Net Metering in Missouri:
The Benefits and The Costs

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Missouri Energy Initiative

Contents

About MEI

Missouri Energy Initiative (MEI) is a nonprofit association of public and private sector entities. MEI is about culture change in Missouri to reverse current trends of poor public support for innovation, technology and education. We believe that providing greater access to non-partisan, science-based information is critical to changing the culture and the mindset of citizens and decision makers. MEI works to enhance and improve the energy business climate in Missouri by coordinating energy activities across all sectors of the Missouri economy, being an honest broker of energy information to the general public, educating K-12, Tech Schools and Higher Education students on energy issues, informing elected officials at the state and federal level on Missouri energy opportunities and issues, and providing a rich environment for energy research and development activities in the state.

Summary of Paper

This paper reviews existing studies on net metering and Missouri IOU net metering data to begin the process of understanding the potential cost benefit of net metering implementation. There are only a few studies that exist so far (Public Service Department, 2013; The Brattle Group, 2012; Ernest Orlando Lawrence Berkeley National Laboratory, 2007[1]), as with this study, all seem to show a positive net overall effect to net metering uptake. These results are dependent on the assumptions made in both costs and benefits. While, Missouri does not currently count many of the listed benefits, its unique regulatory structure, rate setting procedures and electric consumption and production patterns will affect the ultimate cost-effectiveness calculations of net metering as it develops over time including the inclusion of potential benefits.

Purpose

Increasing integration of renewable energy and associated net metering implementation has raised many questions of their impact on the existing electrical system. This paper looks at data prior to 2013 provided by Missouri Investor Owned Utilities and publicly available data sets in hopes of providing stakeholders a better understanding of net metering's potential impact on energy affordability and reliability. The results are not meant to be representative of the actual costs the utilities or ratepayers may incur. This paper is not designed to suggest that renewable energy and the accompanying net metering mechanism is the best policy. Missouri Energy Initiative (MEI) is simply working to expand the understanding of this complicated topic. This paper does not discuss all the positives or negatives of the issue, nor does it explain every background or associated topic.

Net Metering

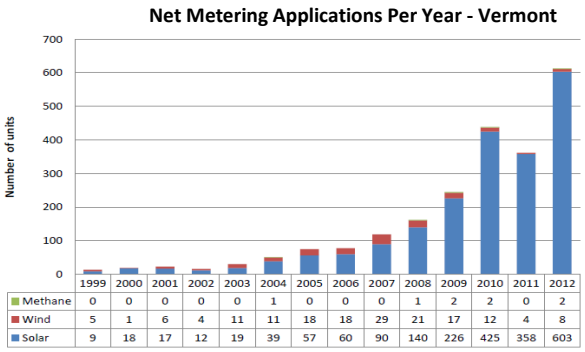
Net metering enables customers to use their own generation from on-site renewable energy systems (only renewables in Missouri) to offset their consumption over a billing period by allowing their electric meters to turn backwards when they generate electricity in excess of their demand, enabling customers to receive retail prices for the excess electricity they generate. Without net metering, a second meter is usually installed to measure the electricity that flows back to the provider, with the provider purchasing the power at a rate much lower than the retail rate. The "net" is the balance of these consumption and production forces.

According to the U.S. Department of Energy (Energy Efficiency & Renewable Energy Green Power Networks): Net metering programs serve as an important incentive for consumer investment in on-site renewable energy generation. The American Public Power Association provides a somewhat simplistic definition of net metering by describing it as "the transaction between an electric utility and its customer when the customer sells surplus electricity to the utility.

Net Metering History

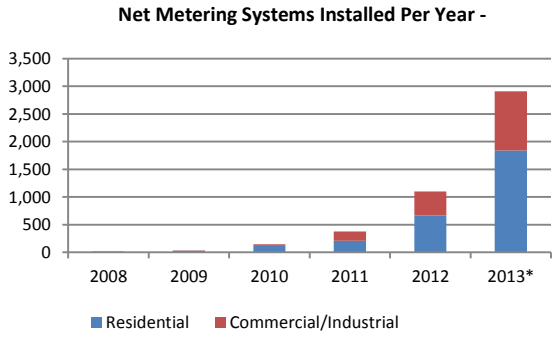
Net metering policies first began emerging in the United States in the early 1980s.[2, 3] Since most currently produced electric meters can already accurately record in both directions[4], net metering is technically viable across the United States. However, a meter exchange would be required for most of currently outdated installed meters in Missouri. In light of this, as part of the Energy Policy Act of 2005, all investor owned electric utilities are now required to offer net metering on request to their customers.[5] The Missouri legislature passed the Easy Connection Act in 2007, which requires all utilities in the state to offer net metering for systems up to 100 kW (and up to a maximum of 5% of their peak demand for the previous year).[6] This law does not apply to Electric Cooperatives or Municipal Power providers, therefore this paper does not reflect these providers generation or integration issues. In recent years, nationally, growth in net metering appears to have taken off.[7] The graphs for Vermont and Missouri (below) are indicative. Current predictions are that the demand for net metering across the United States will only continue to increase due to increasing costs of commodities and environmental mandates, although the rate per state can vary. In terms of actual net metering implementation, there are currently no national standards for interconnection of net metered systems, insurance policies,

technical standards for the equipment, payment schemes, power quality characteristics, etc. This lack of standardization hampers the effectiveness, efficiency, and rate of adoption of net metering systems. If net metering gains pace across the United States, some of these issues may resolve themselves, but currently the lack of standardization in the industry is still something of a bottleneck to adoption.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Methane	0	0	0	0	0	1	0	0	0	1	2	2	0	2
Wind	5	1	6	4	11	11	18	18	29	21	17	12	4	8
Solar	9	18	17	12	19	39	57	60	90	140	226	425	358	603

Source: "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012." Public Service Dept., 2013.



