Could you provide some illustrative examples of metrics you would like to see?

A. Literally anything would be a good start.

Beyond what I referenced already, one illustrative example could be Ameren Missouri's historic and projected (2013 to 2023) distribution rate base dollar per customer amount against the Company's historic and projected energy sales and system peak and how those numbers compare with US IOU averages. These metrics could be cross referenced with SAIDI, SAIFI, and CAIDI scores to show whether previous distribution investments produced meaningful results.

In short, I would want to see some (or any) justification that ratepayers $5 billion + spend on "customer-driven focus" distribution investments will result in customer benefits and not just gold plating a utility's distribution system. Certainly, PISA accounting treatment can produce benefits beyond paperless billing.

The lack of transparent, robust quantitative data is especially disconcerting given the uncertainty surrounding Ameren Missouri's baseload coal plants, which, separate and aside from PISA, may induce billions of dollars in additional investments. Unfortunately, I have little assurance on that issue as well as the Company never modeled such a scenario in its IRP.

[5] EO-2018-0038 Chapter 7 Transmission and Distribution p. 17-19.
[6] See GM-2.

Q. What is your response to Mr. Wood highlighting future AMI investment as a customer-driven focus within Ameren Missouri's Smart Energy Plan?

A. I do not believe it is a foregone conclusion that AMI investment *is* a prudent investment. Based on the evidence in this case, it appears that ratepayers are going to be asked to start paying a return on and of hundreds of millions of dollars in AMI investment starting in the next case with no ability to realize the meaningful benefits for at least five years. This is because of both a staggered deployment and, to date, a nonexistent plan on how to educate customers on TOU rates. In effect, the only benefit that customers appear to be receiving is "the benefit" of being shut off quicker without a door-knock safeguard.

A recent white paper from the American Council for an Energy-Efficient Economy ("ACEEE") titled "Leveraging Advanced Metering Infrastructure To Save Energy" concludes the value-statement for AMI is questionable at best because utilities do not choose to maximize the benefits available from AMI.[7] In 2019, regulators in Virginia rejected Dominion Energy's proposed smart meter rollout, and utility commissions in New Mexico, Massachusetts and Kentucky all rejected utility proposals.[8] Based on those recent results, it would appear unwise to assume that this would be a prudent investment. Ameren Missouri has offered nothing to assuage those concerns. Again, I question the logic of investing hundreds of millions of dollars in AMI when:

- Multiple state Commissions have rejected AMI proposals;
- The Company has provided no demonstrable benefits or agreed-to performance metrics;
- The Company has provided no plan or commitment on how TOU rates will be rolled-out or at what scale; and

[7] York, D. (2020) Smart meters gain popularity, but most utilities don't optimize their potential to save energy.*ACEEE* https://acee.org/blog/2020/01/smart-meters-gain-popularity-most
[8] Walton R. (2020) Most utilities aren't getting full value from smart meters, report warns. *Utilitydive*. https://www.utilitydive.com/news/most-utilities-arent-getting-full-value-from-smart-meters-report-warns/570249/

- The potential for rate-shock inducing costs hover over the future of the Company's coal power plants.

So, yes, I am skeptical of Mr. Wood's customer-driven focus testimony and have legitimate concerns for Ameren Missouri's ratepayers. My hope is that Ameren Missouri will do the proper analysis before making its investments and provide the empirical and objective justifications prior to seeking recovery. It is much more of a challenge for everyone involved and a greater risk to shareholders and ratepayers alike to raise prudency issues on an investment that is operational.

Just because Ameren Missouri was authorized to increase rates by 15% over 5 years doesn't mean that it should.

Keeping Current

Q. What recommendations did you file in direct testimony regarding Keeping Current?

A. I recommend the following:

1.) A 20% budget variance ($141,200) extension be created and applied from the ratepayer-funded portion of the current budget or that any remaining balance be allocated evenly to the remaining participants' last monthly bill; and

2.) Ameren Missouri should be required to contract with a third-party consultant/researcher to provide a report to the Keeping Current collaborative by October 31, 2020, and subsequently filed in Ameren Missouri's next rate case that includes (at a minimum) the following items:

- A literature review of bill assistance best practices across utilities;
- A proposal that includes increasing the annual budget and removing the pilot status;
- An alternative proposal that focuses on specific targeted bill assistance (e.g., former homeless population,[9] electric space-heating, renters, etc.); and

[9] For example, working with the St. Patrick Center in St. Louis https://stpatrickcenter.org/

- A recommendation on how to leverage existing funding mechanisms to maximize program impact moving forward.

Q. What did CCM witness Hutchinson propose for Ameren Missouri's Keeping Current program?

A. Ms. Hutchinson proposes that the Keeping Current and Keeping Cool programs be set at $5 million annually. Ms. Hutchinson further recommends that the costs be allocated among the customer classes based upon a usage allocation (a volumetric basis).

Q. What is your response?

A. I largely agree with everything Ms. Hutchinson says regarding the affordability crisis and energy burden realized by many of Ameren Missouri's customers. Furthermore, I agree with her that the Keeping Current (and Keeping Cool) programs have largely accomplished what they have set out to do on a small-scale. I also support cost recovery allocation from all customer classes.

Q. Do you support a $5 million annual budget for the program?

A. Before I answer that, I do want to highlight Ameren Missouri's recent actions above and beyond what has materialized out of any rate case. In August 2018, Ameren Missouri announced a three-year, $5 million energy assistance program to help limited income customers. $2.5 million was allocated to energy-assistance partners including Heat-Up St. Louis and Heat-Up Missouri and the remaining $2.5 million was administered to community action agencies for weatherization assistance. All of this money was from corporate earnings.[10] In my mind, Ameren Missouri should be commended for their initiative.

In regards to Ms. Hutchinson's recommendation moving forward, I do not object to raising the budget for the Keeping Current program but I do have concerns with raising the budget

[10] Ameren Missouri (2018) Ameren Missouri announces $5 million program for energy assistance to help limited income customers statewide. http://ameren.mediaroom.com/2018-08-30-Ameren-Missouri-announces-5-million-program-for-energy-assistance-to-help-limited-income-customers-statewide

without an action plan as to how exactly we can best spend down that money. That was the intent behind my recommendations in direct testimony.

A $5 million budget is a 276% increase to the current budget ($1,331,000). However, it does not appear as though all of this money would go for bill assistance, as Ms. Hutchison also contemplates funds being allocated to Keeping Current participants for low-income weatherization as well. I support that recommendation as well.

Admittedly, a 276% increase may sound like a lot but context is important. For example, Ameren CEO Warner Baxter's total compensation in 2018 was valued at $8.5 million with additional shares valued at $12.1 million for a total of $20.6 million.[11]

So, the low income bill assistance program for Ameren's most vulnerable, that has not seen an increase in its budget for several years, *is* significantly smaller (or 6.5% of Mr. Baxter's salary) than what Ameren's CEO was awarded in 2018.

Q. What would you recommend?

A. I still maintain my initial recommendations in my direct testimony. I also recommend that the Company increase its contribution to this program. Ameren management and shareholders appears to be doing well and would appear to be in a position to, at a minimum, match what ratepayers are contributing.[12] Finally, I am not opposed to an increase in the overall budget but would want a greater share allocated to low-income weatherization (Keeping Current customers or not).

I support the general spirit of Ms. Hutchinson's recommendation for an increased budget but will defer my specific budgetary recommendations to surrebuttal testimony after I have had an opportunity to review the final copy of the 3rd party evaluation of the Keeping Current program.

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[11] Nicklaus, D. (2019) Ameren CEO's pay rises to $8.5 million. *St. Louis Post Dispatch.* https://www.stltoday.com/business/columns/david-nicklaus/ameren-ceo-s-pay-rises-to-million/article_e4b51ecd-4a17-593f-a301-b049988574c6.html

[12] Total budget is currently set at $1,331,000, with $706,000 provided by ratepayers and $625,000 provided by shareholders. An equivalent shareholder match would be an additional $81,000.

Coal Power Plants

Q. What did the Sierra Club file in regards to Ameren Missouri's coal plants?

A. Sierra Club witness Avi Allison provided the following "findings" and recommendations:

Findings:

1. Each of Ameren's Labadie, Rush Island, and Sioux coal units lost more than $20 million relative to the market over the past three years;
2. Ameren's recent and planned coal investment decisions do not sufficiently account for the major environmental compliance costs facing the Rush Island and Labadie plants;
3. Ameren's 2017 Integrated Resource Plan ("IRP") coal unit analyses cannot be relied upon to support continued investment in Ameren's coal units;
4. Ameren's coal commitment practices have led it to incur unnecessary net operational losses on behalf of ratepayers;
5. Ameren consistently offers its coal units into the MISO energy market at prices that are below their variable costs of production;
6. Ameren's current Fuel Adjustment Clause ("FAC") process does not allow for sufficient review of the Company's commitment and dispatch decisions.[13]

Recommendations:

1. The Commission should not allow the recovery of capital costs incurred at the Rush Island, Labadie, or Sioux plants in 2018 or later until Ameren has presented sound analyses that justify those investments in the face of major environmental compliance costs and declining renewable resource costs.
2. The Commission should require Ameren to present rigorous economic assessments of alternative near-term retirement dates for each of the Rush Island, Labadie, and Sioux units by the end of 2020. These forward-looking

[13] ER-2019-0335 Direct Testimony of Avi Allison, p. 3-4

assessments should be presented in a docketed proceeding to enable full Commission oversight and stakeholder review. They should incorporate up-to-date assumptions regarding market prices, resource costs, and environmental compliance costs.

3. The Commission should disallow the recovery of operational costs incurred through the uneconomic commitment and dispatch of Ameren's coal units. I estimate that Ameren incurred at least $861,000 in unnecessary net operational losses in 2018.

4. The Commission should require Ameren to retain the analyses underlying its unit commitment decisions for a period of at least two years. These analyses should clearly specify the costs and revenues that are accounted for within the analyses.

5. The Commission should revise its requirements regarding Ameren's FAC process to enable more thorough and efficient review of the Company's unit commitment and dispatch practices. I recommend that the Commission pursue this goal by providing Staff and other stakeholders with more time to respond to Ameren's FAC adjustment filings and/or setting minimum FAC filing requirements that better enable Staff and stakeholders to review unit commitment and dispatch practices. In addition, I recommend that the Commission structure the FAC process to enable annual, rather than triannual, review of unit commitment and dispatch practices.[14]

Q. Are you going to respond to all of these recommendations?

A. No, OPC witness Lena Mantle will be responding to Mr. Allison's third, fourth and fifth recommendations. I will respond to Mr. Allison's first two recommendation: 1.) to disallow capital costs incurred at the three coal plants in 2018 or later until Ameren can justify those investments; and 2.) to require Ameren Missouri to present a rigorous economic assessment

[14] Ibid, p. 4-5.

of alternative near-term retirement dates for each of the three plants by the end of 2020 in a docketed proceeding before the Commission.

Q. Do you believe that the Commission should disallow capital costs incurred at the three coals plants in 2018 until Ameren Missouri can justify them?

A. I do not know yet, but that is what a rate case can allow. Presumably, Ameren Missouri will file rebuttal testimony in response to Mr. Allison's recommendation that will attempt to justify those investments in light of the factors Mr. Allison raises. For my part, I would like to hear Ameren Missouri's response before I make any formal recommendations on whether or not those investments should be disallowed.

Q. Do you believe that the Commission should require Ameren Missouri to perform a rigorous economic assessment that looks at the feasibility and prudency of an immediate retirement for Labadie, Rush Island and Sioux?

A. Yes. That sounds very similar to the Integrated Resource Planning ("IRP") process.

Q. Would the IRP process be sufficient in your mind?

A. No, I do not think so. I have gradually lost faith in the IRP process over the past two years. I have been an active participate in the IRP filings and each utility has either delayed filings because the results could negatively impact a concurrent filing (See Evergy Metro and Evergy Missouri West MEEIA filings and Empire's Customer Savings Plan) or failed to model seemingly relevant factors (see Ameren Missouri and environmental costs associated with Rush Island and Labadie). The IRP process allows interveners to raise formal concerns or deficiencies; however, all too often the Commission response is for the utility to "do it next time" and often "if the utility wants to." I think there is value in the IRP process but I do not believe it would be sufficient for the magnitude of costs or expediency in timing of Mr. Allison's recommendations here.

Q. What would you recommend?

A. Again, I do not know. I will give Ameren Missouri the opportunity to respond to Mr. Allison before I make any formal recommendations on whether the traditional IRP process, an

investigatory docket, or something else should be opened to examine his recommendations on Labadie, Rush Island and Sioux.

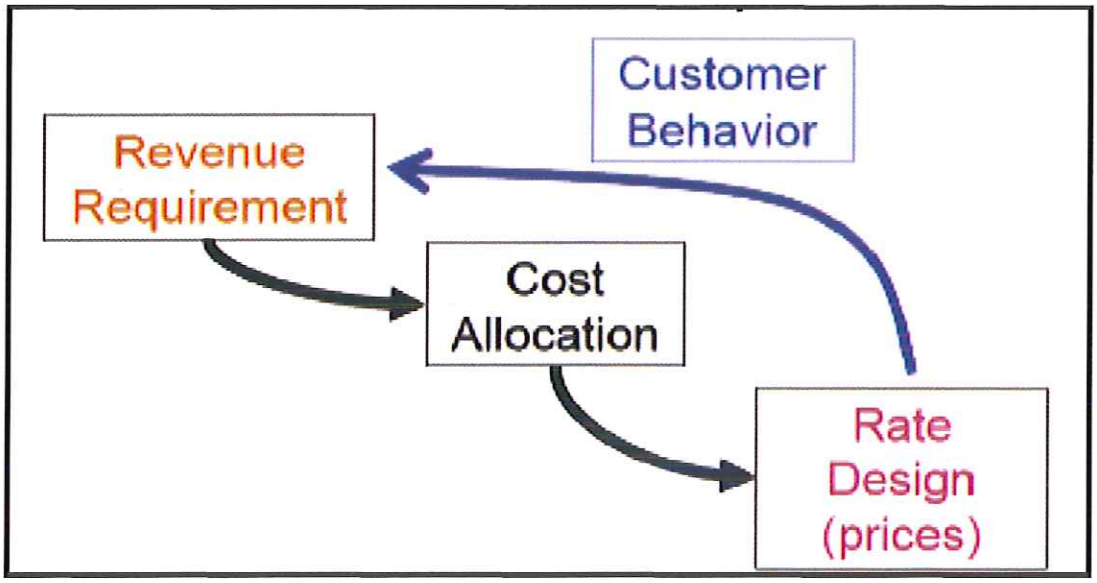
V. RATE DESIGN

Class-Cost-of-Service ("CCOS")

Q. What is a CCOS?

A. It is an analysis that allocates a utility's allowed costs to provide service among its various customer classes. The total cost allocated to a given class represents the costs that class would pay to produce an equal rate of return to other classes. There is no one definitive accepted method. Instead, there are different methodologies (e.g., Average and Peak, Average and Excess, Base-Intermediate-Peak, Capacity-Assigned, etc.) and cost allocation factors that produce different outcomes. If step one in a rate case is determining the revenue requirement then step two is allocating those costs among customer classes. Step three then focuses on designing the rates for appropriate cost recovery. How rates are designed influences future revenue requirements, thus providing a feedback loop on the entire process. Figure 2 provides a simplified, illustrative feedback loop of the rate case process.

