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MISSOURI PUBLIC SERVICE COMMISSION

UNION ELECTRIC COMPANY

d/b/a

AMEREN MISSOURI

CASE NO. ER-2014-0258

DIRECT TESTIMONY

OF

ALEX SCHROEDER

ON

BEHALF OF

MISSOURI DEPARTMENT OF ECONOMIC DEVELOPMENT

DIVISION OF ENERGY

DOE Exhibit No. 707
Date 2-23-15 Reporter KF
File No. ER-2014-0258

(Non-Proprietary)
Jefferson City, Missouri
December 19, 2014

(Rate Design)

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BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Union Electric Company d/b/a Ameren Missouri's Tariffs to Increase Its Revenues for Electric Service	)))	ER-2014-0258

AFFIDAVIT OF ALEX SCHROEDER

STATE OF MISSOURI)
) ss
COUNTY OF COLE)

Alex Schroeder, of lawful age, being duly sworn on his oath, deposes and states:

1. My name is Alex Schroeder. I work in the City of Jefferson, Missouri, and I am employed by the Missouri Department of Economic Development as a Planner III, Division of Energy.
2. Attached hereto and made a part hereof for all purposes is my Direct Testimony on behalf of the Missouri Department of Economic Development – Division of Energy.
3. I hereby swear and affirm that my answers contained in the attached testimony to the questions therein propounded are true and correct to the best of my knowledge.

Alex Schroeder

Alex Schroeder

Subscribed and sworn to before me this 19th day of December, 2014

Kay A. Johannpeter

Notary Public

KAY A. JOHANNPETER NOTARY NOTARY PUBLIC SEAL STATE OF MISSOURI

My commission expires:

KAY A. JOHANNPETER
Notary Public - Notary Seal
STATE OF MISSOURI
Cole County
My Commission Expires: Aug. 4, 2015
Commission # 11561967

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I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Alex Schroeder. My business address is 301 West High Street, Suite 720, PO Box 1766, Jefferson City, Missouri 65102.

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

A. I am employed by the Missouri Department of Economic Development - Division of Energy (DE) as a Planner III - Senior Energy Policy Analyst.

Q. Please describe your educational background and employment experience.

A. In 2008 I graduated from the University of Evansville in Evansville, Indiana with a B.S. in business economics. In 2009 I obtained an M.A. in economics from Fordham University in New York City. And in 2014, I graduated from the University of Missouri - Columbia with a Ph.D. in agricultural economics.

I have been employed by DE since January, 2014. Prior to that, I was employed by the Manhattan Institute in Washington, D.C. as a research associate. During my doctoral studies, I was employed on a part-time basis by the Department of Personal Financial Planning and the Department of Agricultural and Applied Economics as a graduate assistant and a research assistant, respectively.

Q. Have you previously filed testimony before the Missouri Public Service Commission on behalf of DE or any other party?

A. No.

II. PURPOSE AND SUMMARY OF TESTIMONY

Q. What is the purpose of your direct testimony in this proceeding?

A. The purpose of my testimony is to:

a) Briefly define and describe Combined Heat and Power (CHP);

b) List and detail the various benefits associated with CHP;

c) Present an overview of the extent to which CHP systems have been adopted in Ameren Missouri's service territory;

d) Explain how the rate and provisions in Ameren Missouri's Supplementary Service Rider (Rider E) operate and may unduly discourage the uptake of CHP; and

e) Outline how Rider E should be revised to better align the treatment of CHP with the rate principles of cost-causation and nondiscrimination.

In preparation of this testimony, I reviewed a number of guides, white papers, and reports about CHP and standby rates. I also reviewed four different parts of Ameren Missouri's tariffs: a) Small Primary Service Rate, b) Large Primary Service Rate, c) Rider E, and d) Miscellaneous Charges. All references are cited in the footnotes below.

III. OVERVIEW OF CHP AND ITS BENEFITS

Q. What is Combined Heat and Power (CHP)?

A. The EPA defines CHP (also known as cogeneration) as an integrated energy system - located near the energy user - that simultaneously generates electricity from a single fuel source and captures the resultant heat, much of which would otherwise be wasted. This captured heat can then be used to further generate electricity, or can be utilized for thermal energy. Almost three quarters of CHP units in the United States are powered by natural gas (biomass, process wastes, and coal power the rest). The overwhelming majority (almost 90 percent) of U.S. CHP capacity is installed at industrial facilities. However, CHP is potentially applicable beyond industrial contexts in commercial or institutional facilities as well. CHP can function either as a replacement or supplement for other energy sources.[1]

A CHP system can be categorized according to its prime mover, which powers the electricity generator.[2] In the U.S., five types of prime movers make up 99 percent of installed CHP capacity and 97 percent of CHP sites: reciprocating engines, gas turbines, and boiler/steam turbines, microturbines, and fuel cells. Each of these technologies comes with its own set of advantages and disadvantages in measures of emissions, maintenance costs, efficiency, reliability, ease of use, etc.[3]

CHP systems can be further categorized as either "topping cycle" or "bottoming cycle". In a "topping cycle" system, electricity is generated by means of a prime mover, in which some form of fuel is combusted. Heat associated with this process - which would otherwise be lost - is then captured to provide useful thermal energy. In a "bottoming cycle" system, the heat generated from an existing industrial process is used to generate electricity via a prime mover. CHP is considerably more efficient than separate heat and power (SHP), often reaching efficiency levels between 60 and 80 percent, compared to the 45 percent efficiency of SHP.[4] This greater efficiency of CHP stems from two factors: 1) CHP installations capture and make use of waste heat, and 2) CHP units are located near the point at which the energy is consumed, thereby limiting losses associated with

[1] This paragraph draws on two sources: 1) EPA, "Combined Heat and Power Partnership, Basic Information". (http://www.epa.gov/chp/basic/index.html). Accessed November 17th, 2014; and 2) EPA, "Combined Heat and Power: A Clean Energy Solution", August 2012. (http://www.epa.gov/chp/documents/clean_energy_solution.pdf). Accessed November 18th, 2014.

