A Guide to Growing an Energy-Efficient Economy in Mississippi

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Executive Summary

Mississippi has made remarkable progress in the last year in improving the energy efficiency of its economy. Inspired by strong leadership and driven by the need for economic growth, Mississippi is building itself as a shining example for other states in the Southeast region, as well as the rest of the nation, to emulate. While load growth for electricity and natural gas in Mississippi is not expected to increase at rates seen in many other states around the country, the need for policies that promote sustained economic growth has never been more apparent. Energy efficiency is an essential policy area that has the ability to spur economic development. Mississippi's leaders are well aware of this fact, and they have recently taken laudable steps that put the state on a path toward greater economic prosperity and independence.

Governor Phil Bryant released his energy plan, *Energy Works: Mississippi's Energy Roadmap*, in October 2012, calling for Mississippi to leverage its energy resources for the sake of economic development, which included a call for greater energy efficiency.[1] On July 11, 2013 the Mississippi Public Service Commission (MPSC) took laudable strides toward improving energy efficiency in the state by adopting rules that require electric and natural gas utilities under MPSC jurisdiction to implement energy efficiency programs, along with other related regulatory policies that will facilitate cost-effective utility investment in program deployment. Both of these policy developments highlight the strong leadership that Mississippi currently possesses, which is determined to set the state on a path toward greater economic prosperity.

The intent of this report is to identify strategic, actionable opportunities for Mississippi to consider to expand and perpetuate its energy efficiency efforts for the benefit of all Mississippians. Our analysis estimates the potential for a suite of policies and programs to capture untapped energy efficiency resources that exist in Mississippi in order to spur economic development in the state. This report responds to two primary needs: 1) the identification by Governor Phil Bryant in his energy plan of the need for a statewide energy efficiency assessment, and 2) to offer strategic guidance and insights to the MPSC, utilities, and other key stakeholders during the continued development and implementation of the new energy efficiency rules.[2]

KEY FINDINGS

Here, we present the key findings of our statewide analysis:

- A comprehensive portfolio of state-led energy efficiency policies, such as lead-by-example, building energy codes, and utility customer programs have the potential to cost-effectively meet 4% cumulative of statewide electricity needs by 2020, increasing to 13% by 2025, as well as 3% cumulative of natural gas needs by 2020, increasing to 10% cumulative by 2025.

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[1] See http://www.governorbryant.com/wp-content/uploads/2012/10/Energy-Works-Roadmap-Final.pdf
[2] See http://www.psc.state.ms.us/InsiteConnect/InSiteView.aspx?model=INSITE_CONNECT&queue=CTS_ARCHIVEQ&docid=310904

- Utility energy efficiency programs are the lowest-cost option to meet Mississippi's future electricity demand when compared to supply-side alternatives. Efficiency program portfolios modeled in this report cost about $0.02-$0.04 per kilowatt-hour (kWh)-saved,[3] compared with an avoided cost of electricity supply in Mississippi of approximately $0.04-$0.09 per kWh through 2025. Efficiency also creates avoided peak demand, transmission, and distribution benefits.
- Based on the utility customer programs we model in this report, Mississippi can readily and cost-effectively achieve incremental annual electricity savings of 1% by 2022 and by 2025 for natural gas. This does not reflect the maximum, achievable potential for Mississippi, however. There are many more opportunities to capture additional savings beyond the programs we consider here, and Mississippi has a wealth of experience from neighboring states and utilities to draw from in order to realize those additional savings.
- The set of suggested policies and programs in this report, both state- and utility-administered, can reduce Mississippi's energy costs by a net $2.3 billion over the life of the energy-saving measures, which is the total resource cost (TRC) test net reduction to all customers, not just program participants.
- Mississippi's businesses—commercial, industrial, and agricultural—are interested in achieving more energy efficiency, but face barriers such as high up-front costs and lack of technical expertise. There is, however, existing expertise in the state for others to draw from, so it is essential for stakeholders to learn how to leverage this experience in order to benefit from it. Ultimately, businesses that take advantage of energy efficiency upgrades can significantly lower their energy bills as a way to improve their bottom line and remain competitive in the marketplace.
- Our macroeconomic assessment finds that in 2025 alone, the portfolio of efficiency policies and programs will result in nearly $900 million in net economic output, including $225 million in wages, $169 million in business income to small business owners, 6,700 person-years of employment, and increased state and local tax revenue of $21 million.

BACKGROUND

Prior to 2013, energy efficiency potential in Mississippi was largely untapped. Mississippi ranked 51st on *ACEEE's 2012 State Energy Efficiency Scorecard*, reflecting the general trend that most consumers and businesses in the state do not have access to energy efficiency services to help lower their energy bills. This historical trend has manifested into the following scenario: while Mississippi enjoys some of the lowest energy rates in the country, the residential sector suffers from some of the highest energy bills in the country (see Tables 1 and 2 in the report).

The Southeast region as a whole is also trending toward greater interest in and commitment to energy efficiency. For example, in 2010 the Arkansas PSC (APSC) established annual electricity savings goals that ramped up to 0.75% of sales per year by 2013, making Arkansas

[3] While some programs and measures are more cost-effective than others, efficiency program portfolios on average across the country cost in this range, based on a forthcoming ACEEE review of efficiency program costs in about 20 states.

the first state in the Southeast to adopt long-term efficiency targets. Overall, the programs geared up and hit their targets in 2012 at a net benefit to all customers. Given the success of programs, the APSC issued an Order to increase savings targets to 0.9% for electricity and 0.6% for natural gas in 2015 (APSC 2013). Stakeholders have requested an energy efficiency potential study to inform the next round of targets after 2015. Mississippi stakeholders can look to the successes, challenges, and lessons learned from Arkansas to help shape the state's investment in energy efficiency resources.

The recent policy developments discussed above have Mississippi poised to become a regional leader in energy efficiency. There are myriad lessons on effective energy efficiency policy and program design and implementation from across the country for Mississippi to draw from. What is most important is that Mississippi's stakeholders—households, businesses, utilities, the MPSC, etc.—coalesce to increase the state's energy efficiency investments robustly and prudently in order to improve the quality of life for all Mississippians.

METHODOLOGY

This report provides a detailed, quantitative analysis of cost-effective energy efficiency potential in Mississippi's buildings and industrial sectors, focusing on end-use electricity and natural gas usage. We organized the analysis, which covers the period 2014–25, into three overall parts:

1. *Reference Case*: Develop a baseline reference case scenario of statewide forecasts for electricity and natural gas consumption and prices by customer class.
2. *Policy and Program Potential Analysis*: Analyze a suggested set of policy and program options that Mississippi can adopt or expand to develop its energy efficiency potential. Given the formal adoption of energy efficiency rules for utilities by the MPSC, we model utility customer programs for the impending Quick Start and Comprehensive Portfolio phases.
3. *Macroeconomic Assessment*: Analyze the macroeconomic (jobs, gross state product, tax revenue) impacts from the policy and program analysis.

OVERVIEW OF FINDINGS

Our policy and program analysis estimates the savings potential that could be achieved through the adoption of several statewide policy options (Table ES-1) and the implementation of tailored utility customer energy efficiency programs (Table ES-2). We note which of the tailored programs are most likely to be adopted during Mississippi's impending Quick Start phase.

These lists are not exhaustive nor prescriptive: there are many opportunities for additional cost-effective program implementation in addition to those included in the tables below.[4] Rule 29, for example, lists a number of Quick Start program options that we did not consider in this report. Their exclusion does not mean that ACEEE does not consider them to be viable options. Rather, the list we assembled represents the policies and programs that

[4] See York et al. 2013.

Mississippi stakeholders expressed to us as priorities, in addition to those that ACEEE considers to be good options given the collective experience from neighboring states and utilities.

Table ES-1. State Energy Efficiency Policy Options for Mississippi

Statewide Policies, Programs, and Initiatives	Summary of Analysis Recommendation
Benchmarking Energy Consumption in Public Buildings	Take steps toward benchmarking building energy usage for all publically-owned buildings and facilities in order to facilitate the installation of energy efficient measures.
Industrial Initiative	Expand energy efficiency in the industrial sector by addressing three barriers to expanded industrial energy efficiency: need assessments; access to industry-specific expertise; expansion of trained manufacturing workforce. Re-establish an industrial assessment center (IAC) at one of Mississippi's state universities.
Updated Building Energy Codes for Residential and Commercial	Identified as a policy need by Governor Bryant, adopt and implement statewide commercial building energy codes to encourage higher efficiency levels in line with new IECC and ASHRAE standards as they are released. Expand policy to include residential building energy codes. Conduct code compliance surveys and expanded training for local code officials, inspector, builders, and designers to reach 90% building code compliance after several years.
Lead by Example in State & Local Government Facilities	Identified as a policy need by Governor Bryant, improve the efficiency of Mississippi's public facilities and buildings.
Low-Income Weatherization	Provide weatherization services, efficient appliance upgrades, and energy savings kits to income-qualified households to lower energy bills and make homes more comfortable and efficient. Programs may be administered by local community action agencies in coordination with state agencies and utility programs.
Rural, Agricultural, and Fisheries Initiative	Coordinate existing initiatives to develop education program to disseminate information on EE best practices, administer rural audit program building on the USDA Rural Energy for America Program (REAP) to provide technical and financial support, and create pool of matching funds for USDA grants to supplement initiatives.

Table ES-2. Tailored Utility Customer Energy Efficiency Program Options by Customer Class

Residential	Commercial	Industrial
Building Energy Code Support	Building Energy Code Support	C&I Prescriptive Retrofit*
Home Performance with ENERGY STAR*	Small Business Direct-Install*	Large C&I Custom Retrofit (including Self-Direct)
Retail Appliances and Electronics	C&I Prescriptive Retrofit*	
Residential Lighting and Recycling*	Large C&I Custom Retrofit (including Self-Direct)	
Residential Cooling*		
Low-Income Weatherization (coordinate with state programs)*		
Behavior and Information Feedback*		

Note: Programs with an asterisk we assume will be implemented during Mississippi's Quick Start phase and will continue during the Comprehensive Portfolio phase.

Our review of national best-practice program deployment[5] finds that it takes time to ramp up programmatic infrastructure and to roll out effective customer education and marketing efforts, which means that Mississippi should expect similar needs to ramp-up savings over time. Mississippi, however, has ample experience from neighboring states and utilities to draw from in order to meet its goals and, ultimately, eclipse its neighbors to become regional leader.

Our analysis of statewide energy efficiency program potential in Mississippi finds that this combined set of energy efficiency policies and programs could achieve 4% cumulative electricity savings by 2020, increasing to 13% by 2025, and 3% cumulative natural gas savings by 2020, increasing to 10% by 2025 (Table ES-4 and Figures ES-1 and ES-2). In addition, the electricity efficiency gains will also have the impact of reducing peak demand.

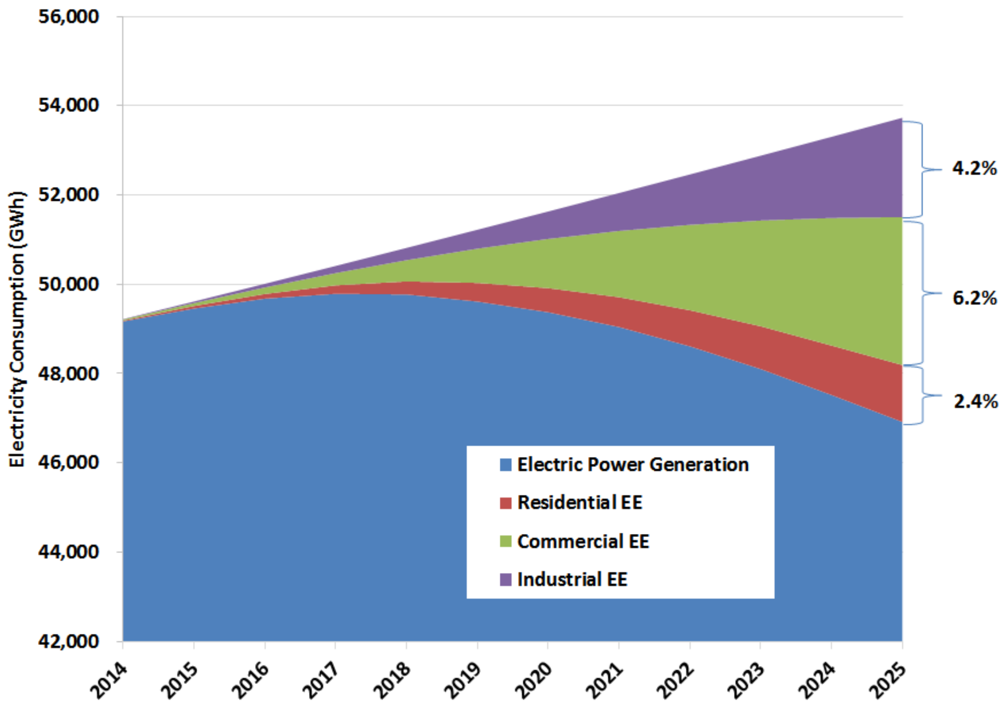
Table ES-3. Summary of Statewide Energy Efficiency Policy and Program Achievable Potential through 2025

Customer Class	Electricity		Natural Gas	
	GWh	%*	MMCF	%*
Residential	1,275	6.5%	1,060	5.3%
Commercial	3,316	22.8%	1,885	8.8%
Industrial	2,225	11.7%	2,307	19.1%
Total	**6,815**	**12.8%**	**5,252**	**9.8%**

*Note: Savings are shown as a percentage of sales in the previous year, by customer class from the reference case forecast. For total savings, percent savings is relative to statewide sales in the previous year also from the reference case forecast.

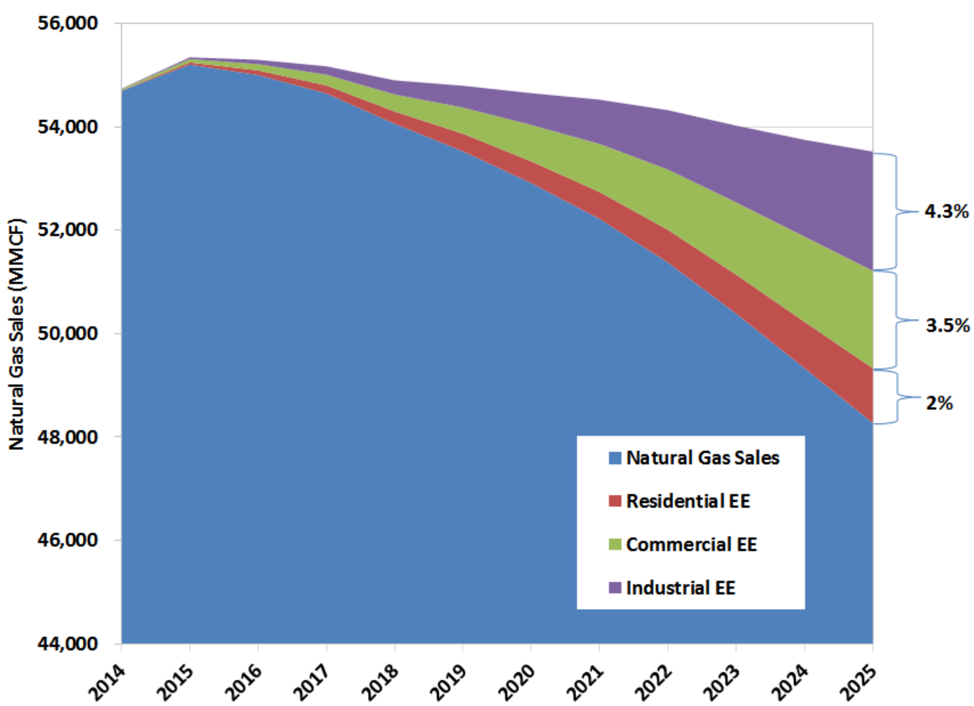
5 See York et al. 2013.

Figure ES-1. Electricity Energy Efficiency Policy and Program Potential through 2025



Note: Percentage values for each customer class are relative to statewide energy sales.

Figure ES-2. Natural Gas Energy Efficiency Policy and Program Potential through 2025



Note: Percentage values for each customer class are relative to statewide energy sales.

Costs and Benefits

Efficiency measures continue saving energy over the lifetime of the upgrades, which can add up to significant savings over the long term. A recent analysis finds that energy efficiency is the least-risk resource compared with other energy resource options.[6]

Our analysis finds that the set of recommended policies and programs can reduce Mississippi's energy costs by $2.3 billion net over the life of the energy savings measures. The estimated total resource cost (TRC) ratio is 2.5; i.e., each $1 invested in efficiency upgrades and programs (customer and program cost) will yield $2.50 benefits in avoided energy costs to the whole system. These impacts will benefit all ratepayers, because utilities could delay or avoid costlier investments in energy supply and in transmission and distribution.

Efficiency programs cost about $0.02–0.04 per kWh-saved, which is lower than the avoided cost of energy in Mississippi of about $0.04–0.09 per kWh through 2025. Efficiency also contributes avoided peak demand and avoided transmission and distribution benefits. Like any resource with up-front costs, stakeholders should not to let the short-term rate impacts from energy efficiency detract from the medium- and long-term benefits of energy efficiency that accrue from delaying or avoiding the need for supply investments. Energy efficiency is a least-cost and least-risk option that is an essential piece of a diversified energy portfolio.

Macroeconomic Analysis

The final component of our study is a macroeconomic assessment of the impacts of the set of programs and policies, conducted by Evergreen Economics. Their analysis finds that the portfolio of efficiency programs and policies we model will result in the following annual benefits over the 11-year study period, through the year 2025: $4.3 billion in net economic output, including $1.1 billion in wages, $825 million in business income to small business owners, 32,800 person-years of employment, and increased state and local tax revenue of $80 million.

Conclusion

Mississippi is poised to reap considerable benefits from its growing energy efficiency initiatives. Already Mississippi leadership and stakeholders have shown dedication to advancing relevant policy that will propel the state forward and help it become a regional leader for others to emulate. Our analysis finds that, as the least-cost resource, energy efficiency will benefit all customers and play a major role in bolstering economic development. The suite of policy and program options presented in this report will help the state along its way, but it by no means is exhaustive: Mississippi can reap additional benefits by expanding upon the policies and programs we consider here. With sustained leadership in the public and private sectors as well as effective policy and program implementation, Mississippi will undoubtedly be successful.

[6] See Binz et al. 2012. *Practicing Risk-Aware Electricity Regulation*. CERES.

Acknowledgments

The authors thank the U.S. Department of Energy, the Mississippi Development Authority, and the Southeast Energy Efficiency Alliance for supporting this project. Thank you to ACEEE colleagues Maggie Molina, Casey Bell, Jim Barrett for contributing to the analyses and report, and to ACEEE's Renee Nida for editorial support. We are especially grateful to the numerous stakeholders in Mississippi (listed below in our report) who met with us to discuss energy policy in Mississippi. Finally, while the ultimate viewpoints and recommendations expressed herein are solely those of ACEEE, thank you to the following individuals and organizations who submitted comments on the draft report: Mark Leggett (MS Poultry Association); Bo Smith (Cornerstone Home Lending); Marcus Craig (Schneider Electric); Tina Ruffin (MS Department of Human Services); Brent Bailey (25x25); Sumesh Arora (Innovate Mississippi); Melvin Wilson (Southern Company); Richard Leger (CenterPoint Energy); Katherine Collier (MS Public Service Commission); Jim Sheble (Nucor Steel Jackson, Inc.); Terry Kemp (Starkville Electric); Ronny Rowland (Prentiss County Electric Power Association); Michael Callahan (Electric Power Associations of MS); Rick Snowden (MS Department of Finance and Administration); David White (Synapse Energy Economics); John Sibley (Independent Consultant); Daniel Saucier (MS Development Authority); Blake Kelly (MS Development Authority); and Jenah Zweig (Southeast Energy Efficiency Alliance).

Introduction

Mississippi's homes, buildings, schools, and facilities hold massive potential for energy efficiency improvements, which can reduce the demand for energy to such a degree that the state can avoid the need for investments in new energy supply and transmission. While load growth in Mississippi is not expected to increase at rates seen in many other states around the country, the need for policies that promote sustained economic growth has never been more apparent. Energy efficiency is one of the key policies that has the ability to spur economic development. Mississippi's leaders are well aware of this fact, and they have recently taken laudable steps that put the state on a path toward greater economic prosperity and independence.

Governor Phil Bryant released his energy plan, *Energy Works: Mississippi's Energy Roadmap*, in October 2012, calling for Mississippi to leverage its energy resources for the sake of economic development, which included a call for greater energy efficiency.[7] On July 11, 2013 the Mississippi Public Service Commission (MPSC) took massive strides in building an energy efficiency industry in the state by adopting rules that require electric and natural gas utilities under MPSC jurisdiction to implement energy efficiency programs, along with other related regulatory policies that will facilitate cost-effective utility investment in program deployment.[8] Both of these policy developments exhibit the strong leadership that Mississippi currently possesses, which is determined to set the state on a path toward greater economic prosperity and self-reliance.

ENERGY EFFICIENCY AS A RESOURCE IN MISSISSIPPI AND THE SOUTHEAST REGION

Energy efficiency is the cheapest, cleanest, and lowest-risk resource to meet rising energy demand while stimulating economic development, helping to reduce energy price volatility and to ensure greater reliability in Mississippi's energy system. The demand for energy efficiency services directly creates jobs and frees up cash to encourage investment elsewhere in the economy, further increasing job opportunities in the state. What is, arguably, most important, is energy efficiency's positive impact on a state's standard of living and cost of doing business. A more reliable energy system with lower operating costs makes Mississippi a highly competitive place for businesses to operate. Homes built to a more efficient standard with energy-efficient equipment and appliances create a safe, comfortable environment that will relieve financial stress on homeowners and help families succeed.

Until this past year, however, energy efficiency potential in Mississippi was largely untapped. Mississippi ranked 51st on ACEEE's *2012 State Energy Efficiency Scorecard* (Foster et al. 2012), reflecting the state's limited efforts to improve energy efficiency and the general trend that most consumers and businesses in the state do not have access to energy efficiency services to help lower their energy bills. This historical trend has manifested into the following scenario: while Mississippi enjoys some of the lowest energy rates in the country, residential customers suffer from some of the highest energy bills in the country.

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[7] See http://www.governorbryant.com/wp-content/uploads/2012/10/Energy-Works-Roadmap-Final.pdf
[8] See http://www.psc.state.ms.us/InsiteConnect/InSiteView.aspx?model=INSITE_CONNECT&queue=CTS_ARCHIVEQ&docid=310904

Table 1 and Table 2 below illustrate this point. We show statewide expenditures for electricity and all energy (electricity, natural gas, propane, wood, etc.) and use U.S. Census data on median household income to determine the percent of income spent on energy. The use and cost of other types of fuel sources for heating, such as the high cost of oil, in states with colder climates pushes several northern states to the top of the list in Table 2, yet still Mississippi remains one of the highest despite its relatively low heating loads. If we were to show the top ten states in Table 1, readers would see that all but two (Oklahoma and West Virginia) reside in the Southeast region.

Table 1. Average Electricity Prices and Electricity Expenditures as a Percent of Median Income—Top 5 States, Residential Only (2011)

State	Avg. Residential Electricity Price (¢/kWh)	Electricity Consumption per Household (kWh)	Median Household Income ($2011)	Electricity Expend. in 2011 (Million $)	Expend. per Household in 2011	Expend. as a Percent (%) of Median Income
Mississippi	**¢10.17**	**17,887**	**$36,919**	**$1,966**	**$1,819**	**4.9%**
Alabama	¢11.09	17,892	$41,415	$3,661	$1,985	4.8%
S. Carolina	¢11.05	17,414	$42,367	$3,405	$1,925	4.5%
Florida	¢11.51	16,372	$44,299	$13,389	$1,884	4.3%
Tennessee	¢9.98	17,455	$41,693	$4,298	$1,742	4.2%

Sources: EIA 2013a, Census 2012, Moody's 2013

Table 2. Total Energy Expenditures as a Percent of Median Income—Top 5 States, Residential Only (2011)

State	Energy Consumption 2011 (Trillion Btu)	Energy Consumption per Household (Million Btu)	Median Household Income ($2011)	Energy Expend. in 2011 (Million $)	Expend. per Household in 2011	Expend. as a Percent (%) of Median Income
Maine	66.5	120.5	$46,033	$1,752	$3,174	6.9%
Vermont	34.3	133.3	$52,776	$885	$3,440	6.5%
Mississippi	**103.0**	**95.3**	**$36,919**	**$2,427**	**$2,245**	**6.1%**
Alabama	162.2	87.9	$41,415	$4,420	$2,396	5.8%
W. Virginia	88.1	119.8	$38,482	$1,581	$2,150	5.6%

Sources: EIA 2013b, Census 2012, Moody's 2013

This disparity in energy expenditures helps convey, in part, why the Southeast region as a whole is trending toward greater interest and commitment to energy efficiency. For example in 2010 the Arkansas Public Service Commission (APSC) established annual electricity savings goals which ramped up to 0.75% of sales per year by 2013, making Arkansas the first state in the Southeast to adopt long-term efficiency targets. While progress toward targets has varied among utilities and by program year, a review of the utilities' annual program reports reveals that overall the programs have geared up and mostly hit their targets in 2012. For example the two largest utilities in Arkansas, Entergy Arkansas, Inc. (EAI) and Southwestern Electric Power Company (SWEPCo), together achieved over

125,000 megawatt hours (MWh) of savings in 2012, which is more than twice the savings in 2011 of about 53,000 MWh. Entergy exceeded its 2011 and 2012 targets of 0.25% and 0.5% of sales, while SWEPCo achieved about 80% of its 2011 target and exceeded its 2012 target.

Moreover, all customers have benefited from these energy efficiency programs. Benefit-cost analysis for these programs in Arkansas found an average total resource cost (TRC) test ratio of about 1.6 in 2011 and 2012, which means that each $1 invested in efficiency improvements yielded $1.60 in benefits to all customers, not just participants. There are multiple ways to examine the costs and benefits of energy efficiency, and another important perspective is from the utility resource perspective—in other words, how do utility energy efficiency programs compare to utility supply side investments? The Arkansas program results find that each $1 invested in efficiency programs yielded $2.30 in avoided energy costs to the entire utility system, which are benefits that ripple through to all customers, not just participants. Given the success of programs, the APSC recently issued an Order to increase savings targets to 0.9% for electricity and 0.6% for natural gas in 2015 (APSC 2013). Stakeholders have requested an energy efficiency potential study to inform the next round of targets after 2015. Mississippi stakeholders can look to the successes, challenges, and lessons learned from Arkansas to help shape the state's investment in energy efficiency resources.

The recent policy developments discussed above have Mississippi poised to become a regional leader in energy efficiency, particularly in light of the adoption of comprehensive energy efficiency rules by the MPSC. Fortunately, Mississippi stakeholders can look to the successes, challenges, and lessons learned from Arkansas and other states to help inform its investment in energy efficiency resources. There are myriad lessons on effective energy efficiency policy and program design and implementation from across the country for Mississippi to draw from. What is most important is that Mississippi's stakeholders—households, businesses, utilities, the MPSC, etc.—coalesce to increase the state's energy efficiency investments robustly and prudently.

Methodology

In this section we describe our overall project approach and methodology. Our report provides useful resources and state-specific information for Mississippi to reference as it charts a path forward with energy efficiency policies and programs. Our discussions throughout the report are set predominantly within the context of Mississippi's new energy efficiency rules adopted by the MPSC, as there is much work to be done by the MPSC and utilities in the design and implementation of policies and programs, both in the short- and long-term.

Our report provides a detailed, quantitative statewide analysis of cost-effective energy efficiency potential in Mississippi's buildings and industrial sectors (we do not include an analysis of transportation efficiency potential) that can be captured by best-practice policies and programs. Our report also outlines a comprehensive set of strategic energy efficiency policy and program opportunities; a detailed analysis of their costs and benefits; and a macroeconomic assessment of the impact of these potential investments on the state's employment and economic vitality.

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 improving energy efficiency, 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 Mississippi is the latest study in this series of reports.

STAKEHOLDER ENGAGEMENT

Part of our project methodology is to engage with stakeholders in Mississippi to understand the policy context and unique needs and energy characteristics of the state. We talked to a broad range of stakeholders over several months. Engaging the many stakeholders groups in Mississippi was a significant undertaking, and we endeavored to meet in person or via telephone with as many different stakeholders as possible, and shared a draft of this report widely, in order to get feedback. The stakeholder groups we met with are listed in the following section, **Background: Policy Context**.

ANALYSIS APPROACH

The following describes each of the steps in our analysis:

1. **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 (2014–2025), as well as population and buildings data. We consulted several data sources to develop reference case projections for electricity and natural gas consumption, avoided energy costs, and retail electricity and natural gas prices.

2. **Energy Efficiency Policy & Program Analysis**—Our study analyzes a specific suite of energy efficiency policies and programs that could be adopted and ramped up over time. These policies and programs are evaluated from a statewide perspective (all energy users in the state) as well as within the context of the new energy efficiency rules recently adopted by the MPSC (where potential participants are limited to customers of investor-owned and cooperative utilities). The new energy efficiency rules call for a "Quick Start" phase followed by a more "Comprehensive Portfolio" phase, and the establishment of energy savings targets for utilities prior to the beginning of the "Comprehensive Portfolio" program phase. This analysis estimates the potential for energy efficiency policies and programs if they were administered statewide for all customers, including municipal utilities. The suite of policies and programs, both state and utility-led, would enable homeowners and businesses in Mississippi to take advantage of substantial energy efficiency resources. This component is comparable to the "achievable potential" as termed in many energy efficiency potential studies.

3. **Macroeconomic Analysis**—Next, using the energy efficiency policy analysis results on energy savings, program costs, and investments, we worked with Evergreen Economics to estimate the policy impacts on jobs, wages, and gross state product

(GSP) in Mississippi. Evergreen Economics uses an input-output model that evaluates macroeconomic impacts of energy efficiency investments.