Figure 2: The Rate Case Feedback Loop



Q. What were the parties' CCOS positions?

A. Predictably, they all varied.

Q. Did OPC perform a CCOS study?

A. No. There was not enough time or resources available. Additionally, I was less inclined to file a CCOS in a case where it was expected there would be an overall rate reduction.

Q. What CCOS study do you believe the Commission should rely on?

A. I think the Commission should rely on Staff's study. I say "think" because it appears the data underlying Ameren Missouri's load research necessary for the CCOS studies has been called into question.

Q. What do you mean?

A. On page 2 of Staff's CCOS report, footnote 2 states:

> On December 18th Staff became aware that Ameren Missouri was redoing its load research process for approximately half of its test period apparently prompted by Staff DR 517. As indicated on page 49 of Staff CoS Report, Staff was concerned that anomalies existed for certain months of data. The December 18th discussion further undermines Staff's confidence in the reliability of this data. Reliable load research data is integral to a reasonable CCoS.

As it stands, I may have to update my position in surrebuttal.

Q. Putting that aside for the moment, conceptually, which methodology should the Commission rely on?

A. I believe the Commission should endorse Staff's Capacity-Assigned CCOS study. Admittedly, I am still processing the results and rationale, but essentially Staff is arguing that the legacy methods of cost allocation (e.g., those found in the 1992 *Electric Utility Cost Allocation Manual* from the National Association of Regulatory Utility Commissioners ("NARUC")) no longer accurately reflect today's electric utility's cost of service. I agree with that overall sentiment and Staff's arguments are at first-blush, persuasive.

Q. What did Staff conclude?

A. That all classes are contributing revenues in excess of the expenses associated with providing service, and all are contributing to the Company's overall return. Residential, Small General Service ("SGS") and Combined Lighting are each contributing at a greater than 5% positive variance while Large Primary Service ("LPS") is at a greater than 5% negative variance to its cost to serve.

Despite these differences, Staff's primary recommendation is for classes to maintain their relative levels of class revenue responsibility. However, Staff does acknowledge that the Commission may want to more properly align rates in this case and thus provides a secondary recommendation set at an overall revenue decrease of $65 million. Those reductions to applicable levels of class revenue responsibility are as follows:

- $5 million decrease to lighting
- $15 million decrease to SGS
- $45 million decrease to Residential

Q. Did Staff file supplemental direct testimony on this subject?

A. They did. On January 9, 2020, Staff witness Sarah Lange filed supplemental direct testimony to the Staff Report amending Staff's initial position, which was designed to recover more revenues than Staff's auditors intended. However, it is not entirely clear to me from the testimony what Staff's recommended revenue requirement is at this point. Further follow-up with Staff is warranted on my end.

Q. Do you have any recommendations now?

A. I recommend an equivalent percentage reduction in rates for the residential, SGS and lighting classes as recommended by Staff aligned with whatever the final overall revenue decrease is.

It is always more difficult for the Commission to move classes toward cost-based rates when the rate increase is much larger than it is when the rate increase is smaller or where there is actually a rate reduction. For this reason, it would definitely be easier for the Commission

to make a larger movement toward cost-based rates in this case rather than making a smaller movement in this case.

I also think it is important to stress the realities of future PISA cost recovery and the impact that will be borne largely by the residential, SGS and lighting classes. Ameren Missouri has announced distribution investment in excess of $5 billion over the next five years.

Per SB 564 (2018), the large power service class has hard caps on the amount of costs it will be responsible for. If cost recovery exceeds those caps, residential, SGS and lighting will be forced to absorb them.

Keep in mind that residential and SGS customers have already been bearing an inequitable amount of costs through MEEIA surcharges for eight years now. Costs that certain LPS customers can "opt-out" of having to pay. Like MEEIA costs, residential and SGS customers will not be able to opt-out or have a "hard cap" to shield them from the expected costs.

With that in mind and based on Staff's CCOS study I support the recommended percentage decrease to residential, SGS and lighting classes based on the overall agreed-to revenue requirement reduction.

Q. Are you concerned about the data underlying the load shapes as raised by Staff?

A. I am, and will monitor that development accordingly. OPC represents all customer classes and will strive to provide an objective, equitable analysis, as such; I reserve the right to amend my recommendation.

Residential Rate Designs: Inclining Block Rate ("IBR"), EV Charging Rate, Three-Part Residential, & Time-of-Use ("TOU") Rate

Q. Can you provide a brief, general summary of the parties' residential rate design positions?

A. Ameren Missouri had four in-house witnesses (across rate design and the CCOS) file testimony and hired arguably the most prominent TOU proponent (Dr. Faruqui) in the

industry as a fifth witness to collectively propose a couple of pilot rates and oppose inclining block rates. Ameren also argued for a tracker for costs related to its pilots.

DE offered up a future framework to evaluate TOU pilots. DE witness Mr. Hyman also stressed that any TOU should be implemented on an opt-in basis as opposed to mandatory or opt-out basis.

Sierra Club opined against Ameren Missouri's three-part tariff pilot due to concerns surrounding the demand charge.

Staff took the position that Ameren Missouri should begin the process of implementing default company-wide TOU rates. Due to the staggered deployment, Staff argues that shadow billing be introduced.as AMI meters are installed.

Q. What is your response?

A. I actually agree with much of the rate design testimony filed on this subject and will address each proposed rate design in turn.

Inclining Block Rates ("IBR"):

Ameren Missouri witness Steve Wills was the only one to file testimony on the potential for residential IBR. He did not support it and went to great lengths to show how an IBR rate was "equitable."

I have opined on the pros and cons of an IBR design in previous cases.[15] The argument for IBR has primarily centered on the perceived public policy position of encouraging and inducing further reductions in energy and demand. Of course, following through with that design will produce tradeoffs that can, among other things, increase the risk exposure of the utility to cover its costs.

[15] See also EW-2017-0245 and/or GM-3.

Although I disagree with Mr. Wills's analysis, I ultimately agree with his conclusion that a residential IBR is inappropriate to pursue in this case in light of the pending TOU and AMI investments.

Three-part Residential Rate:

I agree with Mr. Allison that the three-part residential rate, as designed, is not an optimal rate and should be dismissed. The focus moving forward should center on end-use rate designs (electric vehicles) and TOU rates.

Electric Vehicle ("EV") Charging rate:

I do not take a strong position one way or the other on this design. In general, I support Ameren Missouri's proposed EV pilot rate design. That being said, I am much more interested in how Ameren Missouri intends to educate customers on this rate as that was the subject of a fair amount of testimony in previous dockets. Mr. Hyman's recommendations regarding TOU pilot frameworks are equally valid and should be supported in this context as well. That being said, I suspect that Ameren Missouri will have trouble attracting customers to this rate if the rate design is for the whole house as Ameren Missouri initially anticipates it being. I would recommend that any education or marketing of this rate should be transparent about usage at the whole house level and how it may not be appropriate for all customers.

Time-of-Use ("TOU") Rates:

On this issue, I support Mr. Hyman's evaluation framework but I support all of Staff's recommendations as it pertains to TOU. Staff made a similar argument in the last KCPL/GMO rate case which I did not fully endorse. The issue never went to an evidentiary hearing as parties stipulated to a long, time-intensive pilot process instead. Based on my experience on the west-side of the state and very real possibility that ratepayers may not realize *any* material benefits from AMI for another five years under the best case scenario, I support Staff's proposal to begin the movement to a default TOU.

I see little reason in moving forward with yet another TOU pilot. There are hundreds of TOU pilot studies publically available that can provide all of the information we would need. Putting off Staff's recommendation and reproducing another study would be an enormous waste. I have little doubt that Dr. Faruqui could verbally confirm this to Ameren management without having ratepayers pay for an additional round of written outside expert witness testimony.

The fact is, I am already skeptical about the value proposition of AMI; however, I struggle to find a scenario where AMI could ever be justified if only 1 to 2% of customers are actually using TOU rates. As it stands, I strongly recommend that Staff's proposal be adopted.

Residential Customer Charge

Q. What is the customer charge?

A. A fixed charge to customers each billing period, typically to cover metering, meter reading and billing costs that do not vary with size or usage. Also known as a basic service charge or standing charge.

Q. What kind of costs should be recovered in the customer charge?

A. To state the obvious, customer-related costs should be recovered in the customer charge. These should be costs sensitive to connecting a customer irrespective of the customer's load (e.g., meter, billing). That is, customer-related costs exist even when kW demand and kWh are zero.

When having one or more customers on the system raises the utility's cost regardless of how much the customer uses (billing is an example) then a fixed charge to reflect that additional fixed cost the customer imposes on the system makes perfect economic sense. Utilities can justify a customer charge recovering these basic costs because they are directly related to the number of customers receiving an essential monopoly service. The idea that each household has to cover its customer-specific fixed cost also has obvious appeal on grounds of equity. This

is contrasted with system-wide "fixed" costs, such as maintaining the distribution network, which do not change if one customer were to drop off the system.

Q. What is the end-result of raising or lowering the customer charge?

A. An increase to the customer charge positively impacts above-average use customers and negatively impacts below-average use customers. On the other hand, a decrease to the customer charge positively impacts below-average use customers and negatively impacts above-average use customers.

Stated differently, "in general," a lower customer charge tends to favor, low-income customers, renters, and customers who have invested in energy efficiency and solar (or plan on investing in those items).[16] In contrast, a higher customer charge favors affluent customers and electric space-heating customers. It also provides greater revenue certainty for the utility.

Q. What do parties propose regarding the residential customer charge?

A. There are three options currently in front of the Commission as seen in Table 1 below:

Table 1: Residential Customer Charge recommendations and percentage change

	Recommended amount	**Percentage increase/decrease from current**
Ameren Missouri	$11.00	+22.22%
Staff[17]	$9.00	No change
Sierra Club	$7.90	-12.22%

[16] I say in general, as there will be affluent customers who have below average use and low-income customers with above-average usage.

[17] It is not entirely clear if Staff supports a $9.00 customer charge or not. The recommended TOU rates were modeled on the customer charge remaining as is. As such, I am interpreting $9.00 to be Staff's position.

Q. How did stakeholders reach such different conclusions?

A. Different methodologies utilized in their CCOS studies produce different results. However, this specific issue comes down to how FERC Accounts 364-368, or the fixed distribution investments, are allocated.

The appropriate allocation of these costs are not a new problem. In his 1961 seminal work, *Principles of Public Utility Rates*, James Bonbright concludes that there is no sound basis for the allocation of these costs as either customer or demand:

> But if the hypothetical costs of a minimum-sized distribution system is properly excluded from the demand-related costs for the reasons just given, while it also denied a place among the customer costs for the reason stated previously, to which cost function does it belong then? **The only defensible answer, in my opinion, is that it belongs to none of them. Instead, it should be recognized as a strictly unallocable portion of total costs**. And this is the disposition that it would probably receive in an estimate of long-run marginal costs. But the fully-distributed cost analyst dare not avail himself of this solution, since he is the prisoner of his own assumption that "the sum of the parts equals the whole." **He is therefore under impelling pressure to "fudge" his cost apportionments by using the category of customer costs as a dumping ground for costs that he cannot plausibly impute to any of his other cost categories** (emphasis added).[18]

Q. Is the allocation process involved in the fixed distribution costs arbitrary?

A. Like Bonbright, I believe so. If the allocation can be dramatically changed by replacing one persuasive allocation criterion by another with no less plausibility, then the process ultimately functions as suggestive "guideposts" for the Commission to consider when setting how revenue will be collected. Economist William J. Baumol concurred:

[18] Bonbright, J., et al. (1988) *Principles of Public Utility Rates* p. 492

> No form of cost allocation can pretend to be compatible, generally, with efficiency in resource allocation, no matter how sophisticated its derivation.[19]

It is also unfair to allocate these cost increases uniformly because any standard of "uniformity" inherently handicaps one class of customers to the benefit of another. As Economist Richard L. Schmalensee notes:

> It is not a matter of improving cost studies or methodologies; costs that do not vary with the volume of service cannot be allocated on a cost-causative basis to individual services. Indeed, any allocation of fixed costs is necessarily arbitrary. . . . Shippers of diamonds, coal and feathers would prefer that the railroad allocate the fixed common costs of the railroad tracks on the basis of volume, value, and weight respectively, but none of these allocators is objectively better than the others. Since these fixed costs do not vary with the volume shipped, there is no objectively 'reasonable share of the joint and common costs of facilities' to allocate, and yet each party has a passionate stake in the outcome of the allocation.[20]

Q. If allocations are in part arbitrary, what should the Commission rely on?

A. I suggest that the Commission be cognizant that reasonable minds can and will differ over the appropriate allocation of the distribution system. Moreover, the Commission is not bound to set the customer charge based solely on the results of any CCOS. Cost studies (both marginal and embedded) rely on a host of simplifying assumptions in order to produce workable results. Since one objective of regulation is to serve as a proxy for competition, to impose upon a single provider the disciplines of competitive markets, it is reasonable to consider the structure of prices in competition when pricing monopoly services. Two relevant facts emerge. The first is that goods and services in competition are invariably available and priced on a unit basis. And

[19] Baumol, W.J. & D. Fischer (1986) Superfairness: Applications and Theory. Cambridge. p. 146
[20] Qtd in (1999) Federal Communications Commission filings found in:
http://apps.fcc.gov/ecfs/document/view;jsessionid=yRkfTYLdrdGzpzSNVhHML9FcznF98ppyPfQ1vMgvSky3cDnL14LY!1281169505!1675925370?id=1319580003

the second is that the extent to which more restrictive pricing schemes exist is a measure of the lack of competition in that particular market. In competition, a consumer who does not consume a product or service does not nevertheless pay for the mere ability to consume it. Thus, as a general matter, prices should be structured so that, if a consumer chooses not to purchase a good or service, he or she has no residual obligation to pay for some portion of the costs to provide that good or service. In this sense, from the consumer's perspective, costs should be "avoidable."[21]

Looking at how energy markets operate, it is apparent that the marginal cost of electricity generation goes up at higher-demand times, and all generation gets paid during those high peak prices. That means extra revenue for Ameren Missouri's baseload plants above its marginal costs, and those revenues can go to pay the fixed costs of said plants. The same argument goes for transmission lines, where price differentials between locations means that the transmission line generates revenue above its marginal cost (which is effectively zero), and can go to pay the fixed cost of transmission lines. In fact, the fixed costs of generation and transmission should generally be covered without resorting to increased fixed monthly charges.

Likewise, distribution costs are driven by demand, number of customers, and energy needs. This is true both in the short and long runs. Utilities are continually investing in distribution plants—new facilities, upgrades, and replacements—in response to changes in load, and therefore costs can be avoided. Collecting this revenue through a fixed customer charge suggests that on-peak consumption is less costly than in fact it is.