* Estimated
Source: Ameren, KCP&L-GMO, KCP&L, 2013.

Electricity Generation Background

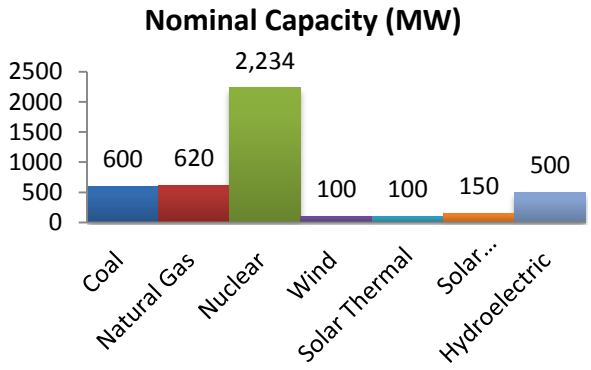
In order to understand the impact of net metering on the state of Missouri, it is worthwhile first to provide some background on relevant electricity production costs and utility rate setting procedures.

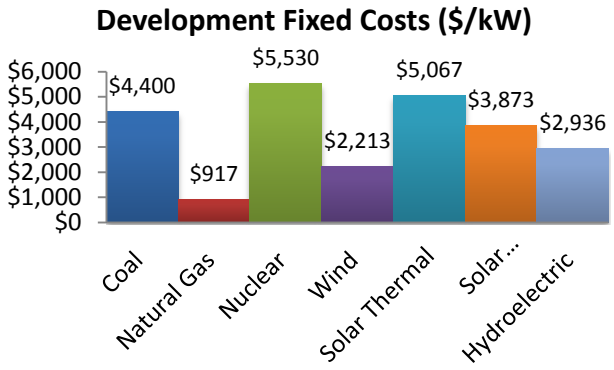
Costs:

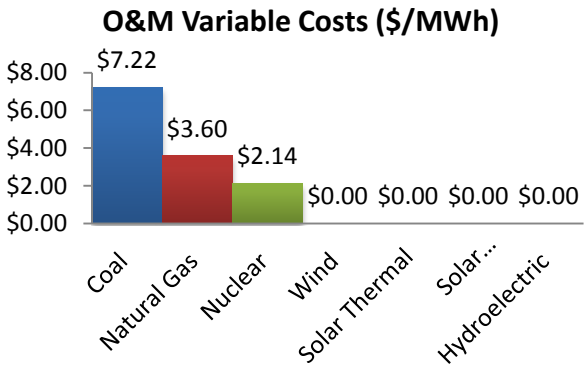
There are two primary categories of costs related to electricity generation: fixed costs and variable costs.[8] Fixed costs are independent of the amount of electricity produced, while variable costs are specifically incurred only when electricity is being generated. Examples of fixed costs include: infrastructure development and maintenance, financing costs, and overhead. Variable costs include rebates, fuel purchases, waste disposal expenses, and on-site labor, materials, and supplies. In a recent report, the U.S. Energy Information Administration (2013) calculated fixed and variable cost estimates for typical utility scale electric generating plants in the U.S. Table 1 below offers a sample of the estimates:

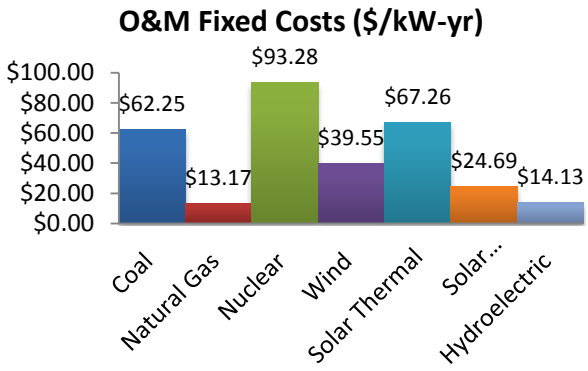
Table 1: U.S. EIA Cost Estimates

Plant	Nominal Capacity (MW)	Development Fixed Costs ($/kW)	O&M Fixed Costs ($/kW-yr)	O&M Variable Costs ($/MWh)
Coal (single unit IGCC)	600	$4,400	$62.25	$7.22
Natural Gas (conventional)	620	$917	$13.17	$3.60
Nuclear (dual unit)	2,234	$5,530	$93.28	$2.14
Wind (onshore)	100	$2,213	$39.55	$0.00
Solar Thermal	100	$5,067	$67.26	$0.00
Solar Photovoltaic	150	$3,873	$24.69	$0.00
Hydroelectric (conventional)	500	$2,936	$14.13	$0.00







