MISSOURI'S ENERGY EFFICIENCY POTENTIAL:
OPPORTUNITIES FOR ECONOMIC GROWTH AND ENERGY SUSTAINABILITY

June 2011

Report Number E11X

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Disclaimer: *While several organizations assisted ACEEE in the completion of this analysis and report, the ultimate analysis and content expressed herein are those of ACEEE.*

CONTENTS

EXECUTIVE SUMMARY

Each year, Missourians spend about $12 billion on their energy bills to heat, cool, and power their homes and businesses (EIA 2010).[1] By comparison, the state collected less in taxes from individuals and businesses - $10.5 billion - in 2010 (MODR 2010). Meeting the energy needs for homes and buildings is clearly a substantial portion of annual costs the state, and these energy needs are growing. Missouri's population is expected to grow 10% by 2025 and with that growth will come increased need for energy resources, which will put a strain on existing resources and services. Energy efficiency – long-term improvements in technology performance and practices that reduce energy demand -- is Missouri's lowest cost energy resource and offers significant potential to meet this growing demand for new energy sources.

National estimates show that energy efficiency improvements cost only a fraction of new electricity supply (see Figure ES-1) (ACEEE 2009 and Lazard 2009). Based on the economics alone, energy efficiency can be a critical resource to foster a secure and sustainable energy future for Missouri. This report examines how energy efficiency policies and programs can reduce energy bills for Missouri homes, businesses, and governments while stimulating the economy and reducing reliance on more expensive energy resources. The multiple economic benefits of efficiency analyzed in this report demonstrate that efficiency is a financially responsible strategy for the state of Missouri that will set the state on a path toward economic growth and energy sustainability.

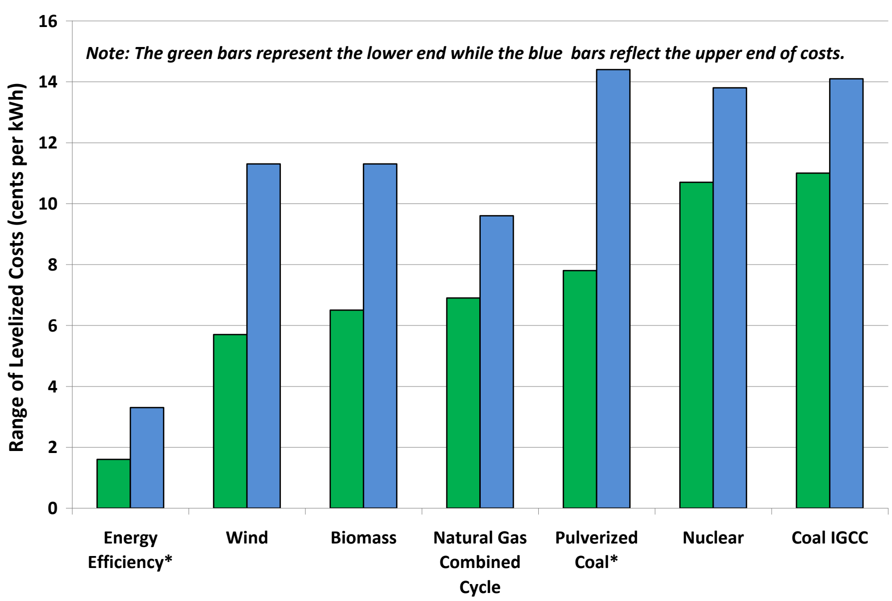
Comment [CDM1]: Note: The metric of energy bills relative to taxes is not meaningful. What would be meaningful is a metric of Missouri energy consumption on a dollars per capita basis relative to other states.

Comment [CDM2]: Note: The term "strain" implies that existing limits are being stretched. Is this really true in Missouri relative to electric generation, distribution or transmission?

Comment [CDM3]: Insert:
meet "a portion of" this growing demand…

Comment [CDM4]: up to a point recognizing that the market acceptance of energy efficiency measures is not limitless

Figure 1. Levelized Costs for Electricity Resources



Notes: Energy efficiency data from Friedrich et al. 2009 (ACEEE) which represents 5 years of utility efficiency program data from 12 states. The states included are geographically disperse and therefore a good indication of efficiency program costs throughout the country; All other data from Lazard 2009. High-end range of advanced pulverized coal includes 90% carbon capture and compression.

[1] This does not include spending on energy for transportation, which accounts for another $14 billion in per year in Missouri. In aggregate, Missourians spend 2.5 times more on energy than on taxes.

Energy Efficiency in Missouri

Missouri is increasingly turning to energy efficiency as an economic policy to save consumers money and create jobs, as well as foster energy sustainability by investing in a clean, local resource that reduces emissions and boosts in-state energy expertise. Missouri state agencies, local governments, utilities, and non-governmental organizations are already investing in energy efficiency, and making notable progress. The state has improved efficiency in its own facilities and rolled out numerous customer programs, utilities have expanded efficiency programs in recent years, and local governments are also taking action through such measures as building energy codes and local community efficiency programs. For example, Kansas City's "Green Impact Zone" is emerging as an example of concentrated energy efficiency initiatives in concert with economic development goals (see Text Box ES-1).

Text Box ES-1. *Targeted Energy Efficiency Investments – The Green Impact Zone and SmartGrid Demonstration Project in Kansas City*

Dozens of local and metropolitan region partner organizations and agencies are collaborating on this geographically-focused community redevelopment project aimed at vastly improving a neighborhood of Kansas City's urban core through coordinated "green" investments. Energy efficiency in buildings is one of the core strategies—along with jobs, safety & services, infrastructure, housing, youth, and agriculture—being applied to transform the neighborhood. Four separate but coordinated programs are working in the Green Impact Zone to improve energy efficiency: a neighborhood-based low-income weatherization program, two building energy assessment and improvement financial incentive programs, and a "Smart Grid" demonstration project. The Green Impact Zone Low-Income Weatherization Program is managed by the zone in partnership with the regional planning agency, Mid-America Regional Council (MARC), and funded by the Missouri Department of Natural Resources.

By March 2012, the program aims to weatherize more than 650 homes in the Zone and at the end of March 2011 the program had completed work on 30 homes, work was underway at another 51 homes, and 109 additional prerequisite energy assessments had been completed. Participants will receive up to 35 percent reduction in energy usage and save on average $435 per house in heating and cooling costs annually at current prices. The program has made a concerted effort to work with contractors to provide jobs and training, as well as outreach about the benefits of the program through door-to-door canvasses and in person meetings with landlords.

Policy Implementation Opportunities

While the state has taken important steps, significant potential for energy efficiency will remain untapped if the state continues on its current track. In this report, we analyze a suite of ten policies and programs that can help to encourage the adoption of greater energy efficiency in Missouri. We then estimate the resulting energy savings compared to a business-as-usual scenario, the associated policy costs and investments, net consumer savings on energy bills, emissions reductions, and macroeconomic impacts such as net job creation.

The suite of 10 energy efficiency-related policies examined in this report includes:

1. Energy efficiency targets for utilities
2. Efficient manufacturing initiative
3. Rural and agricultural initiative
4. Behavioral initiative
5. Building energy codes and enforcement
6. Advanced new buildings initiative
7. State and local public buildings upgrades
8. Manufactured homes programs
9. Combined heat and power (CHP)
10. Demand response

Combined, we estimate that deployment and implementation of these policies and programs through 2025 can achieve total savings of about 18% of electricity usage and 13% of natural gas usage (see Figures ES-2 and Table ES-1). Efficiency targets for utilities are achieved through a portfolio of

Comment [CDM5]: Many of these overlap. "Bucketing" potential in one program may involve removing potential from another.

Comment [CDM6]:
ACEEE's 18% is very high relative to other assessments it is purportedly based on:

2025 savings from Ameren Missouri DSM Potential Study:
RAP = 7.4%
MAP = 11.1%

2020 savings from KEMA Statewide MO Potential Study:
1YR PB = 6.6%
3YR PB = 3.3%
75% Incentive Scenario = 8.2%

proven programs for residential and commercial customers, as displayed in Table ES-2. Efficiency measures can also achieve significant savings in "peak" electricity when demand reaches its highest and it becomes most expensive for utilities to provide power. Demand response programs, which aim to shave electricity usage during the peak hours or shift usage to off-peak hours, can add further reductions. Combined, we estimate that efficiency and demand response can reduce peak demand 25% by 2025 relative to projected demand.

Table ES-1. Summary of Total Annual Energy Savings in 2025 by Policy or Program

Policies and Programs	Electricity		Peak Demand		Natural Gas	
	GWh	%	MW	%	Million Therms	%
Utility Res. Buildings and Equipment Programs*	6,597	6.9%	1,568	8.3%	121	4.5%
Utility Commercial Buildings and Equipment Programs*	3,445	3.6%	499	2.7%	56	2.1%
Manufacturing Initiative	1,580	1.7%	160	0.9%	50	1.9%
Rural and Agriculture Initiative	297	0.3%	29	0.2%	n/a	0.0%
Behavioral Initiative	665	0.7%	166	0.9%	16	0.6%
Building Energy Codes and Enforcement	1,511	1.6%	378	2.0%	60	2.3%
Advanced Buildings Initiative	526	0.6%	87	0.5%	13	0.5%
State and Local Public Building Retrofits	913	1.0%	135	0.7%	16	0.6%
Manufactured Homes	147	0.2%	37	0.2%	4	0.2%
Combined Heat and Power	1,396	1.5%	181	1.0%	n/a	0.0%
Demand Response Programs	n/a	0.0%	1,530	8.1%	n/a	0.0%
Total Savings	17,077	18%	4,771	25.4%	336	12.7%
Reference Case Energy Usage	94,946		18,782		2,650	

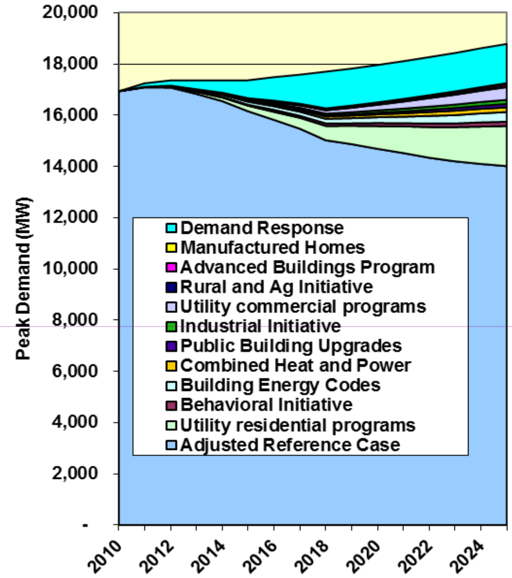
Note: % savings are measured against reference case energy usage in 2025.
*Utility buildings program savings go toward meeting the utility efficiency program targets. A combination of several other programs and policies could contribute to meeting the targets.

Figure ES-2. Missouri Electricity and Peak Demand Savings from Energy Efficiency Scenario

Impacts on Employment and the Economy

While the energy efficiency policies and programs included in this analysis will require public and private investments, they can yield a high return to Missouri consumers and the overall economy. We estimate that by 2025, consumers in Missouri can save a net cumulative $5.9 billion dollars in lower energy bills (see Table ES-2). And because efficiency measures have relatively long lifetimes of about 12 years, net savings will continue to accrue to consumers on the order of $1 billion annually after 2025.

Comment [CDM7]: Our average EUL is more like 10 years.



Investments in efficiency policies and programs can also help create new, high-quality jobs in Missouri while also increasing wages. Our analysis finds that energy efficiency investments can create nearly 9,500 new, local jobs in Missouri by 2025 (see Table ES-2 and Figure ES-3). These include well-paying trade and professional jobs needed to design, install, and operate energy efficiency measures (direct jobs) and also a broader impact on job creation through re-spending of energy bill savings in other areas of the economy (induced jobs).

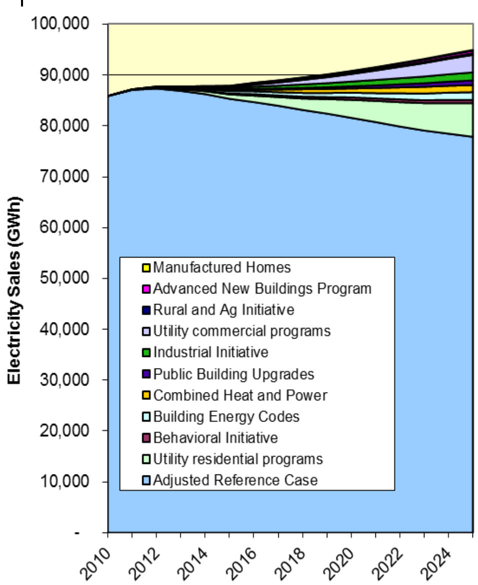


Table ES-2. Economic Impacts from the Energy Efficiency Case Policy Scenario

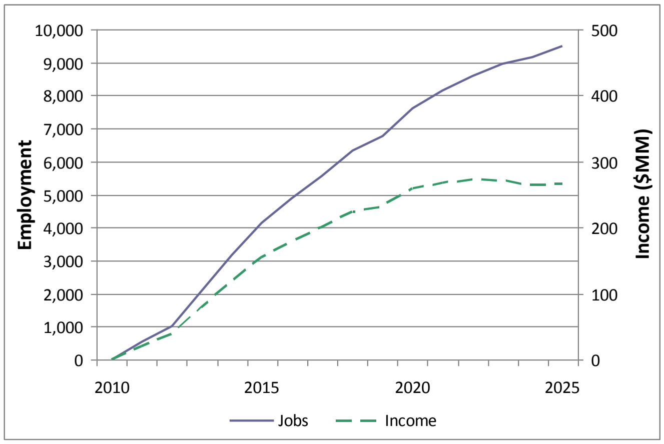
Macroeconomic Impacts	2012	2015	2020	2025
Net Jobs (Actual)	1,096	4,139	7,608	9,492
Wages (Million 2009$)	$43	$153	$257	$265
Cumulative Net Energy-Bill Savings (Million 2009$)	$9	$268	$1,868	$5,915
average salary of created jobs	$39,234	$36,965	$33,780	$27,918

Comment [CDM8]: ADDED ROW WITH CALCULATIONS BASED ON ROW 2 DIVIDED BY ROW 1:

The jobs metric appears to hinder rather than enhance the Missouri business case for highly-expanded energy efficiency. These are low-paying jobs.

Also, Average salary of the jobs created is dropping over time? Why?

Figure ES-3. Net Employment and Wage Impacts for Missouri in Policy Scenario (2011–2025)



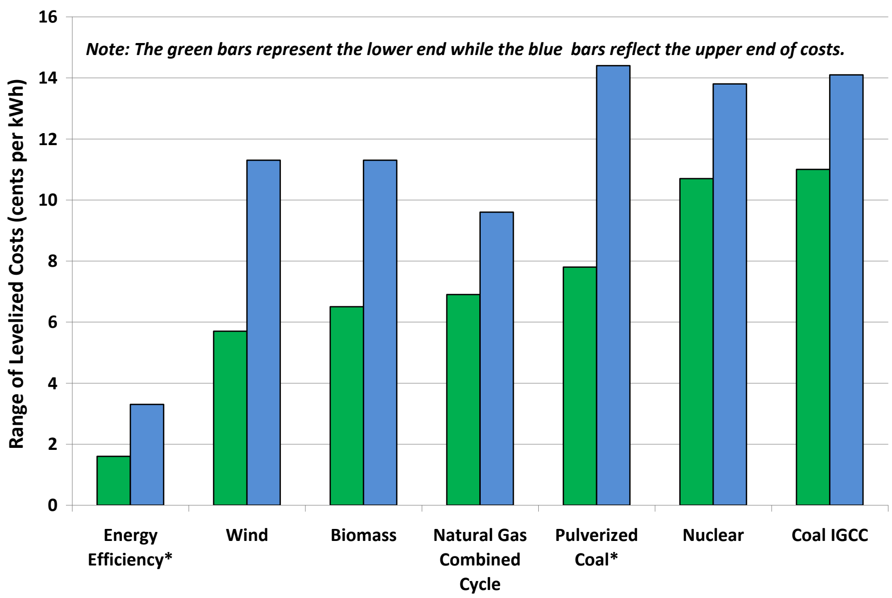
ACKNOWLEDGMENTS

We thank the U.S. Department of Energy and the Missouri Department of Natural Resources for funding this project. We engaged several individuals and organizations in the state, too numerous to list here, who helped to inform our policy analysis for Missouri, and we thank everyone for those invaluable contributions. We describe our stakeholder outreach in the report methodology and mention many of the organizations and individuals whom we met with. Thank you also to several ACEEE staff members who contributed to this report: Nate Kaufman, Skip Laitner, Eric Mackres, Dan Trombley; and Renee Nida for final editing and production of the report.
Note: ACEEE's Dan York spent considerable time from November 2009 through June 2010 facilitating, along with Rich Sedano from RAP and Peter Cappers from LBNL, discussions for Ameren Missouri DSM stakeholders on issues pertaining to the regulatory framework required to move Missouri forward on investments in energy efficiency. This report would have been much more complete and factual had ACEEE chosen to include regulatory framework issues and the lack of resolution to any of those issues in this report.

INTRODUCTION

Each year, Missourians spend about $12 billion on energy bills to heat, cool, and power their homes and businesses (EIA 2010).[2] By comparison, the state collected less - $10.5 billion - in taxes from individuals and businesses in Missouri in 2010 (MODR 2010). Meeting the energy needs for homes and buildings is clearly a substantial portion of annual costs to Missouri residents and businesses and these energy needs are growing. Missouri's population is expected to grow 10% by 2025 and with that growth will come increased need for energy services, which will put strain on existing resources and services.[3] Energy efficiency – long-term improvements in technology performance and practices that reduce energy demand -- is Missouri's lowest cost energy resource and offers significant potential to reduce energy bills for Missouri homes, businesses, and government while stimulating the economy and reducing reliance on more expensive energy resources. National estimates show that energy efficiency improvements cost only a fraction (one-third to one-fifth) of new electricity supply (see Figure 1) (ACEEE 2009 and Lazard 2009). Based on the economics alone, energy efficiency should be a critical resource to foster a secure and sustainable energy future for Missouri.

Figure 1. Levelized Costs for Electricity Resources



Notes: Energy efficiency data from Friedrich et al. 2009 (ACEEE) which represents 5 years of utility efficiency program data from 12 states. The states included are geographically disperse and therefore a good indication of efficiency program costs throughout the country; All other data from Lazard 2009. High-end range of advanced pulverized coal includes 90% carbon capture and compression.

Efficiency also produces macroeconomic benefits in the form of job creation. By lowering consumer energy bills and shifting economic activity toward labor-intensive jobs for energy efficiency services, energy efficiency can create a small, but net positive effect on job creation. The environmental benefits are also substantial. By reducing the electricity generation needs from traditional, carbon-based electricity supplies such as coal and natural gas that pollute the environment, energy efficiency can substantially reduce carbon dioxide, nitrogen oxides, and sulfur dioxide emissions.

[2] This does not include spending on energy for transportation, which accounts for another $14 billion in per year in Missouri. In aggregate, Missourians spend 2.5 times more on energy than on taxes.
[3] Population projection is according to the Missouri Department of Administration (MO Dept. of Admin. 2011).

But despite the benefits of energy efficiency and high returns on investment, most homes and businesses are still highly inefficient. The reason is that consumers face tremendous barriers to improved efficiency, including lack of information, split incentives (when the tenant pays the energy bills but the landlord makes decisions about equipment), upfront costs, access to capital, and aversion to risks. National estimates suggest that more than 20% of energy usage could still be reduced through energy efficiency by 2020 (McKinsey 2009). Note: The McKinsey approach to identify potential was more akin to economic potential as McKinsey attempted to estimate how much energy efficiency was NPV positive. The McKinsey report includes end-use technologies more amenable to federal and state codes and standards. The McKinsey report assumes immediate replacement of all NPV positive energy efficiency technologies. The McKinsey report also includes efficiency gains from combined heat and power plants.

State-level policies and programs have been successful in breaking down many of these barriers to help consumers reap the benefits of energy efficiency. Each year, leading states are already meeting 2% of their overall electricity needs from new energy efficiency alone and saving consumers billions of dollars each year on energy bills. And over the long-term, these efficiency savings accrue and can avoid the need to build new energy supply infrastructure. Most states in fact have long-term resource goals in place to ramp-up their energy efficiency efforts. Local governments are also showing innovative policy solutions to encourage greater energy efficiency.

Comment [CDM9]: Note: This is a bit of a stretch. The 2010 ACEEE state scorecard, based on 2008 data, shows only 5 states achieving greater than 1.0% annual load reductions. Those states are: VT at 2.59%; HI at 1.97%; CT at 1.14%; NV at 1.14% and CA at 1.14%.

All other states achieved less than 0.79% load reductions.

It should also be noted that there is uncertainty regarding whether load reductions are reported on a gross or net basis – a difference of approximately 20%. Finally, the bulk of savings reported in 2008 come from CFLs. For example, approximately 75% of Vermont's reported savings in 2008 came from CFLs. CFLs, for the most part due to federal law, are now considered the baseline for most residential lighting technology

While Missouri has taken some significant steps toward energy efficiency, much more potential remains to create lasting economic benefits to the state. Energy consumption patterns in fact signify an increasing level of energy reliance in the state. For example, per-capita energy consumption has risen from about 300 million Btu's per capita to 325 million Btu's per capita in 2008 (EIA 2010a)[4]. Also, with a strong focus on the historically low electricity rates in Missouri, consumers in the state may not be aware of the significant economic benefits they can still gain by improving efficiency. This report, one in a series of state-level energy efficiency studies by ACEEE, will assess the potential for cost-effective efficiency in Missouri, the policy and program opportunities to encourage greater efficiency, and the benefits that could accrue to the Missouri economy from a long-term energy efficiency strategy.[5]

METHODOLOGY

In this section we describe our overall project approach and methodology.

Overall Project Context

Over the past several years, ACEEE has worked increasingly at the state level as a growing number of state legislatures, governors, and other public entities are showing interest and leadership in energy efficiency. As states engage in this sometimes new area of interest, they identify a need for analysis and technical assistance. ACEEE's State Clean Energy Resource Project (SCERP) aims to create a series of state assessments of efficiency resources and other clean energy strategies, and aims to serve as a center of information and expertise to support relevant policy strategies at the state level. This assessment for Missouri is the latest – and 10th study – in this series of reports.

Comment [CDM10]: Note: ACEEE should compare/contrast the key metrics in the 9 other state studies to Missouri.

Stakeholder Engagement

[4] Readers should note that energy efficiency is one among many factors that underlie changes in per-capita energy consumption metrics, including changes in electricity supply mix, shifts in the share of customers by class (i.e. industrial, commercial, and residential), and changes in sources of end-use energy consumption. It is also true that the price of electricity, population trends, the average number of people per home greatly influence the per-capita energy consumption metric.

[5] For more information on the other studies in the series, see ACEEE"s State Clean Energy Resource Project web page http://aceee.org/sector/state-policy/scerp

Part of our project methodology is to engage with Missouri stakeholders and understand which energy policy options might work best for the state. We talked to a broad range of stakeholders over several months to tailor our proposed recommendations to fit the unique needs of the state. Engaging the many interest groups in Missouri was a significant undertaking. We endeavored to meet in person with as many different sectors as possible in order to get the feedback required to better understand Missouri's unique energy structure and needs. We met with many of the business and environmental groups; the Governor's staff; Commissioners and their staff with the Public Service Commission; the Director and staff of the Division of Natural Resources (DNR); agricultural community representatives including the Missouri Farm Bureau Federation; REGFORM; Regional Commerce & Growth Association; the Mid-America Regional Council; local chambers of commerce; the Missouri Energy Development Authority; utility (gas and electric) companies including; Ameren Missouri, Kansas City Power & Light, the Missouri Association of Municipal Utilities, and Missouri Gas Energy; the Associated Industries of Missouri; the Office of Public Council; and various other interested organizations in the state. We also called or visited with various State legislators' offices and local government representatives such as the Kansas City Dept of City Planning and Development/Development Services. We met with representatives of Washington University in St. Louis.

Comment [CDM11]: Who from Ameren was interviewed for this effort?

We presented on the energy efficiency policy options and methodology for the study to:

- A forum (150 plus in attendance) organized by the MO Public Service Commission titled, "State of Electricity Industry Presentation, Part 2" in Jefferson City on August 24th, 2009.
- Missouri Energy Initiative's Conference, "Missouri's Energy Future", held in Columbia, MO, on November 2nd, 2010.
- "Advancing Renewables in the Midwest", 6th Annual Regional Conference held in Columbia, MO, on March 29th, 2011.

Comment [CDM12]:
Ameren was not aware of or invited to these events.

Also, ACEEE failed to mention the series of DSM regulatory framework workshops that ACEEE's Dan York facilitated on behalf of Ameren Missouri from November 2009 through June 2010. The workshops were important because they highlighted the serious differences in perspectives on the ability for Missouri IOUs to receive timely cost recovery for DSM investments.

We shared a draft version of this study with all of these stakeholders for their review in advance of its final publication, and their comments have been incorporated in this report as appropriate. Free copies of the final report are made available at follow-up outreach events as well as on the ACEEE website.

Reference Case Forecasts

The first step in conducting the analysis was to collect data to characterize the state's current and expected patterns of electricity and natural gas consumption over the study time period (2011 – 2025), as well as population and buildings data. As described in more detail in the next section of the report, we relied on several data sources to develop reference case projections for electricity and natural gas consumption, avoided electricity costs, and retail electricity and natural gas prices.

Energy Efficiency Resource Assessment

There are numerous "levels" of efficiency potential that analysts assess, and these typically include technical, economic, and achievable potential (for a meta-review of efficiency potential studies in the U.S. see Eldridge et. al 2008). The next task in estimating energy efficiency potential is to assess the cost-effective resource that is available given the state's mix of residential, commercial, and industrial energy consumers. Several comprehensive assessments of the energy efficiency potential for Missouri or the surrounding area have been recently completed. In 2009, a meta-review of energy efficiency potential studies was completed for the Midwest (ECW 2009). Next, in 2010 Global Energy Partners completed an energy efficiency potential study for Ameren Missouri's (formerly AmerenUE) service territory (GEP 2010). And finally, KEMA completed a statewide energy efficiency potential study for Missouri in 2011 (KEMA 2011). Together, these studies provided a basis for our energy efficiency resource assessment.

Comment [CDM13]: Note: We do not see where the Ameren Missouri DSM Potential study results have been used in the ACEEE report.

Energy Efficiency Policy Analysis

While efficiency resource assessments provide an important basis for understanding the general magnitude and types of energy efficiency potential in a given state, their limitation is that they provide theoretical estimates but do not provide solutions for capturing the efficiency resource. For example they do not typically address how a state could tap into its cost-effective efficiency potential through policies and programs. Toward this end, our study builds on the recent findings of the various efficiency potential studies and analyzes a specific suite of energy efficiency policies and programs. The suite of policies, including measures like building standards and utility programs for example, would enable homeowners and businesses in the state to take advantage of the energy efficiency resource.

Comment [CDM14]: Note: ACEEE implies that they know how to capture the energy efficiency resource in its entirety. This is a bold claim.

Demand Response Analysis

The Demand Response (DR) analysis, which was prepared by Navigant Consulting, assess current demand response activities in Missouri, uses benchmark information to assess the potential for expanded activities in the state, and offers policy options that could foster demand response as a resource to help the state meet its peak electricity needs. Potential electricity load reductions are estimated for a set of DR programs that represent the technologies and customer types that span a range of DR efforts. These reductions are in addition to demand reductions from expanded energy efficiency. Readers should note that multiple "scenarios" of demand response potential are assessed, however the medium scenario is recommended as a reasonable scenario of demand response potential and therefore is the one scenario incorporated into the overall estimates of energy efficiency and demand response potential in the policy analysis.

Macroeconomic and Emissions Impacts

Next, using the energy efficiency policy analysis results on energy savings, program costs, and investments, we run ACEEE's macroeconomic model, DEEPER, to estimate the policy impacts on jobs, wages, and gross state product (GSP) in Missouri. DEEPER is the Dynamic Energy Efficiency Policy Evaluation Routine, ACEEE's input-output model that evaluates macroeconomic impacts of energy efficiency investments. This is discussed in greater detail in this section of the report. Finally, we assess the impacts of energy efficiency policies to reduce air emissions, including carbon dioxide, sulfur dioxide, and nitrogen oxides.

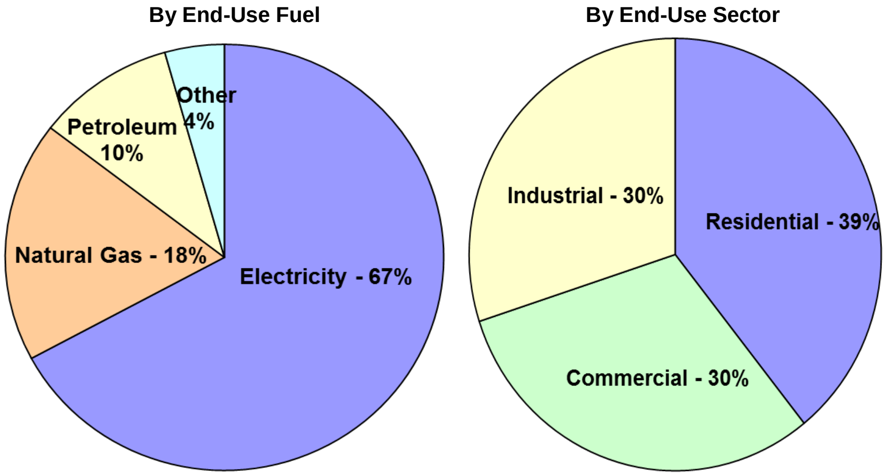
BACKGROUND

This section presents information on current statewide energy consumption trends in Missouri and also on existing efforts to improve energy efficiency. The potential for greater energy efficiency and expanded policy opportunities, as examined in this report, should build on existing experience, lessons learned, and infrastructure related to energy efficiency. Therefore it is important to provide a comprehensive review of what the state has already achieved.

Energy Consumption Trends in Missouri

In this report we examine energy efficiency opportunities in Missouri's residential and commercial buildings, as well as industrial facilities. We do not include efficiency opportunities for the Missouri's transportation sector, however there are numerous policy and technology opportunities the state could explore for this sector (see Eldridge et. al. 2010). Electricity and natural gas account for the vast majority of energy consumption in Missouri's buildings and industries (see Figure 2), and are therefore the focus of this report and analysis. Petroleum use in the state is attributed mainly to the industrial sector, and other fuels include wood and biomass.

Figure 2. Total Energy Consumption in Missouri Buildings and Industry
2008 Consumption = 1,353 Trillion Btu

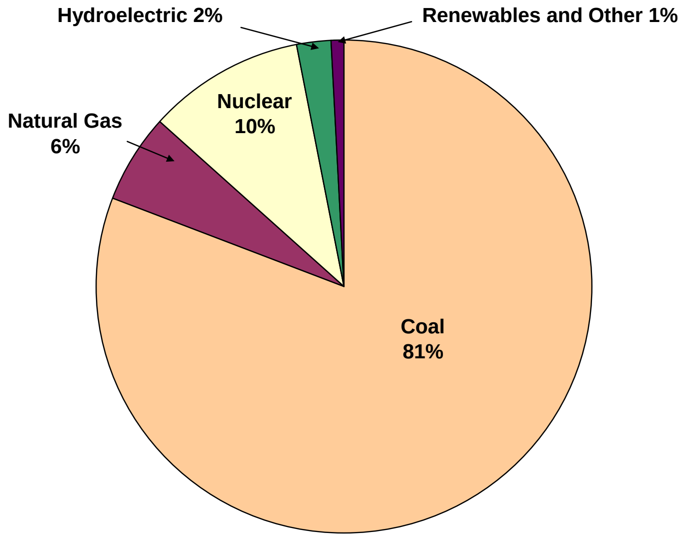


Source: EIA 2010a.
Note: Electricity consumption includes primary energy and the associated generation losses.
Totals may not sum to 100% due to rounding.

Electricity

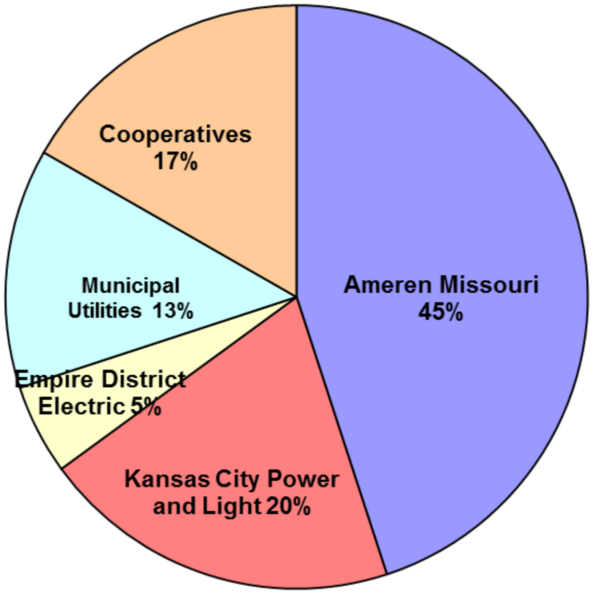
Electricity utilities in Missouri rely heavily on coal-fired power plants for electricity generation (81%), followed by nuclear power (10%) and natural gas (6%) (see Figure 3).

Figure 3. Missouri Electricity Generation by Fuel Type for 2008
(Total Generation = 91,029 GWh)



Source: EIA 2010b.

Figure 4. Missouri Electricity Sales by Utility for 2008 (Total retail sales = 84,382 GWh)



Source: EIA 2010b. Note: Kansas City Power and Light includes both KCP&L and its Greater Missouri Operations (GMO)

As shown in Figure 4, the three regulated investor-owned electric utilities in Missouri include: Ameren Missouri (formerly AmerenUE); Empire District Electric Company; and Kansas City Power & Light

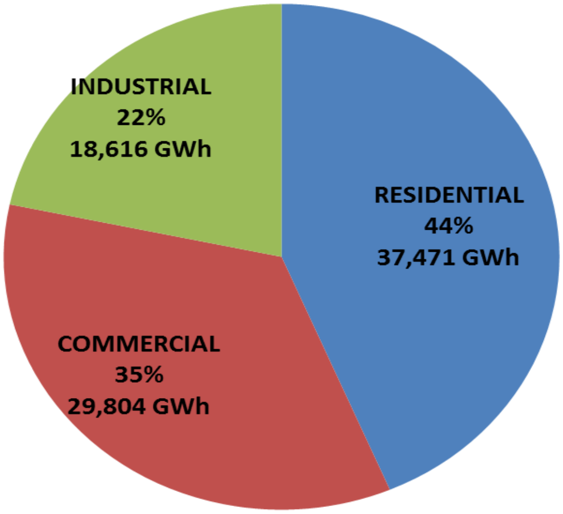
(KP&L), which also includes KCP&L Greater Missouri Operations (GMO)[6]. Ameren Missouri is the largest electric utility in the state, selling the largest share of Missouri's electricity (45%) and serving about 1.2 million electricity customers. The utility also provides natural gas services to about 126,000 customers. Kansas City Power and Light and GMO serve about 20% of electricity sales and Empire District Electric Company serves a small Southwestern portion of the state (5% of sales) (EIA 2010b). The electric cooperatives (17%) and municipal utilities (13%) serve the remaining electricity generation needs.

Missouri's residential sector accounts for the greatest share of electricity consumption, followed by the commercial and industrial sectors (see Figure 5). We base these data on the U.S. Energy Information Administration (EIA) and make some adjustments to the commercial and industrial shares based on the allocations made in the KEMA analysis using data provided by the Missouri utilities.

Natural Gas

As shown in Figure 2, natural gas is a significant direct source of energy to consumers in Missouri in addition to its use for electricity generation. Most homes (58%) in the state use natural gas for heating, and the residential sector accounts for the largest share of natural gas consumption in the state at 46% (see Figure 6). Natural gas energy efficiency efforts will therefore be important for improvements in home heating equipment and systems. Commercial buildings also rely on natural gas for heating and the industrial sector relies on natural gas for some needs. The commercial and industrial sectors both account for about 27% of natural gas consumption in the state. The main natural gas utilities in the state are Missouri Gas Energy and Laclede Gas Company. Ameren Missouri is the third largest natural gas provider in the state.

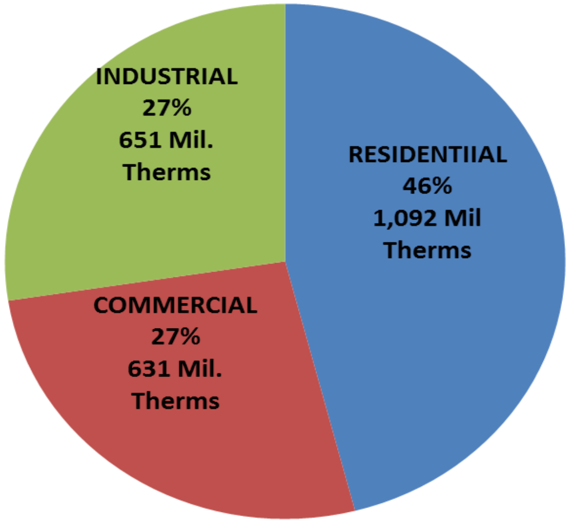
Figure 5. 2010 Electricity sales by sector



Source: EIA 2010b and KEMA 2011

Figure 6. 2009 Natural gas use by sector in Missouri

[6] Both KCP&L and GMO are subsidiaries of Great Plains Energy, however file separate plans with the Public Service Commission

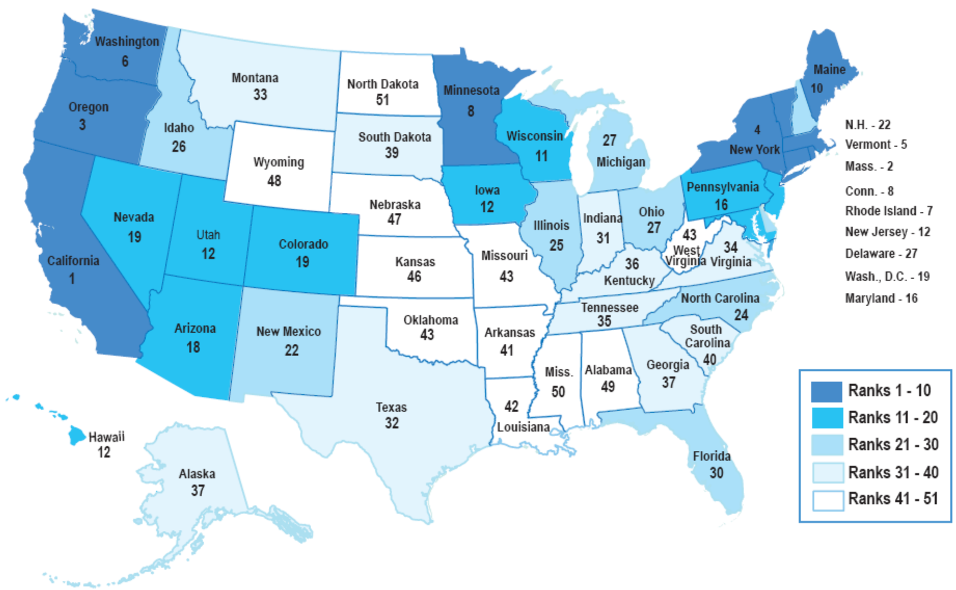


Source: EIA 2010c

Energy Efficiency in Missouri

Historically, Missouri has not typically made significant statewide investments in energy efficiency compared to other leading states. Missouri has ranked in the lower tier of ACEEE annual State Energy Efficiency Scorecards which benchmarks state-level efficiency programs and policies (see for example York and Kushler 2002; and Molina et al. 2010 as shown in Figure 7). However, there has been a recent upswing in energy efficiency program offerings by Missouri utilities as well as legislative and regulatory activity to encourage greater energy efficiency. There have also been recent efforts by local governments, such as building energy code development and implementation of energy efficiency and clean energy projects through federal stimulus funding. State government efficiency programs have also seen an up tick with the support federal stimulus funding. Next we discuss some of these recent efforts in Missouri that signal the state's growing and broadening interest in energy efficiency.