[2] Center for Sustainable Energy, "Combined Heat and Power". (http://energycenter.org/self-generation-incentive-program/business/technologies/chp). Accessed November 20th, 2014.

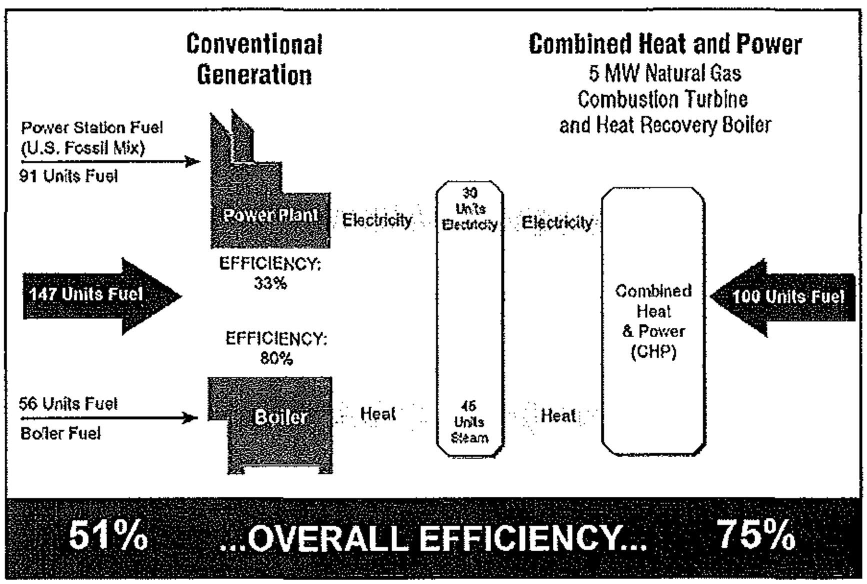
[3] EPA, "Combined Heat and Power Partnership: Catalog of CHP Technologies", September, 2014. Guide authored by Ken Darrow, Rick Tidball, James Wang, and Anne Hampson. (http://www.epa.gov/chp/documents/catalog_chptech_full.pdf). Accessed December 2nd, 2014.

[4] This forgoing draws on: 1) EPA, "Combined Heat and Power Partnership, Combined Heat and Power: Frequently Asked Questions". (http://www.epa.gov/chp/documents/faq.pdf). Accessed November 20th, 2014; and 2) Center for Sustainable Energy, "Combined Heat and Power". (http://energycenter.org/self-generation-incentive-program/business/technologies/chp). Accessed November 20th, 2014.

the transmission and distribution of power.[5] Note here that efficiency is calculated by dividing units of energy output by units of energy input.

Figure 1 below provides an illustration of CHP's efficiency relative to SHP. In this particular example, assuming the existence of a power plant operating at 33 percent efficiency and a boiler operating at 80 percent efficiency, 147 units of energy would be the necessary input to yield 75 units of output with SHP. By comparison, the efficiency advantage of CHP makes it possible to obtain the same energy output for approximately two-thirds (i.e., 100 units) of the fuel input.

Figure 1: Efficiency Comparison Between CHP and SHP[6]



[5] International Energy Agency, "Combined Heat and Power: Evaluating the Benefits of Greater Global Investment". (http://www.iea.org/publications/freepublications/publication/chp_report.pdf). Accessed November 20th, 2014.
[6] EPA, "Combined Heat and Power Partnership: Efficiency Benefits". (http://www.epa.gov/chp/basic/efficiency.html) Accessed December 4th, 2014.

According to the EPA, the two most common types of CHP configurations are a gas turbine/engine with a heat recovery unit and a steam boiler with a steam turbine.[7] Figures 2 and 3 below illustrate how each of these configurations operates.

Figure 2: Gas Turbine or Engine with Heat Recovery Unit[8]

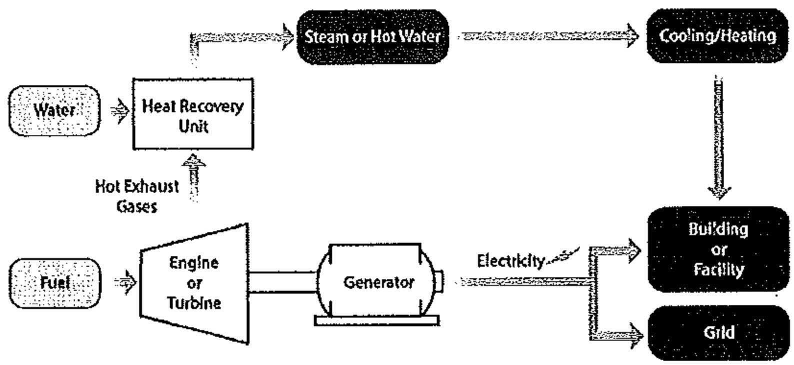
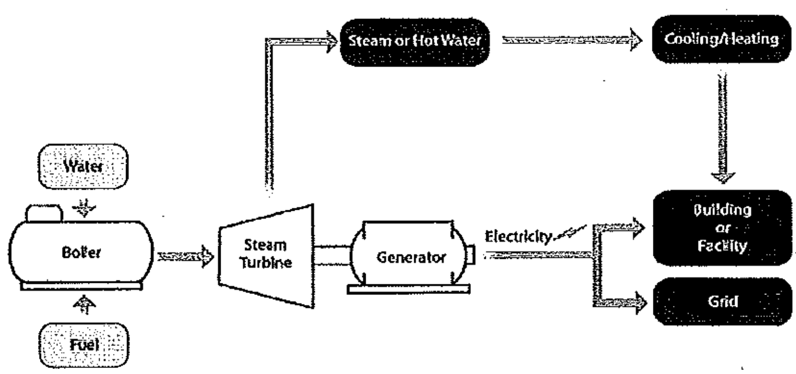


Figure 3: Steam Boiler with Steam Turbine[9]



There are in reality a variety of CHP technologies[10]; the forgoing figures are included here to simply provide readers with concrete examples of how CHP systems could function.