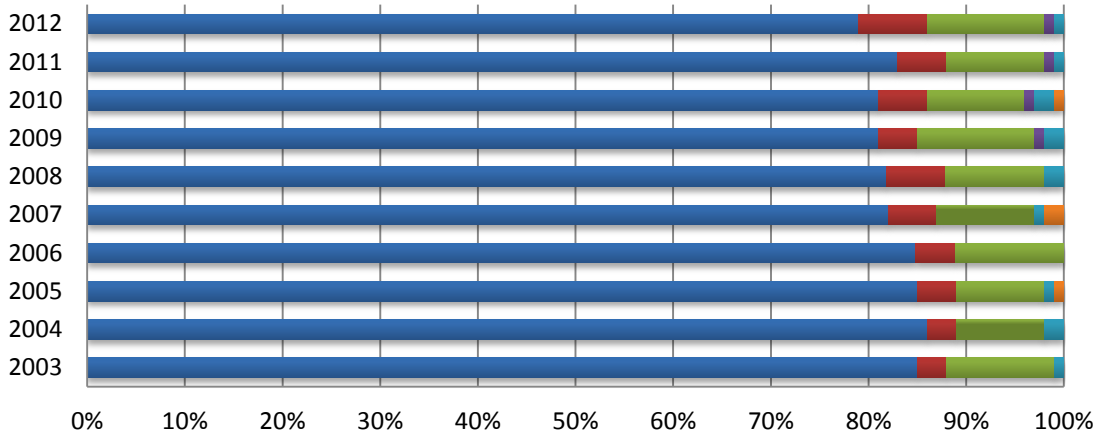


Note: All figures in 2012 dollars.
Source: U.S. Energy Information Administration, 2013, "Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants"

An important observation from this table is that, regardless of the generation source, total fixed costs comprise a rather substantial portion of the overall costs of electricity production.

Electricity in Missouri is primarily generated from coal, although with some natural gas, nuclear power, hydroelectricity, and wind resources utilized as well. Table 2 provides a percentage breakdown of electricity generation by source in Missouri over the decade from 2003-2012.[9]

Table 2: Electricity Generation in Missouri, by Source



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Coal	85%	86%	85%	84%	82%	81%	81%	81%	83%	79%
Natural Gas	3%	3%	4%	4%	5%	6%	4%	5%	5%	7%
Nuclear	11%	9%	9%	11%	10%	10%	12%	10%	10%	12%
Wind	0%	0%	0%	0%	0%	0	1%	1%	1%	1%
Hydroelectric	1%	2%	1%	0	1%	2%	2%	2%	1%	1%
Other	0	0	1%	0	2%	0	0	1%	0	0

Source: U.S. Energy Information Administration, Table: "Net Generation by State by Type of Producer by Energy Source."[10]

On average, Missouri's electricity has been 83% coal-based, 5% natural gas, 10% nuclear, and 2% other. Focusing on the utilities in Missouri, and based on proprietary data provided by them,[11] the ratio of fixed costs to variable costs is 3.5:1. In other words, for every $1 of costs involved in the production of electricity by utilities in Missouri, approximately 78¢ of it involves fixed costs, and 22¢ variable costs.

Rates:

Electricity rates in Missouri are not determined by market demand.[12] The Missouri Public Service Commission (PSC) is the state regulatory agency which "ensures Missouri consumers have access to safe, reliable and reasonably priced utility service."[13] The PSC holds rate hearings for investor owned electric service providers (namely, Ameren Missouri, Empire District Electric Co., Kansas City Power & Light and KCP&L Greater Missouri Operations) to set rates at a level where the consumer receives reliable service, and the provider receives a reasonable return on the investment to the utility.[14, 15]

Rates are set through classifications, and while investor owned utilities set the parameters for these internally, the typical rate classifications are: residential, commercial, and industrial.[16] Rates also differ

across the state and are set differently for the respective providers. When rates are set through a PSC hearing, an abundance of research goes into determining the rates. The utility conducts extensive demand research and cost studies, and the PSC staff conducts its own investigations as well. Generally, the PSC has eleven months to review a rate case, including any additional testimony by the public, before making a formal decision on determining rates.

However, rates are determined in any specific rate hearing, one common factor common is the significance of fixed costs relative to variable costs in making up the final rates chosen. Fixed costs, as shown above, are a significant portion of total electric generating costs, especially relative to variable costs. However, historic ratemaking efforts have purposefully introduced an imbalance into the rate, causing the majority of utility revenues to be collected through variable charges. Prior to the introduction of customer generation and during periods of growing usage, this imbalance was not an issue. Given overall reduction in electric consumption, this has the potential to be an important issue when determining how much net metering customers are responsible for historical fixed costs, when they are no longer utilizing (or utilizing significantly less) fixed equipment from the utility and instead generating electricity on-site.

Potential Benefits & Costs of Net Metering

Net metering involves many potential costs and benefits, to the utility, to customers, and to residents of Missouri overall. The primary potential benefits may include: load reduction and associated avoided energy purchases and ease on the transmission and distribution system, and reducing greenhouse gas emissions. The primary potential costs may include: incentives, cross-subsidization among consumer groups, regulatory lag for utilities to deal with revenue reduction without corresponding reductions in costs, increased taxation on distribution systems not originally designed for self-generation and increased administrative costs in managing a new customer class. The following factors are drawn from common factors in jurisdictions dealing with net metering but are not all formally accepted by the Missouri Public Service Commission.