An efficient price signal recognizes resource allocation is most efficient when all goods and services are priced at marginal cost. For efficient electricity investments to be made, the marginal cost should be based on the appropriate timeframe. Bonbright states:

> I conclude this chapter with the opinion, which would probably represent the majority position among economists, that, as setting a general basis of

[21] Weston F. (2000) Charging for distribution utility services: issues in rate design. The Regulatory Assistance Project.http://www.oca.state.pa.us/cinfo/DistributedResourcesWorkshop/DistributionUtilityIssues/DistributionUtilityRateDesign.pdf

> minimum public utility rates and of rate relationships, the more significant marginal or incremental costs are those of a relatively long-run variety—of a variety which treats even capital costs or "capacity costs" as variable costs.[22]

A fixed charge including long-run marginal costs provides no price signal relevant to resource allocation, since customers cannot reduce consumption enough to avoid the charge. In contrast, an energy charge reflecting long-run marginal costs will encourage customers to consume electricity efficiently and, thereby avoiding inefficient future utility investments.[23]

Q. What is your recommendation?

A. Historically, distribution costs have been recovered through the energy charge in light of economic and public welfare characteristics. More recently, an emphasis on public policy goals focusing on energy efficiency and environmental stewardship have reinforced those decisions. I see very little reason to deviate from that rationale. This is especially true in light of Ameren Missouri's MEEIA Cycle III compensation and reward.

I recommend that the Commission adopt the Sierra Club's recommendation of a 12.22% decrease to the residential customer charge.

Pure Power RECs

Q. What is Ameren Missouri's Pure Power program?

A. Pure Power is a program that provides customers the voluntary option to purchase renewable energy credit ("REC") certificates.

A REC certificate represents positive environmental attributes associated with 1,000 kWh of electricity generated by renewable energy sources such as: solar, wind, hydroelectric, geothermal, landfill gas, biomass, biodiesel used to generate electricity, agricultural crops

[22] Bonbright, J., et al. (1961) *Principles of Public Utility Rates* (New York: Columbia University Press) p. 336
[23] Whited, M. et al. (2016) Caught in a fix Synapse Energy Economics http://www.synapse-energy.com/sites/default/files/Caught-in-a-Fix.pdf

or waste, all animal and organic waste, all energy crops and other renewable resources deemed to be Green-e Certified by the Center for Resource Solution's Green-e Standard.

Interested customers have three payment options, which are added to their monthly bill at one of three possible increments including:

1.) 1.00 cents per metered kWh;

2.) $5.00 per 500 kWh block; or

3.) $10.00 per 1,000 kWh block

Ameren Missouri utilizes a contractual partner, 3 Degrees Inc., to purchase these RECs but the title to the RECs rests with the Company who "retires" the RECs on behalf of the customers who paid for them.

Q. What is Staff proposing to do with the Pure Power tariff?

A. Staff notes that there is currently a discussion on the future status of this program and that the current Pure Power tariff is set to expire on June 30, 2020. Without taking a position as to whether the Pure Power program should be continued or not, Staff filed placeholder testimony to explore a framework to potentially record future Pure Power revenue as an offset to rate base.

Q. What is your response?

A. I do not support the Pure Power Program and do not anticipate recommending that our Office continue its support. Furthermore, I do not see why the issue could not have been addressed in this rate case.

Q. What is your objection to Pure Power?

A. I am at a loss as to why Ameren Missouri wants to continue to support a third-party REC program now that it has started to offer both community solar and Green Tariff options to its customers. The Pure Power program is an inferior and over-priced option for customers who want to support renewable growth.

Customers who want to support *new* renewable energy growth can actually do so directly through the Ameren Missouri's community solar or Green Tariff programs. Customers who

do not want to support actual renewables but rather reward *existing* renewables with a monetary compensation can do so by purchasing the same RECs at one-tenth the cost through the free market today. To be clear, Ameren's Pure Power is not providing a new service. They are merely offering a service that costs more. Ameren Missouri should not get in the way of their own superior "green" customer options.

Q. What is your recommendation regarding Pure Power?

A. I do not support Staff's tentative framework because I do not support Ameren's Pure Power program. The Company should have the good sense to let the tariff expire and direct interested customers to programs that increase renewable generation rather than subsidize existing renewable generation.

It is unlikely that Pure Power will be a contested issue in this rate case as there is already a separate docket (Case No: ET-2020-0042) in place that has "stalled" while this rate case takes precedence. As such, my recommendation is for the Company to withdraw its Pure Power application in ET-2020-0042 and let the program expire on June 30, 2020.

Q. Does this conclude your testimony?

A. Yes.

MEMORANDUM

To: Missouri Public Service Commission Official Case File,
Case No. EW-2019-0002

From: Geoff Marke, Chief Economist
Missouri Office of the Public Counsel

Subject: Allocation of Solar Rebates

Date: July 16, 2018

General Comments:

The Office of the Public Counsel ("OPC") appreciates the opportunity to file comments to the Commission's Staff regarding the Rules Regarding Solar Rebates: 4 CSR 240-20.100 (4). OPC recommends that the solar expenditures required from SB 564 be targeted at commercial, nonprofit, and tax-exempt business customers that are doing business to provide social services to low income public, including homeless shelters, food banks, food pantries, soup kitchens, employment/housing services, worker training, job banks, childcare facilities, and low income elderly nursing homes.

The aforementioned examples all operate to alleviate economic hardships and material deprivation for Missouri's low income population which in turn should provide the basis for more stable utility customers (e.g., customers not dropping on-and-off for service) and reductions in bad debt. There are also many practical and progressive economic arguments for strategically targeting these low income service entities as opposed to providing rebates on a first-come, first-serve basis as previously implemented or by attempting to provide a subscription-based low income community solar program.

The Flawed "First-Come, First-Serve" Solar Rebate Model:

OPC believes the original offering of ratepayer-funded rooftop solar rebates, particularly on a first-come first-serve basis, represented a largely regressive energy policy decision. The large "up front" capital costs and requisite available rooftop functioned as both an effectual barrier and an indirect form of intra-class price discrimination for many within the residential class—most acutely for low income customers. Furthermore, it could be reasonably argued that the basis for dispersing the original rooftop solar rebates included at least some percentage of free riders, or, customers who would have opted to invest in rooftop solar regardless of the rebate.[1] Furthermore, the opacity of the utilities "solar que" and the uncertainty of whether or not solar rebates would be available proved to be a material concern for all parties involved.

[1] OPC makes this generalization based in part on the research associated with income brackets and US Clean Energy Tax Credits. See also: Borenstein, S. and L. Davis, (2015) The distributional effects of U.S. Clean Energy Tax Credits. National Bureau of Economic Research. http://www.nber.org/papers/w21437.pdf

The framework surrounding net metering is also at odds with how a utility recovers its revenue requirement. Electric utilities have a lot of fixed costs that are not dependent on how much electricity is consumed. Every time ratepayers use electricity, they are paying for these fixed costs. With rooftop solar, there is an opportunity to radically reduce the amount of electricity a rooftop solar consumer buys from the utility. However, rooftop solar homes continue to be connected to the grid. Rooftop solar homes use the grid just as much as non-solar homes, as they are always either importing or exporting electricity, it's just that they consume much less grid-electricity.

Presently, rooftop solar consumers contribute much less to paying for utility fixed costs, but the fixed costs have not gone away—those are costs are merely shifted to nonparticipants. Admittedly these costs have historically been very small. It is estimated that only 0.33% of Missouri's electricity is generated from solar with most of that renewable generation derived from utility-scale solar plants not rooftop solar.[2]

The Low Income Burden:

One of the most difficult barriers faced by many low income ratepayers is the insufficiency of income to cover all basic necessitates. In nearly every single case before the Commission in which an investor-owned utility requested to raise rates, both Staff and OPC are contacted by members of the public pleading to the Commission to consider the bill impact of ratepayers on fixed incomes. Of important note, customer related costs associated with involuntary termination of service result in a cost transfer to existing ratepayers via uncollectible bad debt.

As costs for residential heating, cooling and other household energy needs steadily increase, they account for a higher percentage of household budgets and represent emerging disparities between richer and poorer households. Empirical data substantiate that many families are struggling. For example:

1. The U.S. Consumer Financial Protection Bureau's *2017 National Financial Well-Being Survey* found that more than 40 percent of U.S. adults struggle to pay bills, and 34 percent have experienced material hardships in the last year such as running out of food, or not having enough money for medical treatment or paying a utility bill.[3, 4]

2. The U.S. Federal Reserve's *Report on the Economic Well-Being of U.S. Households in 2017* found that:
    - Four in 10 adults, if faced with an unexpected expense of $400, would either not be able to cover it or would cover it by selling something or borrowing money;

[2] Solar Energy Industries Association (2018) Solar State by State: Missouri https://www.seia.org/states-map
[3] THE CFPB defines "material hardships" as: Running out, or worrying about running out, of food, not being able to afford medical treatment or a place to live, or having utilities turned off.
[4] CFBB (2017) Financial well-being in America.
https://files.consumerfinance.gov/f/documents/201709_cfpb_financial-well-being-in-America.pdf

- Over one-fifth of adults are not able to pay all of their current month's bills in full; and
- Over one-fourth of adults skipped necessary medical care in 2017 due to being unable to afford the cost.[5]

3. According to Freddie Mac, the number of apartments deemed affordable for very low income families across the United States fell by more than sixty percent between 2010 and 2016.[6]

4. Speaking to Missouri-specific housing and utility concerns, the National Low Income Housing Coalition estimates that:
   - In Missouri, the Fair Market Rent ("FMR") for a two-bedroom apartment is $815. In order to afford this level of rent and utilities—without paying more than 30% of income on housing—a household must earn $2,716 monthly or $32,588 annually. Assuming a 40-hour work week, 52 weeks per year, this level of income translates into an hourly housing waged of **$15.46**. [7]

   - To put that number into context, the State minimum wage is $7.85. Which means that a minimum wage worker would have to work approximately 79 hours a week to afford a 2-bedroom rental home or 62 hours for a one-bedroom home at fair market value. In Missouri, there is an estimated 787,627 renters, representing roughly 33% of the State's population.[8]

5. The nonpartisan Congressional Research Service estimates only sixteen percent of those eligible for LIHEAP ("Low Income Heating Energy Assistance Program") assistance receive it.[9]

6. A University of Colorado Denver study found, not being able to pay utility bills is the second leading cause of homelessness, behind domestic violence in households with children.[10]

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[5] Board of Governors of the Federal Reserve System (2018) Report on the Economic Well-Being of U.S. Households in 2017. https://www.federalreserve.gov/publications/files/2017-report-economic-well-being-us-households-201805.pdf

[6] Jan. T. (2017) America's affordable-housing stock dropped by 60 percent from 2010 to 2016. *The Washington Post* https://freddiemac.gcs-web.com/news-releases/news-release-details/new-freddie-mac-analysis-finds-widening-shortfall-affordable

[7] U.S. National Low Income Housing Coalition. Out of Reach 2018: Missouri http://nlihc.org/oor/missouri

[8] Ibid.

[9] Congressional Research Service (2018) LIHEAP: Program and Funding https://www.everycrsreport.com/files/20180201_RL31865_b8be422272b48a2f5eefe5881be52c9821464e57.pdf

[10] Colorado Statewide Homeless Count (2007) University of Colorado at Denver. http://www.ucdenver.edu/academics/colleges/SPA/researchandoutreach/SPA%20Institute/Centers/CEPA/Publications/Documents/HomelessExecutive%20Summary-FINAL-2-27-07.pdf

Low Income Community/Subscriber Solar:

As articulated separately in OPC's pleading, OPC is concerned with the legality of targeting certain recipients without a clearly defined public policy rationale. Assuming that undue price discrimination was not an issue for the moment, there are practical design, implementation, and general policy concerns that need to be broached before a low income community/subscriber solar program could reasonably be considered. The terms, conditions, eligibility, credit level, and subsidy levels all need to be determined and accounted for.

Given the finite amount of funds available for any given year, coupled with fluctuations in eligibility and the long-life of solar assets, there will undoubtedly be winners and losers at the intra-class level if a low income community/subscriber program is pursued. OPC welcomes other perspectives on this issue and will seek to elicit further dialogue at the workshop; however, presently, we do not believe such an approach is a prudent use of ratepayer funds.

Low Income Commercial Non-Profits:

Targeting low income, commercial, non-profits through a holistic consideration of economically premised goals provides a more equitable, administratively easier, and seemingly greater opportunity to maximize net benefits to non-participants given the amount of statutorily-authorized funding available. OPC has listed reducing instances of bad debt or encouraging the stabilization of volatile bill fluctuations, supporting customers on existing utility sponsored low income programs, maintaining service reliability and providing solar energy for public areas where benefits are shared by all ratepayers as four goals that are neutral in discrimination but effectively aid all customer.

It is OPC's primary recommendation that homeless shelters satisfy the four aforementioned factors, and should therefore be prioritized. Homeless shelters service a population that will ideally result in "new" customers. Freeing up much of the electricity costs normally set aside for service for these organizations through subsidized solar installations will represent an immediate opportunity to better serve the existing low income population. For example, the money saved from solar installations could be allocated to homeless families needing money to cover the down payment for utility service or help pay off existing bad debt which prevents service from being turned-on.

OPC further recommends that the solar panels and installation be fully covered with the pool of money available for rebates in a given year. The homeless shelters and other low income, commercial, non-profits should be allowed to receive the rooftop solar free of any costs through the available rebate funds. Per SB 564, this would result in up to $5,600,000 per year for Ameren Missouri and $1,600,000 per year for KCPL and GMO. OPC has very little concern that enough eligible low income commercial non-profits could be identified each year.

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

AFFIDAVIT OF GEOFF MARKE

STATE OF MISSOURI)
) SS.
COUNTY OF COLE)

COMES NOW GEOFF MARKE and on his oath declares that he is of sound mind and lawful age; that he contributed to the foregoing *PROPOSED SOLAR REBATE ALLOCATIONS;* and that the same is true and correct according to his best knowledge and belief.

Further the Affiant sayeth not.

Geoff Marke
Chief Economist

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 16th day July, 2018.

NOTARY PUBLIC NOTARY SEAL STATE OF MISSOURI
JERENE A. BUCKMAN
My Commission Expires
August 23, 2021
Cole County
Commission #13754037

Jerene A. Buckman
Notary Public

My Commission expires August 23, 2021.

Ameren Illinois
Voltage Optimization Plan

January 25, 2018

Ameren ILLINOIS

1. Executive Summary

Under 220 ILCS 5/8-103B(b-20) of the Future Energy Jobs Act ("FEJA," SB 2814, 2016), Ameren Illinois Company d/b/a Ameren Illinois is required to file "a plan with the Commission that identifies the cost-effective voltage optimization investment the electric utility plans to undertake through December 31, 2024." The statute requires that Ameren Illinois file its voltage optimization plan (the "VO Plan") within 270 days of the effective date of FEJA, or by February 26, 2018.