Figure 7. Results of ACEEE's *2010 State Energy Efficiency Scorecard*



Source: Molina et al. 2010

Missouri Energy Efficiency Investment Act: SB 376 and PSC Rulemakings

In 2009, the state legislature enacted the Missouri Energy Efficiency Investment Act (MEEIA or SB 376), which sets a goal of achieving all cost-effective electricity savings from consumer efficiency programs and makes equal the value of cost-effective energy efficiency investments compared to investments in electricity supply and delivery infrastructure. Note: The words "all cost effective" appear one time in SB 376. MEEIA's primary goal is not to achieve all cost effective energy efficiency. MEEIA's goals are:

3. It shall be the policy of the state to value demand-side investments equal to traditional investments in supply and delivery infrastructure and allow recovery of all reasonable and prudent costs of delivering cost-effective demand-side programs. In support of this policy, the commission shall:

(1) Provide timely cost recovery for utilities;

(2) Ensure that utility financial incentives are aligned with helping customers use energy more efficiently and in a manner that sustains or enhances utility customers' incentives to use energy more efficiently; and

(3) Provide timely earnings opportunities associated with cost-effective measurable and verifiable efficiency savings.

To achieve these ends, the law allows the Missouri Public Service Commission (PSC) to provide timely cost recovery for energy efficiency programs, to ensure that utilities' financial incentives are

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aligned, and delegates authority to the PSC to establish rules that achieve the MEEIA's all cost-effective efficiency goal.

In April 2011, the PSC issued several final rules on electric utility demand-side energy efficiency programs and demand-side programs investment mechanisms (DSIM), which together were promulgated to implement the MEEIA. [7] The rules establish guidelines by which the PSC can determine whether utility plans would achieve all cost-effective efficiency, and require that the Commission approve a utility plan only if it is consistent with a goal of achieving all cost-effective savings. The rules also have provisions for utility program cost recovery, lost revenue recovery, and incentives, as discussed in more detail later in the report.

The rule requires that the Commission use either an electric utility's efficiency market potential study or a pre-established set of annual goals (whichever is higher) as a guideline for determining whether programs are meeting all cost-effective efficiency. The pre-established incremental annual energy savings goals are: 0.3% in 2012; 0.5% in 2013; 0.7% in 2014; 0.9% in 2015; 1.1% in 2016; 1.3% in 2017; 1.5% in 2018; 1.7% in 2019; and 1.9% in 2020. The goals are not mandatory and no penalty is assessed for not meeting them. Rather, the goals provide useful guidance for comparison to utility proposals.

Utility Energy Efficiency Programs

Most utilities in Missouri currently offer some energy efficiency programs to Missouri electric and natural gas customers and have plans to continue offering programs at some level. In 2009, utilities in Missouri spent about $27 million on electricity and natural gas efficiency programs and in 2010, program budgets totaled about $40 million (CEE 2010a,b).

Ameren Missouri significantly increased its commitment to energy efficiency in recent years. The utility reported efficiency program expenditures of about $3 million in 2008 and a sevenfold increase to a 2009 annual program budget of $21.5 million (CEE 2010b). Ameren Missouri had a comprehensive energy efficiency market potential study completed in early 2010 by Global Energy Partners to assess electrical energy efficiency and demand response potential in the residential, commercial, and industrial sectors for the Ameren Missouri service territory from 2009 to 2030 (GEP 2010). The utility plans to continue offering some level of energy efficiency programs; however they have recently indicated that they will scale back programs from about $25 million in 2010 to about $20 million in 2011 (St. Louis Dispatch 2011). In their most recent Integrated Resource Plan, Ameren Missouri reported plans to spend $60 million over 3 years on energy efficiency programs (Ameren Missouri 2011).

Kansas City Power and Light (KCP&L)[8], the second largest IOU in the state, also offers several energy efficiency programs for customers, and the utility identified an increasing amount of energy efficiency in its most recent resource plan for the Greater Missouri Operations (KCP&L-GMO 2009). KCP&L recently reported its projected expenditures for 2010 at about $26 million including GMO (KCP&L 2010).

Several municipal utilities and electricity cooperatives also currently offer programs. For example, the City Utilities of Springfield, the largest municipal utility in the state, invested about $500 - $600 thousand per year to energy efficiency from 2008 - 2010 (CEE 2010a, 2010b). Columbia Water and Light, another large municipal utility, identified energy efficiency as the least cost power supply option in its 2008 IRP, which identified that programs could reduce demand from the existing forecast by about 5 to 10% over the next 10 years (CLW&P 2008). The Columbia City Council approved the

[7] For the final rules published in the Code of State Regulations in April 2011, see http://www.sos.mo.gov/adrules/csr/current/4csr/4c240-20.pdf

[8] Data for Kansas City Power and Light (KCP&L) also includes KCP&L-Greater Missouri Operations (GMO)

expansion of residential and commercial energy efficiency programs offered by the utility (CWL 2011).

Gas utilities also administer energy efficiency programs. For example, Missouri Gas Energy spent $1.5 million in 2009 on energy efficiency programs for residential customers and ramped up to a budget of $2.25 million in 2010 (CEE 2010b). For more information on energy efficiency programs provided by Missouri gas companies (Laclede Gas Company, Ameren Missouri, Atmos Energy, and Missouri Gas Energy), see the DSIRE web site (www.dsireusa.org).

But while numerous utilities in the state are offering energy efficiency services, the level of collective commitment still falls well below that of leading states. In 2009, Missouri utilities budgeted about 0.4% of its revenues for energy efficiency services, while leading states budgeted on the order of 2-4% of revenues and the national average was about 1% (Molina et al 2010).

State-Led Energy Efficiency Programs

The state government has also developed programs, separate from those offered by utilities, to encourage energy efficiency. With federal stimulus recovery funds (ARRA), the state Department of Natural Resources (DNR) has rolled out several programs and continues to offer resources for Missouri citizens and businesses to improve energy efficiency. Combined, these programs are estimated to achieve significant annual electricity savings of about 240 GWh (Popp 2011). These estimated savings are equivalent to about 0.3% of electricity needs of the entire state.

Comment [CDM15]: We do not understand the basis for this number. We have seen nothing to date from DNR that suggests any ex post evaluation or analysis of the load impact of ARRA funded programs in Missouri.

Assuming the numbers are somewhat representative of reality, Missouri would have spent approximately $226 million in ARRA funds to achieve 240 GWH of savings.

That equates to an average first cost of $0.94/kwh which is about a multiple of five times the average IOU program cost.

For example, the *Energize Missouri* Communities program distributes $43 million to cities and counties (19% of ARRA funding), for public building energy efficiency retrofits, street lighting and traffic signals, and water and wastewater treatment. Over half (54%) of the ARRA funding, or $128 million, goes to the state's Low-Income Weatherization Assistance Program through the *Energize Missouri* Housing Initiative, which focuses on improving energy efficiency in homes of Missouri low-income families. In April 2010, the state rolled out its Energy Star appliance rebate program - $5.6 million (2%) – which provided rebates for gas furnaces, gas water heaters, clothes washers, and dishwashers

The State Energy Program (SEP) received $57 million, or 24% of ARRA funding, for a variety of initiatives. These include programs for Missouri homeowners, industries, and farmers. The *Energize Missouri* Homes program includes a homeowner upgrades program and a neighborhood challenge program. The *Energize Missouri* Industries initiative has developed a competitive grant program and a reverse auction program. The first provides funding through a competitive grant process to assist Missouri industries in reducing energy costs and increasing competitiveness. Most of the grant recipients have been manufacturing companies, including Noranda, New World Pasta, Boulevard Brewing Co. and Purina. Projects have included mostly lighting, motors, heating and air conditioner upgrades. The "Best Price EE Program" is a reverse auction that allowed industries to bid on what savings at what cost they could achieve. There were 16 successful bidders that are implementing $100k - $500k projects for a total of $3 million. The state is also currently putting together a $5.8 revolving loan fund for energy efficiency and waste water treatment projects. And finally, the *Energize Missouri* Agriculture program consists of a cost-share grant program, energy training, and a loan program. This initiative is discussed in greater detail in the policy analysis section on agricultural efficiency.

Energy Efficiency Initiatives in Local Communities and Metropolitan Areas

The metropolitan areas of Kansas City and St. Louis hold around 56 percent of the state's population[9] and the state's major utilities that serve these regions represent about 70% of electricity sales in the

[9] Census 2000. http://factfinder.census.gov/servlet/GCTTable?_bm=y&-context=gct&-ds_name=DEC_2000_SF1_U&-CONTEXT=gct&-mt_name=DEC_2000_SF1_U_GCTPH1_US10&-tree_id=4001&-redoLog=true&-_caller=geoselect&-geo_id=04000US29&-format=ST-1&-_lang=en

state. The other, smaller major population centers in the state, designated by the U.S. Census Bureau as Metropolitan Statistical Areas (MSAs)—the Missouri counties surrounding Jefferson City, Columbia, Springfield, St. Joseph, and Cape Girardeau-Jackson, Joplin, and Fayetteville-Springdale-Rogers—account for nearly an additional 16 percent of the state's population. In total these MSAs make up 18 percent of the state's land area, while accounting for nearly 75 percent of its population.

Regional and local governments, in partnership with utilities and non-profits, have put in place energy efficiency policies and programs that focus on improving energy efficiency in their communities. Local efforts to improve energy efficiency, especially in high population areas, can have a significant energy saving impact for the state as a whole. Additionally, these local efforts can produce significant non-energy benefits such as household and business cost savings and subsequent reinvestment of those savings into the local community. In this section we feature a few of the numerous local energy efficiency initiatives around the state.

Targeted Energy Efficiency Investments – The Green Impact Zone and SmartGrid Demonstration Project in Kansas City

Dozens of local and metropolitan region partner organizations and agencies are collaborating on this geographically-focused community redevelopment project aimed at vastly improving a neighborhood of Kansas City's urban core through coordinated "green" investments. Energy efficiency in buildings is one of the core strategies—along with jobs, safety & services, infrastructure, housing, youth, and agriculture—being applied to transform the neighborhood. Four separate but coordinated programs are working in the Green Impact Zone to improve energy efficiency: a neighborhood-based low-income weatherization program, two building energy assessment and improvement financial incentive programs, and a "Smart Grid" demonstration project. The Green Impact Zone Low-Income Weatherization Program is managed by the zone in partnership with the regional planning agency, Mid-America Regional Council (MARC), and funded by the Missouri Department of Natural Resources. The program aims to weatherize more than 650 homes in the Zone in the twenty-month period ending March 2012. At the end of March 2011 the program had completed work on 30 homes, work was underway at another 51 homes, and 109 additional prerequisite energy assessments had been completed. The program estimates that participants will receive up to 35 percent reduction in energy usage and save on average $435 per house in heating and cooling costs annually at current prices. The program has made a concerted effort to work with contractors to provide jobs and training for residents of the zone and outreach to residents about the benefits of the program through door-to-door canvasses and in person meetings with landlords.

Households that do not qualify for the low-income weatherization program can participate in the regional Home Performance with ENERGY STAR program that is administered by Metropolitan Energy Center in partnership with Missouri Gas Energy and Kansas City Power & Light (KCP&L). The program provides comprehensive energy assessments and rebates of up to $1,200 for the installation of energy saving measures. Between July 2009 and April 2011 homeowners participating in the program spent $3.3 million on home energy improvements and utilities had provided bill credits of $1.8 million to participating customers. During that time, 1,862 projects were completed with predicted annual savings of about 1800 MWh of electricity and 1 million therms of natural gas for a combined annual savings to homeowners of $1.2 million.

A new energy performance program, EnergyWorks KC, is under development to provide energy improvements for homes and businesses in seven neighborhoods, including the Green Impact Zone. The program has been seeded by $20 million in funds from the American Recovery and Reinvestment Act (ARRA) 2009. The Metropolitan Energy Center coordinates a single point-of-contact program for participating property owners, both residential and commercial, to obtain a building analysis, receive information about energy-efficient upgrades, and maximize available incentives and financing that can be used to employ local improvement contractors. MARC is focusing on the workforce development and policy needs that will facilitate a regional expansion of the service. The City is administering the grant and coordinating funds that will be leveraged as a loan loss reserve for participating financial organizations, rebates that help cross-market existing envelope and mechanical incentives from the area utilities, and neighborhood targeted measures, such as free audits, hazard abatement, and deconstruction to solve pre-weatherization bottlenecks.

The SmartGrid Demonstration Project will invest $48 million in the installation of electrical distribution infrastructure that will impact 14,000 customers in and around the Green Impact Zone. It is funded by the U.S. Department of Energy and led by KCP&L in partnership with the Green Impact Zone and other organizations. The infrastructure improvements will provide customers with real time information on their energy use and costs, more efficient delivery of electricity, and improve reliability and response time to outages. The program also aims to increase awareness of KCP&L's energy efficiency programs, provide jobs opportunities in the demonstration area and install an electric vehicle charging stations in the project area. The project is being implemented in five phases scheduled to run from 2009 through 2014. In March 2011 the installation of new electric meters was nearly completed and substation upgrades were underway. In-home displays providing real-time energy use data had been provided to around 700 homes. KCP&L is estimating household energy savings of 6.5% from the in-home displays. They report that other pilots of similar technologies have resulted in energy savings of 2.5 to 15 percent.[10]

Local Leadership on Residential Building Energy Codes – St. Louis County

Although Missouri is one of only eight states which does not have a statewide building energy code for either residential or commercial buildings, many local governments within the state have adopted building codes for their jurisdictions, some of which include energy requirements. St. Louis County has been a leader among local governments by including energy considerations a part of its building code since 1980. Most recently the county adopted a variation on the 2009 International Energy Conservation Code (IECC) for new residential buildings effective November 1, 2010. The previous code in place was the 2003 IECC. Additionally the county has updated its commercial building code to incorporate the most recent energy code, ASHRAE 90.1-2007. The County's code adoption process happens through a series of public hearings of the Building Commission which then sends it recommendation to the County Council and Executive for approval.

Comment [CDM16]: This is critical information that seems at odds with ACEEE findings that there is only a 1.6% load reduction potential in 2025 in Missouri attributable to building energy codes and enforcement.

In addition to applying within unincorporated areas of the county, the County's residential building codes also apply in the 32 (out of a total of 91) municipalities within the county that contract with the county to implement their code. Additionally, the county is seen by municipalities and other counties in the region as a standard to watch for building codes and perhaps follow suit with a similar code update. The department tasked with code implementation emphasizes the important of regional code consistency on its website, "Public Works is interested in promoting uniformity of construction regulations throughout the entire area because we are convinced that uniformity and consistency in building code enforcement will result in better construction quality and attract more industry and businesses to the region."

St. Louis County is home to more than 995,000 people, approximately 17 percent of the state's population and 47 percent of the Missouri population in the St. Louis metropolitan area. Between 2009 and 2010, new home construction has been in the 400-500 annual range for single-family homes and 40-80 range for multi-family. If the County's development rate stays flat at its modest level, as it is expected to do, the improvement of the building energy code from 2003 to 2009 IECC will result in an energy and cost savings for heating, cooling, water heating, and lighting of approximately 17 percent in these new homes.

St. Louis County is now viewed by many homebuilders as "built-out." Much of the new construction has shifted to more historically rural counties, such as St. Charles, which is seeing annual new single-family home construction of 1,200 to 1,400 and 130 to 170 for multi-family. Upgrading to the most

[10] More information is available at: www.greenimpactzone.org, www.hpwes.net, and www.kcplsmartgrid.com ; Image: http://www.kcplsmartgrid.com/about/smartgridmap.pdf

recent building energy code in these high-growth counties in the metropolitan region and elsewhere in the state will produce energy saving for an even larger number of households.

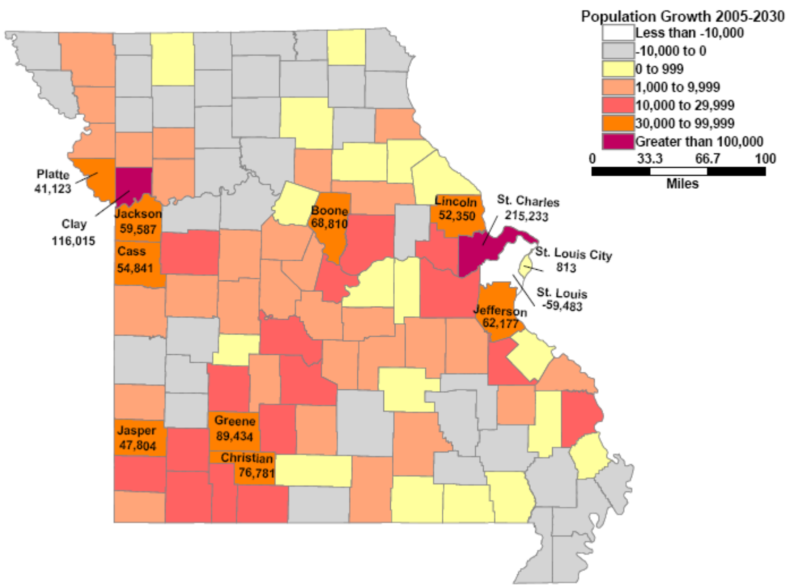
A recent analysis concluded that implementing the 2009 IECC across the entire state of Missouri would on average add a one-time upfront cost of $875 in the construction of new homes but would result in $459 in annual energy cost savings, or a payback of 1.9 years (Paquette et al. 2010). The Building Codes Assistance Project estimates that if Missouri began statewide implementation of the 2009 IECC code for residential buildings and the ASHRAE 90.1-2007 for commercial buildings starting in 2011, it would result in annual savings for households and businesses of $99 million annually in 2020 and $200 million annually in 2030 (BCAP 2011). Later in the report we present an analysis of the statewide energy savings opportunities through improved building energy codes and enforcement similar to the actions already taken by St. Louis County.[11]

Note: If DSM leadership at Ameren Missouri was not contacted by ACEEE for this report, it shows since there is no mention of Ameren Missouri DSM innovation. I would have cited the Ameren Missouri MFIQ, CFL social distribution and Energy Advisor website at cutting edge DSM innovation in DSM program implementation.

REFERENCE CASE

Population in Missouri is expected to grow a moderate 10% by 2025 (Missouri Office of Administration 2011), but with a disparity in growth around the state. The high-concentration of growth will be in the Kansas City and St. Louis metro regions as well as central and southwestern parts of the state, as shown in Figure 8. The top ten growth counties account for 72% of total expected growth in the state's 115 counties.

Figure 8. Projected Population Growth 2005 - 2030



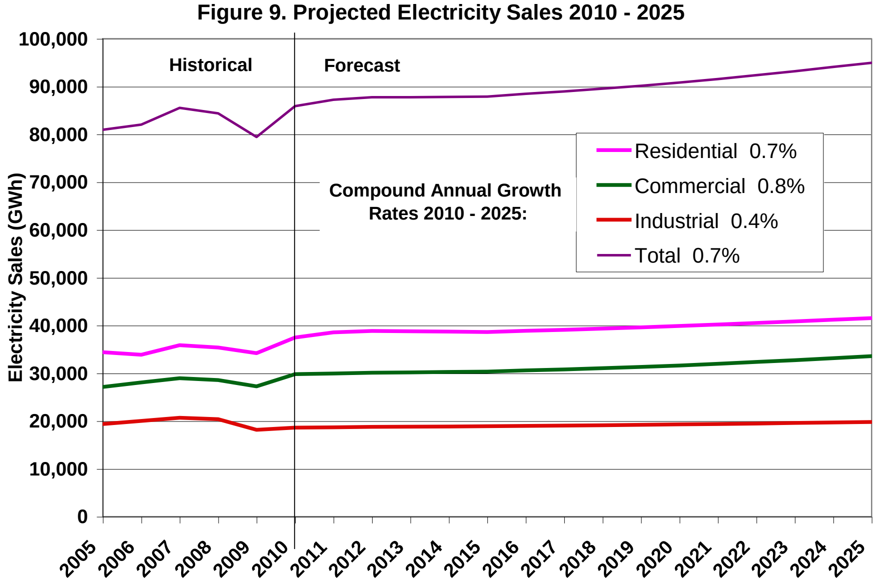
Source: Missouri Office of Administration 2011.

[11] More information is available at: http://ww5.stlouisco.com/pubworks/codesords.html

Next, we develop a reference case for electricity consumption based on various resources, including current retail sales data through 2010 (EIA 2010), Missouri energy efficiency potential studies including the statewide study prepared by KEMA and Ameren Missouri's study (KEMA 2011 and GEP 2010), and utility IRPs. We also make an adjustment to EIA sales data by sector as KEMA's study applied for commercial and industrial sales for 2008 – 2011 (as shown previously in Figure 5). We then adjust the baseline forecast to account for forthcoming federal appliance and equipment standards (Neubauer et al 2009). We find that our adjusted forecast is consistent with KEMA's basecase projections for statewide electricity sales in 2020. Based on Missouri utility IRP projections, we estimate that electricity sales will increase at a compound annual growth rate of 0.7% per year between 2010 and 2025, and sales in the commercial buildings sector (0.8%) will slightly outpace residential (0.7%) and industrial (0.4%) (see Figure 9).

Comment [CDM17]: Includes new appliance & equip standards

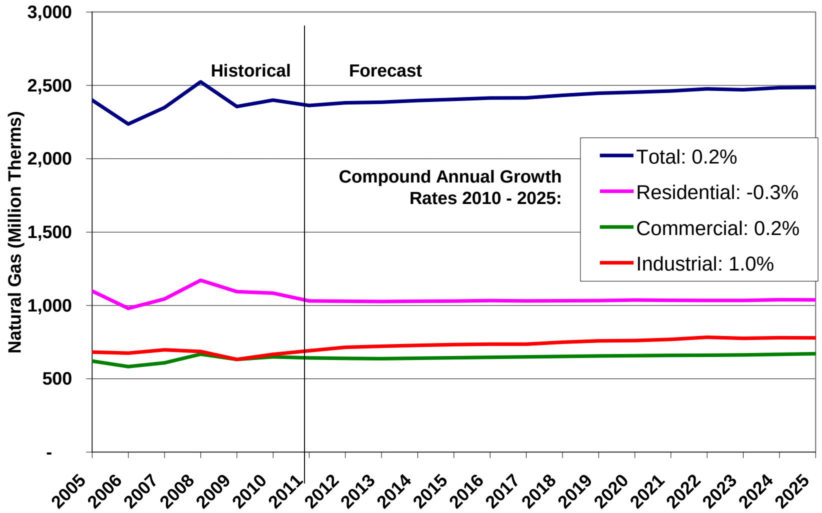
Figure 9. Projected Electricity Sales 2010 - 2025



Sources: See methodology discussion above

For natural gas, we similarly draw upon data from the EIA and from Missouri data sources including the recent KEMA energy efficiency potential study. We develop a reference case forecast using current year natural gas sales (EIA 2010c) and regional projections from the Annual Energy Outlook (AEO) (EIA 2011). We then adjust the baseline to account for forthcoming federal appliance and equipment standards. As is the case for our electricity forecast, our adjusted natural gas forecast based on regional AEO data is similar to the base case projections in the KEMA study. The reference case projects that natural gas sales will increase by about 0.2% per year overall, with most growth coming from the industrial sector (see Figure 10).

Figure 10. Projected Natural Gas Consumption 2010 - 2025



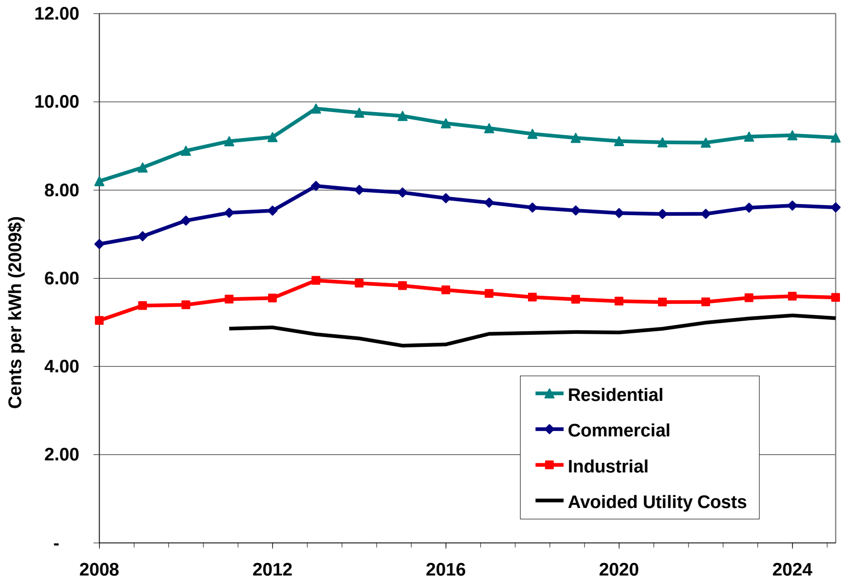
Sources: See methodology discussion above

We also make projections for retail electricity prices in the state in order to estimate benefits to participants from improved energy efficiency services, and avoided costs to utilities in order to estimate system wide benefits for the total resource cost (TRC) test. We rely on the following references and assumptions for the projections in Figure 11:

- Current electricity rates through 2010 are based on state-level data collected by the U.S. EIA (EIA 2010b);
- Short-term retail rate projections are based on recently-approved rate increases for KCP&L and pending rate cases for Ameren and Empire District Electric (MO PSC 2011); and
- Long-term projections are based on the U.S. EIA's AEO 2011 forecasts for the regional electricity markets (EIA 2011).
- Avoided costs are based on estimates from the Missouri PSC, as presented in the KEMA report, and remain relatively flat at about 5 cents/kWh in real dollars. Recent utility IRPs in Missouri do not suggest significant expansion plans for new electricity generation supply over the next 10 years, which explains why the avoided costs do not change (PSC 2011). These rates are conservative for our analysis which extends beyond 10 years to 2025 and it is possible that avoided costs will increase as utilities incorporate expansion plans for generation supply. Also, these avoided costs do not incorporate any price for carbon, which may be likely by 2025.

Comment [CDM18]: What about rising costs of environmental compliance, fuel, transport, borrowing of capital, etc? These would push up both avoided costs and rates.

Figure 11. Projections of Retail Electricity Sales and Avoided Electricity Costs in Missouri (Real, 2009$)



Note: Retail rates are based on data from EIA 2010b and regional projections in the Annual Energy Outlook (EIA 2011). Avoided utility costs are based on data from the Missouri Public Service Commission, as reported in the KEMA 2011 analysis

ENERGY EFFICIENCY RESOURCE POTENTIAL

An assessment of a state's cost-effective energy efficiency resource is an important tool for policymakers and program designers when evaluating and developing energy efficiency policies and programs. There are numerous "levels" of efficiency potential that analysts examine, which typically include technical, economic, and achievable potential, and varying methodologies and assumptions (for a meta-review of state-level efficiency potential analysis in the U.S. see Eldridge et. al 2008):

- *Technical potential*: The technically feasible conservation levels that could be realized over time under specific engineering assumptions about performance and applicability of various efficiency measures. Costs do not serve as a basis; however analysts might have a tendency to include known measures that are generally cost-effective and fewer, less-known emerging technologies with higher costs.

- *Economic potential:* The subset of technical potential expected to be cost-effective, according to various jurisdiction-specific criteria, often the total resource cost (TRC) test.

- *Achievable potential (or Program potential):* The subset of economic potential that can be achieved through programs. Analysts recognize this level as the most uncertain, as it takes into account various levels of investments in incentives and marketing efforts by conservation program administrators.

Numerous energy efficiency resource potential studies have been completed in recent years for a wide geographic range of states and utilities, and increasingly analysts recognize the important of efficiency potential studies in utility resource planning (see Haeri 2011 for a recent review of efficiency potential assessments in the U.S.). This review also points out that while understanding the achievable potential may be important; the determination for policy and program planning has to begin with a robust understanding of what is technically and economically feasible. These estimates provide critical points of reference to help guide resource planning. Ultimately what is reasonably achievable for setting performance standards is a policy and program decision rather than a modeling exercise.

Comment [CDM19]: This appears to be a bold but unsubstantiated statement.

If EERS policies set DSM load reduction goals that exceed maximum achievable potential estimates, economic potential estimates, and even technical potential estimates, such policies cannot be complied with.

Utilities cannot be expected to move independent customers and free markets in ways that are undesired, uneconomic, or not physically possible.

In this section we present a summary of some of the recent studies prepared for Missouri or the Midwest region, including a meta-review of about a dozen studies done for Midwest states (ECW 2009), a potential study for Ameren Missouri in their utility service territory (GEP 2010), and a statewide energy efficiency potential study for Missouri in 2011 (KEMA 2011). Together, these studies provided the basis for our energy efficiency resource assessment. For the KEMA study results, we provide some comments on the methodology and findings, and also note some additional types of energy efficiency opportunities that were not explicitly included in KEMA's analysis nor are typically included in most efficiency potential studies.

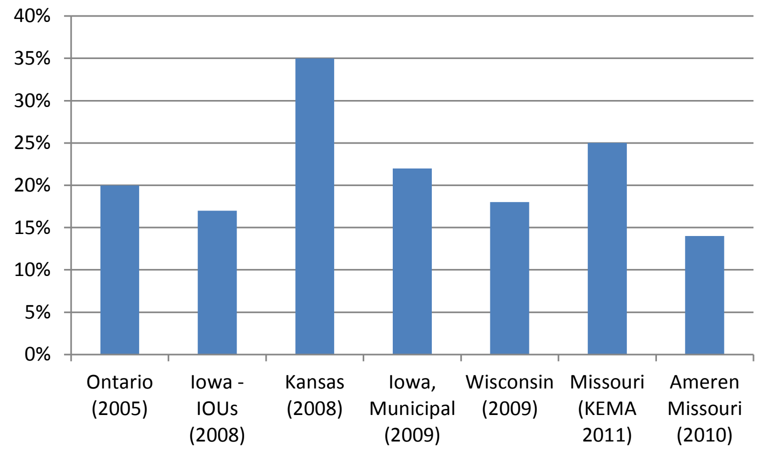
Technical and Economic Potential Results

Technical and economic potential are "bottom-up" assessments that screen all efficiency measures first for technology availability (technical potential) and then for cost-effectiveness (economic potential). The latter are typically evaluated using the Total Resource Cost (TRC) test. This bottom-up approach includes numerous technology measures, and takes into account energy savings, costs, and current saturations of energy efficiency measures, but do not examine program participation. Because technical and economic potential do not model program penetration over a certain number of years, they do not have a time component but rather are a snap-shot of what is cost-effective given current technology and cost assumptions.[12] For this reason, we can draw comparisons among studies of economic potential even if the analysis examined slightly different time periods. As shown in Figure 12, numerous studies recently completed for Missouri and the Midwest as a whole have shown that electricity savings on the order of 15-35% (20% median) are currently cost-effective. We do not attempt to evaluate each study individually, but rather use the broad trends to underscore the finding that a significant, cost-effective energy efficiency resource is available to Missouri should the state choose to deploy policies and should consumers adopt behaviors to capture the resource.

Comment [CDM20]: Not necessarily. Ameren Missouri's study had a time component that evaluated the cost-effectiveness of measures in every year of the study

Figure 12. Economic Potential Results for Electricity Efficiency in Missouri and the Midwest

[12] There will be some variations over time, however, because some measures with long lifetimes may become cost-effective only when consumers are ready to replace them at the end of their lifetime.



Note: For the Ameren Missouri study and KEMA Missouri studies, results for the year 2020 are shown. Other studies have various end-years (Ontario – 2025; Iowa IOUs and Municipal – 2018; Kansas – 2028; Wisconsin – 2018), however as noted above economic potential estimates are less time-dependent than achievable and can therefore be compared as a 'snap-shot' of what is cost-effective under current technology and cost assumptions.

The cost-effective efficiency resource varies by customer class, which is one reason it is important for a particular state or utility service territory to examine economic potential in their own region. Next we provide more detailed sector-specific findings from the KEMA analysis for Missouri, including electricity and natural gas potential.

As shown in Figures 13 and 14, the KEMA study finds that energy efficiency measures can technically reduce about 35% of baseline electricity usage by 2020. Cost-effectiveness screening lowers this level to about 25% of baseline usage (see Figure 13). The potential varies significantly by sector, with the residential sector accounting for the largest potential, followed by the commercial and industrial sectors. Efficiency potential in the natural gas sector is slightly lower, at about 38% and 23% for technical and economic potential, respectively. The residential and commercial sectors both provide about 25% economic potential, but because the residential sector accounts for a larger share of sales, it has the greatest opportunity for energy efficiency savings.

Figure 13. KEMA's Missouri Electricity Efficiency Assessment: Economic and Technical Potential

Comment [CDM21]:

To the unknowledgeable reader, this bar chart shows that Ameren Missouri's estimates of energy efficiency economic potential are lower than every study cited on the chart.

First, it is incorrect – Ameren MO study shows EP = 16.6% in 2030, 15.9% in 2020.
The data point shows it less than 15%

Also, ACEEE fails to note that the Ameren Missouri study is premised on the fact that naturally occurring energy efficiency and known changes to appliance and building codes and standards are incorporated into the baseline sales forecast.

We know with 100% certainty that the KEMA study's economic potential includes both naturally occurring energy efficiency and excludes all known future appliance and building codes and standards.

Therefore, this is truly an apples-to-oranges comparison of economic potentials that ACEEE attempts to exploit to build a case for aggressive EERS.

Comment [CDM22]: Incorrect: All estimates of economic potential are highly dependent on the start and stop dates of the study. ACEEE is completely off base with this comment

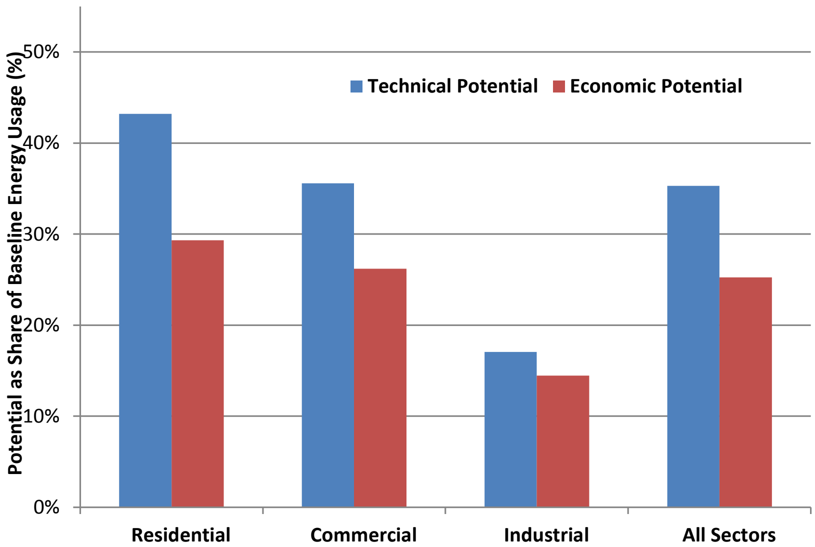
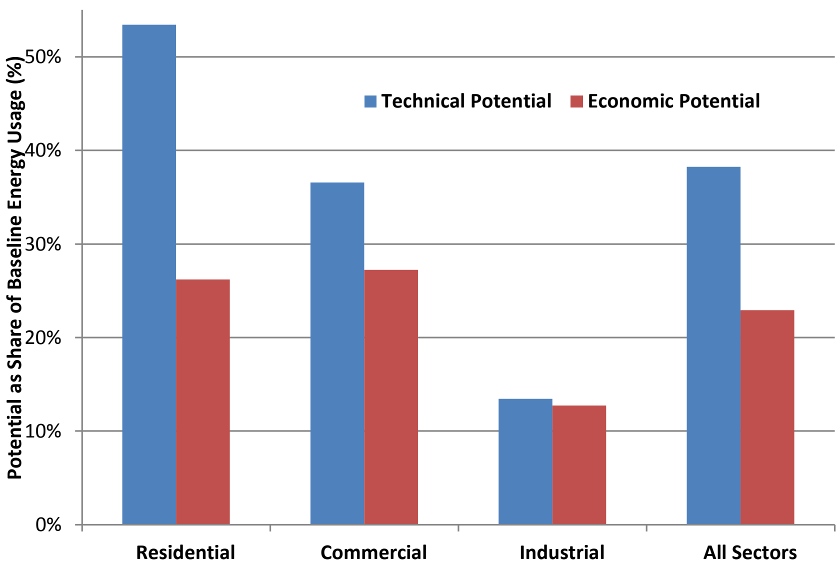


Figure 14. KEMA's Missouri Natural Gas Efficiency Assessment: Economic and Technical Potential



Achievable Energy Efficiency Potential Results

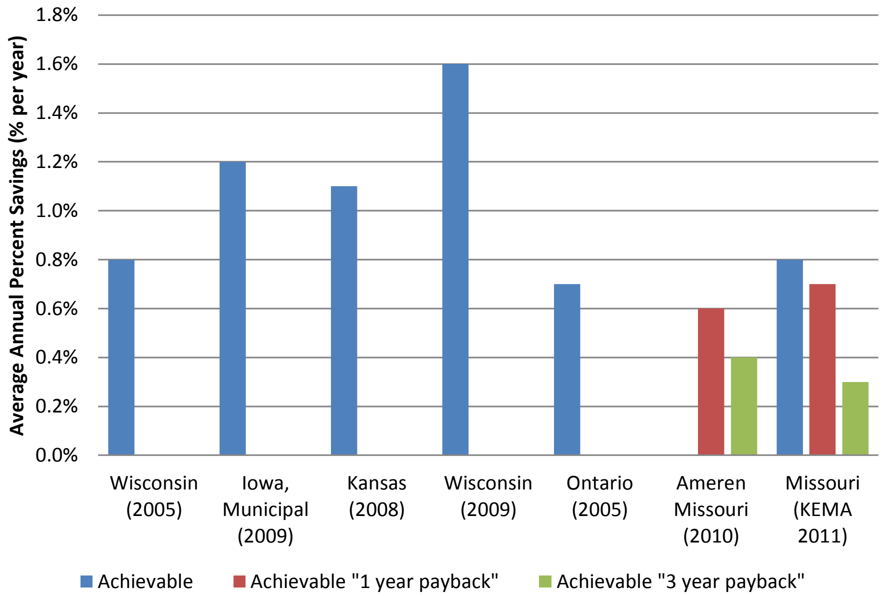
Unlike the technical and economic potential results, achievable potential attempts to account for program participation levels, measure awareness, and other barriers to measure uptake and naturally occurring energy efficiency. Efficiency analysts note that the uncertainty in the achievable potential estimates is greater than the uncertainty of the technical and economic potential results. In Figure 15, we show results for achievable potential from several studies for Missouri and the Midwest, which shows average annual savings over the study time periods. These results show a range of savings of 0.3% - 1.6% per year, and an average and median savings of 0.8% per year. The results of these analyses provide useful guidance to Missouri policymakers and energy efficiency program developers. Next, we provide a brief review of the KEMA study to shed light on some of the uncertainty around achievable results.