+ Load Reduction – Less (generally fossil-fuel based) power has to be produced to meet utility customers' needs. This implies a number of things, including: less input fuels (in Missouri this would primarily translate into coal) that need to be purchased for energy production, less investment costs required as fewer generation systems have to be built over time, and related ease on the transmission and distribution system as less power needs to travel long distances.[17] However, not all load or generation is created equal. Distributed generation may not be generated during peak load periods causing a strain on the distribution system, impacting current base load generation. Additionally, distributed generation's current inconsistent generation may limit its impact on constant load reduction.

+ Reduced greenhouse gas emissions (including any costs from future environmental regulatory schemes) **-** Missouri net metering comes from renewable energy sources (solar, wind, hydro, and methane). Production of energy from these sources often satisfies environmental regulatory requirements such as RPS requirements for utilities, and any future greenhouse gas emission reduction requirements from a carbon-tax or a cap-and-trade scheme.

- Cross-subsidization – The potential for cross-subsidization exists when customers using net metering systems do not pay for utility fixed costs and those fixed costs are increasingly shifted onto other retail electricity customers instead. It is also called a "cost-shift" from net metering customers to non-participating ratepayers. Note that this is about utility-based fixed costs only. Any infrastructure required for net metering itself, customers pay for at installation; that cost has never been distributed/shared to the wider customer base. This issue concerns the utility's remaining fixed costs and if the burden of those costs are transferred in an unequal manner to non-net metering customers[18]. Related to this point will be the socioeconomic characteristics of net metering and non-net metering customers. If the two groups are not characteristically similar, net metering can result in the shifting of costs from one demographic group of customers, on average, to a distinctly different group of customers, on average. The simple cost shifting does not take into account the regulatory lag that is born by the utilities. The regulatory lag is the time between the initial installation of the net metered device and the time the utility is allowed to recover the costs following a regular rate hearing.

- Increased Administrative Costs - Net metering involves administrative costs in setting up the new customers and initiating their new billing procedures. These administrative costs can be significant as the number of net metering customers grows.

- Rebates and Incentives – Many states provide rebates and incentives for solar or other renewable energy installations.. These rebates may or may not be recoverable or capped. Missouri Investor Owned Utilities[19] provide a decreasing $2.00 a watt rebate for solar systems. These incentives and rebates are borne by all ratepayers. Since the inception of Missouri's rebates, IOUs have provided tens of millions in rebates for solar installations.

In addition, there are likely to be other, smaller effects of net metering policies. On the benefits side they include: a more decentralized energy system, reduced energy prices, improved customer awareness, and a local economic boost to jobs and manufacturing. On the costs side they include: reduced profits to utilities and their shareholders, minimal uptake of the net metering system overall, and infrastructure safety issues.

+ A More Decentralized Energy System - Net metering allows for a more decentralized energy system which has benefits including greater security and reliability over conventional systems (i.e. it is harder to take down an entire region's electricity if it is decentralized, and if a piece of the grid does go out of commission, not everyone is affected). However, most net metering systems currently installed in Missouri shut down when the grid goes down, limiting their benefit to reliability under current technologies.

+ Reduced Energy Prices - The majority of net metering in the United States comes from solar power. Solar's coincidence with times of peak energy demand (i.e. the middle of the day) can lead to positive price effects in the form of reduced energy costs (Public Service Department, 2013; The Brattle Group, 2012; Ernest Orlando Lawrence Berkeley National Laboratory, 2007[20]).[21] Note, however, that for this effect to be realized prices must be responsive to the market, and in most states (Missouri included) this isn't the case - regulators set electricity prices. The benefits of this effect in Missouri, therefore, are likely to be minimal in the short run.

+ Improved Customer Awareness - Net metering tends to make customers more *aware* of their energy consumption and use. This can help with efforts to improve energy efficiency and demand

overall. However, net metering and its resulting decrease in costs can result in increased usage due to the perception of free energy.

+ Local Economic Boost - manufacturing and installation of net metering systems in Missouri can give a local economic boost to companies involved with these systems. Due to the fact that net metering installation and production, by definition, cannot be outsourced, increased net metering production means that the State would retain more dollars locally.

- Reduced Utility Profits – as net metering customers produce some of their own energy, the utility has less sales and consequently less profits from participants paying smaller electric bills. The result of lost energy sales will impact remaining consumer rates, and will hurt the returns to shareholders in utility companies. Net metering involves the inclusion of a new party to the energy distribution system which can benefit installation and manufacturing companies in and around states with robust net metering laws.[22]

- Minimal Uptake - Energy produced through net metering will not be a major energy generation source in the state under current policy or technology. It is technically too difficult for the grid to integrate too much sporadic and unreliable net metered production, and so there are generally caps on the amount of net metering allowed in any state. In Missouri it is 5% of peak demand for a utility, as measured from the previous year. Thus, under current Missouri law net metering will not be able to comprehensively solve any of Missouri's energy production and demand issues.

- Infrastructure Safety – the increased use of net metering may cause greater strain on local utility infrastructure and general transmission and distribution systems (The Brattle Group, 2012[23]). Historic infrastructure systems were not built with net metering in mind; integrating uncertain and variable net metered electricity production has the potential to lead to integration and safety issues.