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[7] EPA, "Combined Heat and Power Partnership: Basic Information". (http://www.epa.gov/chp/basic/index.html). Accessed December 5th, 2014.
[8] Ibid.
[9] Ibid.

Q. Are there any benefits associated with CHP systems?

A. Yes. There are a number of benefits that make CHP an attractive option to satisfy Missouri's energy needs. These can be broadly categorized as economic benefits, environmental benefits, and security benefits. While these benefits can be placed into different categories, many of them are interrelated and they all stem from the status of CHP as an efficient and decentralized means of energy production. In recognition of these benefits, a number of states have policies to encourage the uptake of CHP. The American Council for an Energy-Efficient Economy (ACEEE), as part of its State Energy Efficiency Scorecard, calculates an annual index to capture each state's policies toward CHP (at present, Massachusetts and Connecticut have the highest CHP scores at 4.5/5).[11] At the federal level, CHP's myriad benefits motivated President Obama's Executive Order - Accelerating Investment in Industrial Energy Efficiency - that set a national goal to increase industrial CHP capacity by 40 gigawatts (GW) before 2021.[12] This Executive Order represented the most high-profile of policymakers' recent efforts to promote the uptake of CHP.

Q. What are the economic benefits?

A. One of the key economic benefits of CHP is a direct result of greater efficiency, which translates into less energy use and expenditures. The savings associated with reduced energy consumption represents the creation of real wealth; that is, resources previously s spent on energy are now freed up for other purposes. The precise level of savings will be

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[10] EPA, "Combined Heat and Power Partnership: CHP Technologies, Catalog of CHP Technologies". (http://www.epa.gov/chp/technologies.html). Accessed December 9th, 2014.
[11] ACEEE, "The State Energy Efficiency Scorecard". (http://aceee.org/state-policy/scorecard). Accessed December 10th, 2014. Missouri's score was 0/5.
[12] White House, "Executive Order - Accelerating Investment in Industrial Energy Efficiency", August 30th, 2012. (http://www.whitehouse.gov/the-press-office/2012/08/30/executive-order-accelerating-investment-industrial-energy-efficiency). Accessed December 5th, 2014.

a function of a variety of factors, including prevailing prices for "on-grid" electricity and/or thermal energy, the cost of the fuel that is used to power the CHP unit, and the capital, operating, and maintenance costs associated with the unit. Apart from energy savings for the entity with the CHP unit, the technology also has the potential to be a cost-competitive means of new electricity generation, though the specifics here are, as above, contingent on a number of time- and location-specific variables.[13]

Further, because CHP constitutes stand-alone, decentralized energy production, entities with CHP units are to some extent insulated from power outages that result from natural disasters, human error, cyber-attack[14], or other causes. This provides a degree of stability and enables the CHP-using entity to continue operating as before. In recent history, this benefit was perhaps most evident during Hurricane Sandy, where a number of facilities in the impacted area were able to maintain power with their CHP systems (e.g., Danbury Hospital, South Oaks Hospital, the College of New Jersey, Princeton University, and New York University, among others), while 8.5 million customers had none.[15] [16]

To offer just a few concrete examples of CHP's resiliency, during Superstorm Sandy the Public Interest Data Center in New York City remained fully operational with its CHP unit, the installation of which was prompted by the 2003 blackouts in New York. The Sikorsky Aircraft Corporation's CHP system (in Stratford, Connecticut) also remained in

[13] EPA, "Combined Heat and Power: A Clean Energy Solution", August 2012. (http://www.epa.gov/chp/documents/clean_energy_solution.pdf). Accessed December 2nd, 2014.
[14] The recent high-profile cyber-attack allegedly conducted by North Korea may have been a forerunner to attacks on the American energy grid: Reuters, "For North Korea's Cyber Army, Long-Term Target may be Telecoms, Utility Grids", December 19th, 2014. Article authored by Ju-Min Mark and Jack Kim. (http://www.reuters.com/article/2014/12/19/us-sony-cybersecurity-northkorea-idUSKBN0JX0JW20141219). Accessed December 19th, 2014.
[15] American Counsel for an Energy-Efficient Economy, "How CHP Stepped Up When the Power Went Out During Hurricane Sandy", December 6th, 2012. Article authored by Anna Chittum. (http://www.aceee.org/blog/2012/12/how-chp-stepped-when-power-went-out-d). Accessed December 1st, 2014.
[16] ICF International, "Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities", March, 2013. Report authored by Anne Hampson, Tom Bourgeois, Gavin Dillingham, and Isaac Panzarella. (http://energy.gov/sites/prod/files/2013/11/f4/chp_critical_facilities.pdf). Accessed December 5th, 2014.

operation during the Storm. With its CHP system, Louisiana State University in Baton Rouge, Louisiana was able to maintain power supply to critical areas of campus during Hurricane Gustav in 2008. And the Twentynine Palms Marine Corps Air Ground Combat Center in Twentynine Palms, California has weathered numerous grid outages while maintaining power to four critical load circuits with its CHP system.[17]

While an uninterrupted power supply made possible by CHP clearly offers economic benefits, it should be borne in mind that these benefits are not solely economic. There are other, non-economic reasons (e.g., security, health) associated with a resilient power supply. Which of these are more pronounced in a given instance will depend on the nature of the facility in question.

CHP utilization also protects one from the vicissitudes of electricity prices and/or the prices of fuel needed to produce thermal energy. By insulating itself from unpredictable variations in energy costs, a business or industrial concern, hospital, university, or the like can better plan for the future. This is not an insignificant consideration. In certain contexts, unforeseen fluctuations in energy costs can be just as disruptive as absolute levels of such costs. Because a CHP unit must be powered by some type of fuel, absent some form of hedging mechanism, there is a certain degree of risk associated with fuel price volatility. However, it bears mentioning that CHP also affords the host a degree of flexibility on what kind of fuel can be used: "Certain CHP technologies and applications are well equipped to provide a flexible response to changing local fuel opportunities,

[17] Ibid.

enabling CHP owners to respond more directly to changing price signals in fuel markets."[18]

In essence, the economic benefits of CHP can essentially be summed up as *savings* and *stability*.[19]

Q. What are the environmental benefits?

A. The environmental benefits of CHP units result directly from their greater efficiency vis-à-vis SHP. This enhanced efficiency renders it possible to obtain the same energy output for less input. And as a consequence of less fuel input, potentially noxious emissions such as carbon dioxide, nitrogen oxides, and sulfur dioxide, are reduced.[20] While the environmental benefits are not necessarily distinct from those associated with energy efficiency programs and renewables, they are significant and are often cited as a key reason to adopt the technology.