"Voltage optimization measures" are included in the overall "energy efficiency" definition in the IPA Act at 20 ILCS 3855/1-10, and described as "measures that optimize the voltage at points on the electric distribution voltage system and thereby reduce electricity consumption by electric customers' end-use devices." Ameren Illinois defines Voltage Optimization ("VO") as a combination of Volt/VAR Optimization ("VVO") and Conservation Voltage Reduction ("CVR"), which are implemented to first reduce the VAR flows on a circuit, and then lower the voltage to reduce end-use customer energy consumption and utility distribution system losses. VVO optimizes capacitor bank operations to improve power factor and reduce system losses. CVR utilizes voltage regulators, transformer load tap changers, and capacitors to control and reduce end-user voltages, which, in turn, lowers customers' energy consumption.

Ameren Illinois' VO team identified distribution circuits' average delivered energy[1] and categorized those circuits by operating voltage levels. The team then researched, studied, and analyzed industry accepted methodologies that could be used to quantify potential cost-effective VO energy savings of the entire Ameren Illinois distribution network. The result of these efforts is this VO Plan. The VO Plan incorporates a Total Resource Cost (TRC) analysis consistent with Ameren Illinois' energy efficiency plan to determine the cost-effectiveness of VO deployment on each individual circuit. At a very high level, a TRC analysis compares total resource costs (capital and O&M investments) to total resource benefits (primarily energy savings achieved by customers). When a project's total benefit exceeds total costs, the project is considered cost-effective, using the TRC methodology.

- **Key Findings**
  - A VO program deployment on Ameren Illinois' distribution network has the potential to cost-effectively achieve energy savings of an estimated 422 GWh per year by the end of 2025 and has a Plan TRC of 1.36.
  - These VO measures statutorily have a 15-year useful life for purposes of claiming energy savings; thus, AIC is committed to ensuring the VO program continues to produce savings through 2039 for those circuits deployed in 2024.

[1] Average delivered energy on a circuit is based on the customers currently served from the circuit using billing data for the years 2014-2016.

- The population of cost-effective candidate circuits for the VO program deployment is currently estimated at 1,047 circuits, which corresponds to approximately 64% of Ameren Illinois' customers.

- Ameren Illinois will annually refine the appropriateness and timing of deployment of each of these VO candidate circuits using detailed engineering studies and analysis, to achieve its yearly savings targets.

- The cost-effective VO program investment is estimated at approximately $122 million over the period of years 2017-2024. All reasonable and prudently incurred costs, fees, and charges, including, but not limited to, capital and associated O&M costs associated with this VO Plan shall be recovered under the provisions of Section 16-108.5.[2]

- **Approach**

  Ameren Illinois' approach for the VO Plan was designed using proven industry standards for estimating and quantifying cost-effective energy savings on Ameren Illinois' distribution network. Ameren Illinois relied on its previous VO pilot project experiences, recent industry VO activities, as well as recommendations from leading VO experts to create the VO Plan.

  Ameren Illinois' VO Plan has the following attributes:

  - Ameren Illinois, consistent with other EE programs, will use a TRC analysis as the main tool to determine the cost-effective VO circuits.

  - Ameren Illinois used voltage level as the primary criteria for establishing the initial pool of potential candidate circuits to analyze. Circuits served by voltage levels greater than 20 kV are not considered candidates for VO implementation. Based on this criteria, 2,474 distribution circuits were considered for further analysis.

  - Ameren Illinois used a CVR factor of 0.8 and an average voltage reduction of 3% to estimate the end-use customer energy savings per circuit. Ameren Illinois' CVR factor and percent voltage reduction are based on its VO pilot project results, recent VO industry findings, as well as VO industry expert recommendations. This approach of estimating the energy savings per circuit was used in the analysis.

  - This Ameren Illinois VO Plan is being designed and implemented as an energy efficiency measure, consistent with FEJA. The VO functionality is intended to operate 24 hours a day, 365 days a year. The analysis, CVR factor, and

[2] Costs associated with this plan will continue to be recovered until fully recovered under provisions of Article IX, in the event Section 16-108.5 no longer applies.

estimated average voltage reductions are all based on these operating parameters. There will naturally be some demand reduction on some circuits during the 8760 hours of operation of the system in a given year, but the timing and amount of any demand reduction during AIC system peak has not been determined. Since the program is not designed to reduce peak demand, Ameren Illinois has not estimated the amount of peak demand reduction that will result from this VO deployment; thus, peak demand reduction has not been included as a benefit in the TRC analysis.

- The energy savings associated with the VO Plan can be categorized into two forms: end-use load reductions and distribution line loss reductions. The majority of the savings come from end-use load reductions. Consistent with Ameren Illinois energy efficiency filings, Ameren Illinois has included the benefit of line loss reduction of the VO program in the TRC analysis.

- From the 2,474 distribution circuits that are candidates for the analysis, potential energy savings per circuit was estimated using the actual average 2014-2016 delivered energy on the circuit based on connected metered electric energy, the 0.8 CVR factor, and the 3% voltage reduction established above.

- The average cost to implement VO on each circuit, including the necessary infrastructure upgrades, control and communication devices, and appropriate circuit enhancements, was estimated.

- These costs and energy savings were analyzed using a model to evaluate the TRC or benefit-cost ratio of each circuit. The TRC analysis identified 1,047 distribution circuits that are estimated to be cost-effective (TRC score equal to or greater than 1.0) for VO deployment, and these circuits make up the final candidate circuit population for the VO program.

- Based on the estimated 422 GWh-yr total energy savings on 1,047 distribution circuits that the VO program would yield, Ameren Illinois established energy savings targets and investment required to achieve these targets, for every year of the program.

- The 422 GWh-yr target is a percent annual cumulative persisting savings of 1.5% in 2025. This exceeds the cumulative persisting savings of 1.0% established in section 8-103B (b-20) of FEJA.

- The 1,047 cost-effective circuits are spread across Ameren Illinois' service territory, and provide service to communities identified as the top 20 Tier One[3], and to communities with populations below the poverty level.

- Ameren Illinois will use an initial-year voltage reduction analysis to determine the amount of energy savings achieved per implemented circuit. This initial-year proven reduction amount will be considered to occur each of the remaining 14 years of operation of the given circuit after confirming continued VO operation each year.

- Consistent with Ameren Illinois' Energy Efficiency programs, Ameren Illinois will use an independent third-party evaluation, measurement and verification evaluator to review implementation of the plan and confirm estimated savings were achieved.

- Starting in 2018, Ameren Illinois will conduct detailed engineering analysis to determine which circuits to implement in a given year. The detailed engineering analysis could result in a different number of circuits, higher or lower, being deployed with VO than outlined in this Plan; however, the Company is committed to meeting the savings targets outlined in this VO Plan and will adjust circuit deployments as necessary. Ameren Illinois' cadence for implementing the VO Plan for a given program year ***N***, is as follows:

  - Year ***N-2***: Detailed engineering analysis to determine:
    - ✧ Select circuits to meet target for year ***N***.
    - ✧ Complete detailed engineering analysis and design on enhancements selected circuits and determine associated costs.
  - Year ***N-1***: Construct and install VO upgrades per engineering design. Turn VO on and place into service.
  - Year ***N***: 1st full year of VO operation on selected circuits. Measure and record average voltage reduction on circuits.
  - Year ***N+1***: Calculate energy savings and report on savings achieved in Year ***N***.

- **Results**

  The VO TRC benefit-cost analysis estimated the total potential cost-effective energy savings for the VO program to be 422 GWh-yr. These results are based on total investment cost of approximately $122 million, to implement VO on 1,047 distribution circuits. It is also estimated that the yearly O&M costs to operate and maintain the VO program is $7.4 million upon full deployment. A summary of the estimated VO plan results are presented in Tables 1 & 2, and Figure 1, below.

[3] As defined in the "Impact and Process Evaluation of the 2016 (PY9) Ameren Illinois Company Home Efficiency Income Qualified Program", dated December 28, 2017, by Opinion Dynamics.

	VO Plan Results
Estimated VO Savings Potential (Energy MWh/yr)	421,568
Estimated Number of Cost-Effective VO Circuits	1,047
Number of Customers Served by Estimated Cost-Effective VO Circuits	763,958
Average Energy Savings (MWh/yr) per Estimated Cost-Effective Circuit	403
Estimated VO Investment Cost	$122 M
Average VO Deployment Cost per Estimated Cost-Effective Circuits	$ 116,642

Table 1. Summary of VO Program

Year Ending	2018	2019	2020	2021	2022	2023	2024	2025
Estimated Cumulative Persisting Annual Savings (MWh)	0	7,650	59,994	128,433	201,725	275,006	348,287	421,568
% Cumulative Persisting Annual Savings	0%	0.03%	0.21%	0.46%	0.72%	0.98%	1.25%	1.50%
Estimated Incremental # of Circuits Deployed	19	130	170	182	182	182	182	0
Estimated Incremental Construction Cost (Capital Cost)	$2M	$14M	$18M	$19M	$19M	$19M	$19M	$0
Estimated Incremental Total Investment Cost (Construction Capital, Construction O&M, Upfront Capital)	$5M	$17M	$20M	$20M	$20M	$20M	$20M	$0

Table 2. Summary of Ameren Illinois' roll-out plan for the VO program

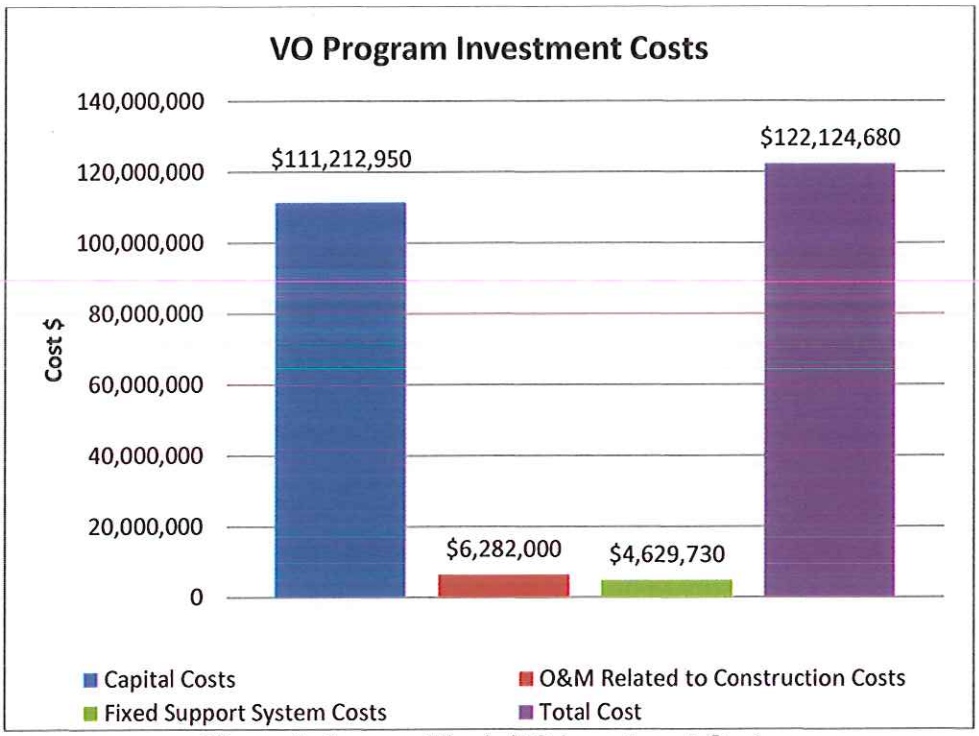

Figure 1. Ameren Illinois VO Investment Costs

Three considerations:

1. The estimated 1.5% of cumulative persisting annual savings after full deployment is based on the total normalized sales of electric power and energy during the calendar years 2014-2016 of 27,960 GWh, after excluding energy delivered to exempt customers identified as of September 1, 2017. If this baseline value is adjusted, the estimated persistent savings percentage will change as well.

2. As part of its EIMA Infrastructure Investment Plan, Ameren Illinois was already in the process of deploying VO on 19 circuits in 2017-2018. Ameren Illinois will incorporate these initial 19 circuits as its initial deployment of its FEJA VO Plan. Ameren Illinois will use these 19 circuits to gain experience designing, implementing, and operating a VO system, as well as determine which of three VO management software systems to use for the remainder of the deployment. Commensurate with an approved VO Plan, Ameren Illinois will begin engineering analysis in 2018 on the circuits it will deploy in 2019.

3. Table 2 shows the estimated number of circuits to be deployed and the estimated capital spend each year. Verification of achieved voltage reductions and realization of savings will occur in the year after deployment. For example, for the year 2020, Ameren Illinois plans to deploy an estimated 130 circuits at an estimated capital spend of approximately $14 Million in

2019, so that by the end of year 2020, an estimated 59,994 MWh are saved and the 0.21% persisting savings target is met.

2. Introduction

Under 220 ILCS 5/8-103B(b-20) of the Future Energy Jobs Act ("FEJA," SB 2814, 2016), Ameren Illinois Company d/b/a Ameren Illinois is required to file "a plan with the Commission that identifies the cost-effective voltage optimization investment the electric utility plans to undertake through December 31, 2024." The statute requires that Ameren Illinois file its voltage optimization plan ("VO Plan") within 270 days of the effective date of FEJA, or by February 26, 2018.

"Voltage optimization measures" are included in the overall "energy efficiency" definition in the IPA Act at 20 ILCS 3855/1-10, and described as "measures that optimize the voltage at points on the electric distribution voltage system and thereby reduce electricity consumption by electric customers' end-use devices." Ameren Illinois defines Voltage Optimization ("VO") as a combination of Volt/VAR Optimization ("VVO") and Conservation Voltage Reduction ("CVR"), which are implemented to first reduce the VAR flows on a circuit, and then lower the voltage to reduce end-use customer energy consumption and utility distribution system losses. VVO optimizes capacitor bank operations to improve power factor and reduce system losses. CVR utilizes voltage regulators, transformer load tap changers and capacitors to control and reduce end-user voltages, which, in turn, lowers customers' energy consumption.

In subsequent sections, Ameren Illinois will provide information on pilot and initial projects that support its VO Plan, identify the goals Ameren Illinois seeks to accomplish with its VO investments, and then identify the VO investments selected to accomplish those goals. Each planned VO investment is then evaluated under the "total resource cost test" or "TRC test," and the results of those TRC tests are summarized. Ameren Illinois explains the estimated "cumulative persisting annual savings" for the VO measures, and how the measures will fit with the savings goals established pursuant to Section 8-103B. The overall schedule for VO measures, or overall VO Plan, is then established. Ameren Illinois concludes by describing the data collection process for the VO Plan, the evaluation, measurement, and verification (EM&V) process, and the process for Ameren Illinois to report results to the Illinois Commerce Commission ("ICC").

3. Background

Ameren Illinois has been piloting and investing in voltage control and management technologies for many years. More recently, since 2012, Ameren Illinois began testing and implementing specific VO approaches and technologies which will be explained further below.

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3.1 *Pilot VO Project*

In Docket 10-0568, the ICC ordered Ameren Illinois to conduct a pilot VO project ("Pilot VO Project") to determine the benefits of wider adoption of an Ameren Illinois' VO program. Docket 10-0568, Dec. 21, 2010 Order, at 28. As part of that Docket, the ICC ordered Ameren Illinois to conduct a conservation voltage reduction pilot to test the feasibility of kWh and kW reduction from reduced voltage. The Pilot was conducted from 2012-2013.