Empirical Analysis

In this section we estimate (on an annual basis) the four main impacts of net metering in Missouri, including: load reduction, reduced greenhouse gas emissions, cross-subsidization among consumer groups, and increased administrative costs in managing a new customer class.

Load Reduction is measured in two parts. First, the reduced power that has to be produced by the utility is approximated. This is done with net metering installation data provided by the utilities[24] along with annual nominal electricity price data provided by the U.S. EIA,[25] input into the National Renewable Energy Laboratory PVWatts website[26] to arrive at final estimates of the value of reduced energy produced by the utility. The PVWatts algorithm takes into account such things as weather data and system performance. However, one drawback is that it is based on the generation value of solar systems only. All net metering systems in Missouri are indeed solar-based, but officially, they do not have to be, they can consist of any system that puts power back onto the grid.

Second, the energy value number is increased by an additional 24% to allow for the estimated ancillary benefits of net metering production, including less investment costs as fewer generation systems have to be built over time, and the resulting ease on the transmission and distribution system. The 24% figure is a conglomeration of two factors. First, a Vermont study (2013) estimates

that the value from power not having to travel long distances is as much as 9% of overall generation. Second, it is assumed that 15% of the value of energy produced must be invested in generation equipment and maintenance annually in order to maintain production. Together (9% plus 15%) we arrive at the 24% figure.[27] The final equation for valuing the benefit of load reduction to net metering uptake in Missouri is:

$$(\boldsymbol{Energy\ Value\ from\ Net\ Metering\ System}) * \mathbf{1.24}$$

The final values for Ameren Missouri, Kansas City Power & Light, and KCP&L Greater Missouri Operations from 2008-2012 are:

Table 3: Load Reduction Valuation Estimates

Ameren	**2008**	**2009**	**2010**	**2011**	**2012**	**Totals**
Residential	$2,258	$5,573	$33,328	$110,705	$429,635	$581,499
Commercial/Industrial	$1,231	$7,806	$28,279	$198,147	$546,714	$782,176
KCP&L-GMO						
Residential		$4,273	$12,049	$24,712	$368,629	$409,662
Commercial/Industrial			$775	$47,960	$263,809	$312,544
KCP&L						
Residential	$47,177	$1,165	$4,742	$10,826	$57,039	$120,949
Commercial/Industrial			$8,971	$52,518	$183,899	$245,388
Totals	$50,666	$18,817	$88,144	$444,868	$1,849,725	$2,452,218*

All values are in nominal dollars. *Totals column and row do not exactly equal due to rounding.

Reduced greenhouse gas emissions are measured by multiplying the estimated value of avoided CO_2 emissions per MW of solar installed capacity in Missouri (1,351), times a price of $15/metric ton. The estimated value of avoided CO2 emissions per MW of solar installed capacity is an average of individual information to this effect provided by Ameren Missouri, Kansas City Power & Light, and KCP&L. It is checked against an estimator calculator as provided in *The Potential of Water Power in the Fight Against Global Warming in the U.S.* (2008)[28], and the utility provided estimates are similar to the calculator estimates when one assumes solar capacity factors at less than 20%.

The $15/metric ton price for emissions reduction is based on a composite of estimates from market-based exchange systems in Europe and the U.S., including the EU Emissions Trading System,[29] the northeastern U.S. Regional Greenhouse Gas Initiative,[30] and the California Air Resources Board cap-and-trade program.[31] It is noteworthy, however, that Missouri does not have a current policy on carbon and prices in such exchanges have exhibited extreme volatility over the years and it is certainly conceivable that prices in future years would bounce around as well. The equation for valuing the benefits of reduced greenhouse gas emissions to net metering uptake in Missouri is:

$$(\boldsymbol{MW\ capacity\ installed} * \mathbf{1,351}) * \$\mathbf{15}$$

The values for Ameren Missouri, Kansas City Power & Light, and KCP&L Greater Missouri Operations from 2008-2012 are:

Table 4: Reduced Greenhouse Gas Emissions Valuation Estimates

Ameren	**2008**	**2009**	**2010**	**2011**	**2012**	**Totals**
Residential	$369	$837	$4,667	$14,766	$54,707	$75,346
Commercial/Industrial	$274	$1,627	$5,625	$36,767	$99,951	$144,244
KCP&L-GMO						
Residential		$651	$1,725	$3,285	$46,834	$52,495
Commercial/Industrial			$152	$8,917	$48,410	$57,479
KCP&L						
Residential	$7,620	$176	$675	$1,435	$7,247	$17,152
Commercial/Industrial			$1,783	$9,764	$33,705	$45,252
Totals	$8,263	$3,291	$14,627	$74,934	$290,854	$391,969*

. * Totals column and row do not exactly equal due to rounding.