CAVEATS

Readers should note the inherent uncertainty, or ranges of possible futures, in any forecast of energy consumption. Our analysis relies on several long-term (through 2025) projections developed by other entities, including Moody's Analytics for housing and population forecasts, utility integrated resource plans (IRPs) for electricity demand and avoided costs forecasts; and the U.S. Energy Information Administration (EIA) for natural gas demand forecasts. Likewise, there is uncertainty in our energy efficiency potential forecast itself, such as uncertainty in technological changes and customer participation rates. Uncertainty in the projections should not mean that the analyses are flawed, but rather an inherent characteristic of resource planning. The goal of these analyses is not to predict the future, but rather to present comprehensive and transparent information to policy makers on possible future scenarios.

Background: Policy Context

The policy context for energy efficiency in Mississippi's buildings and industrial sectors can be characterized by a broad and diverse set of public- and private-sector stakeholders. These stakeholders deliver energy to customers, oversee regulatory policy that governs delivery of natural monopoly utilities, establish policy, etc. Energy efficiency is not the sole focus of these agencies and may represent a tertiary interest, but efficiency can be useful tool to accomplish several economic, energy, social welfare, and environmental goals. These stakeholders include:

- Electric and natural gas utilities, including Entergy Mississippi, Mississippi Power Company, Atmos Energy, CenterPoint Energy, the Tennessee Valley Authority, the Electric Power Associations of Mississippi, and the South Mississippi Electric Power Association.
- The Mississippi Public Service Commission (MPSC), which regulates investor-owned and cooperative utilities, and the Mississippi Public Utilities Staff, which represent the broad interests of the State of Mississippi by balancing the respective concerns of the residential, commercial or industrial ratepayers, and the state and its agencies and departments, and the public utilities;
- The Mississippi State Legislature and the Office of Governor Phil Bryant, which set policy;
- Numerous state agencies and entities, such as the Mississippi Development Authority, the Department of Finance and Administration, the Department of Environmental Quality, the Department of Human Services, the Mississippi Community College Board, Mississippi State University, the Mississippi Department of Transportation, the Attorney General's Office;
- Municipal governments, which oversee building energy code enforcement and often deliver energy to citizens through municipal utilities;
- Non-profit organizations and associations, such as 25x25, Innovate Mississippi, the Mississippi Manufacturers Association, the Mississippi Farm Bureau Federation, the Mississippi Energy Institute, the Public Policy Center of Mississippi, the Mississippi

Economic Policy Center, the Small Business Majority, the Foundation for the Mid-South, the Mississippi Forestry Association, the Mississippi Poultry Association, and;
- Private-sector interests including large manufacturers, such as Schneider Electric, Nucor Steel Jackson, Inc., Nissan North America, Cornerstone Home Lending, Inc., Johnson Controls, and Cree Lighting.

STATE POLICY CONTEXT

In October 2012, Governor Phil Bryant released his energy plan, *Energy Works: Mississippi's Energy Roadmap*, noting that energy policy and economic development policy are inextricably linked. In addition to focusing on supply side issues, Governor Bryant's energy plan calls for Mississippi to find ways to use its energy more efficiently. To reinforce this idea, at the Governor's Energy Summit on October 4, 2012, Governor Bryant presented his vision and referred to Mississippi's position as 51st on ACEEE's *2012 Scorecard* as indicative of the need for Mississippi to expand its energy efficiency resources.

With regards to energy efficiency, Governor Bryant's energy plan identified three initial steps that Mississippi should take to set it on its way toward greater investment in energy efficiency:

1. Implement a "Lead-By-Example" policy to encourage greater deployment of energy efficiency in state-owned buildings and facilities;
2. Adopt statewide commercial energy building codes for new construction;
3. Initiate an energy efficiency market policy/program analysis.

In April 2013, the Mississippi State Legislature passed House Bill 1281,[9] which requires new and renovated state-owned buildings and facilities as well as new, private commercial construction to comply with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-2010, the most recent version of the ASHRAE code. Effective July 1, 2013, this makes Mississippi the second state in the nation, and first in the Southeast region, to adopt this iteration of the ASHRAE 90.1 standard. House Bill 1266, also passed in April 2013, established ASHRAE 90.1-2010 as the statewide standard for public facilities.

This report aims to support the first item on the list above and to satisfy the third item. Our study considers a suite of policies and programs that can be quickly deployed by utilities and the state government, which includes information on best-practice program design for lead-by-example initiatives.

UTILITY REGULATORY POLICY CONTEXT

In addition to the leadership being exhibited from the Governor's Office, Mississippi's utility regulatory body is also in the process of spearheading some major policy changes. The MPSC has jurisdiction over all electricity and natural gas investor-owned utilities (IOUs) in the state, which represents about 50% of the state's electric load and about 80% of

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[9] HB 1281 was codified in the Mississippi Code of 1972, Section 57-39-21. See http://www.mscode.com/free/statutes/57/039/0021.htm

the natural gas load. It has tailored regulatory authority over the 26 electric power associations (cooperatives) and municipal utilities, and it also monitors these areas to provide insight to policy makers.

Below we briefly outline the important regulatory issues being considered at the MPSC, which we discuss in greater detail in the section titled **Utility Regulatory Policies**. We also include a brief discussion on Integrated Resource Planning (which we elaborate upon later in the report) a utility regulatory policy that is not being proposed by the MPSC, but one that is invaluable to level the playing field between demand-side management (energy efficiency) programs and supply-side generation resources.

Energy Efficiency Rules—Chapter 29: Conservation and Energy Efficiency Programs

On August 4, 2011, the MPSC issued an Order proposing rules for energy efficiency programs in Mississippi under Docket No. 2010-AD-2. The rules were successfully adopted July 11, 2013 and will provide a solid foundation upon which utilities in the state can begin to provide programs to homeowners and businesses. The rules apply both to electric and natural gas service providers subject to the jurisdiction of the MPSC, which includes investor-owned utilities and electric cooperatives, but not municipal utilities. The rules also establish a number of policies that will considerably bolster the impact of energy efficiency as a supply resource in the state. The rules are based largely off of the rules established in Arkansas by Order of the Arkansas Public Service Commission in December 2010, which in turn were influenced by the National Action Plan for Energy Efficiency's (NAPEE) recommendations.[10] There are three general areas that are targeted by the rules at the MPSC:

1. The design and implementation of utility energy efficiency programs and portfolios in both "Quick Start" and "Comprehensive Portfolio" phases.
2. Addressing the utility regulatory business model; i.e., addressing appropriate compensation and incentives for utility investments in energy efficiency.
3. Establishing annual energy savings targets for utilities

Below we briefly discuss these areas and how this report is crafted to address these issues for the benefit of the MPSC and the utilities upon which the new rules will apply. We will cover these areas in greater detail below in our **Discussion of Statewide Policies and Programs**.

QUICK START AND COMPREHENSIVE PORTFOLIO PHASES

Rule 29 establishes an initial "Quick Start" phase of utility energy efficiency programs, the goal of which is to "encourage the early implementation of energy efficiency programs and to provide experience on which Mississippi's service providers and the MPSC can build Comprehensive Portfolios—long-term energy efficiency programs." Electric and natural gas utilities with 25,000 meters or more, which does not include municipal utilities, will have six months to develop their plan for delivering their initial energy efficiency programs. Since the rules were adopted on July 11, 2013, Quick Start program offerings must be filed by all applicable utilities no later than January 11, 2014. The rules define the various planning and reporting rules that utilities must follow when seeking approval for and implementing their

[10] See http://www.epa.gov/cleanenergy/energy-programs/suca/resources.html

Quick Start programs. After a three-year (36 month) Quick Start phase or nine months after MPSC approval of energy savings targets, utility program performance will be reviewed and the MPSC will usher in the Comprehensive Portfolio phase.

The utility energy efficiency programs that we model and analyze in this report are intended to provide the MPSC and the utilities with best-practice examples of cost-effective energy efficiency programs that are well-suited for deployment during Quick Start (short-term) and Comprehensive Portfolio (medium- and long-term) phases. For example, programs offered during a Quick Start phase can also play a role—in addition to generating savings and providing administrative experience—of acquiring knowledge on a state's residential and commercial building stock through simple audit and direct install programs. Collecting data on the building stock and its equipment, such as the age and type of heating and/or cooling equipment, will help utilities and the MPSC design effective programs for customers that target relevant energy end-uses and efficient, cost-effective replacement measures.

We note in our discussions of the individual programs those that we consider for implementation during the Quick Start phase and those that we consider for implementation during the Comprehensive Portfolio phase. We distinguish between these two phases to acknowledge that energy efficiency programs often differ in complexity in terms of design and implementation. For example, a residential or commercial lighting program is relatively straightforward to administer, while a commercial custom retrofit program is usually more difficult due to the types of eligible equipment, the need for qualified contractors to install the equipment, identifying vendors, developing marketing materials, etc.

Mississippi stakeholders should not view the suite of programs and policies as exhaustive or prescriptive. There are many opportunities for cost-effective program deployment beyond those that we model in this report. Nonetheless, energy efficiency investments in Mississippi have, to date, been relatively small, so it will take time for stakeholders to become proficient with program design and implementation. If stakeholders are rigorous and collaborative and draw upon the ample experience garnered from elsewhere in the country to create in-state resources and experience, delivering more complex programs with higher savings potential will be achievable and cost-effective.

ADDRESSING THE UTILITY REGULATORY BUSINESS MODEL

Rule 29 also includes language intended to address the inherent disincentive utilities face with investments 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 customers, which leads to lower utility revenue. Utilities and their shareholders have natural concerns that, over time, reduced revenues without timely adjustments for cost recovery could impede their ability to provide energy services due to decreased earnings or financial margins.

To address this barrier, the MPSC has included language in Rule 29 that will allow utilities to:

1. Recover direct energy efficiency program costs in a timely manner;

2. Recover their lost contribution to fixed costs (LCFC), which partially addresses the "throughput incentive";
3. Earn performance-based financial incentives by meeting proposed energy savings targets through a shared savings or other performance-based incentive mechanism.

Combined, these policies form the foundational regulatory framework that is needed to support and enable utilities to begin capturing the energy efficiency resources our analysis suggests are achievable. Setting annual savings targets for utilities and including energy efficiency in the integrated resource planning (IRP) process would create a stronger framework for capturing energy efficiency resources in the long-term.

ESTABLISHING ENERGY SAVINGS TARGETS FOR UTILITIES—ACHIEVEMENT OF 1% ANNUAL SAVINGS

Rule 29 states that "Prior to the Comprehensive Portfolio filing deadlines, the Commission intends to establish specific numerical energy savings targets expressed as percentages of energy sales based on the experience of Quick Start and other relevant information." The Quick Start phase will be important for Mississippi utilities to build experience in program design and administration. But as the state shifts into its Comprehensive Portfolio phase, the establishment of energy efficiency savings targets in addition to the adoption of the regulatory policies outlined above, such as incorporating energy efficiency into the IRP process, will provide regulatory certainty for utilities as well as mitigating the disincentives that currently exist. Target setting also fits well with the IRP process, because IRP can provide optimization analysis of least-cost resources and serve as a tool to determine appropriate and achievable targets to meet over the long term.

This report provides discussion and resources on how best to design and ramp-up energy efficiency savings targets based on the unique characteristics of Mississippi and the current levels of energy efficiency investments. In particular, we focus on the potential for Mississippi's investor-owned and cooperative utilities to collectively achieve 1% electricity savings: how much it could cost and in what year could that likely be achieved. In practice, however, the level of targets should vary between the two types of utilities due to logistical and demographic issues; in other words, investor-owned utilities generally have an easier time meeting aggressive savings targets than cooperative utilities. Our analysis does not target any specific year for the achievement of the 1% goal; rather, we model the programs and policies outside of the context of annual savings targets and, based on the results, determine when the 1% goal could likely be achieved and provide thoughts on how to ramp-up the savings targets over time in order to meet the 1% goal.

For natural gas our approach is the same, however we note that natural gas utilities are generally held to less stringent energy savings targets, due to lower amounts of cost-effective energy efficiency potential. As a result, states that set energy savings targets for both electric and natural gas utilities will ramp-up savings targets more slowly for natural gas utilities. That said, there is still considerable natural gas savings potential to be captured, though the achievement of 1% incremental annual savings will require more time.

Cooperative and Municipal Utilities

Electric cooperatives and municipal utilities also have a role in energy efficiency. Mississippi's cooperative utilities, known as Electric Power Associations (EPA) supply over one-third (36%) of the state's electricity across all sectors. The majority of residential customers in the state (51%) get their electricity from cooperatives, so these utilities have a large role to play in the delivery of energy efficiency services. It is clear that their participation is crucial to the overall goal of improving energy efficiency in the state (see text box).

> **"Energy Efficiency Celebration"**
>
> On October 9, 2013, TVA and Severstal, which makes auto-grade rolled steel from scrap metal, celebrated the successful completion of an energy efficiency project in Lowndes County that began two years prior. The project is saving 2500 kW and over 25 million kWh (25 GWh) annually. The project received over $2.5 million in incentives from TVA, while Severstal contributed the bulk of the financing with $6 million in investments.

Most cooperatives in Mississippi offer energy efficiency programs to their customers, though the scope of programs vary due to the wide range of cooperative members, from 8,000 to 70,000. The 14 EPAs in the Tennessee Valley Authority's (TVA) service territory, for example, purchase their electricity wholesale from TVA and can opt-in to delivering energy efficiency services through TVA's EnergyRight program. Several cooperatives have opted-in, such as 4-County Electric Power Association,[11] Central Electric Power Association,[12] and Tallahatchie Valley Electric Power Association.[13]

Municipal utilities, on the other hand, are not subject to MPSC rules, but rather may follow the leadership of the city or town. Municipal utilities account for about 8% of the state's electricity sales and 16% of the state's natural gas sales, so these utilities will be important in helping all residential customers, and some commercial and industrial customers, gain access to energy efficiency services to reduce their energy bills. We do not, however, consider energy sales by municipal utilities in calculating Mississippi's savings potential, so their efforts are not included in our discussion of energy savings targets. Some municipal utilities in Mississippi have taken the initiative, such as Columbus Light and Water,[14] which is also a wholesale purchaser of electric power from TVA. Columbus Light and Water offers several energy efficiency programs targeted toward residences and businesses, many of which are designed by TVA. As a policy measure, municipal utilities could develop voluntary energy efficiency targets achieved through programs that we model in our analysis.

Integrated Resource Planning

Integrated Resource Planning (IRP) rules require consideration of demand-side management programs as well as supply-side generation resources when utilities plan for meeting growth in energy demand. The ultimate goal is to incorporate and model energy efficiency as a resource on par with the way supply-side resources are modeled in IRPs,

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[11] See http://www.4county.org/home.php#
[12] See http://www.centralepa.com/energyprogramstips.html
[13] See http://www.tvepa.com/residential/additionalServices.aspx
[14] See http://www.columbuslw.com/utilityprogs.htm

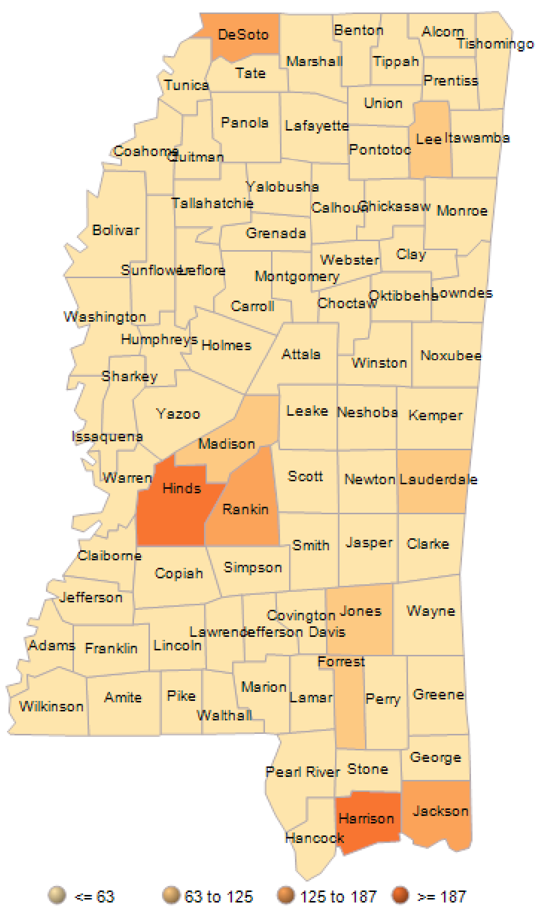
toward the end of optimizing across multiple planning goals, including cost, risk, reliability, and environmental goals. Below we will discuss in more detail the importance of integrated resource planning and provide some resources for Mississippi to reference when establishing its own regulatory language.

Background: Demographics and Energy Consumption

Energy consumption in Mississippi occurs predominately in the industrial sector (35%), followed by the buildings sectors (34%) and the transportation sector (31%) (EIA 2012e). Our analysis covers electricity and natural gas energy efficiency opportunities in buildings and industry, but does not cover the transportation sector.

Figure 1 shows current population by county, which shows that population is largely concentrated in the west central part of the state. Total population in 2012 was almost 3 million and by 2025 that figure is projected to reach about 3.3 million (Moody's 2013).

Figure 1. Mississippi Population by County in 2012 (Thousands)

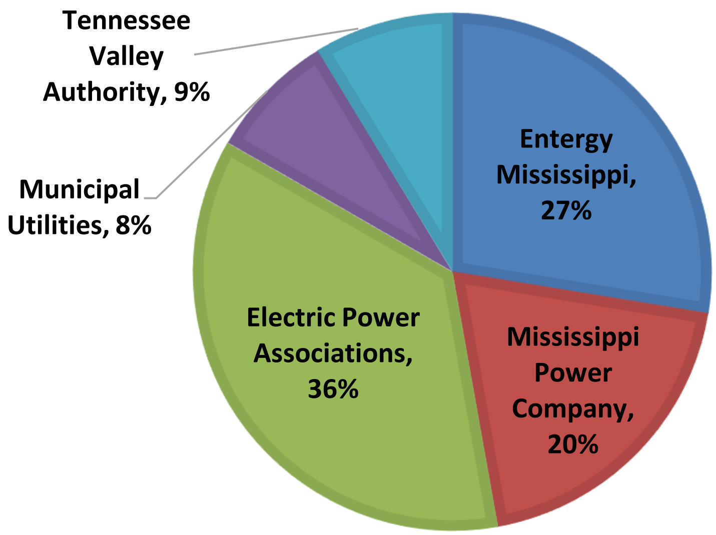


Source: Moody's 2013

ELECTRICITY

Figure 2 shows the breakdown of Mississippi's electricity sales in 2011 by provider type. Mississippi's two investor-owned electric utilities are Entergy Mississippi, Inc. (EMI) and Mississippi Power Company (MPCo). Together, the IOUs comprise the largest portion (47%) of electricity sales in the state. The electric power associations, or cooperatives, account for most of the remaining sales (36%), and the Tennessee Valley Authority (TVA) and municipal utilities make up the rest (9% and 8%, respectively).

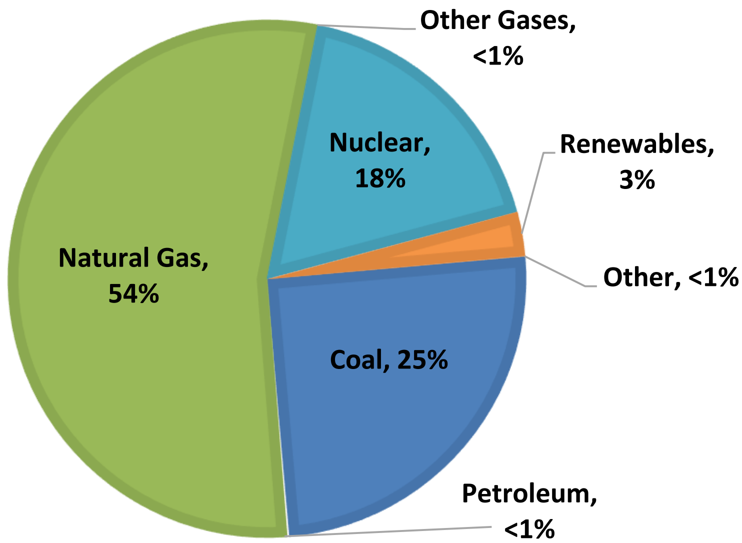
Figure 2. Retail Electricity Sales by Utility in Mississippi (2011), Total Sales



Source: EIA 2012a
Note: Total electricity sales in 2011 were 49,378 GWh

Figure 3 shows the share of electricity generation in Mississippi by resource type in 2010. Natural gas is the largest source, accounting for over half of all electricity generation (54%). Coal (25%) and nuclear (18%) are the next largest sources. Renewables account for 3% of generation, while petroleum and others account for less than 1%.

Figure 3. Mississippi Electricity Generation Mix by Energy Source (2010)



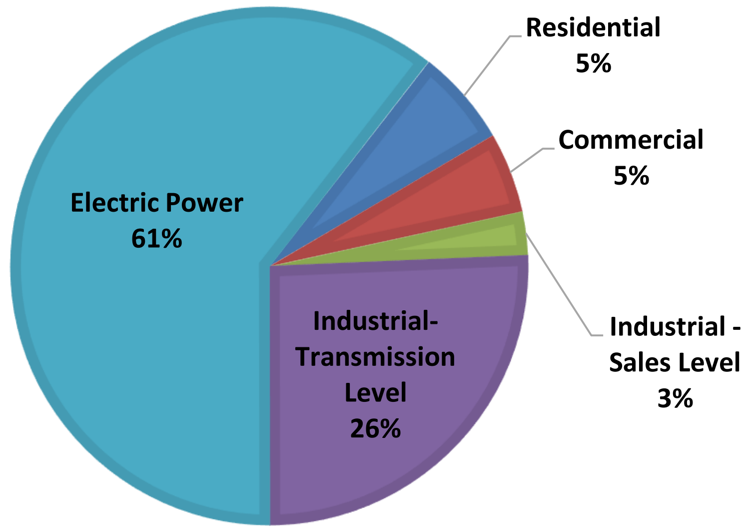
Source: EIA 2012b

NATURAL GAS

Mississippi's natural gas demand is distributed somewhat evenly across customer classes (residential, commercial, and industrial), as seen in Figure 4. This represents demand by customers of natural gas utilities like Atmos Energy and CenterPoint Energy. The majority of natural gas demand in the state is used in the generation of electric power. Furthermore, the vast majority of natural gas consumed in the industrial sector isn't "sold" to customers by utilities, rather it is transmitted directly to customers from the natural gas "manufacturer," The electric power sector and industrial (transmission-level[15]) sectors account for 86% of natural gas usage in Mississippi.

[15] We disaggregate natural gas usage between "transmission-level," in which the customer takes delivery of the natural gas directly from a natural gas transmission pipeline that is regulated at the federal level, and "sales-level," where the customer takes delivery of the gas from a local distribution company (LDC) utility that is regulated at the state or local level. Our analysis focuses on the sales-level delivered natural gas since that falls within the regulatory oversight of policy makers in the state.

Figure 4. Natural Gas Deliveries to Customers in Mississippi by Sector (2011)
(Total Deliveries, 403 Billion Cubic Feet (BCF))

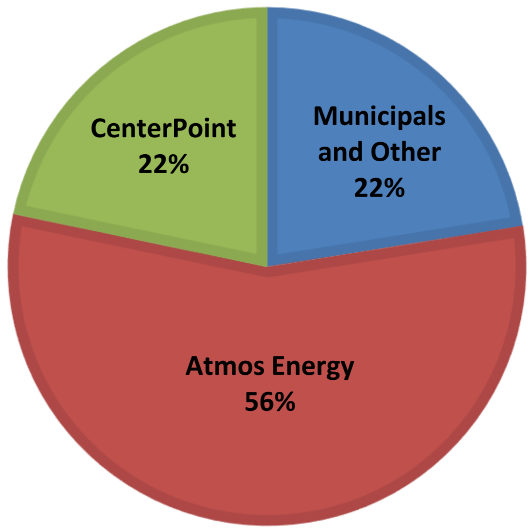


Source: EIA-176 Data for 2011

For the program and policy analysis of end-use efficiency potential in this study, we focus exclusively on the residential, commercial, and industrial sales-level customers. Transmission-level industrial customers also offer large amounts of energy efficiency potential, which can help these customers reduce operating costs and improve global competitiveness. In the policy analysis we offer several policy and program options that can help tap into this potential.

While the residential and commercial buildings sectors appear small compared to the industrial sector, this is mainly due to the very large industrial sector in the state. The size of the buildings sectors are comparable to other states in the region, and have large potential for energy efficiency and economic benefits to residential and commercial customers. For example, about 40% of homes in Mississippi use natural gas for heating, water heating, and/or cooking, as well as other end-uses (EIA 2009). In the commercial sector, an estimated 80% of building floor-space uses natural gas for heating, 64% uses natural gas for water heating, and 34% uses natural gas for cooking (EIA 2003). Several different providers serve these sectors in Mississippi, as shown in Figure 5.

Figure 5. Mississippi Residential and Commercial Natural Gas Sales-Level Deliveries by Utility in 2011 (%) (Total Deliveries ~ 42.5 Billion Cubic Feet (BCF))



Source: EIA-176 Data for 2011

Reference Case

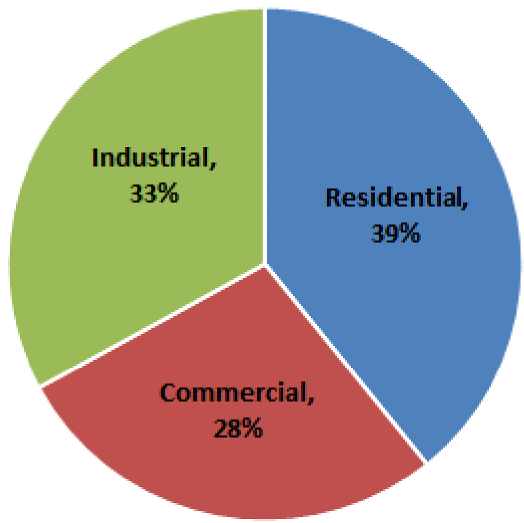
The first task in developing an energy efficiency potential assessment for Mississippi is to determine a reference case forecast of energy consumption in the state. For this report we disaggregate electricity consumption by sector using data from the EIA and utility IRPs over the 2012-2025 time period.

ELECTRICITY

Figure 6 shows the statewide disaggregation of sales by customer segment in 2012 (EIA 2012c). The residential sector accounts for the largest share of electricity sales (39%) followed by the industrial sector (33%) and the commercial sector (28%). Mississippi has a larger share of sales from its industrial sector compared to the national average (24%) and a smaller share of commercial sales compared to the national average (35%).

To develop the electricity reference case, we begin with this historical state-level and utility-level data from EIA. We use the EIA statewide sales data in lieu of individual utility-reported sales data to ensure that we account for all utilities in the state, such as municipal utilities and the electric cooperatives. Synapse Energy Economics, Inc. took this baseline reference data and applied growth rates reported by various utility IRPs in the state, taking into account generation fleet additions and retirements throughout the study period.

Figure 6. Mississippi Electricity Sales by Customer Segment (2011)



Source: EIA 2012c

Using this methodology, we forecast total electricity sales in Mississippi to grow in the reference case at an average annual rate of 0.8% between 2014 and 2025. By customer class, we estimate average annual growth rates of 0.64%, 0.61%, and 1.12% for the residential, commercial, and industrial classes. Actual electric sales in Mississippi in 2011 were 49,338 GWh, and in the reference case are projected to grow to 51,633 GWh in 2020 and 53,731 GWh in 2025. The forecast for total statewide sales is presented in Figure 7 and the same forecast disaggregated by customer class is presented in Figure 8. Synapse also estimated electricity peak demand growth through 2025 using the same methodology provided above, which is also presented in Figure 7.

Figure 7. Mississippi Electricity and Peak Demand Reference Case Forecast (2014-2025)

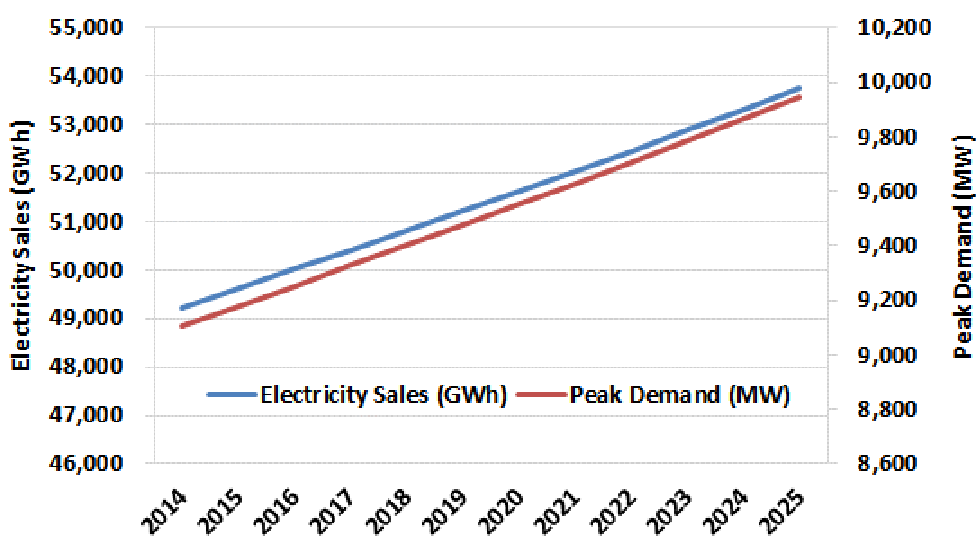
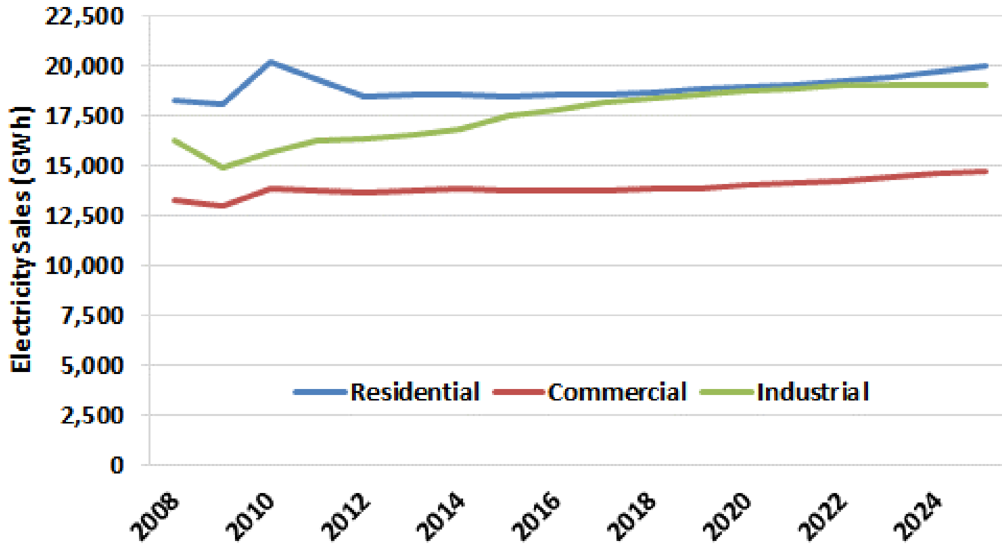


Figure 8. Mississippi Electricity Reference Case by Sector (2008-2025)



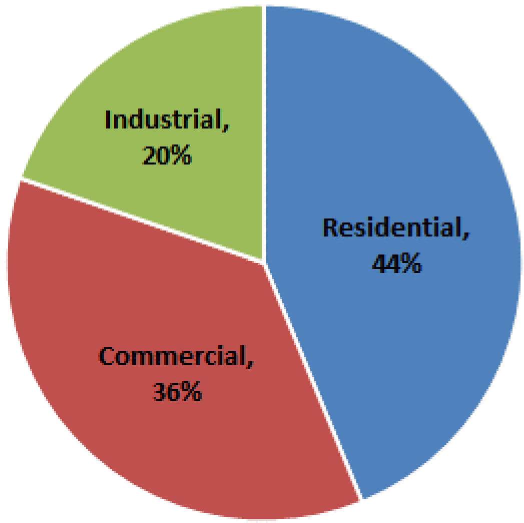
NATURAL GAS

Figure 9 shows the statewide disaggregation of sales by customer segment and Figure 10 shows the natural gas reference case forecast for all sectors. We use data from two EIA reports to develop this reference case for natural gas demand, the Natural Gas Annual Report for 2011 for baseline data on actual consumption from 2008-2011 (EIA 2012d), and the *Annual Energy Outlook 2013* for projections of demand (AEO 2013). We use the annual growth rates from the AEO 2013 projections of natural gas demand in the East South Central Census region (of which Mississippi is a part) and apply these growth rates to actual sales for Mississippi from the Natural Gas Annual Report (EIA 2012d).

