

STATE OF ILLINOIS

ILLINOIS COMMERCE COMMISSION

AMEREN ILLINOIS COMPANY)	
)	
Petition for Approval of)	
Voltage Optimization Plan)	Docket No. 18-0211
Pursuant to Section 8-103B(b-20) of the Public)	
Utilities Act.)	

DIRECT TESTIMONY AND EXHIBITS

OF

MAXIMILIAN CHANG

ON BEHALF OF

THE PEOPLE OF THE STATE OF ILLINOIS

AG Exhibit 1.0C

Originally filed on MARCH 6, 2018
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AG Exhibit 1.1 Resume of Maximilian Chang

1 **I. INTRODUCTION**

2 **Q. PLEASE STATE YOUR NAME, EMPLOYER, AND PRESENT POSITION.**

3 A. My name is Maximilian Chang. I am a Principal Associate at Synapse Energy
4 Economics, Inc., 485 Massachusetts Avenue, Cambridge, MA 02139.

5 **Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS CASE?**

6 A. I am testifying on behalf of the People of the State of Illinois (“the People”), represented
7 by the Office of the Illinois Attorney General (“AG”).

8 **Q. PLEASE DESCRIBE SYNAPSE ENERGY ECONOMICS.**

9 A. Synapse Energy Economics (“Synapse”) is a research and consulting firm specializing in
10 energy and environmental issues, including: electric generation; transmission and
11 distribution system reliability; market power; electricity market prices; stranded costs;
12 efficiency; renewable energy; environmental quality; and nuclear power.

13 **Q. MR. CHANG, PLEASE SUMMARIZE YOUR WORK EXPERIENCE AND**
14 **EDUCATIONAL BACKGROUND.**

15 A. I hold a Master of Science degree from the Harvard School of Public Health in
16 Environmental Health and Engineering Studies, and a Bachelor of Science degree from
17 Cornell University in Biology and Classical Civilizations.

18
19 My experience is summarized in my resume, which is attached as **AG Exhibit 1.1**. I am
20 an environmental engineer and energy economics analyst who has analyzed energy
21 industry issues for more than seven years. In my current position at Synapse Energy
22 Economics, I focus on economic and technical analysis of many aspects of the electric
23 power industry, including, but not limited to: (1) utility reliability performance and

1 distribution investments; (2) nuclear power; (3) wholesale and retail electricity markets;
2 (4) energy efficiency and demand response alternatives; and (5) impacts of utility
3 mergers and acquisitions.

4 **Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

5 A. My testimony responds to the testimony of Ameren Illinois Company (“Ameren” or “the
6 Company”) witnesses Michael Abba, who presents the Company’s voltage optimization
7 plan (“VO Plan”) objectives and components; and Ameren consultant Andrew Cottrell,
8 who describes the cost-effectiveness analysis and evaluation process used in the Ameren
9 VO Plan. My testimony will emphasize the importance of programs that reduce energy
10 bills for low-income customers and recommends that the Commission order the
11 Company to prioritize low-income communities as part of the implementation of any
12 Illinois Commerce Commission (“Commission”) approved VO Plan. In addition, I will
13 discuss recommended changes to Ameren’s VO evaluation plan.

14

15 **II. RECOMMENDATIONS AND FINDINGS**

16

17 **Q. PLEASE SUMMARIZE YOUR FINDINGS AND RECOMMENDATIONS.**

18 A. I make the following findings and recommendations:

- 19 • Under the Illinois Public Utilities Act and the Illinois Energy Efficiency Policy
20 Manual, Ameren is required to implement energy efficiency programs that benefit
21 low-income customers. Ameren’s VO Plan, which would enable the delivery of
22 electricity on a more efficient basis, currently makes no discernible effort to prioritize
23 the delivery of the deemed benefits that result from voltage optimization investments
24 to low income customers – the customer group that typically struggles more than

1 other customers to afford essential utility service and who stand to benefit most from
2 the more efficient delivery of electricity.

- 3 • While the Company concludes that its overall program is cost-effective, I find the
4 Total Resource Cost (“TRC”) benefit-cost ratio of the 621 circuits in the Company’s
5 20 top Tier One (low income) communities to be 1.85, as compared with Ameren’s
6 computed overall average of the circuit-specific ratio for the 1,047 circuits of 1.88.
7 The comparability of the Tier One community and VO plan ratios makes clear that
8 investment in low income communities will deliver significant benefits to
9 communities with primarily economically challenged customers.
- 10 • If it approves Ameren’s voltage optimization plan, the Commission should direct
11 Ameren to sequence its implementation of voltage optimization on cost-effective
12 circuits serving low-income customers first, so that the low-income customers will
13 benefit from the energy savings provided by the VO plan as quickly as possible.
- 14 • The Commission should order Ameren to provide the Commission with updated
15 Conservation Voltage Reduction (“CVR”) factors based on installed circuits in order
16 to ensure the Company’s assumption of a constant CVR factor of 0.8 is reasonable
17 and that future program designs are based on accurate data. The analysis and
18 updating of CVR values should begin within 90 days of the date of the Commission’s
19 order. The Commission should direct Ameren to apply the results of those
20 evaluations to the deemed CVR factor value to better inform any modifications and/or
21 adjustments that might be needed to ensure overall cost-effectiveness of the VO Plan
22 and an accurate assessment of energy savings achieved annually. In that regard, the
23 Commission should further direct Ameren to use the 0.8 CVR factor for planning
24 purposes, but utilize actual CVR factors verified through evaluation for purposes of

1 computing annual energy savings performance. As such, the Company's proposal to
2 suspend the evaluation and utilize the assumed or deemed 0.8 CVR factor until 2023
3 should be rejected.

