Louisiana's 2030 Energy Efficiency Roadmap: Saving Energy, Lowering Bills, and Creating Jobs

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Executive Summary

Louisiana stands at a turning point in its energy future. By 2030, Louisiana expects that future population and economic growth will require new energy resources. Energy efficiency – the energy we do not need to use as a result of improved technologies and practices – can play an important role toward meeting this need as the least-cost component of a well-diversified energy resource portfolio. As the least-cost resource, efficiency investments have the universal effect of lowering energy costs for all customers. Furthermore, investments in efficiency foster economic development in the state and create local jobs. The lower energy bills free up money that customers can use to invest in the local economy and help businesses to remain competitive in the global marketplace. Energy efficiency is the cheapest, cleanest, and lowest-risk solution to meet rising energy demand in Louisiana. How much energy efficiency potential is available in Louisiana, and what specific steps can stakeholders take to harness this potential through policies and programs? We explore these questions in this report, and examine the financial and macro-economic impacts of improved energy efficiency on Louisiana's economy. We find that Louisiana has large, untapped potential for cost-effective energy efficiency that can save consumers billions in lower energy bills and bolster the local economy.

KEY FINDINGS

Here, we present several key findings of our analysis:

- A comprehensive portfolio of energy efficiency policies, such as building energy codes, and utility customer efficiency programs have the potential to cost-effectively meet 5% cumulative of statewide electricity needs by 2020, increasing to 16% cumulative by 2030; and 3% cumulative of natural gas needs by 2020, increasing to 12% cumulative by 2030.
- Energy efficiency programs are the lowest-cost option to meet Louisiana's future electricity demand compared with supply-side alternatives. Efficiency program portfolios cost about $0.02–0.04 per kilowatt-hour (kWh)-saved[1] compared with the avoided cost of supply in Louisiana of about $0.03–0.07 per kWh through 2030. Efficiency also has avoided peak demand and avoided T&D benefits. Energy efficiency rate impacts are thus far lower than rate impacts from building new power plants or transmission infrastructure.
- The set of recommended efficiency policies and programs in this report can reduce Louisiana's energy costs by a net $4.2 billion over the life of the energy-saving measures, which is the total resource cost (TRC) test net reduction to all customers.
- Louisiana businesses are interested in achieving more energy efficiency, but face barriers such as high up-front costs and lack of technical expertise. Businesses that take advantage of energy efficiency upgrades can lower their energy bills as a way to improve their bottom line and remain competitive in the global marketplace.

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[1] 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.

- Combined heat and power (CHP) has the potential to cost-effectively provide an additional 600 MW of capacity in Louisiana by 2020, and 1,500 MW by 2030, equivalent to 5% and 12% of retail electricity sales, respectively. CHP can also serve a strategic role in improving reliability of the electric power system.
- The macroeconomic assessment finds that in 2030, the portfolio of efficiency programs and policies will result annually in about $3 billion in net economic output, including $1 billion in wages, and $663 million in business income to small business owners, 27,100 person-years of employment, and increased state and local tax revenue by $114 million.
- There has been growing momentum toward energy efficiency among stakeholders in Louisiana, particularly in New Orleans, but the existing policies and regulations in place are far from sufficient to drive major investments in energy efficiency. Regulatory and policy changes will be needed to reduce the major market barriers to energy efficiency. Our report offers several program and policy options.

BACKGROUND

Louisiana ranked 43rd on ACEEE's *2012 State Energy Efficiency Scorecard* (Foster et al 2012), reflecting the state's fairly limited efforts to improve energy efficiency and that most consumers and businesses in the state do not have access to energy efficiency options and services to help lower their energy bills. But if Louisiana takes advantage of recent momentum toward efficiency in the state, especially in New Orleans, and elsewhere in the Southeast, such as in Arkansas, it can vastly improve economic benefits to the state. Within Louisiana, the New Orleans City Council has developed *Energy Smart* energy efficiency programs in partnership with Entergy New Orleans, has introduced an integrated resource planning (IRP) process to its electric utility planning, and has promoted the development of a skilled energy efficiency workforce through both the *Energy Smart* and the *NOLA Wise* programs. The Louisiana Public Service Commission (LPSC) has also established an IRP process for electric utilities, which establishes a framework for analyzing least-cost resource options, including demand-side energy efficiency, in utilities' long-term planning structures.

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 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 overall success of programs, the APSC is looking to continue ramping up, and recently issued an order recommending new targets for the next 3 years. Louisiana stakeholders can look to the successes, challenges, and lessons learned from Arkansas to help shape the state's investment in energy efficiency resources.

But while there has been some recent momentum on energy efficiency in Louisiana, there have also been setbacks, which appear to stem largely from misconceptions about energy efficiency. In December 2012, the LPSC approved rules that would set up a framework for energy efficiency programs offered by investor-owned electric and natural gas utilities, and a diverse set of stakeholders agreed to the structure of these rules as a good first step toward improved efficiency. But in late February 2013, the LPSC under new leadership overturned those rules. Some Commissioners misjudged the efficiency programs as costly to customers, but, as our analysis shows, the benefits from energy efficiency accrue to all customers in lower energy bills, avoided energy supply costs, and economic development, and these benefits dwarf the small up-front rate impacts.

Given the potential economic benefits of efficiency there is a need for much more investment in energy efficiency in Louisiana. Both sustained leadership and effective implementation will be critical measures of success in tapping into the state's energy efficiency potential.

METHODOLOGY

This report provides a detailed, quantitative analysis of cost-effective energy efficiency potential in Louisiana's buildings and industrial sectors, focusing on end-use electricity and natural gas usage. We organized the analysis, which covers the period 2011–30, into four overall parts:

1. *Reference Case*: Develop a baseline reference case scenario of statewide forecast electricity and natural gas consumption data and prices by customer class.
2. *Cost-Effective Energy Efficiency Potential*: Estimate cost-effective resources potential in each sector using a bottom-up assessment of individual measures within each customer class.
3. *Program and Policy Potential:* Analyze a comprehensive set of program and policy options that Louisiana can adopt or expand to develop its energy efficiency potential.
4. *Macroeconomic Assessment:* Analyze the macroeconomic (jobs, gross state product, tax revenue) impacts from the program and policy scenario.

OVERVIEW OF FINDINGS

Our analysis presents two levels of energy efficiency potential: (1) *cost-effective* or *economic* potential and (2) *program and policy* or *achievable* potential. The program and policy potential is a *subset* of the cost-effective potential. The cost-effective energy savings potential provides an estimate of the overall energy efficiency resource available, but many market barriers and program infrastructure requirements exist that prevent all of the cost-effective resource potential savings identified from immediately being captured. Toward this end, the program and policy analysis is an estimate of the portion of the cost-effective resource potential that can be captured through energy efficiency policies and programs, given customer acceptance (i.e., program participation rates) and the time it takes to ramp up program infrastructure.

Cost-Effective Resource Potential

Our analysis finds that by 2030, there will be enough cost-effective energy efficiency potential to meet about 27% of the state's electricity needs and 19% of the state's natural gas needs (Table ES-1).

Table ES-1. Summary of Cost-Effective Energy Efficiency Resource Potential Results in 2030

Customer Class	Electricity		Natural Gas	
	GWh	%*	MMCF	%*
Residential**	8,253	29%	8,168	34%
Commercial	9,362	33%	9,879	35%
Industrial	6,892	20%	19,855	16%
Total	24,507	27%	37,902	19%

Notes: GWh = gigawatt hours. MMCF = Million cubic feet. *Percentages for each customer class are expressed as a portion of reference case for that customer class in 2030. **Residential analysis includes only single-family homes due to the scope of the building modeling software we used; efficiency potential from multi-family homes is included in the policy and program analysis.

Policy and Program Potential

The policy and program analysis considers the portion of the cost-effective potential that could be achieved through the adoption of several statewide policy options (Table ES-1) and the widespread adoption of tailored customer energy efficiency programs (Table ES-2).

Table ES-2. State Energy Efficiency Policy Options for Louisiana

Statewide Policies, Programs, and Initiatives	*Summary of Analysis Recommendation*
Integrate Energy Efficiency into Resource Planning and Set Energy Savings Targets	Successfully incorporate energy efficiency as least-cost resource into the integrated resource planning process, making an energy efficiency program portfolio considered on par with supply-side resources. Set incremental annual electricity savings targets ramping up to about 1%/year over 6 years and natural gas targets ramping up to 0.7%/year over 6 years (see Table ES-3 program options that together can reach these target levels, our analysis finds).
Utility Performance Incentives and Cost Recovery	Adopt energy efficiency rules that better align a utility's financial motivations with energy efficiency improvements; measures include timely cost recovery, performance incentives, and removal of the throughput incentive.
Updated Building Energy Codes for Residential and Commercial	Adopt at least 2009 IECC for Residential and ASHRAE 90.1-2010 for Commercial buildings
Lead by Example in State and Local Government Facilities	Benchmark energy usage in public buildings, streamline energy service company (ESCO) options and rules, and set public facility energy savings targets
Low-Income Weatherization	Coordinate state weatherization and utility program offerings
Combined Heat and Power (CHP)	Establish regulatory mechanisms to reduce market barriers to CHP, and explore utility participation in CHP markets

Table ES-3. Tailored Energy Efficiency Program Options by Customer Segment

Residential	Commercial	Industrial
New Construction and Building Energy Code Support	New Construction and Building Code Support	Strategic Energy Management
Multi-Family Buildings	Retrocommissioning and Monitoring-Based Commissioning	Custom Incentives for Retrofits
Home Energy Retrofits	Small Business Direct-Install	Prescriptive Equipment Rebates
Upstream Retail Appliances and Electronics	Custom Incentives for Retrofits	Combined Heat and Power
Lighting	Prescriptive Equipment Rebates	Self-Direct Option
Air-Conditioning	Computer and Plug Load Efficiency	Standard Offer or Reverse Auction
Water Heating	Combined Heat and Power	
Low-Income Weatherization		
Information Feedback		

Our review of national best-practice program deployment finds that it takes time to ramp up programmatic infrastructure and to roll out effective customer education and marketing efforts, which means that Louisiana should expect similar needs to ramp up savings over time. Our analysis of energy efficiency program potential in Louisiana finds that this combined set of energy efficiency policies and programs in the state could reach 5% cumulative electricity savings by 2020, increasing to 16% in 2030, and 3% cumulative natural gas savings by 2020, increasing to 12% by 2030 (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-4. Summary of Customer Energy Efficiency Program and Policy Potential for 2030

Customer Class	Electricity		Natural Gas	
	GWh	%*	MMCF	%*
Residential	6,391	17%	6,850	16%
Commercial	6,658	24%	6,388	22%
Industrial	3,028	9%	10,205	8%
Total	16,078	16%	23,442	12%

Combined heat and power (CHP) also has significant potential to cost-effectively meet an additional 12% of electricity needs (Figure ES-1). Our assessment of CHP is based on a previous study that examined Louisiana potential (Chittum & Sullivan 2012), and considers two areas of potential CHP growth: (1) industrial or institutional CHP systems that are operated on-site at facilities, and (2) utilities that make investments in CHP and become full or partial owners in CHP systems as assets in their portfolio of energy capacity. The analysis finds that Louisiana has the potential to add about 600 MW of cost-effective CHP capacity by 2020 and 1,500 MW by 2030.

Figure ES-1. Electricity Energy Efficiency (EE) and CHP Program and Policy Potential by 2030

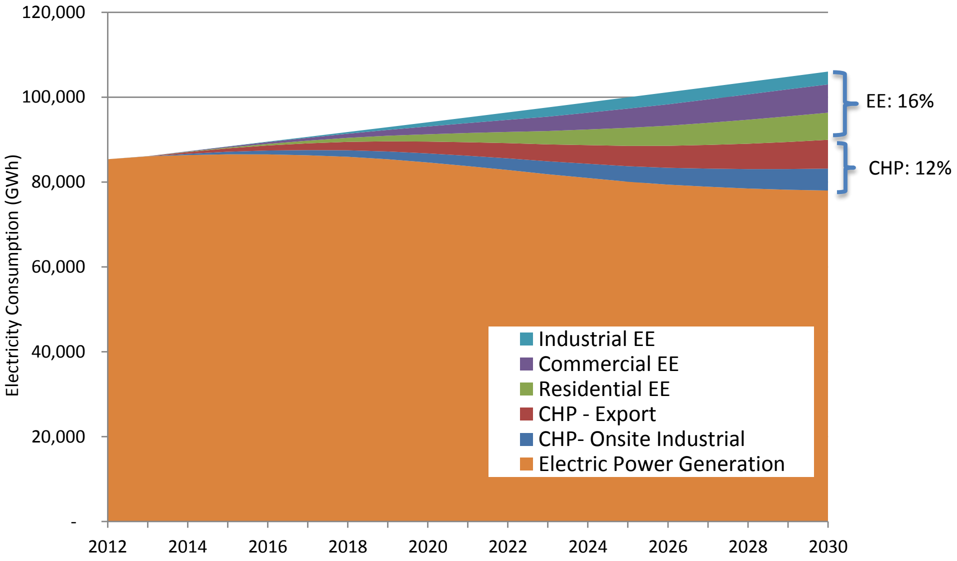
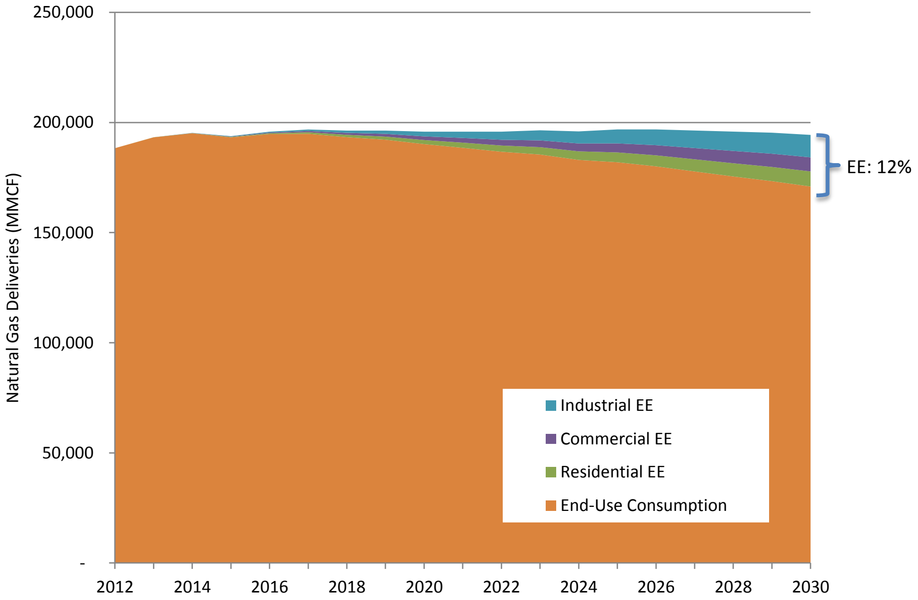


Figure ES-2. Natural Gas Energy Efficiency Program and Policy Potential by 2030



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 and delay or avoid the need to build new power generation. Investments in new power plants or power purchases can be costly and risky long-term investments, which means that the benefits of efficiency to the utility system, and ultimately to all Louisiana ratepayers, can be significant. A recent analysis finds that energy efficiency is the least-risk resource compared with other energy resource options.[2]

Our analysis finds that the set of recommended policies and programs can reduce Louisiana's energy costs by $4.2 billion net over the life of the energy savings measures. The estimated total resource cost (TRC) ratio is 1.8; i.e., each $1 invested in efficiency upgrades and programs (customer and program cost) would yield $1.80 benefits in avoided energy costs to the whole system. These impacts would benefit all ratepayers, because utilities could delay or avoid costlier investments in energy supply and in T&D.

Efficiency programs cost about $0.02–0.04 per kWh-saved, which is lower than the avoided cost of energy in Louisiana of about $0.03–0.07 per kWh through 2030. Efficiency also contributes avoided peak demand and avoided T&D benefits. Thus, energy efficiency rate impacts are far lower than rate impacts from building new power plants or transmission infrastructure. A modest energy efficiency program portfolio such as the quick-start proposal could cost a Louisiana residential customer about $0.47 per monthly bill and a commercial customer about $5.41 per month.[3] To put these charges in context, rate increases from fuel price volatility or new supply or transmission needs can be far higher. As an illustrative example for comparison, the recently proposed rate increases by Entergy Louisiana could mean the same residential customer would see an increase of about $7.56 per monthly bill and the same commercial customer would see an increase of about $76.81.[4] Stakeholders should be careful 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 should be considered as part 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. This comprehensive, analysis finds that the portfolio of efficiency programs and policies would result in the following annual benefits by the year 2030: $3 billion in net economic output, including $1 billion in wages, and $663 million in business income to small business owners, 27,100 person-years of employment, and increased state and local tax revenue by $114 million.

Conclusion

Our analysis finds that energy efficiency can play a critical role in Louisiana's energy future as a least-cost resource that benefits all customers and as an economic development tool. The state's current policies and programs, however, are not sufficient to take advantage of the full energy efficiency potential. The suite of program and policy options presented in

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

[3] This assumes an efficiency program portfolio budget equivalent to 0.5% of revenue, an average residential customer in Louisiana using 1,000 kWh per month, and an average commercial customer using 12,500 kWh per month.

[44] This is for illustrative purposes only, to put the relative size of the rate impact in perspective. The Entergy Louisiana proposed rate increase estimates are from: http://www.entergy-louisiana.com/content/2013ratecase/RateCase_FactSheet.pdf

this report can help the state improve its energy efficiency, lower energy bills for all customers, and foster economic growth. Both sustained leadership and effective implementation will be critical measures of success in tapping into the state's energy efficiency potential.

Acknowledgments

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Introduction

Louisiana’s homes, buildings, and facilities hold great potential for saving energy, which together can reduce energy demand and thereby avoid the need for new energy supply and transmission investments. By 2030, Louisiana expects that future population and economic growth will require new energy resources, and energy efficiency can play an important role toward meeting this need. Energy efficiency is the cheapest, cleanest, and lowest-risk solution to meet rising energy demand while bringing economic development to the state, addressing volatility of fuel prices, and uncertainty in environmental regulations.

Louisiana ranked 43rd on ACEEE’s *2012 State Energy Efficiency Scorecard* (Foster et al 2012), reflecting the state’s fairly limited efforts to improve energy efficiency and that most consumers and businesses in the state do not have access to energy efficiency options and services to help lower their energy bills. But there has been recent momentum toward improving energy efficiency. Within Louisiana, the New Orleans City Council has developed *Energy Smart* energy efficiency programs in partnership with Entergy New Orleans (ENO). The Louisiana Public Service Commission (LPSC) has also established an Integrated Resource Plan (IRP) process for electric utilities, which establishes a framework for analyzing least-cost resource options, including demand-side energy efficiency, in utilities’ long-term planning structures.

The Southeast region as a whole is also trending toward greater interest 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 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 geared up and hit their targets in 2012. The two largest utilities in Arkansas, Entergy and Southwestern Electric Power Company (SWEPCO), together achieved over 125,000 megawatt hours (MWh) of savings in 2012, exceeding their targets. Entergy exceeded its 2011 and 2012 targets of 0.25% and 0.5% of sales, respectively, while SWEPCO achieved about 80% of its target in 2011 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 for the largest two utilities, 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; i.e., how do utility energy efficiency programs compare with utility supply-side investments? The Arkansas program results find a “utility cost test” of about 2.30 from 2011–12, which means that each $1 invested in efficiency programs yielded about $2.30 in benefits to the utility system. Again, these are benefits that ripple through to all customers, not just participants.

Given the overall success of programs, the APSC is looking to refine practices and policies for the next phase and is considering ramping up. The PSC recently issued an order recommending new targets for the next 3-year phase, ramping up to 1%, 1.25%, and 1.5% from 2015–17 (APSC 2013). Before setting the targets, stakeholders requested that an energy efficiency potential study be conducted to guide the decision-making process. Louisiana stakeholders can look to the successes, challenges, and lessons learned from Arkansas to help shape the state's investment in energy efficiency resources.

But along with some recent momentum on energy efficiency in Louisiana, there have been setbacks, which appear to stem largely from misconceptions about energy efficiency. In December 2012, the LPSC approved rules that would set up a framework for energy efficiency programs offered by investor-owned electric and natural gas utilities. A diverse set of stakeholders agreed to the structure of these rules. However, in late February 2013, the LPSC under new leadership overturned those rules. Some Commissioners misjudged the efficiency programs as costly to customers, but as our analysis shows, the benefits from energy efficiency accrue to all customers in lower energy bills, avoided energy supply costs, and economic development, and these benefits dwarf the small, up-front rate impacts.

Energy efficiency not only lowers energy bills, it also strengthens the economy. Given these benefits of efficiency, there is a need for new and expanded efforts in Louisiana, both in sustained leadership and effective implementation. If the state takes advantage of recent momentum on efficiency, it can vastly improve economic benefits to the state.

Methodology

This report provides a detailed, quantitative analysis of cost-effective energy efficiency potential in Louisiana's buildings and industrial sectors statewide.[5] The report also outlines a comprehensive set of energy efficiency options; a detailed analysis of the program costs and benefits; and a macroeconomic assessment of the impact of these potential investments on the state's job and economic situation. In this section we describe our overall project approach and methodology.

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 Louisiana is the latest study in this series of reports. ACEEE also prepared a companion report for New Orleans.

STAKEHOLDER ENGAGEMENT

Part of our project methodology is to engage with stakeholders in Louisiana 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 stakeholder groups in Louisiana was a significant undertaking, and we endeavored to meet in person or via telephone with as

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[5] This report covers energy efficiency potential statewide in Louisiana, including New Orleans. An accompanying report (Mackres and Molina 2013) examines New Orleans in more detail. We do not include an analysis of transportation efficiency potential.

many different stakeholders as possible and shared a draft of this report widely in order to get feedback.

ANALYSIS APPROACH

The following describes each of the steps in our analysis:

1. Reference Case Forecast

The first step in conducting the analysis was to collect data to characterize the state’s current and expected patterns of electricity and natural gas consumption over the study time period (2011–30), 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. Cost-Effective Energy Efficiency Resource Assessment

The next task in estimating energy efficiency potential was to assess the cost-effective resource that is available given the state’s mix of residential, commercial, and industrial energy consumers. This component is comparable to the “economic potential,” as termed in many energy efficiency potential studies. We examined dozens of energy efficiency measures by customer class and by end use for electricity and natural gas potential savings.

3. Energy Efficiency Policy and Program Analysis: A Roadmap to 2030

While cost-effective resource assessments provide an important basis for understanding the general magnitude and types of energy efficiency potential in a given state, their limitation is that they provide theoretical estimates but not solutions for capturing the efficiency resource through specific policies and programs. Toward this end, our study analyzes a specific suite of energy efficiency policies and programs that could be adopted and ramped up over time. The suite of policies, including measures like building codes and utility programs, would enable homeowners and businesses in the state to take advantage of the energy efficiency resource. This component is comparable to the “achievable potential,” as termed in many energy efficiency potential studies.

4. Macroeconomic and Emissions Impacts

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 Louisiana. Evergreen Economics uses an input-output model that evaluates macroeconomic impacts of energy efficiency investments. Finally, we assessed the impacts of energy efficiency policies to reduce air emissions, including carbon dioxide, sulfur dioxide, and nitrogen oxides.

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 2030) 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 it is 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 policymakers on possible future scenarios. We account for uncertainty in this energy efficiency analysis by assuming a 5% real discount rate in the net present value (NPV) cost/benefit analysis of energy efficiency programs and policies.

Background: Policy Context

The policy context for energy efficiency in Louisiana'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 vertically-integrated utilities, and establish policy. 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 (but are not limited to)

- Electric and natural gas utilities, which include investor-owned utilities (IOUs), municipal utilities, and cooperative utilities
- The LPSC, which regulates IOUs and cooperatives
- State legislature and governor's office, which set policy
- Numerous state agencies, including the Louisiana Department of Natural Resource (DNR) (which houses the State Energy Office), Louisiana Economic Development (LED), and Department of Environmental Quality
- Municipal governments, which oversee building energy code enforcement and often deliver energy to citizens through municipal utilities
- Non-profit organizations, such as the Louisiana Association of Community Action Partnerships, which oversees weatherization services
- Private-sector interests, including large manufacturers

UTILITY REGULATORY CONTEXT

The LPSC regulates all electricity and natural gas IOUs and electric cooperatives in the state (except for ENO, which is regulated by the New Orleans City Council) and therefore is a major policy stakeholder. At the LPSC, there have been two recent major developments on energy efficiency policy: (1) IRP process rulemaking (Docket R-30021), and (2) energy efficiency rules for IOUs (Docket R-31106). Both steps point toward a greater interest in putting demand-side energy efficiency on a level playing field with supply-side resources as a least-cost option. The recent reversal of the efficiency rules, however, suggests that the state is moving away from, or at least losing time capturing, its least-cost resource.

Integrated Resource Planning

A process to ensure the long-term reliability of delivered energy at the lowest practical cost, IRP is used in about 40 states (Synapse 2011). In March 2012, the LPSC voted to adopt IRP rules, which direct investor-owned electric utilities in the state to develop long-term plans for both supply- and demand-side resources (LPSC 2012). The rules also provide utilities with the flexibility to develop plans that meet their specific needs, and require a collaborative working process with stakeholders. A utility has 6 months after issuance of the order to file a simplified IRP report based on most recently developed IRPs, 18 months to initiate its first IRP cycle, and for each successive IRP cycle no later than 4 years after the request to initiate the prior cycle.

As the largest IOU in Louisiana, Entergy covers a wide portion of the state (Figure 1). An IRP for the Entergy System issued in October 2012 for 2012–31 updates previous versions of the company's Strategic Resource Plan (Entergy 2012a). The 2012 IRP reflects the long-term resource planning scenarios for the remaining four operating companies within the system.[6] Some of the key uncertainties listed in the IRP include load growth, which will determine actual resource needs; relative economics of technologies; environmental compliance requirements; and access to capital at reasonable cost. In its reference forecast scenario, the company estimates electricity growth to be about 0.8% per year.

Figure 1. Entergy Louisiana and Entergy Gulf States Service Area

Entergy's IRP puts forth a "preferred portfolio" as a strategy to meet long-term electricity needs. Within this strategy, two new resources currently planned are assumed to come online: (1) Ninemile 6 combined-cycle gas turbine (CCGT), under construction, is planned to begin operations in 2015, and (2) 300 MW of capacity (type is unspecified) is added in the Western Area in 2017. Near-term incremental needs through 2020 are met largely from purchased power from existing facilities, and no new resources are needed beyond those mentioned above. Post-2020, the company anticipates new build capacity will come from a combination of combustion turbine (CT) and CCGT resources.