Comment [CDM23]: The 0.8% median value does not mean anything since it is based on totally dissimilar studies taken in dissimilar time periods for dissimilar lengths of time.

Why not show the ACEEE 2010 state scorecard and focus on the Midwest states. If so, the savings will be significantly lower than 0.8% per year.

Additionally, the ability to achieve incremental efficiency gains diminishes over time, so a portfolio might start out with the ability to achieve a certain level, but it will then decline.

Figure 15. Achievable Potential Results for Electricity Efficiency in Missouri and the Midwest



Note: All studies except Ameren Missouri and Missouri (KEMA) are included in the ECW 2010 Meta-review.

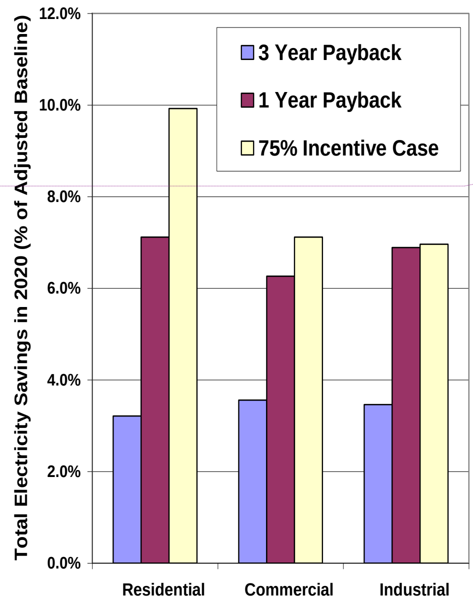
The KEMA study includes several different scenarios as shown in Figure 13, and the variation in savings potential results reflects this uncertainty and variability in what level of savings could be "achievable" under different situations. Customer adoption rates and program funding levels are two clear drivers of efficiency program opportunities.

At the request of the Missouri Public Service Commission (PSC), KEMA used a different approach than usual for its achievable potential in an attempt to make the results more comparable to the recent analysis for Ameren by Global Energy Partners (Ameren 2010).[13] Typically, their analysis modeling assumes that programs provide a certain level of financial incentive as a percent of the incremental measure cost and a certain level of program marketing. The revised methodological approach for the KEMA study classifies efficiency potential according to 1-year and 3-year payback scenarios, and the analysis makes some key assumptions that readers should note: (1) that measures already meeting this threshold are not assigned an incentive and therefore appear not to

[13] KEMA cautions, however, against drawing direct comparisons between the two studies because each study used different modeling approaches and made different assumptions.

be counted in the overall potential estimates; and (2) that all other measures are "bought down" through incentives to these thresholds of 1-year and 3-year paybacks. KEMA also ran their model using the typical incentive approach, which is shown in Figure 16 below as the 75% incentive case.

Figure 16. KEMA Electricity Achievable Potential Results in 2020 by Scenario



Readers should note the inherent uncertainty in using economic parameters as the key driver of evaluating achievable potential. For example the "payback" methodology directly addresses economic viability of an efficiency measure and implies that customer adoption will directly correlate with economic favorability. But in reality, lack of information and misunderstanding – factors that are distinct from economic considerations - are common and persistent barriers to consumer adoption of efficiency (see Stern 1986; Lutzenheiser 1993; and Friedrich et al. 2010) The ultimate example is that measures with no upfront costs and therefore a zero payback (i.e. reducing the temperature on a hot water heater) reduce energy costs but do not have 100% customer adoption. The results of Ameren Missouri's market survey (program-interest) research can help to demonstrate these common trends (Ameren 2010). While the survey research found that the average customer-reported adoption rate was higher for 1-year payback measures (33%) than for 3-year paybacks (25%) (which shows some level of correlation with economic parameters), in both cases the majority of consumers reported that they would not adopt the measures even in the presence of economic incentives and short paybacks.

These results demonstrate that customer education and marketing are critical aspects of energy efficiency incentive programs, and that successful program portfolios will target the multiple barriers to customer adoption. Achievable potential assessments do attempt to account for these behavioral aspects through models of customer adoption rates; however it is important to understand that achievable analyses by nature have this limitation. Wrong. See comment.

We summarize the KEMA achievable results in Table 1. The 1-year payback and 75% payback scenarios present very similar results (7 versus 8% electricity and 5 versus 7% natural gas) and also are the most cost-effective based on the TRC results. These are also the most in line with other Midwest energy efficiency potential studies and also levels of savings already being achieved by leading portfolios, which are readily reaching 1.5 – 2% incremental savings per year. Also, KEMA notes that its analysis is conservative in that they do not include savings from technologies or programs that are not currently in existence.

For our policy analysis we also estimate additional energy efficiency opportunities that are not typically accounted for in the energy efficiency potential studies (discussed next) as well as address areas of overlap.

Comment [CDM24]: Agree

Comment [CDM25]: Is this paragraph meant to argue for the 75% Incentive Case over the payback Case?

It seems merely to state that ANY economic analysis is problematic. I don't understand the reasoning in this section that eventually leads to throwing out the published and accepted KEMA results and using the 3rd case in the KEMA appendix.

Comment [CDM26]: There are limits to the bump in achievement that education and marketing can provide. This is precisely what the Ameren Missouri DSM potential study analyzed. Broad questions and the ensuing analysis in the primary market research phase of the study helped Ameren Missouri better understand achievable potential. Experienced market researchers used state-of-the-art techniques to adjust customer stated intentions to more accurately reflect likely customer response.

Comment [CDM27]: False.

Table 1. Summary of KEMA Achievable Electricity Potential Results for Missouri (2011 – 2020)

	ELECTRICITY	NATURAL GAS

	TRC Ratio	Program Costs (Real, Billion $)	Net Benefits (PV$)	Net Savings (GWh)	% savings	TRC Ratio	Program Costs (Real, Billion $)	Net Benefits (PV$)	Net Savings (Mil. Therms)	% savings
3-Year Payback	2.27	$1.0	$1.6	3,066	3%	1.62	$0.13	$0.12	43	2%
1-Year Payback	2.29	$2.5	$3.3	6,138	7%	1.76	$0.43	$0.36	114	5%
75% Incentive	2.96	$2.2	$4.5	7,569	8%	2.03	$0.43	$0.65	171	7%

Additional Energy Efficiency Opportunities

It is difficult to fully understand the assumptions, methodology, and results of another analyst's energy efficiency potential models. Therefore it is not good practice to dissect the results into individual components and then attempt to evaluate the effects of different assumptions or methods. Rather, the results are best taken in aggregate for general trends and broad classifications. While ACEEE does not attempt to analyze the specific results of the efficiency potential studies presented above, we do offer some general comments here on broad areas of energy efficiency potential that are not typically included in efficiency potential studies. These broad areas of additional efficiency opportunities include behavioral measures (i.e. customer feedback mechanisms and conservation), building energy codes, agricultural production efficiency, and combined heat and power (CHP) systems. Missouri could pursue a combination of or all of these strategies to achieve energy efficiency savings. We discuss and analyze some of these policy and program opportunities in the next section on policy options.

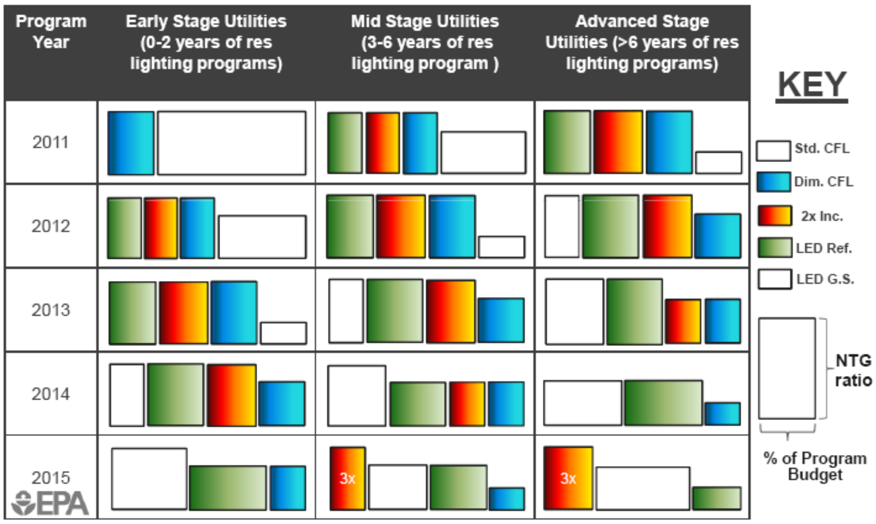
Comment [CDM28]: Fine to include if persistence issues are accounted for (EUL = 1 year or less) and if overlap/double-counting of other, non-behavioral measures is netted out.

Comment [CDM29]: Would take potential away from new construction programs

Also, we noted that the KEMA analysis in its achievable scenarios assumed that CFL lighting programs would cease after 2013 due to the lighting efficiency standards in the Energy Independence and Security Act (EISA) of 2007 that will phase-out traditional incandescent technology beginning in 2012. While savings from lighting programs are somewhat uncertain, it is not yet clear how the new federal lighting standards will shift the "baseline" market of new light bulbs because some incandescent lamps will comply with the new standards along with CFL bulbs. This means that some utility programs for CFL technology and other EISA-compliant light bulbs may still be cost-effective by achieving energy savings above the baseline technology (see Figure 17). For example, programs could target sales of dimmable CFLs and very high-efficiency incandescent light bulbs ("2x Inc" in Figure 17). In short, potential savings from CFLs, LEDs, and other residential lighting will continue to evolve in the near term as an efficiency program opportunity.

Finally, while achievable potential results are a helpful tool to inform policy and program decisions, readers should note that, to some extent, the level of efficiency savings viability are dependent on non-economic factors such as the political willingness to adopt energy efficiency strategies and customer adoption of efficiency measures. Economic models can provide helpful guidance; however program deployment, marketing and outreach, and infrastructure (e.g. training contractors, builders, and programmatic avenues) are difficult to predict and evaluate using an economic model. Economic models are directional and not expected to be taken as exact outcomes of specific policy implementation.

Figure 17. How Utility Efficiency Programs Could Shift Lighting Portfolios 2011 - 2015



Source: EPA Energy Star 2010

Policy Opportunities

Recent assessments of technical, economic, and achievable energy efficiency potential in Missouri clearly identify a significant, untapped resource in the state. But while efficiency has the potential to provide economic and environmental benefits to the state, numerous structural barriers prevent consumer adoption. Missouri policymakers have already begun to address these barriers through state, utility, and local government initiatives. Here we present a number of policy options that can augment existing efforts in the state or open up new opportunities for improved energy efficiency, economic vitality, and sustainable energy use. We estimate that by 2025 this suite of efforts can achieve electricity savings of 18%, reduce peak demand by one-quarter, and save about 13% of natural gas (all relative to projected usage in 2025). At the core of this suite of policies is a set of long-term energy savings targets for utilities to meet through energy efficiency programs and complementary policies. First, we discuss the utility program targets, and then discuss each of the policies listed in Table 2.

Table 2. Summary of Total Annual Energy Savings in 2025 by Policy or Program

Policies and Programs	Electricity		Peak Demand		Natural Gas	
	GWh	%	MW	%	Million Therms	%
Utility Res. Buildings and Equipment Programs*	6,597	6.9%	1,568	8.3%	121	4.5%
Utility Commercial Buildings and Equipment Programs*	3,445	3.6%	499	2.7%	56	2.1%
Manufacturing Initiative	1,580	1.7%	160	0.9%	50	1.9%
Rural and Agriculture Initiative	297	0.3%	29	0.2%	n/a	0.0%
Behavioral Initiative	665	0.7%	166	0.9%	16	0.6%
Building Energy Codes and Enforcement	1,511	1.6%	378	2.0%	60	2.3%
Advanced Buildings Initiative	526	0.6%	87	0.5%	13	0.5%
State and Local Public Building Retrofits	913	1.0%	135	0.7%	16	0.6%
Manufactured Homes	147	0.2%	37	0.2%	4	0.2%
Combined Heat and Power	1,396	1.5%	181	1.0%	n/a	0.0%

Comment [CDM30]: Where does this Utility Program number come from? How is it developed?
6.9 + 3.6 = 10.5%

Comment [CDM31]: Is this pursuing the same savings as the building codes?

Comment [CDM32]: Is this also pursuing the same savings as the building codes?

Comment [CDM33]: All customers in all housing vintages were included in the Ameren MO potential study, so to the extent that we have customers in manufactured homes, these savings would already be accounted for in the Ameren MO potentials.

Demand Response Programs	n/a	0.0%	1,530	8.1%	n/a	0.0%
Total Savings	17,077	18%	4,771	25.4%	336	12.7%
Reference Case Energy Usage	94,946		18,782		2,650	

Note: % savings are measured against reference case energy usage in 2025.
*Utility buildings program savings go toward meeting the utility efficiency program targets. A combination of several other programs and policies could contribute to meeting the targets.

Energy Efficiency Program Targets

Twenty-six states in the U.S. currently are implementing an Energy Efficiency Resource Standard (EERS), which is a policy that sets mandatory, long-term energy-savings targets for utilities. To meet these cost-effective energy savings goals, utilities offer energy efficiency programs of their choosing that help their customers reduce energy usage. These program portfolios aim to address the diverse barriers to efficiency (e.g. rebate and financing programs to address upfront costs; education and marketing to address lack of awareness; and 'up-stream' incentives for retailers and distributers to stock high-efficiency measures, which addresses the split incentive problem). While some state utility commissions set targets annually as part of a ratemaking process, an EERS is a multi-year (at least 3 years) mechanism to lock in future benefits and create certainty that makes it easier for utilities to shape their resource plans. Recent analysis has shown that most states with an EERS for electricity utilities are readily meeting their targets while only a few states with very aggressive goals currently fall short, but are getting back on track to meet their targets (Sciortino et al. 2011).

Comment [CDM34]: While it is true that 26 states have EERS requirements, it is also true that most EERS states have other limits, such as rate caps, that act as a safety valve. Those limits effectively preclude the standards from ever being met. Illinois is a good example. Illinois IOUs have steep, inclining savings mandates, but due to a 2% cumulative rate cap, their EE programs will peak at around 0.8% annual load reductions in 2012 and obtain less and less in each year thereafter.

Based on this recent experience around the country, ACEEE finds that new electricity EERS policies can be most effective in "rapid start" states with limited program experience when the targets start at modest levels, such as 0.3% of annual sales, and ramp up over several years to savings levels of about 1.25% - 2%, which are levels that leading states are readily achieving today. In the recently adopted rules to implement the 2010 Missouri energy efficiency law (MEEIA), the PSC set guidelines for energy efficiency targets that are in line with this approach of gradually ramping up over time.

The targets specified in MEEIA are not based on any type of DSM potential analysis. Consequently, they are relatively meaningless. Ameren Missouri primary market research data clearly shows that the DSM resource follows the law of diminishing returns and decreases over time. See the chart below.

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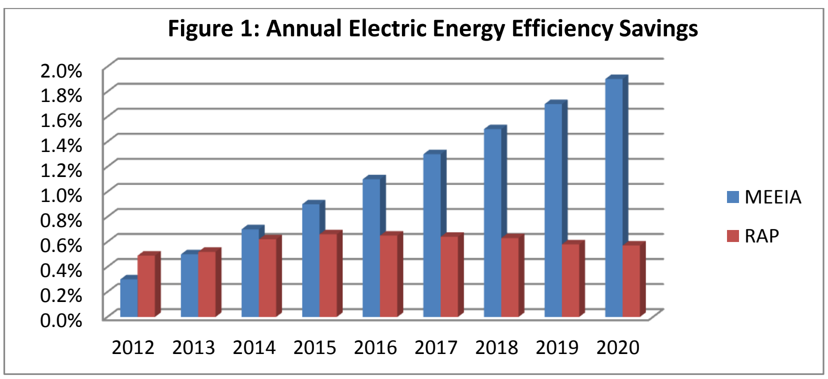

Figure 1: Annual Electric Energy Efficiency Savings

Consequently, an EERS schedule, such as the arbitrary schedule included in the Missouri SB 376 rules, that increases over time at absolute levels that exceed economic potential clearly is unattainable

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Electric utilities in Missouri are already implementing energy efficiency programs and individual utilities plan to meet about 0.2% - 0.5% of their own sales from efficiency, which represents in aggregate about 0.1% of statewide electricity sales.[14] As utilities ramp up their programs and gain programmatic experience and confidence, Missouri could as a next step develop binding, multi-year (e.g. three-year) energy efficiency targets for electricity investor-owned utilities (and natural gas utilities as discussed next). Annual goals would be set as a percentage of electricity sales and could ramp up to 0.3% in 2013; about 1% per year by 2015, 1.5% by 2018, and 1.9% by 2020, consistent with the "soft goals" set forth in the MEEIA rules. The savings targets would apply to the investor-owned utilities (IOUs), which represent about 70% of statewide electricity sales. These utilities (Ameren Missouri, Kansas City Power and Light KCP&L, and Empire District) cover mostly the metropolitan areas of St. Louis, Kansas City, Joplin, and St. Joseph.

While not subject to PSC regulations, electric cooperatives and municipal utilities also offer significant potential to invest in energy efficiency as part of their resource portfolios. These utilities represent 30% of electricity sales in the state and also represent a larger share of residential sales (40%) because they cover rural areas. These utilities will thus be crucial in helping residential customers improve energy efficiency to reduce energy bills. Some cooperative and municipal utilities are already delivering energy efficiency services to their customers. As one example, Columbia Water and Light (CL&W), a municipal utility, outlined energy efficiency (demand side management) programs in their 2008 IRP as the least cost power supply option and offers energy efficiency programs to its roughly 45,000 electricity customers (CLW 2011). As a policy measure, municipal utilities could develop voluntary targets similar to the IOU energy savings targets, as we model in our policy analysis, with savings ramping up more slowly to allow time to build program capacity, from 0.1% in 2012, 0.5% in 2015, 1% in 2017, 1.5% in 2022, and 1.75% in 2024. These are the savings levels we model in our analysis, as discussed at the end of this section.

Natural Gas Program Targets

Comment [CDM35]: Due to the time constraints in the review process, we were not able to perform a thorough review of the Natural Gas analysis portions of the draft report.

Please see other comments in remainder of report as they pertain to Natural Gas.

In addition to savings targets for electricity utilities, several states have set targets for natural gas distribution companies. Leading natural gas efficiency programs in the nation are achieving 0.5% to 1% incremental annual natural gas savings per year after several years of running programs. Promoting efficiency and reducing customer bills are likely to be important to utilities for customer retention in the long term. In our policy analysis we assume savings 0.2% in 2011, 0.3% in 2012, etc., ramping up to annual targets of 1.0% in 2020 and thereafter each year through 2025. As discussed with the electricity program targets, the regulatory framework could allow other, complementary programs to contribute to the savings targets. We assume that industrial consumers would also contribute savings to help meet the targets (which we model as the 'manufacturing initiative' in our policy analysis), as well as other efforts such as a behavioral programs. Building codes could be another option to include in the near-future as programs ramp up if utilities make concerted contributions to code advancement, and could thus justify higher savings targets if code savings are allowed to contribute.

Self-Direct or Opt-Out for Large Industrial Customers

Large industrial consumers in states with Energy Efficiency Resource Standards have often requested the right to "self-direct" and/or "opt-out" as an opportunity to self-fund energy efficiency projects. These consumers cite numerous reasons for requesting to self-direct or opt-out: (1) they often feel that their needs are not adequately served by their local utility's programs; (2) they may have already increased energy efficiency with their own funds; (3) utility programs may emphasize inflexible mandates without considering whether distributed generation such as combined heat and

[14] In 2008, Missouri utilities achieved 0.02% savings as a percent of statewide electricity sales compared to the national average of about 0.2% (Molina et. al 2010). Budgets for 2010 have increased substantially over the 2008 budgets, and we estimate that savings in 2010 are on the order of 0.1% of statewide sales. Ameren Missouri plans to meet about 0.2% of its sales from efficiency in 2012 (Ameren Missouri 2010) and KCP&L plans to meet about 0.5% of sales by 2014 from efficiency programs.

power (CHP) could more cost-effectively meet the energy savings goals (see Chittum et al 2009). But while reasonable consumer concerns might encourage the self-direct or opt-out provisions in energy efficiency standards, utility efficiency program administrators need to weigh other considerations about program administration.

While the terms “self-direct” and “opt-out” have historically been interchangeable, in practice they can vary substantially depending on the goals of the system that these large consumers operate within, and therefore have developed into a continuum. At one end is the pure “opt-out” program, where the industrial end-user declines to pay into efficiency programs, choosing to pursue energy efficiency on its own with no oversight. Further along the continuum are programs that allow large energy consumers to opt out of paying into the programs in exchange for investing in some type of energy efficiency on their own, with varying degrees of oversight, targets and reporting requirements. These programs, while not necessarily maximizing benefits to the entire electricity system, do ensure that these consumers deliver some level of benefits to the system, despite not paying into statewide or utility efficiency programs. While some efficiency gains are achieved, utilities are forced to operate their programs with a smaller revenue pool and a smaller number of participants.

Comment [CDM36]: Note: It does not appear that reasons cited for opting out of paying for DSM programs are applicable to Ameren Missouri industrial customers. Ameren Missouri customers traditionally are motivated by low electric rates

At the other end of the continuum is the “self-direct” approach, where the industrial end-user is responsible for paying into efficiency programs but is given the option to direct a portion or all of that payment into energy-efficiency improvements in their own facilities. Any remainder usually goes into programs that are supported by all consumers. Ideally, “self-direct” programs incorporate targets and reporting requirements in order to provide certainty that the large energy consumers are directing ratepayer funds towards improvements that benefit all consumers within the system.

The MEEIA rules allow large industrial consumers to opt-out of utility energy efficiency programs, with varying approaches along the continuum described above. Customers with demand over 5,000 kW can opt out with no requirement for achieving energy savings, while consumers with a demand between 2,500 kW and 4,999 kW can opt out if they demonstrate to the PSC that their own programs achieve savings at least equal to those expected from utility-provided programs. While this approach addresses the concerns of large industrial consumers, it also needs to be monitored to ensure implementation of energy efficiency improvements. Based on best practice program experience elsewhere, Missouri’s opt-out provision could be improved by establishing verification standards based on best practices and requiring periodic independent verification to ensure the appropriate savings performance.

Utility Program Cost Recovery, Lost Revenues, and Performance Incentives

Utilities across the country have identified the significant disincentive they face to invest in energy efficiency. By reducing customer energy usage and therefore energy bills, energy efficiency can have the effect of lowering electricity and/or natural gas sales to utilities which leads to lower utility revenues. Utilities and their shareholders have natural concerns that, over time, reduced revenues without timely adjustments for cost recovery could impede the utilities’ ability to provide energy services due to decreased earnings or financial margins. To address this barrier, utilities throughout the country have pursued mechanisms such as lost revenue recovery, decoupling, and/or performance incentives, to provide a return on efficiency investments.

Utility performance incentives, for example, are noted as an important indicator that sets apart leading utility energy efficiency programs (York 2009). A recent review of states with performance incentives identifies several examples of states successfully implementing performance incentives and associated lessons learned (Hayes 2010). The Missouri PSC recent rulemaking on MEEIA permits utilities to adopt some measures to implement energy efficiency in the state. For example, it establishes a demand-side investment mechanism (DSIM) that allows utilities to recover program costs, recover lost revenues, and to earn an incentive for high performance toward the savings goals. However, after the rules were finalized the major utilities have sent signals that still more that more needs to be done to create certainty in the regulatory structure, establish firm utility performance incentives, and guarantee timeliness of cost recovery (St. Louis Dispatch 2011). Ameren Missouri

Comment [CDM37]: ACEEE missed a golden opportunity to inform Missouri energy policy makers on DSM cost recovery issues by failing to mention the Ameren Missouri DSM stakeholder meetings that ACEEE’s Dan York facilitated from November 2009 to June 2010. ACEEE could have listed the issues, cited the pros and cons of each issue and then made their policy recommendations.

announced their resource plans which would decrease efficiency investments compared to last year's programs (Ameren 2011) and KCP&L also announced plans to decrease some of their efficiency programs, however the utility was ~~ordered~~ encouraged in its last rate case to continue offering programs at its current levels (KCP&L 2011).

Program Models

There are numerous best practice models for energy efficiency programs from around the nation. In the text box below, we present several of these program types along with specific examples of successful implementations that are drawn from the National Action Plan for Energy Efficiency's Rapid Deployment Energy Efficiency toolkit. ACEEE's report *Compendium of Champions: Chronicling Exemplary Energy Efficiency Programs from across the U.S.* also provides a number of examples (York, Kushler, and Witte 2008). Missouri utilities have already begun to run some of these energy efficiency program models through their energy efficiency programs, however they are far from achieving the levels of savings outlined in this EERS policy analysis. As utilities look to develop future energy efficiency program plans, the examples highlighted in ACEEE's *Best Practices* report and the text box below can provide some guidance on how to expand upon the existing programs in order to offer well-run, comprehensive, and cost-effective utility energy efficiency programs over the long term.

Other Best Practices for Utility Savings Targets

The state could also examine ways the energy efficiency targets for utilities could be inclusive of other energy efficiency efforts in the state. For example, effective, state-led and local program strategies could help to meet the energy savings targets. Collaboration among different program administrators, through some joint education, marketing, and program strategies can enable effective program implementation. To enable collaboration, the state could set up a coordinating entity similar to the Northeast Energy Efficiency Partnerships (NEEP) that has provided shared administration and marketing for some northeast utility programs such as rebates over the past 15 years.[15] The entity would not be the sole program administrator, but rather be a way to share information and marketing as needed. The MEEIA rules have a provision for a mandatory statewide collaborative, which could serve as a starting point for a longer-term coordinating entity. And in addition to the best practice programs described in the text box below, utilities can also explore fairly new areas of savings programs to contribute to the targets, such as encouraging adoption and implementation of building energy codes and behavioral programs. Several of these policies and programs are discussed next, and could contribute to meeting the targets depending on how the goals are designed and how the utilities participate.

Comment [CDM38]: Advocating for an independent third-party administrating entity?..

Methodology for Utility Program Targets

In our policy analysis of utility program targets we assume the levels of electricity savings as described above for the IOUs, municipal, and cooperative utilities, as well as the natural gas savings targets. Cumulatively, these savings accrue to about 16% of electricity sales forecasted in 2025, and 10% of forecasted natural gas use. We then evaluate how the program targets can be met through a combination of efforts. First, proven residential and commercial programs offered by the utilities could achieve the majority of savings. Based on several efficiency potential studies for Missouri and the Midwest, savings of 0.8% - 1% per year will be readily available over the next 10 years through proven programs, and emerging technologies will continue to offer new opportunities for program savings that recent studies have not evaluated. We estimate that proven residential and commercial buildings programs can achieve savings of about 10,000 GWh or 11% of forecasted electricity sales in 2025, and about 7% of natural gas usage.

In addition to proven residential and commercial buildings programs, several complementary program and policy measures such as a manufacturing initiative for industrial consumers, a behavioral initiative to garner conservation savings, manufactured homes program, and an advanced new

[15] For more information, visit www.neep.org

buildings programs could contribute savings. Building energy codes could be another source of savings for utility programs if utilities make concerted efforts to advance stringent and enforced building energy codes. Each of these other policy and program opportunities is discussed next, and offer a variety of avenues for utilities to achieve these program targets and for the state as a whole to take advantage of the efficiency potential. Our analysis does not prescribe one pathway, but rather describes numerous opportunities that utilities and other program administrators could employ to capture cost-effective efficiency resources.

Comment [CDM39]: Building codes as a source of savings if utilities advance them?

What about state and local politicians and enforcement boards?

Examples of Proven Residential and Commercial Efficiency Programs:
The National Action Plan's Rapid Deployment Energy Efficiency Toolkit
As described in: http://www.epa.gov/RDEE/documents/rdee_toolkit.pdf, Wisconsin Focus on Energy and Northwest Industrial Efficiency Alliance

ENERGY STAR Labeled Products: This residential and small commercial sector program promotes efficient lighting (CFLs and fixtures) and appliances through a variety of incentive structures including direct rebates to the customer as well as upstream incentives. This program generally targets the broad residential and small commercial marketplace. Particular products may be selected for inclusion, such as lighting products or home appliances. Savings will depend upon the products included. Typical savings range from approximately 0.5 to 3.0 Million British thermal units (MBtu) per participant.

Residential Energy Audit and Direct Installation: This program targets the same market and works with the same set of contractors as Home Performance with ENERGY STAR (see below); the key difference is a more basic audit and a less-extensive and lower-cost set of measures, such as CFLs, hot water heater wraps, pipe insulation, and low flow showerheads. Typical savings are approximately 3 to 6 MBtu per participant.

Home Performance with ENERGY STAR: This residential sector program offers whole home retrofits using qualified contractors, established home assessment protocols, and incentives from the program sponsor. This program can be a good strategy particularly for older, pre-code constructed homes. The program is estimated to reduce home energy bills by 20 percent on average.
Residential Efficient HVAC: This program targets HVAC contractors and homeowners to increase sales and proper installation of ENERGY STAR-qualified HVAC equipment, such as air conditioners and furnaces. Savings are very sensitive to local climate conditions, but the minimum savings range per participant is approximately 5 to 20 MBtu.

Non-Residential Prescriptive Rebates: This program provides incentives to the commercial, institutional, and industrial market for upgrade or retrofit of equipment with new, more energy-efficient equipment, such as lighting, HVAC equipment, and products like motors and refrigerators. Particular equipment and products may be selected for inclusion in this program, such as lighting; savings depend upon the equipment and products included. Generally, a large percentage of program savings come from lighting retrofits.

Building Retrocommissioning: Retrocommissioning offers building owners a systematic process for evaluating a structure's major energy-consuming systems and identifying opportunities to optimize equipment operation. Retrocommissioning tunes up existing buildings, improving their energy efficiency and operational procedures. It is typically carried out through local networks of commissioning providers. Typical savings range from approximately 4,000 to 20,000 MBtu per participant.

Commercial Food Service Equipment Incentives: This program rebates energy-efficient commercial food service equipment such as refrigerators, freezers, steamers, fryers, hot food holding cabinets, ice machines, dishwashers, ovens, and other technologies, primarily aiming to influence the buyer to purchase more efficient equipment when their existing equipment has failed. Typical savings range from approximately 20 to 60 MBtu per participant.

Continued…

Non-Residential Custom Incentives: A commercial and industrial Custom Program supports C&I customers in identifying and implementing site-specific and complex energy efficiency opportunities, which often require calculations to determine energy savings. A typical project may involve industrial process efficiency, chillers/boilers, data center efficiency, or electric motor retrofits, or projects that otherwise fall outside of the prescriptive program. Savings per project can be very large, but vary widely by state/industry.

Non-Residential Benchmarking and Performance Improvements: This program works with commercial facility operations staff and owners to benchmark, monitor, and improve building energy performance using tools such as ENERGY STAR Portfolio Manager and building sub-metering equipment, as well as to recommend energy efficiency upgrades based on analyses of building performance data. This program is estimated to reduce building energy use by 10 to over 30%.

Non-Residential On-Site Energy Manager: This program assists larger customers by providing an On-Site Energy Manager (OEM) to work with them for a six-month period or longer. During their tenure with a business, the OEM will evaluate facilities' energy use and work with maintenance staff to reduce energy usage and costs. Long-term energy and cost savings of 10-15% are achievable, largely through behavioral changes.

Wisconsin Focus on Energy Industrial Program: This nonprofit organization has a program specifically for industrial efficiency generally focused on projects greater than one-year payback through both prescriptive and custom offerings that complement each other. Focus on Energy programs are both technology- and market sector-based, working with sector trade allies. The program offers field-based technical support, including third-party review of vendor proposals, onsite energy management, technology assessments, measurement and verification, information and education, and project application support.

Northwest Industrial Efficiency Alliance: The Northwest Energy Efficiency Alliance (NEEA) operates an industrial program that leverages industrial allies such as the Northwest Food Processors Association. The effort supports industrial co-led efforts that leverage DOE's Save Energy Now tools and resources to provide corporate executives with an understanding of the strategic importance of efficiency; the resources to identify and implement energy efficiency; and support for the identification of suppliers and technologies to fulfill industry's strategic energy management needs.

Rural and Agricultural Initiative

The agriculture sector presents a unique opportunity for energy efficiency given its prevalence in the Missouri economy. As part of this overall report on energy efficiency opportunities, EnSave, a national program administrator of energy efficiency agriculture programs, prepared the following policy analysis specific to Missouri.

Overview & Demographics

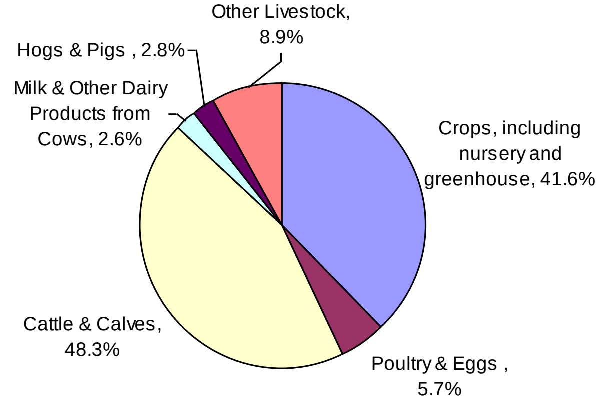
Missouri currently has the 12th largest agricultural economy in the United States, with sales of agricultural products representing over $7.5 billion in 2007. The state's agricultural sector comprises over 100,000 farms and 29 million acres of land, employing about 400,000 people or about 15% of the state's workforce.[16] Missouri is among the top ten U.S. States for value of sales from cotton, poultry and eggs, and beef cattle.[17] With the USDA defining a farm as an operation that produces, or

[16] Missouri Agriculture quick facts, Missouri Agricultural Statistics Service, seen on Missouri Biotechnology Association web site, http://www.mobio.org/docs/pdfs/MoAgQuickFacts.pdf

[17] United States Department of Agriculture National Agricultural Statistics Service 2007 Census of Agriculture, state profile for Missouri

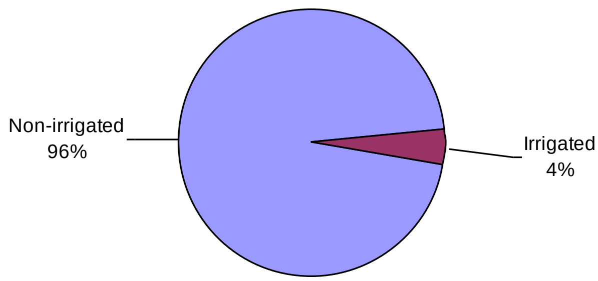
would normally produce and sell $1,000 or more of agricultural products per year, many types of operations are part of the fabric of Missouri agriculture (see Figure 18).

Figure 18. Missouri Farms by Commodity.



Note: Numbers do not add up to 100% due to multiple commodities per farm.
Source: USDA Census of Agriculture 2007.

Figure 19. Missouri Farms by Irrigated Acreage



Source: USDA Census of Agriculture 2007

The agricultural sector is a significant consumer of energy in the state of Missouri, using energy to power equipment used in farm buildings (such as poultry houses, dairy barns, and farm shops), as well as to power field equipment such as tractors and irrigation pumps. The fertilizers used on most farm fields also consume a lot of energy in an indirect manner, as natural gas is used as a main component of synthetic fertilizers.

Missouri has among the lowest electric rates in the nation, with their residential, industrial, and commercial rates rated 9th, 7th, and 5th lowest among the 50 states and the District of Columbia.[18] Low energy prices can be a barrier to progress in energy efficiency, because Missourians may not see a need to conserve a resource that is provided cheaply. Nevertheless, this does not mean that all Missourians can well afford their energy consumption. Many Missouri farmers are struggling to pay their electric and other fuel costs, particularly as other expenses also rise and commodity prices decline.