4 It should be noted that the fact that I do not comment on every aspect of the proposed
5 Plan should not be interpreted as agreement with issues or approaches not addressed.

6 **III. AMEREN'S PROPOSED VOLTAGE OPTIMIZATION PLAN**

7 **Q. PLEASE DEFINE THE CONCEPT OF VOLTAGE OPTIMIZATION IN YOUR**
8 **TESTIMONY.**

9 A. For the purposes of my testimony, we will adhere to the Company's definition of voltage
10 optimization (VO):

11 Ameren Illinois defines Voltage Optimization ("VO") as a combination of
12 Volt/Volt-Ampere Reactive ("VAR") Optimization ("VVO") and
13 Conservation Voltage Reduction ("CVR"), which are implemented to first
14 reduce the VAR flows on a circuit, and then lower the voltage to reduce end-
15 use customer energy consumption and utility distribution system losses. VVO
16 optimizes capacitor bank operations to improve power factor and reduce
17 system losses. CVR utilizes voltage regulators, transformer load tap changers,
18 and capacitors to control and reduce end-user voltages, which, in turn, lowers
19 customers' energy consumption.¹

20
21 Voltage optimization encompasses the Company's operating transformer load tap-
22 changers, line voltage regulators, and capacitor banks that can adjust voltage along a
23 distribution circuit and compensate load power factor.² Coordinating volt-var control
24 devices can achieve voltage profiles that meet the utility's operational objectives,
25 including energy delivery efficiency, power quality, and reliability.^{3 4}

¹ Ameren Ex. 1.1, page 3. (January 25, 2018).

² Department of Energy. *Energy Efficiency in Distribution Systems Impact Analysis Approach*. November 30, 2011. Slide 7. Available at https://www.smartgrid.gov/files/Distribution_System_Energy_Efficiency_17Nov11.pdf, hereafter DOE (2011).

³ DOE (2011).

1 As noted above, the Company defines voltage optimization as consisting of two aspects:
2 Volt/Var Optimization (VVO) and Conservation Voltage Reduction (CVR). Generally,
3 CVR allows the utility to shift feeder voltage from the upper half of voltage requirements
4 (i.e. 120 to 127 volts) to the lower half (113 to 120 volts).

5
6 Using CVR functionality to lower distribution voltages can result in energy savings,
7 without causing customer voltages to fall below minimum operating limits.⁵ Ameren's
8 Plan⁶ correctly notes that voltage optimization measures are included in the overall "energy
9 efficiency" definition in the Illinois Power Agency Act, and described as "measures that
10 optimize the voltage at points on the electric distribution voltage system and thereby reduce
11 electricity consumption by electric customers' end-use devices." 20 ILCS 3855/1-10.
12 Importantly, the resulting voltage optimization and corresponding energy reduction
13 would not result in customers experiencing any changes in service since the voltage
14 optimization occurs along the distribution line before the customer's meter. In addition,
15 line losses are reduced. At the same time, consumers would benefit by using and paying
16 for fewer kilowatt hours of electricity.

17 **Q. HAVE UTILITIES INVESTIGATED VOLTAGE OPTIMIZATION**
18 **GENERALLY?**

19 A. Yes. Utilities have recognized the benefits of managing voltage for many years. In the
20 early 1990s researchers recognized that voltage management could be a means of

⁴ var: voltage-ampere reactive. At a high level, var is the apparent power flowing through reactive load. This power results from current being out of phase with voltage.

⁵ DOE (2011).

⁶ Ameren VO Plan at 3.

1 reducing energy usage.⁷ While voltage reduction is an emergency method to shed load in
2 MISO,⁸ daily management of voltage across feeders is now possible and used by a
3 number of utilities across the country. In recent years, voltage management studies have
4 been updated to extrapolate potential nationwide energy savings.⁹ A National Rural
5 Electric Cooperative Association (NRECA) study based on data from rural electric
6 cooperatives with distribution automation technology found that CVR results in net
7 savings for customers by lowering overall bills, even though rates increased as a result of
8 the investment in CVR.¹⁰

9 **Q. DOES AMEREN HAVE THE ABILITY TO REDUCE VOLTAGE FOR ITS**
10 **DISTRIBUTION SYSTEM CURRENTLY?**

11 A. Yes. The Company has the ability to reduce voltages on its system in the event of
12 unplanned emergency events.¹¹ This is not within the scope of the Company's proposed
13 voltage optimization plan nor the issue of the testimony. I raise this fact to merely point
14 out that voltage reduction may be temporarily, albeit bluntly, applied across the Company
15 system in its current state. At issue, is finding the appropriate technologies and
16 investments to implement voltage optimization where prudent on the Company's system
17 in a more controlled and systematic manner so that the Company can deliver less wasted

⁷ <http://www.osti.gov/scitech/servlets/purl/5402531/>.

⁸ MISO Market Capacity Emergency. SO-P-EOP-00-002 rev: 3. Page 27. Available at <https://www.misoenergy.org/api/documents/getbymediaid/96737>

⁹ Schneider, KP. et al. *Evaluation of Conservation Voltage Reduction (CVR) on a National Level*. July 2010. Available at http://www.pnl.gov/main/publications/external/technical_reports/PNNL-19596.pdf.

¹⁰ National Rural Electric Cooperative Association, Cooperative Research Network. *Costs and Benefits of Conservation Voltage Reduction CVR Warrants Careful Examination Final Report*. May 2014. Page 16.

¹¹ Ameren Illinois Company d/b/a Ameren Illinois Electric Service Schedule III.C.C. No.1. 2nd Revised Sheet No. 3. Original Sheet No. 3.059. Paragraph K. Available at <https://www.ameren.com/-/media/rates/files/illinois/aiel3otctc.ashx>.