The demand-side management (DSM)[7] analysis of the IRP was based on an energy efficiency market-achievable potential study for incremental utility-sponsored programs prepared by ICF International. The analysis modeled 22 DSM programs and included three scenarios of program spending on program incentives (low, reference, and high levels). Total DSM for the system by 2031 is 990 MW. The IRP preferred portfolio has 190 MW for Entergy Louisiana and 131 MW for Entergy Gulf States Louisiana. For ENO specifically, the reference case estimate of DSM potential finds that about 200 MW of peak demand reduction could be achieved by 2031 cost-effectively with an average TRC of 1.9; i.e., every $1 of investment yields $1.90 in benefits of

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[6] Entergy Arkansas (EAI) and Entergy Mississippi will withdraw from the System Agreement.

[7] Demand-side management (DSM) is a commonly used term that often encompasses both energy efficiency and demand response resources.

avoided energy resources (Entergy 2012b). Statewide, the combined DSM from these three Entergy companies (Louisiana, Gulf States, and New Orleans) is 524 MW.

The other IOUs have also submitted IRPs; for example, SWEPCO submitted a "Simplified Integrated Resource Plan" to the LPSC in July 2012 (SWEPCO 2012), and Cleco Power filed its initial IRP in June 2012 (Cleco 2012). Both companies project annual growth in electricity consumption of about 1% per year through 2030.

Going forward, the IRP process will be an important avenue for examining the potential for energy efficiency resources; however, the process alone will not necessarily motivate utilities to deploy available energy efficiency resources. Several barriers may still stand in the way, such as misalignment of the utility business model with energy efficiency and lack of program experience and infrastructure. These barriers are discussed in the policy analysis later in this report.

Energy Efficiency Rules

In December 2012, the LPSC approved new energy efficiency rules, but the rules were subsequently overturned in February 2013 after a change in leadership. The rules had followed some aspects of the Arkansas model, which included a "Quick Start" Phase I, during which utilities would implement an initial set of energy efficiency programs for their customers, and a collaborative Phase II process to discuss long-term energy efficiency rules. The quick-start process would have begun program year (PY) one by early 2014 and would have completed PY two by early 2016.

Cooperatives and municipal utilities also have a role in energy efficiency. They would not have been subject to the LPSC rules that were overturned, but rather could have followed the leadership of the city or town, or in the case of cooperatives, a membership-based structure. The Lafayette Utilities System, for example, is a leader in advanced energy planning among municipal utilities in the state, and has been looking to the LPSC for leadership in energy efficiency. Lafayette has begun initiatives on smart grid projects, but has yet to deploy large-scale energy efficiency programs.

New Orleans

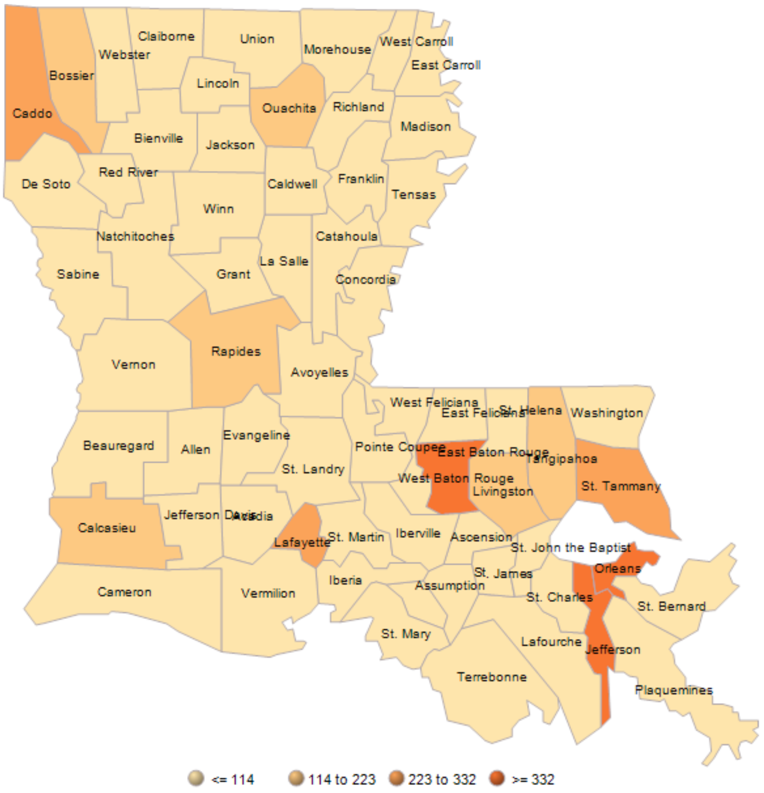
New Orleans has shown leadership on energy efficiency in the state by taking policy and regulatory steps toward greater energy efficiency for its residents. Strong stakeholder interest and the New Orleans City Council's direct regulation of Entergy New Orleans, Inc. has made the city a venue for introducing effective programs and providing an excellent example to the rest of the region. New Orleans has successfully introduced an IRP process to its electric utility planning. The city is 2 years into running its successful *Energy Smart* customer efficiency programs, which are administered by ENO, and is planning to continue them in the next program cycle. Additionally, the city has promoted the adoption of comprehensive efficiency actions and the development of a skilled energy efficiency workforce through both the *Energy Smart* and *NOLA Wise* programs. The successes on energy efficiency in New Orleans still leave many opportunities for further improvement, however. These opportunities for improved energy efficiency are analyzed in a separate companion report on energy efficiency in New Orleans (Mackres and Molina 2013).

Background: Demographics and Energy Consumption

Energy consumption in Louisiana occurs predominately in the industrial sector (66.5%), followed by the transportation (17.1%) and buildings (16.4%) sectors (EIA 2010). Our analysis covers electricity and natural gas energy efficiency opportunities in buildings and industry, but does not cover the transportation sector.

Figure 2 shows the population of Louisiana by parish, which demonstrates that population loads are concentrated mainly in the Southeast portion of the state. Total population in 2012 was about 4.6 million, and by 2030 that figure is projected to reach about 5 million (Moody's Analytics 2012).

Figure 2. Louisiana Population by Parish in 2011 (Thousands)



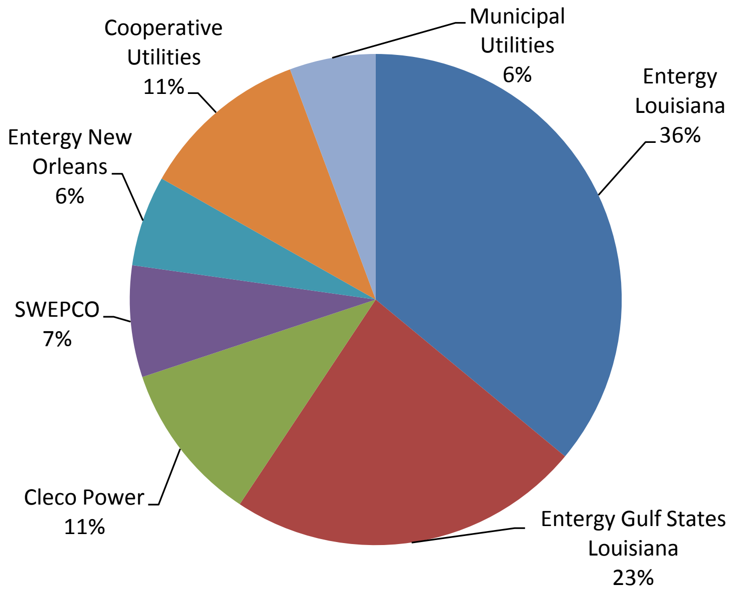
Source: Moody's Analytics

ELECTRICITY

Figure 3 shows the breakdown of Louisiana's electricity sales in 2011 by provider type. The IOUs are Entergy (the three operating companies serving Louisiana are shown), Cleco, and SWEPCO. Together, the IOUs comprise the vast majority (83%) of electricity sales in the state, and the remaining sales are provided by cooperatives (11%) and municipal utilities (6%). Combined, the Entergy operating companies that serve Louisiana provide the majority of the state's electricity load (65%): Entergy Louisiana (36%); Entergy Gulf States Louisiana (23%); and Entergy New Orleans (6%). In total, there are six operating companies within the Entergy System (soon to be four after Entergy Arkansas and Entergy Mississippi leave the system). Cleco is the next largest IOU with 11% of electricity sales, followed by SWEPCO (7%), an

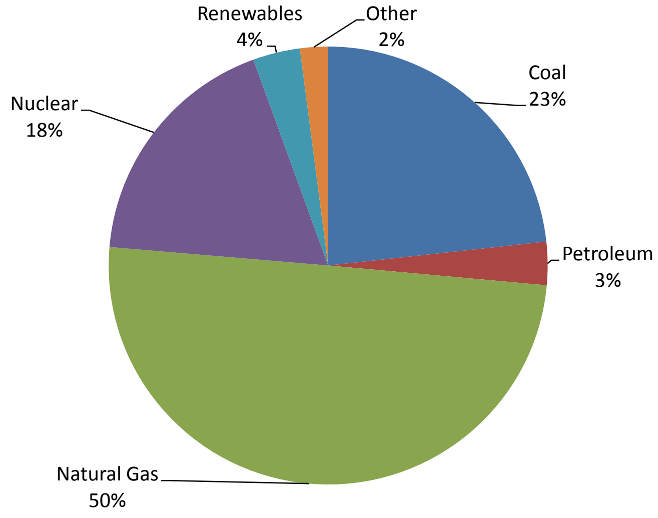
American Electric Power (AEP) company with a service area that includes Louisiana, Arkansas, Texas, and Oklahoma.

Figure 3. Retail Electricity Sales by Utility in Louisiana (2011) Total Sales



Source: EIA 2012a (Electric Power Annual)

Figure 4. Louisiana Electricity Generation Mix by Energy Source (2010)



Source: EIA 2011 (Electric Power Annual)

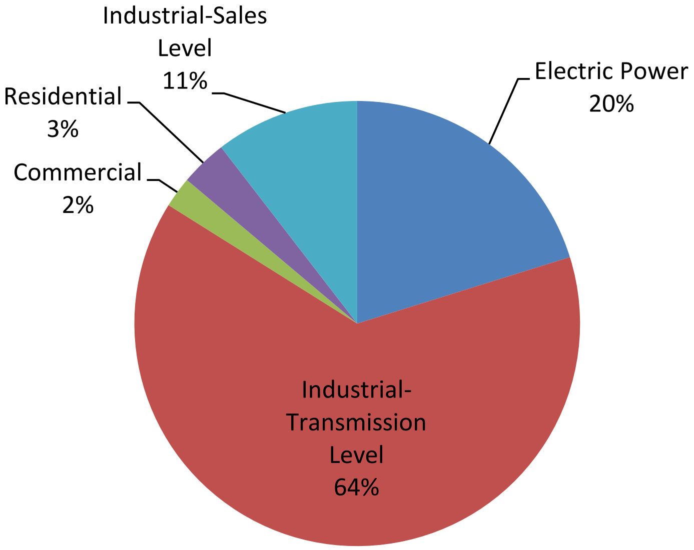
Figure 4 shows the share of electricity generation in Louisiana in 2010 by resource type. Natural gas is the largest source, accounting for half of electricity generation. Coal (23%) and nuclear (18%) are the next largest sources. Renewable energy accounts for 4% of generation, petroleum accounts for 3%, and "other" makes up the remaining 2%.

NATURAL GAS

Louisiana is the second-largest producer of natural gas in the country and the third-largest consumer of natural gas, driven largely by consumption in the state's industrial sector (EIA 2009a). The natural gas sector is characterized by a very diverse set of providers and customer classes. As shown in Figure 5, the electric power sector and industrial (transmission-level[8]) sectors account for the vast majority (84%) of natural gas usage in Louisiana.

Figure 5. Natural Gas Deliveries to Customers in Louisiana by Sector (2011)

(Total Deliveries ~1,160 Billion Cubic Feet [BCF])



Source: EIA 2013a

For the program and policy analysis of end-use efficiency potential in this study, we focused 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 with the industrial sector, this is due mainly to the very large industrial sector in the state. The buildings sectors are comparable in size to those of other states in the region, and have large potential for energy efficiency and economic benefits to residential and commercial customers. For example, nearly half of homes in Louisiana use natural gas for heating, water heating, and/or cooking, as well as other end uses. In the commercial sector, an estimated 63% of building floor space uses

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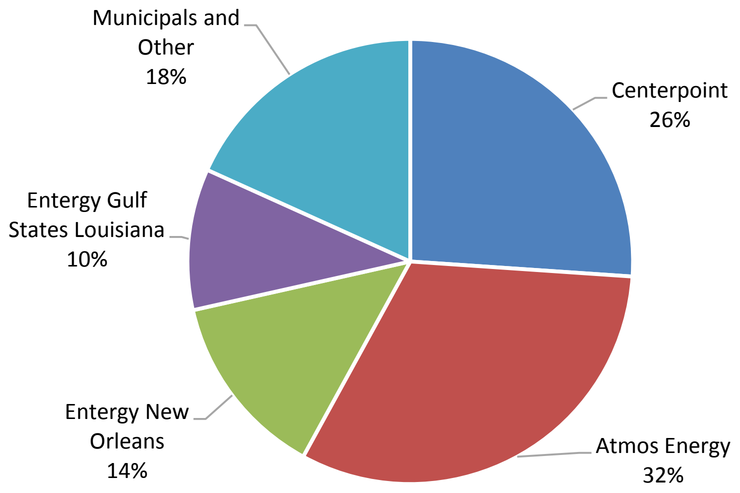
[8] We disaggregate natural gas usage into "transmission-level," in which the customer takes delivery of the natural gas directly from a natural gas transmission pipeline regulated at the federal level, and "sales-level," in which the customer takes delivery of the gas from a local distribution company (LDC) utility 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 policymakers in the state.

natural gas for heating, water heating, and cooking. Several different providers serve these sectors in Louisiana, as shown in Figure 6.

Figure 6. Louisiana Residential and Commercial Natural Gas Sales-Level Deliveries by Utility in 2011

(Total Deliveries ~65 Billion Cubic Feet [BCF])



Source: EIA 2013a

As defined by the LPSC for the purpose of defining which gas utilities would be covered under the energy efficiency rules, “Group I” gas utilities include Atmos Energy Louisiana, CenterPoint Energy Resources Group[9]; and Entergy Gulf States Louisiana. Together, these utilities account for 68% of statewide residential and commercial natural gas deliveries (see Figure above) and 4% of statewide industrial deliveries. Figure 7 shows the distribution of natural gas sales by customer class among Group I utilities alone (for sales-level data only, not transmission-level), which demonstrates that all customer classes can contribute energy efficiency resources to the utility system.

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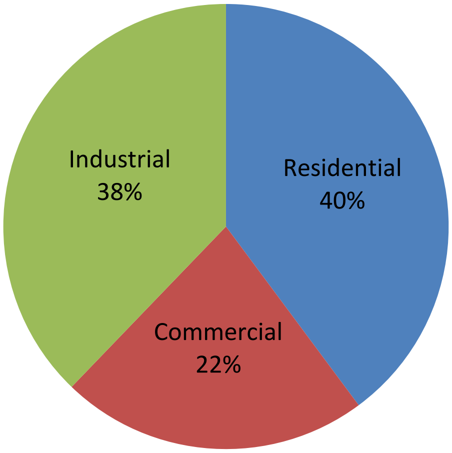
[9] Centerpoint Energy Resources Group includes retail distributors CenterPoint Arkla and Centerpoint Enex; it does not include transmission-level distributors.

Figure 7. "Group I" Sales-Level Natural Gas Deliveries by Sector in Louisiana (2011)

(Total Deliveries ~72 Billion Cubic Feet (BCF))



Source: EIA 2013a

Reference Case

The first task in developing an energy efficiency potential assessment for Louisiana 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 EIA and utility IRP documents over the 2010-30 time period.

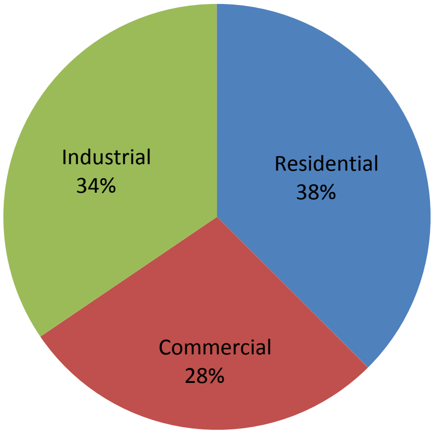
ELECTRICITY

Figure 8 shows the statewide disaggregation of sales by customer segment in 2011 (EIA 2012a). The residential sector accounts for the largest share of electricity sales (38%), followed by the industrial sector (34%) and the commercial sector (28%). Louisiana derives a larger share of sales from its industrial sector compared with the national average of 24%, and a smaller share of commercial sales compared with the national average of 35%.

To develop the electricity reference case, we began with this state-level and utility-level data from EIA. We used the EIA statewide sales data in lieu of individual utility-provided sales data to ensure that we accounted for all utilities in the state, including the smaller IOUs, municipal utilities, and electric cooperatives. Next, we compiled sales forecast data from individual utility IRPs for all IOUs and calculated the projected annual growth rate for each utility's service territory (Entergy 2012a; 2012b; SWEPCO 2012; Cleco 2012). Because each utility has its own growth forecast, which varies based on the needs of its customers, it's important to compile an IRP from each major utility. We apportioned these growth rates according to the percentage of electric sales in the state attributed to each utility. Finally, we applied this aggregate growth rate to the statewide EIA electricity sales data to develop the reference case electricity sales forecast through 2030.

Using this methodology, total electricity sales in Louisiana statewide (including New Orleans) is forecast to grow in the reference case at an average annual rate of 0.8% between 2010 and 2030 (Figure 9). Actual statewide electricity sales in Louisiana in 2011 were 87,105 gigawatt hours (GWh), and in the reference case are projected to grow to 91,445 GWh by 2020 and 99,415 GWh by 2030.

Figure 8. Louisiana Electricity Sales by Customer Segment (2011)



Source: EIA 2012a; Note: Transportation sales accounted for .01% of statewide sales.

Utility forecasts of sales by customer class or segment were not readily available, so we used regional projections in EIA's *Annual Energy Outlook 2012* for the West South Central region to estimate growth by customer segment. Figure 10 shows our projection for electricity demand in Louisiana by customer class for the time period of the study, 2010–30.

We also estimate statewide electricity peak demand growth through 2030 using our statewide sales forecast multiplied by the average of the peak load factors for Entergy Louisiana and Energy Gulf States Louisiana from the 2009 Entergy System IRP. We estimate that peak demand will grow at an average annual rate of 0.8%, from 14,283 MW statewide in 2010, to 15,351 MW in 2020 and 16,830 MW in 2030.

Figure 9. Louisiana Electricity and Peak Demand Reference Case Forecast

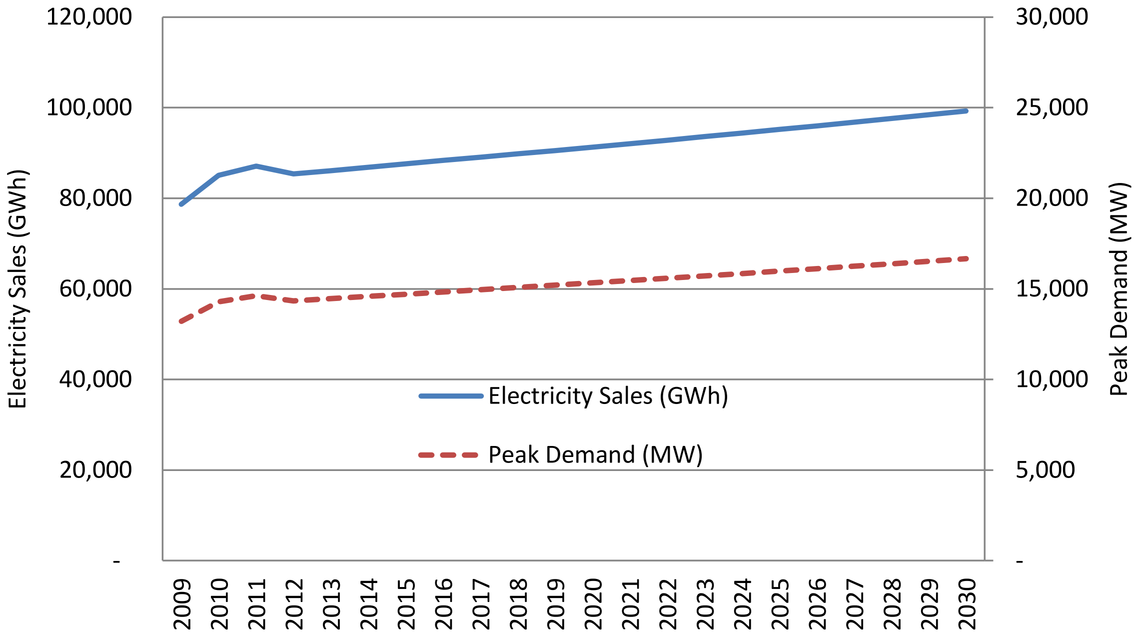
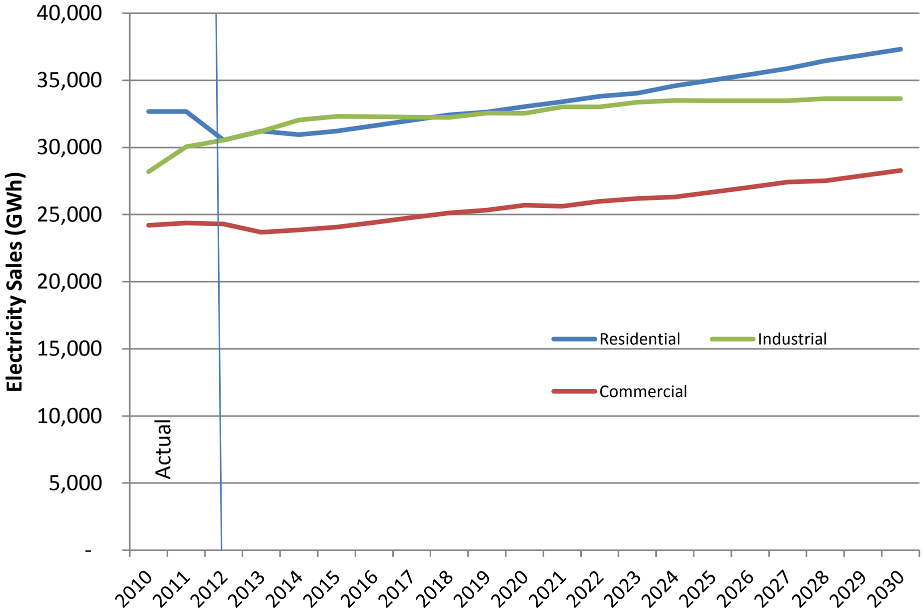


Figure 10. Louisiana Electricity Reference Case Forecast by Sector

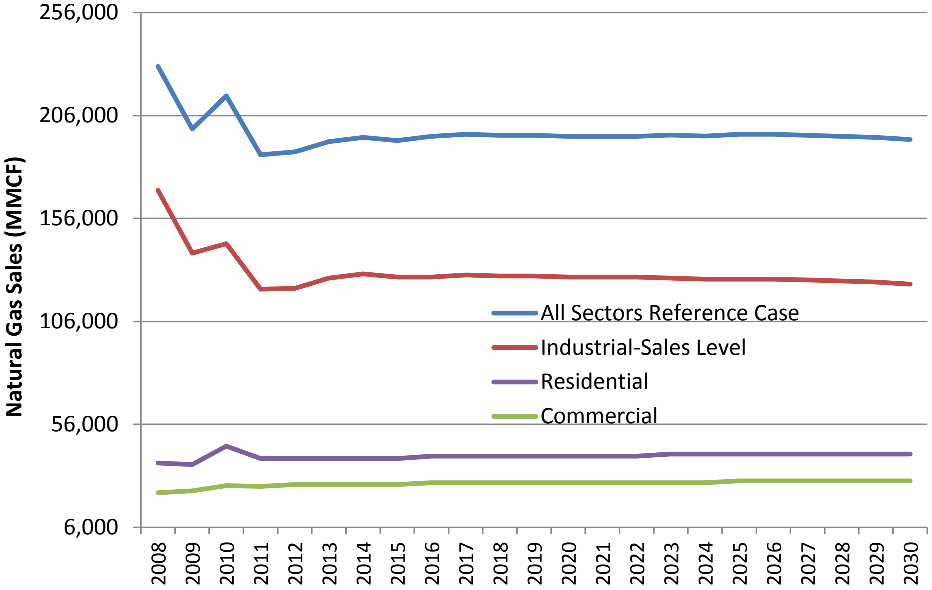


NATURAL GAS

Figure 11 shows the natural gas reference case forecast for all sectors. We used data from two EIA reports to develop this reference case for natural gas demand: the *Natural Gas Annual Respondent Query System* for baseline data on actual consumption from 2008–11 (EIA 2013a), and the *Annual Energy Outlook 2012* for projections of demand (EIA 2012b). We used the annual growth rates from the AEO 2012 projections of natural gas demand in the West South Central census region (of which Louisiana is a part) and applied these growth rates to actual sales for Louisiana.

The reference forecast for the industrial sector includes sales-level data only (not including transmission-level service), and the downward trend in sales-level data in the chart from 2008–11 is somewhat misleading because transmission-level industrial gas demand actually increased over this time. Even though sales-level consumption decreased, total industrial natural gas demand increased from about 793 billion cubic feet (BCF) in 2008 to 863 BCF in 2011. Industrial consumption is projected to increase over the first few years and then decrease slightly over the remainder of the study period. Natural gas demand in the residential and commercial sectors is forecast to see moderate growth over the next 2 decades. Overall, natural gas demand is projected to grow at an average annual rate of 0.04% based on the AEO regional projections (AEO 2012).