The reference forecast for the industrial sector includes sales-level data only (not including transmission-level service), and the slight downward trend in sales level data in the chart from 2008-2011 is somewhat misleading because transmission-level industrial gas demand actually increased over this time. Even though sales-level consumption decreased a bit across all sectors during 2008-2011, total industrial natural gas demand increased from about 105 billion cubic feet (BCF) in 2008 to 114 BCF in 2011. The EIA's AEO projects industrial consumption to decrease slightly over the first few years (2012-2014) and then increase over the remainder of the study period (average annual growth rate of 0.69%, 2014-2025). Natural gas demand in the commercial sectors is forecasted to see low growth over the study period (average annual growth rate of 0.15%), while demand in the residential sector is forecasted to decline over the same period (average annual growth rate of -0.82%). Overall, natural gas demand is projected to decrease at an average annual rate of -0.12% across all sectors for the 2014-2025 study period based on the AEO regional projections.[16]

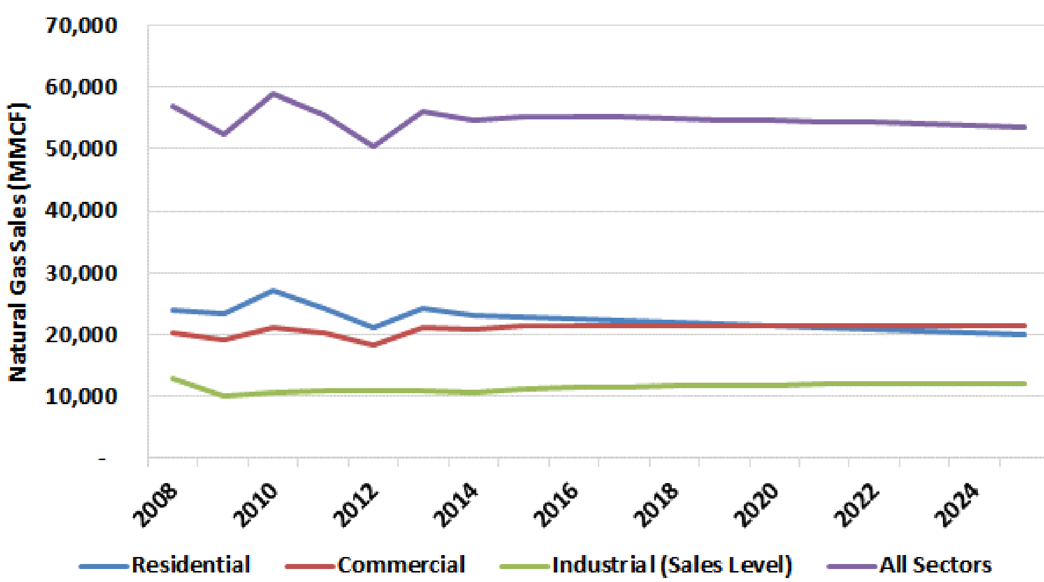
[16] These average annual growth rates, or any other forecast in this report, must not be taken out of context. For example, changing the baseline reference years from 2014 to 2012 or earlier will impact the overall results due to the fluctuations in demand that transpired around the time of the 2008 recession. Using 2012 as the base year,

Figure 9. Mississippi Natural Gas Sales by Customer Segment (2011)



Source: EIA 2012d

Figure 10. Mississippi Statewide Natural Gas Consumption Forecast for Residential, Commercial, and Industrial (Sales-Level) Sectors (MMCF)



RETAIL PRICES AND AVOIDED COSTS FORECAST

Energy efficiency improvements have the effect of lowering, or slowing the growth of, energy consumption, which in turn can avoid the need for new investments in energy

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total statewide sales would be forecast to grow at a positive average annual growth rate because sales were much lower in that year than in 2014, relative to sales forecasted in 2025.

supply or transmission. The benefits to the utility system from energy efficiency therefore are quantified in terms of the "avoided costs." The avoided costs typically included avoided purchases or investments in energy, generation capacity, and transmission and distribution infrastructure.

The analysis of utility avoided costs, for both the reference and energy efficiency cases, was conducted by Synapse Energy Economics, a consultant. A detailed methodology of the analysis appears in Appendix A. Synapse utilized a variety of resources in order to develop the forecasts, including data taken from the U.S. DOE's Energy Information Administration and integrated resource plans filed by several utilities in the state: Entergy Mississippi, Inc., Mississippi Power Company, and the Tennessee Valley Authority. Figure 11 shows the results of the Synapse analyses. We used these values, along with the avoided cost of capacity values also from the Synapse analysis, to evaluate the benefits of the energy efficiency resources identified in this report.

Figure 11. Avoided Cost of Energy Projections through 2025, Reference and Efficiency Cases

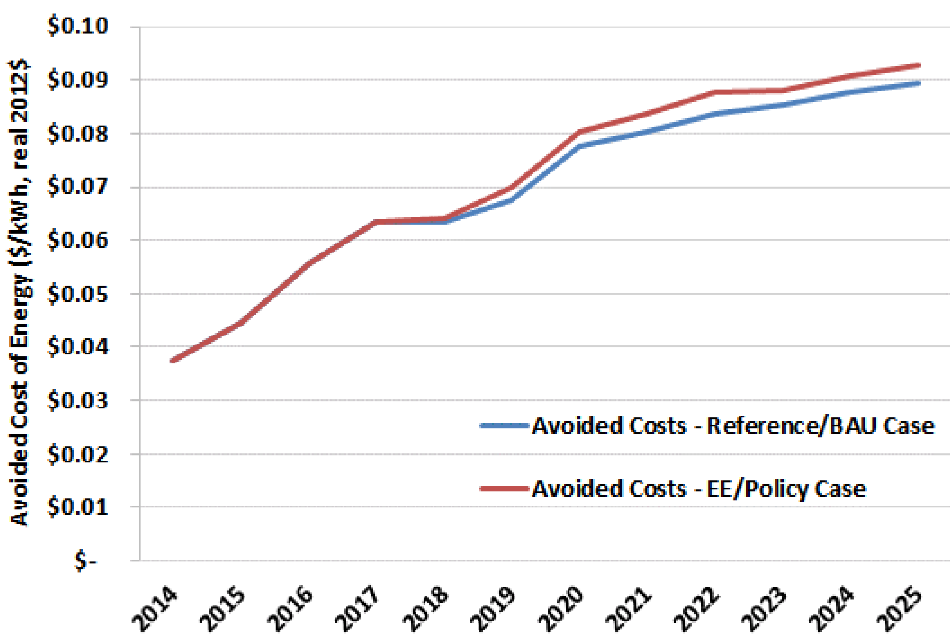
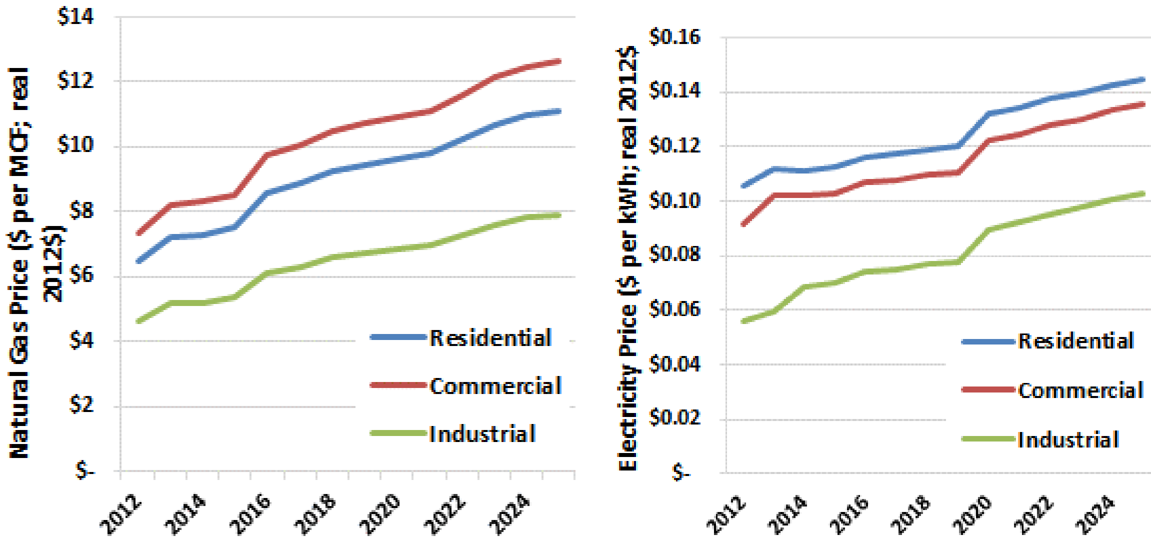


Figure 12 shows projections for retail electricity and natural gas prices for 2012-2025 in the reference case. Statewide electricity and natural gas rates for the baseline year 2012 are based on EIA data (EIA 2013a). We start with 2012 because it is the last year for which there is historical data available for energy prices. Synapse also developed the electricity price forecast using this baseline data and inputs from its avoided cost model. ACEEE developed the price forecast for natural gas, using historical price data and growth rates for the Southeast Electric Reliability Council (SERC) region extrapolated from the EIA's *Annual Energy Outlook*.

Figure 12. Retail Price Forecast by Sector for Natural Gas and Electricity



Energy Efficiency Policy and Program Analysis—Summary of Findings

Numerous opportunities are available to Mississippi to support energy efficiency development and tap into the efficiency resource potential identified in the previous section. This section provides a roadmap and quantitative analysis of specific policy and program options to improve energy efficiency in the state and support economic development. We categorize these opportunities broadly as: 1) statewide programs and initiatives and 2) tailored utility program offerings. In this section we first summarize the policy and program options in each category. We then present a summary of the analysis findings and describe in greater detail each of the policy and program options and methodologies for analysis.

The first category of statewide policy and program mechanisms, as shown in Table 3 and Table 4, describe efforts that could be established either through state legislation, the Public Service Commission, at the Executive level, or through other statewide administrators. We quantify the energy savings benefits for many of these state policy and program options in the analysis that follows, however many of the initiatives are enabling policies that break down market barriers to greater efficiency. For many of these, the potential energy savings or costs are not easy to quantify–for example, establishing regulatory guidelines that better align financial motivations with energy efficiency are beneficial to reduce market barriers.

For the tailored program offerings, which would be administered by utilities or some third-party administrator, we note which we consider for implementation during Mississippi's Quick Start phase and which we consider for the Comprehensive Portfolio phase. We assume programs included in the Quick Start phase continue through the study period. For those programs not included in the Quick Start "portfolio," we limit the analysis of potential savings and costs to those years constituting the Comprehensive Portfolio phase. For the purposes of this analysis and based on Rule 29, we consider Mississippi's Quick Start phase to encompass the years 2014-2016, with the Comprehensive Portfolio phase beginning in the year 2017.

The opportunities listed in these tables are not exhaustive nor prescriptive: there are many opportunities for additional cost-effective program implementation in addition to those included in the tables below. Rule 29, for example, lists a number of Quick Start program options that we did not analyze in this report. Their exclusion does not mean that ACEEE does not consider them to be viable options. Rather, the list we assembled represents the policies and programs that Mississippi stakeholders expressed to us as priorities, in addition to those that ACEEE considers to be good options for a state that still requires time to build related infrastructure and to educate consumers on the importance of energy efficiency.

Table 3. Statewide Energy Efficiency Policy and Program Options for Mississippi

Statewide Policies, Programs, and Initiatives	Summary of Analysis Recommendation
Benchmarking Energy Consumption in Public Buildings	Take steps toward benchmarking building energy usage for all publically-owned buildings and facilities in order to facilitate the installation of energy efficient measures.
Industrial Initiative	Expand energy efficiency in the industrial sector by addressing three barriers to expanded industrial energy efficiency: need assessments; access to industry-specific expertise; expansion of trained manufacturing workforce. Re-establish an industrial assessment center (IAC) at one of Mississippi's state universities.
Updated Building Energy Codes for Residential and Commercial	Identified as a policy need by Governor Bryant, adopt and implement statewide commercial building energy codes to encourage higher efficiency levels in line with new IECC and ASHRAE standards as they are released. Expand policy to include residential building energy codes. Conduct code compliance surveys and expanded training for local code officials, inspector, builders, and designers to reach 90% building code compliance after several years.
Lead by Example in State & Local Government Facilities	Identified as a policy need by Governor Bryant, improve the efficiency of Mississippi's public facilities and buildings.
Low-Income Weatherization	Provide weatherization services, efficient appliance upgrades, and energy savings kits to income-qualified households to lower energy bills and make homes more comfortable. Administered by local community action agencies in coordination with state agencies and utility programs.
Rural, Agricultural, and Fisheries Initiative	Coordinate existing initiatives to develop education program to disseminate information on EE best practices, administer rural audit program building on the USDA Rural Energy for America Program (REAP) to provide technical and financial support, and create pool of matching funds for USDA grants to supplement initiatives.

In addition to the policies and programs in the above table, we also recommend the following enabling programs and policies in Table 4 (these are not explicitly modeled in the program analysis for energy savings and costs, but are important enabling considerations).

Table 4. Enabling Policy and Program Options for Mississippi

Enabling Policies & Programs	Summary of Analysis Recommendation
Workforce Training Initiative	Support and Empower the Mississippi Energy Workforce Consortium to augment workforce development activities at Mississippi's universities, community colleges, and high schools. Develop a well-trained workforce to identify, implement, and operate efficiency measures.
Energy Efficiency Education	Deliver relevant, consistent, and fuel-neutral information and training that encourages energy consumption reductions through energy efficiency and conservation measures. Coordinate efforts across utilities to ensure consistent messaging.
Customer Financing Options	Implement a range of financing opportunities to reduce first-cost barriers to energy efficiency investments, such as financing through utilities by tying repayment to the meter and utility bills, energy efficiency mortgages, or through municipal financing by tying repayment to a property tax bill.
Utility Resource Planning	Implement Mississippi's new energy efficiency rules with policy designs that better align utility financial motivations with energy efficiency improvements, such as timely cost recovery, performance incentives, and removal of the throughput incentive; introduce rules for integrated resource planning and incorporate energy efficiency as a resource.
Research, Development, and Demonstration Initiative	Coordinate research and development efforts across existing entities, such as the Energy Institute at Mississippi State University and Innovate Mississippi, with the goal of developing new technologies and practices to facilitate local development and commercialization of energy-efficient products.
Program and Policy Coordination and Collaboration	Utilities and state-level stakeholders coordinate program offerings when appropriate, e.g., natural gas and electric utilities serving the same territory; Set up stakeholder working group and forum.

The second category of tailored energy efficiency programs, as shown in Table 5, lists several tailored program offerings for all customer classes in Mississippi. This represents an extensive (though not exhaustive) list of energy efficiency program options for Mississippi customers. We analyze potential energy savings, costs, and benefits from each of the programs.

Table 5. Tailored Energy Efficiency Program Options by Customer Segment

Residential	Commercial	Industrial
Building Energy Code Support	Building Energy Code Support	C&I Prescriptive Retrofit*
Home Performance with ENERGY STAR*	Small Business Direct-Install*	Large C&I Custom Retrofit (including Self-Direct)
Retail Appliances and Electronics	C&I Prescriptive Retrofit*	
Residential Lighting and Recycling*	Large C&I Custom Retrofit (including Self-Direct)	
Residential Cooling*		
Low-Income Weatherization (coordinate with state programs)*		
Behavior and Information Feedback*		

Note: Programs with an asterisk we assume will be implemented during Mississippi's Quick Start phase and will continue during the Comprehensive Portfolio phase.

Efficiency upgrades can also save over 3% (cumulative) of natural gas needs by 2020 and about 10% by 2025. In terms of meeting an incremental annual savings goal of 1%, taking into account utility customer programs only, Mississippi could reach this goal by 2025. One of the reasons for this stark contrast between electricity and natural gas programs, relative to our analysis, is that several of the utility customer programs we modeled do not generate natural gas savings (Lighting, Small Business Direct Install, etc.) while all of the state government administered programs (Building Codes, Lead by Example, etc.) do generate natural gas savings. Natural gas sales are also expected to slowly decline throughout the analysis period, increasing the percent savings relative to the baseline forecast.

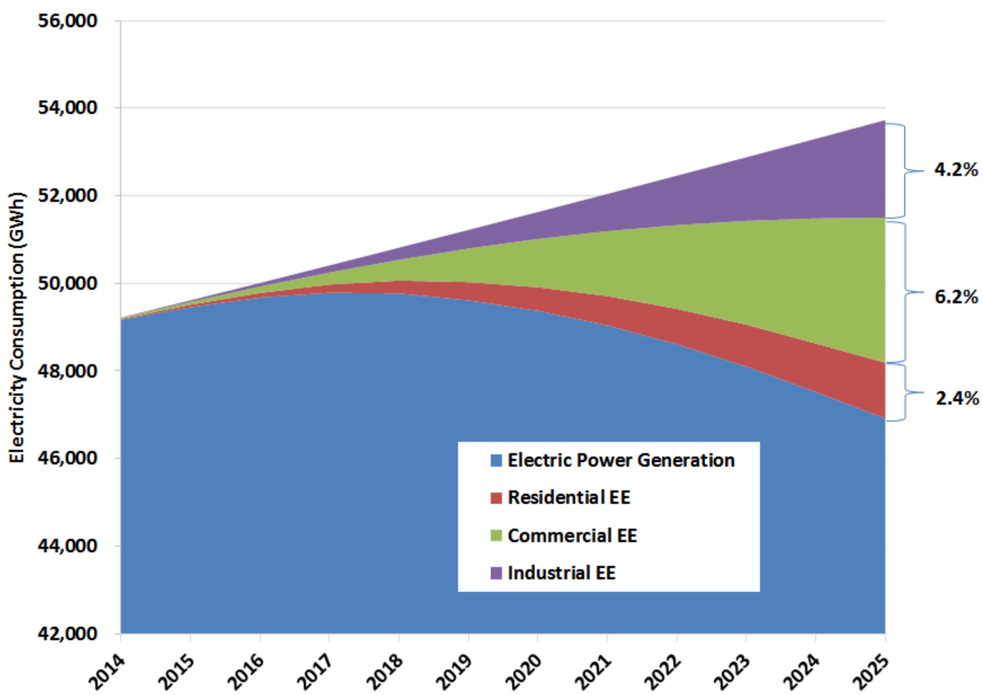
Table 6 and Figure 13 and Figure 14 show a further breakdown of savings potential by customer class. Further details on each of the policies and programs analyzed are presented in a later section.

Table 6. Cumulative Policy and Program Energy Savings for All Programs, by Type and Customer Class in 2020 and 2025

	2015		2020		2025	
Electricity End-Use Efficiency Savings (GWh)	GWh	% of Reference Case*	GWh	% of Reference Case*	GWh	% of Reference Case*
Residential	58	0.3%	542	2.9%	1,275	6.5%
Commercial	67	0.5%	1,102	7.9%	3,316	22.8%
Industrial	34	0.2%	616	3.3%	2,225	11.7%
Electricity Total	**159**	**0.3%**	**2,259**	**4.4%**	**6,815**	**12.8%**
Natural Gas End-Use Efficiency Savings (MMCF)	MMCF	% of Reference Case*	MMCF	% of Reference Case*	MMCF	% of Reference Case*
Residential	43	0.2%	423	2.0%	1,060	5.3%
Commercial	65	0.3%	704	3.3%	1,885	8.8%
Industrial	35	0.3%	616	5.2%	2,307	19.1%
Natural Gas Total	**142**	**0.3%**	**1,742**	**3.2%**	**5,252**	**9.8%**

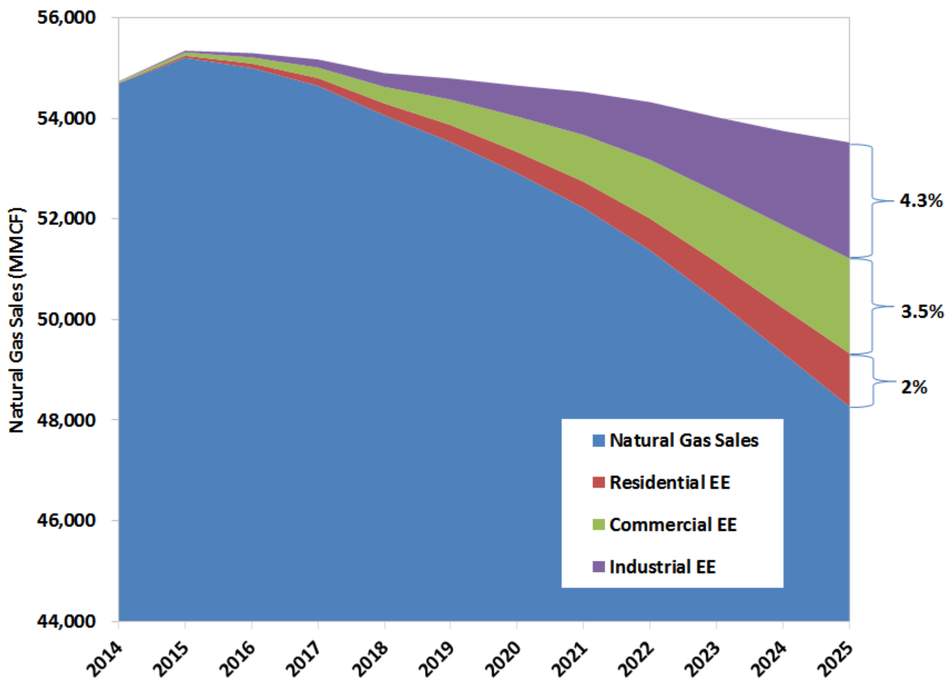
*Note: Savings are shown as a percentage of sales in the previous year, by customer class from the reference case forecast. For total savings, percent savings is relative to statewide sales in the previous year, also from the reference case forecast.

Figure 13. Electricity Energy Efficiency Policy and Program Potential through 2025



Note: Percentage values for each customer class are relative to statewide energy sales.

Figure 14. Natural Gas Energy Efficiency Policy and Program Potential through 2025



Note: Percentage values for each customer class are relative to statewide energy sales.

Discussion of Statewide Policies and Programs

In this section we describe several opportunities for Mississippi within the first category of statewide policies and programs, which may be further implementation or expansion of existing initiatives, or new efforts pursued through legislation, PSC rules, executive orders, and/or by state agencies. This set of statewide policy and program options largely represent new opportunities in Mississippi that are not currently being pursued, however some of the program areas represent either expansions or updates of existing efforts by specific jurisdictions or utilities.

CAVEATS

Stakeholders in Mississippi requested ACEEE to provide insights on the timeline and resources required for utility customer energy efficiency programs to achieve incremental annual energy savings of 1%. The new EE rules adopted by the MPSC require that the MPSC will, prior the start of the Comprehensive Portfolio phase, set energy efficiency savings targets for utilities that are covered by the new rules. The achievement of 1% incremental annual savings is generally regarded as a sign of a mature, comprehensive portfolio design, hence our stakeholders' interest. The suite of utility customer programs we consider in this report are not exhaustive or prescriptive, however: there are ample programmatic opportunities for Mississippi to implement that could help the state achieve higher levels of energy savings. Mississippi also has myriad in- and out-of-state resources to utilize to guide the program design and implementation process, so that program administrators do not have to be concerned with reinventing the wheel.

To estimate when Mississippi can expect to achieve this goal through the implementation of energy efficiency programs under the new rules, we limit the pool of potential participants to 92% of statewide electricity customers and 86% of statewide natural gas customers, across all sectors, to reflect the fact that only these portions of statewide energy sales are subject to the new rules. We do not include savings achieved by policies and programs administered by the Mississippi state government when discussing these policies and programs within the context of the 1% goal.

The results presented elsewhere in this report are presented from a ***statewide*** perspective, meaning that we assume 100% of all sales and all customers are capable of being captured by energy efficiency programs. The results presented in the **Macroeconomic Analysis** section later on in this report, for example, represent the potential impacts that could be achieved if all customers across the state are considered potential participants in energy efficiency programs, both state- and utility-administered.

STATE GOVERNMENT-LED PROGRAMS

Below we discuss several program options for Mississippi's government agencies to consider in order to help grow the energy efficiency industry in the state. Two of the programs—Building Energy Codes and Lead by Example—were identified in Governor Bryant's October 2012 energy plan as priorities for adoption. The third—Building Benchmarking and Disclosure—is a program that was identified as a priority by several stakeholders with whom we spoke. These programs provide an opportunity for Mississippi's government agencies to help stimulate demand for energy efficiency services, which will help drive the market forward and send a signal to companies and citizens that the State is dedicated to improving its infrastructure, to spending taxpayer dollars prudently, and to bolstering its overall economic vitality.

Building Energy Codes and Enforcement

Strong building energy codes that are adequately enforced are a critical foundation for greater energy efficiency in Mississippi. Up-to-date codes and proper training and enforcement ensure lower energy bills and greater comfort for consumers who purchase or rent new homes or buildings. Buildings are much more difficult and costly to retrofit for energy savings after they are built; i.e., they become "lost opportunities" for energy savings. This makes statewide building energy codes a critical foundation for energy efficiency progress in the state.

Mississippi is a home-rule state, so code adoption is advanced through state legislation. There is no set schedule for code changes. Mississippi's statewide residential building energy codes have not been updated in over thirty years, since 1980. The current residential code follows ASHRAE 90-1975, which was mandated for state-owned buildings but is voluntary for residential buildings.

In April 2013, Mississippi's statewide commercial building energy codes were updated for the first time in 30 years through the passing of HB 1281 and HB 1266, making ASHRAE 90.1-2010 mandatory for all new commercial construction and state-owned buildings and facilities. This makes Mississippi only the second state in the country to adopt this stringent code and the first in the Southeast region.

While code adoption occurs at the state level, code enforcement is under the purview of local governments. Stakeholders in Mississippi identified the need for improved training of local code officials and contractors to improve compliance with building energy codes. Utility energy efficiency programs could also play a role in encouraging adoption of strong codes and supporting efforts to ensure compliance; both of these activities could allow options for utilities to earn credit toward any future energy savings targets. Our next section on utility residential and commercial new construction programs, focused solely on compliance support, explores this program area further.

PROGRAM ANALYSIS

For the residential sector, we assume a baseline of the 2006 IECC[17] and that Mississippi adopts the most recent version of the International Energy Conservation Code (IECC) so that the 2012 IECC becomes effective in 2015, which generates 34% savings relative to the 2006 baseline. We assume the code is updated again in 2020, to the 2015 IECC, which adds an additional 10% savings, or 44% relative to the 2006 baseline.[18] We assume that administrative costs include education and training, though those costs will be negligible relative to other program costs in this report. The bulk of expenditures will be made during the year before and after the code adoptions. We assume compliance rates begin at 50% in the year of code adoption and increase by 10% annually, peaking at 90% compliance.

For the commercial sector, we estimate an average 25% savings relative to buildings built to meet the previous model energy code, which we assume is ASHRAE 90.1-2004, in line with the savings for the ASHRAE 90.1-2010 code (Rosenberg and Eley 2013). We estimate another round of code changes in 2020, with the adoption of ASHRAE 90.1-2013 saving an additional 25%. We assume compliance rates begin at 50% in the year of code adoption and increase by 10% annually, peaking at 90% compliance before the next code cycle begins.

Lead by Example in State and Local Government Facilities

State and local government facilities, such as those of state agencies, public schools, and universities, represent unique opportunities for Mississippi to implement and ramp up energy efficiency practices. Other opportunities beyond the buildings sector also exist, such as outdoor street lighting and water/wastewater treatment, both of which are opportunities of particular interest to local governments. Improving efficiency in public facilities is not only a way to capture significant energy savings, but also a powerful outreach tool to lead by example and engage local neighborhoods, the private sector, and individuals.[19]

MISSISSIPPI EFFORTS TO PROMOTE ENERGY EFFICIENCY IN PUBLIC BUILDINGS

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[17] The statewide building energy code for the residential sector has remained unchanged for decades and is a relatively weak standard compared to most states in the country. However, anecdotal evidence provided by stakeholders suggests that most new homes in Mississippi, along the Gulf Coast, for example, are being built to the 2006 IECC.
[18] The 2015 IECC specifications have not yet been finalized; it is likely the savings will increase when they are
[19] For more information on best-practice lead-by-example design and implementation, visit ACEEE's Technical Assistance Toolkit: http://aceee.org/sector/state-policy/toolkit/lbe.