Missouri is primed to become a leader in agricultural energy efficiency. Its agriculture is diverse, and Missouri agricultural leaders are taking an active interest in energy use on the farm. The MEEIA rules

[18] Missouri Energy Task Force Status Report, December 2010

allow investor-owned utilities to recover costs from implementing energy efficiency programs for their customers, an initiative that may lead to greater investment in energy efficiency from the utilities. The increased budget among the utilities, combined with the interest generated by agriculture energy efficiency programs funded by the American Recovery and Reinvestment Act (ARRA) have combined to form a prime opportunity to invest in energy efficiency. There is enormous untapped potential to increase the energy efficiency of Missouri farms and enhance the viability of the farm sector. All that is needed are program recommendations that will resonate with agricultural producers and lead to actual measure implementation.

Energy Consumption/ Projected Savings

The Missouri agricultural sector uses approximately 23 trillion BTUs of energy on an annual basis. About 10.75 trillion BTUs are used by crop production, and 12 trillion BTUs are used for livestock. The annual cost of this energy to Missouri farmers is approximately $380 billion.

Most agricultural products are traded in a commodity market, where farmers have a contract for a set price. This system has two important repercussions for energy efficiency. First, since farmers cannot raise prices at will, their only options to increase profitability are to expand production or reduce operating expenses. With energy as a significant operating expense, farmers can clearly benefit from energy efficiency. However, when commodity prices are low, farmers lose money and have no discretionary income to put towards energy efficiency upgrades, even if a project has a short payback period. This also means that farmers cannot commit to the long-term loans that are popular in commercial and industrial energy efficiency programs. Furthermore, there are many competing priorities on the farm—energy is just one operating cost that also competes with feed costs, insurance, fertilizers, personnel, and other expenses. These factors lead to the ongoing challenge of agricultural energy efficiency programs: how to convince farmers to invest in energy efficiency when funds are extremely limited.

Conservatively, the agricultural sector can save about 1.25% of its propane consumption and 1.75% of its electricity consumption per year from 2011 through 2025.[19] This estimate, and other data in this report referencing the agricultural sector, include the farmstead only and do not take the farm house into account. Farm residence energy savings potential is included in the residential section of this report. The infrastructure for supply and distribution of natural gas is rare in rural settings, where most farms are located. Therefore we do not have a valid basis to assume potential savings for this generalized purpose. Similarly, fuel oil is used relatively rarely on farms and we do not have a valid basis to assume savings. While diesel fuel is a considerable expense on farms, our experience is primarily on the farmstead (not field operations) and therefore we do not have a valid basis to assume potential diesel savings. However, since diesel fuel is sometimes used in irrigation (a significant energy use in Missouri agriculture), and other field operations, a future study estimating diesel energy savings potential in Missouri would be warranted. Our energy savings estimates assume a robust offering of energy efficiency programs, with incentives available to all sectors of agriculture. The status quo for energy efficiency programs in Missouri relies heavily on loans and other options that are less attractive to farmers. If the status quo continued, Missouri will see fewer savings.

To determine these projections, we reviewed the national non-manufacturing sector energy consumption statistics from the Energy Information Administration, which includes agricultural consumption. We then applied factors from the USDA Census of Agriculture data to determine baseline consumption for Missouri agriculture in 2010, and repeated the process to project energy usage over the next fifteen years. We arrived at annual implemented reduction rates of 1.25% for propane and 1.75% for electricity based on savings and percent of farms participating in two representative agricultural energy efficiency programs.

[19] EnSave, Inc.

On an individual basis, recent farm energy audits completed in Missouri have shown energy savings anywhere from 10% to 35% of total energy savings. MBTU (million BTU) savings have ranged from 63 MBTU for a dairy farm to over 2,400 MBTU for a poultry broiler operation.

Existing Energy Efficiency Programs

In the past few years, there have been several initiatives to increase the energy efficiency of Missouri farmers. The Missouri Department of Natural Resources Division of Energy, which administers the state energy program, has overseen the Energize Missouri Agriculture program, a suite of various energy efficiency programs for agriculture using ARRA State Energy Program funds. Additionally, the Missouri Agricultural and Small Business Development Authority offers value-added grants to producers, including projects that use alternative energy.[20]

In 2010, the Division of Energy provided cost share grants through the Energize Missouri Agriculture program, offering grants up to 75% of the cost of an energy saving system, up to $5,000. This program ran from January through April 2010 and awarded $6.1 million in grants to Missouri farms. Also in 2010, the state began operating the Agricultural Energy Loan Program through Energize Missouri Agriculture, which makes $4.5 million in loan funds available, with a minimum loan of $30,000 and a maximum of $500,000.[21] The third component of Energize Missouri Agriculture is the Field Day: Energy Training, which awarded $500,000 to five organizations to offer energy efficiency training to farmers. During the same year, the Missouri Department of Agriculture was awarded an ARRA grant through the Better Buildings program to administer the MAESTRO (Missouri Agriculture and Energy Savings Team- A Revolutionary Opportunity) program. MAESTRO offers cost-shared energy audits, a~~n~~ loan interest buy-down to 3% or an equivalent amount in a cash down payment, loan guarantees up to $50,000, and grants up to 75% of the equipment cost, with a maximum of $5,000.

Energy efficiency assistance has also been available through USDA Rural Development's Rural Energy for America program (REAP), which offers grants and loan guarantees to farms and rural small businesses who install energy efficiency or renewable energy projects. Grants range from $1,500 to $250,000 for energy efficiency projects and $2,500 to $500,000 for renewable energy. Guaranteed loans can fund up to 50% of a project's eligible cost, with a minimum of $5,000 and a maximum of $10 million.

Missouri's REAP awarded thirteen energy efficiency/renewable energy grants in FY 2009 totaling $487,334. Nine of the awards and $470,759 was awarded to farmers. In FY 2010, the REAP awarded fifty five grants totaling $1,986,417. That year, thirty six grants totaling $1,135,232 went to farmers. FY 2010 also saw the awarding of eight guaranteed loans, six of which went to farms. Nearly all the grants in both years went to grain dryer replacements and poultry house energy efficiency.[22] REAP also has an energy audit/renewable energy development assistance grant, which provides funding to units of state, tribal or local government, educational institutions, public power entities, and rural electric cooperatives to provide energy efficiency and renewable energy improvement projects. In 2010 Missouri awarded Associated Electric Power Cooperative with grant funding to offer 100 farm energy audits to members of its distribution cooperatives.

The REAP data from Missouri is encouraging because of the dramatic increase in funded projects from FY 2009 to FY 2010. In many states, REAP awards have historically gone to mostly renewable energy projects, which are very expensive and can dominate the funding. Rural development has made some important changes in recent years to encourage greater participation from farms with smaller projects. They have also made the application process easier and provided a longer application period.

[20] Missouri Department of Agriculture Yearly Review, 2009
[21] Energize Missouri Agriculture web site, www.dnr.mo.gov/transform/energyziemissouriagriculture.htm
[22] List of FY 2009 and FY 2010 REAP awards, provided by USDA Rural Development's Missouri office

Because nearly all farm grants in Missouri funded poultry or grain drying improvements, there is likely some form of technical assistance in-state to assist with determining energy savings from these projects. When REAP is provided on its own without resources to assist farmers with determining energy savings or providing application help, some farmers are unable to seek the assistance they need. However, the presence of other resources to help leverage REAP can make for a successful use of funds.

In 2010, the USDA Natural Resources Conservation Service (NRCS) began offering financial assistance for Agricultural Energy Management Plans (AgEMPs). These AgEMPs provide an energy management plan to farmers, and NRCS provides a payment to the farmer of about 75% of the cost. AgEMPs are provided by Technical Service Providers, professionals who must register and be approved by NRCS before performing services for farmers. By providing assistance with the cost of an energy management plan, NRCS is helping to remove cost as a barrier to farmers receiving energy management plans. This program is promising, especially as it provides a product that can be used with a REAP application and to leverage other funding.

Challenges

According to several leaders of the Missouri agricultural community, the major challenges to Missouri farmers include high input costs (which includes both fuel and fertilizer costs), low commodity prices, volatility of commodity prices, and weather. These challenges are not unique to Missouri, but are felt in some measure by farmers across the U.S. Reduced energy consumption can directly address the concerns about high input costs and uncertain prices. The main obstacle to farmers participating in existing energy efficiency programs—and implementing energy efficient equipment—is seen by many stakeholders as farmers' reluctance to take on additional debt, as well as general lack of education or awareness both about energy efficiency technologies and the programs that encourage those technologies.

To learn of the challenges and opportunities within Missouri for agricultural energy efficiency, we spoke with ten individuals representing nine organizations: Missouri Department of Agriculture, USDA Natural Resources Conservation Service, Missouri Farm Bureau, Associated Electric Cooperative, USDA Rural Development, Missouri Department of Natural Resources, University of Missouri Extension, the Missouri Agricultural and Small Business Development Authority, and the Mid-America Regional Council. We asked stakeholders for their opinions on challenges facing Missouri farmers and small businesses, the extent to which energy prices and consumption were a concern, specific policies that impact energy use, programs or policy actions that would be most helpful to encourage Missouri farmers to adopt more energy efficient practices, and the main obstacles for farmers implementing energy efficient practices and to participating in programs that are currently available.

Several stakeholders pointed to the complexity of energy efficiency programs, which can create challenges for farmers who lack the time or staff needed to complete applications for programs. Stakeholders were somewhat divided in their opinion of to what extent energy prices and consumption are a concern for farmers. Some believed energy is one of their main concerns, while others thought Missouri's relatively low energy prices discouraged greater interest in energy efficiency.

Farmers have access to many loan opportunities through the federal government as well as private lenders. However, with many farmers extremely debt ridden the opportunity to take on additional debt to finance energy efficiency improvements may often be seen as a low priority.

Recommendations

- *Increase availability of grants as a funding instrument for state energy program energy efficiency improvements, particularly for small projects*

Several agricultural stakeholders have mentioned the reluctance of farmers to take on additional debt. By having grants rather than loans available, farmers are more likely to take advantage of a program and implement an energy efficiency measure. Some agricultural programs, such as Energize Missouri Agriculture, have a minimum loan amount of $50,000. Thus far, this program has received minimal participation, perhaps because farmers already have access to other loans and many smaller farms would have energy efficiency projects that fall well below the $50,000 minimum. On the other hand, the Energize Missouri Agriculture grant program was popular because the grants matched the size of most projects, and the grants were much more appealing to farmers than loans. MAESTRO is also seeing more activity with the addition of grants to the funding mix.

Different types of agriculture have wide ranging expenses for energy efficiency projects. Poultry house energy efficiency measures tend to be much more expensive than dairy measures, for example. While there are some technologies, such as lighting, that are used throughout all types of agriculture, some energy efficiency measures are highly specialized to a specific agricultural process (a milk plate cooler, for example). An energy efficiency program that targets all agricultural producers should ensure that grants are appropriately sized to allow all types of farms to access the grants. The program should also have a wide enough range of measures to allow for the diversity of agricultural operations.

- *Engage private sector involvement in agricultural energy efficiency in collaboration with the Missouri Department of Natural Resources Division of Energy*

Several states award some of their energy efficiency funding to the private sector through a competitive bidding process. This method works particularly well when energy service companies and other entities are able to design their own program delivery mechanism because they can control the factors that lead to cost-effectiveness.

Missouri can do well to model its efforts on states that direct the utilities to offer a percentage of their energy efficiency funding to third party program administrators. Such a model encourages innovation by requiring third parties compete for programs on the basis of cost-effectiveness. This allows for a "race to the top," whereby utilities and other program administrators strive to reduce costs and seek energy savings from underserved markets such as agriculture. Other states encourage participation of third party organizations through solicitations for specific projects, and also encourage unsolicited proposals for new program concepts.

Another benefit to involving third parties in the delivery of energy efficiency services is that sometimes farmers are reluctant to participate in a program offered by the typical administrators. For example, the Missouri Department of Natural Resources is seen by many farmers as the prime regulatory agency for animal waste. Some farmers can be leery of an agency that is often seen as an adversary, now offering financial assistance, no matter how good the program. Similarly, because Missouri does not have a long history of utility administered energy efficiency programs, farmers can wonder why their utility is interested in helping them use less energy. With Missouri organizations new to the energy efficiency industry, they can learn from seasoned consultants and experts about the type of program delivery approach that are most likely to deliver energy savings.

Missouri electric utilities should reserve a portion of their funding for the private sector to bid on energy efficiency programs of their own design. Since there are opportunities for rural and agricultural energy efficiency beyond electric savings alone, the Missouri Department of Natural Resources should remain a source of additional funding to address other fuel savings through energy efficiency programs. Like the utilities, MDNR should offer opportunities (subject to available funding) for the private sector to launch energy efficiency programs of their own design.

- *Leverage REAP with additional availability of reduced-cost energy audits and grant opportunities*

Despite the recent increases in funded projects, REAP still has not gained the same traction in Missouri as in other states. State agricultural leaders point to a lack of farmer awareness as the main impediment to participating in energy efficiency programs. Although USDA Rural Development has simplified the application process, many producers who contemplate smaller energy efficiency projects find the lengthy application process outweighs the potential grant benefit.

The ready availability of energy audits can help leverage REAP funding and lead to greater implementation throughout the state. We recommend a program to offer and publicize reduced cost energy audits, which will be used as tools to access REAP funds. A natural partnership exists within USDA, with USDA NRCS' Agricultural Energy Management Plans. By cost-sharing these plans, NRCS creates a source of high-quality, inexpensive energy audits that can be used as part of the application for REAP. Because one of the greatest barriers to program participation is awareness, we recommend a publicity campaign to promote these plans to farmers throughout the state.

- *Offer Micro Loans through Revolving Loan Fund*

Many states look to a revolving loan fund as a self-sustaining mechanism to finance energy efficiency improvements. These loan funds typically work well for commercial or industrial customers, who have more working capital to invest in energy efficiency. However, these loan funds are typically not successful in attracting agricultural participants. As mentioned earlier in this report, agricultural producers are constrained by a commodity market, and energy efficiency must compete with several other priorities on the farm demanding an initial investment.

The overwhelming majority of Missouri agricultural producers are small business operators. While some do have the financial means to invest in energy efficiency, many do not. Of the 107,000 farms in Missouri, 82% have net cash from farm income of $49,000 and less. The average farm net cash is $18,176. Furthermore, the higher income operators are less likely to need any financial assistance while the lower net income producers will likely not have enough available cash to invest in energy efficiency. Also, both the livestock and especially the dairy industries are still reeling from the effects of low milk prices.

To offer a loan program that is tailored to agriculture, we recommend the creation of a pilot loan program that would make streamlined affordable financing available to qualified agricultural businesses. The loan fund would take the form of an on-bill financing model, whereby the loan is amortized over the payback period for the energy efficiency measure installed. The program would require full energy audits in order to determine energy savings from a range of energy efficiency projects. When the farmer installs the project, he or she would begin repaying the loan in an amount less than or equal to the value of the energy savings. For example, if a farmer installed a project that saved $250 per month in energy costs, the loan would be structured so the payments would not exceed $250 per month, meaning that there is no net change in the farmer's cash outlay per month. When the loan is paid off, the farmer begins saving $250 per month for the remaining useful life of the installed equipment.

Comment [CDM40]: Difficult to find projects or measures that fit this description. Illinois OBF difficulties are a case in point.
The crux is the definition of the initial loan payment. EE economics are typically given in terms of "incremental measure cost" (vs the next best alternative technology), whereas loans must pay for the "full measure cost"

We recommend the Missouri Department of Agriculture, which already administers several agricultural loans, be the administrator of this fund. Once the loan fund is established, Missouri will be better positioned to apply to outside funders for additional support. Additionally, all principal repayments stemming from the pilot program will remain in a revolving loan fund and will be available for use in making future farm energy efficiency loans, thus creating a sustainable fund.

- *Encourage Partnerships with Agricultural Organizations in Delivery of Energy Efficiency Programs*

Agricultural organizations, such as the state Department of Agriculture, Farm Bureau, or milk cooperatives are intimately involved with the agricultural producers. The involvement of these organizations is critical to the delivery of a successful farm energy efficiency program. These organizations can be valuable partners in the marketing and administration of an energy efficiency program, working in concert with third-party program administrators.

Any agricultural energy efficiency program needs to fully engage the agricultural community, as these organizations have a direct link to producers and are a trusted source of information about the benefits of a given program.

Manufacturing Initiative

The industrial sector accounts for a large share of electricity and natural gas usage (30%) in Missouri, and therefore represents a significant opportunity for energy efficiency. Based on discussions with a range of stakeholders involved with the manufacturing sector, we propose a government/utility/industrial collaborative we are calling the "Missouri Efficient Manufacturing Initiative." The goal of the initiative would be to address the three key barriers to expanded industrial energy efficiency identified by the stakeholders:

- The need for assessments that identify energy efficiency opportunities;
- Access to industry-specific expertise; and
- The need for an expansion of the trained manufacturing workforce with energy efficiency experience.

The initiative would establish Manufacturing Centers of Excellence in the model of the U.S. Department of Energy's Industrial Assessment Center (IAC)[23] program, where university engineering students are trained to conduct energy audits at industrial sites. Missouri currently has an IAC center at the University of Missouri Columbia, and previously had an IAC at University of Missouri Rolla for most of the 1990s. The IAC program has a proven track record of achieving savings through local manufacturers. An initial Manufacturing Centers of Excellence could be run through the existing IAC, allowing them to expand their industrial services. An additional center could also be established at another major engineering school, perhaps reestablishing a center at UM-Rolla. Expanding beyond the IAC model, these new centers could partner with Missouri's community colleges to bring their students into the larger network centered on the local Center of Excellence. These nearby satellite centers could extend training and associated materials to the community college partners, and offer the opportunity to join the audits they conduct. By applying in-state resources to the IAC model (as several states currently do), the Missouri Centers of Excellence would allow a greater array of training opportunities and be able serve a larger portion of industry, including larger manufacturers not currently served by the IAC program.

Comment [CDM41]: Are these undergrads?

Would want to couple strongly with professors and industry experts if you hope to provide substantial value from audits.

Working together with organizations such as Missouri Enterprise (the local Manufacturing Extension Partnership), the Missouri Chamber of Commerce and Industry, and manufacturing trade associations could provide outreach to manufacturing companies that might not otherwise be aware of energy efficiency programs. Further collaboration with the Missouri Department of Natural Resources' industrial energy efficiency programs would allow the program to coordinate and build on existing infrastructure and expertise on industrial sustainability, energy, and job creation.

Comment [CDM42]: Where has this model been successfully deployed and what have been the results?

This initiative would provide multiple benefits to the state:

- Meet the needs of Missouri manufacturers for a trained technical workforce;
- provide valuable real-world work experience to students interested in working in manufacturing energy management;
- Meet the need of manufacturing facilities for reliable, knowledgeable, and affordable consultation with regard to their energy usage and opportunities for improved productivity; and

23 For more information on the IAC program, visit: http://iac.rutgers.edu/.

- Build capacity at educational facilities and in the MEP outreach efforts that connect Missouri's manufacturers to the wealth of knowledge and proficiency that resides in the state.

This initiative would also be able to leverage the resources and tools developed by the U.S. DOE's Save Energy Now (SEN) program.[24] Supporting an expanded federal manufacturing initiative similar to what has been suggested in recent congressional discussions could also benefit the state's manufacturing base.[25] These proposals would represent an opportunity to leverage successful national efforts to benefit the state's manufacturers.

IAC program and implementation results recorded over the last 20 years show that this program could identify 10-20% electricity savings per facility and achieve a 50% implementation rate. Program costs for the IAC program are about $1 for every $10 saved by industry. We factor in another $0.25 per $10 saved to account for additional education costs. Under these assumptions we estimate the Missouri Efficient Manufacturing Initiative would have cumulative savings of 290 GWh in 2015 and 1,580 GWh in 2025, or 8% of projected industrial electricity consumption in 2025. Similarly, we estimate natural gas savings of 9 million therms by 2015 and 50 million therms in 2025, or over 5% of projected industrial natural gas consumption.

Manufactured Homes

Currently there are nearly 200,000 manufactured homes in Missouri, which represent 7% of the housing stock (Moody's 2011). Manufactured homes built before 1976 were highly inefficient and not subject to federal standards. Energy costs for these pre-1976 homes and also those subject to more recent standards can often be higher than site-built homes. In 1976 the U.S. Department of Housing and Urban Development required construction and safety standards, and homes built since then have improved in efficient practices. Much more potential remains for efficiency improvements, however, including retrofits of existing homes (especially pre-1976 homes) and new homes that go beyond the minimum federal standard.

Energy Star qualified models today achieve about 30% savings on heating and cooling bills compared to homes built to the federal standard. And replacing pre-HUD homes with new Energy Star models can save an average of 6,200 kWh per year and 175 therms of natural gas annually (or about $500 on electricity). Savings are achieved through more insulation, better windows and doors, improved ventilation, better sealed heating ducts, and reduced drafts. Many pre- and post-HUD code homes are also excellent candidates for cost-effective efficiency retrofits including duct sealing, insulation improvements, and HVAC upgrades. But while the vintage of manufactured homes makes them an attractive target for weatherization, in many cases the homes are dilapidated to the extent that weatherization may not be cost-effective and therefore full replacement may be more economical.

Forecasts suggest that another 55,000 manufactured homes will be built in the state by 2025, or 3,000-4,000 homes per year, which means their share will grow to 8% of the housing stock (Moody's 2011). New and existing homes represent a significant potential to achieve energy efficiency savings and economic benefits to Missouri consumers. While new homes are subject to federal efficiency standards, existing manufactured homes in the state represent a significant opportunity for energy savings through efficiency upgrades. We estimate that a targeted energy efficiency upgrade program could achieve about 20% savings per home. When scaled up to retrofit about 35,000 homes by 2025, this could achieve energy savings of about 150 GWh and 4 million therms per year by 2025, equivalent to meeting about 0.2% of the state's electricity and natural gas needs by 2025.

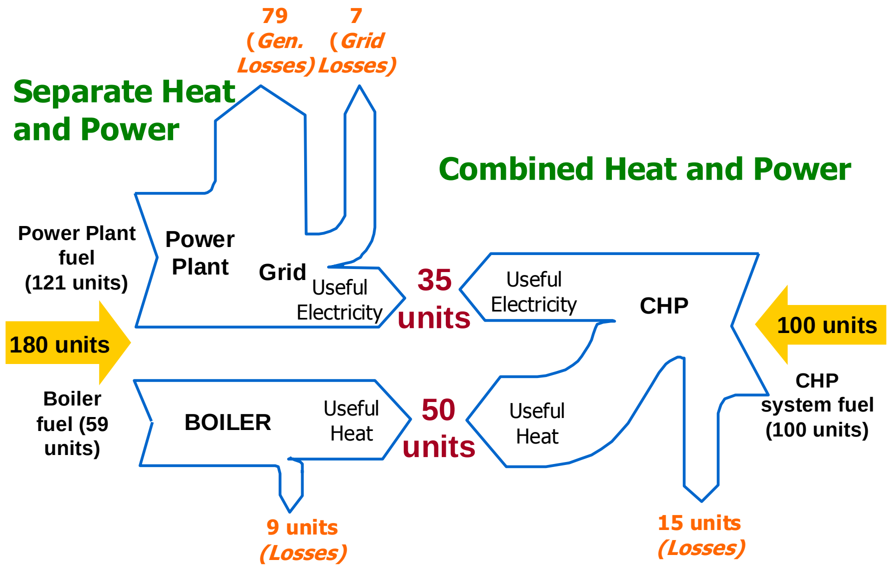
Combined Heat and Power

[24] For more information on SEN program, visit http://www1.eere.energy.gov/industry/saveenergynow/
25 See http://aceee.org/industry/iac.htm.

Combined heat and power improves efficiency by combining usable thermal energy production (e.g., of chilled water and steam) with power production (e.g., electricity). This co-generation process avoids many of the thermal losses inherent in traditional thermal electricity generation, where one-half to two-thirds of fuel input is typically rejected as waste heat. By combining the generation of heat and power into a single process, CHP systems can produce fuel utilization efficiencies of 65% or greater (see Figure 20) (Elliott and Spurr 1999).

Missouri industrial, commercial, and institutional customers could benefit from the improved efficiency of CHP by replacing a thermal system (usually a boiler) with a CHP system that produces both electricity and thermal energy for heating or industrial processes. Currently there are about 20 CHP facilities in operation at sites in Missouri, including the Missouri State Hospital in St. Louis and the University of Missouri in Columbia (see Table A-5 in Appendix A) (ICF 2011). While CHP can represent an attractive energy efficiency opportunity, it can also face significant regulatory and market barriers that inhibit implementation. Policies and market incentives provide an important catalyst to overcoming these barriers and increasing the presence of CHP systems. Next, we discuss the barriers to CHP in Missouri, the policy opportunities to encourage greater deployment, and finally an analysis of CHP potential in the state.

Figure 20. Comparison of a Combined Heat and Power System to Separate heat and Power Systems



Regulatory Barriers and Policy Opportunities

The current policies and regulatory environment in Missouri do not encourage the development of CHP. Between 2005 and 2010, Missouri installed only one new CHP system with a capacity of 10.7 MW. For Missouri to see greater CHP deployment in the future, it is imperative that this policy environment be improved through the policy opportunities discussed below. Supportive CHP policies could help large- and medium-scale manufacturers in the state utilize CHP technology to lower energy costs, thereby greatly increasing their competitiveness. Facilities that use CHP consequently reduce their dependence on grid-supplied electricity, which can free up a grid's reserve margin and increase the grid's reliability and stability – benefiting all electricity users. Many existing industrial boilers may face a need to invest in new boilers to meet new federal EPA air quality regulations.[26] Making these investments in a new CHP system to replace an aging boiler rather than extending the old boiler's life with new pollution controls represents an opportunity for greater efficiency.

Interconnection standard. An interconnection standard provides distributed generation systems such as CHP with clear guidance on how to connect to the local electric grid. Missouri's interconnection standard currently affects only certain smaller renewable-energy systems. The standard applies only to systems up to 100 kW in capacity (DSIRE 2011). Because most CHP systems are far larger, this interconnection standard—even if it explicitly included CHP—would fail to provide a clear path for interconnecting to the grid for most, if not all, viable CHP systems.

A good option for Missouri is to develop an interconnection standard in line with the recommended national guidelines established by EPA.[27] Ideally, an interconnection standard would allow for systems of at least 20 MW in size, and include multiple tiers of interconnection, so that smaller systems would benefit from a more expedited interconnection process. Much of the interconnection process is currently left to the discretion of the state's public and private electric utility companies, whose current business models discourage distributed generation, which includes CHP systems. CHP stakeholders in Missouri have cited interconnection with the grid as being one of the biggest barriers to greater CHP deployment (Chittum and Kaufman 2011).

Net metering. Net metering allows owners of distributed generation systems to receive credit for excess electricity that they produce on-site. Under net metering rules, the customer installs a bi-directional meter that spins backwards when electricity is being sent back to the grid, offsetting the electricity purchased at another time. Missouri's net metering rules, established in 2007 and refined in 2009, currently only apply to renewable energy systems below 100 kW. Therefore, Missouri utilities are not required to purchase power from any non-renewable fueled distributed generation, which includes most CHP systems in the state. We recommend that this policy be amended to apply to non-renewable fuel-powered CHP systems, perhaps with some emission or efficiency criteria, and that the capacity limit be increased substantially. The current rules do not fairly reflect the environmental, economic, and reliability benefits of non-renewable fired CHP as an inherently energy-efficient technology.

Standby rates. Along with clear interconnection standards and net metering, utility standby, backup, and supplemental rates can help determine the economic viability of CHP. To this end, the avoided costs of purchasing electricity from the grid should be greater than the capital and operating costs involved in installing a CHP system. Excessive standby rates and other charges can upset this balance by adding to operating costs, thereby negatively impacting the economics of CHP systems. For onsite generation, *Kansas City Power and Light Company* provides standby service through executed contracts for a specific amount of demand. Customers with independent generators are charged for the contract demand as if they were regular customers, and are then charged for their electricity using real-time standby power pricing, in addition to charges specific to the provision of standby power. There is no demand ratchet in place.[28] *Ameren Missouri* also contracts with standby power customers, which would include most CHP hosts, for a specific amount of energy demand, and then charges for that energy based upon what a typical, non self-generating customer would pay. The demand charges under this rider are high, compared to the energy charges. Neither of these rates is

[26] See EPA's industrial boiler regulations: http://www.epa.gov/airquality/combustion/actions.html

[27] See the EPA's CHP partnership Web pages for additional information on suggested interconnection standards: http://www.epa.gov/chp/state-policy/interconnection.html

[28] The use of demand charge "ratchets" discourages CHP by maintaining a high demand charge, initially levied for a one-time outage, for a period ranging from several months to more than a year. Ratchets thus turn a charge for a one-time demand peak into a long-term fee for the CHP facility.

seen as favorable to CHP. EPA offers useful guidance to states in developing standby rates that are more conducive to CHP development.[29]

Financial incentives. Some states provide incentives to CHP projects in the form of favorable tax treatment, grants or low-interest financing. Stakeholders in Missouri have identified financial constraints as one of the largest barriers to CHP (Chittum and Kaufman 2011). Missouri does not currently offer any statewide financial incentives for CHP, and because CHP installations tend to be capital intensive and require large upfront costs, financial hurdles often preclude development. To further encourage CHP deployment, the state may wish to consider a financial incentive or financing program that directly targets CHP projects and developers.

CHP in a portfolio standard. Missouri voters passed a mandatory renewable electricity standard in 2008 calling for 15% renewable generation by 2021. However, the standard does not include CHP as an eligible technology and there is no complementary energy efficiency resource standard (EERS) that includes CHP. Should the state implement an EERS or individual utility DSM plans, it is important that CHP be included as an eligible resource.[30] When CHP is included as an eligible technology and thus an eligible efficiency resource, there is an increased incentive for CHP developers to bring systems to Missouri. Including CHP as an eligible technology in any definition of an EERS or utility program targets is a positive signal for CHP developers and can help improve the economics of CHP, as utilities are encouraged to deploy technologies that count toward the targets.

Output-based emissions regulations. Output-based emissions regulations define emissions limits based on the amount of pollution produced per unit of useful output (e.g., pounds of sulfur dioxide per megawatt-hour of electricity). A major benefit of output-based emissions standards is that they encourage cost-effective, long-term pollution prevention through process efficiency. The U.S. EPA has proposed a new Air Transport rule designed to reduce the interstate transport of pollutants between states. Once the final rules are promulgated, these regulations will be applicable to Missouri and the state will be required to implement an EPA-developed Federal Implementation Plan (FIP) to achieve the required emission reductions of sulfur dioxide (SO2) and nitrogen oxide (NOx). States will likely be allowed to engage in some intrastate and some interstate trading of emission allowances in order to meet their emission reduction targets, and output-based options will be included in the FIP, encouraging energy efficiency and CHP. The rule is now closed for comment and will likely be published in July 2011, to take effect sometime in 2012.

Many of Missouri's policies and regulations that affect CHP development could be improved by legislative action or regulatory proceedings. Many other U.S states have recently enacted and improved CHP-related policies, providing good examples of steps that could be taken at the state level.[31] These states have better insured that their industrial, commercial, and institutional base of businesses can continue to operate and compete in a more robust and cost-effective manner.

Other Barriers

Missouri's electricity rates are slightly lower than average for the country but like everywhere else are increasing. The exceptionally low rates for commercial and industrial facilities make it much more difficult for CHP to look attractive to developers. With payback periods of 10 to 15 years, large CHP projects rarely come to fruition. Volatile natural gas prices have also made the economic viability of CHP projects uncertain, although recent low natural gas prices make CHP highly economical. What little CHP there is in Missouri was primarily implemented in the industrial sector over 20 years ago thanks to negotiated preferential utility rates. For smaller applications—such as institutions or

[29] See the EPA's CHP Partnership Web page on standby rates for more information: http://www.epa.gov/chp/state-policy/utility_fs.html

[30] For guidance on how to include CHP in and EERS see Chittum and Elliott (2009).

[31] For more information on CHP policies in each state, visit ACEEE's online *State Energy Efficiency Policy Database* at http://aceee.org/sector/state-policy/clean-distributed-generation

hospitals—CHP "just doesn't stand a chance," according to one Missouri advocate (Chittum and Kaufman 2011).

In addition to the economic uncertainty, the electric utility community makes CHP development in Missouri difficult. Dealing with utilities in the state has been reported as being an onerous process (Chittum and Kaufman 2011). Some utilities are more amenable to CHP than others, but Missouri's IOUs in particular have not encouraged CHP development. Some municipal utilities and cooperatives are more interested in CHP, but typically only on a small scale, and the economics of small projects are rarely attractive in the state.

Uncertainty also plays a role in stymieing further development. The implementation of Senate Bill 376 rules, which enables utilities to earn performance incentives for cost-effective energy efficiency programs that achieve certain levels of efficiency, may help to shape decisions about energy use in Missouri. Many industries are putting efficiency projects on hold, awaiting a greater degree of certainty with regard to their investments (Chittum and Kaufman 2011). Additionally, many facilities and developers are not aware of where they can obtain support for CHP project research and implementation (Chittum and Kaufman 2011). One such point of support is the DOE's Midwest Clean Energy Application Center, whose express mission is to facilitate the development of CHP in the Midwest.[32]

Analysis

Based on data from Energy and Environmental Analysis (EEA), a division of ICF International, about 20 CHP plants are currently in operation in Missouri for a total capacity of 225 MW (see Table A-1 in Appendix A). For this report, we estimate potential for higher penetration of CHP systems in Missouri using recent statewide analyses developed by EEA for Arkansas, North Carolina, and South Carolina. We use those analyses as a starting point for comparison. Next, because the economics (relatively low electricity rates compared to natural gas rates, known as the "spark spread") are highly similar between Arkansas and Missouri, we use the Arkansas results as a basis for a reasonable estimate of CHP potential in Missouri (see Neubauer et al 2011). We then adjust the results to account for differences between the two states in terms of the sizes of industrial and commercial/institutional sectors.

Statewide analysis for CHP includes three levels of potential:

- Technical Potential: represents the total capacity potential from existing and new facilities that are likely to have the appropriate physical electric and thermal load characteristics that would support a CHP system with high levels of thermal utilization during business operating hours.
- Economic Potential: reflects the share of the technical potential capacity (and associated number of customers) that would consider the CHP investment economically feasible.
- Cumulative Market Penetration: represents an estimate of CHP capacity that will actually enter the market between 2008 and 2025. This value discounts the economic potential to reflect non-economic screening factors and the rate that CHP is likely to actually enter the market.

Adjusting the Arkansas results to the Missouri mix of industrial and commercial/institutional customers, we estimate technical potential of around 3,600 MW of CHP capacity. Next, we estimate CHP market penetration given market realities in the base case (assuming no policy changes) of 20 MW by 2025. Finally, we estimate market potential in a hypothetical policy scenario, in which changes in policies and regulations reduce costs by $1,000 incentive per MW installed. By 2025, we estimate that about 220 MW of CHP would be cost-effective and feasible in Missouri under this policy

[32] For more information on the Midwest Clean Energy Application Center, visit http://www.chpcentermw.org/home.html.

scenario, which would be the equivalent of doubling the existing capacity of CHP in the state. This would save about 1,400 GWh in 2025, or 1.5% of the state's electricity needs.

Building Energy Codes and Enforcement

Building energy codes are a foundational statewide energy efficiency policy that ensures that new buildings follow current efficiency practices and use minimal energy, saving homeowners and business owners money on energy bills throughout the life of the building. Missouri is one of only a few states in the country that does not have mandatory statewide building energy codes. This gap represents a significant opportunity for the state to tap into its efficiency resource. When buildings do not incorporate optimal energy efficiency at the time of construction, the new building stock represents a "lost opportunity" for energy savings because efficiency is difficult and more expensive to install after construction is completed. Building energy codes capture these energy and dollar savings ~~and dollar~~ by requiring a minimum level of energy efficiency for all new residential and commercial buildings, as well as major renovations. Further, builder compliance is encouraged by adopting straightforward codes, which allow contractors to follow performance-based or prescriptive-based paths, through training, and enforcement strategies.

Adopting the 2009 International Energy Conservation Code (IECC) for residential buildings would substantially improve energy efficiency in Missouri's new and renovated homes, as would the most recent code for new commercial buildings, called ASHRAE 90.1-2007. An average new Missouri home built to the 2009 IECC, for example, could save a homeowner about \$350 - \$565 per year on energy bills, an 18%-26% reduction in code-affected energy usage (DOE 2009). The ASHRAE 90.1-2007 could similarly achieve savings of about 20% for new commercial buildings according to U.S. Department of Energy estimates.

Although there are no existing state standards, local jurisdictions have authority to set minimum required building energy codes for new residential and commercial buildings subject to voter approval. And two counties, Clay (Kansas City metro area) and Jefferson (St. Louis metro area), are authorized to adopt building and construction regulations without voter approval (BCAP 2011). Some jurisdictions have already pursued greater energy efficiency for new buildings. Saint Louis County has adopted the 2009 IECC, and Saint Louis City and St. Charles County are also considering adoption (Belcher 2011). Local jurisdictions typically adopt every other IECC code rather than each 3-year cycle, which means that the 2015 IECC would be the next likely code adoption for the Saint Louis region. Kansas City has adopted the 2006 IECC without amendments, and is exploring adoption of the 2012 IECC. While statewide building standards presents a great opportunity for energy and cost savings, updating to the latest standards in all high-growth local jurisdictions would be a sizeable first step. The Saint Louis and Kansas City Metropolitan Statistical Areas, for example, comprise 50% of the expected growth in the state's population (Census and MO Office of Administration 2010).

To establish streamlined, statewide codes, the Missouri state legislature would have to revise state law. Efforts to adopt statewide codes, however, have not been successful and have been met by strong resistance from many rural parts of the state. But ongoing local efforts across the state are building capacity for updated building energy codes and emphasize that adoption of the latest codes at the local level has been successful model. Other local jurisdictions, especially those which expect higher growth, should pursue building energy codes. Information sharing and cooperation on enforcement and compliance measures, as discussed next, would bolster the effectiveness of local building energy codes.