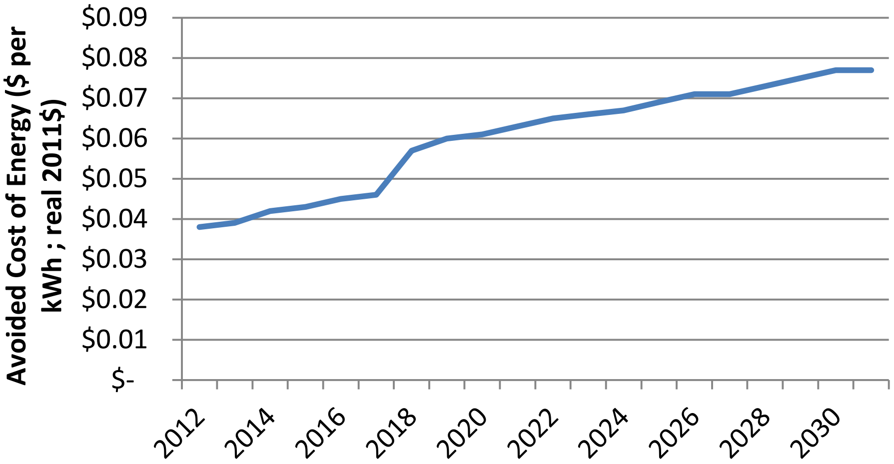
Figure 11. Louisiana Statewide Natural Gas Consumption Forecast for Residential, Commercial, and Industrial (Sales-Level) Sectors (MMCF)



RETAIL PRICES AND AVOIDED COSTS FORECAST

Energy efficiency improvements have the effect of lowering energy consumption, which in turn can avoid the need for new investments in energy supply or transmission. The benefits to the utility system from energy efficiency therefore are quantified in terms of "avoided costs," which typically include avoided purchases or investments in energy, generation capacity, and transmission and distribution (T&D) infrastructure. For this analysis, we used avoided energy cost estimates from the Entergy New Orleans IRP, as shown in Figure 12, which are based on a weighted average forecast for the Entergy system (Entergy 2012b). We used these values, along with the avoided cost of capacity values from the same source to evaluate the benefits of energy efficiency resources. The avoided cost of capacity range from about $160/kW to $170/kW.

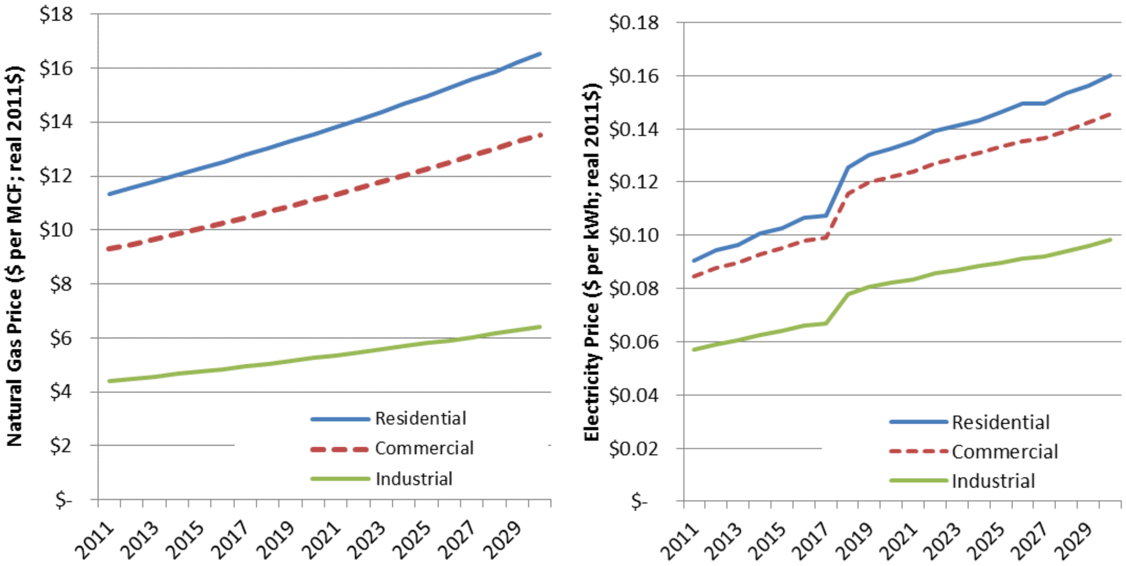
Figure 12. Avoided Cost of Energy Projections through 2030 (2011$)



Source: Entergy 2012b

Figure 13 shows projections for retail electricity and natural gas prices for 2011–30. Statewide electricity and natural gas rates for the baseline year 2011 are based on EIA data (EIA 2012b). We developed a forecast of electricity and natural gas retail prices through 2030 based on the same projections from the Entergy New Orleans 2012 IRP, Appendix C (Entergy 2012b). The annual escalation rates are based on the annual increase in Entergy system avoided costs for electricity prices and are assumed at 2% per year for natural gas prices (Entergy 2012b).

Figure 13. Retail Price Forecast by Sector for Natural Gas and Electricity



Note: MCF = Thousand cubic feet.

Energy Efficiency Resource Potential

This section presents our analysis of statewide cost-effective energy efficiency resources in Louisiana by customer class. The energy efficiency resource assessment represents the potential energy efficiency savings available in the state from implementation of specific end-use measures in buildings and industrial facilities from the end-use customer perspective, without specific consideration of the policy and program drivers needed to capture the efficiency potential.

Our assessment is a bottom-up, measure-by-measure analysis of energy efficiency resources for each customer sector (residential, commercial, and industrial) and for the two largest end-use energy sources (electricity and natural gas). We quantified the potential energy savings and costs through 2030 generated by specific efficient technology measures over their lifetime, such as windows, water heaters, and central air-conditioning units, taking into account estimates of the current market share/penetration of the measures. These values are then used to determine each measure’s overall cost effectiveness from the customer perspective, which compares the incremental efficient measure cost with the retail energy bill savings to the customer.[10]

Our assessment complements ICF International’s energy efficiency potential analysis for ENO, as we drew from similar sources for energy -savings potential and costs of many individual measures, and in some cases used the same assumptions about individual measures. Our analysis examines statewide potential, whereas the ICF analysis examines the New Orleans service area alone. Whereas the ICF potential assessment includes electricity-saving measures alone, our analysis also considers the potential for cost-effective natural gas savings. When natural gas savings are taken into account, some whole-house or whole-building measures that also save electricity, such as infiltration reduction and insulation, may become cost-effective for a wider group of homes and buildings.

For each customer class, we conducted two separate assessments for electricity and natural gas savings, accounting for the fact that the electricity and natural gas measures are applicable to different percentages of homes and commercial floor space in the state. As such, we did not specifically model fuel switching measures; however, as discussed in the energy efficiency program analysis, we recognize that fuel switching measures in some cases (i.e., when they save energy and money for customers) can be cost-effective.

The measures included in this analysis are limited to those currently available commercially and currently cost-effective. New efficiency measures that will become available or cost-effective in the future and offer new opportunities for cost-effective energy efficiency are not captured in this analysis. For all measures that are deemed cost-effective, we aggregated the potential savings, grouped by end use, to provide an estimate of the volume of statewide energy savings potential available in each sector. More detailed information is provided in Appendix A. Table 1 presents a summary of findings from the cost-effective resource potential assessment.

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[10] We took this approach as a way to evaluate the overall cost-effective resource potential in Louisiana. (The next section on program and policy potential evaluates potential more specifically from the utility/program administrator perspective.)

Table 1. Summary of Energy Efficiency Resource Potential Results for 2030

Customer Class	Electricity		Natural Gas	
	GWh	%*	MMCF	%*
Residential**	8,253	29%	8,168	34%
Commercial	9,362	33%	9,879	35%
Industrial	6,892	20%	19,855	16%
Total	24,507	27%	37,902	19%

Notes: *Percentages for each customer class are expressed as a portion of reference case for that customer class in 2030. **Residential analysis includes only single-family homes due to the scope of the building modeling software we used; multi-family homes also have significant potential as modeled in our policy analysis.

The volume of savings quantified in this assessment shows the *cost-effective* energy savings potential available to capture. It is important to understand that many market barriers prevent all of the cost-effective resource potential savings identified from being captured by energy efficiency programs. The *achievable* potential analysis, also known as the program and policy analysis, follows this cost-effective resource assessment and provides an estimate of the portion of the cost-effective resource potential that could be captured through energy efficiency policies and programs.

RESIDENTIAL

For our analysis of energy efficiency potential for Louisiana's residential sector, we used a residential building energy modeling software package, the Targeted Retrofit Energy Analysis Tool (TREAT), to first compute several average "model" baseline Louisiana single-family homes, and the potential energy savings available (PSD 2012). The baseline homes were computed using a variety of housing and energy-uses characteristics gathered from a combination of national datasets with regional data, including EIA's *Residential Energy Consumption Survey (RECS)* (EIA 2009b), Entergy New Orleans' energy efficiency assessment completed by ICF, and conversations with in-state contacts. First, we input these housing characteristics into TREAT to model eight typical home types. See Appendix A for more detailed information on the TREAT model home inputs.

The savings potential in our analysis is based on the amount of energy that can be saved compared with the total single-family energy use in Louisiana. We estimate total energy use in single-family homes by applying the ratio of single-family energy use to average residential use based on data from RECS, and then apportioning energy consumption estimates to the different types of housing.[11] In 2030, this calculation results in baseline consumption of approximately 28,000 GWh for single-family homes out of 37,000 GWh for all residential usage; and 33,000 MMCF natural gas for single-family homes out of 42,000 MMCF for all residential usage.

We were not able to model energy savings measures specifically for multi-family homes with the TREAT software in this analysis; however, many of the same measures for single-family homes are applicable to multi-family residences. Significant potential is available in the multi-family

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[11] We derived this ratio using housing stock data from Louisiana for single-family homes, multi-family homes, and manufactured housing (Moody's 2012).

sector, and we estimate the energy efficiency potential for this sector in the detailed program and policy analysis.

Next we evaluated 18 efficiency measures that could be adopted in existing single-family residential homes based on cost effectiveness. For the purposes of this resource assessment, an upgrade to a new measure was considered cost-effective if its levelized cost of saved energy[12] was less than $0.09 per kWh, or $11.57/MCF for gas, the statewide residential retail prices for energy (EIA 2012a); in other words, if it is cheaper to pay to save a unit of energy than to pay to use that energy. For the measures we analyzed, the average levelized cost per measure was $6.79/MCF for natural gas and $0.03/kWh for electricity. Tables 2 and 3 outline the end uses analyzed, their savings potential, and the estimated cost of saved energy. Our analysis finds that single-family residential homes in Louisiana can cost-effectively save 8,253 GWh by 2030, or 29% relative to reference case forecast.

Table 2. Single-Family Residential Energy Efficiency Potential and Costs in 2030—Electricity

End Use	Savings (GWh)	Savings %[13]	Savings as % of End Use	% of Efficiency Potential	Levelized Cost of Saved Energy ($/kWh Saved)
Heating, Cooling, and Building Envelope	3,717	13%	46%	45%	$0.05
Water Heating	1,319	5%	52%	16%	$0.03
Lighting	1,132	4%	26%	14%	$0.01
Appliances and Plug Loads	564	2%	6%	7%	$0.02
Behavioral	406	1%	2%	5%	$0.01
Subtotal: Existing Homes	7,138	25%	34%	86%	$0.04
New Construction	1,150	4%	16%	14%	$0.02
Total	**8,288**	**29%**	**29%**	**100%**	**$0.03**

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[12] For this analysis, the levelized cost of saved energy is equivalent to the incremental cost of an efficient measure (compared with a baseline measure) discounted over the lifetime of the measure using a 5% real discount rate.

[13] Savings are relative to the 30,005 GWh baseline electricity use for single-family homes.

Figure 14. Share of Single-Family Residential Energy Efficiency Potential in 2030 by End Use— Electricity

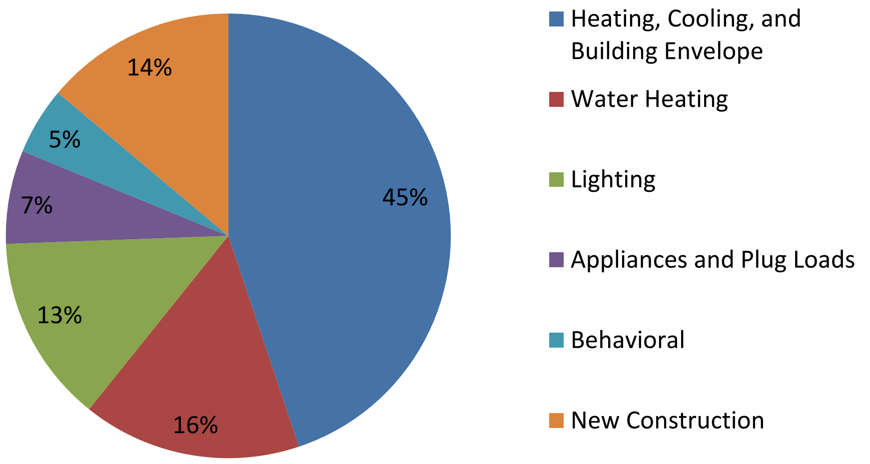

Table 3. Single-Family Residential Energy Efficiency Potential and Costs in 2030 — Natural Gas

End Use	Savings (MMCF)	Savings %[14]	Savings as % of End Use	% of Efficiency Potential	Levelized Cost of Saved Energy ($/MCF)
Heating, Cooling, and Building Envelope	3,880	17%	33%	48%	$7.03
Water Heating	2,807	12%	23%	34%	$6.66
Lighting	n/a	0%	0%	0%	n/a
Appliances and Plug Loads	n/a	0%	0%	0%	n/a
Behavioral	237	1%	1%	3%	$2.19
Subtotal: Existing Buildings	6,924	29%	29%	85%	$6.61
New Construction	1,244	4%	5%	15%	$7.01
Total	**8,168**	**33%**	**34%**	**100%**	**$6.67**

COMMERCIAL

Our analysis of cost-effective energy efficiency potential in Louisiana's commercial buildings sector evaluates sectorwide savings from about 40 electricity end-use and 23 natural gas end-use measures relative to the reference energy forecast and estimated commercial floor space in the state. We did not use building modeling software, as was done for the residential analysis, but rather analyzed potential in aggregate across all building types. Our analysis accounts for pending changes in federal equipment standards; i.e., measure baseline energy usage is adjusted to account for pending upgrades to standards.

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[14] Savings are relative to the 30,000 Btu baseline natural gas use for single family homes.

Electricity

We assessed about 40 measures for electricity savings that could be adopted during the period 2012–30. An upgrade to a new measure is considered cost-effective if its levelized cost of conserved energy is less than $0.85/kWh saved, which is equivalent to the average retail electricity price for the commercial sector in Louisiana. For the sum of all measures, the estimated levelized cost is $0.36/kWh saved (see Table 4). See Appendix A for detailed methodology and specific efficiency opportunities and cost effectiveness for commercial buildings.

Table 4. Cost-Effective Commercial Electricity Potential by End Use in 2030

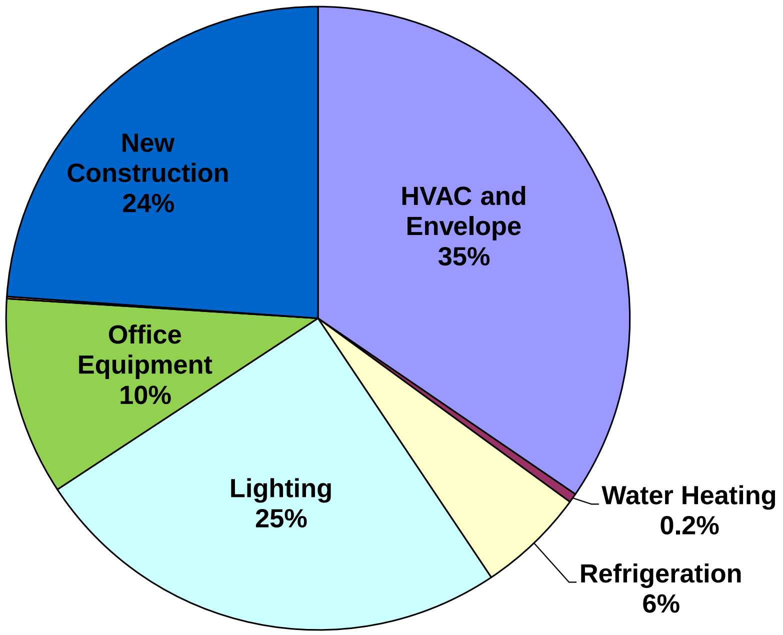
End Use	Savings (GWh)	Savings as % of End Use	% of Efficiency Potential	Levelized Cost of Saved Energy ($/kWh)
Heating, Cooling, and Building Envelope	3,234	40%	35%	$0.030
Water Heating	45	8%	0.2%	$0.032
Refrigeration	524	24%	6%	$0.017
Lighting	2,352	35%	25%	$0.019
Office Equipment	961	53%	10%	$0.003
Appliances and Other	10	0.2%	0%	$0.027
Subtotal: Existing Buildings	7,126	33%	76%	$0.029
New Construction	2,236	33%	24%	$0.051
Total	**9,362**	**33%**	**100%**	**$ 0.030**

*Percentage of savings is relative to forecast consumption for the commercial sector in 2030.

Commercial buildings can cost-effectively save 9,362 GWh, or 33% relative to the reference forecast, through the adoption of a variety of efficiency measures in the period 2012–30. Electricity savings from efficiency resources are realized through improved heating, cooling, and ventilation (HVAC) equipment, controls, and building envelope measures; improved water heating (e.g., heat pump water heaters); more efficient refrigeration systems (e.g., ENERGY STAR® vending machines and coolers); and efficient lighting, office equipment, and miscellaneous appliances. The greatest portion of the savings, at 35%, is from improvements to HVAC equipment and building envelope measures. HVAC equipment measures include better heating and cooling systems (e.g., high-efficiency chillers and heat pumps) and better controls (e.g., dual enthalpy controls and energy management system installations), and envelope measures include improvements such as roof insulation and improved windows. The second largest contribution is from improved lighting systems, which include savings from more efficient light bulbs such as fluorescent, LED, and HID, and improved lighting controls such as daylight dimming systems and occupancy sensors.

Office equipment measures can provide another 10% of the total savings with measures including more efficient computers, printers, and copiers, as well as turning off this equipment after hours. Water heating measures include heat pump water heaters, and efficient clothes washers that reduce hot water demand. Refrigeration measures include improved commercial refrigeration systems (e.g., walk-in coolers and high-efficiency ice makers and vending machines). New construction measures contribute a significant portion of the overall savings potential for the commercial sector, reaching 20% of total electric savings. We estimate that up to 50% savings compared with baseline new construction codes can be reached cost-effectively for commercial new construction (NREL & PNNL 2012).

Figure 15. Commercial Electric Efficiency Potential in 2030 by End Use in Louisiana



Natural Gas

The potential for natural gas savings through energy efficiency in Louisiana's commercial buildings sector is examined through a scenario of 23 cost-effective measures for gas savings that could be adopted through 2030. An upgrade to a new measure is considered cost-effective if its levelized cost of conserved energy is less than $9.29/MCF, which was the average statewide retail natural gas price for the commercial sector in Louisiana in 2011, according to EIA. For the sum of all measures, the estimated levelized cost is $4.90/MCF saved (see Table 5). See Appendix A for a detailed methodology and specific efficiency opportunities and cost effectiveness for commercial buildings.

Table 5. Commercial Natural Gas Efficiency Potential and Costs by End Use in 2030

End Use	Savings (MMCF)	Savings as % of End Use	% of Efficiency Potential	Levelized Cost of Saved Energy ($/MCF)
Heating Equipment and Controls	3,885	27%	39%	$6.00
Building Envelope	432	7%	4%	$0.39
Water Heating	899	15%	9%	$3.55
Cooking	869	28%	9%	$6.21
Retrocommissioning	954	5%	10%	$8.98
Subtotal: Existing Buildings	7,039	35%	71%	$5.96
New Construction	2,841	34%	29%	$5.30
Total	**9,879**	**35%**	**100%**	**$4.90**

*Percentage of savings is relative to forecast consumption for the commercial sector in 2030.

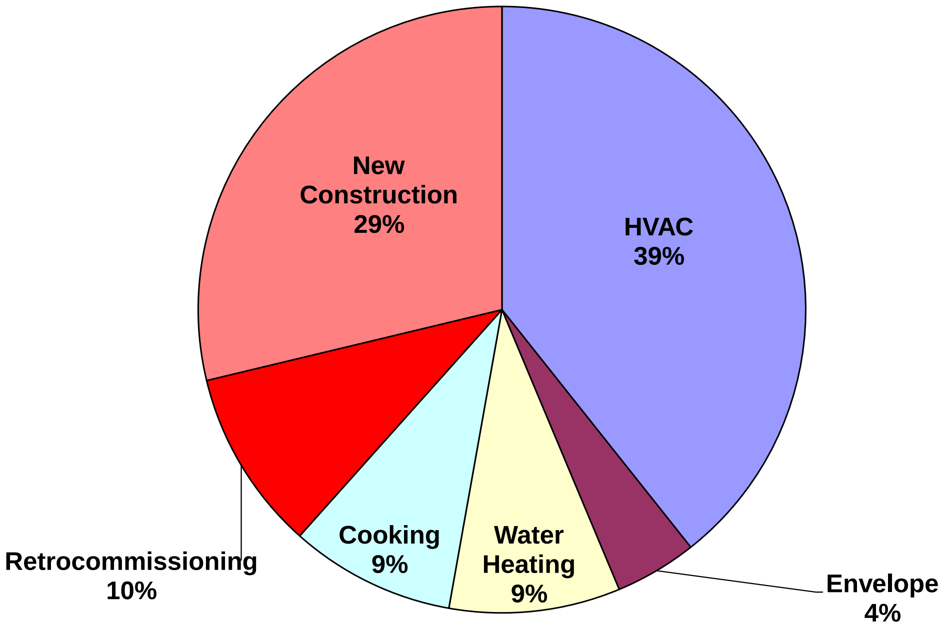
The analysis finds that commercial buildings can cost-effectively save 9,879 MMCF of natural gas, or 35% relative to the reference forecast, through the adoption of a variety of efficiency measures through the period 2012–30.

In the commercial sector, gas savings from efficiency resources are realized through improved HVAC equipment and controls, and building shell measures (e.g., duct sealing and pipe insulation); improved water heating (e.g., instantaneous water heaters); and more efficient cooking equipment. The largest share of savings is provided by improved HVAC measures in existing buildings, including better heating system measures and controls, which provide 39% of the total gas savings potential. Our calculations for improved heating equipment take into account the various types of equipment that are appropriate for different size buildings and include furnaces, rooftop heating units, and boilers. Improved controls include programmable thermostats and energy management systems. Building shell measures include roof insulation and low-e windows.

Improved water heating also provides substantial savings, with 9% of the total gas savings potential, with condensing gas water heaters contributing the vast majority of water heating savings. Building shell and cooking measures provide another 4% and 9% of the savings potential, respectively. For cooking measures, high-efficiency convection ranges/ovens and ENERGY STAR fryers provide the largest portion of the savings, while the envelope measures comprise roof insulation and low-e windows.

New construction measures contribute a sizeable portion of the overall savings potential for the commercial sector as well, totaling 29% of natural gas savings. We estimate that up to 50% savings can be reached cost-effectively for commercial new construction (see NREL & PNNL 2012).

Figure 16. Commercial Natural Gas Efficiency Potential in 2030 by End Use



INDUSTRIAL

The industrial sector is the most diverse economic sector, encompassing agriculture, mining, construction, and manufacturing. Louisiana's industrial sector energy use is dominated by the chemical and petroleum industries. However, this dominance is not the case when considering employment. Based on data from Moody's, in 2012 the chemicals, energy, plastics, and rubber manufacturing sectors accounted for about 30% of the manufacturing workforce, which totaled about 140,000 that year. Natural resources and mining employed another 57,000 people.

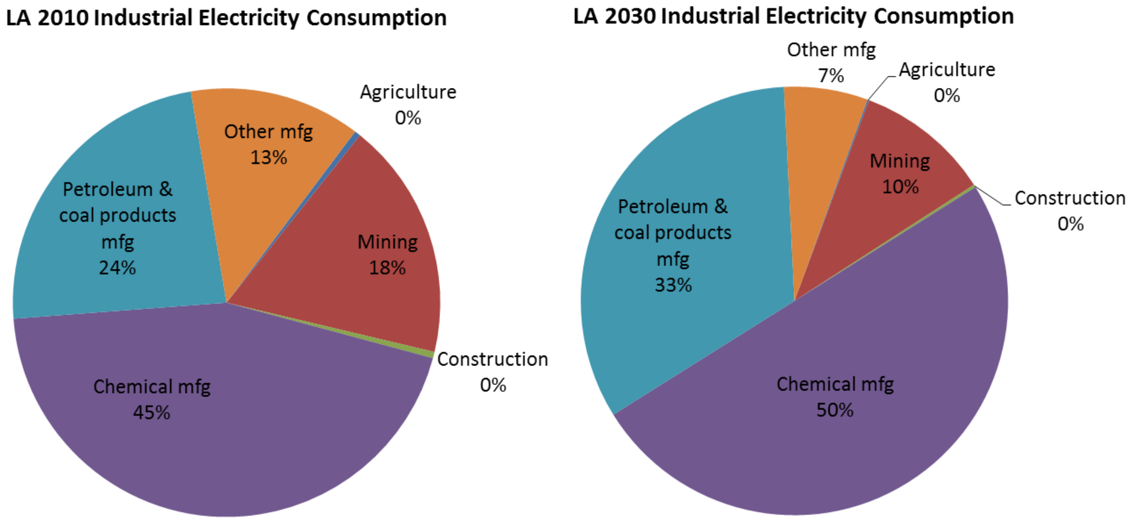
While there are no publicly available data on state-level industry energy consumption by size, the *Manufacturing Energy Consumption Survey (MECS)* (EIA 2009c) showed how manufacturers of different sizes used energy. Energy consumption was more or less evenly split among companies in the following categories: fewer than 99 employees, between 100 and 249, between 250 and 499, between 500 and 999, and more than 1,000 employees. According to the National Association of Manufacturers, over 80% of Louisiana's exported goods come from small businesses (NAM 2012).

Industrial Energy Consumption

Because energy use and efficiency opportunities vary by individual industry (if not individual facility), it is important to develop a disaggregated forecast of industrial electricity and natural gas consumption. Unfortunately, these energy use data are not available at the state level, so ACEEE has developed a method using state-level economic data to estimate statewide disaggregated electricity and natural gas use. This study drew upon national industry data to develop a disaggregated forecast of economic activity for the sector. We then applied energy intensities derived from industry group energy consumption data reported and the value of shipments data to characterize each subsector's share of the industrial sector energy consumption and projected the energy use through 2030.