1 electricity to low-income customers – the customers most in need of lower electricity
2 costs -- by controlling voltage.

3 **Q. WHAT DOES THE PUBLIC UTILITIES ACT REQUIRE OF THE COMPANY**
4 **WHEN IT COMES TO VOLTAGE OPTIMIZATION INVESTMENTS?**

5 **A.** Recently enacted Section 8-103B(b-20) of the Illinois Public Utilities Act (“the Act”)
6 requires Ameren to “file a plan with the Commission that identifies the cost-effective
7 voltage optimization investment the electric utility plans to undertake through December
8 31, 2024.”¹² After notice and hearing, the Commission “shall approve or approve with
9 modification the plan within 120 days after the plan's filing and, in the order approving or
10 approving with modification the plan, the Commission shall adjust the applicable
11 cumulative persisting annual savings goals set forth in subsection (b-15) to reflect any
12 amount of cost-effective energy savings approved by the Commission that is greater than
13 or less than the following cumulative persisting annual savings values attributable to
14 voltage optimization for the applicable year:

- 15 (1) 0.0% of cumulative persisting annual savings for the year
- 16 ending December 31, 2018;
- 17 (2) 0.17% of cumulative persisting annual savings for the year
- 18 ending December 31, 2019;
- 19 (3) 0.17% of cumulative persisting annual savings for the year
- 20 ending December 31, 2020;
- 21 (4) 0.33% of cumulative persisting annual savings for the year
- 22 ending December 31, 2021;
- 23 (5) 0.5% of cumulative persisting annual savings for the year
- 24 ending December 31, 2022;
- 25 (6) 0.67% of cumulative persisting annual savings for the
- 26 year ending December 31, 2023;
- 27 (7) 0.83% of cumulative persisting annual savings for the year
- 28 ending December 31, 2024; and

¹² 220 ILCS 5/8-103B(b-20).

1 (8) 1.0% of cumulative persisting annual savings for the year
2 ending December 31, 2025.”¹³
3

4 I note that the new provisions also permit the State’s two largest electric utilities to earn a
5 return through amortization of energy efficiency program expense, and additional
6 shareholder profits through an energy efficiency formula rate incentive mechanism that
7 rewards achievement of energy savings that exceed the Commission-approved energy
8 savings targets.¹⁴
9

10 Section 8-103B(f) of the Act requires Ameren to file a four-year energy efficiency plan,
11 commencing on January 1, 2018, designed to achieve specific cumulative persisting
12 annual savings (CPAS) goals through implementation of energy efficiency measures for
13 all eligible customers in its service territory¹⁵:

- 14 (1) 7.4% CPAS for the year ending December 31, 2018;
15 (2) 8.2% CPAS for the year ending December 31, 2019;
16 (3) 9.0% CPAS for the year ending December 31, 2020;
17 (4) 9.8% CPAS for the year ending December 31, 2021;
18

19 The annual CPAS goals continue incrementally, culminating in a 16% CPAS for the year
20 ending December 31, 2030.¹⁶ ComEd, too, must file a four-year plan, but has
21 significantly higher annual savings goals, that culminate in a 21.5% CPAS for the year
22 ending December 31, 2030.¹⁷ It should be noted that the Illinois statute specifically

¹³ 220 ILCS 5/8-103B(b-20).

¹⁴ See 220 ILCS 5/8-103B(g)(7), (7.5), (8).

¹⁵ Pursuant to Section 8-103B(1), customers whose total highest 15-minute energy usage demand exceeds 10 megawatts (“MW”) are ineligible for participation in the statutory energy efficiency programs. In ComEd’s service territory, customers whose total highest 30-minute energy usage demand exceeds 10 megawatts (“MW”) are similarly ineligible for participation. 220 ILCS 5/8-103B(1).

¹⁶ 220 ILCS 5/8-103B(b-15).

¹⁷ 220 ILCS 5/8-103B(b-5).

1 permits Illinois' two largest electric utilities to include the VO Plan savings as part of the
2 energy savings needed to achieve these statutory goals.¹⁸

3 **Q. PLEASE SUMMARIZE YOUR UNDERSTANDING OF THE COMPANY'S**
4 **PROPOSED VO PLAN.**

5 A. The Company's proposed voltage optimization program has identified 1,047 circuits,
6 covering 64% of its customers in its service territory, that are cost-effective. The
7 Company has indicated that the benefit-cost ratio is 1.36 for the 1,047 circuits. The
8 estimated cost of Ameren's program is \$122 million.¹⁹

9 **Q. DO THE 1,047 CIRCUITS REPRESENT ALL OF AMEREN'S CIRCUITS?**

10 A. No, as indicated in Mr. Abba's testimony, Ameren included only circuits below 20 kV in
11 its analysis pool, which consists of 2,474 circuits.²⁰ Ameren then commissioned Applied
12 Energy Group, Inc. ("AEG") to conduct a TRC analysis on this pool of circuits, which
13 identified the 1,047 cost-effective circuits.

14 **Q. DOES AMEREN CHARACTERIZE THE BENEFITS OF ITS VOLTAGE**
15 **OPTIMIZATION PLAN?**

16 A. Yes, Ameren witness Cottrell stated that the lifetime savings associated with the 1,047
17 circuits would result in CPAS energy savings of 421,568 MWh.²¹ However, Ameren
18 Exhibit 2.1 and the electronic version provided in Ameren's response to CUB data
19 request 2.07 do not provide a quantification of the benefits of either specific circuits or
20 the overall VO plan. Given the limited time available and the Company's responses to
21 date, I have not been able to independently verify the Company's savings estimates or

¹⁸ 220 ILCS 5/8-103B(b-20).