The MS Energy Sustainability and Development Act (HB 1296) amends the Energy Management Law of 1981, and requires the Mississippi Development Authority (MDA) Energy and Natural Resources Division to coordinate the development and implementation of a state energy management plan for all state-owned or state-leased buildings and facilities which will minimize energy consumption and ensure that buildings and facilities are operated with maximum efficiency of energy use. In addition, the act mandates that state agencies work with MDA and DFA to deploy energy management plans and report usage in order to lower cost and conserve energy (see text box).

Taking the Lead at the Mississippi Department of Environmental Quality

Discussions with stakeholders at the Mississippi Department of Environmental Quality (MDEQ) revealed that is has a wealth of leadership that is driving effective internal efforts to maximize the energy efficiency of its facilities and operations. The MDEQ began it energy efficiency efforts in May 2010 and has decreased it annual utility costs for its two buildings in Jackson by over $140,000, which required no capital expenditures. The MDEQ began by gathering energy usage data, utilizing a tool from the MDA called the Energy Monitoring and Controlling Solution (EMC), and benchmarked energy performance for the two buildings using ENERGY STAR's Portfolio Manager, a free online tool. MDEQ gathered data for 12 months and identified three primary areas where significant reductions could be realized: HVAC, lighting, and plug loads. By implementing control measures to adjust HVAC and lighting usage based on occupancy and time of day, as well as behavioral measures to reduce plug load consumption, MDEQ reduced the Energy Use Intensity of its two buildings by 37% and reduced operating costs by 31%.

ENERGY SERVICE PERFORMANCE CONTRACTING

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 use of energy service performance contracts (ESPC) through energy service companies (ESCO). Under the ESPC model, state agencies hire prequalified ESCOs to implement projects that improve a building's energy efficiency and lower maintenance costs.[20] The ESCO guarantees the performance of its services, and the energy savings are used to repay the project costs. This model has proved to be highly effective for institutional energy customers in many locales, both in terms of delivering energy savings and in cost effectiveness (LBNL 2008).

ESPCs have a high potential for stimulating economic development in Mississippi.[21] Increased demand for performance contracting (PC) services, whether by government entities or non-government organizations, will spur job creation, particularly with local contractors. A number of entities in Mississippi have successfully implemented energy efficiency projects using PC. Three school districts—Biloxi, Holly Springs, and New Albany—have successfully implemented energy efficiency improvements using the ESPC model, saving 15%-25% in their utility bills. In the Biloxi school district, these savings will amount to $4.5 million in savings over the 15-year average

[20] Mississippi currently utilizes the U.S. Department of Energy's list of qualified energy service companies: http://www1.eere.energy.gov/femp/pdfs/doe_ql.pdf.

[21] The Mississippi Development Authority posts relevant information for EPC on its website: http://www.mississippi.org/energy/financing/.

life of measures installed, money that can be reinvested elsewhere in the jurisdiction. Installed measures included lighting retrofits, energy management systems, and HVAC upgrades, among others.[22]

PROGRAM ANALYSIS

There was no savings goal for state facilities targeted in the MS Energy Sustainability and Development Act. For this analysis, we assume that Mississippi sets a goal to achieve 15% cumulative savings by 2025 in all state and local public facilities, using ESPCs and other models to achieve these savings cost-effectively. Given the success of MDEQ to double the amount of savings realized with no capital expenditures, 15% cumulative savings over 10 years is a reasonable goal to set. We assume an average building size of 100,000 square feet (sf) with an average energy intensity of 18.8 kWh/sf and 28.5 cf/sf (each respectively covering only electricity and natural gas end uses), which works out to about 93 kBtu/sf (CBECS 2007).[23] We conservatively estimate that each facility or building can achieve an average of 15% annual savings, though savings decrease over time as fewer energy-intensive buildings are targeted. Program costs are based off best-practice commercial programs targeting similar measures from Rocky Mountain Power, Arizona Public Service, and Xcel Energy Colorado (Public Service Company of Colorado).

Benchmarking and Disclosing Energy Use in Public Buildings and Facilities

Building benchmarking and disclosure is a market-based policy tool that can increase awareness of building energy performance and generate demand for energy efficiency improvements. Through benchmarking a building owner, operator or manager is able to compile data on energy performance, determine baseline energy usage, and create comparable performance metrics to evaluate against a baseline, which can then be used to motivate improvements to the building. Disclosure policies require these performance metrics to be made public, providing a more accurate picture of a building's total operational costs and allowing for better investment decisions.[24]

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[22] More case studies on PC projects in Mississippi can be found here: http://www.mississippi.org/assets/docs/energy/case-studies.pdf.

[23] For perspective, the MDEQ reduced the energy intensity of its facilities from 206 kBtu/sf to 129 kBtu/sf, so our assumptions are conservative, considering that the percent savings are being measured against a smaller number.

[24] See Action Network's report *Benchmarking and Disclosure: State and Local Policy Design Guide and Sample Policy Language* (http://www1.eere.energy.gov/seeaction/pdfs/commercialbuildings_benchmarking_policy.pdf) for more information on implementation. See also www.buildingrating.org for additional resources on program design and implementation.

A building benchmarking and disclosure program for publically-owned buildings is a critical first step toward developing an effective Lead-by-Example program in Mississippi (discussed above). The MDA Energy and Natural Resources Division is currently making headway in this area by benchmarking public building energy usage through its State Energy Management Program (SEMP). To date, 80% of state-owned buildings have been entered into the state's Energy Monitoring and Controlling Solution (EMC), and close to 1,000 smart meters have been deployed in public facilities. MDA is also currently training state agency facility and energy managers in reporting usage data and identifying opportunities to implement energy-conserving measures, and will work with state agencies to develop individualized energy management plans. A robust benchmarking program would create a set of metrics, such as energy consumption by end-use (HVAC, plug loads, water heating), which is typically measured as per-square-foot, and normalize these metrics for a range of factors, such as building size, operational characteristics, and climate.[25] These sorts of metrics are akin to a fuel economy rating for vehicles. Collecting this data over time will allow state agencies, such as the Mississippi Department of Finance and Administration (see text box), which manages the state's buildings and facilities, to more accurately gauge performance and, ultimately, allocate funds for improvements more effectively. Energy savings opportunities can be identified almost immediately, some of which can be achieved through the implementation of simple, behavioral measures.

Managing Energy Efficiency in Mississippi's Public Buildings

The Mississippi Department of Finance and Administration (DFA) directly manages building operations for 28 facilities in Jackson, MS. It has bond making authority to finance projects, such as energy efficiency improvements, in the public sector. As the manager of these buildings, the DFA pays the government's utility bills and thus has access to all public building utility energy data. The DFA therefore has a vested interest in understanding public building energy consumption at the end-use level, in order to target effective energy efficiency improvements. In its most recent energy plan, the DFA estimates that it spends $5.5 million per year on energy expenditures but can cut $1 million from these expenditures in two years primarily through the implementation of operational improvements. The DFA is also in the process of not only installing smart meters in state agencies and campuses, but also installing more than one meter. Many state agencies and campuses only have one meter, rendering the disaggregation of energy consumption and the identification of energy efficiency improvements extremely difficult.

From a state government perspective, benchmarking and disclosing energy consumption in public buildings is also an important facet to improving the public's perception of government prudence, such as how and where taxpayer dollars are being spent. As a short-term policy/program option, implementing a benchmarking program will help stimulate demand for services from Mississippi's growing energy efficiency investments. It will also

[25] Benchmarking programs generally use ENERGY STAR's Portfolio Manager to aggregate building energy consumption data, which is a free, online tool developed by the U.S. EPA. See http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager

help the state gather more information on its building stock: many privately-owned buildings in the state likely resemble publically-owned buildings, both aesthetically and operationally, so efforts made to improve the energy performance of publically-owned buildings will likely facilitate energy efficiency improvements in the private sector. A collective effort to reduce energy consumption in publicly-owned buildings can also foster competition across agencies, schools, or other institutions.

PROGRAM ANALYSIS

We first approximate the number of electric and natural gas customers using a forecast from Moody's Analytics. We limit the eligibility of customers to government-owned buildings and facilities, which we assume constitutes 20% of commercial buildings in the state (CBECS 2007). Based on a similar benchmarking effort in Kentucky's state-owned buildings, we assume that participation—or the number of buildings benchmarked—begins at 0.1% (about 60 facilities in the first year) and ramps up to 5% by 2020 and 8% by 2025, so that by 2025 50% of all government-owned buildings have been benchmarked.[26] We assume an average building size of 100,000 square feet (sf) with an average energy intensity of 18.8 kWh/sf and 28.5 cf/sf (each respectively covering only electricity and natural gas end uses) (CBECS 2007). We assume savings of 2.4% annually, equivalent to the average savings realized through New York City's commercial benchmarking law (Local Law 84), and that savings decrease over time as the program targets less energy-intensive buildings (PlaNYC 2012). Program costs are based off ConEdison's (NYC) benchmarking program, which charges $102.50 to aggregate utility energy data for electricity and natural gas per building, or $205 for both fuel sources (Cox et al. 2012; Burr et al. 2011).

Rural, Agricultural, and Fisheries Initiative

The agricultural sector in general is one of the most energy-intensive industries, on par with most durable goods manufacturing (EIA 2013a). Farms rely on a diverse set of energy sources, including electricity, diesel, propane, fuel oil, and (very rarely) natural gas to power farm activities like heating, tractor use, and irrigation pumps. Farms also rely on indirect energy resources contained in fertilizers or other agricultural chemicals. When energy prices are unstable or increasing, farmers and rural communities are impacted as agriculture becomes less profitable. Fertilizer, manufactured through an energy-intensive process, typically accounts for nearly 15% of total farm cash production expenses (USDA 2006).

In rural areas, such as most of Mississippi, updates to modernize the electric grid are expensive, and investing in on-farm energy efficiency or renewable energy is a more cost-effective option—a near-term resource available to respond to immediate energy challenges in rural communities.

A conservative analysis of the energy cost saving potential in the agricultural industry in the United States shows these savings to be over 34 trillion Btus and one billion dollars per year (Brown and Elliott 2005). This analysis covers the direct benefits from energy savings, but does not include non-energy benefits, such as increased financial stability due to reduced energy cost exposure. The study estimates significant savings by increasing energy efficiency in the production of several commodity crops—4.5 trillion Btu and $67.6 million

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[26] See http://www.kyenergydashboard.ky.gov/#/Home

per year in the poultry industry, and an amazing 17.1 trillion Btu and $167.7 million dollars per year in grain and oilseed operations.

ADVANCING AGRICULTURE IN MISSISSIPPI

Mississippi is one of the most rural states in the union, with about 29% of the state's workforce either directly or indirectly employed by agriculture (MDAC 2013). Poultry is by far the most economically important agricultural product in Mississippi, with almost $2.5 billion in sales in 2007. Most poultry production is concentrated in the southern half of the state (USDA 2009). The most significant use of energy in poultry production is lighting, as chickens are generally raised in long, low buildings with little to no natural light. Ventilation and heating in the colder months are also major energy end-uses. Corn, soybeans, and cotton are the most important row crops in the state. Aquaculture is also an extremely important industry in Mississippi. About half of all US-raised catfish sold, and about a quarter of all farmed fish in general, comes from Mississippi (USDA 2007). Fish are usually raised in artificial ponds filled with water pumped up from aquifers, and must be aerated to provide the fish with adequate dissolved oxygen.

The analysis in this report considers the effect of three energy efficiency interventions in three different agricultural industries—poultry, corn, and aquaculture. For poultry, we looked at LED lighting. Most poultry farmers use incandescent light bulbs in the buildings where chickens are raised. Although the upfront cost of switching to LEDs can be high, costs are quickly falling and the energy savings can be as much as 80%. For corn, we considered the impact of energy efficient grain dryers. Moisture must be removed from corn after harvest so that it can be stored without spoiling, and this is accomplished with equipment that uses heat and ventilation to dry the kernels. Energy efficiency upgrades to grain dryers have long been a popular use of funds from USDA energy efficiency programs in certain states, but historically the funds that Mississippi has received from these programs is usually used for other types of projects. Finally, we consider the energy use of pond aeration equipment in aquaculture. Relatively little work has been done looking at the energy efficiency of aquaculture operations, particularly for aeration equipment. The most common type of aerator is a paddlewheel, which has a 10- to 15-foot hub placed parallel to the surface of the water, with metal paddles radiating out in a pinwheel pattern. These paddlewheels are operated by electric motors that turn the hub so that the paddles agitate the surface of the water, adding oxygen. (Paddlewheels powered by tractors are also common, but not considered here.) This report estimates the energy efficiency gains from switching to other pond aeration methods, such as diffused air systems. Additional research is needed to provide a more accurate assessment.

Although agricultural energy initiatives tend to focus on renewables like biofuels, there is a significant interest in agricultural energy efficiency. The U.S. Department of Agriculture offers a variety of energy efficiency assistance programs, most notably REAP (the Rural Energy for America Program, formerly Section 9006). Organizations specifically dedicated to improving farm and rural small business energy efficiency have emerged to fill this space. Existing energy efficiency programs are widening their focus to include agricultural energy efficiency issues and to provide more on-line and on-farm audits, as well as both technical and financial support. The Energy Title (IX) of the 2008 Farm Bill provides more funding than previous legislative efforts to the Rural Energy for America Program (REAP, formerly Section 9006). REAP provides technical assistance and audits, as well as grants and loan guarantees for energy efficiency and renewable energy projects to farms, ranches, and rural small businesses.

The initiatives described below are meant to build capacity within the state of Mississippi in order to better provide energy efficiency-related knowledge, assessments, technical assistance, and funding for rural small businesses and agricultural operations.

1. CONTINUE TO FUND DEVELOPMENT OF EDUCATIONAL PROGRAMS INCLUDING THE MISSISSIPPI FARM BUREAU, THE MISSISSIPPI EXTENSION SERVICE, AND THE MISSISSIPPI DEPARTMENT OF AGRICULTURE AND COMMERCE PROGRAMS

The Mississippi Department of Agriculture and Commerce (MDAC) does not offer any agricultural energy efficiency programs. Rather, the MDAC's role is limited to promoting the REAP and other related federal programs. Mississippi should look to successful programs in other agricultural states as models for programs to develop. Over the last several years, the Arkansas RC&D Council has been conducting educational seminars across the state for Arkansas farmers on energy risk management, an issue that has become increasingly important as farmers face falling profits and rising energy costs. These seminars focus on several areas aimed at enabling farmers to reduce their energy costs, such as: identifying energy reduction opportunities; disseminating information on federal, state and utility financial incentives; elaborating on the benefits of energy audits and providers of this service; and assistance with applications for financial support. In the Midwest, the Iowa Energy Center funded a project looking at the "Development of an Energy Conservation Education Program for Iowa's Livestock and Poultry Industry."[27] The work products of the study will include a curriculum, with day-long training sessions for farmers, fact sheets, and a reference manual covering energy efficiency techniques, and a training regimen for extension agricultural field specialists, to assist with the distribution of the educational materials.

The Cooperative Extension Service is an important source of information that is widely trusted by farmers. Though extension agents traditionally focus on issues like pest identification and chemical usage, they are potentially an effective means of conveying information about energy efficiency programs directly to farmers. Extension programs exist in all 50 states. They receive funding from USDA, but are staffed and operated by land grant universities in the state. In Mississippi, the extension service is operated by Mississippi State University and Alcorn State University. Most counties have a local extension office where individual farmers can develop a relationship with extension agents, and agents are able to provide information that is most appropriate for the local region. Unfortunately, funding for Extension has decreased over the past several decades, forcing some local offices to reduce their staffs or to close altogether. The Farm Bureau is another organization that can play an important role in providing information to farmers about energy, though it is a membership organization not affiliated with a government institution.

Supporting and augmenting these existing educational programs to further disseminate information on energy efficiency best practices for farmers, ranchers, and rural small businesses will go a long way to ensuring the competitive edge of Mississippi farmers and

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[27] See http://www.energy.iastate.edu/Efficiency/Agricultural/cs/harmon_conserv.htm

rural businesses. This effort could also include a partnership with national organizations, such as the Rural Electricity Resource Council (RERC)[28] or the USDA Rural Development.[29]

2. FURTHER LEVERAGE USDA ENERGY EFFICIENCY PROGRAMS

Mississippi is one of many REAP success stories. As discussed above, poultry and egg production is the top agricultural commodity in Mississippi, with 2,800 producers and around $2.4 billion dollars in annual sales. The Mississippi State Poultry Science Department held educational workshops and provided application assistance to producers, resulting in REAP funding for over 80 projects between 2003 and 2007, totaling around $3 million dollars.[30]

Other agricultural industries in Mississippi have not had the same amount of success as the poultry industry in obtaining REAP grants. This is entirely due to the fact that Mississippi's poultry farmers had access to an advocate—one individual person—who dedicated their time to filing REAP applications on their behalf. During our interviews with stakeholders, we were told that Mississippi farmers do not have the time or resources to fill-out applications on their own. If Mississippi farmers in other agricultural industries are to fully leverage federal funding, it is clear that they will need assistance during the application process.

There are additional USDA programs that provide funding for energy efficiency upgrades. The Environmental Quality Incentives Program (EQIP), which is part of the Natural Resources Conservation Service, provides funding for energy audits as well as assistance for implementing practices identified during the audits. Though the funding is provided by EQIP, the audits themselves are conducted by local, third-party technical service providers. This program can help farmers determine the most cost-effective strategy for energy efficiency upgrades.

3. CREATE A POOL OF MATCHING FUNDS FOR USDA GRANTS

To further promote the implementation of energy efficiency technologies and projects, Mississippi could consider establishing a pooling matching fund for these USDA-REAP grants. Availability of these funds could prove vital for successful REAP applications, as the USDA is considering availability of non-REAP funding as a criterion for the application ranking process. This funding pool could be established through the utilities or from another funding source.

The New York State Energy Research and Development Authority (NYSERDA) runs the FlexTech program, providing cost-sharing of energy audits or feasibility studies of improvements and load management techniques that would save money on farmers' energy bills. The NYSERDA program is open to all sectors, but could be adapted in Mississippi to focus exclusively on agricultural operations as a tie-in with the USDA-REAP program funding. Across all sectors, FlexTech realizes $5 in energy savings and $17 in

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[28] RERC's Web site, www.rerc.org, provides materials on energy efficiency and is a national center for information on rural electricity topics.
[29] See http://www.rurdev.usda.gov/
[30] See http://farmenergy.org/success-stories/energy-efficiency/mississippi-poultry-growers

implementation / construction costs for every dollar spent on feasibility studies (Brooks and Elliott 2007).

PROGRAM ANALYSIS

With our focus on poultry, aquaculture, and corn, we first had to determine the total amount of energy consumed in these sectors in Mississippi, for which we used data from the *2013 Annual Energy Outlook* (EIA 2013a) and from the USDA's Agricultural Census (USDA 2007 and 2009). Based on the end-uses considered in this analysis (lighting, pond aeration, and grain dryers), we then determined the amount of energy in each of the three sectors being consumed for these particular end-uses. We assume that improved lighting, aeration, and drying measures can yield savings of 85%, 30%, and 20% respectively. We assume that program costs are limited to administrative only and that incentives are provided by the USDA, not from the state. Usually the USDA will provide up to 25%-50% of total project costs. We assume participant costs per project of $20,000, which is based on the average 2012 REAP grant in Mississippi, assuming 50% contribution on the part of the farmer. We assume program administrative costs of $5,000 per participant.

Mississippi Manufacturing Initiative

The manufacturing/industrial sector can be difficult to address in terms of energy efficiency policies and programs, but doing so is crucial to improving employment and energy efficiency in the state. An effective statewide program will require leadership and collaboration between the government, industry leaders, and the education system.

Based on discussions with a broad range of stakeholders involved with the manufacturing sector, we propose a government/utility/industrial collaborative we are calling the "Mississippi Manufacturing Initiative." The goal of the initiative would be to address the three key barriers to expanded industrial energy efficiency identified by the stakeholders:

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

The initiative would establish an assessment center in the model of DOE's Industrial Assessment Center (IAC) program, where university engineering students are trained to conduct energy audits at industrial sites. The IAC program is a highly respected program with a proven track record of reducing energy costs for manufacturers and training the next generation of energy engineers. While Mississippi has not had an IAC since it lost the one housed at Mississippi State University in 2012, we recommend that an IAC be reestablished at one of Mississippi's universities. The University of Mississippi has established a Center for Manufacturing Excellence, however the curricula focus on several areas of manufacturing, such as engineering, accounting and business, as opposed to just energy and engineering. Expanding beyond the IAC model, Mississippi could establish satellite IACs in other parts of the state, as well as partner with community colleges and trade schools to bring their students into the larger network centered around the statewide IAC. These nearby satellite centers would extend training and associated materials to the community college partners, and offer the opportunity for students to join the audits they conduct. This approach would allow training not just of engineers, but also technicians and equipment installers, both of which are essential to preserving energy efficiency savings in the long run (see text box).

Collaborating and networking with organizations such as the Southeast Energy Efficiency Alliance (SEEA), Innovate Mississippi (the local Manufacturing Extension Partnership, or MEP), the Mississippi Chamber of Commerce, and manufacturing trade associations, the initiative could provide outreach to manufacturing companies that might not otherwise be aware of energy efficiency programs. Further collaboration with the Mississippi Development Authority's Energy and Natural Resources Division's (MDA) industrial energy efficiency programs would let the program rely on existing

Entrepreneurial Opportunities in Industrial Energy Efficiency

Mississippi's academic institutions are hotbeds of research and development. In addition to workforce education, it is not uncommon for universities to foster, cultivate and deploy private businesses in addition to individual products or technologies. Investments in energy efficiency will drive demand for goods and services, creating entrepreneurial opportunities for the next generation of Mississippi's energy professionals.

There are several state and national organizations that can be utilized to help Mississippi. The Association of University Technology Managers is a member-based organization that offers professional development programs and networking opportunities to facilitate university technology transfer. Innovate Mississippi, the state MEP, a private, non-profit organization, also works with universities, entrepreneurs, and manufacturers to drive innovation and technology-based economic development in the state. Innovate Mississippi is home to the Innovate MEP Manufacturing Extension Partnership, which also promotes E3 (Economy, Energy, and Environment), a technical assistance framework to help strengthen a state's manufacturing base and create new, industry-related jobs. The Strategic Biomass Solutions program at Innovate Mississippi helps early stage entrepreneurs through its Renewable Energy Venture Startup (REVSup) Academy.

.Mississippi's academic institutions and industry-related organizations must also work closely with the state's workforce development programs, such as the Mississippi Energy Workforce Consortium, to ensure that future generations are well-trained and prepared to take advantage of the myriad entrepreneurial opportunities that energy efficiency will eventually create in the state. (See our discussion of workforce development below).

infrastructure and expertise on sustainability, energy, and job creation.

This initiative would provide multiple benefits to the state:

- Meet the needs of Mississippi manufacturers for a trained technical workforce;
- Provide valuable real-world work experience to students interested in working in manufacturing energy management and equipment installation and operation;
- Meet the need of manufacturing facilities for reliable, knowledgeable, and affordable consultation with regard to their energy usage and opportunities for improved productivity; and
- Build capacity at educational facilities and in the MEP outreach efforts that connect Mississippi's manufacturers to the wealth of knowledge and proficiency that resides in the state.

Funding for this initiative could come from a variety of sources. This initiative would also be able to leverage the resources and tools developed by the DOE's Advanced Manufacturing Office. We also encourage the state to support an expanded federal manufacturing initiative similar to what has been suggested in recent Congressional discussions. These proposals would represent an opportunity to leverage successful national efforts to benefit the state's manufacturers.

PROGRAM ANALYSIS

This initiative, based on the Industrial Assessment Center, would serve smaller manufacturers (nominally those with less than 500 employees). Larger customers would be served by other programs or a self-direct initiative. IAC program and implementation results in southeastern states recorded over the last 5 years show that this program could identify about 5% electricity and natural gas savings per facility and achieve an implementation rate between 35% and 45%. The IAC program spends about $11,000 per audit. In addition, we add an incentive for 30% of the installation cost, and assume that half of the projects would use the incentive. Under these assumptions we estimate cumulative savings of about 0.4%of the industrial electric consumption and about 3.2%of industrial natural gas consumption by 2025.[31]

DISCUSSION OF ENABLING POLICIES AND PROGRAMS

This next set of program options serve as enabling tools for policies and programs. We do not directly include these in the quantitative analysis, but they are critical components to drive customer participation in 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

[31] Natural gas savings seem high relative to electricity because most natural gas (75%) is purchased wholesale and is thus not considered in this analysis. The natural gas sold by distribution utilities is mostly sold to smaller manufacturers affected by this program.

encouraged to invest in efficiency**.** For example, Cornerstone Home Lending, Inc. in Jackson, MS, is an ENERGY STAR partner and, as such, offers energy efficient mortgages, which use energy savings from new, energy-efficient homes to increase the home buying power of consumers and capitalize the energy savings in the appraisal. 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.[32]

In the property tax financing, or **Property Assessed Clean Energy (PACE)** model, the local government issues a surcharge on the annual property tax bill. The financing entity in this case is the local government, which could work with a third-party financer. Currently, this option is most appropriate for commercial properties because of Federal Housing Finance Agency regulations in place limiting the option's use for residential properties.

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. Mississippi currently has access to only one lender for energy efficiency mortgages—Cornerstone Home Lending, Inc.[33]—and the state is in a position to encourage lending practices that take efficiency into consideration.

One important aspect of financing mechanisms is that the debt can be spread out over the course of several years over the life of the efficiency measures, 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 (OBF) programs, which would allow utility customers to invest in energy efficiency improvements and repay the funds through additional charges on their utility bills, may be an option for some utilities. But while OBF can provide benefits to customers, there are also challenges with this model, such as the fact that the role of lender is often outside of a utility's business model, or that utility bills may need to be redesigned. In some states, cooperatives have had success implementing OBF programs. See, for example, the Electric Cooperatives of South Carolina's Rural Energy Savings Program Pilot (Ecova 2012).

Workforce Training Enhancement Initiative

As utilities and the MPSC flesh out the energy efficiency rules and other regulatory policy issues, efforts must be made to bolster Mississippi's workforce within the public and private

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[32] For more information on best-practice financing program design and implementation, visit ACEEE's Technical Assistance Toolkit: http://aceee.org/sector/state-policy/toolkit/financing-energy-efficiency.
[33] See http://www.energystar.gov/index.cfm?c=mortgages.energy_efficient_mortgages for more information.

sectors in order to meet the impending rise in demand for energy efficiency services. The MPSC will need to hire and/or train individuals to monitor, review, and evaluate utility program filings and related regulatory requirements. Utilities will require qualified program administrators and other support staff. Universities and colleges will need to develop education and training programs. And the private sector, such as contractors, will have to hire and/or train individuals for a variety of purposes, such as audits and installations.

The state of Mississippi should be primarily concerned with supporting the Mississippi Energy Workforce Consortium[34] to bolster workforce development activities at universities, community colleges, and high schools. The Consortium was created to engage stakeholders on industry needs so as to ensure a highly-skilled workforce to meet those needs. Through the collaboration of energy companies, non-profit organizations, academia and the Mississippi state government, Mississippi can ensure that the state has a well-trained workforce to identify, implement, and operate efficiency measures. In turn, these efforts will create a sustainable job market that will nurture and grow the number of career opportunities in this burgeoning industry.

During interviews with stakeholders, we identified the Mississippi Community College Board (MCCB) as a primary resource for training future energy efficiency service providers. The MCCB has the ability to quickly establish curricula throughout the community college system that can be tailored to meet current workforce needs. Curricula can be crafted to focus on two distinct educational tracks: 1) career-tech (semester-based, credits), which focuses on long-term, career-development programs, akin to degrees earned through traditional four-year programs, and; 2) workforce development (non-credit), which focuses more on short-term, immediate workforce needs (customized training) and allows for more flexible curricula dependent.

Additional support for Mississippi's workforce efforts has come from Governor Bryant, who established the Mississippi Works initiative,[35] which is dedicated to growing Mississippi's workforce as a means of stimulating economic development. Mississippi Works consists of two co-chairs, an executive committee, and a committee-at-large, which is made up of business leaders throughout the state, and coordinates with the Mississippi Economic Council (MEC),[36] the state's chamber of commerce. These two groups focus on the implementation of Blueprint Mississippi,[37] which, among other things, outlined goals to improve communication and coordination among leaders across the state economy and improve the quality of education in Mississippi, with an eye toward economic development.

Research, Development, and Demonstration Initiative

Mississippi has a number of research-focused universities and organizations that could serve as research and development (R&D) incubators for the sake of commercial deployment. The idea is to develop an entity akin to the New York State Energy Research

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[34] See http://getintoenergyms.org/
[35] See http://www.mississippiworks.org/
[36] See http://www.msmec.com/
[37] See http://www.mississippiworks.org/blueprint-goals/ and http://www.msmec.com/blueprint-mississippi

and Development Authority (NYSERDA), which focuses on the development and commercialization of new technologies and practices.

Several of Mississippi's universities already engage in R&D, such as the MicroCHP program at Mississippi State University's Energy Institute,[38] which has a demonstration facility with the capacity to develop and optimize the implementation and use of combined heat and power (CHP). The Energy Institute has another four research programs/organizations that focus on technology development and deployment. Innovate Mississippi,[39] a non-profit organization, also works in this space, driving innovation and technology-based economic development for the state.

As of 2013, Mississippi researchers also have another tool with the Strengthening Mississippi Academic Research through (SMART) Business Act. This law allows companies operating in the state and partnering with a Mississippi Institution of Higher Learning to defray up to 25% of eligible research and development costs, and specifically prioritizes energy-related research as a targeted sector for the program.