This assessment examines potential natural gas and electricity savings from consumption. Of these two energy sources, natural gas dominates Louisiana, accounting for over 10 times the electrical energy consumed by the state's industry. Figure 17 shows the largest electricity-consuming industries in Louisiana in 2010 and their share of expected electricity use changes by 2030.

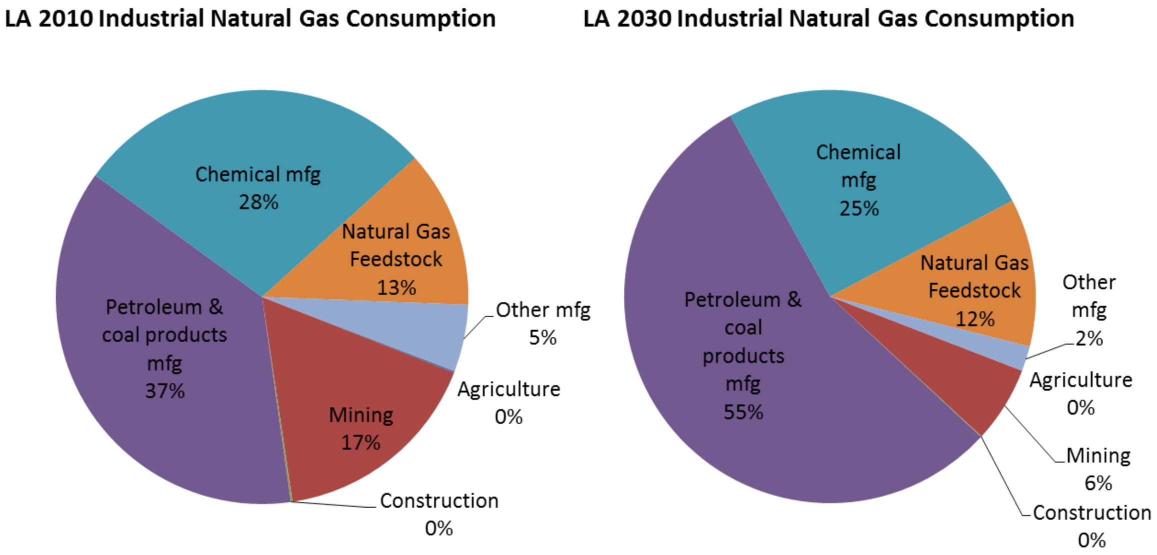
Figure 17. Estimated Electricity Consumption for the Largest Consuming Industries in Louisiana in 2010 and 2030



Due to changes in economic activity and energy intensity as discussed in Appendix B, we see some minor intra-sectoral shifts in electricity consumption. Although the mining sector and several other manufacturing subsections are currently experiencing modest growth, their share of electricity use is expected to fall by 2030. In most manufacturing sectors, growth is offset by projected increases in energy efficiency. Chemical manufacturing and petroleum product manufacturing continue to dominate industrial activity in Louisiana. These intra-sectoral shifts are important because they identify where new investments are being made and where energy efficiency opportunities are concentrated.

Figure 18 shows the largest natural gas–consuming industries in Louisiana in 2010 and their expected share of natural gas use changes by 2030.

Figure 18. Estimated Natural Gas Consumption for the Largest Consuming Industries in Louisiana in 2010 and 2030



Similar changes in economic activity and energy intensity cause significant intra-sectoral shifts in natural gas consumption. While economic growth is projected in both the chemical manufacturing and petroleum products manufacturing sectors, projected increases in energy intensity for petroleum products and a moderate decrease in energy intensity for chemical products cause the shift seen above. All told, while the chemical industry holds its natural gas consumption steady, the petroleum products industry will increase its consumption of industry sector natural gas from 37% in 2010 to 55% in 2030. These intra-sectoral shifts are important because they identify where new investments are being made and where energy efficiency opportunities are concentrated. It is also important to note that the chemical industry uses a significant amount of natural gas as feedstock to make other products, including synthetic gases for other industrial applications, fertilizers, and pharmaceuticals. Based on national data from EIA, we estimate that about 13% of the state’s industrial natural gas is not burned for energy purposes.

Electricity

We examined 13 electricity-saving measures, 10 of which were cost-effective considering Louisiana's projected average industrial electric rate of $08.0/kWh through 2030.[15] These measures were applied to an industry specific end-use electricity breakdown.

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[15] Current electricity rates for industrial customers in Louisiana are about $0.06/kWh. However, we identify the average projected rates through 2030 to benchmark cost-effectiveness from the customer perspective.

Table 6 shows results for industrial energy efficiency potential by 2030. The average levelized cost of saved energy is about $0.02/kWh, and 99% of the estimated potential is less than $0.06/kWh.

Table 6. Industrial Electric Efficiency Potential and Costs by End Use in Louisiana

Measures	Savings Potential in 2030 (GWh)	Savings Potential in 2030 (%)	% of Efficiency Potential	Levelized Cost of Saved Energy ($/kWh)
Sensors and Controls	180	0.5%	3%	$0.014
Energy Information System (EIS)	30	0.1%	0%	$0.061
Duct/Pipe Insulation	592	1.7%	9%	$0.052
Electric Supply*	1,032	3.0%	15%	$0.010
Lighting	263	0.8%	4%	$0.020
Motors	1,754	5.1%	25%	$0.027
Compressed Air	885	2.6%	13%	$0.000
Pumps	1,940	5.6%	28%	$0.008
Fans	162	0.5%	2%	$0.024
Refrigeration	54	0.2%	1%	$0.003
Total	**6,892**	**20%**	**100%**	**$0.017**

*This refers to modifications to existing power supplies that can reduce phase unbalance, voltage variations, and poor supply waveforms, which can otherwise reduce equipment efficiency and cause equipment damage.

This analysis found that these cross-cutting measures produced economic savings of 6,892 million kWh, or 20%, of industrial electricity use in 2030 at a levelized cost of $0.017/kWh saved (Table 6). This analysis did not consider process-specific efficiency measures that could be applied at the individual site level because available time, funding, and data did not allow this level of analysis. However, based on experience from site assessments by the U.S. Department of Energy and other entities, we would anticipate an additional economic savings of 5–10%, primarily at large energy-intensive manufacturing facilities. The overall economic industrial efficiency resource opportunity is therefore on the order of 25–30%. Thus, the total economic potential for electricity savings in the industrial sector in 2030 is about 9,000 GWh, accounting for process-specific efficiency.

Natural Gas

We examined 35 natural gas–saving measures, 33 of which were cost-effective considering Louisiana's average industrial natural gas rate of $4.68/MCF. These measures were applied to an industry specific end-use natural gas breakdown. Table 7 shows summarized results for industrial natural gas efficiency potential by 2030. A full measure list can be found in Appendix B.

Table 7. Industrial Natural Gas Efficiency Potential and Costs by End Use

Measures	Savings Potential in 2030 (MMCF)	Savings Potential in 2030 (%)	% of Efficiency Potential	Levelized Cost of Saved Energy ($/MCF)
Improved Boiler Insulation	20,879	2.9%	18%	$0.65
Steam Trap Maintenance	16,312	2.3%	14%	$0.47
Boiler Load Control	10,439	1.5%	9%	$0.14
Other Boiler Measures	26,054	3.6%	22%	$0.20
HVAC Measures	435	0.1%	0%	$2.67
Process Controls and Management	19,326	2.7%	16%	$0.53
Process Heat Fouling Control	13,836	1.9%	12%	$0.42
Other Process Heat	10,661	1.5%	9%	$1.66
Total	**117,942**	**16.4%**	**100%**	**$0.53**

This analysis found economic savings from these cross-cutting measures of 117,942 MMCF, or 16%, of industrial natural gas use in 2030 at a levelized cost of $0.52 per thousand cubic feet saved (Table 7). Once again, this analysis did not consider process-specific efficiency measures that could be applied at the individual site level. As with electricity, we would anticipate an additional economic savings of 5–10%, primarily at large energy-intensive manufacturing facilities. The overall economic industrial efficiency resource opportunity is on the order of 21–26%. Therefore, the total economic potential for natural gas savings in the industrial sector in 2030 is about 172,000 MMCF.

Energy Efficiency Program and Policy Analysis—Summary of Findings

Louisiana has significant energy efficiency resource potential, as identified in the previous section. Numerous opportunities are available to Louisiana to support energy efficiency development and tap into the efficiency resource potential. This section provides a quantitative analysis and roadmap 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 policies and programs and (2) tailored program offerings. This section first summarizes the policy and program options in each category, then presents a summary of the analysis findings, and finally describes 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 8, describes efforts that could be established through a variety of policy mechanisms, such as through state legislation, through the LPSC, by the governor's office, or by statewide agencies. We quantified the energy savings benefits for some of these state policy options in the analysis that follows. Some of the initiatives are enabling policies that break down market barriers to greater efficiency, yet are not easy to quantify in terms of potential energy savings or costs to implement; for example, establishing regulatory guidelines that better align utility financial motivations with energy efficiency are beneficial to reduce market barriers and therefore are not quantified.

Table 8. State Energy Efficiency Policy and Program Options for Louisiana

Statewide Policies, Programs, and Initiatives	*Summary of Analysis Recommendation*
Integrate Energy Efficiency into Resource Planning and Set Energy Savings Targets	Successfully incorporate energy efficiency as a least-cost and low-risk resource into the integrated resource planning process, considering an energy efficiency program portfolio on par with supply-side resources. Set incremental annual electricity savings targets ramping up to about 1%/year over 6 years and natural gas targets ramping up to about 0.7%/year over 6 years (see Table 9 for program options that together can reach these target levels, according to our analysis).
Utility Performance Incentives and Cost Recovery	Adopt energy efficiency rules that better align utility financial motivations with energy efficiency improvements; measures includes timely cost recovery, performance incentives, and removal of the throughput incentive.
Updated Building Energy Codes for Residential and Commercial	Adopt at least 2009 IECC for Residential new construction and ASHRAE 90.1-2010 for Commercial building new construction
Lead by Example in State and Local Government Facilities	Benchmark energy usage in public buildings, streamline energy service company (ESCO) options and rules, and set public facility energy savings targets
Low-Income Weatherization	Coordinate state weatherization and utility program offerings
Combined Heat and Power (CHP)	Establish regulatory mechanisms to reduce market barriers to CHP, and explore utility participation in CHP markets

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

Enabling Policies and Programs	*Summary of Analysis Recommendation*
Customer Financing Options	Provide financing options for customers
Benchmarking and Disclosure of Building Energy Use	Take steps toward benchmarking and disclosure of all commercial and residential building energy usage
Workforce Training Initiative	Coordinate training of workforce, e.g., through community college initiative
Program and Policy Coordination and Collaboration	Coordinate utility and state 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 9, lists several tailored program offerings for all customer classes in Louisiana. This represents a comprehensive (though not exhaustive) list of energy efficiency program options for Louisiana customers. We have analyzed potential energy savings, costs, and benefits from each of the programs.

Table 9. Tailored Energy Efficiency Program Options by Customer Segment

Residential	Commercial	Industrial
New Construction and Building Energy Code Support	New Construction and Building Code Support	Strategic Energy Management
Multi-Family Buildings	Retrocommissioning and Monitoring-Based Commissioning	Custom Incentives for Retrofits
Home Energy Retrofits	Small Business Direct-Install	Prescriptive Equipment Rebates
Upstream Retail Appliances and Electronics	Custom Incentives for Retrofits	Combined Heat and Power
Lighting	Prescriptive Equipment Rebates	Self-Direct Option
Air-Conditioning	Computer and Plug Load Efficiency	Standard Offer or Reverse Auction
Water Heating	Combined Heat and Power	
Low-Income Weatherization (Coordinated with State Programs)		
Information Feedback		

Next, we present overall findings of the policy and program analysis, including estimated total annual electricity, peak demand, and natural gas–savings impacts from the recommended efficiency policies and programs through 2030. Our analysis finds that a comprehensive set of policies and programs can cost-effectively meet about 5% cumulative of electricity needs by 2020, and 17% by 2030. Efficiency upgrades can also save 3% cumulative of natural gas needs by 2020, and 13% by 2030. Table 10 and Figures 19 and 20 show a further breakdown of savings potential by customer class. Further details on each of the policy or programs analyzed are presented in a later section.

Table 10. Program and Policy Energy Savings Type and Customer Class in 2020 and 2030

	2020		2030	
Electricity End-Use Efficiency Savings (GWh)	GWh	% of Reference Case*	GWh	% of Reference Case*
Residential	1,753	5.3%	6,711	18%
Commercial	1,830	7.1%	6,658	24%
Industrial	990	3.0%	3,028	9%
Electricity Total	4,572	5.0%	16,398	17%
Natural Gas End-Use Efficiency Savings (MMCF)	MMCF	% of Reference Case*	MMCF	% of Reference Case*
Residential	1,939	4.8%	7,717	19%
Commercial	1,659	6.0%	6,387	22%
Industrial	2,128	1.7%	10,205	8%
Natural Gas Total	5,726	2.9%	24,309	13%
Combined Heat & Power Output (GWh)	GWh		GWh	
Onsite Industrial CHP**	2,133	2.3%	5,168	5%
Export CHP**	2,791	3.1%	6,782	7%
Combined Heat and Power Total	4,924	5.4%	11,950	12%

*Note: Savings are shown as a percentage of sales by customer class in the reference case scenario.
**Onsite refers to electricity generated for consumption at the facility, whereas export CHP refers to excess electricity generated that could be exported to the grid.

Figure 19. Electricity Energy Efficiency (EE) and CHP Program and Policy Potential by 2030

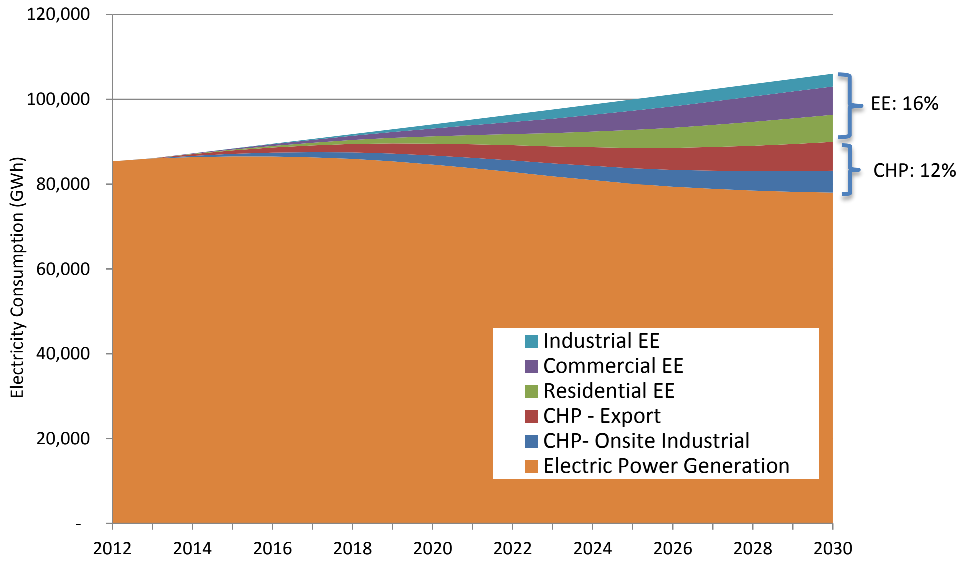
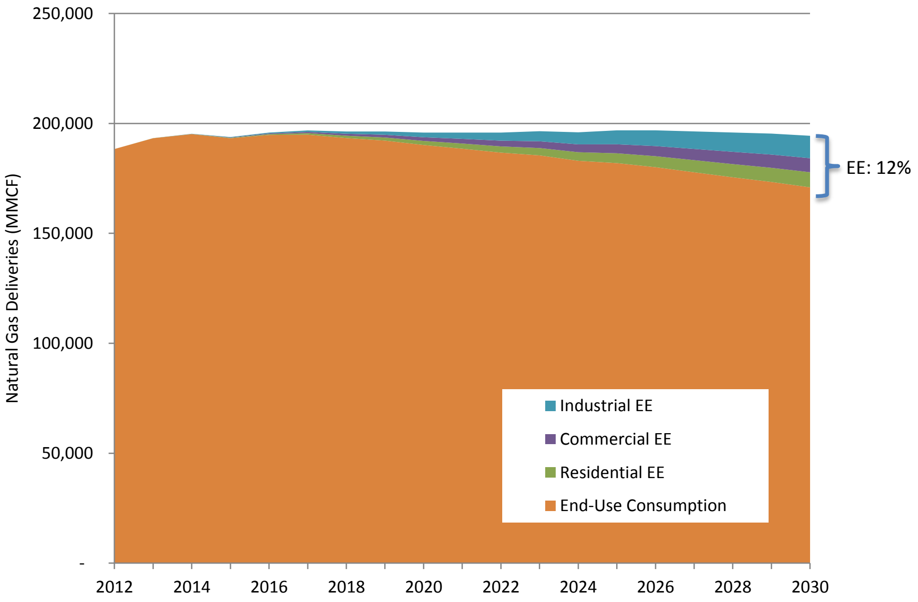


Figure 20. Natural Gas Energy Efficiency Program and Policy Potential by 2030



Statewide Policies and Programs

In this section we describe several opportunities for Louisiana within the first category, statewide policies and programs, which may be further implementation or expansion of existing initiatives, or new efforts pursued through legislation, LPSC rules, executive orders, and/or state agencies. This set of statewide policy and program options largely represent new opportunities in Louisiana 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, most notably the *Energy Smart* programs run by ENO.

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 few utilities in Louisiana offer energy efficiency services for their customers. The LPSC's quick-start energy efficiency rules would be a first step in this direction, and would expand customer access to energy efficiency services in the short term if implemented. Long-term certainty and regulatory mechanisms are also needed. We recommend re-adopting these rules as a first step toward robust energy efficiency in Louisiana.

We also recommend three overarching policy needs to better align utility operations with customer energy efficiency: (1) integrate energy efficiency as a resource into IRP processes; (2) set energy savings targets; and (3) better align utility financial models with energy efficiency.

Integrated Resource Planning

Louisiana has already taken a major step toward the first goal of IRP; however, there is still much to do to ensure effective treatment of energy efficiency in the IRP process. 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). Going forward, implementation of the IRP process in Louisiana 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 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 (SEE Action 2011, Lamont & Gerhard 2013; Neme & Sedano 2012).

Energy Savings Targets

IRP is a critical tool to identify energy efficiency as a least-cost resource opportunity, but without setting energy efficiency targets and adopting appropriate regulatory mechanisms, utilities face regulatory uncertainty about their energy efficiency investments. ACEEE recommends setting specific, long-term (3 years or longer) energy savings targets called Energy Efficiency Resource Standards (EERS), in addition to adopting appropriate cost recovery and incentive mechanisms, as discussed next. This provides 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.

Currently, 24 states, including one in the Southeast (Arkansas), are implementing EERS. States take various approaches in setting the targets, which may be enacted by state legislature, codified by public utility commissions, or established through utilities' IRP processes. 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). While some state utility commissions set targets annually as part of a rate-making process, an EERS is a multi-year mechanism to lock in future benefits and create certainty that makes it easier for utilities to shape their resource plans.

Recent analysis has shown that most states with an EERS for electricity utilities are 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 EERS policies can be most effective when the targets begin at modest levels, such as 0.3% of annual sales, and ramp up 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).

For example, in 2010 the Arkansas PSC (APSC) established annual electricity savings goals of 0.25% in 2011, 0.5% in 2012, and 0.75% in 2013, making Arkansas the first state in the Southeast to adopt long-term targets. Between 2009 and 2011, the two largest IOUs in Arkansas (Entergy Arkansas and SWEPCO) saved about 54,000 MWh each year through energy efficiency programs, or roughly 0.2% of sales at an average total resource benefit-cost ratio of 1.6, and in 2012 the utilities exceeded their targets. Given the success of programs, the APSC intends to continue ramping up and recently issued an order recommending new targets for the next 3 years, ramping up to 1% in 2015, 1.25% in 2016, and 1.5% in 2017 (APSC 2013). Stakeholders have requested an energy efficiency potential study to inform the next round of targets.

Despite the recent success in achieving existing targets, significant challenges lie ahead in achieving higher levels of savings in the next several years. Not only will states have to expand their existing program portfolios, but also program designers must account for upcoming federal efficiency standards, which will reduce some of the easier savings opportunities such as CFL lighting programs. To fill in this savings gap, leading program designers in the country are exploring a host of 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 the easier lighting programs will be challenging, but leading program designers are already showing that the task is doable.

Our analysis of energy efficiency program potential suggests that Louisiana could consider an electricity EERS gradually ramping up to about 1% over 6 years, e.g., 0.15% in 2014, 0.25% in 2015, 0.4% in 2016, 0.6% in 2017, 0.8% in 2018, and 1.0% in 2019. These are incremental annual targets and cumulatively could reach about 4% by 2020 from tailored program offerings. The additional statewide policies such as building energy codes could achieve higher savings, e.g., 5% cumulative by 2020. This ramp-up rate assumes, however, that programs would have to begin rolling out program infrastructure and building participation in 2014. Over the longer term, our analysis finds that Louisiana could then ramp up to annual electricity savings target of about 1.7%: for example, 1.2% in 2020, 1.4% in 2021, 1.6% in 2022, and 1.7% in 2023. Natural gas savings targets should be lower, as many other states have discovered. We find that a realistic set of targets for Louisiana are those that gradually ramp up to 0.7% per year by 2020, and then subsequently consider ramping up to 1% per year.

Targets for subsequent years through 2030 could then be determined based on the results and lessons learned from previous years. Several states periodically evaluate the success of programs, for example, every 3–6 years, and set new targets based on updated analysis of energy efficiency potential and best practices in program design. This is a good option for Louisiana. We also recommend that LPSC establish robust cost effectiveness criteria with appropriate consideration of the full benefits of efficiency to guide energy efficiency investments, rather than limit efficiency investments through a prescriptive spending cap.

Align Utility Financial Motivations with Energy Efficiency

The third policy need is to better align utility financial models 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, 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, utilities throughout the country have pursued mechanisms such as lost revenue recovery or decoupling and performance incentives to mitigate the disincentives that exist to making 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 revenue due to falling sales; and (3) through the lack of a comparable return on investment for demand-side investments when compared with returns on investment for supply-side resources, which are provided through 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 revenue from lower sales hampers 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 in a meaningful way, because neglecting to do so puts utilities in a relatively weaker financial position, dissuading them from further pursuing energy efficiency.

In other words, a strong foundation for utility investments in energy efficiency is to provide a "three-legged stool" approach (see York & Kushler 2011):

1. Timely cost recovery of direct energy efficiency program costs
2. Addressing the throughput incentive by allowing utilities to recover lost fixed costs
3. Financial incentives that meet or exceed energy efficiency performance targets

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.

Cooperatives and Municipal Utilities

Finally, electric cooperatives and municipal utilities also offer significant potential to invest in energy efficiency as part of their resource portfolios. These utilities account for 16% of total electricity sales in Louisiana, but they represent a larger share of residential sales (26%) because they cover rural areas. These utilities will thus be crucial in helping all residential customers gain access to energy efficiency services to reduce energy bills. Some cooperative and municipal utilities are already delivering energy efficiency services to their customers. For example, the Lafayette Municipal Utility System often looks to the leadership of the LPSC, and is exploring demand-side smart grid projects for its customers. As a policy measure, municipal utilities could develop voluntary energy efficiency targets achieved through programs that we model in our analysis.

BUILDING ENERGY CODES AND ENFORCEMENT

Strong building energy codes that are adequately enforced are a critical foundation for greater energy efficiency in Louisiana. 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.

Louisiana's statewide building energy codes were updated fairly recently, but they still have room for improvement. The state's mandatory residential energy code, the Louisiana State Uniform Construction Code (LSUCC) is based on the 2006 International Residential Code (IRC), which became effective in January 2011 (BCAP 2012). The mandatory Louisiana Commercial Building Energy Code is the ASHRAE Standard 90.1-2007, which became effective in August 2012. The code adoption cycle is every 3 years, which means the next round of codes will likely become effective in 2014 and 2015 for residential and commercial construction, respectively. The state could update its codes to the most recent model codes, which are the International Energy Conservation Code (IECC) 2009 or 2012 for residential and ASHRAE 90.1-2010 for commercial.

Code adoption is through state legislation, although the Office of the State Fire Marshal has authority to promulgate amendments or revisions to the code. The role of the Louisiana State Uniform Construction Code Council, which consists of 19 members appointed by the Governor, is to review and adopt the state uniform codes, provide training and education of code officials, and consider amendments to the codes.

While code adoption occurs at the state level, code enforcement occurs through local governments. Stakeholders in Louisiana identified the need for improved training of local code officials and contractors to improve compliance with buildings codes. Utility 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 their energy savings targets. The next section on utility residential and commercial new construction programs explores this program area further.

For the residential sector, the state could immediately jump to the 2012 IECC, which is the most advanced building energy code. For our analysis, we assume the state takes an incremental approach and first adopts the 2009 IECC for residential construction, effective January 2014, followed by the 2012 IECC, which would become effective 3 years later. Incremental costs data are from various sources (Lucas et al 2012; EPA 2012). For the commercial sector, we assume adoption of ASHRAE 90.1-2010, effective in 2015, and a subsequent update 3 years later. Estimates for incremental costs to meet updated codes are from the New Buildings Institute (NBI 2012). To project residential code savings in future years, we developed a forecast of residential new construction completions from Moody's Analytics (Moody's 2012). The commercial building new construction forecast is derived from Louisiana commercial sector employment forecasts from Moody's and regional data on commercial building floor space from the *Annual Energy Outlook 2012* (Moody's 2012; EIA 2012b).

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 Louisiana 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.

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. 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).

Louisiana has taken several steps to achieve savings in public facilities and make use of ESPCs:

- Governor Bobby Jindal signed Executive Order BJ 2008-8 on January 30, 2008, which required the Division of Administration to: (1) set energy efficiency goals for state facilities, office buildings, and complexes for fiscal years 2009, 2010, and 2011 by July 30, 2008; (2) review its purchasing practices to ensure 100% compliance with existing state requirements related to energy conservation; and (3) develop or increase standards for such products as appliances, light bulbs, smart chargers, and computers, using ENERGY STAR as a minimum standard.
- Louisiana statutes require that energy savings performance contracting be used to the "maximum extent possible," and in 2008 Governor Jindal released an executive order that called for energy efficiency targets to be met using ESPCs. The Division of Administration's Office of Contractual Review houses the information about ESPCs[16], including a model contract, state ESPC rules, and a flowchart to describe the process step-by-step.
- Senate Bill 240, signed on July 6, 2007, requires construction or renovation of major state-funded facilities to be designed and built to exceed state energy codes by at least 30%, subject to a life-cycle cost analysis. By December 2011, all new buildings larger than 5,000 square feet were required to comply with the legislation.