Under Ameren Illinois' Pilot VO Project, Ameren Illinois employed CVR on four AIC circuits – the Mt. Zion substation circuit 173, and the Peoria University substation circuits 01, 03, 04. The results of the CVR Pilot Program resulted in determination of a CVR factor that relates percentage change in energy delivered to percentage change in voltage. The average CVR factor was 0.97 and 0.44 for the Mt. Zion test for the summer and fall, respectively. The average CVR factor for the University test was found to be 0.7 and 1.24 for summer and fall, respectively. These values are within the range of CVR factors reported in other industry CVR project results.

Substation	Summer CVRf	Fall CVRf	Average
Mt. Zion	0.97	0.44	0.71
University	0.78	1.24	1.01

Table 3. Ameren Illinois CVR Pilot Results

3.2 *Primary Distribution Volt/VAR Control Infrastructure Investment Program*

In addition to the CVR pilot discussed above, as part of its EIMA Infrastructure Investment Plan, AIC developed a primary distribution Volt/VAR program. The intent of this program is to provide for Dynamic Voltage Control and optimal Reactive Power flow (Volt/VAR Control or Volt/VAR Optimization) on select primary distribution circuits. Phase 1 (2013 engineering with 2014 construction) focused on ensuring all switched low voltage distribution capacitors in the Metro-East area that were controlled by an obsolete system would interact with the new ADMS (Advanced Distribution Management System). Phase 2 (2016/2017 engineering with 2017/2018 construction) is an initial implementation of the VO deployment across 19 AIC primary distribution level (<15kV) circuits by controlling switching capacitor banks, voltage regulators, and transformer load tap changers (LTCs) using a VO computerized control technology solution. This second phase will also focus on the evaluation of three voltage optimization vendor software control solutions for the further voltage optimization deployment. Since AIC plans to have these initial 19 circuits operable in 2018, these circuits will be incorporated as the initial circuits implemented as part of AIC's VO Plan.

Substation	Circuit	Software
Northwest Ckt 002	B00002	Vendor 1
Northwest Ckt 003	B00003	Vendor 1
Quincy 24th & Cherry Lane Ckt 556	V40533	Vendor 2
Quincy 28th & Adams Ckt 533	V42556	Vendor 2
Limit Ckt 015	D31015	Vendor 1
Ridge Ckt 002	C52002	Vendor 1
Ridge Ckt 001	C52001	Vendor 1
Shelbyville Ckt 500	Y79500	Vendor 2
Charleston S. EIU Ckt 501	K11376	Vendor 1
Bethalto Ckt 377	J34377	Vendor 2
Bethalto Ckt 357	J34357	Vendor 2
Caseyville Gardens Ckt 376	K11376	Vendor 1
E. Belleville Ckt 132	L93132	Vendor 2
Belleville 44th Ckt 140	J83140	Vendor 2
Mt. Zion Rt121	P69173	Vendor 3
Quincy 30th & Hampshire	V42572	Vendor 3
Tuscola East	Y98532	Vendor 3
Quincy 36th & College	V45574	Vendor 3
Mt. Vernon 27th St	P58155	Vendor 3

Table 4. Ameren Illinois Primary Distribution Volt/Var Control Infrastructure Program and Initial VO Deployment Circuits

3.3 Goals of VO Plan

A primary objective of this VO Plan is to identify and provide the roadmap to implement the cost-effective voltage optimization investment that AIC plans to undertake through December 31, 2024, as well as outline the reporting and evaluation, measurement, and verification methodology that will be used. Ameren Illinois' approach to identify viable, cost-effective circuits, estimate potential energy savings for the candidate population per viable VO feeder, TRC analysis for viable VO feeder, deployment and implementation schedule per year, and reporting and evaluation, measurement, and verification analysis, is detailed in the sections below.

4. The VO Plan

This plan provides a detailed description of the approach used to perform VO assessment of Ameren Illinois' distribution network to determine energy savings potential and associated costs. Prioritization methods, assumptions, related formulations and process steps are described.

Ameren Illinois' VO Plan was designed using:

1. Proven industry-standard engineering methods that have been used at other utilities similar to Ameren.

2. Reliable analysis and financial modeling techniques that provide representative and reasonable program level VO benefits and costs, consistent with other regulatory proceedings.

3. Reviewed and supported by the collective experience of Accenture consulting services.

4.1 Candidate Feeder Selection

Ameren Illinois operates a high-voltage distribution system (a.k.a. subtransmission system), with voltage levels 34.5kV and 69kV. The subtransmission system at Ameren Illinois includes networked lines, with multiple sources serving low-voltage distribution substations and some industrial customers. Ameren Illinois' distribution system directly serves most of Ameren Illinois' residential, commercial and small industrial customers. This system operates at voltages less than 34.5kV. The most common distribution voltage levels are 4.16kV and 12.47kV.

Ameren Illinois' bulk-supply subtransmission system was excluded from consideration for VO deployment, due to the following reasons:

1. Ameren Illinois' subtransmission system serves a small number of customers that are predominantly industrial customers.

2. Many portions of Ameren Illinois' subtransmission system are networked[4], making VO operation unviable.

3. A substantial number of subtransmission lines have no controllable voltage devices, such as a substation transformer with LTC.

Based on the information above, Ameren Illinois' population of candidate circuits for VO deployment is based on the evaluation of 2,474 distribution circuits through a total resource cost (TRC) analysis, which uses estimated per feeder deployment costs and estimated feeder benefits/savings. This will be explained in more detail under the "TRC Methodology" section.

[4] "Ameren Illinois Utilities Electric Subtransmission System Planning Criteria and Guidelines", Electric Planning Standard No.1, Transmission & Distribution Design Department, Energy Delivery Technical Services 2015.

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4.2 *Estimation of Energy Reduction*

Consistent with FEJA, Ameren Illinois' VO Plan is being designed and implemented as an energy efficiency measure, and has not considered peak demand reduction as a benefit of the program. Therefore, for the purposes of this plan, Ameren Illinois considers the term "load" to be consistent with the term "energy".

The energy savings from CVR is the product of three key parameters:

$$Energy\ Savings\ (kWh) = Load \cdot CVR_f \cdot \Delta V$$

Where:

- $Load$: is the load expressed as energy (kWh) prior to VO implementation
- CVR_f: is the factor which represents the percent change in load for each percent change in voltage
- ΔV: is the percent change in average voltage on a circuit as a result of VO implementation

Determination of these three values drives the estimated energy savings calculations. These items are addressed for the Ameren Illinois' VO program in the sections below.

Load

Baseline loads used to estimate energy savings per circuit for the VO Plan are defined below:

- *Ameren Illinois Program Baseline Load:* Ameren Illinois' average delivery of energy during the calendar years 2014-2016 was 36,900 GWh. This value was then reduced to exclude energy delivered during the same time period to exempt customers, resulting in the baseline of 27,960 GWh. The baseline is the basis for AIC's EE savings goals, including savings achieved through this VVO Plan. The % of cumulative persisting annual savings targets within this VO Plan are based on this 27,960 GWh value. The percentage target values will change if this baseline is adjusted.
- *Candidate VO Circuit Baseline Load:* The total energy delivered for candidate VO circuits was based on the 2014-2016 average MWh.

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CVR Factor (CVR_f)

Based on AIC's 2012 – 2013 Pilot VO Project, and other industry studies, a CVR factor of 0.8 was selected for use across all feeders and aligns with CVR factors reported in industry literature and regulatory filings. The tables below summarize CVR factors from a variety of industry projects as well as extracted from regulatory filings in other jurisdictions.

Utility	CVR Factor
California IOUs	0.75
New York State Electric & Gas	0.6
Central Florida Electric Cooperative	0.5-0.75
Clay Electric Cooperative (Florida)	1.0
Progress Energy – Florida	1.0
Georgia Power	0.8-1.7
Cobb EMC	0.75
Progress Energy – Carolinas	0.4
NRECA[5]	0.80
OG&E[6]	0.70
KCP&L[7]	0.80
Avista Utilities	1.09
Clatskanie PUD	1.4
Inland Power & Light	0.93
Snohomish PUD	0.65
Seattle City Light	0.13
Average	0.8

Table 5[8]. CVR Factors from a Variety of Industry Projects

The data in the above table combined with the results of the Ameren Illinois Pilot VO Project support use of a CVR factor of 0.8 for the evaluation, measurement, and verification of the VO Plan.

[5] National Rural Electric Cooperative Association, Costs and Benefits of Conservation Voltage Reduction – CVR Warrants Careful Examination, Final Report (Technical Report) (Arlington, VA: May 2014).

[6] Oklahoma Gas & Electric, 2015 Oklahoma Demand Programs Annual Report, Attachment H IVVC Impact and Capability Report, http://www.occeweb.com/pu/EnergyEfficiency/2015OGE_DemandProgramsAnnualReport.pdf

[7] "Voltage and Power Optimization Saves Energy and Reduces Peak Power", https://www.smartgrid.gov/files/Voltage-Power-Optimization-Saves-Energy-Reduces-Peak-Power.pdf

[8] "Distribution Efficiency Initiative, Market Progress Evaluation report, No.1", NEEA 1207, Northwest Energy Efficiency Alliance 2007, http://neea.org/docs/reports/distribution-efficiency-initiative-e05-139.pdf?sfvrsn=7

Voltage Change (ΔV)

Ameren Illinois utilized a 3.0% voltage reduction for the assessment of candidate feeder energy savings resulting from VO deployment. The 3.0% voltage reduction was selected based on Ameren Illinois' Pilot VO Project, evaluation of results from VO implementations reported by other utilities, and Ameren Illinois' design and operating practices.

4.3 Loss Reduction

VO-related energy savings consists of two principal items: end-use load reduction and loss reduction. In general, loss reductions are small relative to end use load reductions.

Loss reductions arise as a "side effect" of the VO implementation. Distribution line losses are reduced through two principal mechanisms: 1) reduced customer load reduces the magnitude of the load on lines and transformers, resulting in a corresponding reduction of losses across these elements, and; 2) improved distribution primary power factor from reactive power (capacitor bank) dispatch can further reduce the magnitude of load on lines.

Ameren Illinois captured the benefits associated with loss improvements through use of loss factors in the TRC analysis. However, reporting energy reductions due to VO will be based on metered energy without loss gross up. Reporting will be explained in a later section.

4.4 Peak Demand Reduction

Determination of peak demand savings presents challenges that are not encountered in forecasting and reporting energy savings. Specifically, peak demand is subject to far greater variation from year to year than annual energy, due to variations in weather characteristics. Additionally, due to system electrical characteristics in combination with variable peak loading (due to aforementioned weather characteristics) the voltage reduction effected at peak is subject to greater variation and does not offer the balance of the year offset variation as provided in energy reductions. Finally, peak CVR factors can demonstrate variation due to the unique load mix at the time of peak (and depending on the peak load level in a given year). These factors make projections of peak demand savings difficult and subject to significant variation.

Ameren Illinois' VO Plan is being designed and implemented as an energy reduction measure, consistent with the FEJA. The VO functionality is intended to operate 24 hours a day, 365 days a year. The analysis, CVR factor, and estimated average voltage reductions are all based on these operating parameters.

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4.5 VO Technology

Ameren Illinois identified multiple technology upgrades required for the successful deployment of a VO program. These technology upgrades have hardware, software and communication components. Each component is described below.

Hardware: Hardware upgrades are necessary to enable the execution of VO strategies on the distribution circuit. Upgrades include the installation of new controllers, monitors and metering packages.

- LTC (Load Tap Changer) Controls
- Voltage Regulator Controls
- Capacitor Controls
- Substation Metering
- Voltage Monitors (AMI, Substation SCADA, Field Devices, etc.)

Software: Software is a fundamental piece to the enablement of VO. It is responsible for taking inputs from field devices, circuit models and other sources of information for a given distribution circuit, and then using advanced algorithms to make decisions that optimally operate the circuit so maximum safe voltage reduction can be achieved. Ameren Illinois will deploy software that can:

- Dynamically monitor, optimize and control devices on the distribution circuit to achieve circuit specific maximum safe voltage reduction.
- Use real-time measurements from distribution circuit field devices and AMI meters, so all customer voltages remain in compliance while achieving energy savings.
- Use real-time electrical connectivity circuit models that would reflect the real-time configuration of the distribution circuit, identifying outages, abnormal switching and back-feed scenarios, and adjusting controls and commands according to the system's real-time configuration.

Communications: The reliable communication between the optimization software and field devices is key to achieving maximum attainable savings per distribution circuit. Each controller (voltage regulator controller, capacitor bank controller, LTC controller) as well as each metering package and line voltage monitor, will require a communication device that will connect them to the optimization software.

Circuit Enhancements: To enhance the voltage reduction capability of a distribution circuit, a number of additional enhancements will be done as appropriate. These enhancements may include:

- Phase Balancing

- Power Factor Correction
- Upgrading Distribution Transformers
- Moving Secondary Services
- Adding Line Voltage Regulators

AMI: Ameren Illinois sees significant advantages in using AMI voltage reads that can be fed as inputs to the optimization software and can be used by the software to determine the maximum amount of savings that can be achieved on the circuit, as well as limit the potential for voltage violations on a circuit. AMI voltage data will also be used in the engineering design process.

4.6 TRC Methodology

This evaluation identifies the cost and benefit components using the Total Resource Cost (TRC) analysis. The Act states that an overall portfolio of energy efficiency and demand-response measures is determined cost-effective using the TRC test. The TRC test is a benefit-cost ratio of the net present value of total benefits of the program to the net present value of the total costs, as calculated over the lifetime of the measures. A program is considered cost-effective if this ratio is greater than one. The also Act states that the TRC shall have the meaning set forth in the Illinois Power Agency Act.

"Total Resource Cost test" or "TRC test" means a standard that is met if, for an investment in energy efficiency or demand-response measures, the benefit-cost ratio is greater than one. The benefit-cost ratio is the ratio of the net present value of the total benefits of the program to the net present value of the total costs as calculated over the lifetime of the measures. A total resource cost test compares the sum of avoided electric utility costs, representing the benefits that accrue to the system and the participant in the delivery of those efficiency measures, as well as other quantifiable societal benefits, including avoided natural gas utility costs, to the sum of all incremental costs of end-use measures that are implemented due to the program (including both utility and participant contributions), plus costs to administer, deliver, and evaluate each demand-side program, to quantify the net savings obtained by substituting the demand-side program for supply resources. In calculating avoided costs of power and energy that an electric utility would otherwise have had to acquire, reasonable estimates shall be included of financial costs likely to be imposed by future regulations and legislation on emissions of greenhouse gases."