Cross-subsidization is difficult to measure, but important as net metering can result in significant rate impacts. Other studies (Public Service Department, 2013[32]) have estimated potential cross-subsidization effects as a comprehensive measure, taking into account *all* of the effects of net metering including greenhouse gas emissions reductions, avoided capacity purchases and line losses, and other generalizable effects. Taking such a comprehensive view, most of this literature finds the net cross-subsidization effects to be zero, or even positive (Savage, 2013[33]). However, for this study our goal is to break down each piece of the effect of net metering, and so in this context cross-subsidization is defined as a transfer of fixed costs specifically (and solely) from net metering customers to traditional ratepayers.[34] It is unlikely that the full (78¢ of every $1) amount of fixed costs will ever be entirely transferred to nonparticipants because it this would translate to a zero spend by the consumer, however a portion of it will be. Rates often comprise fixed and variable cost portions, and the fixed cost charges on monthly electric bills are often determined in relation to variable electricity purchases so that if less electricity is purchased from a utility, the fixed costs charges go down as well. Assuming net metering customers reduce their electricity purchases (which is the point), their share of fixed cost payments would then go down as well. Assuming this reduction could be as much as 20%[35] of fixed costs, the equation for valuing the effects of cross-subsidization in Missouri is:

$$(\#\boldsymbol{of\ net\ metering\ customers}) * (\$\mathbf{0.20} * \$\mathbf{0.78} * \boldsymbol{average\ electric\ bill_i})$$

where *i* represents rate payer classification, namely residential, commercial, or industrial.

The computations for Ameren Missouri, Kansas City Power & Light, and KCP&L Greater Missouri Operations from 2008-2012 are:

Table 5: Cross-Subsidization Valuation Estimates

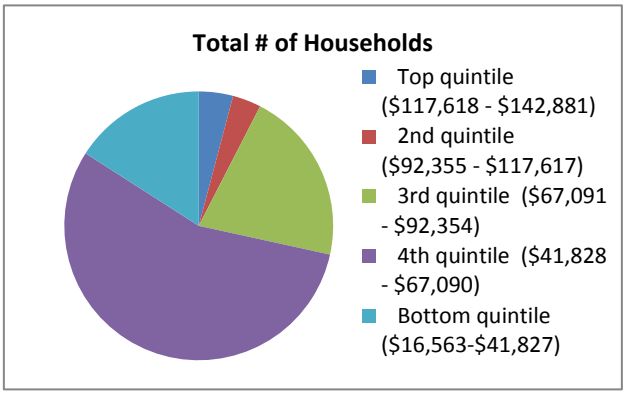
Ameren	**2008**	**2009**	**2010**	**2011**	**2012**	**Totals**
Residential	$889	$2,486	$14,717	$31,156	$93,857	$143,101
Commercial/Industrial	$2,052	$6,481	$21,604	$146,020	$331,349	$507,506
KCP&L-GMO						
Residential		$1,922	$3,311	$3,098	$24,659	$32,989
Commercial/Industrial			$2,867	$33,196	$157,245	$193,309
KCP&L						
Residential	$528	$417	$1,315	$1,846	$3,886	$7,991
Commercial/Industrial			$9,147	$42,364	$145,944	$197,455
Totals	$3,469	$11,306	$52,961	$257,680	$756,940	$1,082,350*

All values are in nominal dollars. *Totals column and row do not exactly equal due to rounding.

Note that this table doesn't describe costs in the traditional manner of economics, but rather "cost-shifts." In other words, these values wouldn't matter from a comprehensive cost-benefit analysis perspective because fixed costs exist no matter who pays for them. However, these values have the potential to matter from a demographic across group perspective. A comparison was done through zip code analysis to determine which socioeconomic classes (based on household median income) have currently taken up residential net metering and which have not. The results, for Ameren Missouri, are provided below:

Table 6: Residential Net Metering Installations, by Household Median Income Quintile (2012)

Ameren	**Total Number**	**% of Total Households**
Top quintile ($117,618 - $142,881)	30	0.15%
2nd quintile ($92,355 - $117,617)	25	0.07%
3rd quintile ($67,091 - $92,354)	152	0.07%
4th quintile ($41,828 - $67,090)	405	0.09%
Bottom quintile ($16,563-$41,827)	116	0.04%
Totals	728	0.42%



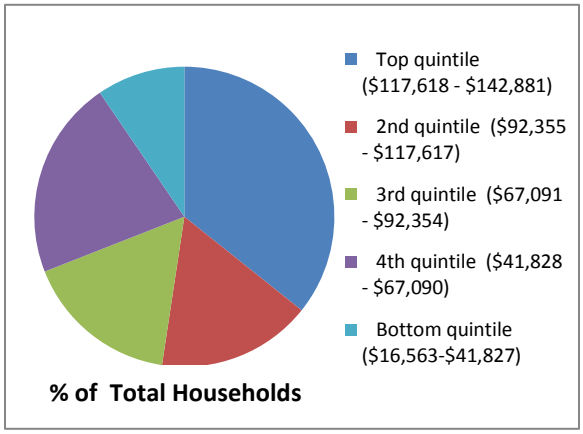


Table 6 presents a group of varied results. The two highest quintile groups that Ameren Missouri serves actually have the lowest number of net metering installations. However, when comparing percentages of households which have taken up net metering in each quintile, it becomes apparent

that the highest income quintile has taken up net metering much more enthusiastically than the lower income quintiles. Whether cross-subsidization of utility fixed costs across income groups is significant or not depends on which column one chooses to focus on. Probably the broader message from Table 6, however, comes from the row of totals which shows that as of today, the rate of net metering uptake in Missouri is still pretty small at less than 1% of the total residential utility customer base. If net metering gains steam in Missouri the issue of cross-subsidization may become more significant, but currently its value is likely to be small.