Our analysis considers a policy along the lines of that recently adopted in Oklahoma, which sets a goal of reducing energy use in public facilities. We assume that Louisiana sets a goal to achieve 20% savings by 2030 in all state and local public facilities in the state, and uses ESPCs and other models to achieve these savings cost-effectively.

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[16] See http://www.doa.louisiana.gov/ocr/ESPC.htm

DISCUSSION OF ENABLING STATEWIDE POLICIES AND PROGRAMS

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

Benchmarking and Disclosure of Building Energy Information

Louisiana Act 504, enacted in 2010, requires property appraisers to incorporate energy efficiency measures into the assessment of a property's value. The law went into effect in 2011, although no guidelines were provided for implementation.

Customer Financing for Energy Efficiency

The up-front costs required for cost-effective energy efficiency improvements can often deter property owners from pursuing efficiency projects, especially during periods of economic uncertainty when consumer confidence is low. An important goal of policies and programs is to help minimize the initial costs of energy efficiency projects or upgrades so owners are encouraged to invest in efficiency. In New Orleans, for example, the *NOLA Wise* Energy Efficiency Loan Program is available to residential and commercial customers. 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.

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.

To encourage homebuyers, one strategy is to make sure that energy-efficient mortgages are available for purchasers of energy-efficient homes and manufactured houses. Energy-efficient mortgages credit a home's energy efficiency in the mortgage itself, giving borrowers the opportunity to finance cost-effective, energy-saving measures as part of mortgages. These 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 the increased prevalence of home ratings such as ENERGY STAR, both for new and existing homes, identification of qualifying properties should not be a barrier. Louisiana currently consumers have access to two lenders for energy efficiency mortgages,[17] and the state could encourage greater lending practices that take efficiency into consideration.

One important aspect of financing mechanisms is that the debt can be spread over several years, if not decades, which decreases the annual costs and substantially increases the annual savings from the efficiency improvements. Energy efficiency improvements to a property also help to

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[17] See http://www.energystar.gov/index.cfm?c=mortgages.energy_efficient_mortgages for more information

increase the overall property value, improve the cash flow of property owners (from reduced liability relative to the up-front 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.[18] 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 Initiative

Establish an interagency stakeholder group to coordinate workforce development activities at universities, community colleges, and high schools. The goal is to develop a well-trained workforce to identify, implement, and operate efficiency measures. Existing contractors need access to rigorous and continuous training opportunities, and this is a good opportunity for collaboration across program administrators.

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. 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, for example.

Demand Response

Demand response programs provide important peak-period benefits for electric utilities and have the added benefit of enabling participation in energy efficiency programs. Demand response and energy efficiency programs can thus create important synergies for customer savings and utility benefits.

COMBINED HEAT AND POWER

Combined Heat and Power (CHP) is the generation of electricity and thermal energy in a single, integrated system. CHP systems are much more efficient than electricity-only generation because they make use of thermal energy that is normally wasted during the separate generation of electricity. CHP technology can help manufacturers and other large facilities such as hospitals and universities in Louisiana lower their energy costs, which will improve their bottom line and competitiveness, or in the case of government institutions, save taxpayer dollars. Facilities that use CHP consequently reduce their dependence on grid-supplied electricity, which can mitigate T&D congestion and increase reserve margins while improving the grid’s reliability and stability, benefiting all electricity users. CHP facilities also improve customer reliability in the case of power outages, and can therefore be highly beneficial in

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[18] See http://aceee.org/files/pdf/toolkit/OBF_toolkit.pdf for a discussion of the successes and challenges of On-Bill Financing programs

critical infrastructure facilities such as hospitals and wastewater treatment plants, as was seen recently during Hurricane Sandy (Chittum 2012).

CHP systems range in size from tens of kilowatts for single buildings up to hundreds of megawatts for large industrial or institutional facilities. Louisiana currently has 6,890 MW of installed CHP capacity, yet there is significant potential for more cost-effective CHP projects, up to an additional 1,485 MW, as discussed in the following analysis (Chittum & Sullivan 2012).

Despite the significant potential for CHP in the state, recent installations have been minimal because of economic uncertainty and unattractive project economics. Over the past 5 years there have been only a few new installations, all occurring within the past 2 years as natural gas prices have fallen and the economy has recovered (Chittum & Sullivan 2012). These installations include a 300 kW fuel cell at an Air Force base and a 4.5 MW natural gas–powered system at a chemical plant.

There has been some recent momentum in Louisiana toward interest in CHP; for example, a Louisiana House Resolution[19] enacted in 2012 requests the Louisiana Department of Natural Resources (DNR) and the LPSC to establish guidelines to evaluate CHP feasibility in critical government facilities, such as hospitals, prisons, police and fire stations, data centers, and waste and wastewater facilities. These critical facilities can benefit from the reliability of CHP systems during periods of power outages, allowing continued operation during the outage.

CHP projects face several barriers that suppress cost effectiveness, and policy changes will be needed in Louisiana to remove these market barriers. In ACEEE's *2012 State Energy Efficiency Scorecard*, the state scores 0.5 out of a possible 5 points on policies and programs that are favorable to CHP. Existing market barriers in Louisiana include: (1) a lack of common and fair interconnection and net metering standards for systems over 300 kW; (2) unfavorable utility standby rates that do not reflect the full costs and benefits of CHP to the system; and (3) emissions regulations that do not recognize the improved efficiency and pollution benefits of CHP systems.

Utilities in Louisiana could also play a much larger role in future CHP development, as discussed later in this section, by assuming an equity position in CHP facilities and taking advantage of the potential benefits to the grid with strategic placement of these facilities. Numerous resources are available to utility regulators and other state policymakers. See the State and Local Energy Efficiency Action Network's *Guide to the Successful Implementation of State Combined Heat and Power Policies* (SEE Action 2013).

CHP Policy Options

Interconnection standard. Interconnection standards provide distributed generation systems with clear guidance on how to connect to the local electricity grid. In general, there are two categories of interconnections: federally regulated interconnections administered by the Federal

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[1919] Louisiana House Resolution 167, enrolled June 1, 2012. http://legiscan.com/LA/text/HR167/id/650709/Louisiana-2012-HR167-Introduced.pdf

Energy Regulatory Commission (FERC) that apply to larger CHP projects, and retail-level projects that are regulated at the state and utility levels.

Section 210 of the *Public Utility Regulatory Policy Act of 1978* (PURPA) compels utilities to interconnect qualifying CHP facilities (QF) under FERC jurisdiction. Only CHP systems interconnected to the transmission system selling power into the wholesale market are eligible to interconnect using FERC-ordered interconnection standards. In Louisiana, facilities need to be either FERC-sanctioned QFs or users of an Open-Access Transmission Tariff (OATT) to be allowed interconnection under FERC standards. Most existing large CHP facilities in Louisiana operate under PURPA QF rules.

Systems that wish to connect to the distribution system and use their power predominately on-site—that is, the majority of potential CHP systems—are not eligible to use these interconnection standards. The Federal Power Act is explicit that FERC's authority does not extend "over local distribution facilities," and so FERC interconnection jurisdiction is applicable only to utility facilities that are regulated by FERC (FERC 2003, 2005; Michaud 2007).

At the state level, CHP deployment is encouraged when multiple levels of interconnection exist, because smaller systems benefit from the reduced cost and time available in a "fast track" type of interconnection standard. Scaling transaction costs and insurance requirements to project size makes economic sense because smaller systems are less complex, whereas larger systems are more complex and could potentially pose certain challenges to the grid if risks aren't adequately controlled.

Louisiana requires that regulated utilities offer interconnection to distributed generation systems powered by renewable fuels only through their net metering rules. The interconnection standard includes fuel cells and microturbines as eligible for interconnection, although they must be fully fueled by renewable fuels such as biomass. The maximum system size is 300kW for non-residential applications (DSIRE 2012). Because most CHP systems are far larger, this interconnection standard—even if it explicitly included other fuel types—would fail to provide a clear path for interconnecting to the grid for most if not all viable CHP systems. A good option for Louisiana is to develop an interconnection standard in line with the recommended national guidelines established by EPA.[20] Resources on interconnection models are also available from the National Association of Regulatory Utility Commissions (NARUC) and from FERC.[21] Ideally, an improved interconnection standard would provide a clear path toward interconnection for systems up to 20 MW in size, which would cover most facilities that are not covered by FERC regulations, and would include multiple tiers of interconnection so that smaller systems could benefit from a more expedited interconnection process. Much of the interconnection process is currently left to the discretion of the state's public and private electric utility companies.

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

[21] See http://www.naruc.org/Publications/dgiaip_oct03.pdf and http://www.ferc.gov/industries/electric/indus-act/gi/small-gen.asp

Standby rates. Along with clear interconnection standards and net metering, utility standby, backup, and supplemental rates can help shape the economic viability of CHP. Historically, many utilities have created rate structures that have overweighted cost and underweighted benefits of adding CHP. One common assumption in the design of these rates is that all CHP systems could fail simultaneously, at the exact moment the grid hits its peak. Such assumptions are not based on actual experience, but instead on theory. Standby and backup rates also do not generally reflect the fact that CHP helps directly reduce T&D congestion, line losses, and a utility's reserve requirement. Rates, then, should reflect the full range of cost and benefits that accrue to the utility from CHP, including benefits such as avoided T&D costs and monetization of ancillary services, as is discussed in Vaidyanathan et al. (2013).

In Louisiana, Entergy Louisiana and Entergy Gulf States provide standby service to QFs only.[22] Both standby rates are primarily demand-based. For Entergy Louisiana, billing demand is based on the three maximum 15-minute demand periods during the month or 70% of the maximum demand over the previous 11 months, whichever is higher. Entergy Gulf States' billing demand is based on the 30-minute maximum demand each month. There is a 12-month ratchet, which is viewed as unfavorable toward CHP.[23] EPA offers useful guidance to states in developing standby rates that are more conducive to CHP development.[24]

Emissions Treatment. Output-based emissions regulations define emissions limits based on the amount of pollution produced per unit of useful output (e.g., pounds of sulfur dioxide per megawatt-hour of electricity). A major benefit of output-based emissions standards is that they encourage cost-effective, long-term pollution prevention through process efficiency. Many states, however, employ emissions regulations for generators by calculating levels of pollutants based on the system's fuel input rather than output. For more information on emissions treatment, visit the EPA's CHP Partnership website.

Utility Investment in or Ownership of CHP. An important barrier to expanded installation of CHP has been that many utilities do not see benefit in allowing CHP systems to operate in their service territory. From a utility's perspective, CHP systems reduce electricity sales and defer the need for capital investments in which a utility can earn a rate of return.

Involving utilities financially in customer CHP projects may represent an opportunity in the future to address both the concerns of utilities while allowing customers to benefit from improved energy efficiency. Utilities gain access to attractive capital rates and have an investment horizon consistent with longer-term assets, such as CHP. The utility would earn a return on these investments just as it would on a new generation or transmission asset. And because electricity output from CHP systems can be less costly than traditional utility generation, utility investments in CHP can accomplish both goals of least-cost planning in an IRP context and meeting utility energy efficiency goals. In addition, with a utility's involvement in the CHP system, the capacity can be more seamlessly integrated into the management of the

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[22] Information on standby rates: http://aceee.org/energy-efficiency-sector/state-policy/Louisiana/191/all/195

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

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

grid and can provide important ancillary services, such as voltage stabilization, reactive power support, and relief of transmission constraints (see Vaidyanathan et al. 2013).

Utility financial involvement in a CHP project can take many forms, from investment in a customer facility to outright ownership and operation of the CHP system. Examples of utility involvement in CHP exist across the county. In Wisconsin, the local utility, Alliant Energy, financed a CHP system at a wastewater treatment plant (ACEEE Case Study 2012). In the Southeast, Southern Company acquired the power island for some of its large industrial firms and has operated them for the customers (Elliott & Spurr 1999). There is no single model that works, but rather multiple options are available. The LPSC could facilitate a dialogue between some large industrial consumers and their utilities to explore paths forward that conferred benefits to both parties. While this may not be a near-term solution because of the challenges associated with a new model that would have to be addressed, it can be a long-term option to improve energy efficiency in Louisiana.

CHP Potential Analysis

Our estimates for achievable CHP potential in Louisiana are based on an analysis by ICF International for a recent ACEEE study (Chittum & Sullivan 2012). Table 11 summarizes results from that analysis for Louisiana through 2020. The technical potential in existing industrial and some commercial facilities, which does not consider cost effectiveness, is 5,327 MW. ICF also examined two economic scenarios: a conservative "base case" scenario and an aggressive "utility ownership" scenario. Table 11 presents results for both onsite CHP potential and incremental export CHP potential. Onsite potential refers to electricity generated for consumption at the facility, whereas incremental export refers to excess electricity generation that is not needed on-site and could be exported to the grid.

The base case economic potential assumes a high degree of risk aversion by facilities considering new CHP projects, which is consistent with recent behavior by industrial and commercial sectors. The base case assumes a 50% acceptance of CHP systems with a 2-year payback period, and estimates an economic potential of 264 MW (2012–20).

The more aggressive utility ownership scenario assumes that utilities make investments in CHP and become full or partial owners in CHP systems as assets to their portfolio of energy capacity. In this scenario, ICF estimates potential of nearly 1,500 MW. This is the scenario we have considered for our analysis.

Table 11. Economic Potential for CHP in Louisiana

Market Summary	Onsite	Incremental Export	Total
Capacity, MW			
Existing CHP			6,890
Remaining Technical Potential	2,549	2,778	5,327
Base Case Market Penetration 2012–20	188	76	264
Utility Ownership Case Market Penetration 2012–20	643	842	1,485
Output, million kWh/year			
Base Case Market Penetration 2012–20	1,514	611	2,125
Utility Ownership Case Market Penetration 2012–20	5,168	6,782	11,950
Cumulative Avoided CO_2 Emissions, 1,000 MT			
Base Case Market Penetration 2012–20	1,049	428	1,477
Utility Ownership Case Market Penetration 2012–20	3,564	4,701	8,265

Source: ICF as referenced in Chittum & Sullivan 2012

Tailored Utility Program Options

This section describes several energy efficiency program options, categorized by targeted customer class, for Louisiana utilities or other program administrators to 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. 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 comprehensive suite of energy efficiency programs that would be deployed statewide (including New Orleans) through 2030. 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, Entergy New Orleans through its *Energy Smart* program has been offering residential and business efficiency programs, which have been highly successful in reaching its goals (ENO 2012). For the programs that are currently being offered through Entergy New Orleans, we used the *Energy Smart* program results as the baseline estimate of program participation and energy savings results for 2011 and 2012.

Some utilities also have efficiency program delivery experience in other service areas close to Louisiana; for example, CenterPoint offers natural gas programs in Arkansas, and SWEPCO offers programs in Arkansas and Texas. We used data, when available, from these other jurisdictions that are in the same climate zones (2 and 3) as Louisiana 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 *Energy Smart* in New Orleans*)*, the residential TREAT modeling software for the efficiency potential assessment presented earlier in this report, regional data from the EIA’s *Residential Energy Consumption Survey* and *Commercial Building Energy Consumption Survey*s (EIA 2007; 2009b), or other energy efficiency programs offered elsewhere in the region in a similar climate zone (e.g., Texas and Arkansas utilities). We also consulted data from these programs and several other best-practice programs 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, however 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 cost-effective program portfolios it is important to maintain enough flexibility so that program administrators can be innovative in program development and can make adjustments to programs as needed to improve participation rates and overall effectiveness.

RESIDENTIAL

This section describes nine program options for residential customers. Combined with improved statewide building energy codes, these programs could save 5.2% cumulative of residential electricity by 2020 relative to reference case electricity sales (Table 12), and 4.6% of residential natural gas by 2020 (Table 12). 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.

These estimates for 2020 assume implementation beginning in 2012. However, for our analysis we assume that implementation of CHP projects will not begin until 2015, so the full potential is not achievable until 2023 at the earliest. We extend this to 2030, however, to allow for a longer period of implementation to adopt policies that encourage CHP. Finally, we assume that all of the cost-effective CHP capacity potential is installed in the industrial sector, which is the general finding of the ICF analysis (the analysis did estimate that about 5% of the potential was in the commercial/institutional sector, but for simplicity we assume all in the industrial sector).

Table 12. Potential Residential Policy and Program Electricity and Natural Gas Savings in 2020

	Electricity		Natural Gas	
Residential Programs	**GWh**	**% of Reference Case**	**MMCF**	**% of Reference Case**
Building Energy Codes	152	0.5%	323	0.8%
New Construction and Code Support	174	0.5%	219	0.5%
Low-Income Weatherization	113	0.3%	439	1.1%
Multi-Family	45	0.1%	54	0.1%
Home Retrofit	181	0.5%	193	0.5%
Retail Products	155	0.5%	n/a	0.0%
Lighting	286	0.9%	n/a	0.0%
Cooling and Heating	152	0.5%	220	0.5%
Water Heating	97	0.3%	250	0.6%
Enhanced Billing and Information Feedback	364	1.1%	155	0.4%
Residential Subtotal	*1,719*	*5.2%*	*1,854*	*4.6%*

New Construction and Code Support

Louisiana is projected to add about 480,000 new single-family and multi-family housing units between 2013 and 2030 (Moody's 2012). This growth in the residential sector offers significant energy savings potential in the new construction market. While building energy codes will promote strong minimum standards, residential new construction efficiency programs can play a unique role in encouraging builders to go beyond code through advanced building measures. New construction programs will reap significantly more energy savings and comfort for homeowners, as well as job benefits in this sector.

Residential new construction programs generally feature training, education, and financial incentives for homebuilders if they meet comprehensive, advanced energy efficiency standards in new homes. 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.

New construction programs could also offer tiers of packages designed to achieve increasing levels of savings. Financial incentives to builders would also follow by tiers, with the first tier, for example, being the ENERGY STAR level, which is designed to achieve at least 15% savings above the 2009 IECC. A second tier could target 30% savings or more beyond the 2009 IECC; for example, Arizona Public Service Company (APS) targets a second tier called ENERGY STAR Plus (York et al 2013). APS holds a number of trainings on the new specification and markets them through a variety of channels. The ultimate goal is to phase out financial incentives, relying on increasing awareness of the benefits of an energy-efficient home to drive participation (i.e., market transformation) and make advanced, energy-efficient new construction the standard practice.

Utilities are also well positioned to support state-level building energy code policies, and program administrators should look closely at energy codes as a potential resource for their portfolios. For example, 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, 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).

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 assume that new construction programs will begin in 2014 and offer two tiers of new construction incentives along with code support activities. The two tiers of advanced new homes target 15% and 30% energy savings beyond code, and based on data from EPA we assume incremental cost estimates of about $4,000 per home for ENERGY STAR new homes. We estimate that participation ramps up steadily so that nearly 215,000 new homes participate in the program through 2030, which represents about 40% of projected new construction by that year. The code support activities would promote further savings in new construction, as discussed in the previous state policy category of building energy codes.

Low-Income Weatherization

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.

The existing federally funded Weatherization Assistance Program (WAP) in Louisiana aims to help low-income households reduce their cooling or heating bills and to improve their health and safety through energy efficiency. The Louisiana Association of Community Action Partnerships (LACAP) administers WAP in partnership with the Louisiana Housing Financing Agency, and LACAP contracts with local community action agencies and local governmental entities to deliver weatherization services to low-income households in all 64 parishes 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.

Fiscal year 2012 funding was $600,000, less than half of FY11 and FY10 (about $1.3 million each year) and a small fraction of FY09 ($3.6 million) (LHFA 2012). Also during recent years, the federal stimulus program, the American Recovery and Reinvestment Act (ARRA), provided significant increased funding of $50.7 million for this program. According to estimates from LACAP, participation has ranged from about 80–200 household participants per year over the past 3 years.

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.

Marketing for low-income weatherization usually consists of contacting by mail and/or by telephone customers who subscribe to the low-income rates but have not received prior energy efficiency services. Outreach and marketing efforts could be expanded to include building relationships with unemployment centers, medical service providers, places of religious worship, and other venues that would reach potential income-eligible customers.

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. 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.

Program Analysis

We assume that the statewide weatherization program is coordinated with utility weatherization offerings. Eligible residential customers for the WAP program are those at or below 200% of federal income poverty guidelines, which is less than $44,100 for a family of four. According to U.S. Census Bureau, about 35% of families in Louisiana were at or below 200% of the poverty threshold in 2010 (Census 2011). We used families as a proxy for households or electricity customers in this analysis. The baseline assessment for 2011 and 2012 includes program impacts from the existing WAP program and the Entergy New Orleans program. Estimated electricity savings per participant are based on data from ENO’s program and multiple program offerings in Texas; for natural gas savings, we estimate that customers with natural gas service will save on average 20%. Program cost estimates are based on the ENO, Texas, and Arkansas program offerings.

Multi-Family Energy Efficiency

About 18% of homes in Louisiana are in multi-family buildings (Moody’s 2012). Nationally, multi-family buildings have been greatly overlooked when it comes to implementing energy efficiency programs, due to several challenges: a disproportionately large number of low-income residents in the buildings; the split incentive problem, which occurs when the party who owns the property and is responsible for capital investments and upkeep (landlord) typically is not the same party who is responsible for paying energy costs (tenants); and multiple utilities, such as natural gas and electricity, servicing the same building.

This type of program provides energy efficiency upgrades for multi-family buildings, typically those with five or more dwelling units, including initial energy assessments, education on energy savings opportunities, direct installation of low-cost measures, and the opportunity to install major measures at a reduced cost. Efficiency measures in this program typically include energy-efficient lighting upgrades and controls (e.g., occupancy sensors), water heating measures (low-flow showerheads, faucet aerators, pipe wrap), programmable thermostats, insulation, air sealing, high-efficiency HVAC equipment, high-efficiency appliances, high-efficiency motors and motor speed controls, energy management systems, high-efficiency water heating equipment, CHP systems, and heat or energy recovery ventilators.

One option for program delivery is to offer property owners free direct installation of low-cost energy-efficient products as well as information on rebate and low-cost financing opportunities for more capital-intensive measures. Other options include building operator training and technical assistance for those projects requiring an engineering study. Multi-family programs should be designed as “one-stop shopping,” multi-fuel, comprehensive programs to encourage program participation and maximize cost-effective energy savings per building. Working with housing authorities and financing organizations is key to reaching the greatest number of buildings and serving a much higher share of customers.

Program Analysis

Target customers are multi-family residential households in Louisiana, whose number we estimate based on projections to 2030 from Moody’s Analytics. Currently, New Orleans and Algiers multi-family customers can participate through the Home Performance with ENERGY STAR program, and new offerings filed by Entergy with the New Orleans City Council include a specific multi-family program. For the statewide analysis, we estimate best-practice participation rates based on programs in the Northeast, which reached 1.5% of eligible customers annually in 2010. We assume that it will take several years for Louisiana programs to scale to this level, and then estimate that programs will ramp up to reach 5% of eligible customers annually by 2020 and each year thereafter. Energy savings per participant are assumed to be 10%, which is the typical level of savings achieved by Austin Energy and Massachusetts utilities in their multi-family programs. Estimates for program costs are also based on data from Austin Energy and Massachusetts utilities.

Whole-House Retrofits

Most residences in Louisiana (69%) are single-family homes and another 13% are mobile homes (Moody’s 2012). 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. Major retrofits of multi-family homes, which comprise the other 18% of homes in the state, will typically fall under the separate multi-family program option as described above. Retrofit programs takes 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 is one popular program design approach to deliver whole-house retrofits.

Program Analysis

Target customers are all single-family and manufactured home residential customers in Louisiana, whose number we estimate based on projections to 2030 from Moody's Analytics. Currently, New Orleans' *Energy Smart* offers a Home Performance with ENERGY STAR program, formerly called Residential Solutions, which reached nearly 1,750 participants from 2011–12. We estimate best-practice participation rates based on programs offered by Austin Energy and Connecticut Light and Power, which recently reached 0.7% and 1.2% of eligible customers annually, respectively. We assume that it will take several years for Louisiana programs to scale to this level, and then estimate that programs can continue ramping up through improved marketing to reach 1.5% participation by 2020, 3% by 2024, and 3.8% by 2026 and each year thereafter so that nearly 40% of eligible customers are reached by 2030. Energy savings per participant are assumed to average about 16%, which is the typical level of savings achieved by Austin Energy in recent years. 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 data from Austin Energy and New Orleans' *Energy Smart* programs.

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 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 2013b). 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.

Program Analysis

This program option targets consumer electronics and appliances. While no programs are currently offered in the state, this type of program was included in program offerings recently filed with the New Orleans City Council. 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

Consumers now have access to a wider choice of energy-efficient lighting options, with more specialty products. 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 type of 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 cost 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 their 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 the residential buildings analysis, which assumes the average home has 32 incandescent bulbs and 16 CFL bulbs. Currently, *Energy Smart* New Orleans offers a residential lighting program targeting CFLs, which reached over 90,000 bulbs distributed in 2011, and absent additional data we assume the program remains steady in 2012 in 2013. We assume that statewide programs can quickly scale up to reach the same level of relative CFL penetration achieved in New Orleans (nearly 1 additional bulb per household on average), and that LED programs begin within a couple of years and achieve participation levels similar to those achieved by Nevada Power. Savings-per-bulb assumptions are based on data from the *Energy Smart* program and Nevada Power, and 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 and Heating

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.

An estimated 75% of residential customers in Louisiana have central air-conditioning (CAC), and the other 25% have room air-conditioners (EIA 2009b). For heating, an estimated 46% of homes have natural gas furnaces, 32% electric resistance heaters, 8% electric heat pumps, and 9% propane-fired furnaces. A residential cooling and heating program would target the customer segments that use CAC for cooling and/or electricity or natural gas for heating. 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.

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 efficient units. The focus is also 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.

Program Analysis

We first estimate the reference case projections of residential households in Louisiana to 2030 based on Moody’s Analytics, and then estimate the number of home CACs and electric heat pumps based on data from EIA’s *Residential Energy Consumption Survey.* For the program analysis, we estimated per-unit savings and costs from high-efficiency CACs and electric heat pumps based on data from the ENO and Texas utility programs.