Mississippi stakeholders noted that several entities exist in the state that focus on R&D and that a main priority is to coordinate efforts across those entities, particularly in the area of energy efficiency. The Association of State Energy Research and Technology Transfer Institutions (ASERTTI) has more information on developing and sustaining state R&D programs.[40]

Energy Efficiency Education

Historically Mississippi customers have not had much access to utility energy efficiency services, so there is not a lot of understanding of the potential benefits of energy efficiency, a barrier that was echoed by several of the stakeholders with whom we spoke. Engaging in a statewide education campaign during Mississippi's Quick Start phase (and beyond) will help increase participation in energy efficiency programs by educating customers about the benefits of energy efficiency as well as raising awareness about the existence of both state- and utility-sponsored programs.

Ideally the education program would be administered by Mississippi utilities in coordination with MDA. Energy Efficiency Arkansas (EEA), Arkansas's energy efficiency education program, is structured in this fashion.[41] A collaborative effort will ensure that statewide messaging is consistent, fuel-neutral, and includes educating builders, contractors, etc. in addition to potential program participants. The program should apply to all customer classes.

The current EEA program focuses on four primary areas: 1) education and information outreach (residential); 2) media promotion; 3) commercial and industrial (C&I) education and information outreach, and; 4) program evaluation. The residential part distributes

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[38] See http://microchp.msstate.edu/
[39] See http://www.innovate.ms/index.php
[40] See http://www.asertti.org/
[41] See Docket No. 07-083-TF at the Arkansas Public Service Commission (http://www.state.ar.us/psc/) for annual filings, which occur April 1st of every year.

kilowatt meters from public libraries, along with CDs and fact sheets that are also distributed at grassroots events. Media promotion entails raising awareness through television and radio advertisements, as well as in local publications. C&I outreach consists of training for school districts, state agencies and large commercial and industrial sectors. The program evaluation is intended to provide feedback to EEA stakeholders on improving program efficiency and effectiveness (AEO 2013).

Program and Policy Collaboration and Coordination

When possible and practical, collaboration across state and utility programs can help streamline program design and improve customer awareness (see our discussion on low-income weatherization programs below). For example, natural gas and electric utilities that serve the same customer base can collaborate on whole-house or new construction programs. Overall, stakeholders can establish a working group that comes together to address common issues with program design and cost effectiveness.

UTILITY REGULATORY POLICIES

Utilities face significant market barriers to pursuing better energy efficiency for their customers, and alternative regulatory mechanisms are needed to better align utility business models with energy efficiency. Currently, only a handful of utilities in Mississippi are offering energy efficiency services for their customers because, prior to the adoption of Rule 29, there was no incentive do so. Apart from energy efficiency programs offered by MPCo, some cooperatives and municipals purchasing wholesale power from TVA administer TVA's EnergyRight Solutions[42] programs for the residential and commercial customer classes. The MPSC's Quick Start energy efficiency rules are a first step in expanding energy efficiency services to customers for as long as the MPSC and its regulated utilities are committed.

Integrated Resource Planning

An IRP is a long-term utility plan for meeting forecasted energy demand within a defined territory and generally IRP rules require consideration of demand-side management programs as well as supply-side resources. In practice, states have interpreted this requirement with varying methods (see Lamont & Gerhard 2013). IRPs are critical for utilities to understand future capacity shortages and constraints and to allocate capital accordingly in order to address long-term issues. IRPs can also be a powerful vehicle for promoting energy efficiency: given that energy efficiency is the least-cost option for meeting energy demand, there will always be some amount of energy efficiency resources available for deployment that can meet demand more cost-effectively than investing in new supply. Through an IRP process utilities can better understand how and where energy efficiency fits in with its long-term capacity needs, and the benefits that will be gained by enhancing the energy system.

Going forward, implementation of the IRP process in Mississippi could look to experience in other states for ways to optimize all energy resource options on equal footing in utility system modeling. Stakeholders should consider the many benefits of energy efficiency in

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[42] See http://www.energyright.com/

utility planning processes as a least-cost resource, a peak-savings measure for the system, and potentially a way to cost-effectively defer upgrades to T&D systems. The ultimate goal is to incorporate and model energy efficiency as a resource on par with the way supply-side resources are modeled in IRPs, toward the end of optimizing across multiple planning goals, including cost, risk, reliability, and environmental goals. Several resources are available for state and local governments interested in best practices on energy efficiency in IRP and analysis of different state-level IRP processes (Wilson & Biewald, 2013; SEE Action 2011; Lamont & Gerhard 2013; Neme & Sedano 2012).[43]

Align Utility Financial Motivations with Energy Efficiency

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 that 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 energy efficiency investments.

Utility spending on energy efficiency programs can impact the financial position of a utility in three ways: (1) through the direct costs of the programs; (2) through reduced revenues due to falling sales; and (3) through the return on investment on supply-side resources guaranteed by traditional utility regulation. Failure to recover the direct costs of efficiency programs means utilities lose the equivalent of those costs from their overall earnings. Falling revenues from lower sales hamper the ability of utilities to pay their fixed costs, such as paying off capital costs. Under traditional utility regulation, utilities are provided a return on their investment in supply-side resources, so spending on efficiency programs is money diverted from these capital investments that provide utilities with a return on their equity. To encourage utilities to invest in energy efficiency, all three of these issues should be addressed because neglecting to do so puts utilities in a relatively weaker financial position, dissuading them from pursuing energy efficiency further.

In other words, a strong foundation for utility investments in energy efficiency is to provide a "three-legged stool" approach:

1. Timely cost recovery of direct energy efficiency program costs;
2. Address the throughput dis-incentive by allowing utilities to recover their fixed costs;
3. Provide financial incentives for utilities that meet or exceed energy efficiency performance targets.

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[43] Visit ACEEE's State Policy Database for information on which states have IRP in place: http://aceee.org/sector/state-policy.

Combined, these legs form the strong regulatory framework that is needed to fully support and enable the utilities to capture the higher levels of cost-effective energy efficiency our analysis suggests are achievable.

Establishing Utility Energy Savings Targets

Rule 29 states that "Prior to the Comprehensive Portfolio filing deadlines, the Commission intends to establish specific numerical energy savings targets expressed as percentages of energy sales based on the experience of Quick Start and other relevant information." These rules pertain only to regulated utilities, so municipal utilities are not subjected to the rules and, hence, are not required to offer programs to their customers. The Quick Start phase will be important for Mississippi utilities to build experience in program design and administration. But as the state shifts into its Comprehensive Portfolio phase, the establishment of energy efficiency savings targets in addition to the adoption of the regulatory policies outlined above will provide regulatory certainty for utilities as well as mitigating the disincentives that currently exist. Eventually, target setting can also fit in well with the IRP process, because IRP processes can provide optimization analysis of least-cost resources and serve as a tool to determine appropriate and achievable targets to meet over the long term.

Currently, 24 states, including one state in the Southeast (Arkansas), have established annual savings targets for their utilities.[44] States take various approaches in setting targets, which may be enacted by state legislature, codified by public utility commissions, or established through utilities' IRP processes. When state utility commissions are responsible for setting targets, it is usually as part of the annual rate-making process, though targets can also be set as part of a multi-year mechanism to lock in future benefits and create certainty that makes it easier for utilities to shape their resource plans.

To meet these cost-effective, energy-saving 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 improved customer efficiency: e.g., rebate and financing programs to address up-front costs; education, marketing, and engineering support to address lack of awareness or information; and "upstream" incentives for retailers and distributors to stock high-efficiency measures, which can address the split incentive problem, in which landlords and tenants have differing incentives for efficiency investments. Without savings targets—and related regulatory policy—to drive utilities to offer energy efficiency programs, most utility customers would not realize these benefits.

Recent analysis has shown that most states with savings targets for electric utilities are generally meeting their targets, while only a few states with very aggressive goals fall short but are getting back on track to meet their targets (Sciortino et al. 2011). A few states with aggressive targets in the first few years have found it challenging to create the program and regulatory guidelines and ramp up program infrastructure in such a short time frame. Based on this recent experience, ACEEE finds that new electricity savings targets can be most effective when the targets begin at modest levels, such as 0.3% of annual sales, and ramp up

[44] Visit ACEEE's State Policy Database for more information on energy savings targets and practicing states: http://aceee.org/sector/state-policy.

after several years to savings levels of about 1.2–1.5%, which are levels that several leading utilities were readily achieving in 2011 (Sciortino et al. 2011).[45]

Despite the belief from some program administrators that higher levels of savings targets will be difficult and more costly to achieve as time progresses, particularly due to building energy codes and federal appliance standards, energy efficiency programs to date have really only scratched the surface in terms of opportunity and potential. Costs of new technologies are constantly falling. The Internet and social media have opened new doors to bolstering program participation rates and decreasing operating costs. Education and marketing about energy efficiency and related programs are at least as equally important as providing customer incentives and rebates.

In terms of program areas, leading program designers around the country are exploring a host of new strategies, such as advanced lighting programs, support for building energy code enforcement to earn savings credit, and increases in penetration of custom efficiency programs for large commercial and industrial customers, including behavioral approaches like Strategic Energy Management (see Nowak et al. 2011; York et al. 2013). Designing and implementing robust program portfolios beyond go well-beyond lighting programs will be challenging but surmountable, and leading program designers are already showing that the task is achievable and cost-effective.

Discussion of Tailored Utility Energy Efficiency Program Options

This section describes several energy efficiency program options, categorized by targeted customer class, for Mississippi utilities or other program administrators would offer their customers in the efficiency program potential scenario. For each program, we present an overview of the program approach and targeted market, and then explain our methodology under the "program analysis" subheading. We also make note of which programs we included for analysis as Quick Start programs and which we include only during the state's Comprehensive Portfolio phase. Key findings—including energy savings and costs and assumptions about average measure lifetime and net-to-gross ratios for program savings evaluation—are presented later in the results section.

METHODOLOGY

Our analysis estimates the potential for a suite of energy efficiency programs through 2025 by the Mississippi state government and utilities regulated by the MPSC. These are largely new programs that are not currently available to customers in the state, or at least not to most customers. Some represent expansions or updates to existing programs. For example, Mississippi Power Company already offers rebates for residential compact fluorescent lamps (CFLs) through its residential lighting program.

Some utilities also have efficiency program delivery experience in other service areas close to Mississippi; for example, CenterPoint Energy offers natural gas programs in Arkansas, Minnesota and Oklahoma, and Entergy offers programs in Arkansas, Louisiana, and Texas.

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[45] For more information on best-practice EERS design and implementation, visit ACEEE's Technical Assistance Toolkit: http://aceee.org/sector/state-policy/energy-efficiency-resource-standard.

We used data, when available, from these other jurisdictions that are in the same climate zones (2 and 3) as Mississippi to help inform energy savings opportunities and program costs for this analysis.

The energy savings assumptions for individual measures and programs are based on data from several sources: existing programs in the state (mainly MPC because it was the only utility from which we were able to acquire program level data), regional data from the EIA's Residential Energy Consumption Survey and Commercial Building Energy Consumption Surveys (EIA 2007; 2009b), or other energy efficiency programs offered elsewhere in the region in a similar climate zone (e.g., Arkansas, Louisiana, and Texas utilities). We also consulted data from these programs and several other best-practice programs from around the country for information on participation rates, program costs, and net-to-gross ratios to estimate the potential impact of these programs.

For each program type, we examined the potential electricity and natural gas savings from individual or whole-building energy efficiency measures. Many of the programs save both electricity and natural gas, in which case we analyzed dual-fuel savings opportunities while apportioning the program costs across both energy savings types. We did not specifically analyze the potential for fuel switching measures due to the complexity of the analysis, but we recognize that fuel switching can be an efficient option in some cases, such as when the measures save energy and money for customers.

The list of programs included in this analysis represents a comprehensive but not exhaustive set of programs, and is based on ACEEE's research on best-practice efficiency programs. For more information on program options from a national best-practice perspective, see *Frontiers of Energy Efficiency: Next Generation Programs Reach for High Energy Savings* (York et al. 2013).

Several other program types could be considered. As mentioned above, fuel switching programs that save consumers energy and money could be considered by utilities and their regulators. Community-based behavioral programs and shared energy managers are other examples of program types that could be considered. Overall, in designing program portfolios it is important to maintain flexibility so that adjustments to programs can be made as needed to improve participation rates and overall effectiveness.

Mississippi Can Set High Savings Goals and Achieve Them

Our analysis of energy efficiency program potential suggests that the tailored utility programs we analyzed for Mississippi could achieve incremental annual electricity savings of 1% by the year 2022. However, there are more opportunities for capturing Mississippi's energy efficiency potential than the programs we consider in this report, so this target could realistically be achieved sooner. How much sooner is dependent upon a number of factors, such as utility regulatory policies, program design, and the state economy. Still, the potential exists and the onus is on the MPSC and utilities to determine formulas for success. With this in mind, it would be reasonable for Mississippi to begin its Comprehensive

Portfolio phase by setting annual targets similar to those set in Arkansas during its first three-year period.[46]

Mississippi is fairly unfamiliar with energy efficiency—as was Arkansas when it adopted its energy efficiency rules—and it still has to build up its related infrastructure (workforce, financing, etc.) as well as garner experience with program administration. But unfamiliarity has an advantage in that Mississippi has myriad resources to draw from when designing its programs and, therefore, does not need to reinvent the wheel. Mississippi's IOUs could surpass savings expectations, given that they have experience with program deployment in other states. Entergy, Mississippi's largest investor-owned utility, operates in several states across the region, including Arkansas. Mississippi Power, a subsidiary of Southern Company, also has experience administering energy efficiency programs and can draw on the experience of other subsidiaries to move its programs forward. Mississippi's cooperatives, on the other hand may find it more difficult to achieve target levels commensurate with IOUs—at least the rate at which the targets increase—due to the logistical difficulty of providing energy efficiency services to rural areas. Still, TVA has years of experience with energy efficiency and distributes electricity to about half of Mississippi's cooperatives, who can elect to participate in TVA's EnergyRight efficiency programs. There are also experiences to learn from in other states in the region, like South Carolina, where cooperatives have historically been more engaged in energy efficiency.

Natural gas utilities are subject to unique market forces, such as climate and weather, which make it more difficult to achieve annual savings targets on par with electric utilities. Natural gas utilities also face competition for customers, and, subsequently, energy savings, from electric utilities, because of the increase in efficiency of electric heating equipment, such as electric heat pumps. Additionally, several of the programs we modeled in this report are focused on electric-only end-uses, such as lighting and cooling. Therefore, we suggest that savings targets for natural gas utilities begin at a lower level and ramp-up at a less-aggressive rate than those for electric utilities.

Beyond utility experience, Arkansas has recently completed its Quick Start phase and has begun its Comprehensive Portfolio phase, and will be a valuable resource to the MPSC as it fleshes out Rule 29. Many of the regulatory and program design questions that the MPSC will deliberate on have already surfaced in Arkansas, so a lot of potential difficulty can be avoided by working in partnership with the APSC.

RESIDENTIAL

This section describes eight program options for residential customers. Combined with improved statewide building energy codes, these programs could save 6.5% cumulative of residential electricity by 2025 and 5.3% of residential natural gas by 2025, relative to reference case sales for the residential sector (Table 7). Many of the programs, such as home retrofit and new construction, save both electricity and natural gas, in which case we analyzed dual-fuel savings opportunities while apportioning the program costs across both energy savings types.

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[46] The APSC set targets during the first three-year period of its Comprehensive phase at 0.25%, 0.50%, and 0.75% (APSC 2010).

Table 7. Potential Residential Policy and Program Electricity and Natural Gas Savings, Cumulative through 2025

	Electricity		Natural Gas	
Residential Programs	GWh	% of Reference Case	MMCF	% of Reference Case
Building Energy Codes	104	0.5%	142	0.7%
Building Energy Codes Support	38	0.2%	48	0.2%
Low-Income Weatherization*	52	0.3%	454	2.3%
Home Performance with ENERGY STAR*	234	1.2%	231	1.1%
Retail Appliances and Electronics	95	0.5%	-	-
Lighting*	184	0.9%	-	-
HVAC*	208	1.1%	-	-
Enhanced Billing & Information Feedback*	360	1.8%	186	0.9%
Residential Subtotal	**1,275**	**6.5%**	**1,060**	**5.3%**

Note: Programs marked with an asterisk are those we consider for Mississippi's Quick Start phase and will continue into the Comprehensive Portfolio phase. Percentages are relative to residential sector sales from the reference case forecast.

Residential Energy Code Support

Mississippi is projected to add almost 70,000 new single-family and multi-family housing units between 2014 and 2025 (Moody's 2013). This growth in the residential sector offers significant energy savings potential in the new construction market. Building energy codes that require measures as required by the latest IECC codes—currently the 2012 IECC—will promote strong minimum standards and ensure a high-efficiency baseline for Mississippi's future residential building stock.

Utilities are well positioned to support state-level building energy code policies, so program administrators should look closely at energy codes as a potential resource for their portfolios. For example, utility code programs could work with contractors and builders to provide training on building energy code compliance as a means of supporting code enforcement and compliance efforts. Code adoption support, implementation, compliance verification, and evaluation are all possible activities that utilities can consider replicating in their own markets. Code-related programs could be evaluated with a proper baseline and annual surveys to measure changes in compliance rates, and the U.S. Department of Energy's new Building Energy Codes Program (BECP) method could be used toward this goal (Misuriello et al. 2012). A handful of states have developed methodologies to attribute savings from compliance with building energy codes to the efforts of code support programs (see Wagner & Lin 2012; Misuriello et al. 2012).

We do not consider this program in our Quick Start portfolio because there are a number of design elements that will take time for utilities to flesh out. Utility code support is a fairly new idea, so there are a limited number of programs in other states to reference when designing this program in Mississippi. Savings attribution is also a facet that will need careful attention, something that utilities and the MPSC will have to collaborate on. Still, utility support for building code adoption and compliance is important for maximizing savings from codes and, over the next several years, should be considered as an integral part of Mississippi's portfolio.

PROGRAM ANALYSIS

The eligible participants for this program are newly constructed single-family and multi-family homes, which we estimate based on projections from Moody's Analytics. For this analysis, we again assume that a new residential code, the 2012 IECC, is adopted and becomes effective in 2015, and that the 2015 IECC is adopted in 2020. As in the State-led program, the baseline code is the 2006 IECC. The new code adoptions therefore generate 34% and 54% savings (or an additional 20% from adopting the 2015 IECC) relative to the 2006 baseline. We assume utility administrative costs of $100,000 to begin in 2017, based off of utility code support efforts in Illinois and Minnesota, which increases over time in order to reach higher compliance rates. For residential codes, we assume participation rates are equivalent to those achieved by state-led compliance efforts and that utilities receive 1/3 savings credit for their efforts.

Utility New Construction Programs for Residential Buildings

Many states also offer new construction energy design assistance programs, such as ENERGY STAR new homes programs, which feature training, education, and financial incentives for homebuilders if they meet comprehensive, advanced energy efficiency standards in new homes. This is an additional program option for Mississippi, although we did not model and analyze the potential savings from such a program. Based on home construction data supplied by Moody's as well as anecdotal evidence from stakeholders in Mississippi and neighboring states (Louisiana), the residential new construction market is not set to grow at rates which precipitate the need for this type of program. The adoption of statewide residential energy codes equivalent to the latest IECC codes would capture much of the potential savings in residential new construction cost-effectively.

Still, when the residential new homes market improves, utilities in Mississippi may consider establishing such a program. The program typically includes field testing of homes to ensure performance. Builders and contractors receive training on building science and energy-efficient construction techniques, emphasizing the whole-building approach, while prospective homebuyers are educated about the benefits of an energy-efficient home. Programs can take advantage of the national ENERGY STAR brand name (EPA 2012a). The program focuses on implementing comprehensive upgrades to a home's HVAC system and envelope, including energy-efficient windows and appliances.

Low Income Weatherization (Quick Start)

Low-income energy efficiency programs usually focus on lighting retrofits and weatherization of the home envelope along with other direct-install measures, which typically achieve savings of about 10% of home energy consumption. Ideally, these services are just a stepping-stone to a comprehensive home retrofit.

Eligible participants usually receive free home energy audits from their local community action agency, which then arranges for weatherization and other services to be completed by a qualified contractor. Weatherization measures typically include insulation (attic, wall, pipe, and duct), air sealing, water heating measures, CFLs, heating system repair and replacement, ENERGY STAR refrigerators and freezers, high-efficiency AC units, and "smart" power strips. Efficiency measures and services are directly installed and delivered with no or a very low co-payment from participating low-income customers.

Program administrators also acknowledge the potential for behavioral measures to help low-income households better manage their energy use, which improves the persistence of savings over time. Educating participants is therefore extremely important, as low-income customers are less likely to be aware of the energy and non-energy benefits of energy efficiency and are also less likely to have the income to direct toward improvements.

In many states, utility program offerings for low-income customers are coordinated with the state-administered weatherization assistance program. This allows for the utilization of existing resources and infrastructure, as well as cost sharing, which helps reduce administrative costs.

WEATHERIZATION ASSISTANCE IN MISSISSIPPI

The existing federally funded Weatherization Assistance Program (WAP) in Mississippi aims to help low-income households reduce their cooling or heating bills and to improve their health and safety through energy efficiency. Mississippi's Community Action Agencies (CAA) administer weatherization services in partnership with the Mississippi Department of Human Services (DHS), and CAA works with local contractors to deliver weatherization services to low-income households in all 82 counties in the state. Households with incomes up to 200% of the poverty level are eligible for this program, although the priority population includes people who are particularly vulnerable, such as the elderly, disabled, and families with children. DHS already provides energy efficiency education to residents of each home that is weatherized and partners with utilities to some degree: utilities send out mailouts to targeted customers about the existence of WAP as well as the Low-Income Home Energy Assistance Program (LIHEAP).

The federal stimulus program, the American Recovery and Reinvestment Act (ARRA), provided $49 million over three years for the MS WAP. Interviews with Mississippi stakeholders revealed that the services provided by community action agencies and contractors during ARRA were very beneficial to participants. The MS WAP weatherized over 6,000 homes with energy efficient equipment as well as health and safety measures, which helped many participants decrease their utility bills by 30-40%; money that could be used for other household needs such as food and medicine.

Mississippi's WAP was among the top three states in the nation that quickly met all ARRA requirements in order to receive all of the ARRA funds allocated to weatherization. The quick "ramp up" process allowed the state to hire and train additional staff and contractors early, helping the program exceed its initial goal of about 5,500 homes. Throughout ARRA, the MS WAP was able to weatherize around 6,800 homes.

The MS WAP program utilizes a whole-house approach to weatherization services at no cost to participants. The whole-house approach means that, as a part of the case management requirement, a households needs are addressed in their entirety through coordination with other federal and state programs provided by the CAAs, such as community service block grants (CSBG) and the low-income home energy assistance program (LIHEAP). This array of services is intended to help stabilize households and promote self-sufficiency.

IMPROVING FUTURE WEATHERIZATION SERVICES

Now that ARRA has passed, the MS WAP must revert to providing quality weatherization services with a limited budget. Fiscal year 2012 funding for the MS WAP was $500,000, down from $1.2 million in 2009. While federal funding for the MS WAP has been steadily declining over the years (not taking into account ARRA), a jointly-administered weatherization program offers a great opportunity to augment services, especially with supplemental funding and other implementation assistance from utilities.

The need for statewide coordination and collaboration in delivering weatherization services to Mississippi's low-income households is exacerbated by the fact that it is the poorest state in the nation, yet its households spend a disproportionate amount of their income on energy (see Table 1). Additionally, the housing stock in Mississippi is relatively old, which requires the state to allocate resources to address structural deficiencies before weatherization can even begin. DHS has programs in place to meet these needs, but resources diverted to fix structural issues, such as time and labor, are resources that cannot be allocated to weatherization.

Additional funding from and coordination with utilities will be a boon to service delivery and help Mississippi emulate Arkansas' highly successful program. In Arkansas, a "Weatherization Network (WAP)," consisting of its Department of Health and Human Services, the state Community Action Agencies Association and local community action agencies, acts as the primary point of contact with customers and is responsible for collecting and administering all co-payments (customer and utility), paying contractors and vendors, and delivering audits and weatherization measures. WAP is also responsible for evaluation, measurement and verification of services. Arkansas' utilities provide additional funding to cover part of the cost of the audit and measure installations (which allows for a greater "whole house" approach) and the balance is the responsibility (co-payment) of the customer. Customers eligible for the WAP have their co-pay covered by funds from the federal program.

PROGRAM ANALYSIS

We assume that the statewide weatherization program is coordinated with utility weatherization offerings. The number of eligible households is determined by multiplying the total number of households in Mississippi by the percent of households living at or below 200% of the federal income poverty guidelines, as reported by the U.S. Census, which was most recently report as almost 36% (Census 2012). Electricity and natural gas savings per participant, costs per participant, as well as participation rates, are based off low-income programs for EAI, SWEPCo and CenterPoint Energy in Arkansas. We assume participation starts at 0.05% in 2014 and ramps up to 1.5% by 2025, resulting in almost 7% of eligible customers receiving weatherization services through the program by 2025.

Home Performance with ENERGY STAR (Quick Start)

Most residences in Mississippi are single-family homes (71%) and another 15% are mobile homes (Moody's 2013). A comprehensive home retrofit program provides a broad framework to deliver high-quality retrofit services to this market: owners or renters of single-family houses or manufactured houses (see text box). Major retrofits of multi-family homes, which comprise the other 14% of homes in the state, will typically fall under the separate multi-family program options, but due to the low

Real Estate Markets and Energy Efficiency: Educating and Informing Home Owners/Buyers, Realtors, Appraisers, and Insurance Providers

When shopping for a new or used car, buyers usually consider its fuel economy, or the miles-per-gallon rating, as a primary influence on purchasing decisions. Why should buying or renting a home be any different, especially when the cost of energy can add up to thousands of dollars every year? Information on a home's "fuel economy," or energy efficiency, is rarely disclosed; not necessarily because of a lack of interest, but because of a lack of awareness on the part of the homebuyer and a lack of obligation on the part of the property owner/manager.

There are two ways to address this issue. The first is to educate renters and home buyers on a home's energy efficiency through energy disclosure policies, such as those in existence in Chicago and Austin, often referred to as "time of sale disclosure." In Chicago, realtors and appraisers can use MyHomeEQ to create and upload a personalized energy report straight to the Multiple Listing Service when a home is listed. There is also the Appraisal Institute's (AI) Green Addendum, which is a voluntary form that appraisers can complete that evaluates a home's "green properties."

The second is to educate realtors, appraisers, and insurance providers on the importance of incorporating energy efficiency into the marketing and value of a home. This can be accomplished by creating mandatory curricula as part of continuing education credits required in these fields. The National Association of Realtors' (NAR) Green Designation, for example, is a voluntary program that provides advanced training in green building and sustainable practices. Currently there are no mandatory energy-related continuing education courses for these professions in Mississippi. Yet realtors and appraisers have unique relationships with homebuyers that should be leveraged in order to educate them on the value of energy efficiency.

Stakeholders like the MPSC, the AI and the NAR should engage in discussions to chart possible paths forward. For more information on energy disclosure, visit ACEEE's blog and search for "Chicago House Hunters Poised to Become More Savvy Homebuyers." See also Cluett and Amann 2013, *Residential Energy Use Disclosure: A Review of Existing Policies*.

saturation of multi-family buildings and the difficulty of designing cost-effective multi-family building retrofit programs, we did not consider these in our analysis.

Retrofit programs take a whole-house approach to home energy savings and comfort improvements, rather than just individual components. Measures typically include a blower door test, some direct installation of lighting measures (CFLs, fixtures, and ceiling fans), home-envelope measures (e.g., insulation, air sealing, and window replacement), and HVAC system upgrades (cooling and heating equipment tune-ups and replacement, duct measures). Incentives are typically provided to customers through a post-purchase application process with incentives paid directly to participating customers.

Home Performance with ENERGY STAR (HPwES) is one popular program design approach to deliver whole-house retrofits. Leveraging HPwES provides program administrators with a nationally-recognized brand that has been delivering services for decades. HPwES focuses on assessing how improvements to the entire home energy system can work together to deliver energy savings and ancillary benefits such as health and comfort, as opposed to one-off equipment replacements or limited upgrades typical of many utility or third-party administered home retrofit programs. Still, while the focus of HPwES is generally on the home energy system, delivered services are sometimes limited to multiple, individual equipment replacements due to customer resource constraints.

PROGRAM ANALYSIS

In this analysis we include all single-family and manufactured home residential customers in Mississippi, whose number we estimate based on projections to 2025 from Moody's Analytics. Because no HPwES program currently exists in Mississippi (MPCo offers an energy audit program as well as an online energy checkup tool), we looked to Arkansas—specifically EAI and SWEPCO—for performance data from their home retrofit programs (Arkansas and Mississippi are, for the most part, in the same climate zones). EAI achieved participation of around 0.2% during the first year of its Quick Start phase, so we assume that Mississippi can achieve the same participation statewide. Other utilities with best-practice programs, such as Austin Energy and Connecticut Light and Power, achieved 0.7% and 1.2% participation recently. We assume it will take Mississippi utilities several years to ramp up to these levels, and estimate that programs can continue ramping up through improved marketing to reach 1.4% participation by 2020 and 3.4% by 2025. Energy savings per participant are assumed to average about 12%, which is the typical level of savings achieved by Austin Energy in recent years.[47] Per-participant savings will likely be higher in the early years, as participants with high usage are targeted, and then gradually decline. Estimates for program costs are also based on performance data from EAI and SWEPCO.

Retail Appliances and Electronics

The energy efficiency of most residential appliances has increased greatly over the past 20 or more years due to a combination of standards, customer energy efficiency programs, labeling (ENERGY STAR), and market changes. Market shares for energy-efficient appliances, such as ENERGY STAR, are high for many common appliances, such as

[47] The ENERGY STAR website promotes that HPwES can achieve utility bill savings of 20% on average: http://www.energystar.gov/index.cfm?c=home_improvement.hpwes_for_homeowners.

dishwashers. The remaining potential for improved energy efficiency of many of these appliances is more limited than the large gains that have been made in the past. Some appliance technologies still have significant potential for improved energy efficiency. New program approaches, such as market lift, may be needed to continue to push the markets for these products by directing incentives to retailers. Market research also suggests that improvements could be made with customer rebate programs through greater segmentation, data analytics, and targeted marketing to broaden participation in market segments where high penetration of energy-efficient units has not been achieved.