The scale of its energy- and emission-saving potential is considerable: According to the U.S. Department of Energy (DOE), increasing CHP capacity by 40 GW by 2020 will save one quadrillion Btu of energy (1 percent of all U.S. energy use) and reduce carbon dioxide emissions by 150 million metric tons annually.[21] In another DOE publication, it is calculated that providing a fifth of U.S. electricity via CHP by 2030 will save approximately 5.3 quadrillion Btu of fuel each year, which is equivalent to half of all

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[18] American Council for an Energy-Efficient Economy, "How Electric Utilities Can Find Value in CHP", July 18th, 2013. White Paper authored by Anna Chittum. (http://www.aceee.org/white-paper/electric-utilities-and-chp). Accessed December 4th, 2014. (Quotation from page 8).
[19] Benefits listed under this section derived from EPA, "Combined Heat and Power Partnership: Economic Benefits". (http://www.epa.gov/chp/basic/economics.html). Accessed December 1st, 2014.
[20] EPA, "Combined Heat and Power Partnership: Environmental Benefits". (http://www.epa.gov/chp/basic/environmental.html). Accessed December 2nd, 2014.
[21] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Benefits of Combined Heat and Power". (http://www.energy.gov/eere/amo/benefits-combined-heat-and-power). Accessed December 3rd, 2014.

energy currently used by American households each year. Further, achieving this goal is estimated to reduce annual carbon dioxide emissions over 800 million metric tons.[22] As concrete examples, consider ExxonMobil's 470 megawatt (MW) CHP system in Beaumont, Texas. This system operates at 88 percent efficiency, and as a result uses 37 percent less fuel than what would be required with SHP. This greater efficiency, in turn, reduces carbon dioxide emissions by approximately 2.4 million tons annually.[23] Consider also the CHP unit at the Sikorsky Aircraft Corporation referenced above; this system reduces greenhouse gas emissions by over 8,900 tons annually, which is equivalent to removing 1,600 passenger vehicles from the roads each year.[24] Reduced emissions are rightly viewed as a positive end in itself: The benefits of such to the environment and human health are palpable and well-documented. However, these environmental considerations are particularly important in the current regulatory context. It has been demonstrated that CHP can play an integral role in achieving cost-effective compliance with the EPA's forthcoming 111(d) standards.[25] [26] Moreover, some have recognized that CHP has the potential to play a role in achieving compliance with the EPA's Boiler Maximum Achievable Control Technology regulations.[27] Therefore, CHP

[22] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Combined Heat and Power: A Decade of Progress, A Vision for the Future". (http://www.energy.gov/sites/prod/files/2013/11/f4/chp_accomplishments_booklet.pdf). Accessed December 5th, 2014.
[23] EPA, "Combined Heat and Power Partnership: Efficiency Benefits". (http://www.epa.gov/chp/basic/efficiency.html). Accessed December 4th, 2014.
[24] Cogeneration and On-Site Power Production, "Sikorsky Powers Up CHP System in Connecticut", October 19th, 2011. By Dr. HeatherJohnstone. (http://www.cospp.com/articles/2011/10/sikorsky-powers-up-chp-system-in-connecticut.html). Accessed December 5th, 2014.
[25] Center for Clean Air Policy, "Report: Expanding the Solution Set: How Combined Heat and Power can Support Compliance with 111(d) Standards for Existing Power Plants", May 2014. Report authored by Stacey Davis and Thomas Simchak. (http://ccap.org/assets/CCAP-Expanding-the-Solution-Set-How-Combined-Heat-and-Power-Can-Support-Compliance-with-111d-Standards-for-Existing-Power-Plants-May-2014.pdf). Accessed December 2nd, 2014.
[26] American Council for an Energy-Efficient Economy, "How Electric Utilities Can Find Value in CHP", July 18th, 2013. White Paper authored by Anna Chittum. (http://www.aceee.org/white-paper/electric-utilities-and-chp). Accessed December 4th, 2014.
[27] ICF International, "From Threat to Asset - How CHP Can Benefit Utilities", July 23rd, 2014. White paper authored by Anne Hampson and Jessica Rackley. (http://www.icfi.com/insights/white-papers/2014/how-chp-can-benefit-utilities). Accessed December 5th, 2014.

should not only be viewed as an important means to directly protect the environment, natural and human. It also achieves the corollary purpose of facilitating compliance with salient environmental regulations.

Q. What are the security benefits?

A. Whereas CHP's environmental benefits primarily stem from its relative efficiency, its security benefits are more related to its decentralized nature. There are certain weaknesses inherent in centralized power production that can be overcome with CHP. In the context of a large, centralized generation facility, damage to that single facility (whether man-caused, as in a terrorist attack or cyber-attack, or natural, as in a hurricane, tornado, earthquake, etc.) can have a widespread negative impact. Such an event has the potential to disrupt service to all customers who rely on that particular facility. CHP systems, in contrast, are comparatively small and less centralized and are therefore not susceptible to this degree of risk. Further, CHP units are located at or near the facility at which the energy is consumed, thereby eliminating potential risks associated with damage to transmission and distribution infrastructure. While they are not invulnerable, damage to a CHP system will typically not have the diffuse knock-on effects of damage to a centralized generation facility. Note also that the relative efficiency of CHP is not merely an economic and environmental benefit, but also brings additional security benefits. Namely, disruptions in fuel input markets are less problematic to CHP systems to the extent that such systems require less fuel. [28]

The security benefits of this resiliency are thoroughgoing. The EPA has recognized a number of "power sensitive customers", which include digital communication facilities,

[28] This paragraph draws on CHP Association, "Benefits". (http://chpassociation.org/benefits/). Accessed December 3rd, 2014.

military operations, wastewater treatment facilities, and hospitals/healthcare facilities.[29] Some of these types of facilities were among those that maintained power during Hurricane Sandy (e.g., Bergen County Utilities Wastewater Treatment Plant, Greenwich Hospital in Greenwich, Connecticut).[30] It is telling that in the aftermath of Hurricane Sandy, New York, New Jersey, and Connecticut all adopted CHP incentive programs.[31] To highlight one such program, the New York State Energy Research and Development Authority (NYSERDA) CHP Acceleration Program, which aims to "leverage $90 million in private capital and reduce peak electric load by 37.5 MW", provides "support for installation of approved modules, support services, technical assistance, system performance data collection, and other activities."[32]

The fact is that human safety, health, and welfare depend in part on the continuous operation of certain facilities, and CHP can play an important role here by ensuring consistent and reliable energy delivery for these facilities when outages occur.