Enforcement and Compliance

Compliance and enforcement are critical in achieving the full savings potential from new buildings energy codes. Whether a state or local jurisdiction adopts a mandatory code, enforcement will be implemented by local code officials. Collaborative training and joint compliance studies are some steps that local jurisdictions can take to achieve greater rates of compliance. It is often difficult, however, for local officials to afford training. It is therefore critical that enforcement agencies have adequate capacity, understanding, technology and training. For example, local jurisdictions need statewide support for training both code officials and builders, and to encourage greater interaction between the two communities. The U.S. Department of Energy has awarded Missouri a grant to provide assistance toward local code adoption, training and compliance, which can be a helpful step toward better codes and compliance.

Analysis

Missouri is estimated to add about 370,000 new homes between 2011 and 2025, which means about a 15% growth from its current housing stock of about 2.5 million homes (Moody's 2011). Based on the state's employment forecasts, we expect commercial construction to grow about 11% over the same time period (Moody's 2011). Our policy analysis assumes that local governments in Missouri adopt building energy codes equivalent to the IECC 2012, which becomes effective in 2013, and this new model code reduces energy usage by about 30% in new residential construction (for energy usage affected by the codes) relative to the 2006 IECC (DOE 2009). We also model the adoption of commercial building energy codes for the most recent ASHRAE 90.1-2007 codes which achieve savings of about 20%. Next, we assume that local jurisdictions update residential code to the 2018 IECC, which can achieve an additional 20% savings over the 2012 IECC, and ASHRAE 90.1-2010, which is estimated to achieve savings of about 20% over the 90.1-2007 code. Through these policy measures, we estimate that the state can achieve total annual energy savings in 2025 of nearly 1,500 GWh and 60 million therms of natural gas from reduced energy consumption in its residential and commercial buildings, enough to meet 1.6% of the state's total electricity needs in 2025 and 2.3% of natural gas needs.

Comment [CDM43]: This is a very rough analysis. How are these savings substantiated or documented?

Advanced New Buildings Program

An Advanced New Building Initiative would complement building energy codes by encouraging voluntary high performance, new residential and commercial buildings. Barriers to low-energy buildings are not technical in nature, but rather based on economic and social barriers: split incentives (builders do not pay the energy bills for the building); various motivations of owners, designers, and builders; and higher up-front costs. As a result the market has been very slow to develop. This advanced buildings initiative, through technical assistance and financial incentives, would increase market share for high performance new building practices while preparing the market for updated building energy codes. This initiative would also complement existing home retrofit programs.

For the residential sector, the Energy Star New Homes program is an excellent model and there are five builders in the state committed to building 100% Energy Star New Homes and numerous more Energy Star builder partners.[33] Best practice programs have demonstrated success in state-led management of this type of program, while bidding out competition for program implementation to local governments, non-profit organizations, and utility partners (Sciortino 2010). For example in Colorado, program partners were selected based on their capacity to implement an aggressive program, ability to develop relationships with stakeholders, and ability to contribute matching funds. While the state manages the program, there is an opportunity to customize the program based on local needs. In the Colorado program, the majority of activities targeted homebuilders, contractors and homebuyers, and the program emphasized integration of local green building programs and utility energy efficiency programs. In coordination with utility programs, Missouri could similarly build on statewide experience.

There are several excellent resources on how to model an effective advanced commercial buildings program. The U.S. Department of Energy, for instance, has developed materials on how to achieve

33 http://www.energystar.gov/index.cfm?fuseaction=new_homes_partners.showAreaResults&s_code=MO&msa_id=all

significant savings in new and existing buildings.[34] Another useful source of information is the New Buildings Institute, which has a Web site on "Getting to Fifty" [percent savings].[35] ENERGY STAR also publishes a breadth of information on energy efficiency in commercial buildings and industrial plants.[36] Providing financial incentives to contractors or building owners will be crucial to guaranteeing that efficiency measures are implemented beyond what is already required by code. The Energy Policy Act of 2005 included a $1.80/square foot tax deduction for commercial building owners for each building constructed that uses 50% less than a new building designed to a national model reference code. Commercial contractors can also visit the Tax Incentives Assistance Project (TIAP) Web site for federal tax incentives for commercial energy efficiency investments: www.energytaxincentives.org.

A coordinated, statewide initiative would strive to achieve 30% and 50% beyond code savings and net-zero energy homes and buildings. For this policy we use the same assumptions as the building code analysis about projected growth in the state, and then estimate savings levels for a gradual ramp-up of the penetration of advanced new buildings. First, we assume an increasing number of homes achieve Energy Star-compliant levels, which currently achieve 18% whole-house energy savings beyond non-Energy Star homes, ramping up from 10% of new homes in 2011 to 25% in 2014, and 55% in 2018. Advanced new homes can achieve 30 – 50% beyond code savings, and in practice this initiative should pursue a multiple pathways of advanced building practices that work best in Missouri. Advanced new commercial buildings should also be included, and can achieve savings of 30-50% beyond code. We assume that penetration of advanced new buildings ramps up from 10% in 2012 to 25% in 2015 and 55% by 2019. For both residential and commercial buildings, the initiative would work in conjunction with building energy code upgrades. We estimate that this effort can achieve energy savings of about 530 GWh by 2025 and 13 million therms in natural gas savings.

Comment [CDM44]: Ameren Illinois has its 1st new net-zero home community. On-site solar and wind options cost $68,000 per each 1,400 sq. ft. house. Clearly, such a program is not economic, and ACEEE is basing this recommendation more on hope than on fact.

Behavioral Initiative

Comment [CDM45]: ACEEE has done an "about face" on the applicability of energy usage behavioral initiatives in a DSM Potential study. ACEEE published a report "Energy Efficiency Resource Potential In The Midwest" in August 2009. Here is what the 2009 ACEEE report states:

"Behavior change is especially difficult to model because over time what now might be considered a change in typical behavior might eventually become the norm. The issue is when a behavior change in an innovation, and when it becomes part of the baseline. This issue, too, needs further research.

Guided by research in social psychology from the past several decades, utilities and the energy industry have recently begun to appreciate the power of providing consumers with localized, comparative information on household energy consumption to influence their behavior and encourage energy conservation. Comparative information, in the form of periodic reports, is equivalent to having an in-home energy monitor that provides information such as seasonal variations of energy use and goes a step further by providing a comparison of one household's consumption pattern to similar households. When households are given information on how they perform relative to their peers, they are motivated to follow suit. Robert Cialdini, a social psychologist, regards this as "social proof," or an instinct akin to peer pressure (Tsui 2009).

Behavior programs are a helpful complement to energy efficiency standards and financial incentive programs. Missouri programs have already begun to deliver behavior-based initiatives, including the Neighborhood Challenge Program administered by the Department of Natural Resources that aims to motivate participants to reduce energy consumption. DNR teamed up with a company called OPOWER to send out home energy reports, to about 1200 homes, and uses in-home energy monitoring devices over the course of year to provide consumers feedback on their energy usage.

Evaluations of OPOWER's programs in other states have shown that mailing comparative energy reports alone can reduce energy consumption between 1.5% and 3.5%. The reports consist of monthly electricity consumption that compares one household's usage patterns to similar neighbors and to neighbors that are relatively more successful (or less successful) in reducing energy usage in their homes. The reports also make energy efficiency recommendations—ranging from simple steps like turning down your thermostat to more time- or dollar-intensive steps like purchasing Energy Star products when replacing appliances and equipment. Targeted rebate coupons can also be issued

[34] http://www.eere.energy.gov/buildings/highperformance/
[35] http://www.advancedbuildings.net/
[36] http://www.energystar.gov/index.cfm?c=business.bus_index

with the reports, increasing the likelihood that consumers will respond to the efficiency recommendations.

We model a statewide behavioral initiative that ramps up participation levels so that 80% of households are reached by 2025. Individual households achieve 2% savings on average each year through conservation measures, and savings persist each year through continuous administration of the program. We estimate that this initiative could achieve savings of 665 GWh in 2025, or 0.7% of the state's electricity needs in that year, and 16 million therms, or 0.6% of the state's natural gas usage.

Comment [CDM46]: OPower's "experimental vs control" design will always require a sizeable group of non-participants to compare savings against.

State and Local Public Building Upgrades: Leading by Example

State and local government facilities, such as state agencies, public schools, and universities, represent unique opportunities for Missouri to implement and ramp up energy efficiency practices. Improving efficiency in these facilities in not only a way to capture significant energy savings, but is also a powerful outreach tool to lead by example and engage local neighborhoods, the private sector, and individuals. Missouri has multiple efforts to achieve savings in public facilities:

- The Missouri DNR Division of Energy maintains an energy revolving loan fund to provide low-interest loans to schools and governments for energy efficiency upgrades in public buildings. Since 1989, the fund has provided more than $80 million for about 440 completed projects that achieved more than $146 million in cumulative energy bill savings (MO DNR 2010).
- In 2008, the Governor signed Senate Bill 1181 which requires that all designs for state buildings over 5,000 square feet involving new construction or substantial renovation and any building over 5,000 square feet considered for purchase or lease by a state agency shall comply with a minimum energy efficiency standard. That standard must be at least as stringent as the 2006 International Energy Conservation Code (2006 IECC), or the latest version of the Code rather than the current standard of American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 90.
- In 2009, Governor Nixon issued Executive Order No. 09-18 which requires that all state agencies under the direction of the Office of Administration adopt policies designed to reduce energy consumption by 2% each year for 10 years. Also enacted in 2009, SB376 requires that appliances purchased by the state be compliant with Energy Star models.

These efforts have made important strides, and lay the groundwork for lasting guidance that will continue to improve efficiency of state facilities. Since Governor Nixon enacted the savings target in 2009, state agencies have cut energy use by 5.5%.[37] This recent success shows that meaningful guidance and tools – through policy and program measures – can be effective in implementing efficiency. There remains significant potential still to improve the efficiency of all state and local public facilities in the state. According to U.S. EIA data, we estimate that all government buildings – state and local – in Missouri comprise about 20% of commercial building electricity and natural gas use.

One of the most effective mechanisms available for financing energy efficiency retrofits in government buildings, which has been used extensively by states and the federal government, is the contracting of energy service performance contracts (ESPC) through energy service companies (ESCOs). Under the ESPC model, state agencies hire pre-qualified ESCO's to implement projects that improve a building's energy efficiency and lower maintenance costs. The ESCO guarantees the performance of its services, and the energy savings are used to repay the project costs, as shown in Figure 21 (KCC 2008). This model has proven to be highly effective for institutional energy customers in many places both in terms of delivering energy savings and in terms of cost-effectiveness (LBNL 2008).

[37] http://www.forbes.com/feeds/ap/2011/05/02/business-us-energy-efficiency-missouri_8445044.html

Figure 21. Graphical Representation of How an ESPC Project Is Financed

Source: KCC (2008)

Missouri has implemented ESPC legislation that authorizes "Guaranteed Energy Savings Contracts" for state and local governments.[38] The policy scenario for this analysis assumes a comprehensive state ESPC program that encourages the majority (80%) of state and also local government facilities to implement efficiency projects that achieve 20% energy savings. We estimate that government owned buildings comprise about 15-20% energy consumption of commercial buildings in Missouri according to regional data from the EIA (EIA 2006). Next, we estimate the public building upgrades through performance contracting and low-interest loans can save about 20% energy consumption in completed projects, and that state initiates a program goal to complete projects in 80% of public buildings by 2025. This effort would save 1,000 GWh annually by 2025, which represents 1% of the state's entire electricity needs.

Discussion of Enabling Programs and Policies

In this section we discuss a couple of best practice policies that enable other programs and policies to be effective, but we do not specifically analyze these policy opportunities for costs and energy savings. Rather, they are necessary tools to enable effective and broad implementation of other programs.

Customer financing for energy efficiency

The up-front costs required for energy efficiency improvements can often deter property owners from pursuing efficiency projects, especially during periods of economic uncertainty when consumer confidence is low. An important goal of policies and programs is to help minimize the initial costs of energy efficiency projects or upgrades so owners are encouraged to invest in efficiency. Below we discuss several options that either encourage consumers to purchase more efficient homes or allow property owners to make energy efficiency retrofits by reducing up-front costs while ensuring that they maximize savings.

For homebuyers, a key strategy is making sure that energy-efficient mortgages are available for purchasers of energy-efficient homes and manufactured houses. Energy-efficient mortgages should be attractive to lenders by reducing the risk of the loan because energy bills are a major household expense, particularly for moderate income households, and lowering energy bills frees up more income to make mortgage payments. With increased prevalence of home ratings such as ENERGY STAR, both for new and existing homes, identification of qualifying properties should not be a barrier. The state is in a position to encourage lending practices that take efficiency into consideration.

[38] See http://www.ornl.gov/info/esco/legislation/mo.shtml

One important aspect of financing mechanisms is that the debt can be spread out over the course of several years, if not decades, which decreases the annual costs thereby increasing the annual savings from the efficiency improvements substantially. Energy efficiency improvements to a property also help to increase the overall property value, and improve the cash flow of property owners (from reduced liability relative to the upfront costs), and improve resale value.

- On-Bill Financing (Collecting): This loan mechanism allows property owners to repay their debt through a fee on their electric bill or in some cases on other utility bills such as water or sewer. The loan can be financed either by the utility or a third-party financer, although the fee would be collected by the utility. The loan may be attached to the property.
- Property Tax Financing (Collecting): This is a similar model to on-bill financing, except that instead of using utility bills as the collection mechanism, the local government issues a surcharge on the annual property tax bill. The financing entity in this case would be the local government, which again could work with a third-party financer.
- Property Assessed Clean Energy (PACE) Bond Financing: A PACE bond is a debt that is backed by assessments against residential, commercial or industrial property that allows the owners to pay the expense of retrofitting their homes, buildings, or facilities through assessment payments normally connected with their property taxes. The bonds can be issued by municipal financing districts or other financing entities, of which the proceeds from the bonds are used to finance energy retrofits (efficiency and renewables). The assessments are then repaid over 15–20 years through annual assessments on property tax bills.

All three of these financing options would help achieve energy and cost savings while creating the jobs necessary to meet the demand for energy retrofits spurred by lower up-front costs. In 2010, the Missouri legislature authorized PACE financing for energy efficiency, however the program has been effectively stalled due to federal involvement and its future remains uncertain. Other forms of financing, however, are viable options for the state, local governments, and utilities to pursue.

Research and Development

Several states support active research and development (R&D) programs designed to develop technologies appropriate to each state's climate, economy, and other resources. R&D is critical to sustain continued improvements in energy efficiency after currently commercialized technologies and practices are widely adopted. Missouri has ongoing research efforts related to energy efficiency, including numerous programs and initiatives at the University of Missouri (MU). The University of Missouri's designated land grant institution has an interdisciplinary, campus-wide sustainable energy emphasis. One of MU's major strengths is energy efficiency. A variety of programs support increased energy efficiency in all aspects of the economy:

- Agricultural production energy efficiency is the focus of a program called the Missouri Agricultural and Energy Saving Team – A Revolutionary Opportunity (MAESTRO). The program provides energy audits, technical assistance, rebates, and low interest loans. With funding from DOE and under a contract with the Missouri Department of Agriculture, MU and EnSave are working to assist farmers in reducing this major cost component of their businesses.

- Energy efficient (green) building construction & retrofit is the focus of several programs at MU. The Architectural Studies Department of the College of Human Environmental Sciences (HES), Agricultural Extension and HES Extension have been teaching and assisting Missouri citizens in this area for many years. MU has partnered with the Home Builders Associations of Missouri to host an annual Greening Midwest Communities Conference that is supported by a variety of associations and business organizations.

- MU has a combined heat and power (CHP) electric generating plant that is a leader in biomass co-fired production, a well advanced smart grid, and a comprehensive building energy monitoring and control network. The development of this system was commenced more than 20 years ago. It yields a multi-million dollar annual savings compared to the electric supply costs prior to the system implementation.

- As discussed in the manufacturing initiative policy in the previous section, two industrial energy efficiency internships, the USDOE Industrial Assessment Center (IAC) and the USEPA Pollution Prevention (P2) Program provide energy efficiency services to businesses and industries across the state.

- The University houses the state Small Business and Technology Development Center (SBTDC) Program. The SBTDC provides assistance to operating and start-up companies in business and technology development. A number of energy efficiency related companies participate in this program.

These efforts at the University provide a foundation for an energy R&D center in Missouri that would give the state an independent entity that would engage in objective research, disseminate information, and provide education on energy efficiency technologies to business and policymakers. The Association for State Energy Research and Technology Transfer Institutions (ASERTTI) is a membership organization dedicated to increasing the effectiveness of research efforts that contribute to economic growth, environmental quality, and energy security. ASERTTI collaborates on research projects with state, federal, and private partners and also acts as a clearinghouse by sharing technical and operational information among its members and associates. ASERTTI members include federal research organizations, universities, state research organizations, and non-governmental organizations.

POLICY ANALYSIS – ENERGY SAVINGS, COSTS, AND BENEFITS

This section describes results from our policy analysis, including estimated total annual electricity, peak demand, and natural gas savings impacts from the efficiency policies and programs in 2025. More detailed results and assumptions are shown in Appendix A. The demand response impacts are covered in the next section and in Appendix B.

Energy Savings

Table 3 shows the energy savings estimates from each policy included in the analysis. We estimate that Missouri can achieve 18% electricity savings, 25% peak demand reduction, and 13% natural gas savings compared to the reference case scenario. Savings are "total annual," meaning they account for savings achieved in previous years and which continue to accrue over the life of the measures. See Appendix A for savings estimates in each year.

Table 3. Summary of Total Annual Energy Savings in 2025 by Policy or Program

Policies and Programs	Electricity		Peak Demand		Natural Gas	
	GWh	%	MW	%	Million Therms	%
Utility Res. Buildings and Equipment Programs*	6,597	6.9%	1,568	8.3%	121	4.5%
Utility Commercial Buildings and Equipment Programs*	3,445	3.6%	499	2.7%	56	2.1%
Manufacturing Initiative	1,580	1.7%	160	0.9%	50	1.9%
Rural and Agriculture Initiative	297	0.3%	29	0.2%	n/a	0.0%
Behavioral Initiative	665	0.7%	166	0.9%	16	0.6%
Building Energy Codes and Enforcement	1,511	1.6%	378	2.0%	60	2.3%
Advanced Buildings Initiative	526	0.6%	87	0.5%	13	0.5%
State and Local Public Building Retrofits	913	1.0%	135	0.7%	16	0.6%

Manufactured Homes	147	0.2%	37	0.2%	4	0.2%
Combined Heat and Power	1,396	1.5%	181	1.0%	n/a	0.0%
Demand Response Programs	n/a	0.0%	1,530	8.1%	n/a	0.0%
Total Savings	17,077	18%	4,771	25.4%	336	12.7%
Reference Case Energy Usage	94,946		18,782		2,650	

Note: % savings are measured against reference case energy usage in 2025.
*Utility buildings program savings go toward meeting the utility efficiency program targets. A combination of several other programs and policies could contribute to meeting the targets.

Figure 22. Electricity Savings in Energy Efficiency Policy Scenario, 2011 - 2025

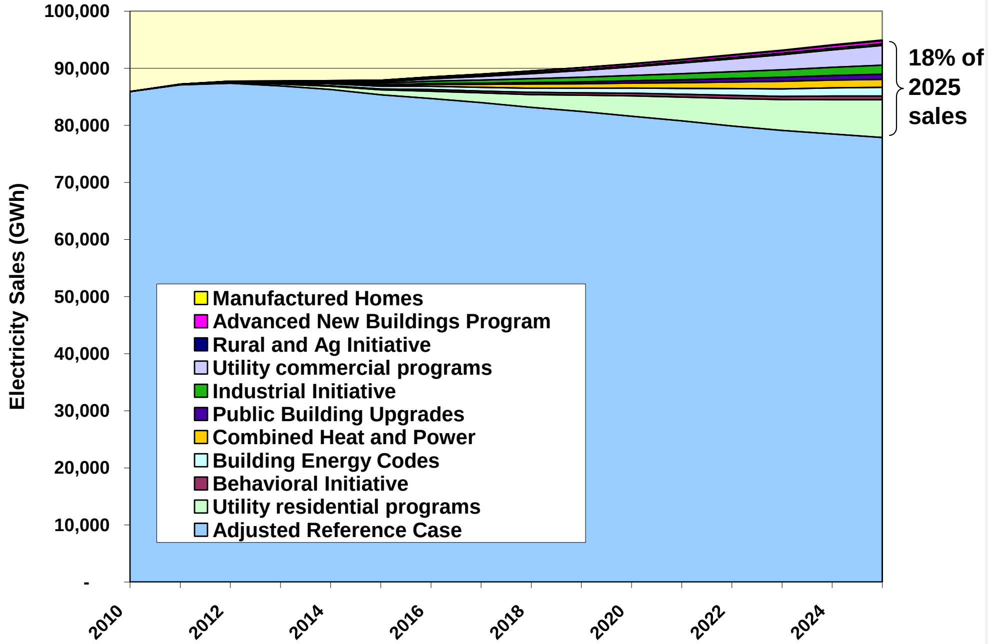


Figure 23. Share Electricity Savings by Policy in 2025
Total Savings = 17,080 GWh or 18% of Forecasted Use

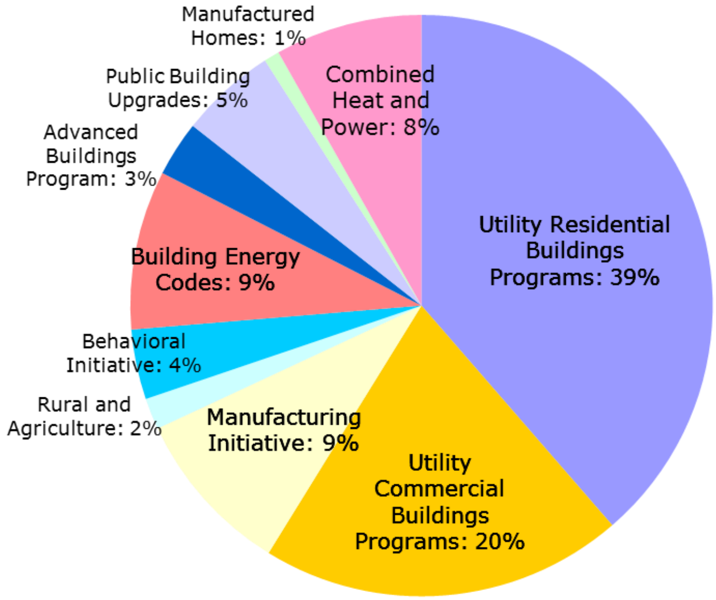


Figure 24. Peak Demand Savings in Energy Efficiency Policy Scenario, 2011 - 2025

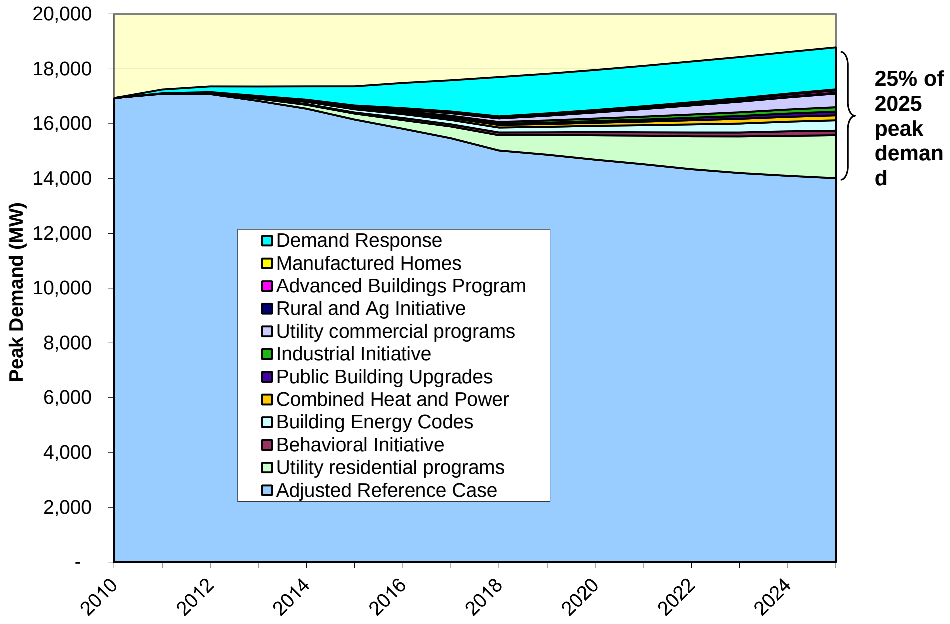
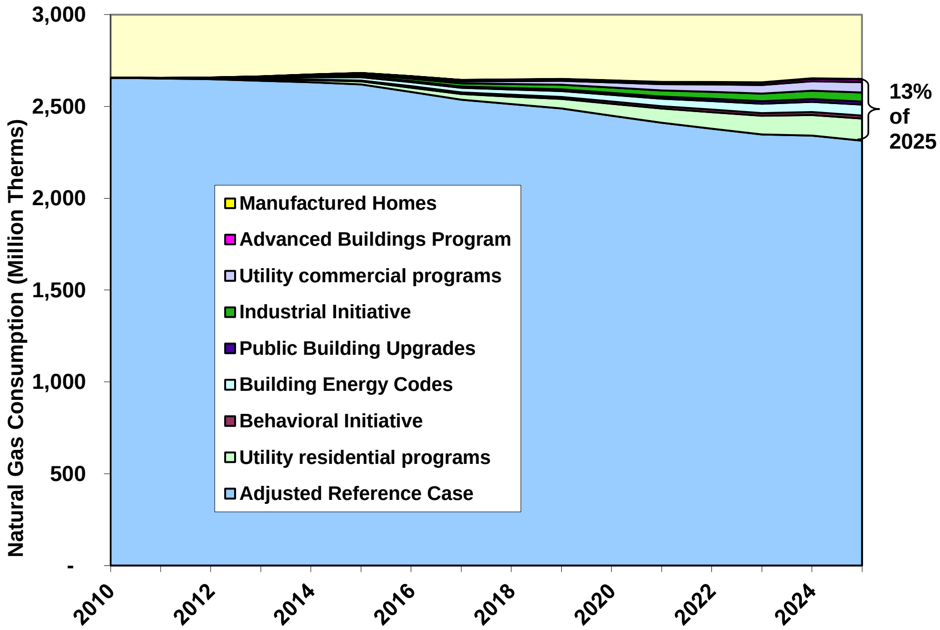


Figure 25. Natural Gas Savings in Energy Efficiency Policy Scenario, 2011 - 2025



Costs

Table 4 shows the estimated technology investments (in the form of both customer costs and program incentives) and administrative or marketing costs needed to implement the efficiency policies and programs in the policy analysis. The macroeconomic analysis uses these cost figures to estimate impacts of the efficiency scenario on the Missouri economy, including benefits to customers.

Table 4. Annual Energy Efficiency Costs in Policy Scenario

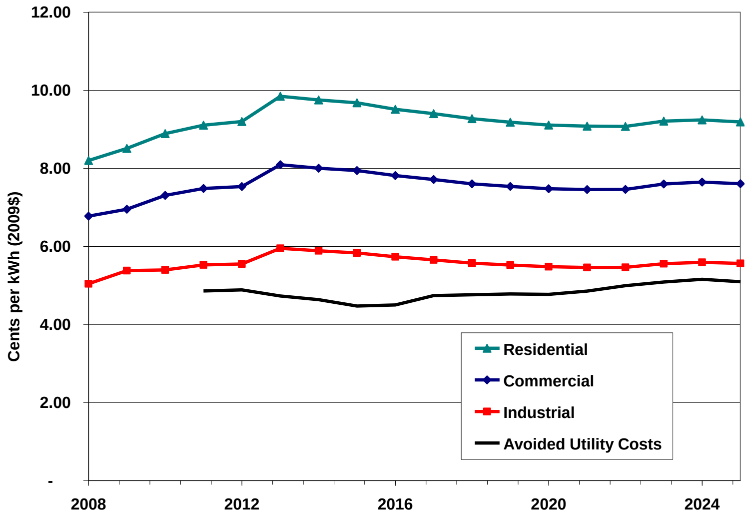
	2015			2025		
	Electricity	Natural Gas	Total	Electricity	Natural Gas	Total
Technology investments	$248	$75	$323	$442	$91	$533
Admin/marketing costs	$48	$13	$60	$93	$28	$121
Total	$296	$87	$383	$536	$119	$655

Note: Technology investments include both program incentives and customer contributions to energy efficiency measures.

Next we present a net present value (NPV) analysis of costs and benefits for the electricity policies to program administrators, participants, and to the total electricity system. The next few tables show results from the Program Administrators Cost test, the Participant Cost Test, and the Total Resource Cost Test (TRC). Readers should note that although the study time period ends in 2025, we estimate savings from the efficiency measures as they persist over the lifetime of each measure. Without accounting for these additional savings beyond the study time period would yield a more conservative estimate of benefits and therefore a lower benefit/cost ratio.

Energy efficiency programs are highly cost effective, and on average around the country cost about 2.5 cents/kWh-saved for utilities to administer programs (Friedrich et al. 2009). At an avoided utility cost of about 5 cents/kWh in Missouri (see Figure 26), efficiency programs generate roughly $2 in benefits for every $1 invested, as analyzed in the program administrator's cost test (see Table 5).

Figure 26. Projections of Retail Electricity Sales and Avoided Electricity Costs in Missouri (Real, 2009$)



Note: Retail rates are based on data from EIA 2010b and regional projections in the Annual Energy Outlook (EIA 2011). Avoided utility costs are based on data from KEMA 2011, as reported by the Missouri PSC

Table 5. Program Administrator Cost Test for Electricity Policy Measures through 2025, 2009$

	NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
Proven Residential Programs	$1,160	$1,920	$761	1.7
Proven Commercial Programs	$642	$966	$324	1.5
Manufacturing Initiative	$226	$514	$287	2.3
Behavioral Initiative	$58	$153	$95	2.6
Manufactured Homes Initiative	$28	$44	$15.6	1.6
Advanced New Buildings Program	$135	$208	$73	1.5
Rural & Agricultural Initiative	$57	$115	$58	2.0
Building Energy Codes	$106	$656	$549	6.2
Combined Heat and Power	$147	$510	$363	3.5
State and Local Public Facilities	$31	$244	$213	7.8
	$2,589	**$5,329**	**$2,739**	**2.1**

Note: Benefits are valued over the lifetime of the efficiency measure. Costs and benefits are discounted assuming a real discount rate of 5%

In Table 6 we present estimates for the participant cost test, which assumes the perspective of an individual participating in the programs by including the participant costs only and values benefits at retail electricity prices (see Figure 26). Results of the participant test show that for every dollar invested in energy efficiency, participants will save three dollars in lower energy bills.

Table 6. Participant Cost Test for Electricity Policy Measures through 2025, 2009$

	NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
Proven Residential Programs	$1,175	$4,431	$3,256	3.8
Proven Commercial Programs	$668	$1,965	$1,297	2.9
Manufacturing Initiative	$226	$575	$349	2.5
Behavioral Initiative	n/a	n/a	n/a	n/a
Manufactured Homes Initiative	$32	$100	$67	3.1
Advanced New Buildings Program	$158	$454	$296.6	2.9
Rural & Agricultural Initiative	$80	$218	$137	2.7
Building Energy Codes	$304	$1,242	$937	4.1
Combined Heat and Power	$485	$723	$238	1.5
State and Local Public Facilities	$156	$371	$215	2.4
	$3,285	**$10,078**	**$6,793**	**3.1**

Note: Benefits are valued over the lifetime of the efficiency measure. Costs and benefits are discounted assuming a real discount rate of 5%

The Total resource cost (TRC) test assumes a system wide perspective and considers total costs and values benefits at utility avoided costs (Table 7). Total resource benefits are $1.4 dollars for every dollar invested, which assumes benefits as the utility avoided costs. Readers should note, however, that the assumed utility avoided costs are conservative for long-range estimates because they hold relatively flat (because they assume no major expansions in electricity generating capability) and do not account for any future carbon emissions cost.

Table 7. Total Resource Cost Test for Electricity Policy Measures through 2025, 2009$

	NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
Proven Residential Programs	$1,453	$1,920	$467	1.3
Proven Commercial Programs	$809	$966	$157	1.2
Manufacturing Initiative	$234	$514	$279	2.2
Behavioral Initiative	$58	$153	$95	2.6
Manufactured Homes Initiative	$40	$44	$3.6	1.1
Advanced New Buildings Program	$188	$208	$19	1.1
Rural & Agricultural Initiative	$94	$115	$21	1.2
Building Energy Codes	$309	$656	$346	2.1
Combined Heat and Power	$489	$510	$21	1.0
State and Local Public Facilities	$179	$244	$64	1.4
	$3,855	**$5,329**	**$1,474**	**1.4**

Note: Benefits are valued over the lifetime of the efficiency measure. Costs and benefits are discounted assuming a real discount rate of 5%

Assessment of Demand Response Potential

Comment [CDM47]: Due to the time constraints in the review process, we were not able to perform a thorough review of the Demand Response portion of the draft report.

Please see other comments in remainder of report as they pertain to this section.

This section, prepared by Navigant Consulting, defines Demand Response (DR), assesses current DR activities in Missouri, identifies policies in the state that impact DR, uses benchmark information to assess DR potential in Missouri, and identifies barriers in the state that might keep DR contributing appropriately to the resource mix that can be used to meet electricity needs. The analysis concludes with identification of policy recommendations regarding DR. Readers should note that multiple "scenarios" of demand response potential are assessed, however the medium scenario is recommended as a reasonable scenario of demand response potential and therefore is the one scenario incorporated into the overall estimates of energy efficiency and demand response potential in the policy analysis.

Defining Demand Response

DR focuses on shifting energy from peak periods to off-peak periods and clipping peak demands on days with the highest demands. Within the set of demand-side options, DR focuses on clipping peak demands that may allow for the deferral of new capacity additions and enhance operating reserves to mitigate system emergencies. Energy efficiency focuses on reducing overall energy consumption with attendant permanent reductions in peak demand growth. Taken together, these two demand-side options can provide opportunities to more efficiently manage growth, provide customers with increased options to manage energy costs and develop least cost resource plans.

DR resources are usually grouped into two types: 1) load-curtailment activities where utilities can "call" for load reductions; and 2) price-based incentives which use time-differentiated and/or dispatchable rates to shift load away from peak demand periods and reduce overall peak-period consumption. Interest in both types of DR activities has increased across the country as fuel input prices have increased, environmental compliance costs have become more uncertain, and the substantial investment in overall electric infrastructure needed to support new generation resources.

The summary of DR potential presented on Table 1 focuses on load-curtailment and backup generation and does not include savings resulting from price-based incentives. Residential load-curtailment typically involves direct load control (DLC) of air conditioners—although this can also cover other appliances—as well as temperature offsets, which increase thermostat settings for a certain period of time. Commercial and industrial applications of DR focus on load control of space conditioning equipment, however this depends on customer size: self-activated load reductions are usually more prudent for larger customers. Backup generation for commercial and industrial applications involves generators with start-up equipment that allows them to come online with short notice from utilities, relieving the additional demand on the system during peak hours.

Rationale for Investigating Demand Response

DR alternatives can be implemented to help ensure that a utility continues to provide reliable electric service at the least cost to its customers. Specific drivers often cited for DR include the following:

- Ensure reliability—DR provides load reductions on the customer side of the meter that can help alleviate system emergencies and help create a robust resource portfolio of both demand-side and supply-side resources that meet reliability objectives.
- Reduce supply costs—DR may be less expensive per megawatt than other resource alternatives.
- Manage operational and economic risk through portfolio diversification—DR capability is a resource that can diversify peaking capabilities. This creates an alternative means of meeting peak demand and reduces the risk that utilities will suffer financially due to transmission constraints, fuel supply disruptions, or increases in fuel costs.
- Provide customers with greater control over electric bills –DR programs would allow customers to save on their electric bills by shifting their consumption away from higher cost hours and/or responding to DR events.

Address legislative/regulatory interest in DR – The Missouri Energy Efficiency Investment Act (MEEIA), Senate Bill 376, declares that the policy of Missouri is to value demand-side investments equal to traditional investments in supply and delivery infrastructure. The Commission is investigating how to achieve its new responsibilities under the MEEIA, within the background of FERC policies that eliminate barriers to DR and that direct MISO and SPP to accommodate state policy regarding retail customer demand-side activity.

Demand Response in Missouri—Background

A sound strategy for development of DR resources requires an understanding of Missouri's demand and resource supply situation, including projected system demand, peak-day load shapes, and existing and planned generation resources and costs.

Missouri utilities serve a population of almost 6 million, and generate over 91 million megawatt hours of electricity (EIA, 2009). Missouri had a system peak load forecast of 17,739MW in 2009 (KEMA, 2011). Electricity demand has grown an average of 3% per year over the period 1990 to 2008, fluctuating moderately (EIA, 2009).

Coal-fired plants in Missouri supplied about 81% of State electricity generation in 2008 (EIA, 2009). Missouri has been and likely will continue to be an importer of energy: Missouri imported more than 99 percent of the coal its power plants burned in 2008—mainly from Wyoming (UCS, 2011).

Role of Demand Response in Missouri's Resource Portfolio

The DR capabilities deployed by Missouri utilities can become part of a long-term resource strategy that also includes resources such as traditional generation resources, power purchase agreements, options for fuel and capacity, and energy efficiency and load management programs. Objectives include meeting future loads at lower cost, diversifying the portfolio to reduce operational and regulatory risk, and allowing Missouri customers to better manage their electricity costs.

The 2005 Energy Policy Act provisions for Demand Response and Smart Metering has lead to a number of states and utilities piloting and implementing a Smart Grid, or sometimes referred to as Advanced Metering Infrastructure (AMI). Smart Grid is a transformed electricity transmission and distribution network or "grid" that can use robust two-way communications, advanced sensors, and distributed computers to improve the efficiency, reliability and safety of power delivery and use. For energy delivery, the Smart Grid has the ability to sense when a part of its system is overloaded and reroute power to reduce that overload and prevent a potential outage situation. Principal benefits of Smart Grid technologies for DR include increased participation rates and lower costs.

The growth of renewable energy supply (and plans for increased growth) can also increase the importance of DR in the portfolio mix. For example, sudden renewable energy supply reductions (e.g., from an abrupt loss in wind) may be mitigated quickly with DR.