The TRC test compares benefits (energy costs times energy savings, plus the value of resulting carbon reduction) to costs (incremental capital, installation and O&M costs of measures + utility implementation and administration costs). The formal expression of the Illinois TRC test is as follows:

TRC = Benefits/Costs

$$BTRC = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}}$$

$$CTRC = \sum_{t=1}^{N} \frac{PRC_t + PCN_t + UIC_t}{(1+d)^{t-1}}$$

Where:

BTRC = Benefits of the program/measure

CTRC = Costs of the program/measure

UAC_t = Utility avoided supply costs plus avoided O&M costs in year t

UIC_t = Utility increased supply costs in year t

PRC_t = Program Administrator (Utility) program costs in year t

PCN = Net Participant Costs

BenCost Modeling Tool: The TRC analysis utilized a modeling tool called BenCost. The BenCost modeling tool is a powerful modeling tool that is used to evaluate the costs, benefits, and risks of DSM programs and services. It is a Microsoft Excel-based tool built by Applied Energy Group (AEG) to conduct robust cost-effectiveness evaluations consistent with industry best practices and individual client needs. The model utilizes information obtained directly from Ameren Illinois to ensure that results are accurate and reliable. AEG's approach to cost-effectiveness analysis has been honed over decades of experience with program planning, design, and evaluation. BenCost is used by more than 25 utilities and state agencies, including Ameren Illinois, for DSM program planning.

4.7 TRC Analysis Results

Ameren utilized the BenCost tool to conduct the TRC analysis on each viable circuit, based on the estimated incremental cost of implementing the circuit, and the estimated energy reduction that could be realized from the circuit. Program fixed costs not directly dependent on the number of circuits implemented (such as the initial and ongoing software costs, and overall administration, measurement, and evaluation, etc.) were not included in the individual circuit TRC analysis. The results of this analysis yielded 1,047 cost-effective circuits, with an estimated total energy savings after full deployment of 422 GWh. The overall TRC of the VO Plan assuming implementation of all circuits with an individual TRC greater than 1.0 is 1.36.

	VO Plan Results
Estimated VO Savings Potential (Energy MWh/yr)	421,568
Estimated Number of Cost-Effective VO Circuits	1,047
Number of Customers Served by Estimated Cost-Effective VO Circuits	763,958
Average Energy Savings (MWh/yr) per Estimated Cost-Effective Circuit	403
Estimated VO Investment Cost	$122M
Average VO Deployment Cost per Estimated Cost-Effective Circuits	$ 116,642

Table 6. Summary of VO Plan Results.

4.8 *Distribution of Cost-Effective Circuits*

The population of cost-effective candidate circuits for the VO program deployment is currently estimated at 1,047 circuits, which corresponds to approximately 64% of Ameren Illinois' customers. Unlike other energy efficiency programs, all customers served from one of these circuits, will directly benefit from VO, as they do not have to decide to opt-in. These customers are spread across the full territory of Ameren Illinois.

Locations	Circuits / Division	Customers in Division	Estimated # of Customers on Cost Effective Circuits
Division 1	260	267,824	213,988
Division 2	103	123,978	53,684
Division 3	132	152,003	112,636
Division 4	231	250,323	151,181
Division 5	107	147,170	83,572
Division 6	214	263,078	148,897
Totals	1047	1,204,376	763,958

Table 7. Cost effective circuits by Division.

Based on zip codes of customers served by the proposed feeders, these circuits also serve portions of the top 20 Tier One communities (defined below), with the exception of Springfield and Peru which are not totally within AIC electric service territory. The below table provides the names of 20 Tier One communities, ranked in terms of the number of estimated eligible households. Tier One communities are defined as communities where over 50% of households are low-

income, less than 10% of households are multifamily, and less than 10% of households participated in previous residential energy efficiency programs.

Ranking (Top 10)	Name*	Estimated Eligible Households	Estimated Population Below Poverty Level	Estimated # of Customers on Cost-Effective Circuits	Ranking (11-20)	Name*	Estimated Eligible Households	Estimated Population Below Poverty Level	Estimated # of Customers on Cost-Effective Circuits
1	Springfield[1]	13,897	8,807	6,600	11	Belleville	2,675	4,542	37,490
2	Decatur	4,888	7,773	29,202	12	Jacksonville	2,294	3,702	9,798
3	Bloomington	4,370	7,416	19,264	13	Ottawa	1,954	3,426	9,584
4	Centralia	4,100	4,399	4,874	14	Alton	1,917	6,702	4,958
5	East Saint Louis	3,519	5,790	1,457	15	Salem	1,623	1,652	1,222
6	Danville	3,439	10,286	11,316	16	Marseilles	1,470	1,310	3,719
7	Galesburg	2,980	6,788	13,674	17	Olney	1,442	1,960	3,105
8	Carbondale	2,956	10,688	7,590	18	Quincy	1,338	6,522	12,022
9	Mount Vernon	2,897	4,471	5,381	19	Peru[1]	1,283	1,034	330
10	Granite City	2,887	7,612	6,777	20	Monmouth	1,233	1,911	3,340

[1] Ameren Illinois Only Serves a small portion of the Springfield & Peru Zip Codes

* Communities named based on the city to which they belong.[9]

Table 8. EE Top 20 Tier One Communities

4.9 VO Plan Implementation Costs

The Ameren Illinois VO team has conducted a detailed cost assessment of the VO program to determine the capital and operations and maintenance (O&M) costs associated with the VO deployment. Table 9 shows the total estimated project costs broken down by category.

[9] "Impact and Process Evaluation of the 2016 (PY9) Ameren Illinois Company Home Efficiency Income Qualified Program", dated December 28, 2017, by Opinion Dynamics

Project Costs	Total (M)
Capital Construction-Automation, Communications	$48
Capital Construction- Circuit Enhancements	$63
O&M Related to Construction Costs	$6
Fixed Support System Capital Costs	$5

Table 9. Total VO Program Costs

4.9.1 Capital & O&M Related to Construction

Based on the candidate cost-effective VO circuit population of 1,047, the number of devices necessary to implement the VO program was assessed. For each circuit, Ameren Illinois' VO team identified the following items for the enablement of the VO implementation:

- Number of LTC Controllers
- Number of Voltage Regulator Controllers
- Number of Voltage Regulators
- Number of Capacitor Banks
- Number of Capacitor Controllers
- Number of Communication Devices
- Number of Substation Metering Installations

The Ameren Illinois VO team also identified circuit enhancement work that is necessary to enable the successful operations of VO, and to achieve the estimated 3% voltage reduction outlined in the plan. The potential circuit enhancement work was assessed by the Ameren Illinois team as follows:

- Phase Balancing
- Power Factor Correction
- Upgrading Distribution Transformers
- Moving Secondary Services
- Adding Line Voltage Regulators

Circuit Enhancement Work	Cost per Circuit
Phase Balancing – for 20% or more phase unbalance	$10,000
Power Factor Correction – for circuits with Power Factor worse than 98% lagging/leading. Estimated adding a capacitor bank and relocating another.	$20,000
Upgrading Distribution Transformer – estimated for replacing one distribution transformer.	$2,500
Moving Secondary Services – for low voltage conditions. Estimated moving three secondary services.	$2,500
Adding Line Voltage Regulators – for low voltage zones within circuits. Estimated adding one set of three-phase voltage regulators.	$25,000
Total	$60,000

Table 10. Estimated Circuit Enhancement Costs

Ameren Illinois' VO team also identified the following items necessary for the implementation of the VO program and are independent of the number of circuits implemented. This includes the implementation of a VO software system that is integrated with our Advanced Distribution Management System (ADMS) and AMI system. It also includes the enhancement of the existing AMI system to retrieve voltage values from the meters and store in a data warehouse. These total fixed costs are estimated to be $4.6M.

Material and labor costs were estimated through the use of equipment quantities known for each of the 1,047 circuits, as well as labor estimates from internal work management systems, or directly from vendors.

The figure below further summarizes the VO Plan investment costs.

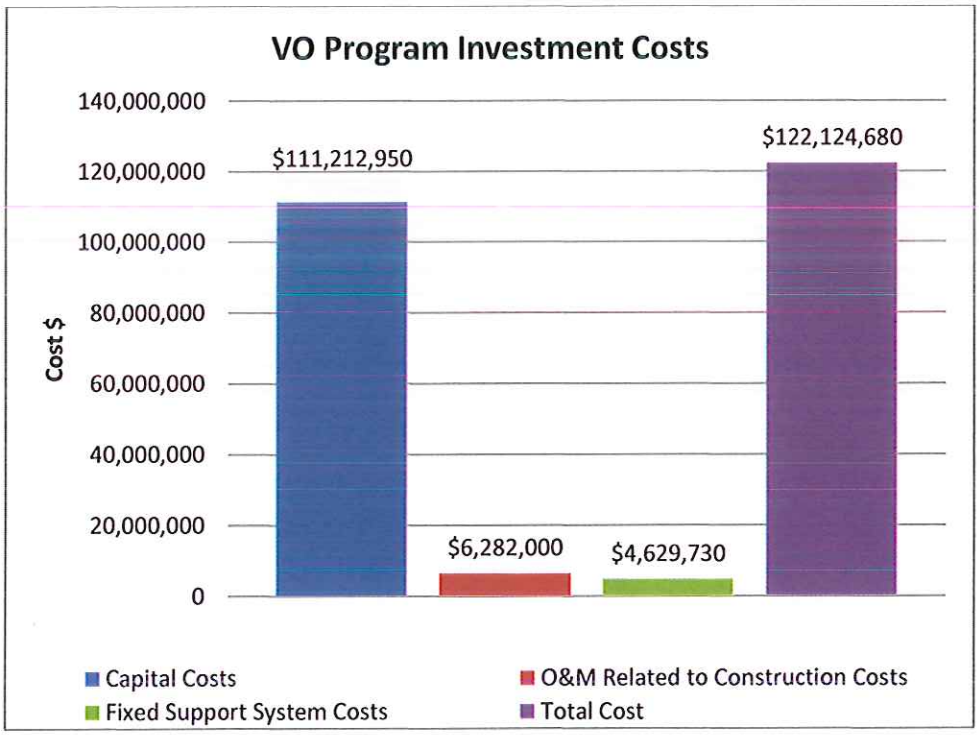

Figure 2. Ameren Illinois VO investment Cost.

4.9.2 Ongoing O&M

The ongoing operating and maintenance cost of the VO Plan is estimated at $7.4M (these estimates include engineering, operating, engineering technician and substation/lineman support to maintain the VO systems and equipment).

5. Timeframe and Implementation Plan

Based on the estimated 422 GWh-yr total energy savings on 1,047 distribution circuits that the VO program would yield, Ameren Illinois established energy savings targets, as well as the estimated investment required to achieve these targets, for every year of the program. Starting in 2018, Ameren Illinois will conduct further detailed engineering analysis and determine which circuits to implement in a given year. The detailed engineering analysis could result in some of the 1,047 circuits falling out of the cost effective candidate list, while other circuits might be determined cost-effective and are added as candidates. Therefore, the number of circuits deployed in any given year may differ from those outlined in the Plan to meet savings goals.

Ameren Illinois' cadence for implementing the VO plan for a given program year ***N***, is as follows:

- Year ***N-2***: Detailed engineering analysis to determine:
  - Select circuits to meet or exceed energy savings target for year ***N***
  - ✧ Complete detailed engineering analysis and design on selected circuits and determine associated costs
- Year ***N-1***: Construct and install VO upgrades per engineering design. Turn VO on and place in service.
- Year ***N***: 1st full year of VO operation on selected circuits. Monitor voltage reduction.
- Year ***N+1***: Calculate energy savings and report on savings captured in Year ***N***

The summary of Ameren Illinois' roll-out for the VO Plan is shown in Table 11 below. All investments and amounts shown are subject to revision as AIC refines and adapts the VO Plan in light of future analysis, findings and circumstances. The work may evolve from that originally planned; and planned schedules may be either accelerated or delayed. Implementation of the VO Plan may also involve the increase or reduction in the number of cost-effective circuits deployed, at lower or higher cost than originally estimated. Such occurrences shall not imply the imprudence or unreasonableness of the VO Plan, including, but not limited to, its programs, cost or schedule.

Year Ending	2018	2019	2020	2021	2022	2023	2024	2025
Estimated Cumulative Persisting Annual Savings (MWh)	0	7,650	59,994	128,433	201,725	275,006	348,287	421,568
% Cumulative Persisting Annual Savings	0%	0.03%	0.21%	0.46%	0.72%	0.98%	1.25%	1.50%
Estimated Incremental # of Circuits Deployed	19	130	170	182	182	182	182	0
Estimated Incremental Construction Cost (Capital Cost)	$2M	$14M	$18M	$19M	$19M	$19M	$19M	$0
Estimated Incremental Total Investment Cost (Construction Capital, Construction O&M, Upfront Capital)	$5M	$17M	$20M	$20M	$20M	$20M	$20M	$0

Table 11. Summary of Ameren Illinois' roll-out plan for the VO program.

Ameren Illinois' VO Plan, as proposed, is estimated to yield a percent annual cumulative persisting savings of 1.5% in 2025. This exceeds the cumulative persisting savings of 1.0% established in section 8-103B (b-20) of FEJA, as outlined in the table below. The estimated 1.5% of persisting annual savings after full deployment is based on the total normalized sales of electric power and energy during the calendar years 2014-2016 of

27,960 GWh, after excluding energy delivered to exempt customers identified as of September 1, 2017. If this baseline value is adjusted, the estimated persistent savings percentage will change as well.

Year Ending	2018	2019	2020	2021	2022	2023	2024	2025
Estimated Cumulative Persisting Annual Savings (MWh)	0	7,650	59,994	128,433	201,725	275,006	348,287	421,568
% Cumulative Persisting Annual Savings	0.00%	0.03%	0.21%	0.46%	0.72%	0.98%	1.25%	1.50%
% Cumulative Persisting Annual Savings from Section 8-103B (b-20) of FEJA	0.00%	0.17%	0.17%	0.33%	0.50%	0.67%	0.83%	1.00%

Table 12. VO Plan cumulative savings target percentages compared to FEJA.

6. Voltage Data Collection

For purposes of evaluation, measurement and verification of the VO program, Ameren Illinois will collect voltage data from multiple sources that will be utilized to verify the execution of VO and measure the savings that result from its execution.

As discussed in the EM&V section below, Ameren Illinois will rely on voltage values pre-VO execution and post-VO execution to evaluate the energy savings. The general approach to collecting voltage data will be as follows:

- **Pre-VO Deployment Voltage**
  For pre-VO deployment voltage values, data will be collected based on one of the options listed below in order of priority:
  - AMI Measurement Values: Hourly Averages for each meter on the circuit for the pre-VO deployment.
  - SCADA Measurement Values: Hourly Averages for all SCADA-enabled devices for the pre-VO deployment year.

  Ameren Illinois plans to complete AMI deployment by the end of 2019. Therefore, it is expected that the AMI Measurement Values option for pre-VO deployment voltage data will be the option used after 2020.

  Substations at Ameren Illinois differ in design, configuration and available metering. The sections below provide detail and guidance to the data collection process for the different substation and feeder types.

Substation LTC

Some of Ameren Illinois Distribution substations are fed by an LTC (Load Tap Changer) Transformer. An LTC Transformer has built-in voltage regulators that are used to ensure that distribution feeders provide proper voltage levels to customers. For substations that have LTCs, there are no individual feeder regulators, and the LTC is responsible for providing regulation to downstream feeders.