Residential Water Heating

This program option is similar to the cooling and heating equipment program, with a focus on high-efficiency equipment rebates to customers along with a more midstream focus on retailers. It encourages customers to purchase high-efficiency electric heat pump water heaters or condensing gas water heaters through rebates, and promotes greater adoption of low-flow showerheads and faucet aerators, which lower the demand for hot water and can enable the purchase of smaller systems. The program would typically provide both direct rebates to customers as well as work with retailers, contractors, and distributors; participate in trade shows; and offer point-of-purchase materials available at large retailers.

Program Analysis

We first estimate reference case projections of residential households based on Moody’s Analytics, and then estimate the number of households with electric or natural gas water heaters based on data from EIA’s *Residential Energy Consumption Survey.* We estimate per-unit electric and gas savings based on the residential TREAT model analysis for a typical home in Louisiana. Estimated participation rate of 0.1% of eligible customers (i.e. those with the appropriate technology) is based on Xcel Colorado’s recent program, and we estimate the program could gradually ramp up to reach 3% of eligible customers per year. Program costs are based on experience with Xcel Colorado’s program.

Behavior-Based Programs: Enhanced Billing and Real-Time Feedback

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 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. Finally, interest in behavior-based programs also stems from a desire to further promote and enroll more customers in existing programs.

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 such tools as in-home information feedback devices, which are linked to smart meters and provide meaningful information to customers.

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% on 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 eight 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 7.1% electricity savings and 6.0% natural gas savings by 2020 (Table 13).

Table 13. Potential Commercial Program Electricity and Natural Gas Savings in 2020

	Electricity		Natural Gas	
Commercial Programs	GWh	% of Reference Case	MMCF	% of Reference Case
Building Energy Codes	335	1.3%	589	2.3%
Lead by Example in Government Facilities	295	1.1%	101	0.4%
New Construction and Code Support	44	0.2%	47	0.2%
Small Commercial	244	1.0%	n/a	n/a
Large Commercial Custom	518	2.0%	402	1.6%
Computer Efficiency and Plug Loads	154	0.6%	n/a	n/a
Prescriptive Rebates and Upstream Incentives	184	0.7%	459	1.8%
Retrocommissioning	58	0.2%	62	0.2%
Commercial Subtotal	**1,833**	**7.1%**	**1,660**	**6.0%**

New Construction and Code Support

Building design is a primary determinant of energy use for the lifetime of buildings. Most design and construction processes are fragmented, fast-paced, and driven by low first cost. Such processes are at odds with the design process needed to achieve high-efficiency buildings, a process that requires more time to develop alternative designs and model their performance and energy use. New construction energy design assistance programs address this gap by providing resources and incentives to project design teams and building owners that enable them to consider a wider range of design options intended to minimize energy use. Programs consider and include a variety of building technologies, including advanced lighting, high-efficiency HVAC systems, and high-efficiency building envelopes.

The main strategy for this type of program is to provide resources and incentives to building owners during the design phase so that the project architects and engineers can model and analyze the energy performance of a variety of designs in order to yield an integrated, energy-efficient design—one that delivers high building performance and low energy use.

Utilities and related organizations can also play a role in working on development and compliance with more stringent building energy codes. In these ways, the baselines for building energy use are moving toward higher efficiency, while the performance of the most efficient buildings is promoted through building design assistance programs. At the same time, private markets for green buildings have grown and continue to grow rapidly, suggesting an increasing number of owners and occupants who value high-performance, low-energy buildings.

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 2012* 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 Louisiana can ramp up to this participation level over 5 years. For the incentive portion of the program, we estimate an average of 20% savings until a new energy code takes effect and that, after the new code takes effect, all new buildings improve in energy efficiency. We estimate an average 25% savings relative to buildings built to meet the previous model energy code, in line with the savings for the ASHRAE 90.1-2010 code (Thornton et al. 2011). We estimate another round of code changes 5 years later (i.e., in 2019), with the new code saving an additional 25%. For example, ASHRAE is targeting 20% savings from the 2013 version of its standard; savings targets have not yet been set for the 2016 standard. We estimate program costs, including both incentives and marketing/administrative costs, for the incentive program based on data from Southern California Edison (SCE) and Connecticut.

Small Business "Direct Install"

Small business programs are often "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. Historically, small business program participation rates 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.

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 64% of commercial electricity customers fall within this threshold. We assume 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 2030, we start with the estimated growth rate in new commercial floorspace as described in the previous program. However, we assume only 50% of the growth rate applies to eligible customers for this program because we assume that many customers are already relatively energy-efficient due to building energy codes or utility new construction incentive programs. We estimate that utilities can reasonably ramp up to 2% participation per year, based on best-practice programs offered by SCE, Massachusetts, and Connecticut utilities. We estimate program costs in the first few years based on ENO's cost results, and as the program targets more participants, we assume costs based on data from Austin Energy, SCE, Massachusetts, and Connecticut utilities. Per-participant savings are based on verified program results from the same utilities.

Prescriptive Equipment Rebates

A prescriptive equipment program option helps business customers improve the efficiency of their new or replacement lighting, motors, refrigeration, heating, ventilation, and air-conditioning (HVAC), and other equipment by providing prescriptive rebates on commonplace efficiency measures. Both new construction and retrofit customers would be eligible for the program. The program also administers upstream incentives to equipment distributors for selected products.

Typical examples are HVAC programs for roof-top units for midsized and big-box applications (air-conditioning, heating, and ventilation; chillers and chilled water systems for large buildings; ground-source heat pump systems; and condensing boilers for schools and other larger buildings with large heating loads). Programs can span the system life cycle, including incentives for advanced designs (system approaches), incentives for installing advanced systems for new construction and retrofits, and performance-based approaches to operations and maintenance (O&M) programs. All have high potential, but vary in their maturity level for replication by program administrators.

Lighting is another major savings opportunity for the commercial sector. Recently, 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 will change substantially with the full implementation of new federal minimum efficiency standards, which will affect the baselines commonly used by energy efficiency programs. (However, not all states are addressing these changes uniformly. Impact evaluation and regulatory decisions could result in program administrators getting 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.)

To reach the higher bar required in the new environment, next-generation commercial lighting programs take a more holistic, systems-oriented approach that incorporates advances in technology, rather than the simpler traditional approach of replacing lighting products and equipment with similar, yet more efficient ones. As a result, lighting programs will span beyond the prescriptive approach into custom approaches as well.

Barriers to comprehensive next-generation lighting ramping up to scale include high up-front costs for advanced controls and equipment, including changing the arrangement and wiring of fixtures, and a shortage of trained lighting contractors. Targeting larger customers and lighting designers/electrical engineers to promote advanced lighting systems and the integration of lighting with HVAC and other measures improves cost effectiveness. Programs should place greater emphasis on training contractors to take more complex and sophisticated approaches, which are customized to the needs of commercial customers and the characteristics of each market segment.

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. Such redesigns can include high-efficiency lighting fixtures such as direct-indirect fixtures, use of one- and two-lamp fixtures instead of the three- and four-lamp fixtures that were popular in the past, and use of task-ambient lighting approaches, in which overall ambient lighting levels are sufficient to do most work for the average person and task lights are used for particularly demanding tasks or people with below-average vision. In addition, use of advanced lighting controls is another area of technology development and innovation that holds great promise.

LED lighting is clearly prominent among new lighting technologies. It may save 10–20% more energy than high performance T8s and even more relative to the halogen reflector lamps commonly used in retail stores and a variety of other applications. LEDs also provide non-energy benefits relative to fluorescents, such as greater control and being mercury-free.

Program Analysis

We assume that all commercial and industrial customers are eligible for this program. Our analysis for prescriptive rebates begins with reference case projections of commercial and industrial customers for electricity and natural gas, based on Moody's Analytics employment growth rates. To project eligible customers through 2030, as described for the previous program, we assume only 50% of the growth rate because we estimate the other half of new construction customers will be affected by the new construction efficiency programs. We also back out public-sector customers, because we assume their participation is captured in the lead-by-example program type. Per-participant savings estimates, program cost estimates, and participation rates are informed by results from several program resources, including Pacificorp’s FinAnswer Express Program, Centerpoint Arkansas’ Small Commercial and Large C&I Rebate program, Efficiency Vermont’s equipment replacement program, Texas utility commercial programs, and Xcel Colorado’s equipment replacement program.

Custom Projects

Unlike a prescriptive approach, a custom-based program option target large, unique energy savings opportunities. A custom program typically provides energy engineering technical assistance and incentives to large business customers to target specialized projects requiring project-specific energy savings analysis. The program option provides custom rebates on a wide variety of equipment, retrofits, and process improvements that do not fall within the prescriptive rebates, and therefore operates as a complement to the more streamlined prescriptive rebate program. Custom efficiency projects require pre-approval before installation to ensure projects are cost-effective and meet other program requirements.

This type of program promotes continuous energy improvement in order to promote deep and ongoing energy savings by large, more sophisticated customers. Model 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.

Program Analysis

We examined regional and national best-practice programs such as Xcel’s Process Efficiency program, Texas utility custom solutions programs, and programs offered by Energy Trust of Oregon and Efficiency Vermont. We start with data for total number of existing commercial customers in Louisiana, and we assume that all commercial customers that do not qualify for the small business program are eligible (i.e., about 20% of customers). To project the number of customers eligible through 2030, we apply the same methodology as described in the previous commercial programs. Based on participation results from best-practice programs, we estimate that Louisiana can ramp up to participation levels of about 1–2% of eligible customers per year. Participant savings and costs are based on the same best-practice programs as above, scaling the savings estimate from utility programs in Texas to the average-sized customer in Louisiana. Large commercial customer size can vary substantially, and our estimates for savings per participant represent an average savings.

Retrocommissioning

Building systems, especially HVAC and lighting, often do not operate as designed and can fall out of optimal working order even after tune-ups take place. Furthermore, building owners or operators often do not have dedicated staff for tracking energy management. And when buildings do have facility energy managers or operators, those personnel do not necessarily have adequate training or the tools needed to improve the efficiency of building systems, nor do they typically have sufficient time or resources. Inadequate maintenance in commercial buildings and lack of calibration based on changes to occupancy and use can lead to poor performance and high energy costs. These problems create the need for ongoing O&M activities targeted to building energy systems, making changes and repairs, and doing tune-ups.

Program administrators can pursue multiple strategies to achieve energy savings through improved commercial buildings operations. Retrocommissioning, monitoring-based commissioning, and strategic energy management programs are some of the ways to improve energy management. These strategies enable the identification of low- and no-cost efficiency measures, typically in large commercial buildings and institutional or government facilities. Through the commissioning process, building operators verify performance and design intent of various systems, and then correct deficiencies in existing equipment and systems rather than focusing on purchasing new equipment. The benefits of improved system operations include energy savings and reduced peak demands, as well as improved air quality, occupant comfort, and even employee productivity.

Training programs are also critical components to this sector, and approaches such as building operator certification and subsidized energy manager programs are ways to expand expertise in the building operations industry.

Retrocommissioning program administrators are looking to improved access to real-time data and monitoring tools, which can improve initial customer screening, provide more accurate energy baselines and estimates of measure savings, and enable ongoing or monitoring-based commissioning. To increase customer participation, programs should first develop a well-planned outreach strategy that effectively communicates the business case to an appropriate base of potential customers. Programs also need a strong base of qualified contractors, which in some cases may be partnerships between software companies and engineering firms. Finally, strong and ongoing relationships among all stakeholders, including customers, utilities/program managers, and vendors can boost participation by leveraging key account management for marketing to bridge customers to and/or from capital improvement or demand response programs. The goal is to encourage customers to take advantage of multiple program offerings.

Program Analysis

We first estimate a reference forecast of total business customers in the state using the forecast as described previously, and then we estimate eligibility based on the proportion of commercial buildings over 100,000 square feet in the West South Central states. For participation rates, we estimate a slow but steady ramp-up until about two-thirds of customers are reached. Typical savings and costs for retrocommissioning services are based on a national review of best-practice programs (York et al 2013), as well as Texas retrocommissioning programs.

INDUSTRIAL

The industrial sector in Louisiana is the largest segment of energy usage, accounting for 66.5% of total energy usage and 34% of electricity sales. Untapped energy savings in this sector remain large for both electricity and natural gas, and our analysis of the cost-effective resource potential finds that there is approximately 16-20% of cost-effective savings available by 2030 in electricity and natural gas savings. 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.

Despite this large efficiency potential and the ultimate benefits to business, there are a number of barriers to the participation of industrial customers in energy efficiency programs and to adoption of efficiency upgrades on their own. These barriers must be addressed to achieve larger-scale efficiency gains in the industrial sector:

- 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 four different program options designed to overcome these barriers and help industrial customers to improve efficiency: (1) prescriptive equipment incentives, (2) custom solutions, (3) strategic energy management, and (4) a self-direct option. Our analysis finds that these programs could produce electricity savings of 2.9% of sales by 2020 and 9% by 2030 (Table 14).

Table 14. Potential Industrial Program Electricity and Natural Gas Savings in 2020

	2020		2030	
Industrial Programs	GWh	% of Reference Case	2030	% of Reference Case
Prescriptive Rebates and Upstream Incentives	224	0.7%	972	2.9%
Custom, Self-Direct, or Reverse Auction	428	1.3%	1,613	4.8%
Strategic Energy Management	338	1.0%	444	1.3%
Industrial Subtotal	**990**	**2.9%**	**3,028**	**9.0%**

Note: Program potential for custom and self-direct programs are considered in the same category of savings.

Prescriptive Equipment Energy Efficiency Services

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.

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).

It is worth noting that agriculture customers could also benefit from participation in a custom solutions program, or perhaps an agriculture-specific program. Agriculture is the second largest industry in Louisiana after petrochemicals. In 2011, the largest gross farm income was from plant enterprises ($3.8 billion), followed by animal enterprises ($1.69 billion) and fisheries and wildlife enterprises ($569 million).[25]

Strategic Energy Management

Strategic Energy Management (SEM) programs are a major new energy efficiency program trend that focuses on integrating energy management practices into a company's culture, standard operating procedures, and profitability. For many years, manufacturers have used strategic management systems to improve quality and safety in their plants, making the process a natural extension of energy efficiency management.

SEM programs typically involve a review of how a company manages its energy use, engages executive-level leadership from the company, and suggests the implementation of (or improvements to) an energy management strategy. SEM is a system of *practices* that create reliable and persistent energy savings and is currently demonstrating potential to add significant energy savings to industrial processes. Some overarching trends to improve SEM include standardizing savings protocols/accounting and leveraging information and data systems. Energy savings from SEM programs come from multiple sources: (1) direct behavior changes such as O&M improvements; (2) indirect savings from incremental increases in capital energy efficiency projects, such as improved lighting efficiency; (3) indirect savings from additional capital projects that otherwise would not have been pursued, such as process changes; and (4) improved persistence of energy savings due to better management.

BC Hydro's program, for example, offers industrial customers assistance through its Energy Manager for BC Manufacturers and Energy Manager for BC Food Processors programs. BC Hydro's customers register for these programs through British Columbia manufacturing and

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[25] http://www.lsuagcenter.com/agsummary/narrative

food processing associations. After they register, they are assigned an energy manager who works with them to create a customized Sustainable Energy Management Plan for their company. After outlining practical recommendations for saving energy, the energy manager assists with project implementation and helps them apply for incentives from BC Hydro's Power Smart program.

The transaction cost of custom program approaches makes them impractical for individual small and medium enterprise/business customers. Reaching this sector requires approaches that allow the program to work with multiple facilities of the same company or same type of company. Two approaches have shown success: working with regional trade associations to leverage their existing member relationships to deliver energy efficiency offerings; and working with large manufacturers who work with their suppliers to adopt energy efficiency measures.

Self-Direct Programs for Large Industrial Customers

Some large customers may find the self-direct option more appropriate if program offerings are not responsive to their needs or if they already have and will continue to invest in all 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.

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 Chittum 2011, 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 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-administered 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.

The LPSC quick-start energy efficiency rules would allow industrial customers to opt out of programs during the quick-start phase. While this approach addresses the concerns of large industrial consumers, it also needs to consider the utility-system benefits that are avoided by allowing all large industrial customers to opt out. Based on best-practice program experience elsewhere, Louisiana's opt-out provision could be improved by establishing a self-direct option with verification standards and requiring periodic independent verification to ensure the appropriate savings performance.

Program and Policy Analysis: Detailed Results of Costs and Benefits

PROGRAM COSTS

Table 15 presents the summary of estimated annual program and policy costs from the program analysis for benchmark years. Table 16 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 15. Energy Efficiency Program and Policy Spending in $Mil in Louisiana (Benchmark Years, 2010–30)

Sector and Program Type	2015	2020	2025	2030
Residential				
Building Energy Codes	$-	$-	$-	$-
New Construction and Code Support	$6	$14	$18	$16
Low-Income Weatherization	$6	$13	$15	$15
Multi-Family	$1	$6	$7	$7
Home Retrofit	$5	$31	$42	$28
Retail Products	$2	$5	$13	$13
Lighting	$8	$5	$8	$9
Cooling and Heating	$4	$15	$26	$36
Water Heating	$2	$22	$27	$28
Enhanced Billing and Information Feedback	$0	$10	$24	$29
Residential Subtotal	***$34***	***$123***	***$179***	***$180***
Commercial				
Building Energy Codes	$-	$-	$-	$-
Lead by Example in Government Facilities	$2	$16	$18	$14
New Construction and Code Support	$2	$5	$9	$8
Small Commercial	$9	$19	$19	$19
Large Commercial Custom	$12	$17	$13	$10
Computer Efficiency and Plug Loads	$0	$8	$8	$8
Prescriptive Rebates and Upstream Incentives	$4	$35	$63	$63
Retrocommissioning	$0	$7	$25	$27
Commercial Subtotal	***$29***	***$106***	***$154***	***$149***
Industrial				
Strategic Energy Management	$-	$32	$22	$14
Prescriptive Rebates and Upstream Incentives	$7	$25	$41	$41
Custom, Self-Direct, or Reverse Auction	$3	$33	$35	$19
Industrial Subtotal	***$10***	***$91***	***$98***	***$74***
Total Programs	**$72**	**$319**	**$432**	**$403**

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

Table 16. Estimated Energy Efficiency Customer Investments in $Mil in Louisiana (Bench Years, 2010–30)

Sector and Program Type	2015	2020	2025	2030
Residential				
Building Energy Codes	$-	$12	$16	$16
New Construction and Code Support	$9	$24	$27	$21
Low-Income Weatherization	$-	$-	$-	$-
Multi-Family	$0	$1	$1	$1
Home Retrofit	$3	$16	$21	$14
Retail Products	$2	$6	$15	$15
Lighting	$4	$6	$10	$11
Cooling and Heating	$3	$12	$23	$33
Water Heating	$2	$22	$26	$27
Enhanced Billing and Information Feedback	$-	$2	$4	$4
Residential Subtotal	*$23*	*$101*	*$143*	*$142*
Commercial				
Building Energy Codes and New Construction and Code Support	$19	$42	$46	$43
Lead by Example in Government Facilities	$2	$16	$18	$14
Small Commercial	$4	$8	$8	$8
Large Commercial Custom Retrofit	$12	$17	$13	$10
Computer Efficiency and Plug Loads	$0	$3	$11	$11
Prescriptive Rebates and Upstream Incentives	$1	$10	$21	$21
Retrocommissioning	$0	$7	$25	$27
Commercial Subtotal	***$37***	***$103***	***$143***	***$135***
Industrial				
Strategic Energy Management	$-	$45	$31	$20
Prescriptive Rebates and Upstream Incentives	$6	$8	$13	$13
Custom, Self-Direct, or Reverse Auction	$4	$46	$49	$27
Industrial Subtotal	***$10***	***$100***	***$94***	***$60***
Total Programs	**$71**	**$304**	**$379**	**$337**

Note: These are statewide estimates and include customer investments in both electricity and natural gas efficiency measures. Due to rounding, totals may differ from 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 systemwide 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.[26] The program period is through 2030; however, the NPV analysis is over the life of the measures (i.e., measures installed in 2030 continue saving energy over their useful lifetimes). We present the results in Tables 17, 18, and 19, 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 Louisiana 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 1.8 over the analysis period, which means that each $1 invested in programs and customer measures would yield $1.80 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 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

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[26] We use a real (rather than nominal) discount rate because our analysis is in terms of real dollars (2011$).

that accrue to all customers from the program impacts (the same as the TRC benefits). We estimate a PAC/UCT ratio of 3.4 over the analysis period, which means that each $1 invested in utility programs would yield $3.40 in avoided energy costs, which are universal benefits to all customers.

- 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 3.5 over the analysis period, which means that each $1 invested in customer measures would yield $3.50 in energy bill savings.

Table 17. Total Resource Cost (TRC) Test

NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
$2,046	$3,921	$1,875	1.9
$1,926	$3,577	$1,651	1.9
$1,248	$2,004	$757	1.6
$5,219	**$9,502**	**$4,282**	**1.8**

Note: Assumes a 5% real discount rate

Table 18. Program Administrator Cost Test (PAC)/Utility Cost Test (UCT)

NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
$1,130	$3,921	$2,791	3.5
$975	$3,577	$2,602	3.7
$626	$1,717	$1,091	2.7
$2,731	**$9,214**	**$6,483**	**3.4**

Note: Assumes a 5% real discount rate

Table 19. Participant Cost Test (PCT)

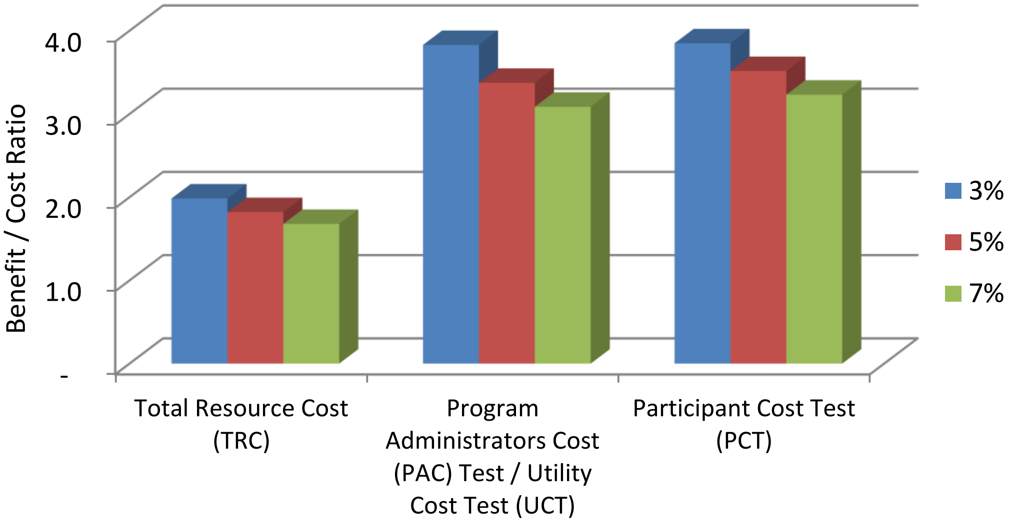
NPV Costs	NPV Benefits	Net Benefit	B/C Ratio
$1,707	$6,490	$4,783	3.8
$1,633	$6,038	$4,405	3.7
$809	$2,062	$1,252	2.5
$4,150	**$14,590**	**$10,440**	**3.5**

Note: Assumes a 5% real discount rate

These results suggest that a comprehensive energy efficiency program and policy for Louisiana 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.[27] 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 20 we present the results of various assumptions that could be used instead.

Figure 20. Results of Cost-Benefit Analysis with Various Real Discount Rate Assumptions



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 Louisiana of about $0.03–0.07 per kWh through 2030. Thus, energy efficiency rate impacts are far lower than rate impacts from building new energy supply or transmission infrastructure. A modest energy efficiency program portfolio such as the quick-start proposal could cost a Louisiana residential customer about $0.47 per monthly bill and a commercial customer about $5.41 per month.[28] Rate increases from fuel price volatility or new supply or transmission needs can be far higher. As an illustrative example for comparison, the recently proposed rate increases by Entergy Louisiana could mean the same residential customer would see an estimated increase of $7.56 per monthly

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

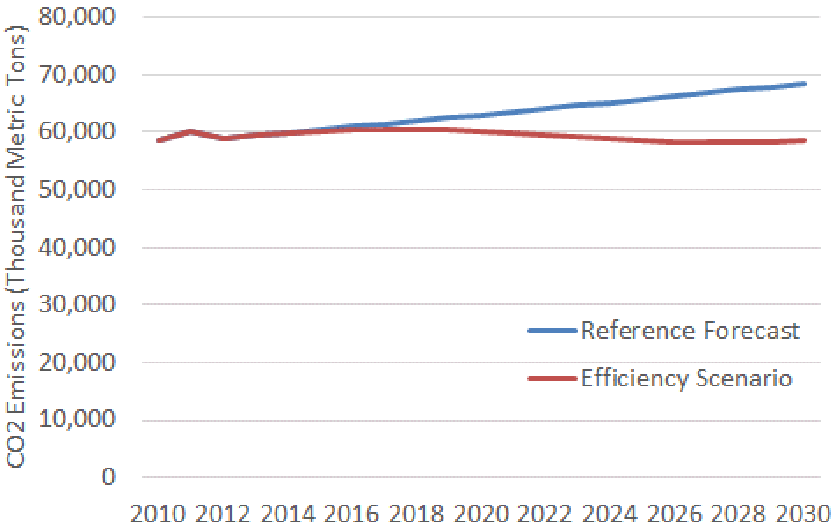
[28] This assumes an electricity efficiency program portfolio budget equivalent to 0.5% of revenues, an average residential customer in Louisiana using 1,000 kWh per month, and an average commercial customer using 12,500 kWh per month.

bill and the same commercial customer would see an increase of $76.81.[29] Stakeholders should be careful not to let short-term rate impacts detract from the medium- and long-term benefits of energy efficiency that accrue from delaying or avoiding the need for supply investments and the host of other benefits. Energy efficiency is a low-cost and low-risk option that should be considered as part of a well-diversified energy portfolio.

AVOIDED EMISSIONS

We also examined emissions impacts from the energy efficiency program and policy analysis scenario (for the electric power sector only). Figure 21 shows the estimated avoided carbon dioxide (CO_2) emissions from the efficiency scenario, based on marginal CO_2 emission rates from EPA's eGrid data (EPA 2012b). The analysis suggests that the energy efficiency policies and programs can avoid about 14% of the projected emissions from the electric power sector by 2030.