Assessment of Demand Response Potential in Missouri

Table 1 shows the resulting load shed reductions possible (using results of this study from the recommended "medium" scenario) for Missouri, by sector, for years 2015, 2020, and 2025. Load impacts grow rapidly through 2018 as program implementation takes hold. After 2018, the program impacts increase at the same rate as the forecasted growth in peak demand.

The recommended and conservative results show a reduction in peak demand of 699MW is possible by 2015 (4.0% of peak demand); 1,458MW is possible by 2020 (8.1% of peak demand); and 1,530MW is possible by 2025 (8.1% of peak demand).

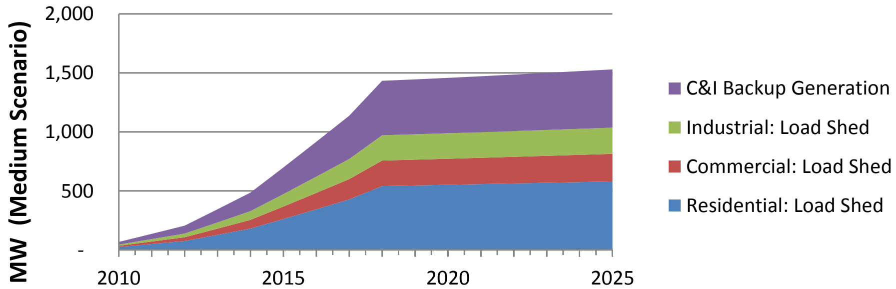
Table 8. Summary of Potential DR in Missouri, By Sector, for Years 2015, 2020, and 2025a

	Medium Scenario *Recommended Policy Scenario		
	2015	2020	2025
Load Sheds (MW)			
Residential	262	553	580
Commercial	106	220	234
Industrial	106	216	222
C&I Backup Generation (MW)	225	469	494

Total DR Potential (MW)	699	1,458	1,530
DR Potential as % of Total Peak Demand	4.0%	8.1%	8.1%
a. See Section 3 for underlying data and assumptions.			

Figure 27 shows the resulting load shed reductions possible for Missouri, by sector, from year 2010, when load reductions are expected to begin, through year 2025.

Figure 27. Potential DR Load Reduction in Missouri by Sector



These estimates reflect the level of effort put forth and utilities are recommended to set targets for the high scenarios. These estimates are based on assumptions regarding growth rates, participation rates, and program design. These factors are discussed further in this Appendix. In developing these DR potential estimates, the integration of DR with select energy efficiency activities was considered to help ensure that load impacts were not double counted. The estimated load reduction per program participant is conservatively estimated to account for increased energy efficiency in the future.

Policy Options

This assessment indicates that the system peak demand can be reduced by approximately 8.1% or 1,458MW in 2020 in the medium case. Key recommendations for increasing load reductions from DR programs include:

- Research should continue (as initiated by the Commission) to determine if any Missouri statute, law, or regulation are prohibiting or restricting electric utility customers from participating directly or indirectly through aggregator of retail customers (ARCs) in DR bidding programs and other issues concerning implementation of DR.

- Appropriate financial incentives need to be offered for programs administered directly by the utilities or for outsourcing DR efforts to aggregators. Research should also be conducted to determine the optimal relationship between Missouri customers, utilities and ARCS in regards to DR participation.

- Missouri has some history of time-differentiated rates. Pricing should form the cornerstone of an efficient electric market. Daily Time of Use (TOU) pricing and day-ahead hourly pricing will increase overall market efficiency by causing shifts in energy use from on-peak to off-peak hours every day of the year. However, this does not diminish the need to have dispatchable DR programs that can address those few days that represent extreme events where the highest demands occur. These events are best addressed by dispatchable DR programs.

- DR programs need to be integrated with the delivery of EE programs for greatest impact and efficiencies. Gains in delivery efficiency are possible by combining and cross-marketing EE and DR programs. These can include new building codes and standards that include not only energy efficiency construction and equipment, but also the installation of addressable and dispatchable equipment. This can include addressable thermostats in new residences and the installation of addressable energy management systems in commercial and industrial buildings that can reduce loads in select end-uses across the building/facility. In addition, energy audits of residential or commercial facilities can also include an assessment of whether that facility is a good candidate for participation in a DR program through the identification of dispatchable loads. Furthermore, building commissioning and retro-commissioning EE programs that are becoming popular in many commercial and industrial sector programs have the energy management system as a core component of program delivery. At this time, the application of auto-DR can be assessed and marketed to the customer along with the EE savings from these site-commissioning programs.

- Key programs that should be offered by Missouri energy providers which can be designed within a 12-month period include:
    - Residential and small business AC direct load control using switches or thermostats (or giving customers their choice of technology).
    - Auto-DR programs providing direct load curtailment for larger commercial and industrial customers.
    - Callable interruptible programs with manual response to an event notification for larger commercial and industrial customers where auto-DR approaches are not acceptable to the customer or technically not feasible.
    - Aggressive enrollment of back-up generators in DR programs.

- Load reduction programs typically have less need for pilot programs as the reductions are defined by the equipment and processes outlined by the program for each participant. Time differentiated pricing is a cornerstone of efficient electric markets and the design of these programs may need more pilot testing as the customer response to pricing is voluntary and not set (as often) by program design.

- Plan for at-scale programs through the rollout period. Pilot programs can be important in determining the appropriate design of cost-effective DR programs. However, there are established DR programs and technologies. Even with the unique circumstances in Missouri, these programs can be designed for deployment at scale. However, this approach recognizes that the first year of program deployment and possibly the second year should be designed to test key design components as part of a program shakeout. The third year of a program that should represent an efficient design and an at-scale program. DSM programs are designed to be flexible and undergo year-to-year changes due to market, customer and technology factors. This will always be the case and the benefits of discrete pilot program can limit overall program participation for a number of years resulting in "lost DR MWs." The politics of DSM and diverse positions of parties can result in a compromise in the implementation of programs leading to a two to three-year pilot program. This can delay the delivery of DR at scale resulting in higher overall costs. The over-use of pilots that do not acknowledge the ability of a program roll-out to have at-scale deliver as its goal in year three, but to also have tests of design components and decision nodes built into the first two year of program rollout can result in "death by piloting" for attainable DR MWs. Also, a decision to run a pilot program must be based on the assumption that the program will not have enough flexibility in design and on-going decision nodes during the first two years to allow for the ramp up into full scale efficient deployment in year three.

- Customer education should also be included in DR efforts in Missouri. There is some perceived lack of customer awareness of programs and incentives where programs do exist. In addition, new programs will need marketing efforts as well as technical assistance to help customers identify where load reductions can be obtained and the technologies/actions needed to achieve these load reductions. Also, high-level education on the volatility of electricity markets helps customers understand why utilities and other entities are promoting DR and the customers' role in increasing demand response to help match up with supply-side resources to achieve lower cost resource solutions when markets become tight.

COMBINED MACROECONOMIC AND EMISSIONS IMPACTS FROM ELECTRICITY AND NATURAL GAS EFFICIENCY

Up to this point in the analysis we have examined the potential costs and benefits of implementing policies that might stimulate greater levels of energy efficiency in Missouri. The evidence suggests that smart policies and programs can drive more productive investments in energy efficiency technologies, and they can do so in ways that reduce the state's total energy expenditures. But the question remains, what does this mean for the state economy? Do the higher gains in energy productivity—that is, do the increased levels of efficiency investment with their concomitant reduction in the need for conventional energy resources—also create a net economic boost for Missouri? Or, does the diversion of revenues away from energy-related industries negatively impact the economy? In this chapter, we explore those issues and we present the analytical results of an economic model used to evaluate the impact of efficiency investments on jobs, income, and the overall size of the economy.

A meta-review of 48 energy policy studies done within the United States suggests that if investments in more efficient technologies are cost-effective, the impacts on the economy should be small but net positive (Laitner and McKinney 2008). As shown elsewhere in the report, from a total resource cost perspective, the benefits (i.e., the energy bill savings) outweigh both the policy costs and investments by about 1.5. In other words, the energy efficiency policy recommendations highlighted in the policy scenario result in a substantial savings for households and businesses compared to the costs of implementing the policies. As we also discuss below, this consumer energy bill savings can drive a significant increase in the number of net new jobs within Missouri.[39] In fact, continued investments in energy efficiency resources would maintain the energy resource benefits for many years into the future, well beyond the period of analysis examined in this report.[40] The state therefore has the opportunity to transition its economy to a more sustainable pattern of energy production and consumption in ways that benefit consumers and businesses.

The results in Table 9 below detail the benefits that will accrue to the state of Missouri when policies encourage a more efficient use of energy resources. Further discussion in this section will provide an overview of the DEEPER model and more detailed background information for the state of Missouri.

Table 9. Economic Impact of Energy Efficiency Investments in Missouri

Macroeconomic Impacts	2012	2015	2020	2025
Net Jobs (Actual)	1,096	4,139	7,608	9,492
Wages (Million $2009)	$43	$153	$257	$265

[39] As we use the term here, the word "consumer" refers to any one who buys and uses energy. Thus, we include both households and businesses as among the consumers who benefit from greater investments in energy efficiency.

[40] As we note elsewhere, the policy analysis ends in the year 2025. Yet, many of the investments we describe have a technology of perhaps 15 years. This means that investments made in 2025 would continue to pay for themselves through perhaps the year 2040 and beyond; and none of those ongoing energy savings is reflected in the analysis described in this chapter.

Methodology

This macroeconomic evaluation consists of three steps. First, we calibrate ACEEE's economic assessment model called DEEPER (or the Dynamic Energy Efficiency Policy Evaluation Routine) to reflect the economic profile of the Missouri economy (IMPLAN 2011). This evaluation is done for the period 2009 (the base year of the model) through 2025 (the last year of this particular analysis). In this respect, we incorporate the anticipated investment and spending patterns that are suggested by the standard forecast modeling assumptions. These patterns range from typical spending by businesses and households in the analytical period to the anticipated construction of new electric power plants and other energy-related spending that might also be highlighted in the forecast. Second, we transform the set of key efficiency scenario results from the policy analysis into the direct inputs which are needed for the economic model. The resulting inputs include such parameters as:

- The level of annual policy and/or program spending that drives the key policy scenario investments;
- The capital and operating costs associated with more energy efficiency technologies;
- The energy bill savings that result from the various energy efficiency policies described in the main body of the report; and
- Finally, a set of calibration or diagnostic model runs to check both the logic and the internal consistency of the modeling results.

So that we can more fully characterize the analysis that was completed for this report, we next provide a simplified working example of how the modeling is done. We first describe the financial assumptions that underpin the analysis. We then highlight the analytical technique by showing the kinds of calculations that are used and then summarize the overall results in terms of net job impacts. Following this example, we then review the net impacts of the various policies as evaluated in our DEEPER model.

Illustrating the Methodology: Missouri Jobs from Efficiency Gains

To illustrate how a job impact analysis might be done, we will use the simplified example of installing one hundred million dollars of efficiency improvements within large office buildings throughout Missouri. Office buildings—traditionally large users of energy due to heating and air-conditioning loads, significant use of lighting and electronic office equipment, and the large numbers of persons employed and served—provide substantial opportunities for energy-saving investments. The results of this example are summarized in Table 10.

Table 10. Illustrative Example: Jobs Impacts from Commercial Building Efficiency Improvements

Expenditure Category	Amount (Million $)	Employment Coefficient	Job Impact
Installing Efficiency Improvements in Year One	$100	11.1	1,110

Diverting Expenditures to Fund Efficiency Improvements	-$100	10.3	(1,030)
Energy Bill Savings in Years One through 15	$200	10.3	2,060
Lower Utility Revenues in Years One through 15	-$200	3.5	(700)
Net 15-Year Change	$0.0		1,440

Note: The employment multipliers are adapted from the appropriate sector multipliers within the Missouri version of the DEEPER model. The benefit-cost ratio is assumed to be 2.0. The column marked "job impact" is the result of multiplying the row change in expenditure by the row multiplier. The sum of these products yields a working estimate of total net job-years over the 15-year time horizon. To find the average annual net jobs in this simplified analysis we would divide the total job-years by 15 years which, of course, gives us an estimated net gain of 96 jobs per year for each of the 15 years.

The assumption used in this example is that the investment has a positive benefit-cost ratio of 2.0. In other words, the assumption is that for every dollar of cost used to increase a building's overall energy efficiency, the upgrades might be expected to return a total of two dollars in reduced electricity and natural gas costs over the useful life of the technologies. This ratio is similar to those cited elsewhere in this report. At the same time, if we anticipate that the efficiency changes will have an expected life of roughly 15 years, then we can establish a 15-year period of analysis. In this illustration, we further assume that the efficiency upgrades take place in the first year of the analysis, while the electricity bill savings occur in years one through 15.

The analysis assumes that we are interested in the net effect of employment and other economic changes. This means we must first examine all changes in household and business expenditures—both positive and negative—that result from a movement toward greater levels of energy efficiency. Although more detailed and complicated within the DEEPER model, for this heuristic exercise we then multiply each change in expenditures by the appropriate sector employment coefficient as they are adapted from the IMPLAN (2010) data. The sum of these products will then yield the net result for which we are looking.

In our example above, there are four separate changes in expenditures, each with their separate impact. As Table xx indicates, the net impact of the scenario suggests a cumulative gain of 1,440 jobs in each of the 15-year period of analysis. This translates into an average net increase of 96 jobs each year for 15 years. In other words, the $100 million efficiency investment made in Missouri's office buildings is projected to sustain an average of 96 jobs each year over a 15-year period compared to a "business-as-usual" scenario.

The economic assessment of the alternative energy scenarios was carried out in a very similar manner as the example described above. That is, the changes in energy expenditures brought about by investments in energy efficiency and renewable technologies were matched with their appropriate employment multipliers. There are several modifications to this technique, however.

First, it was assumed that only 71% of the energy bill savings are spent within Missouri. We base this ratio on the consumer spending patterns reflected in the IMPLAN (2011) dataset as it describes local purchase patterns that typically now occur in the state. We also anticipate that 90% of the efficiency installations are likely (or could be) carried out by local contractors and dealers. At the same time, the scenario also assumes Missouri provides only 20% of the manufactured products consumed within the state. But again, a concerted effort to build manufacturing capacity for the set of clean energy technologies would increase the benefits from developing a broader in-state clean energy manufacturing capability.

Second, an adjustment in the employment impacts was made to account for assumed future changes in labor productivity. As outlined in the Bureau of Labor Statistics Outlook 2008–2018, productivity rates are expected to vary widely among sectors (BLS 2010). For instance, drawing from the BLS data we would expect that electric utilities might increase labor productivity by 2.8% annually while the economy as a whole might increase productivity by 1.9% per year. This means, for example, that we might expect that a one million dollar expenditure for utility services in the year 2025 would support only 64% of the jobs that the same expenditure would have supported in 2009 (the base year of the model), while other sectors of the economy would support only 72% of the jobs as in 2009.

Third, for purposes of estimating energy bill savings, it was assumed that retail electricity prices in Missouri would follow the same growth rate as that described in the reference case section. Fourth, it was assumed that the efficiency investments' upgrades are financed by bank loans that carry an average 6% interest rate over a five-year period. To limit the scope of the analysis, however, no parameters were established to account for any changes in interest rates as less capital-intensive technologies (i.e., efficiency investments) are substituted for conventional supply strategies, or in labor participation rates—all of which might affect overall spending patterns. Fortunately, however, it is unlikely that these sensitivities would greatly impact the overall outcome of this analysis.

While the higher cost premiums associated with the energy efficiency investments might be expected to drive up the level of borrowing (in the short term), and therefore interest rates, this upward pressure would be offset to some degree by the investment avoided in new power plant capacity, exploratory well drilling, and new pipelines. Similarly, while an increase in demand for labor would tend to increase the overall level of wages (and thus lessen economic activity), the job benefits are small compared to the current level of unemployment or underemployment in the state. Hence the effect would be negligible.

Fifth, as described in the previous sections for the energy efficiency policies it was assumed that a program and marketing expenditure would be required to promote market penetration of the efficiency improvements. Since these vary significantly by policy bundle we don't summarize them here but payment for these policy and program expenditures were treated as if new taxes were levied on the state commensurate with the level of energy demands within the state. Hence, the positive program spending impacts are offset by reduced revenues elsewhere in the economy.

Sixth, it should be noted that the full effects of the efficiency investments are not accounted for since the savings beyond 2025 are not incorporated in the analysis. Nor does the analysis include other benefits and costs that can stem from the efficiency investments. Non-energy benefits can include increased worker productivity, comfort and safety, and water savings, while non-energy costs can include aesthetic issues associated with compact fluorescent lamps and increased maintenance costs due to a lack of familiarity with new energy efficiency equipment (EPA 2007d). Productivity benefits, for example, can be substantial, especially in the industrial sector. Industrial investments that increase energy efficiency often result in achieving other economic goals such as improved product quality, lower capital and operating costs, increased employee productivity, or capturing specialized product markets (see, for example, Worrell et al. 2003).

To the extent these "co-benefits" exceed any non-energy costs, the economic impacts of an energy efficiency initiative in Missouri would be more favorable than those reported here. Finally, although we show in Table 8 above just how the calculations would look from an employment perspective, we don't show the same kind of data or assumptions for income. Nonetheless, the approach is very similar to that described for net job impacts. And while we do not explore potential the net gains in gross regional productive in this analysis, preliminary working calculations suggest an essentially unchanged size to the overall state economy. In effect, the composition of the economy may shift in favor of more labor intensive sectors while the scale of the economy remains at projected levels.

Impacts of Recommended Energy Efficiency Policies

For each year in the analytical period, the given change in a sector spending pattern (relative to the reference scenario) was matched to the appropriate sector impact coefficients. Two points are worth special note: first, it was important to match the right change in spending to the right sector of the Missouri economy; and second, these coefficients change over time. For example, as previously suggested, labor productivity changes mean that there may be fewer jobs supported by a one million dollar expenditure today compared to that same level of spending in 2025. Both the negative and positive impacts were summed to generate the estimated net results shown in the series of tables that follow. Presented here are two basic sets of macroeconomic impacts for the benchmark years of 2012, 2015, 2020, and 2025. These include the financial flows that result from the policies described in the previous chapters. They also include the net jobs and income that result from the changed investment and spending patterns.

Table 11 presents the changes in consumer expenditures that result from these policies. While the first row in the table presents the full cost of the energy efficiency policies, programs and investments, the utility customers will likely borrow all or at least a portion of the money to pay for these investments, repaying the debt over the course of the study period. Thus, “annual consumer outlays,” estimated at $35 million in 2012, rise to $700 million in 2025. These outlays include actual “out-of-pocket” spending for programs and investments, along with money borrowed to underwrite the larger technology investments. The annual energy bill savings reported here is a function of reduced energy purchases.

As we further highlight in Table 11, the annual energy bill savings begins with a net gain of $10 million, reflecting the large investment required to get programs and infrastructure in place before savings can truly being to accrue. However, as more investments are directed toward policies and programs and the purchase of more energy efficient technologies, the investments are paid back in lower energy bills and the net cumulative savings quickly build up, reaching just over one billion net annual savings in 2025. Cumulative net energy bill savings reach over $5.9 billion for consumers in Missouri by 2025.

Table 11. Financial Impacts from the Energy Efficiency Policy Scenario (Million 2009$)

(Million 2009$)	2012	2015	2020	2025
Annual Consumer Outlays	$35	$150	$436	$700
Annual Energy-Bill Savings	$44	$278	$910	$1,732
Annual Net Consumer Savings	$10	$128	$474	$1,032
Cumulative Net Energy-Bill Savings	$9	$268	$1,868	$5,915

- ‘Annual’ refers to the total that is reported in the benchmark year while ‘Cumulative” is the total from previous years beginning in 2011 through the benchmark year.
- Annual consumer outlays include administrative costs to run programs, incentives provided to consumers, investments in efficiency devices and interest paid on loans needed to underwrite the needed efficiency investments.
- Annual energy bill savings is the reduced expenditures for energy services that benefit both households and businesses within a given year. The net savings is the difference between savings and total consumer outlays.

Now that we have estimates of how financial flows are distributed across the end-use sectors, we can assess the impacts on the state economy using the DEEPER model. The model evaluates impact on jobs and wages sector by sector, and evaluates their contribution to Missouri’s Gross State Product, which is a sum of the net gain in value-added contributions provided by the energy productivity gains throughout all sectors of the state economy. As with the previous table on financial impacts, for reader convenience, Table 12 repeats the net economic impacts.

Table 12. Economic Impact of Energy Efficiency Investments in Missouri

Macroeconomic Impacts	2012	2015	2020	2025

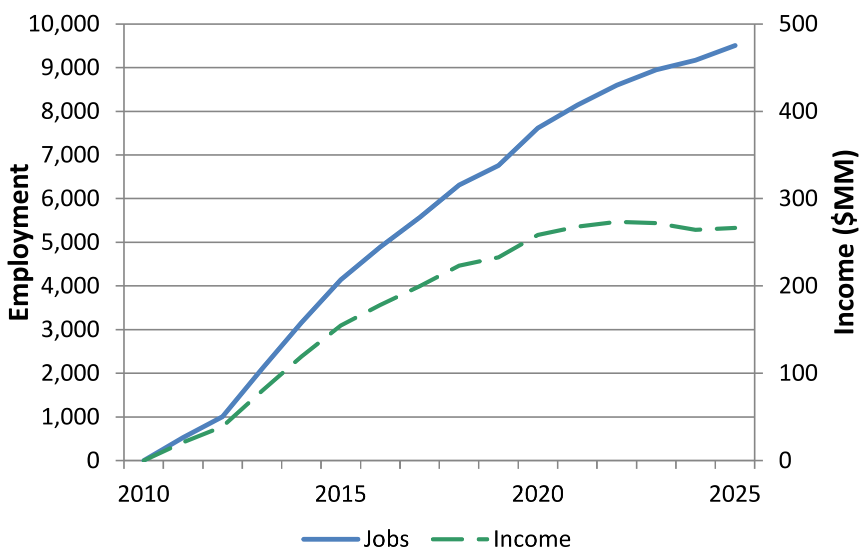
Net Jobs (Actual)	1,096	4,139	7,608	9,492
Wages (Million $2009)	$43	$153	$257	$265

Given both the financial flows and the modeling framework, the analysis suggests a net contribution to the state's employment base as measured by full-time jobs equivalent. Assuming there is an immediate set of investments in 2011, the employment benefit begins almost immediately with a net gain of just over 1,000 jobs in 2012. By the year 2015 we see a net increase of over 4,000 jobs, which increases to a significantly larger total of almost 9,500 jobs by 2025.

In Missouri, the electric power and the natural gas service sectors directly and indirectly employ about 3.5 jobs for every $1 million of spending. But, all other sectors, including those vital to energy efficiency improvements like manufacturing and construction, utilize 10.3 jobs per $1 million of spending. Once job gains and losses are netted out in each year, the analysis suggests that, by diverting expenditures away from non-labor intensive energy sectors, the cost-effective energy policies can positively impact the larger Missouri economy—even in the early years, but especially in the later years of the analysis as the energy savings continue to mount.

To highlight the results of this analysis in a little more detail, Figure 28 provides year-by-year impacts of the energy efficiency policies on net jobs in Missouri and the anticipated net gain to the state's wage and salary compensation (with the latter measured in millions of 2009 dollars).

Figure 28. Net Employment and Wage Impacts for Missouri in Policy Scenario (2011–2025)



The results of the policy analysis suggests that an early program incentive that drives a higher level of efficiency investments can actually increase the robustness Missouri employment and income, creating about 4,000 *net* new jobs in 2015, and rising to just short of 9,500 net new jobs in 2025. This is roughly equivalent to the employment that would be directly and indirectly supported by the construction and operation of 60 small manufacturing plants within Missouri. As indicated by Figure 28, these investments also increase wages in Missouri. It is worth noting that a more complete analysis of the *non-energy* or *productivity* benefits of energy efficiency investments would likely increase the overall GSP impacts. There is growing literature that documents several categories of "non-energy" financial benefits in addition to the anticipated energy bill savings (Laitner 2009). These additional savings include reduced operating and maintenance costs, improved process controls, increased amenities or other conveniences, and direct and indirect economic benefits from downsizing or elimination of other equipment (Worrell et al. 2003). The non-energy or productivity benefits can amplify energy bill savings by an additional 20 to 40 percent or more.

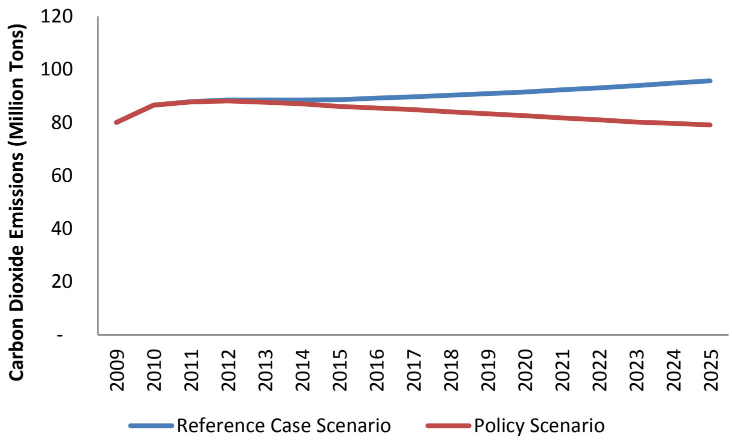
In short, the more efficient use of energy resources provides a cost-effective redirection of spending away from less labor-intensive sectors into those sectors that provide a greater number of jobs throughout Missouri. Similarly, cost-effective energy productivity gains also redirect spending away from sectors that provide a smaller rate of value-added into those sectors with slightly higher levels of value-added returns per dollar of revenue. The extent to which these benefits are realized will depend on the willingness of business and policy leaders to implement the recommendations that are at the heart of this report and found earlier in this assessment. Indeed, to the extent that business and policy leaders go beyond the recommendations described here, the evidence further suggests an even greater net positive impact on the Missouri economy.[41]

Emissions Impacts

Reducing the demand for electricity through efficiency resources reduces the need to generate electricity, which in turn lowers the air emissions that are a by-product of generation. Thus, energy efficiency also represents a cost-effective strategy to reduce emissions. The electricity policies we present in the policy scenario would reduce annual carbon dioxide (CO_2) emissions by about 17 million tons in 2025. This is equivalent to about a 17% reduction in electric power sector emissions in Missouri, back down to 2009 emissions levels (see Figure 29). Through 2025, energy efficiency can reduce CO_2 emissions cumulatively by almost 105 million tons.

Figure 29. Carbon Dioxide Emissions Reductions from Policy Scenario*

[41] As a further thought experiment, we ran the DEEPER model to test the potential impact of both greater in-state spending that might result from the set of policies characterized in this analysis, and from the inclusion of non-energy benefits that are likely to follow from this policy scenario. Following an analysis by Laitner and Lung (2009), we conservatively assumed a set of non-energy benefits that might be about 20% of the energy bill savings for the buildings sector and 40% for industrial sectors throughout the economy. With that change the net employment impacts rose from 9,500 jobs in the year 2025 to 12,000 jobs in that same year. Moreover, GSP was boosted to a small net positive gain that averaged 0.06% over the study timeline.



Note: Savings are from the electricity policies only. This assumes a marginal (non-baseload) carbon dioxide emissions factor of 1,946 lbs/MWh per EPA's eGrid database (EPA 2010).

CONCLUSIONS

Missouri has demonstrated a growing commitment to energy efficiency as a means to attain energy, economic, environmental, and sustainability goals. And the state stands to gain much more from broadening its policies and programs that encourage efficiency. Several recent studies have demonstrated that there is a large amount of cost-effective efficiency that the state could take advantage of over the next 15 years. This report complements those recent studies by laying out a series of concrete, long-term state policy and program strategies that have the potential to meet nearly one-fifth of the state's electricity needs and create up to 9,500 new jobs. A comprehensive set of state and local policy strategies can enable Missouri to reap this potential efficiency resource while returning numerous benefits to Missouri's economy and environment.

Energy Efficiency as a Resource

The energy efficiency policies assessed in this report have the potential to meet nearly one-fifth of the state's electricity needs in 2025, reduce peak demand by 25%, and meet about 13% of natural gas use. While the state does not have significant plans to expand electricity generation capacity over the next 10 years, the state's population is growing and the state will have to modernize its energy resources. Therefore it is extremely timely to invest in a robust energy efficiency strategy to forestall the need to build expensive new electricity generation. Reduced demand will facilitate modernization of the state's electric generation resources by enabling the retirement of older plants. This report has presented a policy scenario which provides numerous avenues for the state to develop a robust efficiency strategy.

Economic Benefits

Not only will an energy efficiency strategy enable the state to modernize its energy system, it will also generate a significant economic return to customers in the form of lower energy bills and job creation. We estimate that energy efficiency policies return $3 in energy savings to participants for every $1 invested in programs. And all customers will benefit from a more modern and reliable energy system that is less vulnerable to changes in electricity supply.

Our macroeconomic analysis estimates that consumers will save $5.9 billion cumulatively through 2025 in lower energy bills if the state follows a path laid out in this report. In 2025, annual savings alone reach about $1 billion, which is an 8% cut in current energy bills. And consumers will continue to reap those benefits in years that follow because efficiency creates lasting resource. We have also estimated the significant job creation that Missouri could see with a robust efficiency scenario – up to 9,500 net, new jobs in 2025. In a time of tight state fiscal budgets and high unemployment, energy efficiency offers a financially responsible strategy for the state that can also help to boost job creation.

Policy Solutions

Energy efficiency is a win-win strategy for Missouri's clean energy and economic future. But numerous barriers have prevented consumers from taking advantage of the efficiency resource. The ten policies and programs presented in this report aim to break down those barriers and open up the efficiency resource to Missouri residents and businesses. The state faces several challenges in addressing these barriers, as they involve multiple stakeholder perspectives and represent a complicated array of regulations and policies that span different levels of government.

At the utility regulatory level, recent action by the Public Service Commission to enable cost-effective energy efficiency has signaled an interest in pursuing energy efficiency as a resource; however subsequent indications from the major utilities in the state have shown that the utilities' interest in pursuing efficiency is not aligned with their business model. More work will need to be done to address these issues if the state strives to rely on energy efficiency as a long-term, energy resource.

State and local governments will also need to work together to achieve energy efficiency as a long-term resource. Building energy codes, for example, are gaining traction in some local governments, and have vast opportunity to improve energy efficiency across the state. Information sharing among state and local governments on best practices will be critical to success.

To address these numerous challenges, the policies in the study encompass a concerted and broad effort designed to engage multiple stakeholders and to realize the benefit of energy efficiency. Missouri has already shown the desire to embrace energy efficiency and recent developments have reinforced its position. But meeting this goal will require a concerted effort from all parties: the utility commission, state agencies, the State Legislature, utilities, businesses, and residents. If all parties can find and implement a path forward, the state, its businesses, and its consumers will reap the benefits for years to come.

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APPENDIX A. POLICY ANALYSIS METHODOLOGY

In this Appendix we present year-by-year estimates of energy savings and provide key assumptions for each of the program and policy measures included in the policy analysis.

Utility Energy Efficiency Targets

- Electricity investor-owned utilities achieve incremental annual savings goals according to the following schedule which is consistent with the MEEIA rules: 0.14% in 2011; 0.3% in 2012; 0.5% in 2013; 0.7% in 2014; 0.9% in 2015; 1.1% in 2016; 1.3% in 2017; 1.5% in 2018; 1.7% in 2019; and 1.9% in 2020 and each year thereafter through 2025.
- Electricity municipal utilities and electric cooperatives achieve incremental annual savings goals according to the following schedule: 0.1% in 2011 – 2012; 0.3% in 2013 – 2014; 0.5% in 2015 – 2016; 1% in 2017 – 2018; 1.3% in 2019 – 2020; 1.5% in 2021 – 2023; and 1.75% in
- Natural gas utilities achieve incremental annual savings goals according to the following schedule: 0.1% in 2011, ramping up 0.1% each year through 2020 when it reaches 1.0%, then remains at 1% per year through 2025.
- Utilities deploy best-practice, proven programs for residential and commercial buildings & equipment to achieve a majority share of the targets. This savings level is estimated according to the results of several achievable potential analyses for Missouri and the Midwest. In addition, we assume that the remaining policies and programs in our analysis could be deployed to achieve the remainder of the savings targets. However, the savings achieved in aggregate in the policy scenario are greater than those set by the targets, which shows that there are ample savings opportunities to achieve the targets.
- We assume that the incremental annual percentage targets are applied to a moving baseline of the average of 3-year previous sales. As savings accrue over time, the reference case forecast is adjusted to reflect lower sales and therefore the targets reflect the adjusted sales forecast.
- Cost assumptions for residential and commercial buildings and equipment programs are based on data in the KEMA analysis and a national review by ACEEE of utility programs in twelve states (Friedrich et al 2009).

Building Energy Codes and Enforcement.

- First, we develop baseline forecast of new construction in the state based on Moody's Economy.com projections from January 2011 for new housing completions. For commercial new construction, absent other data we use employment projections from Moody's Economy.com as a proxy for growth trends in new commercial building construction.
- For the residential sector, we assume codes adoption of the IECC 2009 average savings of 18% per new home per the U.S. DOE Building Energy Codes Program relative to standard practice in the state. (DOE 2009). We assume that the entire state adopts the 2009 IECC for residential buildings and implements the code by 2012. The policy scenario reflects new savings from adoption of the 2009 IECC throughout the state. We then assume that the state subsequently adopts the 2012 IECC and the 2018 IECC, effective in 2020, which achieves an additional 20% savings beyond the previous code.
- For the commercial sector, we assume first the code adoption of ASHRAE 90.1-2007 standards effective in 2012, which achieve about 20% savings. A new commercial standard is adopted in 2018 and effective 2020 which achieves an additional 20% savings beyond the previous code.
- We assume that code enforcement starts at 70% the first year of adoption and ramps up to 90% as training and enforcement efforts increase.

Comment [CDM48]: ACEEE assumes Utility Programs can achieve MEEIA goals. This significantly exceeds the realistic achievable potential outlined in Ameren Missouri's Potential Study. See comments in above report.

Comment [CDM49]: Finish sentence?

Comment [CDM50]: Does this seem optimistic for a region that has never had codes?

- Building investment cost assumptions are from KEMA's analysis for residential and commercial new construction (e.g. about $5-$6 per first-year therm of natural gas). We assume that program administrative costs for implementation of a state energy code start at about $2.5 million per year for the first 2 years of implementation, and subsequently $250,000 per year in staffing according to information from BCAP. Each code cycle adoption would incur the same program costs.

- We assume that the KEMA study achievable results account for some of the potential savings for building energy codes in its scenario results for the new construction sector, however we presume the analysis misses some of the potential because it does not assume that the measures would be required installations by codes. Based on the new construction results for residential and commercial buildings, we estimate that 50% of the savings potential from new building energy codes is in addition to the achievable results identified in the KEMA analysis.

Manufactured Homes Program

- Manufactured homes represent about 7% of all residential homes in Missouri. For this analysis, we model a program that specifically aims to upgrade energy efficiency in manufactured homes in the state through measures like insulation, better windows and doors, improved ventilation, better sealed heating ducts, and reduced drafts.
- In the policy case, we assume that the program can achieve average savings of x% in 20% of manufactured homes by 2025, or about 37,000 homes and 2500 per year. This ultimately achieves efficiency gains in about 5% of all existing manufactured homes by 2025.
- Costs are based on average residential estimates from the KEMA analysis.

State and Local Public Buildings

- Government owned buildings comprise about 15-20% energy consumption of commercial buildings in Missouri according to regional data from the EIA. We use the Commercial Building Energy Consumption Survey (CBECS) for 2003. For the West North Central region, the EIA reports that government owned buildings account for 17% of electricity consumption and 15% of natural gas consumption for the state's commercial buildings.
- We estimate the public building upgrades through performance contracting and low-interest loans can save about 20% energy consumption in completed projects, and that state initiates a program goal to complete projects in 80% of public buildings by 2025.
- Costs are based on average commercial building estimate from the KEMA analysis.

Behavior Program

- We estimate savings for a customer feedback program similar to those operated by OPOWER. Evaluations of OPOWER's programs identify consistent energy savings of 2% per year. We assume that savings have a 1-year lifetime, meaning that programs in a given year will enable consumers to save energy through conservation but not adopt permanent (multi-year) equipment or other efficiency measure installations.
- Cost assumptions are based on data from the OPOWER program.

Combined Heat and Power

- We estimate potential for greater deployment of Combined Heat and Power (CHP) based on a recent analysis prepared by ICF for an ACEEE energy efficiency assessment for Arkansas (see Neubauer et. al 2011). The cost-effectiveness of CHP systems is based largely on "spark spread," or the ratio of electricity rates to the retail cost of natural gas. Because electricity rates are relatively low in Arkansas and Missouri, CHP systems can have fairly long paybacks (10 – 15 years). Because the current spark spread for Arkansas (1.6) is very similar to that of Missouri (1.7), we use the Arkansas analysis results as a reasonable estimate of potential in Missouri.

Comment [CDM51]: What is x?

Comment [CDM52]: These 2% figures are for whole house usage – does not distinguish between behavior changes and permanent technology installations that may have been due to other programs or naturally occurring energy efficiency.