¹⁹ Ameren Exhibit 2.0 at 6:133. Table 12 of Exhibit 1.1 notes the CPAS in 2025 to be 421,568 MWh.

²⁰ Ameren Exhibit 1.0 at 11:243-246.

²¹ Ameren Exhibit 2.0 at 6:133.

1 benefit calculations. As I discuss later in my testimony, the Company's CVR factor
2 directly impacts the quantity of energy saved by the VO plan and thus links to the
3 Company's quantification of benefits attributed to the VO plan.
4

5 **IV. LOW-INCOME CUSTOMERS AND AMEREN'S PROPOSED VOLTAGE**
6 **OPTIMIZATION PLAN**

7
8 **Q. PLEASE SUMMARIZE YOUR CONCERNS ABOUT WHETHER THE**
9 **PROPOSED VO PLAN WILL BENEFIT LOW-INCOME CUSTOMERS IN**
10 **AMEREN'S SERVICE TERRITORY.**

11 A. According to the Company's Plan and discovery responses issued in this case, locations
12 identified as Tier One Communities serve as a proxy for geographic areas serving
13 Ameren's low-income customers. The Company defines Tier One Communities as
14 communities that are predominantly single-family, more than 50% low-income, and
15 generally do not participate in the Company's energy efficiency programs. Ameren's VO
16 Plan, however, makes no effort to prioritize these communities for order of deployment
17 of VO investment, where a majority of customers who struggle most to pay electric
18 utility and other bills reside. Moreover, Ameren makes no attempt to identify the
19 location of low-income customers that are not categorized within the Tier One
20 communities.

21 **Q. DOES AMEREN'S VO PLAN EXTEND THE BENEFITS OF VOLTAGE**
22 **OPTIMIZATION TO LOW INCOME CUSTOMERS?**

23 A. Ameren includes low-income customers only indirectly; the Company indicates that the
24 1,047 circuits determined by AEG to be cost-effective encompass 64 percent of

1 Ameren’s customers.²² Ameren witness Abba’s testimony states that the energy savings
2 attributable to the voltage optimization program would benefit customers in the top 20
3 Tier One communities within its service territory, which would thereby benefit low-
4 income customers residing in those communities.²³ Mr. Abba indicates that the data is
5 not available to determine exact matches of the customers of the 1,047 circuits to the
6 customers in the top 20 Tier One communities or those whose incomes fall below the
7 poverty level.²⁴ That said, Mr. Abba’s testimony does not explicitly quantify the number
8 of low-income customers that could benefit from the Company’s voltage optimization
9 program. In Table 8 of Ameren Exhibit 1.1, the Company *does* estimate the number of
10 customers below the poverty line²⁵ in the top 20 Tier One communities.²⁶ The number
11 appears to be 106,791 low-income customers. In his testimony, Mr. Abba indicates that
12 the proposed VO Plan has the intention of providing shared benefits to all customers
13 where the circuits are found to be cost-effective.²⁷

14
15 However, this observation ignores the fact that Ameren’s low-income population is
16 significantly larger than those residing in Tier One communities. Ameren’s own 2018
17 Energy Efficiency Plan filed with the Commission last year noted that approximately
18 41% of Ameren Illinois residential customers are classified as low income under the
19 definition used by the Illinois Weatherization Assistance Program (“IWAP”), which is
20 equivalent to a household income of \$49,200 for a family of four. The Company stated

²² Ameren Exhibit 1.0 at 12:251-252.

²³ *Id.* at 12:255-257.

²⁴ *Id.* at 12:254-256.

²⁵ Poverty line references customers whose annual incomes fall at or below 150% of the federal poverty level.

²⁶ Ameren Ex. 1.1, Table 8, page 20.

²⁷ Ameren Ex. 1.0 at 12:258-260.

1 in its energy efficiency filing that “[t]hese customers are at increased risk of financial
2 hardship due to increases in their energy costs and other market conditions, and have
3 limited discretionary income to invest in energy efficiency improvements.”²⁸

4

5 **Q. DOES AMEREN SPECIFICALLY DEFINE A TIER ONE COMMUNITY IN ITS**
6 **PETITION?**

7 A. No, the definition is found in an Ameren reference dated December 28, 2017 to an
8 Opinion Dynamics memorandum.²⁹ Specifically, Table 6 of the Opinion Dynamics
9 memorandum defines Tier One as: “Low-income communities, mostly single-family
10 areas that are underserved by residential programs.”³⁰ The Opinion Dynamics report
11 further characterizes Tier One communities as having:

- 12 • Over 50 percent low-income households;
- 13 • Less than 10 percent multi-family households;
- 14 • Less than 10 percent of households participating in previous
15 energy efficiency programs.³¹

16

17 The Opinion Dynamics report estimates that the Tier One communities represent
18 approximately 10% percent of Ameren’s customers, or approximately 106,000 of
19 Ameren’s total 1.06 million electric residential customers.³² As noted above, this is
20 significantly less than the 41% total low-income population, or 434,600³³ Ameren
21 electric customers, that Ameren identified in its energy efficiency filing. Table 6 in the
22 report also describes Tier Two and Three communities, which represent an additional 19

²⁸ ICC Docket No. 17-0311, Ameren Ex. 1.1 (Ameren 2018 Energy Efficiency Plan), at 12.

²⁹ Abba DWP-1 AIC PY9 HEIQ Evaluation Report Final Draft 2017-12-28.pdf

³⁰ Abba DWP-1. Table 6, page 12.

³¹ *Id.*

³² *Id.*

³³ $0.41 * 1,060,000 = 434,000$.