IV. CHP IN AMEREN MISSOURI'S SERVICE TERRITORY

Q. How extensive is CHP in Ameren Missouri's service territory?

A. In response to data request DED-DE 001, which asked Ameren Missouri to list the CHP units in its service territory that have operated within the last five years, the Company provided a list of ** ______________________________ **NP**

[29] EPA, "Combined Heat and Power Partnership: Calculating Reliability Benefits". (http://www.epa.gov/chp/basic/benefits.html). Accessed December 3rd, 2014.
[30] ICF International, "Combined Heat and Power: Enabling Resilient Energy Infrastructure for Critical Facilities", March 2013. Report authored by Anne Hampson, Tom Bourgeois, Gavin Dillingham, and Isaac Panzarella. (http://energy.gov/sites/prod/files/2013/11/f4/chp_critical_facilities.pdf). Accessed December 5th, 2014.
[31] ICF International, "From Threat to Asset - How CHP Can Benefit Utilities", July 23rd, 2014. White paper authored by Anne Hampson and Jessica Rackley. (http://www.icfi.com/insights/white-papers/2014/how-chp-can-benefit-utilities). Accessed December 5th, 2014.
[32] Clean Energy States Alliance, "State Leadership in Clean Energy Awards: Outstanding Programs Found Here", November, 2014. (http://www.cesa.org/assets/2014-Files/SLICE-2014/CESA-SLICE-2014-Report-LR.pdf). Accessed December 9th, 2014. (Quotation from page 16).

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To put this in perspective, last year ICF International estimated Missouri's technical potential of industrial and commercial CHP (for units less than 100 MW) at 2,555 MW.[33] This indicates that there is significant potential for the further diffusion of CHP in Missouri and, by extension, Ameren Missouri's service territory.

V. STANDBY RATES AND AMEREN MISSOURI'S RIDER E

Q. What are standby rates?

A. In the context of CHP, standby rates are rates charged by a utility for the services it provides to a CHP customer (henceforth used interchangeably with "cogenerator"). These services may include power supplied during temporary generator outages (which can be planned, as in the case of maintenance, or unplanned), supplemental power (which is necessary when the CHP unit is not meeting the energy needs of its host), power that is cheaper than that which can be generated on-site, and the delivery associated with all of the forgoing. Standby rates typically include a charge for the capacity necessary to provide service to customers when CHP outages (planned or unplanned) occur, a charge

[33] ICF International, "The Opportunity for CHP in the United States", May 2013. Report prepared by Bruce Hedman, Anne Hampson, and Ken Darrow of ICF International for the American Gas Association. (http://www.aga.org/sites/default/files/legacy-assets/Kc/analyses-and-statistics/studies/efficiency_and_environment/Documents/The%20Opportunity%20for%20CHP%20in%20the%20United%20States%20-%20Final%20Report.pdf). Accessed December 16th, 2014.

for the electricity supplied by the utility during an outage, and associated distribution c costs.[34]

The structure of standby rates is a key determinant of how attractive CHP would be from an economic perspective: "Electric rate structures, particularly standby and backup rates, can have a significant impact on CHP economics by affecting the amount of actual savings resulting from reduced electricity purchases from the grid."[35] Standby rates are particularly important in Missouri, which scored a 0/5 on ACEEE's 2014 CHP policy index.[36] Policy incentives and standby rates are two major channels through which CHP can be encouraged or discouraged. The lack of policy incentives for CHP in Missouri makes the structure of standby rates even more consequential, as there is no policy framework to counterbalance poorly-structured rates.[37]

Q. What is the "avoided rate"?

A. The "avoided rate", or the "avoided cost percentage", is a primary channel through which standby rates function to either incentivize or discourage on-site generation (CHP in the present context). In essence, the avoided rate indicates the extent to which an entity stands to benefit (economically) by installing a CHP system. Tariffs can be structured such that the savings associated with onsite generation are retained by the generating tity to varying degrees. According to the EPA, the "avoided cost percentage is an

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[34] Regulatory Assistance Project, "Standby Rates for Combined Heat and Power Systems: Economic Analysis and Recommendations for Five States", February 2014. Report authored by James Selecky, Kathryn Iverson, and Ali Al-Jabir (Foreword authored by Richard Sedano). (www.raponline.org/document/download/id/7020). Accessed December 3rd, 2014.
[35] EPA, "Standby Rates for Customer-Sited Resources: Issues, Considerations, and the Elements of Model Tariffs," December 2009. Report prepared by the Regulatory Assistance Project and ICF International. (http://www.epa.gov/chp/documents/standby_rates.pdf). Accessed December 3rd, 2014. (Quotation from page 2).
[36] ACEEE, "The State Energy Efficiency Scorecard". (http://aceee.org/state-policy/scorecard). Accessed December 10th, 2014.
[37] The purpose of this testimony is not to argue for policy incentives for CHP, and these sentences should not be read as such.

important concept for evaluating the treatment of onsite generation by partial requirement tariff structures." It continues by emphasizing that