Unlike appliances, the consumer electronics and plug loads share of electricity usage is projected to grow more than other end uses. The EIA projects that residential plug loads and other electronics-related end uses will increase 1% per year by 2030, while appliance electricity usage will increase by 0.5% per year (EIA 2013a). This mid-stream retail appliances and electronics program aims to achieve energy efficiency gains in the plug loads segment as well as in appliances. Onsite training and education of retail sales forces can therefore have a significant impact on customer purchases of energy-efficient products. Well-designed marketing efforts and accessible educational resources, such as social media and program websites, can have a significant impact on consumers' purchasing decisions and drive demand for energy-efficient products.

This type of program builds awareness, customer acceptance, and market share of high-efficiency customer electronics and appliances. Program delivery can be through either point-of-purchase rebates or midstream and upstream incentives to retailers and manufacturers to increase the stocking, promotion, and sales of qualifying energy-efficient electronics and appliances, with the incentives paid on a per-unit-sold basis. This program is designed to move quickly with the rapidly evolving electronics market and should incorporate new product measures as they demonstrate cost-effective efficiency potential. The program requires retailers to develop marketing and merchandising plans, implement sales training for employees, display point of purchase signage, and submit sales data on a monthly basis. Utilities will typically partner with both manufacturers and retailers to offer education and training regarding the benefits of energy-efficient products to local retail sales staff and customers.

Typical measures include the highest tiers of ENERGY STAR and Consortium for Energy Efficiency (CEE)-qualified televisions, desktop PCs, set-top boxes, game consoles, computer monitors, clothes washers, dishwashers, refrigerators, freezers, room air-conditioners, and high-efficiency pool pumps and pump timers.

ACEEE did not consider this program type for Mississippi's Quick Start phase, but if utilities do include this in their portfolios, they have some experience to draw from in the MS State Energy Efficient Appliance Rebate Program (SEEARP) that was offered by the MDA, leveraging stimulus funds from ARRA (see text box). There are several program design elements that will require thoughtful consideration prior to implementation, however. Stakeholder engagement—such as with big box retailers and HVAC equipment distributors—is critical during the early stages of program design in order to build the necessary relationships. Designing effective materials to educate consumers and sales representatives, as well as in-store marketing strategies (product placement) is time intensive. Participation in this type of a program may also be best augmented by building awareness of energy efficiency through other utility and state-led program offerings.

Mississippi's Experience with Appliance Rebate Programs

The Mississippi Development Authority's Energy Division (now Energy and Natural Resources Division) was allocated almost $3 million dollars, along with $100k from the State Energy Program (SEP) to develop and administer the 2010 Mississippi State Energy Efficient Appliance Rebate Program (SEEARP). The program offered rebates to customers who purchased energy efficient appliances, such as refrigerators, furnaces, and water heaters. Almost 30,000 rebates were issued to residents who purchased targeted appliances and a database of all appliances sold is maintained by the MDA. For more information see *The Impact of the Mississippi State Energy Efficient Appliance Rebate Program* (Phillips et al. 2011).

PROGRAM ANALYSIS

This program option targets consumer electronics and appliances. There are no existing programs like this currently being offered in the state. For the statewide analysis, we estimate the number of products per household based on data from EIA's Residential Energy Consumption Survey (RECS), and assume that new products are purchased once they reach the end of their useful life. That point of sale is the opportunity to improve efficiency, and this program option targets midstream retailers and upstream manufacturers through financial incentives. Average savings per product are estimated from a variety of sources, including ENERGY STAR ACEEE analysis of appliance efficiency standards, and other programs including those offered by Nevada Power and Austin Energy. We take into account pending federal efficiency standards by adjusting per-product savings downward once new standards take effect. We estimate best-practice participation rates and program costs based on several programs in the Southwest, including those of PacifiCorp, Nevada Power, and Xcel Colorado.

Residential Lighting (Quick Start)

Consumers now have access to a wider choice of energy-efficient lighting options, with more specialty products and light- emitting diodes (LEDs). A combination of forces is spurring innovation for the next generation of lighting efficiency, one of the largest and most cost-effective contributors of energy savings to energy efficiency program portfolios. More stringent federal lighting efficiency standards are driving residential lighting programs to seize the opportunities presented by the proliferation of efficient lighting technologies. Next-generation residential lighting programs are increasing customer education, honing financial incentive levels and delivery methods, and engaging in new marketing approaches with retailers, all in an effort to help consumers purchase the most efficient lamps to meet their lighting needs, allowing them to increase energy savings and minimize costs. As the cost of newer efficient lighting technologies, especially LEDs, continues to drop and quality improves, next-generation lighting programs will gain a growing share of program savings beyond standard CFLs.

This program provides outreach, education, and financial incentives to increase the availability, consumer acceptance, and use of high-quality, energy-efficient lighting technologies and controls. Many programs recruit and train retail partners and provide them upstream incentives to increase sales and lower the costs of high-efficiency products, including LEDs and ENERGY STAR-qualified specialty CFLs. The cost savings are ultimately passed on to the customer as an instant rebate at the point of purchase. Marketing materials are also placed in participating stores to educate customers on high-efficiency lighting options and the federal efficiency standards. The upstream incentive can account for 30-70% of the incremental cost of the high-efficiency lighting options, depending on the bulb.

PROGRAM ANALYSIS

We estimate the baseline number of residential lighting fixtures using data from EIA. We assume that the average home has 32 incandescent bulbs and 16 CFLs. Currently, Mississippi Power Company offers a residential lighting program targeting CFLs, which reached over 30,000 bulbs in 2011, and we assume the number of bulb replacements remains steady in 2012 and 2013. We assume that statewide programs can quickly scale up to reach the same level of relative CFL penetration achieved by MPC. Since customer participation in lighting programs is measured by bulb replacements, we assume that, since 20% of statewide electricity sales are attributable to MPC assets, MPC's performance represents 20% of what could be achieved statewide. LED programs begin in 2016 and achieve participation levels similar to those achieved by Nevada Power. Savings-per-bulb for CFLs are based on data from MPC's CFL program and Nevada Power for LEDs, and are adjusted in future years to take into account federal efficiency standards. Program costs are estimated based on Xcel Colorado and Nevada Power programs.

Residential Cooling (Quick Start)

Rebate programs for the purchase of energy-efficient mechanical equipment have long been and will continue to be a staple of energy efficiency program portfolios. There are a variety of products (air-source versus ductless heat pumps) and efficiency levels within product categories that allow customers a considerable degree of choice when investing in new, high-efficiency equipment. These programs must also provide services beyond equipment replacement: improving the installation of equipment and/or systems to ensure it delivers conditioned air efficiently is a source of significant savings, if only because this equipment is often installed improperly. Achieved savings are typically around 20% of heating and cooling loads when incorporating quality installation/quality assurance measures.

An estimated 80% of residential customers in Mississippi have central air-conditioning (CAC), and the other 26% have electric heat pumps (EIA 2009). The residential cooling program we model targets the customer segments that use CAC or heat pumps for cooling and replace that equipment with efficient models, as well as a tune-up/quality installation component.[48] Incentives are provided to homeowners, residential homebuilders, and/or HVAC contractors who purchase or install high-efficiency equipment and use best-practice installation and sizing methods. In addition, the program could include an air-conditioner tune-up component.

[48] Other programs in the region, with similar climates, are either targeting or will begin to target ductless heat pumps / mini-splits as alternatives to room ACs or central systems. Ductless systems are generally more efficient than room AC units and offer homeowners the ability to limit cooling to one or several rooms.

While incentives for HVAC equipment upgrades are generally targeted to end users, some programs target retailers, contractors, and manufacturers in order to encourage the sale or production of larger volumes of efficient equipment. This can also facilitate stocking practices so that units available for emergency repairs are more likely to be energy efficient units. These programs increasingly focus on training equipment dealers and installers to ensure that cooling equipment is sized and installed properly. In addition, the program can promote an air-conditioner tune-up and duct testing and sealing service, with discounts provided for such services. The quality installation process is based on standards developed by the Air Conditioning Contractors of America, which dictate the steps a contractor must take to ensure that the total energy savings potential of newly installed AC equipment is realized.

We include residential cooling for consideration as a potential Quick Start for a number of reasons. First, there is a high cooling load in Mississippi: 19% of the state's residential electricity consumption is dedicated to cooling (compared to an average of 21% for the entire Southern region), so there is a considerable amount of energy savings to be captured by this program (EIA 2009). Second, if designed properly, a lot of information about the saturation of cooling equipment in Mississippi's homes could be gathered, enabling future program design to better identify the types of equipment best suited for replacing existing equipment in Mississippi homes. Third, from a program design perspective, developing a residential cooling program should be relatively straightforward given how ubiquitous these programs are across the country. Guaranteeing quality installations of cooling equipment is a barrier, with contractors often the root of this problem, though there are resources available to guide Mississippi in the process of contractor training. Additionally, there are likely a number of HVAC equipment contractors already in the state, which will facilitate the process of pre-qualifying contractors to provide these services.

PROGRAM ANALYSIS

We first estimate the reference case projections of residential households in Mississippi to 2025 based on Moody's Analytics, and then estimate the number of home CACs and heat pumps, based on data from EIA's Residential Energy Consumption Survey. For the program analysis, we estimated program participation, per-unit savings and costs for high-efficiency CACs, AC tune-ups and quality installation, and heat pumps, using data from several programs in Arkansas, Louisiana, and Texas. We assume participation begins at 3% for equipment upgrades (CAC and heat pumps), ramping up to 25% participation by 2025. Tune-ups and quality installation measures begin at 0.3% participation (based on data from EAI), ramping up to 3% by 2025.

Behavior-Based Programs: Enhanced Billing and Information Feedback (Quick-Start)

Behavior-based energy efficiency programs employ both informational and social components to better engage consumers and increase energy savings. These programs are cost-effective and are a helpful complement to financial incentive and technical assistance programs, because they enable utilities to better engage their customers and promote other energy efficiency services.

There are several drivers for the growth of interest in behavior-based efficiency programs. The continued deployment of smart meters has the potential to provide the average household with more frequent information about its energy use, addressing the current lag—in the form of the monthly utility bill—between energy use and feedback about that use. Utilities are also seeking a broader set of tools to better engage their customers and improve customer service.

In particular, there is growing experience with: (1) enhanced billing services; and (2) real-time feedback on energy consumption. Enhanced billing services help customers manage their energy use by providing comparative reports through the mail and/or Internet. Home energy reports, which vary depending on the household's energy consumption patterns and other characteristics, include tailored recommendations that each household can take to reduce its energy use. The continued progress of smart meter deployment has the potential to provide households with more timely information about their energy use. Smart meters simply gather energy use data, which must be processed and presented through additional software and hardware. Real-time feedback programs promote tools such as in-home information feedback devices, which are linked to smart meters and provide meaningful information to customers.

An enhanced billing program could serve a number of purposes during Mississippi's Quick Start phase and beyond. It is a relatively simple program to administer that requires little oversight, so the savings generated are inexpensive to acquire. The monthly reports will act as an educational tool for customers to learn more about energy efficiency, but they can also act as vehicle through which Mississippi utilities promote other residential energy efficiency programs or financing opportunities. Program administrators have also used behavioral programs to foster friendly competition: for example, having neighborhoods compete to achieve the highest savings over a three-month period. In fact, the monthly reports usually have a competitive aspect built in, by comparing a household's energy use data with others in the surrounding area.

PROGRAM ANALYSIS

Based on a recent meta-review of enhanced-billing programs in the United States, we estimate customers can save on average 2% on electricity consumption and 1% of natural gas consumption (York et al. 2013). For this program, we assume that home energy reports are provided to households free of charge, with all costs paid by the utility efficiency program. Customers participating in the information feedback/in-home display portion of the program receive a $100 rebate toward the purchase and installation of this equipment.

COMMERCIAL

This section covers seven different program options for commercial customers. Our analysis finds that these programs, combined with improved statewide building energy codes and lead-by-example policies for government facilities, can achieve about 23% electricity savings and about 9% natural gas savings by 2025 with respect to the reference case forecast for the commercial sector (Table 8).

Table 8. Potential Commercial Policy and Program Electricity and Natural Gas Savings, Cumulative through 2025

	Electricity		Natural Gas	
Commercial Programs	GWh	% of Reference Case	MMCF	% of Reference Case
Building Energy Codes	216	1.5%	377	1.8%
Building Energy Codes Support	69	0.5%	121	0.6%
Lead by Example	610	4.2%	207	1.0%
Building Benchmarking	716	4.9%	243	1.1%
Small Commercial / Direct Install*	278	1.9%	-	-
Large Commercial Custom	351	2.4%	159	0.7%
Large Commercial Prescriptive*	1,077	7.4%	779	3.6%
Commercial Subtotal	**3,316**	**22.8%**	**1,885**	**8.8%**

Note: Programs marked with an asterisk are those we consider for Mississippi's Quick Start phase and will continue into the Comprehensive Portfolio phase.

Commercial Building Energy Code Support

Utilities are well positioned to support state-level building energy code policies, so program administrators should look closely at energy codes as a potential resource for their portfolios. For example, utility code programs could work with contractors and builders to provide training on building energy code compliance as a means of supporting code enforcement and compliance efforts. Code adoption support, implementation, compliance verification, and evaluation are all possible activities that utilities can consider replicating in their own markets. Code-related programs could be evaluated with a proper baseline and annual surveys to measure changes in compliance rates, and the U.S. Department of Energy's new Building Energy Codes Program (BECP) method could be used toward this goal (Misuriello et al. 2012). A handful of states have developed methodologies to attribute savings from compliance with building energy codes to the efforts of code support programs (see Wagner & Lin 2012; Misuriello et al. 2012).

We do not consider this program in our Quick Start portfolio because there are a number of design elements that will take time for utilities to flesh out. Utility code support is a fairly new concept, so there are a limited number of programs in other states to reference when designing this program in Mississippi. Savings attribution is also a facet that will need careful attention, something that utilities and the MPSC will have to collaborate on. Still, utility support for building code adoption and compliance is important for maximizing savings from codes and, over the next several years, should be considered as an integral part of Mississippi's portfolio.

PROGRAM ANALYSIS

To calculate savings for this program, we first estimate eligible participants by developing a new construction forecast using national projections for new commercial building floor space from EIA's *Annual Energy Outlook 2013* and estimating state-specific shares using commercial-sector employment projections from Moody's Analytics. Future participation rates are estimated from national best practices, including National Grid and Northeast Utilities, which are achieving over 50% participation in Massachusetts, Rhode Island, and Connecticut. We assume that utilities in Mississippi can ramp up to this participation level over 8 years. As is the case for the State-led program, the baseline energy code for this program is ASHRAE 90.1-2004. ASHRAE 90.1-2010 became effective July 1, 2013 and we assume that ASHRAE 90.1-2013 becomes effective in 2020, which generate 25% and 45% savings relative to the 2004 baseline. We assume annual utility program expenditures of $1 million, which reflects the added difficulty of compliance in the commercial buildings sector. Unlike the residential program, we do not adjust annual expenditures to account for increasing compliance rates. Savings are based on the percent savings of the ASHRAE standards, which we express in energy consumption (kWh or cf) per square foot. Utilities are awarded 1/3 savings credit for their efforts.

Small Business "Direct Install" (Quick Start)

Small business programs are often designed as "direct install" programs, which means that contractors qualified and selected by the program do the energy audit and equipment installation, while the customers simply enroll in the program and approve specific measures. This keeps it simple and easy for small business owners, since most small businesses do not have building managers or operators to address energy use in their buildings, and owners are sometimes not available on a day-to-day basis to deal with energy use. Many small business efficiency programs rely on efficient lighting measures for most if not all of their energy savings. Programs define eligible businesses by average electric demand use, usually with a threshold of 100 or 200 kW per month.

Typical measures installed in small business programs today include linear fluorescents, screw-in LED lamps and ballasts, LED display case lighting and open/closed signs, window film, occupancy sensors, and vending misers.[49] Historically, participation rates for this type of program have been modest, as many programs are budget constrained and have sought to gradually penetrate the small building stock at the rate of a few thousand customers per year.

As minimum efficiency standards and building codes improve the efficiency of baseline lighting systems, additional measures beyond lighting should be added to these programs. To remain cost-effective, strategies for these programs are to: (1) enhance marketing and outreach, with a customer-centered, local community–based strategy that uses customer relationship manager software for more targeted market segmentation; (2) integrate demand response programs with small business efficiency programs; and (3) improve financing terms for customers.

[49] Vending misers are energy-saving controls systems that shut off the refrigeration on soft drink machines when beverages do not need to be kept as cold, usually nights and weekends. They are not timers, but rather contain a combination of infrared sensors and temperature sensors that detect if anyone is within a set distance of the machine.

Established programs that have continued to increase program participation, and to raise "take rates," [50] are those that increased their outreach, used multiple marketing communications channels, and, most importantly, geared their marketing to the unique perspectives of each business owner. Regarding the latter, successful small business programs have targeted specific market segments, such as restaurants or convenience stores. These programs take a sales approach and customize how the message is delivered to the small business owner's industry sector, community, culture, and even the owner's neighborhood. Partnering an energy advisor with a trade ally while performing energy assessments can help build trust and participation.

PROGRAM ANALYSIS

Our program analysis assumes that small commercial customers under 250,000 kWh per year are eligible for this program option, and we estimate that 85% of commercial electricity customers fall within this threshold (this does not include the 20% of commercial buildings that are government-owned, as they will participate in the Lead by Example program discussed earlier) (EIA 2007). We assume that this program targets direct-install lighting savings, and therefore we do not assume that natural gas savings accrue from this program. To project total eligible customers through 2025, we start with the estimated growth rate in new commercial floorspace as described in the Building Energy Code Support program above. Our assumptions for participation come from a variety of sources. We estimate that Mississippi utilities can reasonably ramp up to 1% participation per year by 2020 and 2% by 2025, based on best-practice programs offered by Arkansas, Massachusetts and Connecticut utilities. We estimate program administrative costs based on Entergy Arkansas' cost results, which are on par with more mature small business programs from Austin Energy, Massachusetts, and Connecticut utilities and similar to those reported by Entergy New Orleans. Per-participant savings are based on verified program results from the same utilities, including Entergy Arkansas.

Prescriptive Equipment Rebates (Quick Start)

Prescriptive equipment programs offer financial incentives for the installation of a wide range of energy efficiency measures that provide energy savings in facilities. These types of programs often target all non-government owned commercial buildings, with no limitations on the size (load) of the participant. Generally, the program requires no pre-application and the incentives are paid per unit of eligible equipment or service. The program also administers upstream incentives to equipment distributors for selected products. Covered products include lighting, HVAC equipment, commercial refrigeration equipment, food service equipment, building insulation and windows. Trade allies are important stakeholders for commercial incentive programs and most marketing materials and efforts are aimed at them. Principal trade allies are building contractors, engineers, designers,

[50] "Take rate" refers here to the percentage of those small businesses receiving an energy audit that become program participants with energy efficiency measures installed.

distributors and manufacturers. Trade ally meetings and trade shows are a potential outlet for utility-developed marketing materials.[51]

Lighting is a major Quick Start savings opportunity for the commercial sector. Lighting upgrades include a large number of measures though in a relatively nascent market such as Mississippi, simple lighting measures can yield significant savings with high Net-to-Gross (NTG) ratios. The bread-and-butter of commercial lighting replacement programs has been providing rebates to promote the substitution of fluorescent T8 or "super" T8s for T12 linear fluorescent lamps. This may change to a certain extent with the full implementation of new federal minimum efficiency standards and adoption of modern building energy codes, both of which affect the baselines commonly used by energy efficiency programs.[52] However, with the evolution in lighting technologies other lighting measures, such as replacing incandescent lamps with compact fluorescent lighting (CFL) and light-emitting diodes (LEDs), and installing motion and occupancy sensors, offer significant efficiency potential. Illuminated exit signs that operate 24 hours a day often use older, incandescent and fluorescent lamps and replacing these with highly efficient LED exit signs offers another good savings opportunity.

Not all prescriptive programs require equipment replacement. Service, tune-up and repair of major systems can potentially save a lot of energy at a low cost. For instance, Puget Sound Energy pays a rebate of up to $1,310 per unit for services that increase the efficiency of packaged HVAC rooftop units. Standard rooftop unit maintenance often focuses on select system components and does not optimize overall energy consumption. The program incentivizes specific service measures through qualified contractors. The 'efficiency service' includes recalibration of set points and schedules, testing sensors, adjusting airflow and recalibration or installation of economizers.

Additionally, prescriptive programs are not always restricted to existing building retrofits. Entergy Arkansas' commercial prescriptive program provides rebates for improved building design for new construction.[53]

To encourage adoption of higher efficiency equipment, some programs tie the rebate amount with efficiency levels. For example, CenterPoint Energy in Minnesota offers a prescriptive rebate of $150/furnace for forced-air furnaces with 92% to 93.9% annual fuel utilization efficiency (AFUE) and $300/furnace for those with 94% to 95.9% AFUE.[54] Another way to maximize energy savings is by encouraging multiple measures—some programs provide a bonus incentive to customers that install more than one prescriptive measure.

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[51] See https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/2009ProgramEvalLightingEfficiency.pdf

[52] However, not all states are addressing these changes uniformly. Impact evaluation and regulatory decisions could result in program administrators being credited for less energy savings resulting from programs unless they go beyond the new standards to improved energy-saving fixtures, controls, and lighting design approaches.

[53] See http://www.entergy-arkansas.com/your_business/LG_CI_ES_1.aspx#table

[54] See http://www.centerpointenergy.com/staticfiles/CNP/Common/SiteAssets/doc/Keynote_2_Jen_Stokes.pdf

Commercial prescriptive equipment rebates are an integral part of energy efficiency portfolios of most utilities across the country and we recommend them for inclusion as a Quick Start strategy for Mississippi. Other than, the examples discussed above many other resources are available publically to help kick-start these programs. Wirtshafter Associates published a best practices report on commercial lighting programs based on interviews with program managers and evaluation experts across the United States. A good summary of best practices in HVAC rebate programs are available with the Energy Efficiency Best Practices Project.[55]

In the Southeastern region, the Tennessee Valley Authority (TVA) offers the EnergyRight Solutions standard program through Mississippi's electric cooperatives,[56] which provides rebates to commercial customers for a wide variety of prescriptive measures.

PROGRAM ANALYSIS

For the equipment rebate program analysis, we include all commercial electricity and natural gas customers except customers in government facilities (assuming that they will participate in lead by example programs as discussed earlier). Customer growth rate is projected using employment forecast from Moody's Analytics. We assume the participation rate ramps up gradually but steadily in the first ten years starting from 0.25% in the first two years of the program and peaking at 2.0% in 2025. This gives an average penetration of about 1.1% every year until 2025, which is comparable to that of Centerpoint Arkansas and well within the range of leading programs that achieve about 2%penetration annually. Federal standards for light bulbs will be phased in from 2012 to 2014 thus with more efficient light bulbs being installed the savings opportunity from lighting rebate programs diminishes to a certain extent. Factoring this, and taking the average of savings from Texas and Utah programs, we have estimated savings of 59,000 kWh per participant per year. Our cost estimates are based on equipment replacement programs in Arkansas, Colorado and Utah and we assume these costs increase gradually after the initial low-cost savings are realized.

Custom Projects

Unlike a prescriptive approach, a custom-based program targets large energy savings opportunities that are unique to a project. In many cases, custom programs have eligibility requirements, which may be on the basis of annual energy consumption (or average demand) or the size of a facility. To begin with, most programs fund and conduct an energy audit and assessment of the commercial establishment to identify savings opportunities. The program provides rebates on a wide variety of equipment, retrofits, and process improvements that do not fall within the scope of prescriptive programs, and therefore operates as a complement to the more streamlined prescriptive programs. Once the program administrator approves the grant application, the customer may select contractors (usually prequalified or recommended by the program administrator) to implement the measures.

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[55] See http://www.eebestpractices.com/ProgramArea.asp?BPProgID=NR2

[56] See http://www.energyright.com/business/how_to.html, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=TN69F&re=1&ee=1, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=GA70F&re=1&ee=1

Incentives offered by best-practice programs range from $0.05/kWh[57] to $0.30/kWh[58] depending on electricity rates, among other factors. Total incentive levels may be as high as to cover 70% of the project cost.[59]

Custom programs incentivize comprehensive energy saving measures in order to promote deep and ongoing energy savings by large, more sophisticated customers. Targeted systems include lighting, HVAC, plug loads, refrigeration, building envelope and often a combination of two or more of these. For instance, an integrated chiller replacement program can yield savings through efficient pumps, fans and motors, variable volume air handling systems, and automated control systems that improve capacity utilization. The same program can achieve even higher savings if measures like more efficient lighting, windows and envelope improvements are pursued simultaneously, thus creating opportunities for chiller downsizing by reducing the cooling load.

To reach the higher bar required in the new environment, next-generation commercial lighting programs take a more holistic, systems-oriented approach that incorporate advances in technology, rather than the traditional approach of replacing lighting products and equipment with similar, yet more efficient ones. As a result, lighting programs naturally evolve beyond the prescriptive approach into custom approaches as well. Lighting redesigns are common when tenants change in commercial buildings. The creation of a complete lighting system by design, with efficient equipment, sensors, and integrated controls, has the potential to reduce lighting energy use by 50% or more.

Model custom incentive programs include the Process Efficiency program implemented by Xcel Energy in Colorado, the FinAnswer program implemented by Rocky Mountain Power in Utah, and the Energy Leadership Challenge program implemented by Efficiency Vermont. The Vermont program is ramping up its large customer technical support and custom incentive program to achieve 7.5% savings over 2 years from its largest customers. Large commercial customers in northeast Mississippi can participate in the TVA EnergyRight program through consumer-owned electric utilities in the region of the Tennessee Valley.[60] The TVA program offers incentives ranging between $0.05 to $0.10/kWh of estimates savings and covers up to 70% of the project cost.[61]

PROGRAM ANALYSIS

In our analysis, we have considered 12% of the total commercial customers as 'large' (over 250,000 kWh/year) and non-government (80% of commercial buildings in Mississippi are non-government owned and 15% of all commercial customers are "large") and, hence, suitable targets for custom retrofit programs. The remaining commercial customers are

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[57] See http://www.centralepa.com/energyprogramstips.html
[58] See http://pse.com/savingsandenergycenter/ForBusinesses/Pages/Custom-Grant-Programs.aspx
[59] Most custom programs limit the funding to 50% of the project cost, in addition to covering the cost of the energy audit.
[60] See http://www.energyright.com/nmisdist.html and http://www.centralepa.com/energyprogramstips.html
[61] See http://www.energyright.com/business/how_to.html, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=TN69F&re=1&ee=1, andhttp://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=GA70F&re=1&ee=1

covered as small businesses or facilities owned by the government and therefore targeted by our Lead by Example and Small Business Direct Install programs. Since commercial custom programs presuppose a certain level of energy assessment, monitoring and verification infrastructure, we assumed that this type of program would be introduced during the Comprehensive Portfolio phase. Large commercial programs in other states have experienced participation rates ranging between 0.3% (PacifiCorp Utah) to 2% (Vermont). We assume a modest 0.1% participation in the first year gradually ramping up to a stable level of 1.0% per year. Based on a weighted average of similar programs in Texas, Utah and the North East we arrive at annual saving of 170,615 kWh that reduces at a nominal rate of 5% every year as the biggest customers are targeted first. Program costs in Louisiana, Texas and Utah have ranged from $0.08/kWh to $0.22/kWh and we have assumed an average of $0.16/kWh for Mississippi.

INDUSTRIAL

The industrial sector in Mississippi is the largest segment of energy consumption, accounting for 45% of total energy usage and 33% of electricity sales. Untapped energy savings in this sector remain large for both electricity and natural gas. At the same time, industrial companies in the United States are facing dramatic changes in production costs, global competition, regulation, and consolidation. These changes are creating pressure on companies to reduce costs and risks through better management of resources, including energy. Improving energy efficiency can reduce facilities' long-term costs; increase productivity, quality, and profit margins; and increase competitiveness.

There is considerable energy efficiency potential in the industrial sector and focusing on the key barriers we highlight below will help garner greater participation in utility programs as well as investment in efficiency upgrades independent of incentives:

- One program will not fit all customers. Industrial operations vary widely by size, product, process, annual budget, equipment replacement cycles, and staff technical sophistication.

- Although most industries would like to reduce energy waste, it is not their primary focus and they choose to put their time and effort into their primary business product. Those making decisions about capital investments are often not familiar with energy efficiency opportunities and their cost effectiveness.

- Industrial customers are often charged lower energy rates compared with other sectors, which makes energy efficiency seem a less attractive investment. Often, however, the industrial sector offers some of the most cost-effective energy efficiency opportunities.

- Some larger industries have onsite experts who feel that they already invest in all necessary and cost-effective energy efficiency opportunities.

- Many industrial customers are sensitive to sharing information they feel is proprietary, making it difficult to ascertain the distinct opportunities available in certain facilities.

These barriers present substantial challenges to emphasizing the benefits of energy efficiency to a company. Companies will often respond well to innovative outreach approaches, such as leveraging the relationships of an existing trade association. Because of the heterogeneous nature of industry, programs must be flexible in order to be customized to individual industry types.

This section covers fiver different program options designed to overcome these barriers and help industrial customers improve the efficiency of their facilities and manufacturing processes. Our analysis finds that these program options could produce electricity savings of almost 12% and natural gas savings of 19% by 2025, relative to the reference case forecast for the industrial sector (Table 9).

Table 9. Potential Industrial Policy and Program Electricity and Natural Gas Savings, Cumulative through 2025

	Electricity		Natural Gas	
Industrial Programs	GWh	% of Reference Case	MMCF	% of Reference Case
Industrial/Manufacturing Initiative	410	2.2%	2,056	17.0%
Self-Direct*	1,169	6.1%	-	-
Rural, Ag., and Fisheries Initiative	441	2.3%	-	-
Industrial Custom	127	0.7%	107	0.9%
Industrial Prescriptive*	78	0.4%	145	1.2%
Industrial Subtotal	**2,225**	**11.7%**	**2,307**	**19.1%**

Note: Programs marked with an asterisk are those we consider for Mississippi's Quick Start phase and will continue into the Comprehensive Portfolio phase.

Prescriptive Equipment Energy Efficiency Services (Quick Start)

For many customers, project-specific programs that provide prescriptive equipment incentives are easy to use. The customer receives an incentive for installing energy-efficient equipment such as motors and lighting. These incentives can also serve as an introduction to the program and help build a trust relationship with the customer; this can lead to future energy efficiency projects that access process energy efficiency opportunities, where the largest savings exist. The custom solutions approach is the next step for these customers who identify further improvement opportunities.