1 percent of Ameren’s customers. I note that Ameren’s petition does not mention the
2 inclusion of Tier Two or Three community benefits, nor does Ameren reference other
3 categories such as low-income multifamily customers. Thus, the Company’s reference to
4 Tier One communities apparently represents only a subset of the low-income customers
5 within Ameren’s service territory. In other words, there are many more low-income
6 customers served by Ameren that are not specifically targeted to benefit from the
7 Company’s proposed voltage optimization program currently planned and submitted to
8 the Commission for approval.

9 **Q. HOW MANY LOW-INCOME CUSTOMERS DOES THE VO PLAN PROPOSE**
10 **TO SERVE?**

11 A. Ameren identified 1,047 cost-effective circuits throughout its service territory, including
12 circuits that serve the top 20 Tier One communities.³⁴ The Plan does not specify the
13 percentage of each Tier One community served by cost-effective circuits, the estimated
14 number of low-income customers by circuit, or the total number of low-income
15 customers served. Instead, the Company only provides a summary of the top 20 Tier One
16 communities in its service territory and states that circuits that are part of the VO Plan
17 would serve these communities. The Company states that it does not have the data
18 available to determine an exact match between the 1,047 circuits and low-income or Tier
19 One communities.

20 **Q. GIVEN THIS LIMITED INFORMATION, WHAT STEPS DID YOU TAKE TO**
21 **FURTHER ANALYZE THE PLAN TO IDENTIFY COST-EFFECTIVE**
22 **CIRCUITS SERVING LOW-INCOME CUSTOMERS IN THE AMEREN**
23 **SERVICE TERRITORY?**

³⁴ Ameren Exhibit 2.1.

1 A. I conducted an analysis that matched low-income customer counts, circuit zip codes, and
2 the Company-identified top 20 Tier One communities. I recognize that circuits may
3 serve multiple zip codes, communities may contain multiple zip codes, and zip codes will
4 have residents of different economic strata. Nonetheless, I believe that the results of my
5 analysis should be used to focus the Company’s obligations to serve additional low-
6 income customers through its VO plan.

7 **Q. PLEASE SUMMARIZE YOUR FINDINGS.**

8 A. I find that the average Total Resource Cost (“TRC”) ratio for implementation of voltage
9 optimization for the 621 circuits associated with the 20 Tier One communities is 1.85
10 based on data from workbooks titled “Poverty Status Past 12 Months” (Abba DWP 5),
11 “Circuit Customer Count Zip Codes” (Abba DWP 4), and Ameren’s response to CUB
12 data request 2.07. The VO plan proposed by the Company has an overall 1.36 benefit-
13 cost ratio versus the *circuit-specific* ratio for the 1,047 circuits of 1.88. The VO Plan
14 program level ratio includes fixed capital costs, and fixed annual operations and
15 maintenance expenses not included in the circuit specific TRC ratios. Table 1
16 summarizes the average TRC results for each top 20 Tier One community identified by
17 the Company.³⁵

³⁵ TRC test is defined under 20 ILCS 3855/1-5

1

Table 1: Tier One Communities Summary³⁶

Tier One Communities	Cost-Effective Circuits (Average TRC = 1.85)		
	Total Number of Customers	Estimated Number of LI Customers	Average TRC
Alton	4,958	1,616	1.32
Belleville	37,490	7,300	1.72
Bloomington	28,353	6,983	1.98
Carbondale	7,590	4,208	1.59
Centralia	4,874	1,672	1.66
Danville	11,316	4,141	2.31
Decatur	29,202	9,086	1.77
East Saint Louis	1,457	786	2.57
Galesburg	13,674	4,867	1.62
Granite City	6,777	1,914	2.45
Jacksonville	9,798	2,510	2.57
Marseilles	3,719	964	1.66
Monmouth	3,340	1,090	2.48
Mount Vernon	5,381	1,531	1.53
Olney	3,105	916	1.32
Ottawa	9,584	2,123	2.43
Peru	330	62	1.32
Quincy	12,022	3,103	1.72
Salem	1,222	304	1.49
Springfield	6,600	1,420	1.46

2

3

4 **Q. WHAT METHODOLOGY DID YOU USE TO CALCULATE THE TOTAL NUMBER**
5 **OF CUSTOMERS, THE ESTIMATED NUMBER OF LOW-INCOME**
6 **CUSTOMERS, AND THE TRC VALUES IN TABLE 1?**

7 A. To calculate the total number of customers served by each Tier One community, I
8 summed the customer count provided in the workbook “Circuit Customer Count Zip
9 Codes” for the cost-effective circuits with zip codes in each community. I estimated the
10 number of low-income customers at the circuit level by multiplying the customer count

³⁶ Note: Sources for Table 1 are the attachments provided by Ameren Illinois in its response to CUB data request 2.07, Abba DWP Exhibit 5, and Abba DWP Exhibit 4.

1 by the zip code-specific ratio of the population below 150% of the poverty level to the
2 total population provided in Mr. Abba's DWP-4 workpaper.^{37,38} I then summed the
3 results for each community. To get the average TRC values, I matched the feeder
4 numbers and substation identifications for cost-effective circuits to each Tier One
5 community using the common zip codes. For each community, I averaged the TRCs for
6 all feeders, accounting for feeder counts of greater than 1.0 where applicable.³⁹

7 **Q. WHAT DOES THIS ANALYSIS TELL YOU ABOUT AMEREN'S SELECTION**
8 **OF CIRCUITS AND THE PRIORITIZATION OF COMMUNITIES FOR THE**
9 **INSTALLATION OF VOLTAGE OPTIMIZATION INFRASTRUCTURE?**

10 A. My analysis shows that the circuit-level benefits for the 621 circuits that serve the top 20
11 Tier One communities are similar to the overall circuit level VO plan benefits. This
12 indicates that the Company could prioritize the deployment of its VO plan on the 621
13 Tier One communities and achieve benefits consistent with its proposed plan. This
14 prioritization would provide energy savings benefits to an underserved and financially
15 challenged customer class first.