Increased administrative costs are measured from estimates provided by Ameren Missouri and KCP&L Greater Missouri Operations for the costs involved in administratively setting up net metering customers into the billing system.[36] Set-up cost estimates per application average 7.5 hours of employee labor time. Valued at $25/hour, this comes to an initial set-up fee of $187.50 per application.[37]

The final equation for valuing the increased administrative costs to net metering uptake in Missouri is:

$$(\#\boldsymbol{of\ customers}) * \$\mathbf{187.50}$$

The estimated administrative costs for Ameren Missouri, Kansas City Power & Light, and KCP&L Greater Missouri Operations from 2008-2012 are:

Table 7: Increased Administrative Costs Valuation Estimates

Ameren	**2008**	**2009**	**2010**	**2011**	**2012**	**Totals**
Residential	$1,125	$3,000	$16,875	$33,938	$97,125	$152,063
Commercial/Industrial	$375	$1,125	$3,563	$22,875	$49,313	$77,250
KCP&L-GMO						
Residential		$2,063	$3,375	$3,000	$22,688	$31,125
Commercial/Industrial			$375	$4,125	$18,563	$23,063
KCP&L						
Residential	$750	$563	$1,688	$2,250	$4,500	$9,750
Commercial/Industrial			$938	$4,125	$13,500	$18,563
Totals	$2,250	$6,751	$26,814	$70,313	$205,689	$311,814*

All values are in nominal dollars. * Totals column and row do not exactly equal due to rounding.

It is important to note that these administrative costs occur once per customer, in the initial year of set-up only. The estimate values in the previous tables (for load reduction, reduced greenhouse gas emissions, and cross subsidization) occur not just in the initial year of set up, but for every year thereafter for which net metering is in effect; in other words, the previous estimate values are more like flows, while administrative costs are a stock.[38]

Net Estimate:

Considering the benefit and cost categories described above over the time period 2008-2012, it appears that the net effect of net metering in Missouri is positive. This is because, even valuing cross-subsidization effects at their full estimates and including administrative costs as if they were a flow instead of a stock, benefits in every year (2008-2012) are greater than the costs. This positive net effect is expected to be maintained over time as the rate of net metering uptake continues in line with projections. Net metering does entail both benefits and costs, but the benefits are ongoing while the main costs are either one-time (administrative billing costs), or transfers (cross-subsidization effects) which in pure economic terms carry a cost of zero. Overall, therefore, net metering appears to be positive for the state of Missouri.

There are other effects of net metering policies (i.e. reduced energy prices, reduced utility profits, infrastructure safety issues, etc.), however, which while assumed to be relatively minor factors at the moment, could become significant in any overall net benefit calculation over time. For example, the reduction in natural gas or utility-generated electricity prices could become significant enough to affect demand levels and consumption patterns. This would require a recalculation of all of the above effects, including reduced greenhouse gas emissions and cross-subsidization levels. Alternatively, infrastructure safety concerns could grow with less investment by and responsibility of the utility for overall infrastructure upkeep. It is important not to dismiss these secondary effects of net metering, as described in the previous section, as continually and necessarily insignificant.

Disclaimer

This paper was reviewed and approved by the MEI Board of Directors with at least a two-thirds vote, but should not be construed as their words as individuals or individual organizations. Each MEI Director has the ability to agree or disagree with portions of this paper after its publication.

Utility Statement

Ameren and Kansas City Power & Light (the Utilities), two investor-owned utilities in Missouri, are members of the Missouri Energy Initiative (MEI) and are represented on the MEI Board of Directors. The Utilities support the mission of the association to enhance and improve energy-related activities in Missouri and to have collaborative interactions ensuring the existence of innovative, reliable, clean and sustainable energy information and solutions for Missouri.

The Utilities have further supported MEI by providing data and comments in support of the research performed for the white paper “Net Metering in Missouri – the Benefits & the Costs” released in Winter 2014. After review of the final version, the Utilities believe the Net Metering white paper is incomplete, too reliant on a single study from Vermont, and should be updated to accurately reflect the current conditions and significant investments made in Missouri.

The Utilities are party to a number of net metering-related proceedings currently before the Missouri Public Service Commission (MPSC) and Missouri Court of Appeals where related issues are being vetted on their individual merits. As a result, the Utilities wish to clearly express that, while supportive of the intent of the white paper, we cannot support the opinions and conclusions offered in this document. Further, the fact that Utility data is used in the report should not imply that this data is

accurate for regulatory purposes, comparisons to other net metering related filings, or reflective of any formal, Utility data presented to the MPSC.