PROGRAM ANALYSIS

Our analysis begins by estimating the eligible program participants, i.e., electric and natural gas industrial customers (EIA 2012b and 2012d). We assume participation starts at 0.25% in 2014, ramping up to 1.5% in 2020 and 2% by 2025. Assumptions on participation are based off of similar industrial prescriptive programs from PacifiCorp (Utah) and CenterPoint Arkansas. Assumptions on savings per participant and program costs are based off programs from PacifiCorp, CenterPoint Arkansas and Xcel Energy Colorado.

Custom Energy Efficiency Services

For large, highly engaged customers, custom incentive programs are the standard for encouraging unique and large energy savings projects. Custom programs can be responsive to very specific customer needs in ways that prescriptive programs cannot. Nearly all established industrial programs offered by utilities have some form of custom incentive program available to their customers. This could also be coordinated with a standard offer program or a reverse auction approach.

Typically, the customer works with the program staff to identify a project, analyze energy savings, and estimate a project budget. The program administrator agrees to an incentive amount, often based on the projected energy savings and capped as a portion of eligible project costs. Many projects involve optimization of electric motor systems, including fan, pump or compressed air systems, and advanced sensors and controls to dynamically optimize the system to respond to variations in the needs of process that they serve. This application of technology is sometimes referred to as "intelligent efficiency" or "smart manufacturing."

Custom programs are generally the best way to help industrial customers meet their most complex needs and achieve larger volumes of savings. However, these facility and process-specific opportunities can be a challenge because programs may have difficulty identifying industry-specific expertise to meet customers' unique technical needs. Building these networks can be an important role that a regional energy efficiency program can play, and the Electric Power Research Institute is a source of referrals for member utilities.

One challenge is that industrial facilities can be in a variety of positions within their capital investment cycle and so may not be ready to make a major investment for several years. These firms may also need a significant amount of time to approve the investment internally, which, added to the time a complicated capital investment takes just to plan, purchase, and install, can well exceed 1 year. As a result, the most advanced custom programs increasingly allow for longer time frames between when a customer becomes eligible for a program and when the eligible project is actually completed. It is critical to send the correct market signals of long-term program availability to develop trust between the program administrator and the industrial customer.

Project savings from custom programs can be significant, often exceeding 20%. In addition, these projects typically have significant non-energy benefits making them compelling to the manufacturing facility. These non-energy benefits include improved productivity and product quality, and reduced emissions and lost-work injuries. Investigations of the total benefits of implemented industrial energy efficiency projects suggest the total benefits are three to five times direct energy savings (Elliott, Laitner & Pye 1997; Lung et al. 2005; Worrell et al. 2003).

PROGRAM ANALYSIS

We begin our analysis by determining the number of eligible participants, i.e., existing industrial electric and natural gas customers (EIA 2012b and 2012d). We assume participation begins in 2017 at 0.05%, ramping up to 0.25% in 2020 and 1.5% by 2025. Assumptions on participation, savings, and program costs are based on similar programs from PacifiCorp (Utah) and Xcel Energy Colorado.

Self-Direct Programs for Large Industrial Customers

The language adopted by the MPSC in Rule 29 does not include language on industrial customer's ability to "opt-out" or "self-direct," following the example set by the Arkansas PSC where it allowed for more time for stakeholder discussions on the design of this policy. It is still undecided, then, if industrial customers will be required to pay energy efficiency riders in their rates in order to gain access to utility energy efficiency services. The participation of industrial customers in Mississippi energy efficiency programs will clearly be an important part of meeting any future savings goals established by the MPSC. Therefore it is critical that the MPSC have an open forum for discussions with stakeholders in order to chart the best path forward.

Some large customers may find the self-direct option more appealing if they already have and will continue to invest in cost-effective energy efficiency on their own and have onsite energy management expertise (Chittum 2011). Self-direct programs give these large customers the option of doing their own energy efficiency upgrades while still requiring that energy efficiency resources are harvested as a least-cost energy resource.[62]

While this approach is not always a program in itself, it is a response to a growing trend by some industrial firms to seek exemption from paying for or directly participating in industrial energy efficiency programs. Some large industrial customers may not see the benefits of participating in a program offering if they have sufficient and steady onsite expertise and resources to implement their own energy efficiency projects. Still, the energy efficiency gains from these customers are a valuable energy efficiency resource to the system at large and should be measured, verified, and accounted for. In these situations, utilities may give industrial customers an option to self-direct the energy efficiency program costs and make investments in onsite energy efficiency programs in lieu of participating in one of the program administrator's existing programs. For more information, see *Follow the Leaders: Improving Large Customer Self-Direct Programs*, which reviews numerous self-direct programs and documents best practices and lists specific recommendations for program administrators regarding self-direct programs (Chittum 2011).

Large industrial consumers have often requested the right to self-direct and/or opt out as an opportunity to self-fund energy efficiency projects in their own facilities. 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 CHP could more cost-effectively meet the energy savings goals (see Chittum, Elliott, and Kaufman 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" are often used interchangeably, in practice they can vary substantially depending on the goals of the system that these large consumers

[62] For more information on best-practice self-direct policy design and implementation, visit ACEEE's Technical Assistance Toolkit: http://aceee.org/sector/state-policy/toolkit/industrial-self-direct.

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. Farther 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.

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 its 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 toward improvements that benefit all consumers within the system.

It is worth noting, however, that recent experience suggests that certain customers may prefer to use utility-led programs even after trying self-direct options. Here are several examples from Chittum 2011: In Oregon, of the five largest customers self-directing in recent years, three have returned to Energy Trust of Oregon (ETO) programs, having decided they are better served by ETO. Although 66 companies are eligible to self-direct, only about 5 are actively self-directing, meaning that the remainder have begun using ETO programs. In Michigan, of the 77 companies that were self-directing initially, 30 have returned to paying for traditional energy efficiency programming. When the program offerings are well designed and well run, industrial customers may prefer to take advantage of them rather than self-direct.

A personal relationship between the industrial firm and the program is a critical element in success. The key account manager represents a bridge between the program offering and all the program resources, including efficiency and demand response programs. This advocate can help to determine the best energy cost structure to meet the customer's needs. His or her ongoing dialog with the customer also allows the program to identify opportunities, such as planned investments that can be leveraged to implement energy efficiency projects (Chittum, Elliott & Kaufman 2009).

The energy efficiency program can also serve the role of helping the industrial customer identify other resources that are available at the state, regional, or national level to help implement energy efficiency projects.

PROGRAM ANALYSIS

The self-direct program should be available to only the largest manufacturing companies. This analysis assumes that 5 large customers self-direct the first year, ramping up to 25 in later years. Program costs and savings are estimated based on data from PacifiCorp's self-direct program in Utah.

Program and Policy Analysis: Detailed Results of Costs and Benefits

PROGRAM COSTS

Table 10 presents the summary of estimated annual program and policy costs from the program analysis for benchmark years. Table 11 then presents the estimated customer investments in energy efficiency measures. These estimates are used for the cost-benefit analysis and as inputs for the macroeconomic assessment provided in the next section.

These energy efficiency program and customer investments yield a multitude of benefits to utilities, customers, and society in the form of avoided energy supply and T&D investments, environmental benefits including reduced emissions, and reduced investment risk, as well as several non-energy benefits such as improved comfort and reliability. Stakeholders use multiple cost-effectiveness tests to evaluate these various impacts of energy efficiency investments, and each of the tests provides different information about the impacts of efficiency programs from the disparate vantage points in the energy system. Here, we present a summary of the different approaches, challenges, and best practices, but readers should consult Woolf et al. 2012 for a more complete discussion of cost-effectiveness tests.

The societal cost test (SCT) and the total resource cost (TRC) test take the most comprehensive approach, indicating whether programs will produce a net reduction in energy costs in the utility service area, or to society at large, over the lifetime of the program impacts. The other tests are used as distributional assessments; i.e., they indicate the vantage points of the different stakeholders. These tests are the program administrators cost (PAC) test, also known as the utility cost test (UCT); the participant cost test (PCT); and the rate impact measure (RIM) test.

The benefits side of the SCT, TRC, and PAC typically include the avoided electricity and natural gas costs, and related avoided energy costs. The two main types of avoided electricity costs are avoided energy costs ($ per kWh), which reflect variable costs such as energy and fuel costs, and avoided capacity costs ($ per kW), which reflect infrastructure costs such as building power plants. The avoided natural gas costs are variable fuel costs. Other benefits that accrue from energy efficiency and should be included in these tests are avoided T&D costs, reductions in the costs of environmental compliance, and reduced risk. The SCT is the most expansive view of benefits to society, and should include societal benefits such as avoided emissions. The TRC and the PAC take a more limited perspective. Policymakers typically decide which specific benefits should be included in the cost-benefit analysis.

Table 10. Energy Efficiency Program and Policy Spending in Mississippi ($Million, Benchmark Years, 2014-2025)

Sector and Program Type	2015	2020	2025
Residential			
Building Energy Codes	$-	$-	$-
Code Support	$-	$0.07	$0.14
Low-Income Weatherization	$0.7	$3.9	$12.0
Home Performance with ENERGY STAR	$4.0	$15.3	$29.9
Consumer Electronics and Appliances	$-	$1.9	$6.4
Lighting	$0.8	$2.0	$2.2
Cooling	$4.0	$11.3	$22.9
Enhanced Billing and Information Feedback	$0.2	$3.4	$7.8
Residential Subtotal	***$9.8***	***$37.8***	***$81.4***
Commercial			
Building Energy Codes	$-	$-	$-
Code Support	$-	$1.0	$1.0
Lead by Example	$2.0	$12.8	$16.6
Building Benchmarking	$0.03	$0.3	$0.5
Small Business Direct Install	$0.4	$10.4	$16.6
Large Commercial Custom	$4.6	$9.8	$7.8
Large Commercial Prescriptive	$0.8	$32.7	$56.5
Commercial Subtotal	***$7.8***	***$67.1***	***$99.1***
Industrial			
Manufacturing Initiative	$0.8	$2.5	$2.5
Self-Direct	$0.1	$0.4	$0.4
Rural, Agricultural, and Fisheries Initiative	$0.6	$1.7	$3.3
Industrial Custom	$-	$1.6	$6.0
Industrial Prescriptive	$0.5	$2.8	$3.9
Industrial Subtotal	***$2.0***	***$8.9***	***$16.0***
Total All Programs	**$19.6**	**$113.9**	**$196.5**

Note: These are statewide estimates and include both electricity and natural gas efficiency programs and policies. Due to rounding, totals may differ from the sum of individual program amounts.

Table 11. Estimated Energy Efficiency Customer/Participant Investments ($Mill, Benchmark Years, 2014-2025)

Sector and Program Type	2015	2020	2025
Residential			
Building Energy Codes	$-	$-	$-
Code Support	$-	$1.2	$2.3
Low-Income Weatherization	$-	$-	$-
Home Performance with ENERGY STAR	$2.4	$7.6	$15.0
Consumer Electronics and Appliances	$-	$2.1	$7.3
Lighting	$-	$1.4	$2.7
Cooling	$2.4	$6.0	$11.4
Enhanced Billing and Information Feedback	$-	$0.6	$1.2
Residential Subtotal	***$4.8***	***$18.9***	***$39.8***
Commercial			
Building Energy Codes	$-	$-	$-
Code Support	$-	$0.9	$4.3
Lead by Example	$2.0	$12.8	$16.6
Building Benchmarking	$-	$-	$-
Small Business Direct Install	$0.2	$4.5	$7.1
Large Commercial Custom	$4.6	$9.8	$7.8
Large Commercial Prescriptive	$1.4	$14.6	$26.4
Commercial Subtotal	***$8.2***	***$42.6***	***$62.3***
Industrial			
Manufacturing Initiative	$3.0	$8.9	$8.9
Self-Direct	$2.1	$5.2	$5.2
Rural, Agricultural, and Fisheries Initiative	$2.2	$7.0	$13.2
Industrial Custom	$-	$2.2	$8.4
Industrial Prescriptive	$0.7	$1.2	$1.6
Industrial Subtotal	***$8.0***	***$24.4***	***$37.3***
Total All Programs	**$20.9**	**$86.0**	**$139.4**

Note: These are statewide estimates and include both electricity and natural gas efficiency programs and policies. Due to rounding, totals may differ from the sum of individual program amounts.

Some states designate a primary test to use, while other states require all tests or no specific tests. As of 2008, the TRC was the most common primary measurement of efficiency cost effectiveness (EPA 2008). However, in recent years there has been increasing concern about the methodology and application of the TRC, along with calls to improve the comprehensiveness of the benefits side of the test (See Kushler et al. 2012; Woolf et al. 2012). And with many states and regions increasingly using energy efficiency as a resource in the utility system, the PAC/UCT has gained greater attention. The PAC/UCT is recommended for jurisdictions seeking to emphasize efficiency as a resource to the utility system on a par with other supply-side resources.

The PCT is fundamentally different from the other tests because it limits benefits to customer bill savings and limits costs to customers. Therefore, it should be used as an indication of the distributional effects of energy efficiency programs rather than an indication of universal system benefits. Finally, the RIM test, which also looks at distributional effects, is now widely recognized as inappropriate for screening energy efficiency programs, has fallen out of use, and is not recommended (Woolf et al. 2012). Screening efficiency programs with the RIM test is inconsistent with the way supply-side resources are screened, which creates an uneven playing field. As a result, it can lead to the rejection of large amounts of cost-effective energy savings, which could otherwise reduce customer energy bills and provide system-wide benefits.

Because utilities use these various methodologies to examine the cost effectiveness of energy efficiency programs, there are multiple ways to present the benefits of an energy efficiency portfolio. For this analysis, we consider two of the most common tests, the TRC and the PAC/UCT, as well as the PCT. For the net-present value (NPV) analysis, we assume a 5% real discount rate. The program period is through 2025; however, the NPV analysis is over the life of the measures (i.e., measures installed in 2025 continue saving energy over their useful lifetimes). We present the results in Table 12, Table 13, and Table 14, below. This analysis includes both electric and natural gas utility programs and policies, as modeled in the program analysis. Readers should note that, for the purposes of this analysis, we use a limited application of the TRC test. For program development and evaluation, stakeholders in Mississippi should consider a more comprehensive TRC application that includes other societal benefits. We also consider the implications of using different levels of real discount rates. The results of our cost-benefit analysis of the various tests are as follows:

- The TRC test measures the benefits of energy efficiency programs for the region as a whole. Costs are the incremental costs to purchase and install energy efficiency improvements, incurred by both the program administrators and the participants, as well as the overhead to administer the programs. The benefits are the universal avoided costs of energy and capacity from the program impacts that accrue to all customers. We estimate a TRC ratio of 2.5 over the analysis period, which means that each $1 invested in programs and customer measures would yield $2.50 in total system benefits. As discussed above, however, there have been calls for improving the comprehensiveness of the benefits side of the TRC test. Our analysis is a fairly limited assessment of benefits; i.e., the avoided costs of energy and demand saved.

- The PCT measures the benefits and costs from the perspective of a program participant. Costs are the incremental costs to purchase and install energy efficiency improvements, incurred by both the program administrators and the participants, while the benefits are the avoided retail customer costs plus the rebates/incentives paid to the participants. We estimate a PCT ratio of 4.3 over the analysis period, which means that each $1 invested in customer measures would yield $4.30 in energy bill savings.

- The PAC/UCT, measures the benefits and costs from the perspective of considering energy efficiency as a resource to the utility on a par with supply-side resources. The costs are those incurred by the utility/program administrators, which include financial incentives such as rebates or technical expertise, as well as program overhead such as marketing and administration. The benefits are the avoided costs of energy and capacity that accrue to all customers from the program impacts (the same as the TRC benefits). We estimate a PAC/UCT ratio of 4.5 over the analysis period, which means that each $1 invested in utility programs would yield $4.50 in avoided energy costs, which are universal benefits to all customers.

Table 12. Total Resource Cost (TRC) Test

Sector	NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
Residential	$464	$778	$314	*1.7*
Commercial	$764	$1,785	$1,021	*2.3*
Industrial	$251	$1,167	$917	*4.7*
Total	**$1,479**	**$3,730**	**$2,251**	***2.5***

Note: Assumes a 5% real discount rate

Table 13. Participant Cost Test (PCT)

Sector	NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
Residential	$372	$1,302	$930	*3.5*
Commercial	$628	$2,759	$2,132	*4.4*
Industrial	$230	$1,252	$1,022	*5.4*
Total	**$1,230**	**$5,313**	**$4,083**	***4.3***

Note: Assumes a 5% real discount rate

Table 14. Program Administrator Cost (PAC) Test / Utility Cost Test (UCT)

Sector	NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
Residential	$305	$778	$473	*2.5*
Commercial	$454	$1,785	$1,330	*3.9*
Industrial	$69	$1,167	$1,099	*17.0*
Total	**$828**	**$3,730**	**$2,902**	***4.5***

Notes: Assumes a 5% real discount rate. Industrial B/C ratio is relatively high because two of the industrial programs/policies are state-administered and therefore do not require utility investments. Additionally, the self-direct program generates considerable electric savings but requires relatively low utility program investments.

These results suggest that a comprehensive energy efficiency program and policy for Mississippi would yield universal net benefits to the state, universal net benefits to the utility system, and direct benefits to program participants. From multiple vantage points, energy efficiency is a low-cost approach that yields benefits greater than costs.

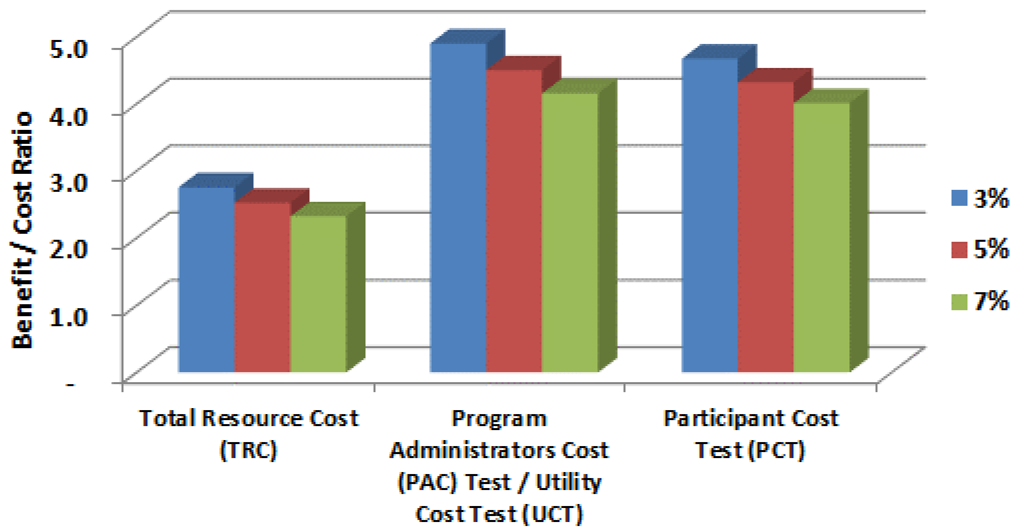
The assumed discount rate is one important consideration in the cost/benefit analysis. Benefits from energy efficiency accrue over the lifetime of the energy savings measures, and therefore the stream of monetized benefits is discounted to compare those benefits with the implementation costs in the same time frame. Toward this end, NPV analysis is used and assumes a discount rate to represent future cash flow in present dollar terms. The specific discount rate assumptions are a significant driver of the results of cost/benefit analysis. Typically, the utility weighted average cost of capital (WACC) is used for the PAC/UCT and the TRC. The real (as opposed to nominal) cost of capital for electric utilities is currently about 3.5%, according to one comprehensive analysis of the cost of capital among various economic sectors.[63] For our analysis, which examines a long-term portfolio of energy efficiency programs in real dollar terms rather than the impacts of 1-year program implementation in nominal dollars, we assume a real discount rate rather than a nominal rate. We assume a 5% real discount rate in the results presented above; however, in Figure 15 we present the results of various assumptions that could be used instead.

While these NPV cost-benefit tests are the best way to evaluate policies and long-term planning in general, and energy efficiency specifically, several stakeholders are also interested in the estimated short-term rate impacts for customers. Efficiency programs cost utilities about $0.02–0.04 per kWh-saved, which is lower than the avoided cost of energy in Mississippi of about $0.04– $0.09 per kWh through 2025.

Stakeholders should be careful not to let short-term rate impacts detract from the medium- and long-term benefits of energy efficiency. Energy efficiency is a low-cost and low-risk option that should be considered as part of a well-diversified energy portfolio.

[63] See http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/wacc.htm

Figure 15. Results of Cost-Benefit Analysis with Various Real Discount Rate Assumptions



Macroeconomic Analysis

In support of ACEEE's efforts to prepare a study of the economic and achievable potential for energy efficiency resources in Mississippi, Evergreen Economics estimated the economic and fiscal impacts of the proposed portfolio of policies and programs over an eleven-year study period (2014-2025).

Economic and fiscal impacts were measured using an input-output modeling framework and the IMPLAN economic impact modeling software. The IMPLAN model is constructed with historical government data from industries and households in Mississippi. The inputs utilized by the state-level model include program implementation costs, net incremental measure spending, net energy savings to households and businesses, changes in utility revenues, and changes in household spending on non-utility goods and services. Economic impacts are measured as changes in output, wages, business income, and employment. Fiscal impacts include changes in tax and fee revenues for state and local taxing jurisdictions.

For this analysis, gross impacts are calculated and then compared against a base case spending scenario that assumes the funds that were used to support program activities and incentives are spent by Mississippi ratepayers. The difference in economic impacts attributed to the programs and the base case scenario are referred to as net impacts.

In addition to the economic benefits that occur with the initial equipment expenditures, the energy efficiency programs generate energy bill savings that continue to benefit program participants beyond the first year of measure implementation. Consequently, Evergreen Economics also analyzed the economic and fiscal impacts attributed to energy savings that continue in the future—i.e., post-2025—over the expected lifespan of the installed energy efficiency equipment.

KEY FINDINGS

Mississippi's investments in energy efficiency are expected to result in energy savings, increased economic output, business income, jobs, and state and local taxes in the 11-year program period and beyond. As shown in Table 15, between 2014 and 2025 it is estimated that the portfolio of efficiency programs will result in the following *cumulative* net impacts:

- Nearly $4.3 billion in economic output, including $1.1 billion in wages, nearly $825 million in business income to small business owners, and over 32,800 person-years of employment over the 11-year period.
- Increased state and local tax revenue by $80 million over the 11-year period.
- Additional energy savings in future out-years after the programs end in 2025[64] will sustain a total of $6.4 billion in output, including $1.7 billion in wages, $1.2 billion in business income, almost 52,300 person-years of employment, and an increase of $269 million in state and local tax revenue.

Table 15. Summary of Energy Savings and Net Economic Impacts in Mississippi

Impact Measure	Impact During Program Years 2014-2025	Impact in Future Out-Years, 2026-2040
Electricity Savings (GWh)	38,410	89,860
Natural Gas Savings (MMCF)	31,290	62,770
Output ($MM)	$4,256	$6,454
Wages ($MM)	$1,103	$1,701
Jobs (Person-Years)	32,800	52,300
Business Income ($MM)	$825	$1,176
State and Local Taxes ($MM)	$80	$269

Presented in another way, these programs would result in the following *annual* impacts *in* 2025:

- Nearly $900 million in economic output, including $225 million in wages, $169 million in business income to small business owners, and 6,700 person-years of employment in the year 2025 alone.
- Increased state and local tax revenue by $21 million.
- Additional energy savings after the programs end that continue to sustain economic benefits.

[64] Energy efficiency measure installations in the year 2025 will continue to generate savings over their useful lives.

The remainder of this section documents the analysis that was completed to develop these economic impact estimates, beginning with a summary of model inputs and methodology and ending with detailed results.

PROGRAM ACTIVITIES

Expenditures

For this analysis, spending and energy savings data relating to the proposed efficiency programs were provided by ACEEE and aggregated into several general categories to facilitate economic impact modeling. Table 16 shows the spending for residential, commercial, and industrial programs and policies in select years. Although additional program expenditures occur on an annual basis for most programs, Table 16 omits many of these years for ease of presentation. Note that total program spending on energy efficiency resources increases from 2014 to 2025, and that commercial program spending is greater than spending on residential programs, which in turn is greater than spending on industrial programs.

Table 16. Expected Energy Efficiency Program Spending in Mississippi ($Million, Benchmark Years, 2014-2025)

Impact Measure	2015	2020	2025	Total Program (2014-2025)
Residential	$9.8	$37.8	$81.4	$460.3
Commercial	$7.8	$67.1	$99.1	$687.1
Industrial	$2.0	$8.9	$16.0	$102.7
Total All Programs	**$17.6**	**$104.9**	**$180.5**	**$1,147.4**

Energy Efficiency Equipment Spending

Next, our analysis considers incremental equipment spending by program. Net incremental spending represents additional spending on energy efficiency equipment in homes and businesses above what would have been spent on standard equipment in the absence of energy efficiency programs. In general, equipment spending and program spending exhibit an increasing trend from 2014 to 2025 even as new codes and standards come into effect and base efficiency levels increase.

ECONOMIC IMPACT ANALYSIS METHODS

Measuring the economic impacts attributable to efficiency programs is a complex process, as spending by the state of Mississippi and local utilities—and subsequent changes in spending by program participants—unfold over a lengthy period of time. From this perspective, the most appropriate analytical framework for estimating the economic impacts is to classify them into the following categories:

- *Short-term* impacts are associated with changes in business activity as a direct result of changes in spending (or final demand) by program implementers; energy

efficiency program participants; and ratepayers who provide funding for energy efficiency programs.
- *Long-term* impacts are associated with the potential changes in relative prices; factor costs (e.g.,. changes in wage rates, cost of capital, and fuel prices); and the optimal use of resources among program participants as well as industries and households linked by competitive, supply chain, or other factors.

This analysis measures the short-term economic impacts associated with efficiency programs in Mississippi. These impacts are driven by changes (both positive and negative) in final demand, and are measured within a static input-output modeling framework that relies on data for an economy at a point in time and assumes that program spending does not affect the evolution of the state economy. Energy efficiency programs may have longer lasting effects, and this is clearly the case for continued energy savings beyond the end of the programs in 2025. However, these long-term, dynamic effects are not measured in this analysis.

The IMPLAN input-output model has several features that make it particularly well suited for estimating these short-term impacts:

- The IMPLAN model is widely used and well respected. The IMPLAN model is constructed with data assembled for national income accounting purposes, thereby providing a tool that has a robust link to widely accepted data development efforts. The U.S. Department of Agriculture (USDA) recognized the IMPLAN modeling framework as "one of the most credible regional impact models used for regional economic impact analysis" and, following a review by experts from seven USDA agencies, selected IMPLAN as its analysis framework for monitoring job creation associated with the American Recovery and Reinvestment Act (ARRA) of 2009.[65]
- The IMPLAN model's input-output framework and descriptive capabilities allow for the construction of economic models with region-specific data for 440 different industry sectors, as well as for households and government institutions. These details permit accurate mapping of program spending and energy savings to industry and household sectors in the IMPLAN model.
- Finally, the IMPLAN model is based on historical economic data for Mississippi and therefore reflects the unique nature of Mississippi's economy.

Input-output analysis employs specific terminology to identify the different types of economic impacts. Energy efficiency programs affect the state directly, through the purchase of goods and services within the region. Specific direct impacts include spending by staff administering the energy efficiency programs and by manufacturers and contractors that produce and install the energy-efficient equipment. Direct impacts also include changes in spending or output attributed to energy bill savings for households and businesses participating in efficiency programs.

[65] See excerpts from an April 9, 2009, letter to MIG, Inc., from John Kort, Acting Administrator of the USDA Economic Research Service, on behalf of Secretary Vilsack, at http://www.implan.com.

These direct changes in economic activity will indirectly generate purchases of intermediate goods and services from related sectors of the economy. In addition, the direct and indirect increases in employment and income enhance overall purchasing power, thereby inducing further economic impacts as households increase spending and businesses increase investment. This cycle continues until the spending eventually leaks out of the local economy as a result of taxes, savings, and purchases of non-locally produced goods and services.

Within this framework, the IMPLAN model reports the following impact measures:

- **Output** is the value of production for a specified period of time. It is the broadest measure of economic activity and includes intermediate goods and services and the components of value added (personal income, other income, and indirect business taxes).
- **Wages** includes workers' wages and salaries, as well as other benefits such as health and life insurance, retirement payments, and non-cash compensation.
- **Business income** is also called **proprietary income** (or small business income) and represents the payments received by small business owners or self-employed workers.
- **Job impacts** include both full- and part-time employment. Over time, these job impacts are expressed as person-years of employment, as they represent the number of jobs sustained over a single year.

Given the static nature of the input-output model used in this analysis, it is important to note that the cumulative impacts presented do not take into account changes in production and business processes that businesses make in anticipation of future increased energy prices and/or competition to increase production efficiency. To the extent that Mississippi businesses are already adjusting in anticipation of these factors, the cumulative impacts presented here may be overstated, as the overall market may become more efficient due to factors outside program influence.

The cumulative numbers also rely on the critical assumption that each dollar saved will translate into a dollar of increased economic output for those businesses adopting conservation measures. This assumption conforms to findings in previous research conducted by Evergreen staff[66] and is reasonable in the short run. In the long run, however, it is likely that a dollar of energy savings will translate to less than a dollar of increased economic output as the businesses adopt more efficient production practices. Despite these caveats, the ongoing and cumulative effect of conservation due to energy efficiency program activities is nevertheless a significant net benefit to Mississippi's economy.

Gross and Net Economic Impacts

For this analysis, *gross impacts* refer to *economic impacts* that do not include a counterfactual base case scenario that compares alternative uses of program funding. The gross impacts are calculated based on the annual program spending and energy savings for Mississippi

[66] For more information please see the following documentation: http://www.ecy.wa.gov/climatechange/docs/20100707_wci_econanalysis.pdf.

discussed below. These input parameters are then compared with a base case spending scenario that assumes the Mississippi program funding is returned to Mississippi ratepayers and spent following historical purchase patterns. The difference between the gross economic impacts attributed to the proposed Mississippi programs and the base case scenario is referred to as *net impacts*.