> [o]ne of the key economic values of onsite generation is the displacement of purchased electricity and the avoidance of those costs. Ideally, the reduction in electricity price should be commensurate with the reduction in purchased electricity. If the onsite system reduces consumption by 80 percent, the cost of electricity purchases would also be reduced by 80 percent. The economics are severely impacted if partial requirements rates are structured so that only a small portion of the electricity price can be avoided. The higher the ratio of avoided costs to the full retail average price, the higher the user's savings. As an evaluation measure, partial requirement rate tariffs that result in avoided costs that are above 90 percent of the full service retail rate percentage generally provide adequate savings to support onsite generation.[38]

The avoided rate is a critical variable of interest when evaluating Ameren Missouri's supplementary service rider (i.e., their closest analog to standby rates). Assume for a moment that an industrial entity installs a CHP system and begins to generate a portion of its own electricity. As a result of this onsite generation, the entity will now purchase less electricity from the utility. And here is where the concept of avoided rate comes in: the higher the percentage of costs of this unpurchased electricity that the entity can avoid, the more favorable the utility's standby rates are to CHP. As the paragraph above states, in an ideal world, the percentage of costs for purchased electricity that the entity could avoid would be identical to the percentage decrease in electricity it demands from the utility. But apart from the ideal, a 90 percent avoided rate is typically considered favorable to CHP.[39]

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[38] EPA, "Standby Rates for Customer-Sited Resources: Issues, Considerations, and the Elements of Model Tariffs," December 2009. Report prepared by the Regulatory Assistance Project and ICF International. (http://www.epa.gov/chp/documents/standby_rates.pdf). Accessed December 3rd, 2014. (Quotations from pages 8-9).
[39] Ibid.

To provide a simplistic illustration of the concept, assume that each month the entity above was purchasing 10 units of electricity from the utility for $1 per unit (i.e., purchases $10 worth of electricity from the utility). The entity then installs a CHP system and as a result, only needs to purchase 5 units of electricity from the utility (since it now generates 5 units onsite). Ideally, assuming a 100 percent avoided rate, it will pay the utility $5 less for electricity (100%*5 units of unneeded electricity*$1 per unit). Here the percentage of costs of purchased electricity that the entity could avoid ($5 saved/$10 previously paid=50%) would be identical to the percentage decrease in electricity it demands from the utility (5 units saved/10 units previously purchased=50%). With a 90 percent avoided rate, it will still purchase 5 fewer units, but will only save 90 percent of the associated costs, or $4.50 (90%*5 units of unneeded electricity*$1 per unit). With an 80 percent avoided rate, it will purchase 5 fewer units, but only save $4, and so on. A 0 percent avoided rate would indicate that in spite of purchasing 5 fewer units of electricity from the utility, the entity would still pay the full cost of those 5 units. The lower the avoided rate, the less economic incentive an entity has to invest in a CHP system for onsite generation. A lower avoided rate indicates that onsite generation will yield less savings, and that it will therefore take longer to recoup the initial capital outlays associated with installing the CHP application. The positive relationship between the avoided rate and potential payoff of CHP should be borne in mind when evaluating a utility's tariffs to determine whether they unduly discriminate against CHP.

Q. What is supplementary service?

A. In the context of CHP in Ameren Missouri's service territory, supplementary service is best conceptualized as the service a CHP customer must purchase from the utility in addition to that which it generates itself. Supplementary service (or supplementary power) is defined in the Missouri Code of State Regulations (4 CSR 240-20.060(1)(J)) as "electric energy or capacity supplied by an electric utility, regularly used by a qualifying facility[40] in addition to that which the facility generates itself." In Ameren Missouri's Rider E: Supplementary Service, "supplementary service" is defined as such:

> Where the service supplied by Company is available in the event of failure or shutdown of customer's private plant service or any other source of electrical energy or motive power through electrical or mechanical means or by means of operational procedure, or where the service in effect serves to relieve, sustain or augment any other source of power, such service shall constitute Supplementary Service.[41]

Rider E contains the closest analog to standby rates in Ameren Missouri's tariffs. However, it should be pointed out here that the charges provided for therein simply outline a framework for calculating a minimum monthly charge.

Rider E specifies that "supplementary service will be delivered to customer under the Primary Service Rate at a primary service voltage to be selected by Company." Therefore Rider E defers to the Primary Service Rate, but it does articulate a framework for calculating a minimum charge, which is entirely independent of actual electricity used (see C.3. of Rider E). ** ______________________________ ______________________________ ** **NP**

For a comprehensive analysis of how Rider E functions and discourages CHP in Ameren Missouri's service territory, I direct readers to the testimony of expert witness Graeme

[40] "Qualifying facility" is defined in 4 CSR 240-20.060(1)(G) as "a cogeneration facility or a small power production facility which is a qualifying facility under Subpart B of Part 292 of the Federal Energy Regulatory Commission's (FERC) regulations."
[41] Union Electric Company, "Rider E: Supplementary Service". (https://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet78RiderESupplementaryService.pdf). Accessed December 3rd, 2014.

Miller of the Energy Resources Center. What follows is a brief survey of how this Rider operates in practice, as well as why it may represent a barrier to CHP.

Q. How does Ameren Missouri's supplementary service rider - Rider E - function?

A. Rider E, as stated above, first directs one to the Primary Service Rate. There are actually two different primary service rates: the Large Primary Service Rate and the Small Primary Service Rate[42]. Though the specific rate is not specified here, in response to data request DED-DE 006, Ameren Missouri states in part that "Supplementary Service is applicable to customers served at and billed under the Primary Service Rate." It continues by stating that "all electric service provided by Ameren Missouri will first be billed according to the customer's *selected* rate."[43] This suggests that the customer has a choice as to which of the two primary service rates the customer would like to be billed under. However, Section C.3. of Rider E states that

> [t]he monthly bill to be paid by customer, whether or not any electric service is actually used, shall in no case be less than the minimum charge specified in the applicable rate or the amount based on the Contract Demand (as hereinafter defined) computed on the schedule of charges set forth on Sheet No. 63, Miscellaneous Charges, whichever is greater.[44]

"Contract demand", for its part, is the higher of a) "The number of kilowatts mutually agreed upon by Company with customer as representing customer's maximum service requirements under all conditions of use", or b) "The maximum demand established by customer in use of Company's service."