Figure 21. Avoided CO_2 Emissions from Energy Efficiency Program and Policy Analysis (Electricity Only)



Macroeconomic Analysis

Authored by Evergreen Economics

In support of ACEEE's efforts to prepare a study of the economic and achievable potential for energy efficiency resources in Louisiana, Evergreen Economics estimated the economic and fiscal impacts of the proposed portfolio of programs over a 20-year study period (2010–30).

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 Louisiana. The inputs utilized by

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[29] This is for illustrative purposes only, to put the relative size of the rate impact in perspective. The Entergy Louisiana proposed rate increase estimates are from: http://www.entergy-louisiana.com/content/2013ratecase/RateCase_FactSheet.pdf

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 Louisiana 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 over the expected lifespan of the installed energy efficiency equipment.

KEY FINDINGS

Summary of Findings

Louisiana'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 20-year program period and beyond. As shown in Table 20, between 2010 and 2030 it is estimated that the portfolio of efficiency programs will result in the following net *cumulative* impacts:

- Over $28 billion in economic output, including $9.4 billion in wages, nearly $6 billion in business income to small business owners, and 240,600 person-years of employment over the 20-year period
- Increased state and local tax revenue by $798 million over the 20-year period
- Additional energy savings in future out-years after the programs end in 2030 will sustain a total of nearly $16.2 billion in output, including $5 billion in wages, nearly $3.3 billion in business income, 143,000 person-years of employment, and an increase of $898 million in state and local tax revenue

Table 20. Summary of Energy Savings and Net Economic Impacts in Louisiana

Impact Measure	Impacts During Program Years 2010–30	Impacts in Future Out-Years 2031–40
Electricity Savings (GWh)	175,370	159,040
Natural Gas Savings (MMCF)	168,920	169,810
Output ($MM)	$28,039	$16,183
Wages ($MM)	$9,408	$5,013
Jobs (Person-Years)	240,600	143,000
Business Income ($MM)	$5,973	$3,287
State and Local Taxes ($MM)	$798	$898

Presented another way, these programs would result in the following *annual* impacts *in* 2030:

- $3.1 billion in economic output, including $1 billion in wages, and $663 million in business income to small business owners, and 27,100 person-years of employment in 2030
- Increased state and local tax revenue by $114 million
- Additional energy savings after the programs end that continue to sustain economic benefits

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 21 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 21 omits many of these years for ease of presentation. Note that total program spending on energy efficiency resources increases from 2015–30, and that residential program spending is greater than spending on commercial programs which in turn is greater than spending on industrial programs.

Table 21. Expected Energy Efficiency Program Spending in $MM in Louisiana (Benchmark Years, 2010–30)

Impact Measure	2015	2020	2025	2030	Total Program (2010–30)
Total Residential	$33.62	$122.54	$179.01	$180.10	$2,187.37
Total Commercial	$29.16	$106.10	$154.41	$148.82	$1,879.82
Total Industrial	$9.71	$90.67	$98.30	$74.08	$1,193.91
Total All Programs	**$72.49**	**$319.30**	**$431.71**	**$403.00**	**$5,261.10**

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. While equipment spending and program spending generally exhibit an increasing trend from 2010–25, as new codes and standards come into effect and base efficiency levels increase, incremental equipment spending begins to decrease. By 2030, we find the total amount of equipment spending attributed to energy efficiency programs is less than the amount of spending that occurs in 2025.

ECONOMIC IMPACT ANALYSIS METHODS

Measuring the economic impacts attributable to efficiency programs is a complex process, as spending by the state of Louisiana 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 Louisiana. 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 2030. 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.[30]
- 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 Louisiana and therefore reflects the unique nature of Louisiana's economy.

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[30] 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.

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.

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 Louisiana 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[31] 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

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

cumulative effect of conservation due to energy efficiency program activities is nevertheless a significant net benefit to Louisiana'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 Louisiana discussed below. These input parameters are then compared with a base case spending scenario that assumes the Louisiana program funding is returned to Louisiana ratepayers and spent following historical purchase patterns. The difference between the gross economic impacts attributed to the proposed Louisiana programs and the base case scenario is referred to as *net impacts.*

For the proposed Louisiana 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, which 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 that 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.
- 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.[32] 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.

ECONOMIC IMPACT RESULTS

The economic impacts associated with Louisiana efficiency 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.
- Economic impacts attributed to energy savings continuing in future years after the programs have ended in 2030.

Total Gross and Net Impacts

Error! Reference source not found.22 shows the total cumulative gross and net economic impacts in Louisiana from residential efficiency programs from 2010–30. Over this 20-year program period, we expect to see a total increase in state economic output of nearly $9.3 billion relative to the base case scenario. Stated another way, the efficiency programs will increase economic output in Louisiana by $9.3 billion 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 $2.7 billion in increased wage income and over $2 billion in business income. Over this period, the net gains associated with the efficiency scenario are able to sustain 83,100 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 $317 million in tax revenue over the base case scenario.

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[32] A quick review of the energy cost data provided for Louisiana 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.

Table 22. Total Gross and Net Economic Impacts for Residential Efficiency Programs (2010–30)

Impact Measure	Gross Impacts	Net Impacts
Residential		
Electricity Savings (GWh)	56,278	56,278
Natural Gas Savings (MMCF)	57,793	57,793
Output ($ MM)	$11,994	$9,304
Wages ($ MM)	$3,595	$2,730
Jobs (Person-Years)	110,300	83,100
Business Income ($ MM)	$2,604	$2,095
State and Local Taxes ($ MM)	$469	$317

Table 23 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. In general, energy savings are expected to be slightly lower for the commercial sector, and as a consequence the resulting economic impacts are also lower relative to the residential programs. The net benefits relative to the base case scenario are still positive, however. 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 2010–30, we expect to see an increase in state economic activity equal to nearly $7.3 billion relative to the base scenario in which the efficiency programs do not exist. We also find that energy efficiency programs will help sustain 60,800 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 $225 million in tax revenue relative to what would occur in the base scenario.

Table 23. Total Gross and Net Economic Impacts for Commercial Efficiency Programs (2010–30)

Impact Measure	Gross Impacts	Net Impacts
Commercial		
Electricity Savings (GWh)	49,568	49,568
Natural Gas Savings (MMCF)	44,929	44,929
Output ($ MM)	$11,361	$7,282
Wages ($ MM)	$3,982	$2,490
Jobs (Person-Years)	101,600	60,800
Business Income ($ MM)	$2,399	$1,483
State and Local Taxes ($ MM)	$438	$225

With regard to the Industrial sector, our analysis finds that the expected energy savings are lower due to less program and participant spending, and consequently the sum of the economic impacts of these programs is also lower relative to the residential and commercial programs. These results are shown in Table 24. In total from 2010–30, we expect to see an increase in state economic activity equal to $4.3 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 34,900 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 24. Total Gross and Net Economic Impacts for Commercial Efficiency Programs (2010–30)

Impact Measure	Gross Impacts	Net Impacts
Commercial		
Electricity Savings (GWh)	25,456	25,456
Natural Gas Savings (MMCF)	66,197	66,197
Output ($ MM)	$5,828	$4,331
Wages ($ MM)	$1,841	$1,497
Jobs (Person-Years)	43,500	34,900
Business Income ($ MM)	$1,200	$899
State and Local Taxes ($ MM)	$202	$115

The final analysis addresses the significant savings resulting from Combined Heat and Power (CHP), which were modeled separately outside the industrial sector due to the unique nature of the CHP facilities. The results from the CHP projects are shown in Table 25. Given that the energy gains estimated from CHP are similar to those anticipated in the commercial sector, the economic benefits are also similar. In total from 2010–30, we expect to see an increase in state economic activity equal to $7.1 billion from CHP facilities relative to the base case. We also find these projects will help sustain 61,800 person-years of employment, and $1.5 billion in wages over the same time period.

Table 25. Total Gross and Net Economic Impacts for Combined Heat and Power (2010–30)

Impact Measure	Gross Impacts	Net Impacts
Commercial		
Electricity Savings (GWh)	44,056	44,056
Natural Gas Savings (MMCF)	0	0
Output ($ MM)	$10,442	$7,122
Wages ($ MM)	$3,453	$2,690
Jobs (Person-Years)	80,900	61,800
Business Income ($ MM)	$2,162	$1,496
State and Local Taxes ($ MM)	$337	$142

Overall, the portfolio of residential, commercial, and industrial energy efficiency programs (and including CHP) 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 resulting 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

In this analysis, we explored the questions of how much energy efficiency potential is available in Louisiana and what specific steps stakeholders can take to harness this potential through policies and programs. Our analysis finds that energy efficiency potential is largely untapped in the state, and that a concrete set of policies and programs recommended can cost-effectively meet 16% of the state's electricity needs and 12% of natural gas needs by 2030. CHP systems hold additional potential of about 1,500 MW of capacity by 2030, equivalent to 12% of electricity sales. Louisiana's investments in energy efficiency are expected to result not only in energy savings, but also increased economic output, business income, jobs, and state and local taxes. Despite this significant potential, the state has yet to embrace energy efficiency policies and programs due to pervasive market barriers. Customers and businesses often face high up-front costs and lack information or expertise, tenants and building owners encounter differing incentives, and utilities' business interests are fundamentally misaligned with the goals of energy efficiency. The policies and programs outlined in this report will help chart a path for Louisiana to start to address these barriers and take greater advantage of energy efficiency as a means to grow the economy.

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Appendix A. Residential and Commercial Buildings Sectors

A.1. RESIDENTIAL BUILDINGS SECTOR

Overview of Approach

Our analysis of energy efficiency potential for Louisiana's residential electricity and natural gas sectors considered a scenario with widespread adoption of cost-effective energy efficiency measures during the 18-year period 2013–30. We analyzed 21 single-family measures for existing and new single-family homes in Louisiana. These measures are grouped by end use (heating and cooling, water heating, appliances, etc.). For each measure, we estimated average measure lifetime, energy savings, and costs per home upon "replacement on burnout" of the product (i.e., we assume most products are replaced at the end of their useful life but not earlier). For a replacement-on-burnout measure, the cost is the incremental cost of the efficient technology compared with the baseline technology. A retrofit measure is one in which exiting equipment is not being replaced, such as improved insulation and infiltration reduction; its cost is the full installation cost of the measure.

A measure is determined to be cost-effective if its levelized cost of saved energy (CSE), which discounts the incremental cost of a measure over its lifetime, is less than $0.09/kWh for electricity or $11.57/MCF for natural gas, the current average residential costs in Louisiana. The estimated levelized cost for each efficiency measure, which assumes a discount rate of 5%,[33] is shown in Table A-4. Equation 1 shows the calculation for cost of conserved energy using the payment function in Excel.

Equation 1. CSE = PMT ((Discount Rate), (Measure Lifetime), (Measure Cost)) / (Annual Savings per Measure)

Existing Buildings

Existing buildings were analyzed using building modeling software. The software package, TREAT,[34] was chosen for its reputation as one of the better residential modeling packages available. It uses a variety of inputs, including house characteristics, appliances, weather data, and occupancy patterns, to model the expected energy use of a particular home. It also includes a library of efficiency measures that can be used to model potential efficiency improvements. TREAT was used to establish a baseline as well as model the effects of efficiency improvement measures on the average Louisiana single-family home.

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[33] The 5% discount rate is a real discount rate, which excludes the effects of inflation. A 5% real discount rate is equivalent to an 8–9% nominal discount rate as typically used by utilities in their analyses of cost effectiveness. Nominal discount rates are typically based on utility cost of capital and include allowance for inflation. Our assumption of a 5% real discount rate applies to our commercial and industrial analyses as well. We use real rates since all of our calculations are in 2007$.

[34] http://www.psdconsulting.com/software/treat

Establishing a Baseline

TREAT uses multiple house characteristics and measures to determine annual energy use. We used approximately 100 inputs to model the baseline average Louisiana home. First, we gathered Louisiana-specific data for each of the inputs, using detailed housing characteristic estimates based on RECS data, Building America averages, in-state experts from Louisiana, and TREAT defaults to fill in the gaps. In several cases, further calculations were needed to determine the inputs. Table A-1 gives the data collected for the various TREAT inputs (with multiple values for different percentages of the population, in some instances). For inputs without values, either the default TREAT value was used, or a value had to be derived.

Table A-1. Data Collected for TREAT Inputs

TREAT Input Categories	TREAT Inputs	Louisiana		Data Source	Value to Be Used in TREAT
		Actual Value	% of Homes		
Weather/Defaults	City (TMY2 / TMY3)			Largest population, TMY3 is more recent typical weather than TMY2	TMY3 New Orleans (international AP)
	Heating / Cooling Seasons			Analyzed typical HDD and CDD per month. HDD/month>50 = heating month, CDD/month>50 = cooling month	Heating: Nov–Mar Cooling: Mar–Nov
	Stories	1 2	87% 12%	RECS 2009	1
	# Bedrooms	1 2 3 4 5	3% 18% 61% 17% 2%	RECS 2009	3
	# Occupants				3
	Wall Color			Default	Dark
	Roof Color			Default	Light
	Use Window Shades in Summer?			Default	Checked
	Adv. Inputs: Shielding Class			Default	3
	Adv. Inputs: Common Wall Area (SF)			Default	0
	Adv. Inputs: Entering Cold Water Temperature (F)			Home Energy Saver Documentation of New Orleans	66
	Adv. Inputs: Latent Load Factor			Home Energy Saver Documentation of New Orleans	16%
	Adv. Inputs: Account Climate impact on SEER			Default	Checked
	Adv. Inputs: Account for Part Load Eff			Default	Unchecked
Spaces	Foundation Type	Basement Crawlspace Slab on grade	4% 32% 58%	RECS 2009	VARIABLE: Crawlspace vs Slab
	Foundation (Crawl or Slab) Floor Area (SF)			Crawlspaces typically above grade and vented	1784

TREAT Input Categories	TREAT Inputs	Louisiana		Data Source	Value to Be Used in TREAT
		Actual Value	% of Homes		
	If Crawlspace, Ceiling Height			Maggie's LA field contact	4.0
	If Crawlspace, Ceiling Height				
	If Crawlspace, Adv. Input: Furnished			Default	No
	If crawlspace, Adv. Input: Free Ventilation			Default	Yes
	Vented Attic: Ceiling Height (ft)				4
	Vented Attic: Floor Area (SF)				1784
	Vented Attic: Space Type				Unheated High ACH
	Vented Attic: Adv. Input: Furnished?			Default	No
	Vented Attic: Adv. Input: Free Ventilation?			Default	Yes
	Living Space: Ceiling Height (ft)			Default	8.0
	Living Space: Floor Area (SF)			Use New Orleans number	1784
	Living Space: Space Type				Living Space
	Living Space: Occupied			Default	Yes
	Living Space: Occupied Hrs/Day				16.5
	Living Space: Persons				3
Surface Construction	Living Space Walls - Constr	Brick Wood Siding	34% 25% 30%	Building America Paper, average of mid-century wall cavity ins r-value, R-9	TREAT Code = 283
	Living Space Walls - Dims				42.2 ft x 8 ft
	Living Space Floor Above Grade – Constr				TREAT Code = 327
	Living Space Floor Above Grade – Dims			No insulation	42.2 ft x 42.2 ft
	Living Space Ceiling – Constr			LA DNR:: older homes typically have no insulation (before 1950s); **R-10 after t**hat; R-19 for newer homes since the 1960s	TREAT Code = 159
Windows	Glazing	Single Double	44% 51%	from 2006 IRC which is the reference for current construction code for New Orleans, U=0.75, SHGC = 0.4	TREAT Code = 20
	Frame Type			Wood/Vinyl, Operable	TREAT Code = 15
	Custom Properties in TREAT			see 2006 IRC code min	U = 0.75, U =0.4
	Number of Windows	None 1-2 3-5 6-9 10-15 16-19 20-29 30+	5% 2% 4% 18% 43% 8% 14% 5%	Calculated based on 15% of conditioned floor area, Building America Paper	18
	Frame Type			Wood/Vinyl, Operable	TREAT Code = 15
	Size			Typical	3ft x 5ft

		Louisiana			
TREAT Input Categories	**TREAT Inputs**	**Actual Value**	**% of Homes**	**Data Source**	**Value to Be Used in TREAT**
Thermostats	Is the Space Cooled?	Yes	99%	RECS 2009	Yes
	Programmable Thermostat?			Default	No
	Cooling Set Point - Central AC			LA DNR contact	72
	Cooling Set Point - Room AC			reduction to account for 2 AC units/house, outside calc =24000/(9.8/3.413)/3413*1244 = **3047 kWh/yr**, adjusted TREAT t-stat to get same cooling usage	81.4
	Heating Set Point			LA DNR contact	68
	Hours Per Day Occupied	16.5		Building America	16.5
Exterior doors	Quantity of Doors on Each Wall	2		Assumption, one facing North and one South	2
	Door Type			Default	TREAT Code = 22
	Size			Default	3ft x 6.7ft
	U-Value	0.2		Building America	0.2
Infiltration	Heated Area Infiltration (ACH)				0.60
	Unheated Space: Crawlspace (ACH)				1.0
	Unheated Space: Attic (ACH)				2.0
Heating	Heating Type	Furnace Heat pump Room gas furnace	70% 8% 11%	RECS 2009	Variable: Gas Furnace Elec Resistance Heat Pump
	Heating Fuel	Natural gas Electric Propane	46% 40% 9%	RECS 2009	VARIABLE: Gas & electric
	Input Capacity (Btu/Hr)			Determine using TREAT, for ASHP assumed 4 tons and converted from output to input using the stated efficiency below.	Furnace: 60,000 Heat pump: 21,300 Elec Resist: 60,000
	Efficiency			IRC 2006	Furnace: 80 AFUE Heat pump: 7.7 HSPF Elec Resist: 100%
	Location			Default	Furnace & Heat pump: Attic Elec Resist: Living Space
	Year of Heating Equipment	<1 year 2-4 years 5-9 years 10-14 years 15-19 years 20+ years	11% 17% 34% 18% 8% 13%	RECS 2009, not used in TREAT model	1999

TREAT Input Categories	TREAT Inputs	Louisiana			
		Actual Value	% of Homes	Data Source	Value to Be Used in TREAT
	Supply Temperature (F)			Default	Furnace: 130 Heat pump: 110
	Distribution – Ins R-Value			Assumption for some ducts having insulation or being flex duct	Supply = 2 Return = 2
	Distribution - Duct Leakage (CFM25)			Pg 15, Leakage Diagnostics, Sealant Longevity, Sizing and Technology Transfer in Residential Thermal Distribution Systems: Part II Residential Thermal Distribution Systems Phase VI Final Report, based on fan flow	Supply = 88 Return = 88
	Distribution - Duct Pressure (in w.c.)			TREAT Default	0.1
	Distribution - Duct Area (SF)			TREAT Default: For supply ductwork default is equal to 0.27*Conditioned Area For return ductwork default is 0.15*Conditioned Area (per ASHRAE 152)	Supply = 482 Return = 268
	Ductwork - Location			LA DNR contact	Supply = 100% in Vented Attic Return 100% in Vented Attic
	Ductwork - Shared with Cooling				Checked
Cooling	Capacity (Btu/Hr)			Determine using TREAT, 4 tons	Room AC = 24000 Central AC = 48000
	Efficiency			Fed min req since 2011	Room AC = 9.8 EER Central AC = 13 SEER
	Supply Temperature (F)			TREAT Default	55
	Number of Units			Default	1
	Type of Unit	Central Room Central AND Room	75% 24% 1%	RECS 2009	for Elec Baseboard: use Room AC for other heating: use Central AC
	Distribution				Room AC: None Central AC: shared with Primary
Fans	Ventilated Area	2.4 fans/home		Living Space	1784
	Ventilation Rate (CFM)			Typical existing fans, derated for typical flow	100
	Heat Recovery Effectiveness			Default	0
	Hours/Day Used			from BA house sim protocol paper and field staff	1 hr per day

TREAT Input Categories	TREAT Inputs	Louisiana Actual Value	Louisiana % of Homes	Data Source	Value to Be Used in TREAT
Hot Water	Type of Unit	Storage unit		RECS 2009	Storage unit
	Hot Water Fuel	Natural gas Electric Propane	45% 46% 8%	RECS 2009	VARIABLE: Gas & Electric
	Tank Volume (Gal)	< 30 gallons 31 - 49 gallons 50+ gallons	12% 69% 18%	RECS 2009	Gas = 40 Elec = 50
	Input Capacity (Btu/Hr)			Typical	40000
	Supply Temperature (F)			TREAT Default	120
	Additional Insulation R-Value			TREAT Default	0
	Location			LA DNR contact: typically outside or in attic, crawlspace will make savings more conservative than attic.	When Crawlspace use Crawlspace When Slab use Attic
	Number of Units			Typical	1
	Solar Fraction of Water Heating			Typical	0
	Thermal Efficiency			From TREAT library for EF listed below	Elec = 99% Gas = 76%
	Energy Factor			Code min	Elec = 0.90 EF electric Gas = 0.54 EF
	Piping – Ins R-value			Typical	0
	Piping – Area (SF)			TREAT Default	8.0
	Piping – Recirc			Typical single family	No
	Piping – Location and %			Typical for DHW heater location	50% uncond space (crawl or attic), 50% conditioned
	Demand – Usage Adjustment			Default	1
	Demand – Fixture Details – Reg Shower (gpm)			EPAct 2005	2.5
	Demand – Fixture Details – Faucet Shower (gpm)			EPAct 2005	2.2
	Demand – Hand Wash Dishes			RECS 2009 62% used dishwasher	No
Lighting	Watts per Fixture			Incandescent - Existing	60
	Hours/Day Used			BA Simulation Protocols	1.8
	# of Fixtures			from BA Analysis Procedures for Existing Homes, 2/3 inc, 1/3 CFL from Amanda's original	32

TREAT Input Categories	TREAT Inputs	Louisiana		Data Source	Value to Be Used in TREAT
		Actual Value	% of Homes		
	Watts per Fixture			CFL - Existing	15
	Hours/Day Used			BA Simulation Protocols	1.8
	# of Fixtures			from BA Analysis Procedures for Existing Homes, 2/3 inc, 1/3 CFL from Amanda's original	16
Appliances	Refrigerator #1 (to be upgraded)	1 2 3	80% 19% 1%	18-cf top-mount (486kWh/yr from Estar calc)	486 kWh/yr
	Refrigerator #2 (to be removed)			Maggie's Notes "Let’s use 660 kWh per unit, which is the average usage of a 1990 refrigerator, assuming the program targets 20-year old refrigerators (according to AHAM data); "	660 kWh/yr
	Clothes Dryer	1.00	97%	Elec Dryer, 6 loads/wk	1248 kWh/yr
	Clothes Washer	1.00	97%	use warm-cold wash cycle, not Estar, 6 loads/wk	117 kWh/yr 2626 gal/yr
	TVs	0 1 2 3 4+	1% 9% 39% 29% 21%	RECS 2009, TV (61 kWh savings/TV)	Quantity = 2 110 kWh/yr each
	Dishwasher	1.00	64%	TREAT typical 2000 model,4 loads/wk from DOE	elec = 247 kWh hw = 1768 gal/yr
	Range – Cooking	0 1 2	14% 85% 1%	RECS 2009; 50% Electric, 35% gas Using 2 hrs/day from TREAT library	2409 kWh/hr
	Electronics to be Plugged into Smart Strip			from Maggie	79 kWh/yr
	Remaining Misc Electric Load			RECS 2005 end-use tables	2657 kWh/yr

After gathering and/or calculating the data, we determined which values to use in TREAT. Because TREAT models a single home, for inputs that had multiple values (e.g., 87% of homes are one story and 12% are two stories) a determination was made about which value to use. Wherever possible, an average was used. However, for discrete data points (e.g., gas versus electric), the majority won. This method was used for all inputs except for five inputs deemed most critical to baseline energy use: foundation type, heating equipment, square footage, air-conditioner type, and water heater fuel. These five were selected to have variable inputs. We ran the model for eight different base case combinations of these five inputs, and used a weighted average of the results to calculate the average baseline home. TREAT takes these inputs and gives total home energy use as well as electricity and natural gas consumption by end-use category. Table A-2 gives the average energy use of a Louisiana single-family home, per TREAT. Note that these modeled energy usage baselines differ from data from RECS; however, we used the modeled usage data to determine relative energy savings rather than absolute energy savings. The relative savings per home were then compared with absolute usage from state-specific data.

Table A-2. Average Energy Use of a Single-Family Louisiana Home per TREAT

End-Use	Average Electricity Use (kWh/yr)	Average Gas Use (therms/yr)
Heating	1,494	227
Cooling	5,255	—
Water Heating, Lighting, Appliances, and Other	11,816	236
Total	18,564	463

Statewide Efficiency Potential Analysis

For the analysis of energy efficiency improvement measures, we used TREAT to calculate the savings against the established baseline homes. Measures were chosen that were applicable to the baseline (e.g., efficient pool pumps were not chosen since pool pumps were not included in the baseline). Cost assumptions and lifetime estimates for each of the measures came from multiple sources and were evaluated for cost effectiveness independently of the TREAT model.

One of the advantages of using modeling software is that the interaction factors between various measures are taken into account. For instance, when lighting is switched from incandescent bulbs to CFLs, the cooling load decreases slightly and the heating load increases slightly. These interactions are difficult to account for without the assistance of modeling software. Because TREAT displays both the savings from individual measures and the overall savings of all the measures as a package, this phenomenon can be quantified.

We ran these efficiency improvement models on all of the variable scenarios. The weighted average individual measure savings were used to compute the residential efficiency potential in Louisiana homes. The next step was to adjust the measure savings by the current market share of products that already meet the efficiency criteria. We also adjusted the incremental cost so that the cost would be split between gas and electric savings. The electric incremental cost for a measure was determined by the percentage of savings attributed to electricity (versus gas); and vice versa for determining gas incremental cost. We then adjusted replacement measures with lifetimes more than 18 years to account only for the percentage turning over in 18 years, which represents the time period of the analysis. Equation 3 shows our calculation for efficiency resource potential, incorporating the two factors discussed above.

Equation 3. Efficiency Resource Potential = ∑ (Annual Savings per Measure) x (Percent Turnover) x (Percent Applicable)

To calculate the efficiency resource potential savings by end use in 2030, we presented savings as a percentage of end-use energy consumption (assuming current energy consumption by end use from the baseline TREAT modeling). We then multiplied the "% savings" by projected residential energy consumption for that end use in 2030 to estimate the total savings potential in that year (see Equation 3).