16 **Q. WHY SHOULD AMEREN PRIORITIZE VOLTAGE OPTIMIZATION FOR**
17 **CIRCUITS CONTAINING HIGH CONCENTRATIONS OF LOW-INCOME**
18 **CUSTOMERS?**

19 A. First, low-income customers face a disproportionate home energy burden. In Illinois,
20 customers at or below 150% of the poverty level typically pay 8 to 28% of their annual

³⁷ The estimated number of low-income customers is based only on the population demographics of the entire zip code. The calculation is meant to be illustrative.

³⁸ I compared the population below the poverty level provided in the workbook "Poverty Status Past 12 Months" with the population below the poverty level provided in Exhibit 1.1. Eight of the twenty communities had a different quantity between the two sources. My estimate of low-income customers was based on the workbook "Poverty Status Past 12 Months."

³⁹ Ideally, I would have summed the total benefits and total costs for each feeder to produce an accurately weighted TRC for each community, however the discovery responses from Ameren did not provide the complete information to quantify circuit specific benefits.

1 income on home energy bills.⁴⁰ A reduction in energy bills will have the greatest benefit
2 for low-income customers. A successful voltage optimization project will provide
3 benefits to low-income customers by lowering their energy usage without any further
4 action by the customers.

5
6 Ameren also benefits by prioritizing circuits that serve low-income customers. Ameren's
7 classification of Tier One communities highlights the low penetration of participation in
8 the Company's programs. Voltage optimization may reduce energy usage for customers
9 less likely to save through other energy efficiency programs. Ameren has stated that a
10 primary objective for the 2018 budget is "[m]aximizing expenditures for hard-to-reach
11 sectors such as low-income and small business."⁴¹ Prioritizing VO investments in these
12 communities will serve this objective while simultaneously benefitting these customers.

13 **Q. DOES ILLINOIS STATE LAW REQUIRE AMEREN TO CONDUCT VOLTAGE**
14 **OPTIMIZATION?**

15 A. Yes, although I am not an attorney, I am advised by counsel that Public Act 99-0906
16 requires Ameren to submit a voltage optimization program for approval. The Act
17 requires Ameren to submit a voltage optimization plan for Commission approval as part
18 of its required achievement of cumulative persisting annual energy savings goals.

19 Specifically, the Act states:

20 Within 270 days after the effective date of this amendatory Act of the 99th
21 General Assembly, an electric utility that serves less than 3,000,000 retail
22 customers but more than 500,000 retail customers in the State shall file a
23 plan with the Commission that identifies the cost-effective voltage

⁴⁰ Fisher, Sheehan & Colton, "The Home Energy Affordability Gap 2016: Illinois Fact Sheet."

⁴¹ Keith Martin, "Ameren Illinois Presentation to SAG."

1 optimization investment the electric utility plans to undertake through
2 December 31, 2024.⁴²
3

4 It is my understanding that the Company's petition in this docket is the Company's
5 response to the aforementioned filing requirement under Public Act 99-0906.

6 **Q. IS VOLTAGE OPTIMIZATION CONSIDERED ENERGY EFFICIENCY UNDER**
7 **ILLINOIS STATUTE?**

8 A. Yes, under Public Act 99-0906 the definition of energy efficiency includes the following
9 addition:

10 [E]nergy efficiency includes voltage optimization measures that optimize
11 the voltage at points on the electric distribution voltage system and
12 thereby reduce electricity consumption by electric customers' end use
13 devices.⁴³
14

15 **Q. DOES THE PUBLIC UTILITIES ACT INCLUDE PROVISIONS REGARDING**
16 **LOW-INCOME CUSTOMERS?**

17 A. Yes, I am advised by counsel that the Public Utilities Act ("the Act") differentiates low-
18 income customers from the other sectors. The Act states that low-income programs do
19 not need to meet the cost-effectiveness standards applied to residential, commercial, or
20 industrial programs through the Total Resource Cost test⁴⁴, and that utilities should
21 prioritize the implementation of low-income programs.⁴⁵

22 **Q. HOW DOES THE ACT DEFINE LOW-INCOME CUSTOMERS?**

⁴² Public Act 99-0906 (b-20).

⁴³ Public Act 99-0906, 20 ILCS 3855/1-10 (*Definitions*).

⁴⁴ Illinois Power Agency Act (20 ILCS 3855/1-10); Public Utilities Act (220 ILCS 5/8-103B(a); 220 ILCS 5/8-104(b)).

⁴⁵ 220 ILCS 5/8-103B.

1 A. Section 8-103B(c) of the Act categorizes customers with income at or below 80% of the
2 median income, or 150% of the federal poverty level, as low-income customers.⁴⁶

3 **Q. ARE THERE MINIMUM SPENDING LEVELS FOR ENERGY EFFICIENCY**
4 **PROGRAMS THAT BENEFIT LOW-INCOME CUSTOMERS?**

5 A. Yes, The Illinois Energy Efficiency Policy Manual (Version 1.1) recommends that
6 Program Administrators deliver “programs to moderate-low income populations in order
7 to help foster the affordability of utility service”.⁴⁷

8 **Q. GIVEN THESE DIRECTIVES AND THE ASSOCIATED BENEFITS THAT**
9 **LOW-INCOME CUSTOMERS STAND TO GAIN THROUGH VO**
10 **INVESTMENTS IN CIRCUITS THAT SERVE LOW INCOME CUSTOMERS,**
11 **WHAT DO YOU RECOMMEND?**

12 A. I recommend that Ameren prioritize the installation of voltage optimization in Tier One
13 communities consistent with its stated objectives, since the program can claim energy
14 savings for low-income customers without additional program marketing and community
15 engagement. In addition, I recommend that the Commission order Ameren to investigate
16 voltage optimization opportunities for low-income customers outside of its definition of
17 Tier One communities, given what the data shows about the substantial number of low
18 income customers in Ameren’s service territory who would benefit from VO
19 infrastructure installations. The Commission’s order should require Ameren to prioritize
20 these circuits for planned and future VO installations.