For the proposed Mississippi energy efficiency programs and policies, specific gross spending impacts include:

- Program administration as program implementers incur administrative costs and purchase labor and materials to carry out energy efficiency programs.
- Incremental measure spending represents additional spending on energy efficiency above what would have been spent on standard efficiency measures in the base case.
- Reductions in energy consumption and the associated increase in household disposable income and lower operating costs for businesses.
- For residential program participants, lower energy costs that increase household disposable income, which is assumed to be spent following historical purchase patterns.
- For businesses, energy savings lower production costs, which, in the short run, lead to changes in productivity. To estimate the economic impacts associated with these lower energy costs, Evergreen Economics used an elasticity-based approach to measure the direct change in output and associated changes in direct employment and income.
- Energy savings that begin to accrue after energy efficiency measures have been installed. Thus, energy savings in the program year must take into account the timing of these installations. In this analysis, we assume that installations occur evenly throughout the year and use a 50% implementation adjustment factor for energy savings in the first program year.
- The efficiency gains result in some loss of utility revenues due to lower power sales. We assume that the utilities are able to recover from ratepayers the costs of implementing the efficiency programs plus some lost revenues. The mechanisms typically used for revenue recovery are complicated and vary from state to state. To simplify this process for the IMPLAN model, we assume that the utilities are able to recover 50% of their lost retail revenues to simulate the revenue recovery process. Our 50% estimate assumes that half of utility revenues cover fixed costs, which then need to be recovered from ratepayers, while the other 50% represents variable costs that the utility can save as the need for power declines.[67] To reflect the ratepayer perspective, the energy savings of households and businesses are also reduced by 50% as part of the revenue recovery mechanism (e.g., half of the energy savings value is transferred from ratepayers to the utility sector through the revenue recovery process). The 50% assumption is likely higher than what utilities would actually be able to recover (i.e., fixed costs are likely less than 50% of revenues), which results in a conservative estimate of impacts for our model.

[67] A quick review of the energy cost data provided for Mississippi shows that about 50% of the retail power costs are avoided costs, indicating that the remaining 50% are likely fixed costs, which helps support the assumption used in our model.

ECONOMIC IMPACT RESULTS

The economic impacts associated with Mississippi energy efficiency policies and programs are reported in this section. Results are arranged as follows:

- **Total gross and net economic impacts**. This section also reports the distribution of net impacts by residential, commercial, and industrial programs and for combined heat and power.

Total Gross and Net Impacts

Table 17 shows the total cumulative gross and net economic impacts in Mississippi from residential efficiency programs from 2014–2025. Over this 11-year program period, we expect to see a total increase in state economic output of nearly $809 million relative to the base case scenario. Stated another way, the efficiency programs will increase economic output in Mississippi by $809 million over what would have occurred had the programs not existed, the energy efficiency savings had not been achieved, and the program spending funds had been returned to ratepayers and spent following historical purchase patterns. This estimate (and all the ones discussed below) also takes into account the costs of the programs and the higher equipment costs to consumers, and assumes a revenue mechanism in which ratepayers compensate utilities for lost revenues.

This increase in economic output corresponds to an increase of $174 million in increased wage income and over $223 million in business income. Over this period, the net gains associated with the efficiency scenario are able to sustain 5,700 jobs (measured in person-years of employment). Finally, the net gain in economic activity also results in an increase in tax revenue generated for state and local governments. As shown at the bottom of the table, state and local governments will see an increase of $10 million in tax revenue over the base case scenario.

Table 18 shows the analogous gross and net economic impacts for the commercial efficiency programs. These impacts are in addition to those estimated for the residential sector. All of the same assumptions discussed for the residential sector are also used in the commercial sector, including the assumptions regarding utility revenue recovery.

In total from 2014–25, we expect to see an increase in state economic activity equal to $2.4 billion relative to the base scenario in which the efficiency programs do not exist. We also find that energy efficiency programs will help sustain 21,500 person-years of employment over the same time period, in addition to the job gains that occur due to the residential sector efficiency programs. The net increase in economic benefits also increase expected tax revenue, with state and local government estimated to receive an additional $51 million in tax revenue relative to what would occur in the base scenario.

Table 17. Total Gross and Net Economic Impacts for Residential Energy Efficiency Policies and Programs (2014-2025)

Impact Measure	Gross Impacts	Net Impacts
Residential		
Electricity Savings (GWh)	5,876	5,786
Natural Gas Savings (MMCF)	6,139	6,139
Output ($MM)	$1,441	$809
Wages ($MM)	$355	$174
Jobs (Person-Years)	12,000	5,700
Business Income ($MM)	$357	$223
State and Local Taxes ($MM)	$47	$10

Table 18. Total Gross and Net Economic Impacts for Commercial Energy Efficiency Policies and Programs (2014-2025)

Impact Measure	Gross Impacts	Net Impacts
Commercial		
Electricity Savings (GWh)	20,403	20,403
Natural Gas Savings (MMCF)	12,844	12,844
Output ($MM)	$2,951	$2,383
Wages ($MM)	$921	$731
Jobs (Person-Years)	27,100	21,500
Business Income ($MM)	$569	$453
State and Local Taxes ($MM)	$78	$51

With regard to the industrial sector, our analysis finds that the expected energy savings are lower than commercial savings due to less program and participant spending, and these results are shown in Table 19. In total from 2014-2025, we expect to see an increase in state economic activity equal to $1.1 billion over what would have occurred in the base scenario without the industrial efficiency programs. We also find that the industrial energy efficiency programs will help sustain over 5,700 person-years of employment over the same time period. As before, these impacts are in addition to what is estimated for the commercial and residential efficiency programs.

Table 19. Total Gross and Net Economic Impacts for Industrial Efficiency Policies and Programs (2014-2025)

Impact Measure	Gross Impacts	Net Impacts
Industrial		
Electricity Savings (GWh)	12,130	12,130
Natural Gas Savings (MMCF)	12,310	12,310
Output ($MM)	$1,212	$1,065
Wages ($MM)	$218	$198
Jobs (Person-Years)	6,200	5,700
Business Income ($MM)	$167	$149
State and Local Taxes ($MM)	$21	$19

Overall, the portfolio of residential, commercial, and industrial energy efficiency programs is expected to achieve significant gains in the regional economic activity beyond the base case scenario. The primary driving force behind these net economic gains is the energy bill savings enjoyed by households and businesses that result from the increase in energy efficiency. And these energy savings continue beyond the initial installation year, resulting in a substantial amount of economic benefits accruing throughout the study period.

Conclusion

Mississippi is poised to reap considerable benefits from its growing energy efficiency initiatives. Already its leaders and stakeholders have shown dedication to advancing relevant policy that will propel the state forward and help it become a regional leader for others to emulate. Our analysis finds that, as the least-cost resource, energy efficiency will benefit all customers and play a major role in bolstering economic development. The suite of policy and program options presented in this report will help the state along its way, but it by no means is exhaustive: Mississippi can reap additional benefits by expanding upon the policies and programs we consider here. Nonetheless, sustained leadership in the public and private sectors as well as effective policy and program implementation will be critical in order to maximize the success of the state's future energy efficiency investments.

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Appendix A: Utility Avoided Costs Analysis and Supply Price Forecast—Methodology and Assumptions

A.1. INTRODUCTION

The projected electricity supply prices and avoided costs reported in this Appendix are based upon a number of simplifying and conservative assumptions that we would not consider to be reasonable in other contexts. These include a simplified representation of avoided costs for different load factors and load shapes, and generic estimates of the capital costs of new resources.

Reference Case Electricity Supply Prices

The reference case load forecast, supply forecast, and supply prices by year are presented in Table A-1. The forecast of physical supply is set to equal the forecast of physical load plus the level of estimated losses in transmission and distribution. The supply prices consist of the projected wholesale electricity supply costs each year. The retail margin reflects the projected recovery of the costs of local transmission and distribution service. (Retail margin equals the base year average annual retail price minus base year average supply cost). It is assumed to remain constant in real dollars. The total average retail rate equals the supply cost plus the retail margin. The retail rate forecast only reflects the projected changes in energy supply costs.

Avoided Electricity Costs—Reference Case

Utility avoided costs are presented in Table A-2. The avoided capacity costs are presented in $/kw-year while the avoided electric energy costs are given in ¢/kwh. For consistency and simplicity we have based the avoided capacity costs on the net costs for a new natural gas combustion turbine peaker unit. In the future other capacity resources might be cheaper, or there might be limited need for new capacity because of reduced or declining load growth and renewable additions.

Policy Case Electricity Supply Prices

The Policy Case load forecast, supply forecast, and supply prices are presented in Table A-3. The supply forecast exceeds the load forecast by the level of estimated losses in transmission and distribution. The supply prices include the projected incremental generation costs each year, the retail margin each year, and the resulting total average retail rate.

Avoided Electricity Costs—Policy Case

The avoided costs are presented in Table A-4. The avoided capacity costs are presented in $/kw-year while the avoided electric energy costs are given in ¢/kwh.

Table A-1. Load, Capacity and Retail Prices, Reference Case Forecasts

All costs in constant 2012 dollars.

CASE:	Reference Case 6/19/13																	
Category	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load Forecast																		
Retail Energy	GWh	49,222	49,616	50,013	50,413	50,816	51,223	51,633	52,046	52,462	52,882	53,305	53,731	54,161	54,594	55,031	55,471	55,915
Retail Demand	MW	9,107	9,180	9,253	9,327	9,402	9,477	9,553	9,629	9,706	9,784	9,862	9,941	10,021	10,101	10,182	10,263	10,345
Supply Forecast																		
Capacity Requirement	MW	11,434	11,525	11,617	11,710	11,804	11,898	11,993	12,089	12,186	12,284	12,382	12,481	12,581	12,681	12,783	12,885	12,988
Capacity Sources																		
In-State Capacity	MW	15,540	15,540	15,540	15,542	16,152	16,159	16,167	16,174	15,732	15,890	15,449	15,007	14,565	14,123	13,681	13,239	12,797
Out-of-State Capacity	MW	-4,107	-4,015	-3,923	-3,832	-4,348	-4,261	-4,173	-4,085	-3,546	-3,607	-3,067	-2,526	-1,984	-1,441	-898	-354	191
Total Capacity Provided	MW	11,434	11,525	11,617	11,710	11,804	11,898	11,993	12,089	12,186	12,284	12,382	12,481	12,581	12,681	12,783	12,885	12,988
Energy Requirement	GWh	55,176	55,618	56,063	56,511	56,963	57,419	57,878	58,341	58,808	59,278	59,753	60,231	60,713	61,198	61,688	62,181	62,679
Energy Sources																		
In-State Generation	GWh	55,060	55,501	55,945	56,392	56,843	57,298	57,757	58,219	58,684	59,154	59,627	60,104	60,585	61,070	61,558	62,051	62,547
Out-of-State Generation	GWh	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132
Total Energy Provided	GWh	55,176	55,618	56,063	56,511	56,963	57,419	57,878	58,341	58,808	59,278	59,753	60,231	60,713	61,198	61,688	62,181	62,679
Supply Price Forecast																		
Average Production Cost	¢/kWh	6.70	6.79	7.19	7.32	7.47	7.57	8.78	9.01	9.33	9.57	9.86	10.06	10.33	10.54	10.79	11.02	11.24
Retail Margin	¢/kWh	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Average Retail Rate	¢/kWh	8.91	9.00	9.40	9.53	9.68	9.78	10.98	11.22	11.53	11.78	12.06	12.27	12.54	12.74	13.00	13.23	13.45

Table A-2. Utility Avoided Costs, Reference Case Forecast

All costs in constant 2012 dollars.

CASE:	Reference Case 6/19/13																	
Category	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Avoided Costs by costing period																		
Avoided Resource Cost	¢/kWh	4.95	5.66	6.75	7.55	7.53	7.96	8.95	9.23	9.57	9.72	9.98	10.14	10.37	10.53	10.74	10.91	11.07
Avoided Capacity Cost	$/kW-yr	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84
	¢/kWh	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Avoided Energy Only Cost	¢/kWh	3.75	4.46	5.55	6.35	6.33	6.76	7.75	8.03	8.37	8.52	8.78	8.94	9.17	9.33	9.54	9.72	9.87

Notes: Avoided Resource Costs represent avoided production costs (fuel, O&M, CO_2) for all resources, plus levelized capital costs for new resources.
Avoided Capacity Cost in $/kw-yr is converted into an energy cost equivalent (c/kWh) using the system load factor.
Avoided Energy Cost represents Total Avoided Resource Cost less Avoided Capacity Cost expressed as energy cost equivalent.

Table A-3. Load, Capacity and Retail Prices, Policy Case Forecast

All costs in constant 2012 dollars.

CASE:	**MS Policy Case 8/13/13**																	
Category	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Load Forecast																		
Retail Energy	GWh	49,176	49,473	49,703	49,821	49,817	49,670	49,428	49,093	48,657	48,149	47,562	46,960	47,954	48,952	49,953	50,957	51,965
Retail Demand	MW	9,098	9,153	9,196	9,218	9,217	9,190	9,145	9,083	9,002	8,908	8,800	8,688	8,872	9,057	9,242	9,428	9,614
Supply Forecast																		
Capacity Requirement	MW	11,423	11,492	11,545	11,573	11,572	11,538	11,481	11,404	11,302	11,184	11,048	10,908	11,139	11,371	11,603	11,837	12,071
Capacity Sources																		
In-State Capacity	MW	15,540	15,540	15,540	15,542	15,852	15,859	15,867	15,874	15,432	15,290	14,849	14,407	13,965	13,523	13,081	12,639	12,197
Out-of-State Capacity	MW	-4,117	-4,049	-3,995	-3,970	-4,280	-4,322	-4,385	-4,471	-4,130	-4,106	-3,801	-3,499	-2,826	-2,152	-1,478	-802	-126
Total Capacity Provided	MW	11,423	11,492	11,545	11,573	11,572	11,538	11,481	11,404	11,302	11,184	11,048	10,908	11,139	11,371	11,603	11,837	12,071
Energy Requirement	GWh	55,125	55,457	55,715	55,848	55,844	55,679	55,407	55,032	54,542	53,973	53,315	52,640	53,755	54,873	55,995	57,121	58,251
Energy Sources																		
In-State Generation	GWh	55,009	55,341	55,598	55,731	55,726	55,562	55,291	54,916	54,428	53,860	53,203	52,530	53,642	54,758	55,877	57,001	58,129
Out-of-State Generation	GWh	116	117	117	117	117	117	116	116	115	113	112	111	113	115	118	120	122
Total Energy Provided	GWh	55,125	55,457	55,715	55,848	55,844	55,679	55,407	55,032	54,542	53,973	53,315	52,640	53,755	54,873	55,995	57,121	58,251
Supply Price Forecast																		
Average Production Cost	¢/kWh	6.70	6.79	7.19	7.31	7.47	7.56	8.76	8.98	9.28	9.52	9.78	9.96	10.24	10.47	10.74	10.99	11.23
Retail Margin	¢/kWh	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.21
Average Retail Rate	¢/kWh	8.91	9.00	9.39	9.52	9.68	9.77	10.97	11.19	11.48	11.73	11.99	12.17	12.45	12.68	12.95	13.20	13.44

Table A-4. Utility Avoided Costs, Policy Case

All costs in constant 2012 dollars.

CASE:	**MS Policy Case 8/13/13**																	
Category	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Avoided Costs by costing period																		
Avoided Resource Cost	¢/kWh	4.95	5.66	6.75	7.56	7.61	8.19	9.24	9.58	9.97	9.99	10.28	10.48	10.69	10.82	11.01	11.17	11.30
Avoided Capacity Cost	$/kW-yr	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84	64.84
	¢/kWh	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Avoided Energy Only Cost	¢/kWh	3.75	4.46	5.55	6.36	6.41	6.99	8.04	8.38	8.77	8.79	9.08	9.28	9.49	9.62	9.81	9.97	10.10

Notes: Avoided Resource Costs represent avoided production costs (fuel, O&M, CO_2) for all resources, plus levelized capital costs for new resources.
Avoided Capacity Cost in $/kw-yr is converted into an energy cost equivalent (c/kWh) using the system load factor.
Avoided Energy Cost represents Total Avoided Resource Cost less Avoided Capacity Cost expressed as energy cost equivalent.

A.2. ASSUMPTIONS

In this section we describe the key inputs to the electricity model (Electricity Avoided Cost Model) that Synapse Energy Economics has developed for Mississippi, the rational for the proposed values of those inputs and their sources. We also provide a description of the Electricity Avoided Cost Model that is used to estimate future production and avoided costs in the following "Methodology" section, which is a basic dispatch and production cost model conducted in Microsoft Excel. The model also calculates resource investment costs using exogenously specified capacity additions and retirements based on current resource plans.

Basic Modeling Assumptions

The base year for the analysis is 2012. All monetary values are reported in constant 2012 year dollars unless noted otherwise. The study period begins in 2014 and ends in 2025, an analysis period of 11 years. The reporting period is 2014 through 2030, a total of 17 years.

The financial parameters for costing resource additions are as follows:

- **Inflation Rate = 2.00%**. Based on an analysis done for the New England AESC study[68] reflecting recent conditions.
- **Nominal Discount Rate = 8.0%**. This represents the value for an independent power producer with a mix of equity and bond financing. Based on a 50/50 equity/debt mix with 10% for equity and 6% for debt. Used for the levelization of capital expenditures. Actual rates for specific projects will vary depending on the nature of the project and the implementing entity.
- **Real Discount Rate. 5.88%**. Derived from the Nominal Discount Rate and the Inflation Rate.
- **Income Tax Rate = Federal rate of 35% and MS state corporate rate of 5.0%**. Property tax rate at the nominal level of 0.5% per annum of the initial plant cost (local rates vary considerably). This is used for capital cost levelization.

Base Year Sales and Revenues

The historic sales and revenues data through 2011 are obtained from the EIA's "State Electric Profile" Table 8 as of June 2013.[69] The historic data indicates that MS is a modest net importer and exports about 2% of its energy. The in-state capacity is more than adequate to meet the in-state peak loads.

Base Year Load and Resource Balance

The historic sales and revenues data are obtained from the EIA's "State Electric Profile" Tables 5, 8 and 10 as of June 2013.[70] Supplemental data for 2012 from the EIA 861 data files.

In-State Base Year Generation Resource Performance and Cost Data

From the above EIA data, we have the generation, CO_2 emissions and fuel costs for each

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[68] Avoided Energy Supply Costs in New England: 2011 Report." Synapse Energy Economics for the Avoided-Energy-Supply Component (AESC) Study Group, August 2011.
[69] See http://www.eia.doe.gov/cneaf/electricity/st_profiles/e_profiles_sum.html
[70] *Ibid.*

group or category of generating units—for example, coal, natural gas combined cycle (NGCC), natural gas combustion turbine (NGCT), and nuclear. From that data we can derive the average heat rate for each group and the fuel component of the generation costs. To that we add typical industry values for operation and maintenance. From this EIA data we also have the historic capacity factors associated with resource group. These historic patterns are used to set the basis for future performance.

New Generation Resource Performance and Cost Data
For new generation resources we have used the technology parameters from the AEO Assumptions document ("Assumptions to the Annual Energy Outlook 2013," April 2013). For capital costs we have used our professional judgment based on a number of sources to reflect current cost expectations for new construction.

Fuel Types
We use the three basic fossil fuel types (coal, petroleum and natural gas) as specified in the EIA's "State Electric Profile," with the addition of nuclear and biomass.

Annual Energy and Peak Load
For energy and peak loads we have developed the Reference Case Forecast for Mississippi based on a 0.8% load growth as used in the Entergy 2012 Integrated Resource Plan.

Capacity Retirements
There is limited information about future retirements of existing generating units and a variety of unknown circumstances may either work in favor of, or against, continued operation of individual units. It is, however, likely that some older, less-efficient generating units will be retired in the future. To reflect this we represent modest gradual retirement of existing units in the model. But it is possible that some existing units will be retrofitted and their lives extended.

Capacity Additions
In order to meet the forecasted growth in annual energy and peak load estimated in the Reference Case with an adequate reserve margin of 15%, new capacity must be added to the existing generation capacity. Because the Electricity Avoided Cost Model is not a capacity expansion model, we add new capacity resources "manually." Our analysis will consider three sets of capacity additions:

1. **Planned Capacity Additions**—Near-term proposed new additions or uprates to existing plants that are in development or advanced stages of permitting and have a high likelihood of reaching commercial operation. Presently nearly all generation in Mississippi is from natural gas plants. Currently the state has adequate capacity. The existing utility plans are somewhat vague about new additions, although Entergy discusses adding some new natural gas (CC & CT) facilities in the future. In the reference case we add new natural gas combined cycle and peaking plants in 2018 and 2023.
2. **Renewable Portfolio Standard (RPS) Capacity Additions**—Renewable generation capacity that is added to meet existing or anticipated RPS in each state. There is no RPS in Mississippi, thus we have not included one in the reference case. However, the utilities do discuss the possibility of renewable capacity

additions. Based on EIA data there is currently 235 MW of renewable capacity in the state. For the reference case we assume a nominal doubling of that by 2030, split evenly between wind, solar and biomass. In reality, given the potential in Mississippi, it could be somewhat more.

3. **Generic Capacity Additions**—New, generic conventional resources that are added to meet any residual capacity need after Planned and RPS Capacity Additions. Under the Reference Case, additional new capacity will be needed in the long-term portion of the forecast period after 2030. A range of generation technologies was considered for this purpose, including gas/oil-fired combined-cycle, gas/oil combustion turbines.

Fuel Prices

We start with fuel prices reported for the base year of 2012. For consistency and simplicity we used the base year historical prices and scaled them using the AEO 2013 Reference Case forecast year-to-year changes for the Southeastern Electric Reliability Council Delta region.

Carbon Emission Costs

Carbon compliance costs are set at the Synapse 2012 mid-case level (see "Synapse 2012 CO2 Price Forecasts," October 2012, Rachel Wilson et al.).

Wholesale Market Structure and Prices

Mississippi is not part of a wholesale market *per se* although interstate transactions are regulated by FERC. We assume that cost trends for interstate power purchases and sales follow those for in-state power production.

A.3. Methodology for the Electricity Planning and Costing Model

The model begins with an analysis of actual physical and cost data for a base year, develops a plan for meeting projected physical requirements in each future year of the study period and then calculates the incremental wholesale electricity costs associated with that plan. (Incremental to electricity supply costs being recovered in current retail rates).

Base Year Data

The actual data for the base year, and prior years, provides our starting point. That dataset contains historical data in the following categories:

- Recent year summary statistics
- Listing of the ten largest plants in the state
- Top five providers of retail electricity
- Electric capability by primary energy source
- Generation by primary energy source
- Fuel prices and quality
- Emissions
- Retail sales and revenues by customer class
- Retail sales by various provider types
- Supply and distribution of electricity

This data enables us to characterize the electric supply system and its costs; for example, the capacity, generation and capacity factor, average heat rate and fuel costs for different classes of resources. We can also calculate the retail margin from this data, i.e., the margin between average retail rates and variable production costs. The retail margin reflects the transmission and distribution costs being recovered in retail rates plus the fixed generation costs being recovered in those rates. This data is a very broad brush since the resources are grouped by fuel type and their operation is not characterized in great detail.

Future Years

We begin with the forecast of annual demand and energy in each future year provided by the ACEEE stakeholder group. Next we develop a physical plan to meet the load in each of those future years. This is done in the model via the following steps:

1. Derive annual capacity and generation requirements from forecast of retail annual demand and energy, and reserve margins;
2. Determine the relative quantities of annual capacity and generation to be provided by in-state and out-state resources based on the current mix of in-state and out-of state resources;
3. Estimate resource retirements. It is quite difficult to predict the timing of actual plant retirements, but it is reasonable to assume that some older facilities will be retired during the study period. We assume gradual retirement of existing resources over time based on typical operating lifetimes. This is explicitly specified in the input data section and can easily be modified if more specific data becomes available;
4. Estimate the capacity and timing of new generation additions, in-state and out of state. Our model is not a capacity expansion model and therefore does not make capacity additions "automatically." Instead, after we include "planned" capacity additions, we add enough "generic" capacity additions to maintain the reserve margin. Our generic additions are a mix of peaking, intermediate and baseload units that maintain the historical mix of those categories in the state. The additions are explicitly specified in the input data section;
5. Calculate the quantity of annual generation from each category of capacity, existing and new, in-state and out of state. The estimated quantity of generation from each category of capacity is derived from the operating capacity factors. These are generally based upon economic dispatch, i.e., dispatch from each category in order of increasing variable production costs.

Calculate Average Production (Supply) Costs

The model calculates the average production costs, i.e., energy plus capacity, for the particular case in the Production Model worksheet provided to ACEEE.

For states with **regulated wholesale markets**, the Production Model worksheet calculations are made as follows:

6. Calculate total cost of generation from existing in-state resources, purchases from out-of-state resources, and new in-state resources:

a. The unit production costs of existing in-state generation includes variable operating costs plus fixed costs.[71] The aggregate cost of generation from these resources declines over time as existing coal, oil and gas plants are retired, while the existing nuclear plants with low operating costs continue operation;
b. The unit production costs of new in-state generation consist of the levelized capital cost of new capacity additions plus their variable operating costs. The capacity cost of new capacity additions are levelized using the capital recovery factors developed in the Capital Recovery Calculation (CRC) worksheet provided to ACEEE.
c. The cost of power imported or exported is indexed to the generation-weighted average cost of generation from the in-state resources, i.e., existing and new. That is, the base-year import/export price changes in parallel with the in-state cost, e.g., an x% change of in-state production costs is reflected in an x% change of import/export prices. The rationale is that relative changes of in-state costs will be reflected outside the state as well.

For states with **de-regulated wholesale markets,** the Production Model worksheet calculations are made as follows:

7. The first step is to calculate the reference year market prices for the state being studied. The next step is to calculate the relationship between those state prices and market location for which future prices are available. The third step is to then apply that relationship to the futures prices to produce a forecast for market prices in the study state.

Calculate Avoided Costs

For states with **regulated wholesale markets** the Production Model worksheet calculates the total avoided costs, avoided capacity costs and avoided energy costs via the following steps:

8. **Total avoided costs**. The worksheet calculates "all-in" avoided costs that include both energy and capacity costs.
    a. **Years 1 to 5**. For the first five years the avoided costs are a mix of avoided dispatch of existing resources and avoided total cost of new resources that would otherwise come-on-line during that period. The percentage of new resources included in that mix is phased-in, starting at 0% in year 1 and rising to 100% in year 5.
    b. **Year 6 onward**. After year 5 the avoided costs in each year are equal to the average total costs of new resources in that year. This calculation assumes that the capital costs of new resources are avoidable either through avoiding their actual construction or through recovery from revenues from off-system sales.
9. **Avoided capacity cost**. To estimate the avoided cost of capacity only we use the proxy plant approach which is used by several ISOs. This avoided capacity cost is

[71] For existing resources fixed costs are estimated on an aggregate basis based on the base year difference between fuel and other variable costs and the retail revenues less a retail markup component.

based upon cost of "capacity only" from a new gas combustion turbine "peaker" unit. Basing avoided capacity cost on the capital cost of a new peaker is a commonly accepted method.

10. **Avoided energy cost**. The avoided energy cost is the total avoided cost from step 8 minus the avoided capacity cost from step 9.

For states with **de-regulated wholesale markets** the Production Model worksheet calculates the total avoided costs, avoided capacity costs and avoided energy costs differently for different time-periods:

11. Near-term years for which futures prices are available, e.g., first 4 to 5 years:
    a. **Avoided energy cost**. This is calculated from the energy futures market prices with appropriate historic-based adjustments for the state service area.
    b. **Avoided capacity cost**. This is based on the available appropriate capacity market results.
    c. **Total avoided cost**. This is obtained by combining the avoided energy cost with the avoided capacity cost using the base year system load factor to arrive at the combined total avoided cost on a per MWh basis.
12. Long-term years for which futures prices are not available. After the period for which futures are available, the total avoided costs, avoided capacity cost and avoided energy cost are developed in the same manner as for regulated states, in steps 8, 9 and 10.

Inputs into Macroeconomic Analysis

Synapse's avoided cost model provides three sets of inputs for the macroeconomic assessment:

1. Annual incremental investments in new resources;
2. Annual O&M and fuel costs, and;
3. Annual fuel prices for electric generation.

Appendix B: Existing Combined Heat and Power Units in Mississippi

City	Organization Name	Application	Capacity (kW)	Fuel Type
Baldwyn	Riverwood Products Inc.	Furniture	300	WOOD
Clarksdale	Archer Daniels Midland Company	Food Processing	3,000	NAT GAS
Columbus	Weyerhaeuser Company	Pulp and Paper	122,600	WASTE
Eupora	Eupora Woodworking	Furniture	700	WOOD
Forest	Quinton Mills Dairy	Agriculture	50	BIOMASS
Greenville	Comet Agri Systems	Food Processing	5,000	BIOMASS
Grenada	Memphis Hardwood Flooring Co.	Wood Products	600	WOOD
Jackson	Baptist Medical Center	Hospitals/Healthcare	4,200	NAT GAS
Jones (2010)	Jones County Poultry Digester	Agriculture	150	BIOMASS
Monticello	Georgia-Pacific Corporation	Pulp and Paper	60,000	WASTE
Morton	International Paper Company	Wood Products	1,000	WOOD
Natchez	International Paper Company	Pulp and Paper	52,500	NAT GAS
New Augusta	Georgia-Pacific Corporation	Pulp and Paper	60,000	WASTE
Pascagoula	Chevron USA., Inc.	Refining	6,000	OTR
Pascagoula	Mississippi Power	Refining	146,900	NAT GAS
Pearlington	Calgon Carbon	Electronics	732	WASTE
Prentiss	Brinson Farms	Agriculture	75	BIOMASS

Starkville	Mississippi State University	Colleges/Univ.	28,500	NAT GAS
Tieplant	Koppers Industries Inc.	Wood Products	750	WOOD
Tylertown	Transcontinental Gas PL Corp	Utilities	1,600	NAT GAS
Vicksburg	International Paper Company	Pulp and Paper	50,500	WASTE
Vicksburg	Ergon Refining, Inc.	Refining	4,720	NAT GAS
Yazoo City	Mississippi Chemical Corporation	Chemicals	20,500	NAT GAS

Source: IFC International