There are three main types of available data at LTC locations:

1. LTC-Controlled Circuits with AMI deployed
   Data to be collected is the average hourly voltage value for each meter.

2. LTC SCADA – Three-phase Voltage
   Data to be collected from this location is the average hourly voltage value for each phase; then average the three phases into one average reading.

3. LTC SCADA – Bus Voltage
   Data to be collected from this location is the average hourly voltage value.

Voltage Regulators

Unlike substations with LTC Transformers, the majority of Ameren Illinois distribution substations have independent phase voltage regulation for each individual circuit. This is done by having a set of three single-phase voltage regulators that ensure that each circuit phase from the substation provides proper voltage. Unlike substation LTC transformers, Ameren Illinois does not have metering for all circuit voltage regulators. Ameren Illinois will rely on the following methods to collect voltage values:

1. Voltage Regulator Controlled Circuits with AMI deployed
   Data to be collected is the average hourly voltage value for each meter.

2. Voltage Regulator SCADA – Three-phase Voltage
   Data to be collected from this location is the average hourly voltage value for each phase; then average the three phases into one average reading.

- **Post-VO Deployment Voltage**
  For post-VO deployment voltage values, data will be collected based on one of the options listed below in order of priority:
  - AMI Measurement Values: Hourly Averages for each meter on the circuit for the post-VO deployment.
  - SCADA Measurement Values: Hourly Averages for all SCADA-enabled devices on the circuit the post-VO deployment year.

Part of the VO implementation plan is to allow for circuit voltage metering to be captured and collected. It is also part of the VO implementation plan to allow for AMI metering to make interval voltage data available to be collected. These two methods will be used to collect voltage data post-VO deployment.

7. EM&V

Ameren Illinois proposes evaluation, measurement and validation of the VO program benefits, utilizing a continuous operation approach to ensure achievement of the greatest customer benefits. Ameren Illinois considered use of an "on/off' testing approach for every deployed circuit; however, such approaches sacrifice up to half of the customer energy savings that might otherwise be achieved during the testing period. On/off testing subjects voltage regulating equipment to increased number of operations, which reduces the life of these devices. Also, on/off testing requires increased labor resources, due to manipulation and monitoring of the VO control solution, as well as data analysis efforts to assess the operational performance data.

7.1 Savings Evaluation

Energy savings are computed in a manner similar to that outlined above, and is based on the average annual energy use in the 2014-2016 timeframe less energy use by exempt customers. The energy savings from conservation voltage reduction is the product of three key parameters:

$$Energy\ Savings = Annual\ Energy\ Use\ 2014-2016 \cdot CVR_f \cdot \Delta V$$

Where:

- *Annual Energy Use 2014-2016* is the average annual customer energy use over the 2014-2016 timeframe, less energy use by exempt customers.
- CVR_f is the factor which represents the percent change in load for each percent change in voltage
- ΔV is the percent change in voltage as a result of VO implementation

These three items are discussed further below:

Annual Energy Use

Annual energy use is taken as the 2014-2016 annual energy use for each feeder as outlined above and consistent with the direction provided in FEJA that energy reduction is to be measured based on a 2014-2016 baseline.

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CVR Factor

A CVR factor of 0.8 was selected based on the pilot results and survey of industry reported CVR factors.

Voltage Change (ΔV)

The voltage change is the average hourly voltage reduction achieved throughout the initial full year of deployment compared to pre-deployment (i.e., average annual voltage change). Importantly, the average annual voltage change shall be from voltages measured from the same system level (i.e., either customer level (meter) voltages shall be used for both pre- and post-VO voltage measurements or primary SCADA based voltages shall be used for both pre- and post-VO voltage measurements).

Pre Deployment Voltage

Hourly pre-deployment voltages will be captured as described in the section above for one year prior to the enablement of VO on the subject circuits. (Note: the availability of pre-deployment AMI voltages will determine whether AMI voltages can be used to support M&V.)

Missing or zero data points will be removed from the dataset, as such points are not representative of normal system operation (i.e., missing voltages may be due to loss of remote terminal unit communications, resulting in missing periods of data across all measurement types for a particular feeder).

Post Deployment Voltage

Hourly post-deployment voltages will be captured as described in the section above for the initial full year of the enablement of VO on the subject circuits. Note: The post- deployment voltages collected shall align with the locations for the pre-deployment voltages (i.e., if customer meter voltages are used for pre-deployment annual average voltages, customer meter should also be used for post-deployment annual average voltage determination).

Missing, zero and outlying data points will be removed from the dataset, as such points are not representative of normal system operation (i.e., missing voltages may be due to loss of remote terminal unit communications, resulting in missing periods of data across all measurement types for a particular feeder). An overall average annual post deployment voltage will be computed, based on the dataset with missing or zero data points excluded.

Average Annual Voltage Change

The average annual voltage change shall be computed from the difference between the average annual pre-deployment voltage and the average annual post-deployment voltage.

7.2 Ongoing Evaluation, Measurement & Verification Methodology

Consistent with Ameren Illinois' Energy Efficiency programs, Ameren Illinois will use an independent third-party evaluation, measurement, and verification evaluator to review Ameren Illinois' implementation of this plan and confirm estimated savings were achieved. The evaluator will review and confirm the following:

1. The new circuits were deployed with VO in the year reported.
2. The new circuits were appropriately operating for the initial evaluation, measurement, and verification year.
3. The resulting % voltage reduction pre- vs. post-deployment of the newly deployed circuits.
4. The resulting energy savings calculation realized from the newly deployed circuits using the plan approved CVR factor and savings calculation methodology.
5. Circuits deployed and verified in previous years are still in operation.
6. The new cumulative persisting annual savings of all deployed circuits.

Once the voltage reduction is verified for a circuit in its initial-year of operation, and thereby the energy savings is calculated using the plan approved CVR factor, this initial-year proven energy savings is considered to occur the full 15-year life of the VO operation, provided VO continues to be operated on the circuit throughout the entire 15-year life of the program. No subsequent voltage reduction calculations, CVR factor adjustment, or delivered energy verification, will be made on a deployed circuit, once the savings on a circuit has been calculated and verified in its initial year of operation.

As a confirmation that the proven CVR factor of 0.8 is still valid for the VO deployment outlined in this plan, and to further confirm the relationship among typical circuit delivered energy, voltage, and other appropriate parameters, in 2020 Ameren Illinois plans to conduct a test of the CVR factor and other appropriate parameters using appropriate analysis methods on a representative sample of the estimated 130 circuits deployed in 2019. If the resultant CVR factor materially differs from the proven 0.8 factor used in the plan development and implementation to that point, then Ameren Illinois will use the new CVR factor in all engineering and economic analysis related to the plan in all subsequent years beginning in 2021, and resulting energy savings verification in all subsequent years beginning in 2023. Changes to the CVR factor will not change the 15-year deemed savings of circuits already deployed.

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8. Reporting

As outlined in the legislation, Ameren Illinois will provide the utility data to its independent evaluator 30 days after the calendar year. The independent evaluator will have draft evaluations completed by March 15 and circulated to the Stakeholders Advisory Group for comment. These draft evaluations will provide the annual incremental and cumulative persisting savings related to the VO program. Interested stakeholders will be provided a comment period, after which evaluators will review and address. Final evaluations will be delivered no later than April 30. The VO program results will be incorporated into an annual integrated report detailing all Ameren Illinois Efficiency program annual persisting, and annual incremental savings.

9. 2017 / 2018 Detailed Plan

As mentioned above, Ameren Illinois will use the 19 circuits already planned for VO implementation as part of its EIMA Infrastructure Investment Plan as the initial implementation of this VO plan.

In 2017, Ameren Illinois began deployment of VO technologies on 14 of the 19 circuits. Seven of these circuits will be deployed with a Vendor 1 VO control software package. The other seven will be deployed with a second Vendor VO control software package. Table 13 below shows the 14 circuits that are being deployed.

Substation	Circuit	Software
Northwest Ckt 002	B00002	Vendor 1
Northwest Ckt 003	B00003	Vendor 1
Quincy 24th & Cherry Lane Ckt 556	V40533	Vendor 2
Quincy 28th & Adams Ckt 533	V42556	Vendor 2
Limit Ckt 015	D31015	Vendor 1
Ridge Ckt 002	C52002	Vendor 1
Ridge Ckt 001	C52001	Vendor 1
Shelbyville Ckt 500	Y79500	Vendor 2
Charleston S. EIU Ckt 501	K11376	Vendor 1
Bethalto Ckt 377	J34377	Vendor 2
Bethalto Ckt 357	J34357	Vendor 2
Caseyville Gardens Ckt 376	K11376	Vendor 1

Substation	Circuit	Software
E. Belleville Ckt 132	L93132	Vendor 2
Belleville 44th Ckt 140	J83140	Vendor 2

Table 13. Ameren Illinois' 2017 Primary Distribution Volt/VAR Control Infrastructure Investment Program Circuits

An additional 5 circuits will be deployed in 2018 for a total of 19 circuits. The additional 5 circuits will be deployed with a third Vendor VO control software package. These circuits are listed in Table 14.

Substation	Circuit	Software
Quincy 36th & College	V45574	Vendor 3
Quincy 30th & Hampshire	V42572	Vendor 3
Tuscola East	Y98532	Vendor 3
Mt. Zion Rt121	P69173	Vendor 3
Mt. Vernon 27th St	P58155	Vendor 3

Table 14. Ameren Illinois' 2018 Primary Distribution Volt/VAR Control Infrastructure Investment Program Circuits

In 2018, Ameren Illinois will also perform a more detailed engineering assessment of the 19 VO circuits consistent with this proposed VO Plan. The assessment will be used to further determine the circuit enhancement requirements of each circuit. The assessment will include the following:

- Voltage High/Low Study
- Power Factor Correction
- Load Imbalance

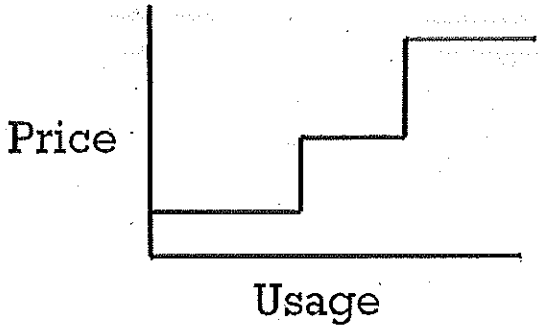
The circuit enhancement work that will result from these studies will be done in 2018. Once the circuit enhancement work is complete for each circuit, VO will start operations and verification of voltage reduction capabilities of each circuit. The three software packages will also be tested to determine which provides the most appropriate solution for full VO deployment. Ameren Illinois will use the chosen software solution for the subsequent circuits deployed as part of this plan.

Based on the Plan, Ameren Illinois is estimating energy savings for the 19 circuits to be 7,650 MWh-yr. This savings is expected to begin during the first full year of operation of these circuits in 2019.

Ameren Illinois will use the learnings from the implementation and initial operation of these 19 circuits to inform the design, deployment, and operation of subsequent circuits deployed as part of the plan.

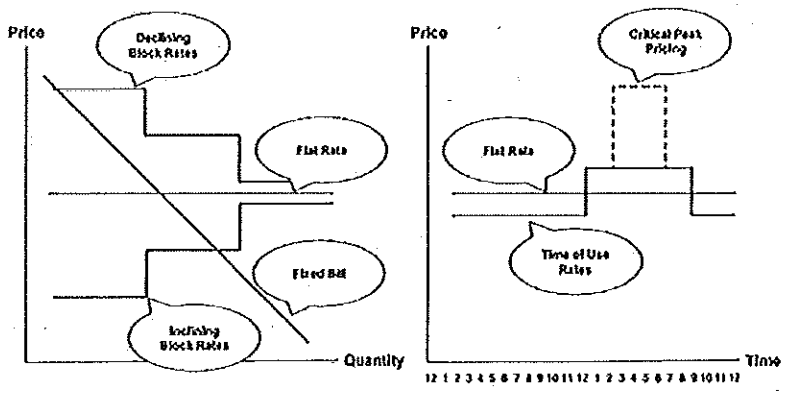
Rate Design:

Residential Electric Inclining Block Rates

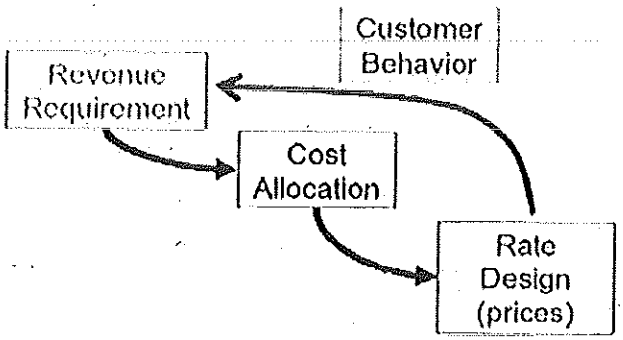


Geoff Marke, Economist
Missouri Office of the Public Counsel

Pricing influences usage



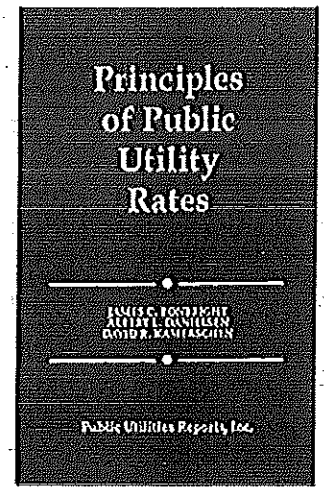
The Feedback Loop



Determine Rate Design Goals

Bonbright Principles

- Efficiency
- Simplicity
- Continuity
- Equity
- Stability



More art than science

- Tradeoffs between principles
- Different conditions between utilities
- Different interpretations of the principles
- Competing policy and/or mandates

- **Positive statements**

  are objective statements that can be tested, amended or rejected by referring to the available evidence.

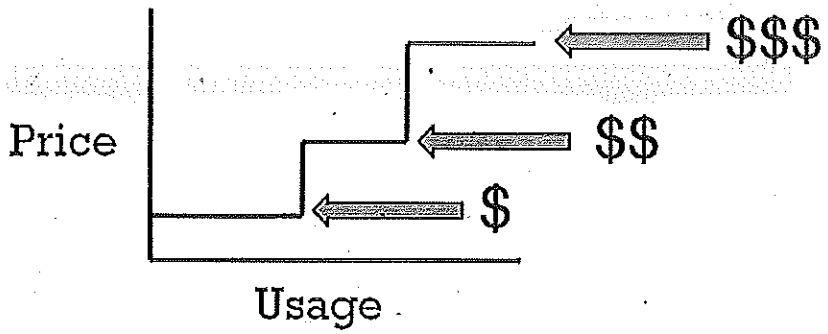
- **Normative Statements**

  expresses a value judgment about whether a situation is desirable or undesirable. It looks at the world as it "should" be.

What is an Inclining Block Rate?

Inclining Block Rates

- The more you use, the more expensive it gets



What does the literature say?