21

⁴⁶ 220 ILCS 5/8-103B(c); 220 ILCS 5/8-104(f)(4); 220 ILCS 5/8-104(f)(4).

⁴⁷ The Policy Manual Version 1.1 was created by the SAG to incorporate updates to the Future Energy Jobs Act in 2017. More information is available in ICC Docket No. 17-0270 and at <http://www.ilsag.info/illinois-ee-policy-manual.html>; EE Stakeholder Advisory Group, “Illinois Energy Efficiency Policy Manual Version 1.1 - A Manual Guiding the Operation of Illinois Energy Efficiency Programs,” 13.

1 **V. CVR FACTOR**

2 **Q. PLEASE DEFINE CVR FACTOR.**

3 A. Electric utilities use the term “CVR factor” to identify the load-to-voltage sensitivity of
4 an electrical device, circuit, or system as in the case of this petition.

5 **Q: WHY IS THE CVR FACTOR IMPORTANT?**

6 A. Quite simply, the Company’s CVR factor determines the amount of savings associated
7 with its proposed VO plan. The Company’s proposed CVR factor of 0.8 means that the
8 Company anticipates a savings of 0.8 percent in energy consumption for a 1 percent
9 decline in voltage. A CVR factor of 0.6 would mean that a one percent decline in voltage
10 would result in a 0.6 percent decline in energy consumption. As a result, the higher the
11 CVR factor, the more in expected energy savings. Conversely, a lower CVR factor
12 would mean lower energy usage savings.

13 **Q. WHAT ARE THE IMPLICATIONS OF OVERSTATING OR UNDERSTATING**
14 **THE FORECASTED ENERGY SAVINGS ASSOCIATED WITH VOLTAGE**
15 **OPTIMIZATION CVR FACTORS GIVEN THE ACT’S INCENTIVE PAYMENT**
16 **OPPORTUNITIES UNDER SECTION 8-103B(g) FOR EXCEPTIONAL ENERGY**
17 **SAVINGS PERFORMANCE?**

18 A. An overestimate of a deemed CVR factor would provide the Company with more energy
19 savings than what would be actually observed. The “overestimated” energy savings
20 would then be factored into the incentive mechanism described under Sections 8-103B(g)
21 (7.5), (8). This could result in allowing the Company to achieve a higher return on equity
22 on its energy efficiency investments than is actually deserved.

23 **Q. WHAT IS THE CVR FACTOR PROPOSED BY THE COMPANY?**

1 A. The Company is proposing to use a CVR factor of 0.8 based on the results of its 2012–
2 2013 pilot project and a review of CVR factors reported by other utilities.⁴⁸

3 **Q. IS THIS SIMILAR TO CVR FACTORS USED BY OTHER ILLINOIS**
4 **UTILITIES?**

5 A. Yes. In 2014, Commonwealth Edison Company (“ComEd”) reported a range of voltage
6 optimization factors across its customer classes based on a feasibility study conducted by
7 AEG in 2014.⁴⁹ The 2014 AEG report used the term voltage optimization factor to
8 represent “a per unit change in energy to per unit change in average annual voltage.”
9 This is consistent with Ameren’s terminology of CVR factor.⁵⁰ ComEd’s analysis used a
10 global voltage optimization factor of 0.753, which is about 6 percent lower than
11 Ameren’s factor of 0.8.⁵¹

12 **Q WHAT DOES THE COMPANY PROPOSE IN ORDER TO UPDATE DEEMED**
13 **CVR FACTORS?**

14 A. The Company plans to conduct a test of the CVR factor in 2020 based on a representative
15 sample of 130 circuits deployed in 2019.⁵² Based on the results of the verification study,
16 the Company will use updated CVR factors for planning purposes beginning in 2021 and
17 for energy savings verification in 2023.⁵³

18 **Q. DO YOU HAVE CONCERNS WITH THIS PROPOSED APPROACH TO**
19 **EVALUATION OF DEEMED CVR FACTORS?**

⁴⁸ Ameren Exhibit 1.1. at page 14.

⁴⁹ Applied Energy Group. *Voltage Optimization (VO) Feasibility Study Task 10- Final Report*. December 17, 2014. Table 15. Page 45. Available at <http://blogs.edf.org/energyexchange/files/2015/04/ComEd-study.pdf> (hereinafter “AEG 2014 Report”).

⁵⁰ AEG 2014Report at page 45.

⁵¹ AEG 2014 Report at page 99.

⁵² Ameren Exhibit 1.1 at page 29 and Ameren’s response to data request CUB 2.03.

⁵³ *Id.*

1 **A,** Yes, I do. I am concerned that the timing of the evaluation may be too late to provide
2 meaningful information to the Commission at the beginning of this program and for
3 purposes of reconciling actual energy savings achieved from VO measures annually.