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[1] Full references citation: "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012," Public Service Department, 2013; "The Potential Impact of Solar PV on Electricity Markets in Texas," The Brattle Group, 2012; "The Impact of Retail Rate Structures on the Economics of Commercial Photovoltaic Systems in California," Ernest Orlando Lawrence Berkeley National Laboratory, 2007.
[2] Iowa, Arizona, Massachusetts and Minnesota were some of the first states to pass net metering laws.
[3] Keyes, Jason B. and Joseph F. Wiedman. 2012. *Solar America Board for Codes and Standards Report: A Generalized Approach to Assessing the Rate Impacts of Net Energy Metering.* Interstate Renewable Energy Council.
[4] "Both directions" means that the meter can track power this is both taken from the grid (usage) and power put back onto the grid (generated from distributed generation like solar pv)
[5] Energy Policy Act of 2005: http://www.gpo.gov/fdsys/pkg/BILLS-109hr6enr/pdf/BILLS-109hr6enr.pdf
[6] Easy Connection Act: http://www.dnr.mo.gov/pubs/pub2238.pdf; RSMo 386.890 and Mo Regs: 4 CSR 240-20.065
[7] "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012." Public Service Department. 2013.
[8] Fixed costs apply over a specific time horizon the variation between the two are sometime disputed between parties.
[9] Note that significant renewables have been added to the grid since 2012, but are not included in this paper.
[10] Data can be found at: http://www.eia.gov/electricity/data/state/
[11] Proprietary data provided by Ameren Missouri, Kansas City Power & Light, and KCP&L Greater Missouri Operations.
[12] This is because electricity generation is what is called a "natural monopoly," meaning there are high fixed costs and it is only cost-competitive for there to be one provider per geographic area. It is common across the United

States for electricity rates to be set through regulatory rate proceedings, and not in the free market. Municipal power providers and Cooperative Power companies are controlled by the voters and shareholders respectively.

[13] The PSC consists of five appointed members. It's website is: psc.mo.gov

[14] The PSC does not oversee municipal or cooperative electricity service providers.

[15] The PSC makes rate case and tariff filings available on their website: psc.mo.gov

[16] Though in Missouri rate categories include: small general, large general, small primary, large primary, large transmission, commercial building, total electric building, general power, large power, and frozen power feed mills.

[17] Ease on the transmission and distribution system means avoided line losses (i.e. energy produced on-site, due to net metering, doesn't have to travel as far as traditional distributed energy, so line losses - which have been estimated at 9% of production, Vermont 2013 - are insignificant), avoided capacity costs including need for ancillary services and interruptible load operations in capacity constrained areas, and avoided in-state and regional transmission and distribution costs.

[18] When this cross-subsidization occurs, it is possible the utility will experience a revenue reduction without a corresponding reduction in costs in between rate cases.

[19] Limited to KCP&L and Ameren. Empire Electric currently does not provide this rebate.

[20] Full references citation: "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012," Public Service Department, 2013; "The Potential Impact of Solar PV on Electricity Markets in Texas," The Brattle Group, 2012; "The Impact of Retail Rate Structures on the Economics of Commercial Photovoltaic Systems in California," Ernest Orlando Lawrence Berkeley National Laboratory, 2007.

[21] The reduced energy costs include reduced electricity prices, as well as reduced coal and natural gas prices as the effects of lower electricity prices filter through to competing fossil fuel markets.

[22] Note that we aren't counting as a benefit reduced utility bills to customers. While net metering customers will see reduced utility bills as they generate their own energy, this savings comes at the expense of installing the net metering equipment in the first place, which is borne by the net metering customer, minus any solar rebates. (In Missouri, solar rebates were legislated in 2008 as part of Proposition C). Net metering equipment may result in overall savings after approximately 10-20 years, but not initially.

[23] "The Potential Impact of Solar PV on Electricity Markets in Texas," The Brattle Group, 2012.

[24] Data was provided by Ameren Missouri, Kansas City Power & Light, and KCP&L Greater Missouri Operations only.

[25] U.S. EIA Table "Average Price by State by Provider, 1990-2012."

[26] The website and energy value calculator (Version 1) can be found at: http://www.nrel.gov/rredc/pvwatts/.

[27] Ideally, we would estimate the ancillary benefits of net metering energy production from disaggregated data provided by the utilities. Unfortunately, at this time, such data is unavailable.

[28] Kosnik, Lea-Rachel. 2008. "The Potential of Water Power in the Fight Against Global Warming in the U.S." *Energy Policy* 36(9):3252-3265.

[29] Website: http://ec.europa.eu/clima/policies/ets/index_en.htm

[30] Website: http://www.rggi.org/

[31] Website: http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

[32] "Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012," Public Service Department, 2013.

[33] Savage, Andrew. January 21, 2013. "New State Study Demonstrates Net Metering Benefits for Ratepayers." *Renewable Energy World*. Website: http://www.renewableenergyworld.com/rea/blog/post/2013/01/new-state-study-demonstrates-benefit-to-ratepayers-of-net-metering.

[34] This fixed cost does not include solar rebate payments.

[35] The 20% assumption was taken from an average of existing studies, used throughout this paper.

[36] Some studies on net metering from other states ("Evaluation of Net Metering in Vermont Conducted Pursuant to Act 125 of 2012," Public Service Department, 2013) report an additional annual administrative cost to maintain a separate billing system for net metering customers only, but the utilities in Missouri do not maintain a separate billing system for net metering customers so such an additional cost does not appear to be a factor in Missouri.

[37] For reference, the one time set-up costs are estimated at $20/per kWh of net metering capacity in the Vermont (2013) report.

[38] "flow" is a quantity which is measured with reference *to a period* of time. "stock" is a quantity which is measurable *at a particular* point of time.