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[42] Union Electric Company, "Service Classification No. 4(M): Small Primary Service Rate". (https://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet57Rate4MSPS.pdf). Accessed December 15th, 2014.
Union Electric Company, "Service Classification No. 11(M): Large Primary Service Rate". (https://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet61Rate11MLPS.pdf). Accessed December 15th, 2014.
[43] Italics added.
[44] The Miscellaneous charges sheet is available here: Union Electric Company, "Miscellaneous Charges". (https://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet63MiscChgs.pdf). Accessed December 17th, 2014.

Therefore, Rider E essentially consists of a framework for calculating a minimum charge. Tables 1, 2, and 3 below present the possible minimum charges for a customer subject to Rider E.[45] Table 4 summarizes these minimum charges. Note that these minimums are calculated assuming no energy charges (i.e., no electricity is purchased from the utility by the customer).

Table 1: Minimum Monthly Charge for Small Primary Service Rate

Charges	Summer	Winter
Customer Charge	$299.60	$299.60
Low-Income Pilot Program Charge	$0.50	$0.50
Demand Charge	$382.00	$139.00
Total Monthly Minimum Charge	$682.10	$439.10

Table 2: Minimum Monthly Charge for Large Primary Service Rate

Charges	Summer	Winter
Customer Charge	$299.60	$299.60
Low-Income Pilot Program Charge	$50.00	$50.00
Demand Charge	$96,800	$43,950
Total Monthly Minimum Charge	$97,149.60	$44,299.60

Table 3: Minimum Monthly Charge Calculated from Sheet No. 63, Miscellaneous Charges

Charges	Summer	Winter
Customer Charge	$299.60	$299.60
Low-Income Pilot Program Charge	$50.00	$50.00
Charge for "All kW @ $19.36	$19.36(kW)	N/A
Charge for "All kW @ $8.79	N/A	$8.79(kW)
Total Monthly Minimum Charge	$349.60+$19.36(kW)	$349.60+$8.79(kW)

[45] Note here that "summer" means the "4 monthly billing periods of June through September" and "winter" means the "8 monthly billing periods of October through May".

The minimum demand charge for the Small Primary Service Rate is calculated assuming 100 kW, in accordance with Section 5 of the Small Primary Service Rate tariff. The minimum demand charge for the Large Primary Service Rate is calculated assuming 5,000 kW, in accordance with Section 5 of the Large Primary Service Rate tariff.

For the Small Primary Service Rate, the per kW demand charge is $3.82 and $1.39 for summer and winter, respectively. For the Large Primary Service Rate, the per kW demand charge is $19.36 and $8.79 for summer and winter, respectively.

Table 4: Summary of Minimum Monthly Charges

Minimum Monthly Charges	Summer	Winter
Small Primary Service Rate	$682.10	$439.10
Large Primary Service Rate	$97,149.60	$44,299.60
Rider E (i.e., Sheet No. 63)	$349.60+$19.36(kW)	$349.60+$8.79(kW)

For the kW variable in the Miscellaneous Charges sheet, kW represents "the number of kilowatts mutually agreed upon by Company with customer as representing customer's maximum service requirements under all conditions of use." For a Small Primary Service customer, the minimum monthly charge will either be a) the minimum specified in the Small Primary Service Rate, or b) the minimum calculated from Sheet No. 63. For a Large Primary Service customer, the minimum monthly charge will either be a) the minimum specified in the Large Primary Service Rate, or b) the minimum calculated from Sheet No. 63. In accordance with Section C.3 of Rider E, in any given case, the higher of the two prevails.

Q. How might the charges provided for in Rider E discourage the uptake of CHP in Ameren Missouri's service territory?

A. Under Rider E, a customer's minimum charge, "whether or not any electric service is actually used", will either be the minimum in the Small Primary Service Rate (which places a floor of 100 kW for calculating the demand charge) or the minimum in the Large Primary Service Rate (which places a floor of 5,000 kW for calculating the demand charge). In any case, if the minimum calculated in accordance with Sheet No. 63 is higher, that minimum will apply.

An obvious shortcoming in this rate structure is that the minimum charge formula derived from the Miscellaneous Charges sheet is calculated assuming the maximum demand the customer places on the system at any time. That is, in every month, even when no electricity is needed from the utility, the CHP customer is paying for a level of capacity necessary to serve the customer's *maximum service requirements* - the most demand the customer will ever, "under all conditions of use", place on Ameren Missouri's system. No consideration is given here to how infrequently this maximum demand may occur[46], or whether it occurs during peak versus nonpeak periods. In contrast, in both the Small and Large Primary Service Rates the calculation of the monthly demand charge reflects actual demand imposed on the utility that month, and whether it occurred during peak or non-peak hours.

For example, if a customer's CHP unit fails for a few hours a year or must be shut down for routine maintenance, that customer would be charged for the capacity necessary to serve it during that time *every month*. This problem is compounded when we consider that this same treatment is applied to all CHP customers requiring supplementary service: All CHP customers consistently (i.e., on a monthly basis) pay for a level of capacity necessary to simultaneously serve their respective maximum service requirements. The minimum charge provided for in Rider E could only be justified if it is demonstrated that it will be necessary to simultaneously provide all CHP customers (subject to Rider E) with their maximum service requirements.

Theoretically such a contingency may arise. However, it is unlikely and becomes more so as more customers adopt CHP and become subject to Rider E. And this unlikelihood is compounded by the fact that maintenance outages can be scheduled ahead of time, which is to say that many outages can be planned around other outages during non-peak hours.

[46] Among CHP customers, some may rarely need to purchase any electricity from the utility, whereas others may regularly purchase a fraction of their maximum service requirements to supplement onsite generation.

This rate structure is analogous to an insurance company not factoring risk probabilities into the calculation of their price structures. Therefore, before even modeling these rates to obtain avoided cost figures, we have a strong mathematical justification for believing that Rider E may be unduly discriminatory against CHP.