4 **Q. IS THE COMPANY UNDERTAKING THE INSTALLATION OF VOLTAGE**
5 **OPTIMIZATION IN ITS SERVICE TERRITORY CURRENTLY?**

6 A. Yes, Ameren had planned to install voltage optimization technologies in 19 circuits as
7 part of its Energy Infrastructure Modernization Act Investment Plan, which it now
8 proposes to be the initial implementation of the voltage optimization plan.⁵⁴ The
9 Company states that it has installed voltage optimization technologies in 14 circuits in
10 2017 and plans to install voltage optimization technologies in the remaining five circuits
11 in 2018. Ameren has indicated that it will use the 19 circuits to assess voltage high/low,
12 power factor corrections, and load imbalance.⁵⁵ In fact, Ameren states: “Ameren Illinois
13 will use the learnings from the implementation and initial operation of these 19 circuits to
14 inform the design, deployment, and operation of subsequent circuits deployed as part of the
15 plan.”⁵⁶

16 **Q. DOES THE COMPANY PLAN TO TEST CVR FACTORS ON THE 19**
17 **CIRCUITS?**

18 A. The Company does not make any explicit statement that CVR factors will be evaluated
19 on the 19 circuits.

20 **Q WHY IS IT IMPORTANT TO REQUIRE THE COMPANY TO UPDATE**
21 **DEEMED CVR ESTIMATES WITH ACTUAL DATA?**

⁵⁴ Ameren Ex. 1.1 at page 30.

⁵⁵ *Id.* at page 31.

⁵⁶ *Id.* at page 31.

1 A. It is my understanding that Ameren can still earn the same return on its unamortized energy
2 efficiency spending asset if it achieves savings that are less than 100% of the Commission-
3 established energy savings goal. Specifically, Ameren can achieve the same return it would
4 have earned if it achieved above 84.4% of its modified goal up to 100% of its established
5 goal.⁵⁷ Below 84.4%, the Company loses 8 basis points for every percentage point below
6 84.4% of its goal with a maximum possible reduction of 200 basis points through 2025. On
7 the other hand, if Ameren exceeds 100% of its goal, including modified goals, it receives an
8 increased return that evenly apportions 200 basis points between 100% of its modified goal
9 and 125% of its unmodified goal.⁵⁸ The incentive structure to reward overachievement
10 should not afford the Company the opportunity to overestimate actual VO savings by using a
11 potentially inflated CVR factor. Accordingly, it is important to require regular, timely
12 updates of CVR deemed estimates to ensure that customers are not paying for increased
13 returns on unsubstantiated CVR deemed savings figures.

14 **Q. WHAT IS YOUR RECOMMENDATION?**

15 A. Given that the Company has already deployed voltage optimization in 14 circuits, the
16 Company should be directed to begin evaluating these completed circuits. The
17 Commission should order Ameren to provide the Commission with updated CVR factors
18 based on installed circuits in order to ensure the Company's assumption of a constant
19 CVR factor of 0.8 is reasonable and that future program designs are based on accurate
20 data. The analysis and updating of CVR values should begin within 90 days of the date
21 of the Commission's order. The Commission should direct Ameren to apply the results
22 of those evaluations to the deemed CVR factor value to better inform any modifications
23 and/or adjustments that might be needed to ensure overall cost-effectiveness of the VO

⁵⁷ 220 ILCS 5/8-103B(g)(7.5)(A)(i)

⁵⁸ *Id.*; 220 ILCS 5/8-103B(g)(8)(ii).

1 Plan and an accurate assessment of energy savings achieved annually. In that regard, the
2 Commission should further direct Ameren to use the 0.8 CVR factor for planning
3 purposes, but utilize actual CVR factors verified through evaluation for purposes of
4 computing annual energy savings performance.

5 **VI. RECOMMENDATIONS AND CONCLUSIONS**

6 **Q. PLEASE SUMMARIZE YOUR FINDINGS AND RECOMMENDATIONS.**

7 A. I make the following findings and recommendations:

- 8 • Both the Public Utilities Act and the Illinois Energy Efficiency Policy Manual require
9 Ameren to implement energy efficiency programs that benefit low-income customers.
- 10 • I find the benefit-cost ratio of the 621 circuits in the Company's Tier One
11 communities to be 1.85. This value is consistent with the circuit-specific ratio of 1.88
12 for 1,047 circuits in the Company's VO plan. The comparability of the Tier One
13 community and VO plan ratios makes clear that investment in low income
14 communities will deliver significant benefits to communities with primarily
15 economically challenged customers. Ameren's VO Plan, which would enable the
16 delivery of electricity on a more efficient basis, currently makes no discernible effort
17 to prioritize the delivery of the deemed benefits that result from voltage optimization
18 investments to low income customers – the customer group that typically struggles
19 more than other customers to afford essential utility service and who stand to benefit
20 most from the more efficient delivery of electricity.
- 21 • The Commission should order Ameren to modify its voltage optimization plan to
22 prioritize cost effective investment in communities that have the greatest percentage
23 of low-income customers. I recommend that Ameren prioritize the installation of

1 voltage optimization in Tier One communities to the benefit of its low-income
2 customers. In addition, I recommend that the Commission order Ameren to
3 investigate voltage optimization opportunities for low-income customers outside of
4 its definition of Tier One communities and order Ameren to prioritize these circuits
5 for planned and future VO installations.

- 6 • The Commission should order Ameren to provide the Commission with updated CVR
7 factors based on installed circuits in order to ensure the Company's assumption of a
8 constant CVR factor of 0.8 is reasonable and that future program designs are based on
9 accurate data. The analysis and updating of CVR values should begin within 90 days
10 of the date of the Commission's order. The Commission should direct Ameren to
11 apply the results of those evaluations to the deemed CVR factor value to better inform
12 any modifications and/or adjustments that might be needed to ensure overall cost-
13 effectiveness of the VO Plan and an accurate assessment of energy savings achieved
14 annually. In that regard, the Commission should further direct Ameren to use the 0.8
15 CVR factor for planning purposes, but utilize actual CVR factors verified through
16 evaluation for purposes of computing annual energy savings performance.

17
18 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

19 A. Yes.

20