Table A-1. Reference Case Projections of Electricity (GWh) and Natural Gas Usage (Million Therms)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Modified Electricity Sales Reference Case																		
Residential	35,390	34,221	37,471	38,554	38,870	38,780	38,707	38,627	38,891	39,098	39,349	39,606	39,909	40,201	40,518	40,839	41,208	41,544
Commercial	28,577	27,266	29,804	29,964	30,100	30,176	30,266	30,351	30,601	30,817	31,066	31,321	31,605	31,971	32,357	32,749	33,174	33,582
Industrial	20,391	18,178	18,616	18,699	18,774	18,817	18,866	18,913	18,997	19,056	19,130	19,208	19,306	19,393	19,491	19,591	19,713	19,820
Total	84,382	79,456	85,891	87,218	87,744	87,773	87,839	87,891	88,489	88,971	89,546	90,135	90,819	91,565	92,366	93,179	94,095	94,946
Modified Natural Gas Sales Reference Case																		
Residential	1,080	1,081	1,079	1,078	1,071	1,066	1,062	1,060	1,051	1,045	1,039	1,036	1,028	1,023	1,018	1,015	1,007	1,002
Commercial	653	664	671	674	675	676	676	675	673	671	669	667	666	665	665	665	666	667
Industrial	878	893	907	903	912	921	936	948	941	929	939	946	948	945	951	951	981	981
Total	2,611	2,638	2,657	2,655	2,658	2,664	2,674	2,682	2,665	2,645	2,647	2,650	2,642	2,634	2,633	2,631	2,653	2,650

Table A-2. Electricity Savings and Adjusted Forecast in Policy Case (GWh)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	% in 2025
Proven Utility Res. Buildings and Equipment Programs	52	163	326	561	871	1,257	1,712	2,239	2,863	3,552	4,173	4,794	5,395	5,996	6,597	**6.9%**
Proven Utility Commercial Buildings and Equipment P	26	62	75	107	215	402	631	888	1,169	1,482	1,863	2,243	2,644	3,045	3,445	**3.6%**
Manufacturing Initiative	0	16	65	161	290	419	548	677	806	935	1,064	1,193	1,322	1,451	1,580	**1.7%**
Rural and Agriculture Initiative	36	54	74	92	110	129	147	166	183	202	220	240	259	278	297	**0.3%**
Behavioral Initiative	0	39	78	116	155	311	313	393	396	479	482	567	572	659	665	**0.7%**
Building Energy Standards and Enforcement	0	0	154	334	472	559	637	717	801	909	1,034	1,172	1,304	1,408	1,511	**1.6%**
Advanced Buildings Initiative	3	31	75	137	181	211	245	288	312	334	363	397	434	476	526	**0.6%**
State and Local Public Building Retrofits	5	14	32	59	96	142	196	260	333	416	507	603	703	804	913	**1.0%**
Manufactured Homes	0	2	7	11	18	25	33	42	56	69	83	100	118	134	147	**0.2%**
Combined Heat and Power	0	0	0	0	146	340	534	728	788	848	1,009	1,169	1,330	1,363	1,396	**1.5%**
Total Policy Savings	**122**	**381**	**884**	**1,578**	**2,553**	**3,794**	**4,996**	**6,399**	**7,709**	**9,226**	**10,798**	**12,479**	**14,080**	**15,613**	**17,077**	**18%**
Adjusted Forecast	87,096	87,363	86,890	86,261	85,338	84,695	83,974	83,147	82,426	81,593	80,767	79,886	79,099	78,483	77,869	
Savings as Percent of Forecast Sales	0.14%	0.4%	1.0%	1.8%	2.9%	4.3%	5.6%	7.1%	8.6%	10.2%	11.8%	13.5%	15.1%	16.6%	18.0%	

Table A-3. Summer Peak Demand Reference Case, Savings in Policy Case, and Adjusted Forecast (MW)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	% in 2025
Peak Demand Reference Case (MW)	17,246	17,359	17,356	17,361	17,362	17,484	17,583	17,700	17,820	17,958	18,107	18,267	18,430	18,613	18,782	
Proven Utility Res. Buildings and Equipment Programs	13	41	81	140	218	314	428	560	716	888	1,043	1,198	1,336	1,458	1,568	8.3%
Proven Utility Commercial Buildings and Equipment P	4	9	11	16	32	60	93	131	173	219	276	332	387	442	499	2.7%
Industrial Initiative	-	2	7	16	29	42	56	69	82	95	108	121	134	147	160	0.9%
Rural and Agriculture Initiative	4	5	7	9	11	13	14	16	18	20	22	24	25	27	29	0.2%
Behavioral Initiative	-	10	19	29	39	78	78	98	99	120	121	142	143	165	166	0.9%
Building Energy Codes	-	-	38	84	118	140	159	179	200	227	258	293	326	352	378	2.0%
Advanced Buildings Initiative	1	5	12	21	28	34	40	48	52	56	60	66	72	79	87	0.5%
State and Local Public Building Retrofits	1	2	5	9	14	21	29	39	49	62	75	89	104	119	135	0.7%
Manufactured Homes	-	1	2	3	4	6	8	11	14	17	21	25	30	33	37	0.2%
Combined Heat and Power	-	-	-	-	19	44	69	95	102	110	131	152	173	177	181	1.0%
Demand Response Programs	136	206	345	486	699	917	1,137	1,434	1,446	1,458	1,472	1,486	1,501	1,516	1,530	8.1%
Total EE Policy Savings	**22**	**74**	**182**	**327**	**512**	**751**	**976**	**1,245**	**1,506**	**1,814**	**2,115**	**2,442**	**2,730**	**2,999**	**3,241**	17.3%
Total DR Policy Savings	**136**	**206**	**345**	**486**	**699**	**917**	**1,137**	**1,434**	**1,446**	**1,458**	**1,472**	**1,486**	**1,501**	**1,516**	**1,530**	8.1%
Total EE + DR Policy Savings	**158**	**280**	**527**	**813**	**1,211**	**1,668**	**2,113**	**2,679**	**2,951**	**3,272**	**3,587**	**3,928**	**4,231**	**4,515**	**4,771**	25%
Adjusted Forecast	17,088	17,079	16,829	16,548	16,151	15,816	15,470	15,021	14,869	14,687	14,521	14,339	14,199	14,097	14,011	
Savings as Percent of Forecast Sales	0.9%	1.6%	3.0%	4.7%	7.0%	9.5%	12.0%	15.1%	16.6%	18.2%	19.8%	21.5%	23.0%	24.3%	25.4%	

Table A-4. Natural Gas Savings in Policy Case, and Adjusted Forecast (Million Therms)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	% in 2025
Proven Utility Res. Buildings and Equipment Programs	1	4	8	12	17	23	31	41	52	65	78	90	102	112	121	**4.5%**
Proven Utility Commercial Buildings and Equipment P	1	1	1	2	4	7	11	16	21	28	34	41	47	52	56	**2.1%**
Manufacturing Initiative	-	1	2	5	9	13	17	21	25	29	33	38	42	46	50	**1.9%**
Rural and Agriculture Initiative																**0.0%**
Behavioral Initiative	-	1	2	3	4	8	8	10	10	12	12	14	14	16	16	**0.6%**
Building Energy Standards and Enforcement	-	-	6	13	18	22	25	29	32	36	41	46	51	56	60	**2.3%**
Advanced Buildings Initiative	0	2	2	4	5	6	7	8	9	9	10	11	11	12	13	**0.5%**
State and Local Public Building Retrofits	-	1	2	3	5	6	7	8	9	10	11	13	14	15	16	**0.6%**
Manufactured Homes	-	0	0	0	0	1	1	1	1	2	2	3	3	4	4	**0.2%**
Combined Heat and Power																
Total Policy Savings	**3**	**9**	**24**	**42**	**62**	**86**	**108**	**134**	**161**	**192**	**222**	**254**	**284**	**312**	**336**	**13%**
Adjusted Forecast	2,652	2,648	2,640	2,632	2,620	2,579	2,537	2,513	2,489	2,450	2,411	2,379	2,348	2,341	2,314	
Savings as Percent of Forecast Sales	0.1%	0.3%	0.9%	1.6%	2.3%	3.2%	4.1%	5.1%	6.1%	7.3%	8.4%	9.7%	10.8%	11.8%	12.7%	

Table A-5. Combined Heat and Power Units located in Missouri

City	Organization Name	Facility Name	Application	NAICS	Op Year	Prime Mover	Capacity (kw)	Fuel Type
Butler	City of Butler	Butler	District Energy	22133	1946	ERENG	13,100	OIL
Cape Girardeau	Southeast Missouri State University	Southeast Missouri State University	Colleges/Univ.	61131	1972	B/ST	6,250	COAL
Columbia	University Of Missouri	University Of Missouri Power Plant	Colleges/Univ.	61131	1961	B/ST	83,500	COAL
Florissant	Service Merchandise Company, Inc	Service Merchandise Company, Inc	General Merch. Stores	45299	1985	ERENG	60	NG
Hannibal	Overland Energy Corporation	Clemmons Hotel	Hotels	72111	1990	ERENG	150	NG
Kansas City	Bolling GSA office	Bolling GSA office	General Gov't	92119	2000	B/ST	100	WAST
Kansas	Trigen Energy	Trigen-Kansas	District Energy	22133	1990	B/ST	6,000	COAL
City	Corp	City Energy Corporation						
Laddonia	POET Biorefining - Laddonia	POET Biorefining - Missouri Ethanol	Chemicals	325193	2007	CT	10,700	NG
Lewistown	Lewistown School District	Lewistown School District	Schools	61111	2003	MT	60	NG
Louisiana	Missouri Chemical	Hercules, Inc.	Chemicals	325311	1942	B/ST	15,000	COAL
Macon	Macon Ethanol	Northeast Missouri	Chemicals	325193	2000	CT	10,000	NG
Mountain View	Smith Flooring, Inc.	Smith Flooring, Inc.	Wood Products	321918	1989	B/ST	500	WOOD
Neosho	La-Z-Boy Chair Company, Inc.	La-Z-Boy Chair Company	Furniture	337112	1984	B/ST	750	WOOD
North Kansas City	Archer Daniels Midland Company	North Kansas City	Agriculture	11115	1987	CC	4,000	NG
St Louis	Southwestern Bell Telephone Co	Southwestern Bell Telephone	Communications	51331	1992	ERENG	6,000	OIL
St. Louis	Anheuser-Busch	Anheuser-Busch	Food Processing	31212	1951	B/ST	27,600	COAL
St. Louis	Trigen Energy Corp	Ashley Plant	District Energy	22133	1999	CT	33,450	NG
St. Louis	Nooney Management	Laclede Gas Building	Office Buildings	53112	1970	ERENG	4,300	NG
St. Louis	Missouri State Hospital	Missouri State Hospital	Hospitals/ Healthcare	62211	1977	OTR	5,000	COAL

Source: ICF CHP Database (ICF 2011)

Table A-5 Key:

Prime Mover Code	Description
B/ST	Boiler/Steam Turbine
CC	Combined Cycle
CT	Combustion Turbine
FCEL	Fuel Cell
MT	Microturbine
ERENG	Reciprocating Engine
WHR	Waste Heat Recovery
OTR	Other

Fuel Code	Description
BIOMASS	Biomass, LFG, Digester Gas, Bagasse
COAL	Coal
NG	Natural Gas, Propane
OIL	Oil, Distillate Fuel Oil, Jet Fuel, Kerosene, RFO
WAST	Waste, Waste Heat, MSW, Black Liquor, Blast Furnace Gas, Petroleum Coke, Process Gas
WOOD	Wood, Wood Waste
OTR	Other

APPENDIX B. DEMAND RESPONSE ANALYSIS

*** Section numbering and references in this Appendix, prepared by Navigant Consulting, is independent of the rest of the report.

Introduction

This report defines Demand Response (DR), assesses current DR activities in Missouri, identifies policies in the state that impact DR, uses benchmark information to assess DR potential in Missouri, and identifies barriers in the state that might keep DR contributing appropriately to the resource mix that can be used to meet electricity needs. The analysis concludes with identification of policy recommendations regarding DR. Note: The demand response analysis examines multiple policy scenarios, however only the medium scenario is incorporated into the overall report.

Objectives of this Assessment

This assessment develops estimates of DR potential for Missouri. Potential load reductions from DR are estimated for the residential, commercial, and industrial sectors (see Section 3). The assessment also includes discussions of reductions possible from other DR programs, such as DR rate designs (see Section 3.6).

Role of Demand Response in Missouri's Resource Portfolio

The DR capabilities developed by Missouri utilities will become part of a resource strategy that includes resources such as traditional generation resources, renewable energy, power purchase agreements, options for fuel and capacity, energy efficiency and load management programs. Objectives include meeting future loads at lower cost, diversifying the portfolio to reduce operational and regulatory risk, and allow Missouri customers to better manage their electricity costs. The growth of renewable energy supply (and plans for increased growth) can increase the importance of DR in the portfolio mix. For example, sudden renewable energy supply reductions (e.g., from an abrupt loss in wind) may be mitigated quickly with DR.

Summary of DR Potential Estimates in Missouri

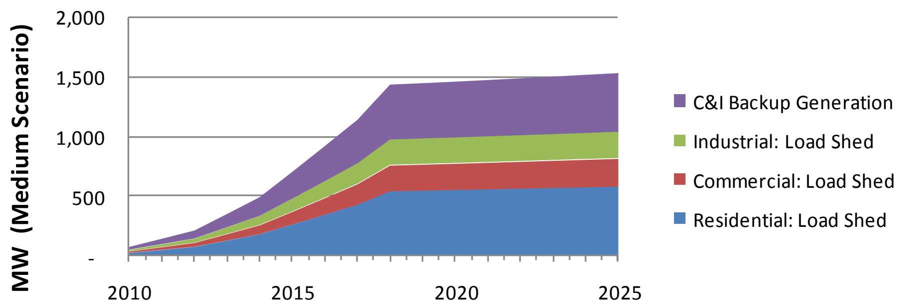
Table 1 shows the resulting load shed reductions possible (using results of this study from the Medium Scenario) for Missouri, by sector, for years 2015, 2020, and 2025. Load impacts grow rapidly through 2018 as program implementation takes hold. After 2018, the program impacts increase at the same rate as the forecasted growth in peak demand.

The recommended, conservative, Medium Scenario results show a reduction in peak demand of 699MW is possible by 2015 (4.0% of peak demand); 1,458MW is possible by 2020 (8.1% of peak demand); and 1,530MW is possible by 2025 (8.1% of peak demand).

Table 1. Summary of Potential DR in Missouri, By Sector, for Years 2015, 2020, and 2025a			
	Medium Scenario *Recommended Scenario		
	2015	2020	2025
Load Sheds (MW)			
Residential	262	553	580
Commercial	106	220	234
Industrial	106	216	222
C&I Backup Generation (MW)	225	469	494
Total DR Potential (MW)	699	1,458	1,530
DR Potential as % of Total Peak Demand	4.0%	8.1%	8.1%
a. See Section 3 for underlying data and assumptions.			

Figure 1 shows the resulting load shed reductions possible for Missouri, by sector, from year 2010, when load reductions are expected to begin, through year 2025.

Figure 1. Potential DR Load Reductions in Missouri By Sector (Medium Scenario)



These estimates reflect the level of effort put forth and utilities are recommended to set targets for the high scenarios. These estimates are based on assumptions regarding growth rates, participation rates, and program design. These factors are discussed further in this Appendix. In developing these DR potential estimates, the integration of DR with select energy efficiency activities was considered to help ensure that load impacts were not double counted. The estimated load reduction per program participant is conservatively estimated to account for increased energy efficiency in the future.

Defining Demand Response

DR focuses on shifting energy from peak periods to off-peak periods and clipping peak demands on days with the highest demands. Within the set of demand-side options, DR focuses on clipping peak demands that may allow for the deferral of new capacity additions, and it can enhance operating reserves available to mitigate system emergencies. Energy efficiency focuses on reducing overall energy consumption with attendant permanent reductions in peak demand growth. Taken together, these two demand-side options can provide opportunities to more efficiently manage growth, provide customers with increased options to manage energy costs, and develop least cost resource plans.

DR is an increasingly important tool for resource planning as power plant siting has grown more difficult and the costs of peak power have increased. Through development of DR capability, utilities can complement existing energy efficiency programs with a set of offerings that provide, at a minimum, 1) enhanced reliability, 2) cost savings, 3) reduced operating risk through resource diversification, and 4) increased opportunities for customers to manage their electric bills.

DR resources are usually grouped into two types: 1) load-curtailment activities where utilities can "call" for load reductions; and 2) price-based incentives which use time-differentiated and/or dispatchable rates to shift load away from peak demand periods and reduce overall peak-period consumption. Interest in both types of DR activities has increased across the country as fuel input prices have increased, environmental compliance costs have become more uncertain, and investment in overall electric infrastructure is needed to support new generation resources.

The mechanisms that utilities may use to achieve load reductions can range from voluntary curtailments to mandatory interruptions. These mechanisms include, but are not limited to:

- Direct load control by the utility using radio frequency or other communications platforms to trigger load devices connected to air conditioners, electric water heaters, and pool pumps;
- Manual load curtailments at commercial and industrial (C&I) facilities, including shutting off production lines and dimming overhead lighting;
- Automated DR ("Auto-DR") technologies utilizing controls or energy management systems to reduce major C&I loads in a pre-determined manner (e.g., raising temperature set points and reducing lighting loads); and
- Behavior modifications such as raising thermostat set points, deferring electric clothes drying in homes, and reducing lighting loads in commercial facilities.

Rationale for Demand Response

DR alternatives can be implemented to help ensure that a utility continues to provide reliable electric service at the least cost to its customers. Specific drivers often cited for DR include the following:

- Ensure reliability—DR provides load reductions on the customer side of the meter that can help alleviate system emergencies and help create a robust resource portfolio of both demand-side and supply-side resources that help meet reliability objectives.

- Reduce system costs—DR may be a less expensive option per megawatt than other resource alternatives. DR resources compete directly with supply-side resources and other resource investments in many regions of the country. Portfolios that help lower the increase in customers' expenditures on electricity over time represent an increasingly important attribute from the perspective of many energy customers.

- Manage operational and economic risk through portfolio diversification—DR capability is a resource that can diversify peaking capabilities. This creates an alternative means of meeting peak demand and reduces the risk that utilities will suffer financially due to transmission constraints, fuel supply disruptions, or increases in fuel costs.

- Provide customers with greater control over electric bills –DR programs would allow customers to save on their electric bills by shifting their consumption away from higher cost hours and/or responding to DR events. The ability to manage increases in energy costs has increased in importance for both residential and commercial customers. Standard residential and commercial tariffs provide customers with relatively few opportunities to manage their bills.

- **Address legislative/regulatory interest in DR –** The Missouri Energy Efficiency Investment Act (MEEIA), Senate Bill 376, declares that the policy of Missouri is to value demand-side investments equal to traditional investments in supply and delivery infrastructure. Among other provisions, the law requires the Commission to direct the implementation of demand-side programs "with a goal of achieving all cost effective demand-side savings," coupled with

> timely cost recovery and alignment of utility financial incentives with energy efficiency. The Commission is opening this case to investigate how to achieve its new responsibilities under the MEEIA, within the background of FERC policies that eliminate barriers to DR and that direct MISO and SPP to accommodate state policy regarding retail customer demand-side activity (MO PSC, 2010).

DR is gaining greater acceptance among both utilities and regulators in the United States. A 2006 FERC survey found that 234 “entities” were offering direct load control programs and the FERC’s assessment noted that “there has been a recent upsurge in interest and activity in DR nationally and, in particular, regional markets” (FERC, 2006).[42] The recent proliferation of DR offerings has been promoted in part by utilities hoping to reduce system peaks while offering customers more control over electric bills and in part by regulators. Although federal legislation has not been the driver behind the trend, it is one of many indications, at all levels of government and industry, of the growing support for DR.[43]

Many states experience significant reductions in peak demand from Demand-Side Management (DSM) programs (which include DR programs). Regulatory filings show that California experienced 495 MW in peak demand reductions in 2005 (1% of total peak demand); New York experienced 288 MW reductions in 2005 (1% of total peak demand); and Texas experienced 181 MW in reductions in 2005 (1% of total peak demand) from DSM programs. These results are annual values that do not consider the cumulative (i.e., year-to-year) impacts that accrue over the lifetimes of the conservation measures. Therefore, cumulative percentage reductions in peak demand are much higher than the annual figures stated.

Assessment Methods

As has been shown in numerous other jurisdictions across North America, well-designed DSM programs incorporating DR strategies represent an effective and affordable option for reducing peak demand and meeting growing demand for electricity. This effort estimated conservative peak demand reduction for Missouri using local energy use characteristics, demographics, and forecast peak demand, assuming relatively basic DR strategies comprising responsive reductions in demand. The following research approach was used to conduct the analysis:

- Review of existing information regarding Missouri’s customer base including:
    - Customer counts and average annual energy consumption by market segment;
    - Forecasts of future energy consumption and customer counts by market segment;
    - Previous DSM planning and potential studies.
- Review of additional publicly-available secondary sources including:
    - U.S. DOE’s Commercial Building Energy Consumption Survey (CBECS) and Residential Energy Consumption Survey (RECS) data;
    - Previous studies relevant to the current effort completed by Navigant Consulting in other regions as well as entities in other jurisdictions.

[42] The FERC report uses the term “entities” to refer to all types of electric utilities, as well as organizations such as power marketers and curtailment service providers.

[43] The federal Energy Policy Act of 2005 (EPAct) directs the Secretary of Energy to “identify and address barriers to the adoption of demand response programs,” and the Act declares a U.S. policy in support of “State energy policies to provide reliable and affordable demand response services.” EPAct directed FERC to conduct its survey of DR programs and also directed the U.S. Department of Energy to report on the benefits of DR and how to achieve them (DOE, 2006). Separately, a *National Action Plan for Energy Efficiency,* which advocates DR and other efficiency efforts, was developed by more than 50 U.S. companies, government bodies, and other organizations, including co-chairs Diane Munns, President of NARUC and Jim Rogers, President and CEO of Duke Energy (U.S. Environmental Protection Agency, 2006). Other utility industry members of the Leadership Group included Southern Company, AEP, PG&E, TVA, PJM Interconnection, ISO New England, and the California Energy Commission.

- Development of baseline profiles for residential and commercial customers. These profiles include current and forecast numbers of customers by market segment and electricity use profiles by segment.
- Incorporation of ACEEE baseline data and reference case into analysis.
- Obtaining state-level data when possible and estimation of information for the State of Missouri, when state-level data was not available.
- Development of a spreadsheet approach for estimating peak demand reduction potential associated with the DR programs/technologies deemed to be most applicable to Missouri. Estimates are developed for three scenarios—low, medium and high case scenarios.
- Telephone calls with ACEEE staff and industry professionals to discuss assessment processes and legislative, regulatory, and other factors specific to the State of Missouri.
- Incorporation of all sources of information and references into report, noting on each figure the source of the information.
- Revision of draft report based on comments from ACEEE, industry specialists and utility commenters.

The DR potential estimated used historical data and experience to obtain curtailment levels. This potential is assumed to be the achievable potential that would be cost effective, given the range of incentives that are typically required and the range of the utilities' avoided costs. A cost-effectiveness analysis was not performed for this study. Sufficient incentives could be provided to customers to encourage load reductions while maintaining a cost-effective program. A study by KEMA projected avoided costs of approximately $108 per kW for 2011 (KEMA, 2011).

State of Missouri - Background

A sound strategy for development of DR resources requires an understanding of Missouri's demand and resource supply situation, including projected system demand, peak-day load shapes, and existing and planned generation resources and costs.

Missouri utilities serve a population of almost 6 million, and generates over 91 million megawatt hours of electricity (EIA, 2009). Missouri had a system peak load forecast of 17,739MW in 2009 (KEMA, 2011). Electricity demand has grown an average of 3% per year over the period 1990 to 2008, fluctuating moderately (EIA, 2009).

Coal-fired plants in Missouri supplied about 81% of State electricity generation in 2008 (EIA, 2009). Missouri has been and likely will continue to be an importer of energy: Missouri imported more than 99 percent of the coal its power plants burned in 2008—mainly from Wyoming (UCS, 2011).

45% of the total sales in Missouri are attributed to Union Electric Co. Kansas City Power & Light Co and KCP&L Greater Missouri Operations each contribute 10%. The five largest electricity retailers in Missouri are the following entities, with percent contribution in parentheses:

1. Ameren Missouri (45%)
2. Kansas City Power & Light Co (KCP&L) (10%)
3. KCP&L Greater Missouri Operations (KCP&L GMO) (10%)
4. Empire District Electric Co (5%)
5. City Utilities of Springfield (4%)

Assessment of Utility DR Activities

This section outlines existing DR programs currently being offered to customers in Missouri, by utility.

Ameren Missouri

Ameren Missouri offers time-of-use rates to residential customers (but has low participation) and a "Peak Power Rebate Program" in which participating C&I customers get paid for voluntarily reducing electricity use during peak times. Minimum participation requirements include:

- Be on rate 3(M), 4(M), or 11(M)
- Have the ability to reduce load by at least 200 kilowatts (kW)
- Have an interval meter with communications equipment
- Have a computer with Internet access and a phone
- Have a plan that can reduce your electric demand.

The C&I program started in 2009 but did not call on participants in 2010 and is not anticipating calling on customers in 2011.

Ameren Missouri launched a similar incentive program to residential customers in '09, but the program has been discontinued.

Kansas City Power & Light Co (KCP&L)

KCP&L currently offers:

- The Energy Optimizer Program: For residential and small business customers, KCP&L offers a free programmable thermostat that customers can control remotely via the Internet. Customers partner with the utility to control peak demand. On the hottest summer weekdays, when electricity demand is greatest, KCP&L will adjust the thermostat setting up a few degrees for a short period to reduce air conditioning load.
- Real-Time Pricing Program: Commercial or industrial customers are able to buy electricity at marginal cost-based prices, shift usage to lower cost periods and reduce load to avoid expensive periods.
- The MPower Program: Commercial and industrial customers can manage their load to off-peak times. As of April 2011, there is a waiting list to participate in this program.

Empire District Electric Co

For industrial customers, Empire District Electric Co offers participation in a Special Transmission Service Contract: Praxair. This entails interruptible demand of at least 5600 kW, a minimum of 30 minutes notice, and no more than 400 hrs of DR over 12 months.

Summary of DR Programs in Missouri offered to Commercial and Industrial Customers

Table 2 summarizes the load reductions achieved in 2008 from DR programs offered to Missouri's Commercial and Industrial (C&I) customers

Table 2. Enrollment in and Reductions from C&I DR Programs in Missouri in 2008

Name	Ownership	Program	Customers Enrolled (#)	MW Enrolled	Actual Peak Reductions in 2008 (MW)
White River Valley Electric Cooperative, Inc	Coop	Interruptible Rate	40	24	16
Columbia Water & Light Dept	Muni	Load Shedding	23	21.753	7.445
Columbia Water & Light Dept	Muni	Load Management	774	21.753	0.23
Columbia Water & Light Dept	Muni	High Load Factor Rider	3	8.202	1.082
Empire District Electric Company	IOU	Special Transmission Service Contract: Praxair	1	8.1	7.6
Columbia Water & Light Dept	Muni	Thermal Storage Rider	1	7.173	0.819
Cuivre River Electric Cooperative	Coop	Peal Alert Demand Curtailment	12	6.8	5.2

Source: Navigant Consulting, Forthcoming.

Assessment of Current State Policies Affecting DR

In Order 719 and Order 719-A issued by the Federal Energy Regulatory Commission ("FERC"), the FERC enacted new rules aimed at eliminating barriers to demand response while achieving comity between state and federal regulatory policy concerning demand response in areas served by organized wholesale electric markets.

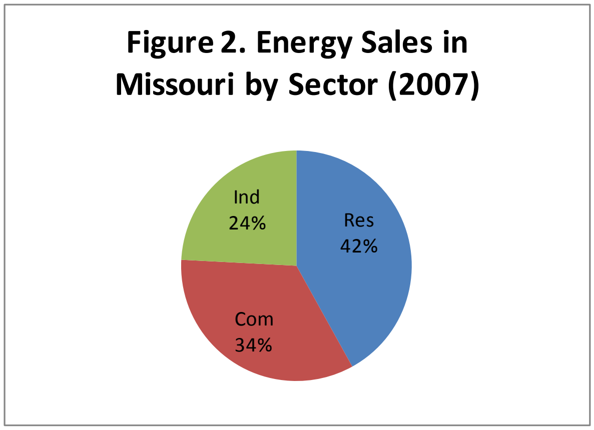
The Missouri Energy Efficiency Investment Act (MEEIA), Senate Bill 376, declares that the policy of Missouri is to value demand-side investments equal to traditional investments in supply and delivery infrastructure. Among other provisions, the law requires the Commission to direct the implementation of demand-side programs "with a goal of achieving all cost effective demand-side savings," coupled with timely cost recovery and alignment of utility financial incentives with energy efficiency. The Commission is opening this case to investigate how to achieve its new responsibilities under the MEEIA, within the background of FERC policies that eliminate barriers to DR and that direct MISO and SPP to accommodate state policy regarding retail customer demand-side activity. The Commission is investigating if any Missouri statute, law, or regulation prohibit or restrict electric utility customers from participating directly or indirectly through aggregator of retail customers (ARCs) in DR bidding programs and other issues concerning implementation of DR (MO PSC, 2010).

Many states have put in place renewable portfolio standards (RPS) to ensure that a minimum amount of renewable energy is included in the portfolio of the electricity resources serving a state. Many RPS include demand side options among the means by which the standards can be met. Missouri's RPS objective of 15% by 2021 was enacted July 2007. Credits towards this goal can be achieved through implementation of energy-efficient practices, defined as "verifiable reductions in energy consumption, or verifiable reductions in the rate of energy consumption growth." Eligible energy efficient improvements include pricing signals, electronic controls, education, information, infrastructure improvements, and the use of high-efficiency equipment and lighting (APPA, 2010).

In November 2008, voters passed a ballot initiative that establishes a mandatory RPS for investor-owned utilities of 2% by 2011 and 15% by 2021. It does not define renewable resources or include any references to energy efficiency (APPA, 2010).

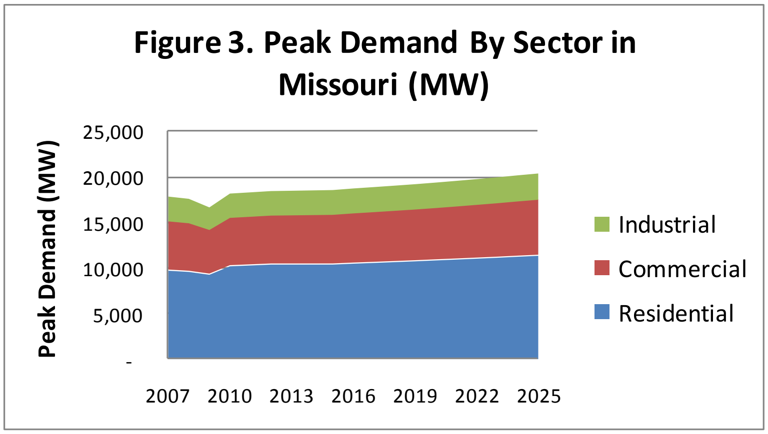
Energy and Peak Demands

Use of energy in Missouri is distributed to end use categories as follows: 42% residential, 34% commercial, and 24% industrial sectors (see Figure 2).



Source: ACEEE Missouri Reference Case

In 2007, the total summer peak load was 17,801MW and is projected to grow an average of 0.76% per year through 2025. Figure 3 displays peak demand by sector. In 2007, residential peak demand was estimated at 9,580MW; commercial was 5,338MW; and industrial was 2,642MW.



Source: ACEEE Reference Case for Missouri

Smart Grids and Advanced Metering Infrastructure (AMI)

The EPACT provisions for DR and Smart Metering have lead to a number of states and utilities piloting and implementing a Smart Grid, or sometimes referred to as Advanced Metering Infrastructure (AMI).

Smart Grid is a transformed electricity transmission and distribution network or "grid" that uses robust two-way communications, advanced sensors, and distributed computers to improve the efficiency, reliability and safety of power delivery and use. For energy delivery, the Smart Grid has the ability to sense when a part of its system is overloaded and reroute power to reduce that overload and prevent a potential outage situation. The end user is equipped with real-time communication between the consumer and utility allowing optimization of a consumer's energy usage based on environmental and/or price preferences (for example, critical peak pricing and time of use rates).

AMI provides:

- Two-way communication between the utility and the customer through the customer's smart meter.
- More efficient management of customer outages (location, re-routing).
- More accurate meter reading (minute, 15 minute intervals).
- More timely collection efforts (real time).
- Improved efficiency in handling service orders.
- More detailed, timely information about energy use to help customers make informed energy decisions (real time).
- Ability to reduce peak demand.
- More innovative rate options and tools for customers to manage their bills.

Smart Energy Pricing provides:

- Incentives to customers to shift energy away from critical peak periods
- The ability to for customers to save on their electricity bills.
- Lower wholesale prices for capacity and transmission—in the longer term.
- Improved electric system reliability, as demand is moderated.
- Potential to defer new transmission and generation.

The Smart Grid is comprised of multiple communication systems and equipment, which interoperability is crucial. Not all communication protocols are applicable to every utility's geography; therefore, pilots are essential in testing the equipment and communication software for various geographies. Furthermore, the identification of those geographic regions with the best return on investment during a pilot will aid the staged implementation plan. Standards are continuing to be researched through organizations including: 1) IntelliGrid—Created by the Electric Power Research Institute (EPRI); 2) Modern Grid Initiative (MGI) is a collaborative effort between the U.S. Department of Energy (DOE), the National Energy Technology Laboratory (NETL), utilities, consumers, researchers, and other grid stakeholders; 3) Grid 2030—Grid 2030 is a joint vision statement for the U.S. electrical system developed by the electric utility industry, equipment manufacturers, information technology providers, federal and state government agencies, interest groups, universities, and national laboratories; 4) GridWise—a DOE Office of Electricity Delivery and Energy Reliability (OE) program; 5) GridWise Architecture Council (GWAC) was formed by the U.S. Department of Energy; and 6) GridWorks—A DOE OE program.

Developments in technology allowing real time signaling and automated response will improve DR capabilities. However, existing technology exists for successful DR implementation and it is important to point out that there are no technology obstacles to effective DR.

Assessment of DR Potential in Missouri

This section examines and quantifies DR potential in Missouri. Section 3.1 outlines the general DR program categories, while Sections 3.2 and 3.3 outline the DR potential in the residential and commercial /industrial sectors, respectively. Section 3.4 discusses the load reduction potential from backup generation and Section 3.5 explains the issues surrounding rate pricing, even though benefits from this form of DR are not quantified in this analysis. Section 3.6 concludes with a summary of DR potential in Missouri.

Demand Response Program Categories

For the purposes of assessing DR alternatives, the following programs could be employed in Missouri to achieve the DR potential we outlined in this report:

Resource Category	Characteristics
Direct Load Control (DLC)	Direct load control (DLC) programs have typically been mass-market programs directed at residential and small commercial (<100 kW peak demand) air conditioning and other appliances. However, an emerging trend is to target commercial buildings with what has become known as Automated Demand Response or Auto-DR. Increased use and functionality of energy management systems at commercial sites and an increased interest by commercial customers in participating in these programs is driving growth in automated commercial curtailment in response to a utility signal. The common factor in these programs is that they are actuated directly by the utility and require the installation of control and communications infrastructure to facilitate the control process.
Callable Customer Load Response	With this type of program, utilities offer customers incentives to reduce their electric demand for specified periods of time when notified by the utility. These programs include curtailable and interruptible rate programs and demand bidding/buyback programs. Curtailable and interruptible rate programs can be used as "emergency demand response" if the advanced notice requirements are short enough. All customer load response programs require communications protocols to notify customers and appropriate metering to assess customer response.
Scheduled Load Control	This is a class of programs where customers schedule load reductions at pre-determined times and in pre-determined amounts. A variant on this theme is thermal energy storage which employs fixed asset technology to reduce air conditioning loads consistently during peak afternoon load periods.
Time-differentiated Rates	Pricing programs can employ rates that vary over time to encourage customers to reduce their demand for electricity in response to economic signals—in some cases these load reductions can be automated when a price trigger is exceeded. An example is a critical peak price which is "called" by the utility or system operator. In response to this critical price, residential customers can have AC cycling or temperature setbacks automatically deployed. Similar automated responses can be deployed by commercial customers. These rate programs are not analyzed for this assessment, but are further discussed in Section 3.5.

DR for Residential Customers

Air conditioner and other appliance direct load control (DLC) is the most common form of non-price-based DR program in terms of the number of utilities using it and the number of customers enrolled. According to FERC's 2006 assessment of DR and advanced metering, there are 234 utilities (including municipalities, cooperatives, and related entities) with DLC programs across the United

States. Approximately 4.8 million customers are participating in DLC programs across the country (FERC, 2006).

The prominent and growing role of air conditioning in creating system peaks makes it a high-profile candidate for DR efforts. The advances in DR technology that make AC load management economically viable make AC load control a high-priority program—one that has been proven reliable and effective at many utilities. Pool pumps are also a relatively easy and non-disruptive load that can be controlled for DR purposes.

Residential Control Strategies

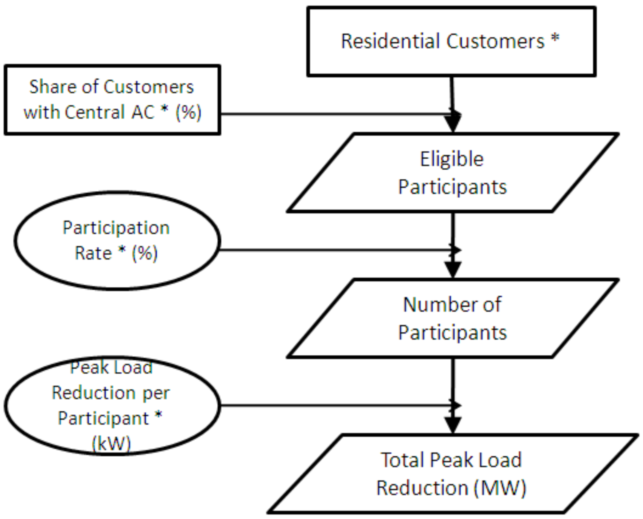
There are two basic types of control strategies: AC cycling and temperature offset. AC cycling limits ACs being on to a certain number of minutes than they otherwise would have been on. Some techniques limit ACs to being on for 50% of the minutes they would otherwise have been on. A temperature offset increases the thermostat setting for a certain period of time, for a certain number of degrees higher than it would have otherwise been set. This essentially causes the AC compressor to cycle as the temperature set-back reduces the AC demand. Sequential thermostat setbacks, i.e., one degree in a hour one, two degrees in hour two, three degrees in hour three, and four degrees in hour four can mimic an AC cycling strategy.

Cycling strategies have evolved where an optimal impact on peak kW demand may be obtained by varying the cycling time across the hours of an event. For example, there may be one hour of pre-cooling followed by 33% cycling in the first hour, 50% cycling in the second hour, 66% cycling in the third hour and dropping back to 33% in the fourth hour. Strategies like this have been deployed in pilot programs at Progress Energy Carolinas (PEC) and in PSE&G's MyPower pilot program. This type of strategy requires that forecasters accurately predict the hour(s) in which the peak system demand will occur.