High usage = bigger price elasticity

- As prices increase, less quantity is demanded

TABLE 1 DISTRIBUTION OF RESIDENTIAL PRICE ELASTICITIES

		Low	Most Likely	High
Short Run	Block 1	-0.01	-0.13	-0.20
	Block 2	-0.02	-0.26	-0.39
Long Run	Block 1	-0.03	-0.39	-0.60
	Block 2	-0.06	-0.78	-1.17

Farqui, A. (2008) Inclining Toward Efficiency. The Brattle Group
https://www.fortnightly.com/fortnightly/2008/08/inclining-toward-efficiency

Kansas Corporation Commission Study

Table 5.1: Percentage Changes in Usage by Season and Utility, *SFV*

Utility	Summer	Winter
KCP&L	+3.0%	+1.1%
Westar	+6.8%	+2.5%
Midwest	+4.6%	+2.6%

Straight-Fixed Variable Rate Design Increases Consumption

Table 5.2: Percentage Changes in Usage by Season and Utility, *IBR*

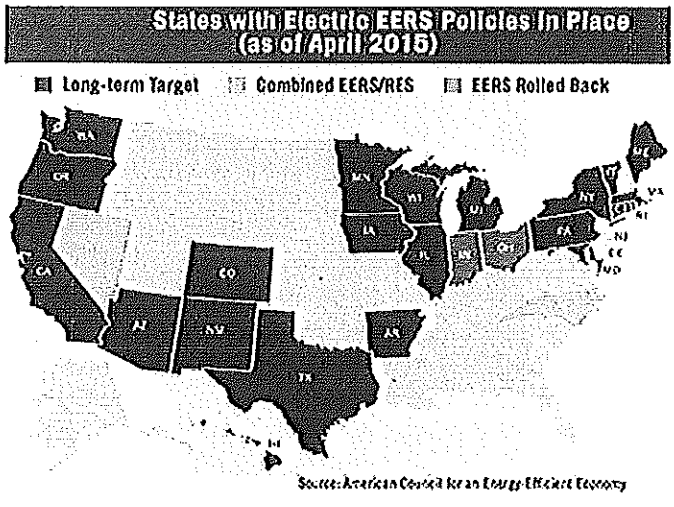
Utility	Summer	Winter
KCP&L	-2.3%	-3.4%
Westar	-0.3%	-3.7%
Midwest	-2.8%	-3.9%

Inclining Block Rate Design Decreases Consumption

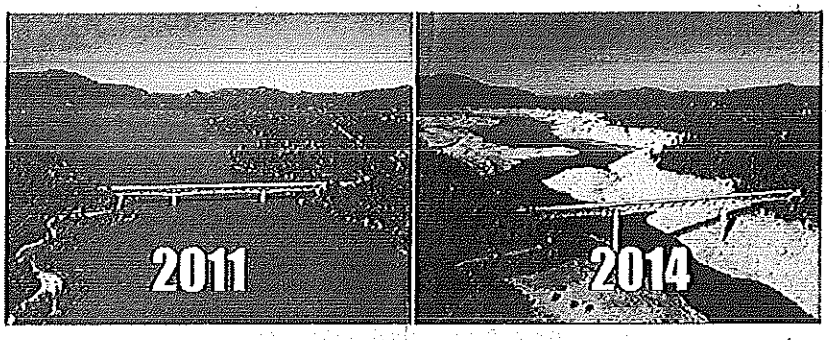
Hansen, D.G. and Michael O Sheasy (2012) Residential Rate Study for Kansas Corporation Commission Final Report.
http://www.kcc.state.ks.us/electric/residential_rate_study_final_20120411.pdf

Policy Rationale
Supporting
Inclining Block Rates

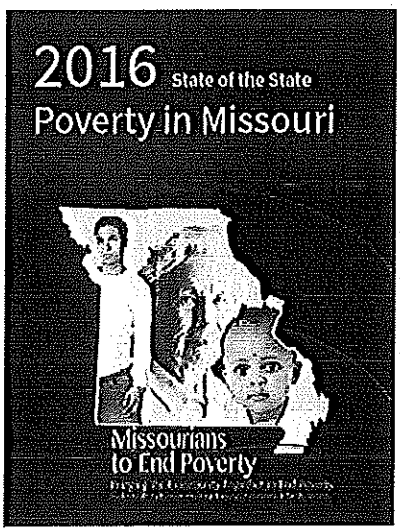
Promote conservation & meet mandates



Resource Crisis



Lifeline Rates



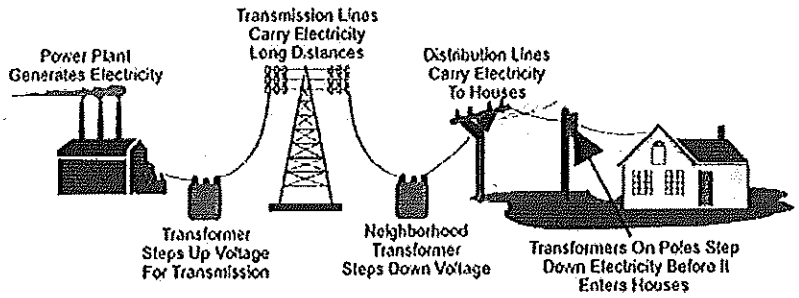
Lifeline Rates Cont…

Figure 2: Characteristics of above-average and below-average Empire residential ratepayers[31]

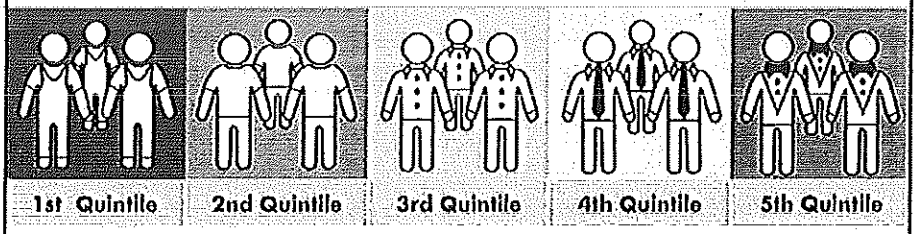
Who uses more energy on average?	Who uses less energy on average?
Homeowners	Renters
Homes with 3+ people living in them	Homes with 1 person living in them
Single-family homes and mobile homes	Multi-family apartments with 5+ units
Homes with more than 3,000 square feet	Homes with less than 1,000 square feet
Homes built 2000-2009 (pre-tornado)	Home built prior to 1970
High-income earning homes ($75K+)	Low-income earning homes (<$35K)

Long-run or social marginal costs

- In the long run, all costs are variable



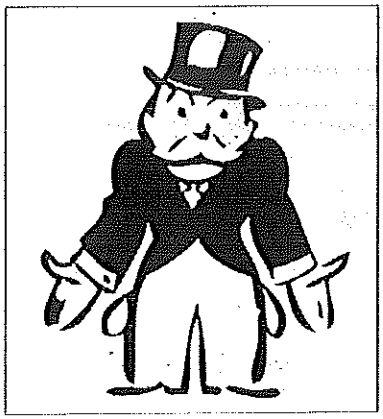
More "equitable" than energy efficiency?



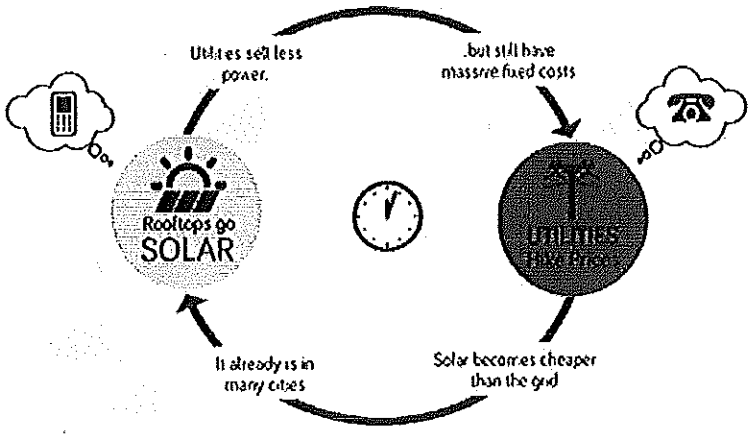
Policy Rationale Against Inclining Block Rates

Revenue Instability

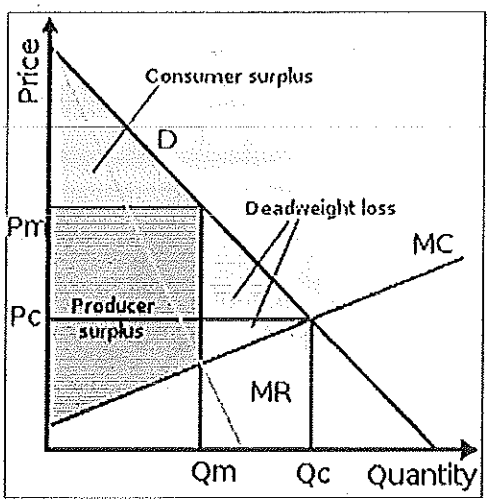
- Natural Monopolies = large fixed costs



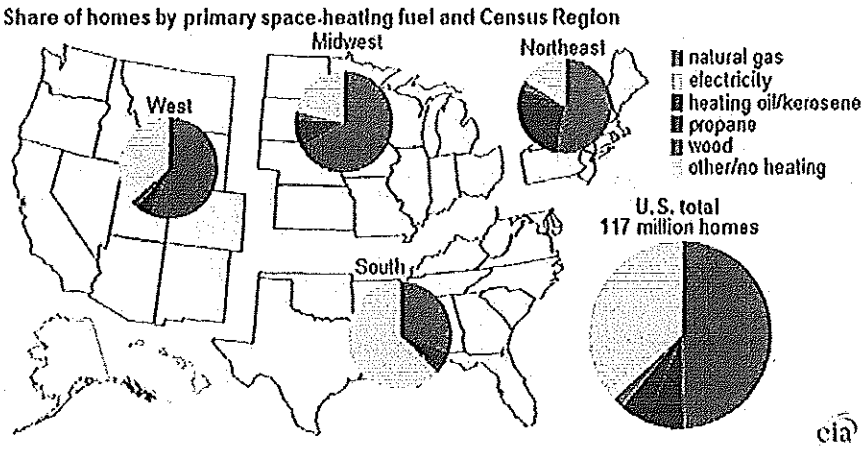
Grid Defection



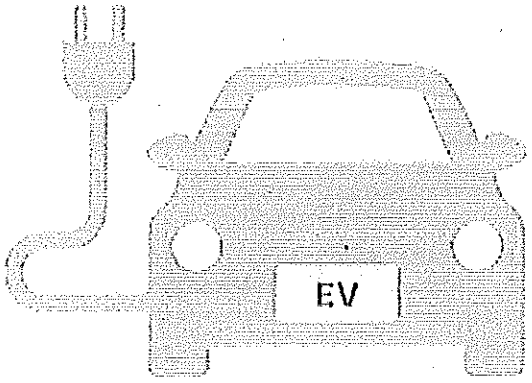
Deadweight Loss



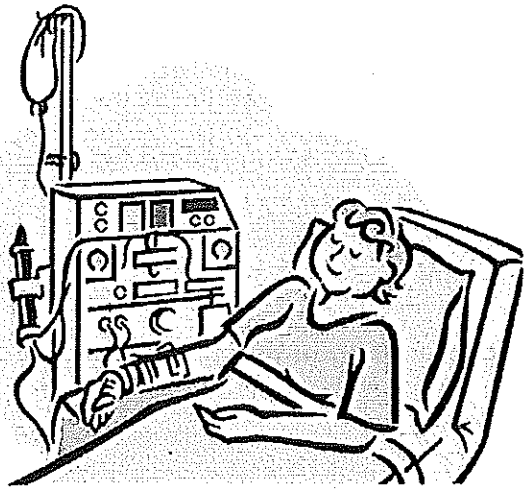
Space Heating



Special Rates



Special rates



Summary

Policy Arguments For:

- Promote conservation and meet mandates
- Resource crisis
- Lifeline rates
  - Low usage, low income
  - Multi-family
- Long-term or social marginal costs
- More equitable than energy efficiency

Policy Arguments Against:

- Revenue Instability
- Deadweight loss
- Grid Defection
- Space Heating
- Special rates
  - (e.g., electric vehicles, medical baseline etc…)

Final Thoughts

Do ratepayers understand this?

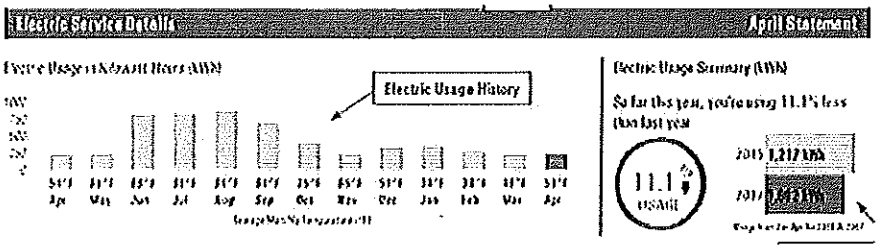
Account Detail

Electric 000011-11-001 For Service at 101 Main Street, Anywhere, PA 11111			Rate: RS Residential
Read For: 09118237 From 10/07/16 to 11/07/16 (29 Days, Curr Read - 13701 Prev Read - 12701, Total Kwh 1,000 Kwh			
11/07/16	Customer Charge	1 x 13.00	$13.00
11/07/16	Usage Charge	600kwhrs x .13005	$78.03
11/07/16	Usage Charge	400kwhrs x .10574	$42.30
11/07/16	Energy Efficiency Program Cost	1000kwhrs x .0001	$0.10
11/07/16	Fuel Adjust Charge	1000kwhrs x .00097	$2.07 CR
11/07/16	Anywhere County Tax	111.18 x .00875	$0.97
		Current Months Charges:	$132.64
11/07/16	AFP Installment		$135.00
		Billed Charges:	$155.00

Contract Update

AFP — Status before payment is $132.64, after payment is $132.36. This account will be reevaluated in October.

Do ratepayers understand this?



Research suggests that

- "In reality, consumers make such decisions with limited information, attention and cognitive abilities."
- "It is quite clear from studies of cellphone pricing and marginal income taxes that consumer understanding of non-linear price schedules varies widely…

- Such understanding seems amenable to education campaigns, though such approaches will still run up against attention and cognition constraints that are likely significant for the vast majority of consumers who don't think like economists, and even for many who do."

Borenstein, S. (2009) To what electricity price do consumers respond? Residential demand electricity under increasing-block pricing. *Energy Institute at Haas.* http://faculty.haas.berkeley.edu/borenste/download/NBER_SI_2009.pdf

And

- "Given the information available to most residential electricity customers in my sample period, the information cost of understanding the marginal price of electricity is likely to be substantial."

Ito, Koichiro (2012) Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing. *Energy Institute at Haas.* https://ei.haas.berkeley.edu/research/papers/WP210.pdf

Recommendations

- Display the rate structure on the consumer's bill in a way that conveys the cost (savings) from increased (decreased) usage.
- Do not raise the (fixed) residential customer charge.

Questions

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