Second, the modeling conducted by the Energy Resources Center at the University of Illinois - Chicago[47] provides concrete illustration of how Rider E blunts the incentive to adopt a CHP system. What the modeling results reveal is that there is a positive relationship between a cogenerator's avoided rate and the amount of electricity it purchases from Ameren Missouri. In other words, the less electricity that is purchased from Ameren Missouri, the less attractive CHP will appear. This creates an incentive for CHP customers to purchase more electricity than they otherwise would in the context of unbiased standby rates.

A third concern pertains to the complexity and ambiguity of parts of Rider E. Section C.1 references the "Primary Service Rate" without specifying whether the Small Primary Service Rate or the Large Primary Service Rate is to apply. The response to DED-DE 006 suggests that it is the customer's choice as which of the two will apply, but as Rider E currently stands, this is ambiguous. Further, Rider E is needlessly complex. Its entire *raison d'être* is to simply provide for a minimum charge. To the extent the provisions of Rider E remain unchanged, they could be communicated much more succinctly and clearly by redrafting Rider E such that it can stand on its own (i.e., such that it does not cross-reference three other parts of Ameren Missouri's tariffs).

[47] The results of this modeling are presented in the expert testimony of Graeme Miller.

Q. Is there a sound economic rationale for the minimum charges provided for in Rider E.?

A. No.

Q. Please elaborate.

A. In data request DED-DE 004, Ameren Missouri was asked, "Please provide a copy of all studies performed by or on behalf of Ameren that quantify the difference in costs of serving a CHP customer compared to a firm service customer. Please also provide a copy of other studies that Ameren referenced or relied upon to quantify this difference." The Company's response was "No such study exists."

In data request DED-DE 005, Ameren Missouri was asked, "To the extent possible, please provide a detailed explanation of the difference in costs between serving a CHP customer and a firm service customer." The Company's response was "Consistent with the response to data request DED-DE 004, Ameren Missouri has not conducted a study to determine the difference in costs between serving a CHP customer and a firm service customer."

In data request DED-DE 015, Ameren Missouri was asked to "[p]lease provide a copy of all studies performed by or on behalf of Ameren that quantify the difference in cost of providing supplementary service compared to firm service. Please also provide a copy of other studies that Ameren referenced or relied upon to quantify this difference." The Company's response was that "[t]he Company's Rider E provisions were established more than thirty years ago and no such study exists from this time."

The responses to the forgoing data requests indicate that Rider E may not be rooted in a solid economic foundation.

Q. Is there a compelling statutory and/or regulatory justification for insisting that Rider E not unduly discriminate against CHP?

A. Yes. Section 393.130.1 of Missouri Revised Statutes mandates that "all charges made or demanded" by an "electrical corporation" must be "just and reasonable and not more than allowed by law or by order or decision of the commission." Currently, there is evidence to indicate that Ameren Missouri's Rider E may lack any rational relationship to actual cost-of-service, and may single out CHP-adopting customers for disparate treatment relative to similarly situated customers. Further, the Company has not been able to provide any theoretical or empirical studies that suggest the contrary.

There are also some potential concerns with Rider E's consistency with Missouri rules implementing the Public Utility Regulatory Policies Act of 1978 (PURPA). Commission rule 4 CSR 240-20.060(5)(A) requires that

> [r]ates for sales shall be just reasonable and in the public interest and shall not discriminate against any qualifying facility in comparison to rates for sales to other customers served by the electric utility. Rates for sales which are based on accurate data and consistent system-wide costing principles shall not be considered to discriminate against any qualifying facility to the extent that those rates apply to the utility's other customers with similar load or other cost-related characteristics.

Again, no studies were produced to indicate that the charges provided for in Rider E "are based on accurate data and consistent system-wide costing principles."

Section 4 CSR 240-20.060(5)(C) of the rules states that

> [t]he rate for sales of back-up power or maintenance power - 1) *Shall not* be based upon an assumption (unless supported by factual data) that forced outages or other reductions in electric output by all qualifying facilities on an electric utility's system will occur simultaneously or during the system peak or both; and 2) Shall take into account the extent to which scheduled outages of

> the qualifying facilities can be usefully coordinated with scheduled outages of the utility's facilities.[48]

As indicated above, regardless of actual outage patterns, all cogenerators (subject to Rider E) are subject to a monthly "per kW" charge the structure of which assumes that outages occur simultaneously and cannot be scheduled in advance.

The forgoing should not be construed as an exhaustive list of statues and/or regulations that may be pertinent here. It is rather included to indicate that the structure of Rider E is an issue with statutory and regulatory implications.

Q. Should Rider E be modified? If so, what changes should be made?

A. The minimum charge provisions in Rider E should be eliminated, and supplementary service should simply be provided in accordance with the Small or Large Primary Service Rate schedule. Which of the two applies should also be specified.

Both primary service rates already include a demand charge. And as I have shown in this testimony, there is no compelling economic basis for charging cogenerators a monthly "per kW" charge that reflects the customer's "maximum service requirements under all conditions of use". Both firm service customers and cogenerators are fundamentally similar in that they may purchase electricity intermittently or at varying levels. Absent supporting cost justification, it is unclear why a CHP customer must pay for its maximum demand every month regardless of how much electricity they actually use that month, whereas a normal primary service rate customer simply pays a monthly "per kW of Billing Demand" demand charge. And further, the "per kW" charge for which Rider E provides is not adjusted according to peak vs. non-peak hours.

[48] Italics added.

In short, all CHP customers subject to Rider E are required to reserve, via a monthly "per kW" charge, the maximum capacity they would ever need. In contrast, Small or Large Primary Service Rate customers face a demand charge that is more reasonable for two reasons: a) it bears a relation to the actual demand the customer imposes on Ameren Missouri's system in a month, and b) it is adjusted according to when that demand is actually imposed (i.e. peak vs. non-peak hours)[49].

At present, there is not a sound economic rationale for the disparate treatment afforded to normal primary service rate customers and CHP customers subject to Rider E. The Commission should eliminate this disparate rate treatment by adopting my proposal.

Q. Does this conclude your direct testimony in this case?

A. Yes.

[49] See section 5 ("Demand Billing") of the Small and Large Primary Service Rate schedules.