Assessment of DR Potential in Residential Homes in Missouri

For Missouri, estimates for possible load reductions for residential housing units were obtained by applying the methodology displayed in Figure 4.

Figure 4. Residential Peak Load Reduction



* Input data by Single Family and Multi-Family Residences, and by Existing Home and New Construction.

The figure shows how load reductions and participations rates are applied to housing data. Items listed in rectangular shapes are factual inputs; items in circular shapes are assumptions; and items in parallelogram shapes are results. The analysis conducted for this study was based on demand response for summer loads, especially air conditioning, since Missouri's major utilities are summer-peaking. However, it should be noted that some mountainous regions in the western portion of the state are winter peaking, and DR programs have targeted electric space and water heating loads.

Load Reductions

Recent surveys show that DLC programs are being implemented by a number of utilities. Load impacts are dependent on many variables. The control strategy used, the outdoor temperature, the time of day, the customer segment, ease of and ability to override control, reliability of communication signals, age and working condition of installed equipment, and local AC use patterns all have significant effects on the load impact. Even within a single program, there is variability in impacts across event days that cannot yet be fully explained. Measuring impacts typically requires expensive monitoring equipment and as a result is often done on small sample sizes.

Even with this variability, a review of reported impacts does show some general consistencies. As expected, impacts increase as the duty cycle goes up. Table 2 shows the average reported kW impact based on 20 load control impact studies for programs based on the duty cycle used. These results support the oft-quoted rule-of-thumb that the load impact for 50% duty cycling is 1 kW per customer, which is the impact used in this analysis. However, many homes will experience an impact greater than I kW, especially newer homes.

Table 2. Average Load Impacts by Cycling Strategy for AC DLC Programs

Cycling Strategy	Average Load Impact KW/Customer

33%	0.74
45%	0.81
50%	1.04
66%	1.36

Source: Summit Blue, 2007b.

Customer type also makes a difference. In a few cases where single-family and multi-family impacts were measured separately, multi-family impacts were 60% of single-family, and thus a 0.6kW load reduction is applied in this analysis for multi-family units (Summit Blue, 2007b).

Eligible Residential Customers

All residential customers with central air-conditioning that live in areas that can receive control signals are considered eligible for the direct load control program. This includes single family and multi-family housing units. Residential accounts without central AC are assumed to have no participation.

It has been estimated that 87.1%% of Missouri single-family customers have central AC, and 88.6% multi-family customers (Ameren 2010 and RLW 2006).

Multi-family housing units often have building tenants which are not the account holders, therefore accounts are often aggregated into buildings. Some accounts have a master meter for the entire building, including tenants. Some accounts are for the "common" building loads (i.e., those loads that are part of a building account such as elevators, A/C (if applicable), lobby lighting, etc.), but individual tenants in these buildings have their own accounts. Therefore, multi-family units often have fewer units with central AC than single family. For the purposes of this analysis, it is assumed that multi-family units have 20% less units than single family.

Residential Participation Rates

Participation rates experienced in AC DLC programs vary across utilities typically from 7% of eligible customers to 40%, depending upon the effort made in maintaining and marketing the program (Summit Blue, 2007a). The utilities with the low levels of participation had essentially stopped marketing the program in recent years. Utilities with programs with sustained attention to customer retention or recruitment show higher participation rates than utilities with one-time or intermittent promotion. In Maryland, BG&E's Demand Response Service program anticipates a residential participation rate of 50%, or approximately 450,000 controlled units (BGE, 2007). The pilot phase of this program was conducted from June 1 through September 30, 2007, and 58% received a "smart" load control switch, and 42% had a "smart" thermostat installed (BGE, 2007). One study examined 15 AC DLC programs nationwide and found an average of 24% participation for eligible customers (Summit Blue, 2008b).[44] For this analysis, 3 typical yet conservative scenarios were used: a low scenario of 15% for eligible customers; a medium scenario of 25%; and a high scenario of 35%.

Results

Table 3 displays the input data and results. In summary, the results for residential programs reveal that a medium scenario reduction of 262MW is possible by 2015 (with 157MW possible by the low scenario, and 367MW by the high). By 2020, 553MW is achievable through the medium scenario (with 332MW possible by the low scenario, and 774MW by the high).

[44] Programs where participants are included in a program unless they chose to "opt-out" experience much higher participation rates. One utility is proposing a "hybrid" program for new construction, where existing customers must opt-in and new construction customers must opt-out. This program assumes that 70% of new construction customers will enroll in the initial years, and 80% in later years (Summit Blue, 2008b).

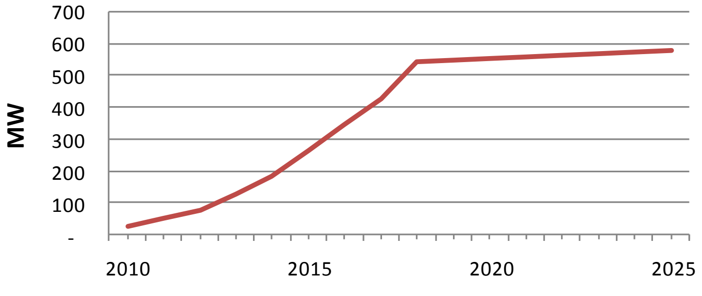
Table 3. Potential Load Reduction from AC-DLC In Missouri Residential Homes, in years 2015 and 2020

INPUTS	2015	2020
Residential Peak Demand (MW)	9,717	10,040
Residential Customers (in thousands) a: Total	2,813	2,966
Single Family	2,055	2,153
Multi-Family	559	596
Eligible Residential Customers: Single Familyb	87%	
Eligible Residential Customers: Multi-Familyb	89%	
Load Reduction per AC-DLC per Single-Family Unit (kW)	1.0	
Load Reduction per AC-DLC per Multi-Family Unit (kW)	0.6	
DR Participation Rates of eligible customers:		
Low Scenario	25%	
Medium Scenario	25%	
High Scenario c	35%	
RESULTS	2015	2020
Residential Potential DR Load Reduction (MW):		
Low Scenario	157	332
Medium Scenario	262	553
High Scenario	367	774

Notes:
a. Residential customers reflect number of housing units, as reported from Economy.com.
b. Analysis assumes residences with central AC are eligible. Residential accounts without central AC are assumed to have no participation. Central AC percents obtained from Ameren 2010 and RLW 2006.
c. Higher participation than applied in the High Scenario is possible through design of program features, such as “opt-out” participation where participants are included in a program unless they chose to “opt-out”.

Figure 5 shows the resulting residential load shed reductions possible for Missouri, from year 2010, when load reductions are expected to begin, through year 2025.

Figure 5. Potential Residential Load Shed in Missouri (Medium Scenario)



Room Air Conditioners

Other DR residential programs could involve tapping into the potential for callable load reductions from room air conditioners. At least one prominent DR provider is exploring the possibility of having manufacturers of room AC units embedding a home-area-network communication device into new units. This would enable cycling of room air conditioners without the need to install radio frequency load switches commonly used for residential direct load control applications. Callable load reductions from room air conditioners would provide a significant boost to load control capability and these reductions would be dispatchable in less than ten minutes. Some utilities are projecting to add a large number of new room air conditioners in the next five to ten years. The additional participation of a fraction of these room AC units could provide a substantial increase to the AC DLC program.

Other Appliances

Based on the experiences of other utilities, expanding the equipment controlled to other equipment beyond AC units can produce additional kW reductions. This could include electric hot water heaters and pool pumps. However, the saturation of electric hot water heaters is lower than for air conditioning, and control of hot water heaters generally produces only about one-third the load impact of air conditioners, especially in the summer when Missouri utilities would most likely be calling DR events.

Commercial and Industrial DR Potential in Missouri

Appropriate commercial sector DR programs will vary according to customer size and the type of facility. Direct load control of space conditioner equipment is a primary DR strategy intended for small commercial customers (e.g., under 100 kW peak load), although TOU rates combined with promising new thermal energy storage technologies could prove an effective combination. Mid-to-large commercial customers and smaller industrial customers could best be targeted for a curtailable load program requiring several hours of advanced notification or, where practical, for an Auto-DR program that can deliver load reductions with no more than ten minutes of advance notice. Thermal energy storage and other scheduled load control programs may also be applicable for some larger buildings or water pumping customers. In this assessment of DR potential, the focus is on the use of direct load control and curtailable load response programs. Studies have shown that pricing programs, specifically dispatchable pricing programs such as critical peak pricing (CPP) programs can provide similar impacts. These pricing programs are discussed in Section 3.2. However, for the purposes of this assessment, a focus on these load response programs is believed to be able to fully represent the DR potential, even though pricing programs could be used instead of these curtailable load programs with equal, or in some cases, greater efficiency.

The following DR program descriptions apply to both commercial and industrial customers:

- Small business direct load control (air conditioning)—Small commercial customers (under 100 kW peak load) account for a majority of customer accounts but typically only about one-quarter of total commercial load. Due to the nature of small businesses, particularly their small staffs for which energy management is a relatively low priority, it is not practical to rely on active customer response to load control events. Thus, small businesses may best be viewed in the same way as residential customers for purposes of DR.
- Curtailable load program—This program would be applicable to commercial and industrial customers willing to commit to self-activated load reductions of a minimum of perhaps 50 kW in response to a notice and request from a utility. The minimum curtailment threshold is designed to improve program cost-effectiveness by ensuring that recruitment and technical assistance costs are used for customers who can deliver significant load reductions. Advanced notice requirements would likely be two hours— long enough to allow customers an opportunity to prepare but short enough to maintain the DR resource as a viable resource that can be dispatched by operations staff. Enabling technologies would vary greatly, but utilities would educate customers about alternatives and could work with equipment vendors to facilitate equipment acquisition and installation. Incentives would be paid as capacity payment (in $/kW-month) or a discount on the customers' demand charges. Utilities could

also offer a voluntary version of the program to attract greater participation. Customers would not commit to load reductions, but incentives would be lower and would be paid only on the reductions achieved during curtailment events.

- Automated demand response (Auto-DR)—This program would be marketed to facilities such as high-rise office buildings and large retail businesses that have energy management and control systems (EMCS) that monitor and control HVAC systems, lighting, and other building functions. The benefits of Auto-DR over curtailable load programs include customer loads curtailments with as little as ten minutes notice and greater assurance that customers will reduce loads by at least their contracted amount. Incentives would be paid as either capacity payments or demand charge discounts, but would be greater than for curtailable load program participants due to the additional technology investment that may be required and the allowance of curtailments on relatively short notice. Utilities would offer extensive technical assistance in setting up Auto-DR capability and would potentially provide financial assistance as well for customers making long-term commitments.
- Scheduled load control programs (including thermal energy storage)—Scheduled load control can help reduce utility peak demand, especially through shifting of space cooling loads enabled by thermal energy storage technologies. Large-customer TES systems could be promoted along with customer commitments to reduce operation of chillers or rooftop air conditioners during specified peak hours. Customers' return on investment can be increased by encouraging migration to a TOU rate, which would offer a rate discount for many of the hours that TES systems are recharging cooling capacity. Water pumping systems are typically good candidates for scheduled load control programs and utilities can investigate opportunities in the municipal water supply and irrigation sectors. Other, less traditional, opportunities may also be available, such as the leisure/resort industry's limiting recharging of electric golf carts to off-peak hours.
- Emergency under-frequency relay (program add-on)—Under-frequency relays (UFRs) automatically shut off electrical circuits in response to the circuits exceeding pre-set voltage thresholds specified by the utility. Use of UFRs is a valuable addition to a DR portfolio because the load response is both automatic and virtually instantaneous. UFRs can best be integrated into another DR program where participants are already engaging in load curtailment activities. It is expected that some customers who might consider participating in a DR program will not be willing to allow loads to be controlled via UFR since they would not receive any advanced notice. Incentives would also need to be greater to attract participants and provide acceptable compensation. However, the benefits of UFRs warrant their consideration as part of a utility's proposed DR portfolio.

Commercial DR Potential
To estimate potential load reductions for commercial units, a straight-forward approach of applying load shed participation rates and curtailment rates directly to commercial peak demand.

First, assumptions were made on the percentage of commercial customers who are willing to participate in DR programs. One study applied commercial participation rates ranging from 11% to 48% for commercial customers (Summit Blue, 2008a). Table 4 displays participation rates for various types of commercial customers, disaggregated into two different peak demand categories (<300kW and >300kW).

Table 4. Examples of Commercial Load Shed Participation Rates

	Peak Category	
Customer Segment	<300kW	>300kW
Office Buildings	11% - 15%	45% - 48%
Hospitals	13%	48%
Hotels	14%	45%
Educational Facilities	13%	43%

Retail	11%	42%
Supermarkets	12%	33%
Restaurants	11%	39%
Other Government Facilities	15%	44%
Entertainment	13%	41%
Source: Summit Blue, 2008a.		

Because facility-specific data was not available for Missouri, three conservative scenarios for participation rates were applied. A medium-scenario load participation rate of 20% was applied as it appears to be an average participation rate found by utilities with DR programs in place. A low scenario of 10% and a high scenario of 30% are applied.

Then, assumptions were made for curtailment rates, based on existing estimates of the fraction of load that has been shed by commercial customers enrolled in event-based DR programs callable by the utility. Table 5 displays curtailment rates for various types of commercial customers, which range from 13% to 43%. For the purposes of this analysis, 3 conservative scenarios were applied: a low curtailment rate of 15%, a medium curtailment rate of 20%, and a high rate of 25%.

Table 5. Examples of Commercial Curtailment Rates

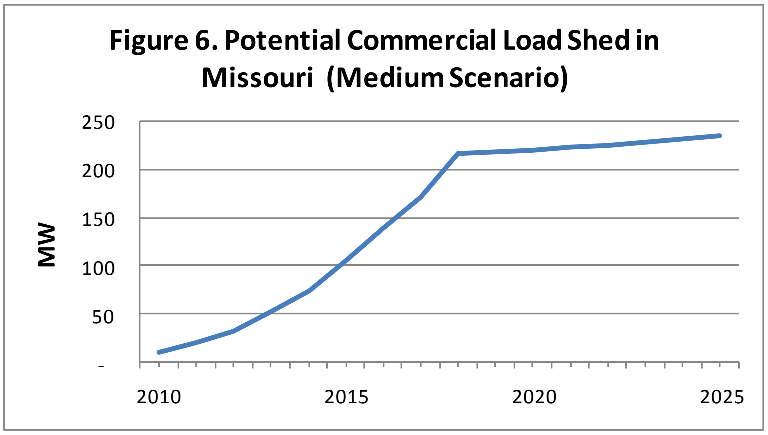
Customer Segment	Average Curtailment Rate
Office Buildings	21%
Hospitals	18%
Hotels	15%
Educational Facilities	22%
Retail	18%
Supermarkets	13%
Restaurants	17%
Other Government Facilities	38%
Entertainment	43%
Source: Summit Blue, 2008a.	

Table 6 displays the input data and results. In summary, the commercial sector results reveal that a medium scenario reduction of 106MW is possible by 2015 (with 40MW possible by the low scenario, and 198MW by the high). By 2020, 220MW is achievable through the medium scenario (with 83MW possible by the low scenario, and 413MW by the high).

Table 6. Potential Commercial Load Shed in Missouri, in Years 2015 and 2020

INPUTS	2015	2020
Commercial Peak Demand (MW)	5,287	5,505
Load Shed Participation Rates:		
Low	10%	
Medium	20%	
High	30%	
Curtailment Rates:		
Low	15%	
Medium	20%	
High	25%	
RESULTS	2015	2020
Commercial DR load reductions (MW):		
Low	40	83
Medium	106	220
High	198	413

Figure 6 shows the resulting commercial load shed reductions possible for Missouri, from year 2010, when load reductions are expected to begin, through year 2025.



DR programs that move towards the auto-DR concept can typically provide some load sheds that only require ten-minute notification or less. While some customer surveys have shown that most customers would prefer longer notification periods, many of these customers have not put in place the technologies to automate DR both load shed within a facility and the startup of emergency generation (ConEd, 2008). The value of DR and the design of DR programs should take into account system operations. Ten-minute notice DR can be valuable in helping defer some investment in T&D. While not all customers may choose to provide ten-minute notice response, there should be an increasing number of customers that will provide this type of response in the future and programs should be designed to acquire this resource. This type of DR is often a more valuable form of DR with higher savings for the utility, and utilities are often ready to pay up to twice as much to customers for this short-notice responsiveness.

Industrial DR Potential

A similar analysis was conducted for the industrial sector: load shed participation rates and curtailment rates were applied to industrial peak demand. A previous study found industrial participation rates to vary from 25% for facilities <300kW, to 50% for >300kW (Summit Blue, 2008a). For this study, the following rates were applied to participation: Low (20%); Medium (30%); and High (40%).

Previous studies have found industrial curtailment rates to vary from 17% (Quantec, 2007), to 30% (Consortium, 2004), to 75% (Nordham, 2007), resulting in a mean of 41%. The following conservative rates were applied to curtailment for this study: Low (20%); Medium (30%); and High (40%). With these participation rates and potential load curtailments, the high load reduction potential for the overall industrial sector loads is 16% (i.e., 40% participation and 40% of that load participating).

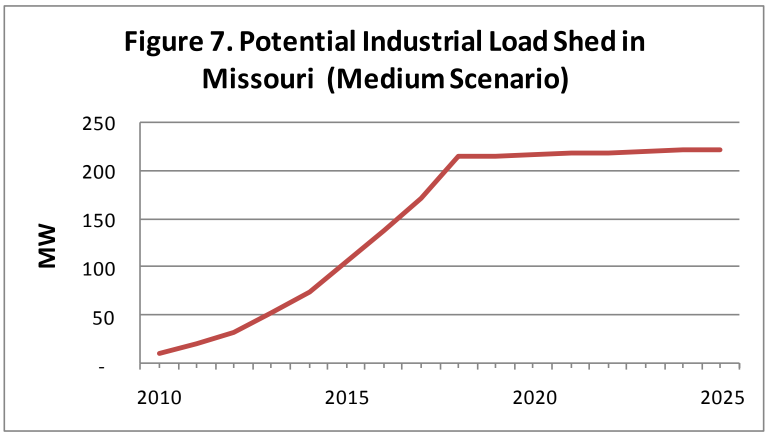
Table 7 displays the input data and results. In summary, the industrial sector results reveal that a medium scenario reduction of 106MW is possible by 2015 (with 47MW possible by the low scenario, and 188MW by the high). By 2020, 216MW is achievable through the medium scenario (with 96MW possible by the low scenario, and 384MW by the high).

Table 7. Potential Industrial Load Shed in Missouri, in Years 2015 and 2020

INPUTS	2015	2020

Industrial Peak Demand (MW)	2,354	2,403
Load Participation Rates:		
Low	20%	
Medium	30%	
High	40%	
Curtailment Rates:		
Low	20%	
Medium	30%	
High	40%	
RESULTS	2015	2020
Industrial DR load reductions (MW):		
Low	47	96
Medium	106	216
High	188	384

Figure 7 shows the resulting industrial load shed reductions possible for Missouri, from year 2010, when load reductions are expected to begin, through year 2025.



The largest load reductions, and often the most cost-effective, may be found in Missouri's largest commercial and industrial customers. Data concerning these largest facilities were not available in Missouri so estimates are not quantified separately from the industrial analysis given in the previous section.

It is a topic of concern how the economic downturn could potentially affect DR, particularly in the commercial and industrial sectors. Industry communications reveal that DR efforts have not slowed down with the economy. Many utilities are supporting DR programs, even if capacity is not a current driver. Progress Energy is continuing ahead with their DR programs and recently received approval for their C&I DR program (see Section "Assessment of Utility DR Activities").

Commercial and Industrial Backup Generation Potential

Emergency backup generation is a prominent component of a callable load program strategy. Some of the emergency generators not currently participating in DR programs may not be permitted for use as a DR resource and regulations may further limit the availability of emergency generation for DR. In some cases, backup generators may not be equipped with the start-up equipment to allow the generator to participate in short-term notification programs. Utilities could consider a program to assist customers with equipment specification and set-up to promote DR program participation by backup generators.

In some instances, there may be environmental restrictions on emergency generation. Emissions of emergency generation may be regulated, and the future of such regulations may add some uncertainty. However, some areas have been able to have such restrictions lifted during system emergencies.

Two approaches can increase the amount of emergency generation in DR programs: 1) facilitating customer-owned generation, and 2) utility ownership of the generation, which is used to provide additional reliability for customers willing to locate the equipment at their facilities.

Customer-owned Emergency Generation

To increase customer-owned emergency generation, utilities may assist customers with ownership of grid-synchronized emergency generation. Utilities may offer to pay for all equipment necessary for parallel interconnection with the utility grid, as well as all maintenance and fuel expenses. Once operational, the standby generators can be monitored and dispatched from a utility's control center, and they can also provide backup power during an outage. An additional benefit to the customer relative to typical backup generation is the seamless transition to and from the generator without the usual momentary power interruption.

Utility-owned Emergency Generation

A second approach to increasing the availability of emergency generation for DR is by locating generation at customer sites that can be owned by a utility. Through this type of program, the customer receives emergency generation capability during system outages in exchange for paying a monthly fee consisting of both levelized capital costs and operation and maintenance costs. Participants would likely receive capacity payments ($/kW-month) and/or energy payments ($/kWh) in exchange for granting a utility to dispatch the units for a limited number of events and total hours per year.

Backup Generation in Missouri

Total Missouri back-up generation capacity for 2015 is estimated at approximately 1,123MW.[45] Additional analysis revealed that the commercial and industrial back-up capacity, each, is approximately half of the total capacity, at just over 563MW.[46] Assuming a medium scenario that 40% of the total backup in Missouri is available for load shed, then 225MW of backup generation is available by 2015 and 469MW is available by 2020 (see Table 8).

Table 8. Potential Reductions from C&I Backup Generation in Missouri, in Years 2015 and 2020a

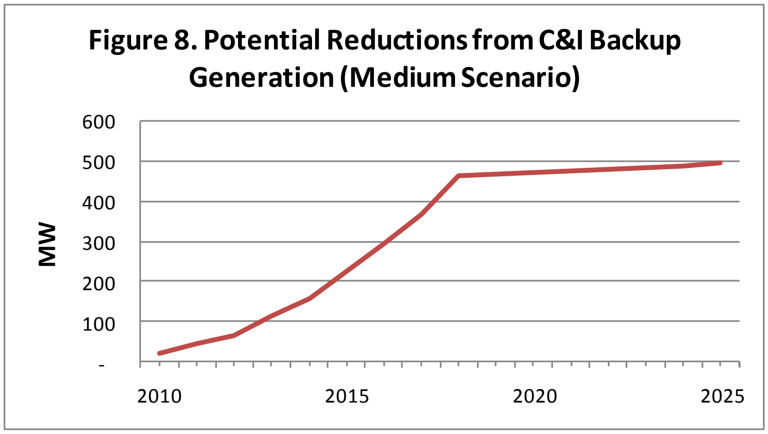
INPUTS	2015	2020
Total Backup Generation Capacity (MW)	1,123	1,173
Backup Generation Potential (%):		
Low	30%	
Medium	40%	
High	50%	

[45] Back-up generation capacity in Missouri was estimated from form EIA-861 filings submitted by utilities nationwide (EIA, 2007). However, only utilities providing approximately one-quarter of total kWh report these numbers. It was assumed that the prevalence and usage of distributed generation in the remaining 75% of utilities is similar.

[46] The analysis first determined the back-up generator population nation-wide, and then scaled the data down to the Midwest region (CBECS resolution), accounting for proportional differences in building stock nation-wide and region-wide. The region-wide results were then scaled down to Missouri specifically using theratio of Missouri population to regional population.

RESULTS	2015	2020
Potential Reduction from C&I Backup Generation (MW):		
Low	169	352
Medium	225	469
High	282	587

Figure 8 shows the resulting commercial and industrial backup generation reductions possible for Missouri, from year 2010, when load reductions are expected to begin, through year 2025.



Pricing and Rates

In this assessment of DR potential, the focus is on the use of direct load control and curtailable load response programs callable by the utility. Studies have shown that pricing programs, specifically dispatchable pricing programs such as critical peak pricing (CPP) programs can provide similar impacts; however, for the purposes of this assessment, a focus on the these load response programs is believed to be able to fully represent the DR potential, even though pricing programs could be used instead of these curtailable load programs with equal, or in some cases, greater efficiency.

New rates may be introduced as part of a DR program, and may include real-time prices, or other time-differentiated rates, for commercial and industrial customers, and a modification of any existing residential time-of-use (TOU) rates. Any new rate structures would be designed to reduce system demand during peak periods and provide an opportunity for customers to reduce electric bills through load shifting.

Critical peak pricing (CPP) is a viable option for inclusion in a DR portfolio. In FERC's 2006 survey of utilities offering DR programs (citation below), roughly 25 entities reported offering at least one CPP tariff. However, many of the tariffs were pilot programs only, and almost all of the 11,000 participants were residential customers. The apparent lack of commercial CPP programs is supported by a 2006 survey of pricing and DR programs commissioned by the U.S. EPA (below), which found only four large-customer CPP programs, all of them in California. The pilot programs in California linked the CPP rate with "automated demand response" technologies that provide most of the impact. The CPP rate itself, and the price incentive that it creates, is not the driver behind the load reductions.

As stated, rate pricing options were not analyzed in this analysis. Event-based pricing programs achieve impacts very similar to the callable load programs presented above. Pilot studies and tariff evaluations of TOU-CPP programs[47] show the load reductions for called events are similar in magnitude to air conditioning DLC programs. This is not surprising in that most TOU-CPP participants use a programmable-automated thermostat to respond to CPP events in a manner similar to a DLC strategy. One difference is that the customer response is less under the control of the program or system operator that could change cycling strategies or thermostat set points across different events or different hours within an event. Similarly, demand-bid programs are simply calls for target load sheds, i.e., those bid into the program.

In general, the direct load shed programs seem to provide greater MW of participation and more reliable reductions. However, the use of either TOU-CPP or a demand-bid program represents a point of view or policy position that price should be a centerpiece of the DR effort and help customers see prices in the electricity markets. From a point of view of simplicity and attaining firm capacity reductions, the direct load shed programs may offer some advantages. Ultimately, the choice between these direct load shed programs and pricing programs may come down to customer preferences and decisions by policy makers on the emphasis of DR efforts.

A time-differentiated rate is another option to consider that may not be "callable." Such rates include day-ahead real-time pricing (RTP), two-part RTP tariffs, and standard TOU rates. Although they are not "callable" in that the rate is generally in effect every day, there may be synergies between time-differentiated rates and callable load programs. In general, an RTP option will result in customers learning how to reduce energy consumption on essentially a daily basis when prices tend to be high (e.g., summer season afternoons and early evenings). Customers do not tend to track exact hourly prices, but they know when prices are likely to be higher (e.g., summer season afternoons with higher prices on hot days).[48] The benefits to the customer come from reducing consumption across many summer days when prices are high, rather than a focus on reduction during system event days. In general, the reductions on system peak days are roughly the same as on any summer day when prices are reasonably high. As a result, an RTP option can provide substantial benefits by increasing overall market and system efficiency through shifting loads from high priced periods to periods with lower prices. However, these tariffs may not provide the needed load relief on system-constrained event days.[49], [50]

Summary of DR Potential Estimates in Missouri

Table 9 shows the resulting load shed reductions possible for Missouri, by sector, for years 2015, 2020, and 2025. Load impacts grow rapidly through 2018 as program implementation takes hold. After 2018, the program impacts increase at the same rate as the forecasted growth in peak demand.

The recommended, conservative, medium scenario results show a reduction in peak demand of 699MW is possible by 2015 (4.0% of peak demand); 1,458MW is possible by 2020 (8.1% of peak demand); and 1,530MW is possible by 2025 (8.1% of peak demand).

[47] See Public Service Electric and Gas Company, "Evaluation of the MyPower Pricing Pilot Program," prepared by Summit Blue Consulting, 2007; and the California Energy Commission, "Impact evaluation of the California Statewide Pricing Pilot—Final Report," March 16, 2005. Web reference: http://www.energy.ca.gov/demandresponse/documents/index.html#group3.

[48] See evaluations of the hourly pricing experiment offered by ComEd and the Chicago Energy Cooperative performed by Summit Blue Consulting (2003 through 2006).

[49] One way to make an RTP tariff more like an event-based DR program is to overlay a critical peak pricing (CPP) component on the RTP tariff where unusually high prices would be posted to customers with some notification period. Otherwise, it is unlikely that the high levels of reduction needed for system-event days would be attained.

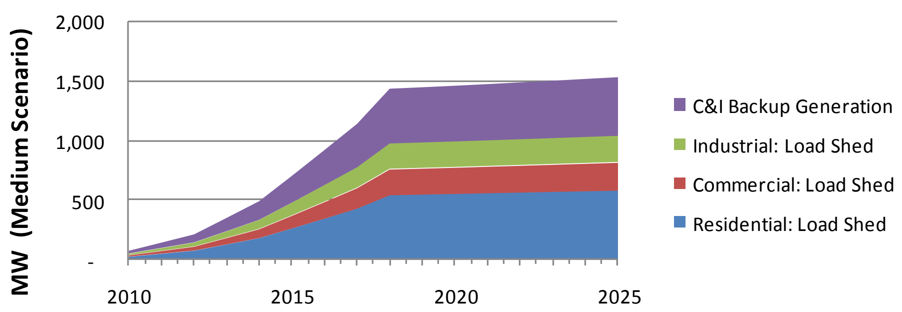
[50] The complementary of event-based load shed programs with RTP tariffs is assessed in: Violette, D., R. Freeman, and C. Neil. "*DR Valuation and Market Analysis—Volume II: Assessing the DR Benefits and Costs*," Prepared for the International Energy Agency, TASK XIII, Demand-Side Programme, Demand Response Resources, January 6, 2006. Updated results are presented in: Violette, D. and R. Freeman; "*Integrating Demand Side Resource Evaluations in Resource Planning*;" Proceedings of the International Energy Program Evaluation Conference (IEPEC), Chicago, August 2007 (also at www.IEPEC.com).

	Medium Scenario *Recommended Scenario		
	2015	2020	2025
Residential	262	553	580
Commercial	106	220	234
Industrial	106	216	222
C&I Backup Generation (MW)	225	469	494
Total DR Potential (MW)	699	1,458	1,530
DR Potential as % of Total Peak Demand	4.0%	8.1%	8.1%

The high scenario DR load potential reduction is 2,158MW or 12.0%. This is within a range of reasonable outcomes in that it has a ten year rollout period (beginning of 2012 through the end of 2020), providing a relatively long period of time to ramp up and integrate new technologies that support DR. A value near the high scenario would make a good MW target for a set of DR activities. However, for the purposes of this study, we state the Medium Scenario as a realistic potential estimate of load reductions from DR programs.

Figure 9 shows the resulting load shed reductions possible for Missouri, by sector, from year 2010, when load reductions are expected to begin, through year 2025.

Figure 9. Potential DR Load Reductions in Missouri By Sector (Medium Scenario)



These estimates reflect the level of effort put forth and utilities are recommended to set targets for the high scenarios. These estimates include assumptions based on utility experience regarding growth rates, participation rates, and program design, among others, and will adjust accordingly if differing assumptions are made. The assumptions made are believed to be conservative, and reflect minimum achievable DR potential. For example, participation rates for all of the sectors are based on experience in other states, and are based primarily on customer awareness, the ability to have automated response, and the adequacy of reward. If the statewide education program now required in Missouri promotes DR programs and adequate incentives are offered, then participation rates higher than the medium scenario are entirely realistic.

Comparison of Estimated DR Potential with Results from Other Studies

These estimated reductions in peak demand are within a range to be expected for a population of Missouri's size. Estimates of DR in other states show that the estimates calculated here for Missouri are reasonable: 15% reductions in peak demand in Florida are possible by 2023 (Elliot et al., 2007a), and 13% are possible in Texas, also by year 2023 (Elliot et al., 2007b). DR potential for a utility in New York was estimated to be 9.3% of peak demand in 2017 (Summit Blue, 2008a). This finding is similar to that of a recent analysis estimating that peak load reductions from DR nationwide will be 8.2% of system peak load in 2020 and 14% by 2030 (EPRI and EEI, 2009). Estimation methods differ among the studies, but nonetheless show that the 8% (medium scenario) and 12% (high scenario) reductions in Missouri are realistic and achievable with institutional and economic commitments.

A FERC Staff Report released in the Summer of 2009 on DR potential concludes that 9% and 14% reductions are feasible in Missouri, from the "Expanded Business as Usual" and "Achievable Potential" scenarios for 2019 (FERC, 2009). The KEMA (2011) report also used the FERC models (with slight adjustments made to inputs) and estimated the same reductions.

The FERC analysis includes significant contributions from innovative pricing and rates, and is based on higher participation rates and a quicker rollout, and consequently are higher than those estimated in this report and ramp up more quickly.

As stated in the "Pricing and Rates" section of this report, the DR potential estimates focus on the use of direct load control and curtailable load response programs callable by the utility. This focus is believed to be able to fully represent the DR potential, even though pricing programs could be used instead of these curtailable load programs with equal, or in some cases, greater efficiency. Whereas the FERC estimates gain most benefits from pricing programs, this report did not examine aggressive pricing scenarios or complete restructuring of rates (covering all customers) where prices would be responsive to market effects and have considerable impact on peak demand. This report examined cases involving 10%-40% of customer load participating in DR programs. Newer visions for pricing options enabled by a smart grid infrastructure have larger numbers of customers facing real-time market pricing, resulting in greater decrease in peak demand. The FERC report's "Achievable Potential" is realized if all customers have dynamic pricing tariffs as their default tariff and 60%-75% of customers adopt this default tariff. Therefore, the estimates derived in the FERC study give further support that the results from this report are reasonable and achievable through traditional DR programs.

Recommendations

This assessment indicates that the system peak demand can be reduced by approximately 8.1% or 1,458MW in 2020 in the medium case and 12.0% or 2,158MW in the high case. The medium scenario is the recommended scenario and even the high case is considered to be within a reasonable range if aggressive action begins by the end of 2011, providing for a ten-year rollout of the DR efforts (at the beginning of 2012 through the end of 2020).

Key recommendations for increasing load reductions from DR programs include:

- Research should continue (as initiated by the Commission) to determine if any Missouri statute, law, or regulation are prohibiting or restricting electric utility customers from participating directly or indirectly through aggregator of retail customers (ARCs) in DR bidding programs and other issues concerning implementation of DR.

- Appropriate financial incentives need to be offered for programs administered directly by the utilities or for outsourcing DR efforts to aggregators. Research should also be conducted to determine the optimal relationship between Missouri customers, utilities and ARCS in regards to DR participation.

- Missouri has some history of time-differentiated rates. Pricing should form the cornerstone of an efficient electric market. Daily TOU pricing and day-ahead hourly pricing will increase overall market efficiency by causing shifts in energy use from on-peak to off-peak hours every day of the year. However, this does not diminish the need to have dispatchable DR programs that can address those few days that represent extreme events where the highest demands occur. These events are best addressed by dispatchable DR programs.

- DR programs need to be integrated with the delivery of EE programs for impact greateset impact and efficiencies. Gains in delivery efficiency are possible by combining and cross-marketing EE and DR programs. These can include new building codes and standards that include not only energy efficiency construction and equipment, but also the installation of addressable and dispatchable equipment. This can include addressable thermostats in new residences and the installation of addressable energy management systems in commercial and industrial buildings that can reduce loads in select end-uses across the building/facility. In addition, energy audits of residential or commercial facilities can also include an assessment of whether that facility is a good candidate for participation in a DR program through the identification of dispatchable loads. Furthermore, building commissioning and retro-commissioning EE programs that are becoming popular in many commercial and industrial sector programs have the energy management system as a core component of program delivery. At this time, the application of auto-DR can be assessed and marketed to the customer along with the EE savings from these site-commissioning programs.

- Key programs that should be offered by Missouri energy providers which can be designed within a 12-month period include:
  - Residential and small business AC direct load control using switches or thermostats (or giving customers their choice of technology).
  - Auto-DR programs providing direct load curtailment for larger commercial and industrial customers.
  - Callable interruptible programs with manual response to an event notification for larger commercial and industrial customers where auto-DR approaches are not acceptable to the customer or technically not feasible.
  - Aggressive enrollment of back-up generators in DR programs.

- Load reduction programs typically have less need for pilot programs as the reductions are defined by the equipment and processes outlined by the program for each participant. Time differentiated pricing is a cornerstone of efficient electric markets and the design of these programs may need more pilot testing as the customer response to pricing is voluntary and not set (as often) by program design.

- Plan for at-scale programs through the rollout period. Pilot programs can be important in determining the appropriate design of cost-effective DR programs. However, there are established DR programs and technologies. Even with the unique circumstances in Missouri, these programs can be designed for deployment at scale. However, this approach recognizes that the first year of program deployment and possibly the second year should be designed to test key design components as part of a program shakeout. The third year of a program that should represent an efficient design and an at-scale program. DSM programs are designed to be flexible and undergo year-to-year changes due to market, customer and technology factors. This will always be the case and the benefits of discrete pilot program can limit overall program participation for a number of years resulting in “lost DR MWs.” The politics of DSM and diverse positions of parties can result in a compromise in the implementation of programs leading to a two to three-year pilot program. This can delay the delivery of DR at scale resulting in higher overall costs. The over-use of pilots that do not acknowledge the ability of a program roll-out to have at-scale deliver as its goal in year three, but to also have tests of design components and decision nodes built into the first two year of program rollout can result in “death by piloting” for attainable DR MWs. Also, a decision to run a pilot program must be based on the assumption that the program will not have enough flexibility in design and on-going decision nodes during the first two years to allow for the ramp up into full scale efficient deployment in year three.

- Customer education should also be included in DR efforts in Missouri. There is some perceived lack of customer awareness of programs and incentives were programs do exist. In addition, new programs will need marketing efforts as well as technical assistance to help customers identify where load reductions can be obtained and the technologies/actions needed to achieve these load reductions. Also, high-level education on the volatility of electricity markets helps customers understand why utilities and other entities are promoting DR and the customers' role in increasing demand response to help match up with supply-side resources to achieve lower cost resource solutions when markets become tight.

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