Table A-3 summarizes these results by measure and end-use category for the electricity savings measures. Note that the adjusted savings per home already accounts for current market share and the percentage of homes that are applicable to the measure (e.g. savings are adjusted downward relative to the share of homes that the measure applies to and relative to existing market share). The percentage turnover by 2030 accounts for the share of the baseline measures that will be “replaced on burnout,” i.e. the share of efficient measures that could be cost-effectively installed.

Table A-3. Residential Single-Family Energy Efficiency Measure Characterizations - Electricity

Measures	End-use category	% Applicable	Adjusted savings per home	Cost of saved energy	% Turnover by 2030	% End-use savings	Total savings in 2030
			kWh	$/kWh			GWh
Attic insulation	HVAC	100%	766	$0.09	85%	10%	727
Infiltration reduction	HVAC	100%	232	$0.08	100%	3%	259
SEER 16 AC	HVAC	100%	1029	$0.07	100%	15%	1,150
Mini-split heat pump	HVAC	34%	906	$0.01		13%	1,012
Triple-pane windows	HVAC	42%	355	$0.05	68%	4%	270
HVAC tune-up	HVAC	100%	267	$0.01	100%	4%	298
Heating, cooling, and building envelope measures						***49%***	***3,717***
CFLs	Lighting	100%	644	$0.01	100%	11%	720
Advanced lighting (LEDs)	Lighting	100%	369	$0.05	100%	20%	412
Lighting Measures						***31%***	***1,132***
Smart strip	Appliances	100%	89	$0.05	100%	2%	99
ENERGY STAR refrigerator	Appliances	100%	53	$0.03	89%	5%	53
ENERGY STAR clothes washer	Appliances	46%	41	$0.05	100%	3%	46
ENERGY STAR dishwasher	Appliances	100%	73	$0.01	100%	3%	82
ENERGY STAR TV	Appliances	100%	107	$0.02	100%	0%	119
Second refrigerator removal	Appliances	20%	147	$0.01	100%	4%	165
Appliance Measures						***18%***	***564***
Low-Flow Showerheads	Water heating	100%	371	$0.01	100%	8%	415
Faucet aerators	Water heating	100%	33	$0.02			36
Heat pump water heater	Water heating	32%	776	$0.03	100%	11%	867
Water Heating Measures						***20%***	***1,319***
Whole-house information feedback system	ALL	100%	364	$0.01	100%	2%	406
Behavioral Measures						***2%***	***406***
New home (Energy Star home Version 3)	New Construction	75%	4,397	$0.02	100%	0%	932
Advanced New home 30% better than ENERGY STAR	New Construction	25%	1,031	$0.02	100%	4%	219
New Construction						***6%***	***1,150***
TOTAL							**8,288**

Residential Sector Measure Descriptions

Attic Insulation
Measure Description: Addition of insulation in attic floor to R-30.
Data Explanation: Incremental cost of $0.90/sq. ft., useful measure life of 20 years, and current market share of 5% from ICF 2012.

Infiltration Reduction
Measure Description: Application of foam and/or caulk around leakage areas applied and tested by a professional using a blower-door.
Data Explanation: Assume 10% reduction in leakage at a cost of $0.12/sq. ft., 10-year useful life, and a 30% current market share (ICF 2012).

Efficient Windows
Measure Description: Replacement of existing single-pane windows with triple-pane, argon-filled, and U-0.35 and SHGC 0.3.
Data Explanation: Incremental cost of $3.87/sq. ft. of window area (PNNL 2012). Number of windows (18) determined by regional RECS data, and size of windows set as TREAT default, resulting in an average of 268 sq. ft. of fenestration.

Efficient Central AC
Measure Description: Upgrade to 16 SEER Central AC
Data Explanation: Incremental cost of $814/3-ton unit is based on average cost from the ENERGY STAR calculator (EPA 2008) and ICF 2012. We assume a 5% current market share (ICF 2012).

Efficient Central Heat Pump
Measure Description: Replacement on burnout of air source heat pump, HSPF 9.
Data Explanation: Baseline is federal standard, HSPF 7.7. Incremental cost ($274/ton) for a 3-ton unit and average measure life (15 years) from ICF 2012.

Efficient Mini-Split Heat Pump
Measure Description: Replacement of electric baseboard heating and room air-conditioners with mini-split, ductless heat pump (HSPF 9, SEER 16) rather than a ducted air source heat pump, which is the baseline measure in this case.
Data Explanation: Baseline is federal standard, HSPF 7.7. Incremental cost ($375/ton) and average measure life (15 years) from ICF 2012.

Efficient Gas Furnace
Measure Description: Replacement on burnout of gas furnace, AFUE 94%.
Data Explanation: Baseline is federal standard. Incremental cost ($300) and measure life (18 years) from ENERGY STAR calculator (EPA 2008). Market share (55%) is a national estimate from EPA (2012a).

HVAC Tune-Up
Measure Description: Tune-up of heating and cooling equipment.
Data Explanation: Incremental cost ($125) and Measure life (5 years) are ACEEE estimates.

Low-Flow Showerhead

Measure Description: Replacement of inefficient showerhead with low-flow model using 1.5 gallons per minute (gpm), efficiency level based on EPA's Water Sense program.
Data Explanation: Baseline is 2.5 gpm showerhead. Cost estimate ($10) for a low-cost, basic model from ICF 2012. Measure life (10 years) from ICF 2012.

Condensing Gas Water Heater
Measure Description: Installation of 54-gallon natural gas storage water heater, 0.86 energy factor (EF), upon product replacement.
Data Explanation: Incremental cost ($750) and measure life (13 years) from Amann et al. (2007).

Heat Pump Water Heater
Measure Description: Installation of 50-gallon heat pump water heater, 2.0 EF, upon product replacement.
Data Explanation: Incremental cost ($814), savings per unit (977 kWh), measure life (13 years), and market share (5%) from Lowenberger et al (2012). ACEEE estimates that 68% of electric water heaters are the appropriate size for heat pump water heater replacement.

Compact Fluorescent Lighting
Measure Description: Replacement of 70% of baseline lighting that isn't already CFL with 15W CFLs.
Data Explanation: Incremental cost ($0.56/bulb) and lifetime (6.3 years) are from ICF 2012.

LED Lighting
Measure Description: Replacement of 30% of baseline lighting that isn't already CFL with 12 W LEDs.
Data Explanation: Incremental cost ($28), market share (0%), and incremental cost ($5.06) per bulb are from ICF 2012.

Efficient Refrigerator
Measure Description: ENERGY STAR 18-cu. ft. top-freezer refrigerator.
Data Explanation: Baseline is federal standard 18-cu. ft. refrigerator. Incremental cost ($40) is from EPA's ENERGY STAR Appliance Calculator (EPA 2012c) and measure life (19 years) from ACEEE analysis for PG&E/CA Title 24 (PG&E 2007). Market share (55%) is a national estimate of appliance sales data (EPA 2012d).

Removal of Second Refrigerator
Measure Description: Removal service for homes with a second refrigerator.
Data Explanation: Average savings determined through TREAT modeling software. The incremental cost is assumed to be zero, because utilities typically offer an incentive to homeowners for refrigerator removal. Market share is zero, as there are no known programs currently being run in Louisiana.

Efficient Clothes Washer
Measure Description: Replacement on burnout of clothes washer with ENERGY STAR model.
Data Explanation: Incremental cost ($167) from Sanchez et al. (2007). Current market share (60%) from EPA (2012a).

Efficient Dishwasher
Measure Description: Replacement on burnout of dishwasher with ENERGY STAR model.
Data Explanation: Incremental cost ($10) from EPA (2012c). Market share estimate (58%) from EPA 2010.

Efficient Television
Measure Descriptions: Replacement on burnout of television with ENERGY STAR model.
Data Explanation: Based on an analysis of the ENERGY STAR version 5.3 specification (Lowenberger et al 2012), which estimates per-unit savings of 61 kWh, measure lifetime of 10 years, and current market share of 60%.

Enhanced Billing and Home Energy Reports
Measure Description: Improved information in utility bills on how energy is being used in the home, along with customized home energy reports.
Data Explanation: Savings estimate (2% of electricity use and 1% of natural gas usage) from York et al 2013. Current market share (1%), measure life (1 year), and incremental cost ($10) are ACEEE estimates.

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A.2. COMMERCIAL BUILDINGS SECTOR

Electric Analysis

To estimate the cost-effective resource potential for efficiency in Louisiana's commercial buildings, we first developed a disaggregate characterization of baseline electricity consumption in the state for current electricity use and a reference load forecast (see Table A-4 below). Unfortunately, highly disaggregated commercial electricity consumption data are not available at the state level. To estimate these data, we started with current electricity consumption for the Louisiana commercial sector and a forecast out to 2030 based on utility IRP forecasts (see statewide reference case), and we disaggregated by end use using average regional data from CBECS 2003 (EIA 2007) and *Annual Energy Outlook 2012*.

Table A-4. Baseline Commercial Electricity Consumption by End Use (GWh)

End-Use	2011	%	2020	%	2030	%
Heating	767.92	3%	809	3%	765	3%
Cooling	4,537	19%	4,780	18%	4,836	17%
Ventilation	2,727	11%	2,873	11%	3,163	11%
Water Heating	545	2%	574	2%	573	2%
Cooking	136	1%	144	1%	143	1%
Refrigeration	6,757	28%	7,119	27%	7,572	27%
Lighting	2,225	9%	2,344	8%	2,278	8%
Office Equipment	1,804	7%	1,901	8%	2,251	8%
Other	4,880	20%	5,142	22%	6,700	24%
Total	**24,379**	**100%**	**25,688**	**100%**	**15,800**	**100%**

Next, we estimated commercial square footage in the state using electricity intensity data (kWh per square foot) by census region from CBECS (EIA 2006). We used the West South Central census region to estimate overall electricity intensity of 15.3 kWh per square foot for the state of Louisiana. Total electricity consumption in the state divided by the electricity intensity provides an estimate of commercial floor space. Using this methodology, we estimated 1,593 million square feet of commercial floor space in the state.

Measure Cost Effectiveness

We then analyzed 35 efficiency measures for existing commercial buildings and 3 whole-building measures for new construction to examine the cost-effective energy efficiency resource potential. For each efficiency measure, we estimated electricity savings (annual savings per measure) and incremental cost (measure cost) in a “replacement on burnout” scenario, which assumes that the product is replaced at the end of its useful life. Savings and costs are incremental to an assumed baseline measure. We estimated savings (kWh) and costs ($) on a per-unit and/or a per-square foot commercial floor space basis. For each measure we also assumed a measure lifetime, or the estimated useful life of the product.

A measure is determined to be cost effective if its levelized cost of saved energy, or cost of conserved energy (CCE), is less than $0.085/kWh, the current average commercial cost of electricity in Louisiana, per EIA. The estimated CCE for each efficiency measure, which assumes a discount rate of 5%, is shown in the measure descriptions below. Equation 1 shows the calculation for CCE.

Our assumed baseline measure, annual savings per measure, measure cost, measure lifetime, and CCE are reported for each of the efficiency measures in the list of measure descriptions below. We grouped the 35 efficiency measures for existing commercial buildings by end use and listed the 3 measures for new buildings last.

Equation 1. CCE = PMT ((Discount Rate), (Measure Lifetime), (Measure Cost)) / (Annual Savings per Measure (kWh))

Total Statewide Resource Potential

For each measure, we derived annual savings per measure on a per-square-foot basis (kWh per square foot) for the applicable end use. For measures for which we have only savings on a per-unit or per-building basis, we first derived the percentage of savings and multiplied by the baseline electricity intensity for that end use. The assumed baseline intensities for each end use are shown in Table A-5. As an example, for a specific lighting measure we multiplied its percentage of savings by the baseline electricity intensity (kWh per square foot) for the lighting end use.

Table A-5. Commercial End-Use Baseline Electricity Intensities (kWh per sq. ft.)

End Use	kWh	MBtu
Heating	0.5	1.7
Cooling	2.7	9.3
Ventilation	1.7	5.7
Water Heating	0.4	1.2
Cooking	0.1	0.3
Lighting	4.3	14.8
Refrigeration	1.4	4.9
Office Equipment	1.1	3.6
Other	3.1	10.6
HVAC Subtotal	*4.9*	*16.7*
Total	**15.3**	**52.2**

To estimate the total efficiency resource potential in existing commercial buildings in Louisiana by 2025, we first adjusted the individual measure savings by an adjustment factor (See Equation 2). This factor accounts for two adjustments: the technical feasibility of efficiency measures, called "percent applicable" (the percentage of Louisiana floor space that satisfies the base case conditions and other technical prerequisites such as heating fuel type and cooling equipment); and current market share, or the percentage of products that already meet the efficiency criteria. These assumptions are outlined in each of the efficiency measure descriptions below.

Equation 2. Adjustment Factor = Percent Applicable x (1-Current Market Share)

We then adjusted total savings for interactions among individual measures. For example, we adjusted HVAC equipment savings downward to account for savings already realized through improved building envelope measures (insulation and windows), which reduce heating and cooling loads. Similarly, we adjusted water heating equipment savings to account for reduced water heating loads from the use of more efficient clothes washers. The multiplier for these adjustments is called the interaction factor.

Finally, we adjusted replacement measures with lifetimes of more than 10 and 20 years to account only for the percentage turning over in 10 and 20 years, which represents the benchmark years of 2020 and 2030, respectively. Note that the multiplier, "percent turnover," is applicable only to products being replaced on burnout and not to retrofit measures such as insulation. These retrofit measures therefore have 100% of measures turning over.

We then calculated the resource potential for each measure in the state using Equation 3, which takes into account all of the adjustments described above. The sum of the resource potential from all measures is the overall energy efficiency resource potential in the state's commercial buildings sector.

Equation 3. Efficiency Resource Potential in 2015 and 2025 (GWh) = (Annual Savings per Measure (kWh per square foot)) x (Commercial Floor Space in Louisiana in Millions of Square Feet) x (Percent Applicable) x (Interaction Factor) x (Percent Turnover)

Efficiency Measures

Below we present the 35 efficiency measures examined for this analysis, grouped by end-use costs, savings (kWh) per product or square foot, percent applicable, interaction factor, percent turnover, and total savings potential (GWh) in 2030. Detailed descriptions of each measure are given below, grouped by end use.

Building Envelope Improvements

Cool Roof

Measure Description: Installation of a sun-reflective coating on the roof of a building with a flat top, which reduces air-conditioning energy loads by reducing the solar energy absorbed by the roof.

Base Case: The baseline electricity intensity for HVAC end uses in Louisiana at 5 kWh/sq. ft·/year.

Data Explanation: We assume 4% HVAC load savings (ACEEE 1997) off the baseline electricity intensity for HVAC end uses in Louisiana (EIA 2006), an incremental cost of $0.38/sq. ft· (Urban 2010), and a 20-year average lifetime. Percent applicable (80%) is an ACEEE estimate. Savings and cost per unit are based on a 15,000-sq. ft. building (ACEEE 1997).

Roof Insulation

Measure Description: Addition of fiberglass or cellulose insulation material in roof cavities to reduce heat transfer, although the type of building construction limits insulation possibilities. R-values describe the performance factor for insulation levels.

Base Case: Electricity intensity was disaggregated from the post-savings electricity intensity and percentage of savings.

Data Explanation: We assume 3% savings and a post-savings electricity intensity of 0.28 kWh/sq. ft./year, based on an average of four building types (ACEEE 1997). An average lifetime of 25 years (CL&P 2007) and an incremental cost of $0.08/sq. ft. were also assumed. The measure costs are shared with gas savings.

Double Pane Low-Emissivity Windows

Measure Description: Replacement of existing single-pane windows with double-pane windows containing low-emissivity (low-e) glass. Double-pane windows have insulating air- or gas-filled spaces between each pane to resist heat flow, and low-e glass has a special surface coating to reduce heat transfer back through the window. Low-e windows are particularly useful in climates with heavy cooling loads, because they can reflect anywhere from 40–70% of the heat normally transmitted through clear glass. The Solar Heat Gain Coefficient (SHGC) represents the fraction of solar energy transferred through a window. For example, a low-e window with a 0.4 SHGC keeps out 60% of the sun's heat.

Base Case: Electricity intensity for this measure assumes that 34% of the Louisiana HVAC load is attributable to windows (Apte 2008).

Data Explanation: Savings of 30% is the difference between low-e window savings and base case scenario in Apte 2008. Incremental costs assume $18.20/sq. ft. of window (SWEEP 2002). This measure is shared with gas savings. A measure life of 25 years is from SWEEP 2002. Percent applicable is an ACEEE estimate.

Reflective Window Film

Measure Description: Installation of reflective window film that reduces solar heat gain by reflecting light unlike tinted film that absorbs heat and can substantially reduce useful light. It is most effective on east-, west-, and south-facing windows.

Base Case: Electricity intensity for this measure assumes that 34% of the Louisiana HVAC load is attributable to windows (Apte 2008).

Data Explanation: 27% savings is an estimate based on average of single- and double-pane windows (ConSol 2011) and applies to percentage of Louisiana HVAC load attributable to windows (34%) (Apte 2008). Incremental costs assume $4/sq. ft. of window (ConSol 2011). A measure life of 10 years is from Entergy 2011. Percent applicable is an ACEEE estimate. The levelized cost is calculated at $0.08.2/kWh.

Heating and Cooling Measures: Equipment and Controls

Duct Testing and Sealing

Measure Description: Testing and sealing of air distribution ducts. This measure assumes supply and return ducts will be fully sealed.

Base Case: Assumes air loss of 29% of fan flow, and leakage of 15% of the system flow.

Data Explanation: Savings of 7% apply to whole-building electricity consumption (Hamilton 2003). An incremental cost of $3,375, which assumes $300/ton, a 10-year lifetime, and 25% applicability are ACEEE estimates.

Primary Air-Handler Fan with Variable-Frequency Drive

Measure Description: Variable Frequency Drive (VFD) controls the speed of a motor by adjusting the frequency of incoming power. By controlling the speed of a motor, the output of the system can be matched to the requirements of the process, thereby improving efficiency.

Base Case: 50-hp fan with 60% load factor, 93% efficiency (ODP, EPAct levels) and 3,653 operating hours/year (21–50-hp category from ACEEE standards savings analysis).

Data Explanation: We assume 25% savings applies to ventilation only (ACEEE 1997), which is a conservative estimate. We estimated a $6,650 incremental cost, which assumes $125/hp for VFD and $8/hp for a better fan, and a 10-year measure life (SWEEP 2002). ACEEE estimates that this measure can apply to 40% of systems.

High-Efficiency Unitary AC/HP

Measure Description: Installation of high-efficiency unitary packaged air-conditioners and heat pumps, which represent the heating, ventilating, and air-conditioning (HVAC) equipment class with the greatest energy use in the commercial sector in the United States, and are used in approximately 48% of the cooled floor space in the commercial sector (DOE 2004). High-efficiency units have a greater energy efficiency ratio (EER).

Base Case: The assumed base case unit meets the 2010 federal efficiency standard. Baseline electricity intensity for this end use, 4.9 kWh/sq. ft., is the estimated HVAC consumption in commercial buildings in Louisiana. This is data from the West South Central census region from EIA’s commercial buildings survey (EIA 2006).

Data Explanation: This measure includes two size ranges: 65,000–135,000 Btu and 135,000–240,000 Btu. The measure assumes a 12-EER unit relative to the 2010 federal standard, which ranges from about 10.4–11.2 EER, depending on unit type and size. The energy savings average 1,070 kWh (7.2%) for the smaller unit and 3,371 kWh (10.8%) for the larger unit. We assume a measure lifetime of 15 years (LBNL 2003). Incremental costs (averaging $629 for 65–135 kBtu and $1,415 for 135–240 kBtu) are derived from DOE’s Technical Support Document (DOE 2004). Percent applicable (33% for 65–135 kBtu and 15% for 135–240 kBtu) and percentage of floor space with cooling from unitary equipment are also from DOE’s Technical Support Document (DOE 2004). The levelized cost is calculated to be $0.04–0.05.7/kWh, depending on unit type and size.

High-Efficiency Packaged Terminal AC/HP

Measure Description: PTACs and PTHPs are self-contained heating and air-conditioning units encased inside a sleeve specifically designed to go through the exterior building wall. The basic design of a PTAC consists of a compressor, evaporator, condenser, fan, and enclosure. They are primarily used to provide space conditioning for commercial facilities such as hotels, hospitals, apartments, dormitories, schools, and offices. High-efficiency units have a higher energy efficiency ratio (EER) for cooling units and coefficient of performance (COP) for heat pumps.

Base Case: Consistent with all HVAC-related measures, the baseline electricity intensity is 5.0 kWh/sq. ft., which is the estimated HVAC consumption in commercial buildings in Louisiana. This is based on the West South Central census region from EIA’s commercial buildings survey (EIA 2006).

Data Explanation: We assume that high-efficiency units save an average of 10%, or 155 kWh/unit, relative to the 2012 federal standard (EPA 2011). The incremental cost is $75 (EPA 2011). The measure life is 10 years (DOE 2008). Percent applicable is 5%, which is the percent of cooling floor space from packaged terminal units (ADL 2001).

Efficient Room Air-Conditioner

Measure Description: Installation of an ENERGY STAR room AC, which must be at least a 10% improvement over the 2000 federal standard (an average 8,000-Btu unit must have a 10.8 EER).

Base Case: Room AC that meets 2000 federal energy standards (an average 8,000-Btu unit has a 9.8 EER) and uses an average of 677 kWh/unit. Baseline electricity intensity for this end use, 2.8 kWh/sq. ft., is the estimated cooling consumption in commercial buildings in Louisiana. This is based on the West South Central census region from EIA's commercial buildings survey (EIA 2006).

Data Explanation: We assume an ENERGY STAR room AC uses 590 kWh/year, saves 13% of base case energy, and has an incremental cost of $35 (ENERGY STAR calculator). We assume a measure life of 13 years (ENERGY STAR calculator), a current market share of 52% (EPA 2007a), and percent applicable assumes 8% percent of cooling floor space uses room AC units (ADL 2001). This measure is applicable only through the end of 2013.

2014 Efficient Room Air-Conditioner

Measure Description: A room AC with higher efficiency than the 2014 federal standard

B*ase Case*: Room AC that meets 2014 federal energy standards (an 8,000-Btu unit must meet 10.9 CEER) and uses an average of 969 kWh/unit in commercial applications. Baseline electricity intensity for this end use, 2.8 kWh/sq. ft., is the estimated cooling consumption in commercial buildings in Louisiana. This is based on the West South Central census region from EIA's commercial buildings survey (EIA 2006).

Data Explanation: We assume a moderate increase in efficiency to 11.5 CEER, which saves 51 kWh/year, or 5% of annual energy consumption. This efficiency level carries an incremental cost of $28 (DOE 2011). We assume a measure life of 13 years (ENERGY STAR calculator) and a current market share of 52% (EPA 2007a). Percent applicable assumes 8% percent of cooling floor space uses room AC units (ADL 2001). This measure is applicable only from 2014 through 2030.

High-Efficiency Chiller

Measure Description: Installation of high-efficiency chiller, which is the heart of very large air-conditioning systems for buildings and campuses with central chilled water systems. A centrifugal chiller utilizes the vapor compression cycle to chill water and reject the heat collected from the chilled water plus the heat from the compressor to a second water loop controlled by a cooling tower.

Base Case: The base case unit assumes 0.634 kW/ton T24 from California's DEER database for an average 150-ton system and 1,593 national average full-load operating hours from the ASHRAE 90.1-1999 analysis. Baseline electricity intensity for this end use, 5 kWh/sq. ft., is the estimated HVAC consumption in commercial buildings in Louisiana.

Data Explanation: We assume the new measure has 20% savings, which is an ACEEE estimate. The lifetime estimate of 23 years is from the ASHRAE Handbook (ASHRAE 2007). Incremental costs are $9,900 and assume a 150-ton average unit (CEC 2005). Percent applicable (33%) assumes percentage of cooling floor space using chillers (ADL 2001).

Dual-Enthalpy Economizer

Measure Description: Economizers modulate the amount of outside air introduced into the ventilation system based on the relative temperature and humidity of the outside and return air. If the enthalpy, or latent and sensible heat, of the outside air is less than that of the return air when space cooling is required, then the outside air is allowed to reduce or eliminate the cooling requirement of the AC equipment.

Base Case: Baseline electricity intensity, 2.8 kWh/sq. ft., is the estimated cooling load in commercial buildings.

Data Explanation: Savings per unit assumes 276 kWh/ton (20% savings) for an average 11-ton unit (CL&P 2007). Average measure life is 10 years (CL&P 2007). Incremental cost of $889/unit is from NYSERDA 2003. Percent applicable is the portion of cooling square footage represented by packaged AC and HP units (48%). It also assumes a 5% current market share (ACEEE estimate).

Demand-Controlled Ventilation

Measure Description: Often, HVAC systems are designed to supply ventilated air based on assumed occupancy levels, resulting in over-ventilation. Installation of demand-controlled ventilation that monitors CO_2 levels in different zones and delivers the required ventilation only when and where it is needed.

Base Case: Standard ventilation electricity consumption for a 50,000-sq. ft. office building, or about 40,000 kWh/year (Sachs et al. 2004). Baseline electricity intensity for this end use, 1.7 kWh/sq. ft., is the estimated ventilation consumption in commercial buildings in Louisiana.

Data Explanation: We assume 20% savings for this measure, energy use per unit of 32,000 kWh/year, assuming a 50,000-sq. ft. building, lifetime estimate of 15 years, and incremental costs of $3,450 (all from Sachs et al. 2004). Measure is applicable to 90% of larger (60%) cooling units (Sachs et al. 2004).

HVAC Tune-Up

Measure Description: Tune-up of heating and cooling equipment. Most HVAC technicians lack interest, training, equipment and methods to perform quality refrigerant charge and airflow (RCA) tune-ups. Because many new and existing air-conditioners have improper RCA, which reduces efficiency, there is significant potential for energy savings by diagnosing and correcting RCA.

Base Case: 4.5-ton commercial unitary AC/HP per California program experience (CPUC 2006), estimated to use 8,396 kWh/year per the unitary AC/HP measure. The base electricity intensity for the HVAC end use is 5.1 kWh/sq. ft., the average for small buildings less than 25,000 sq. ft., for which this measure is applicable.

Data Explanation: We assume 11% savings from this measure according to California’s DEER database (CEC 2005) and the California RCA program report (CPUC 2006). We assume that 60% of units have improper RCA (CPUC 2006), and therefore this measure is applicable to 60% of unitary HVAC units in buildings less than or equal to 25,000 sq. ft. (EIA 2006, West South Central census region). We estimate an average measure life of 3 years, as units need to be periodically re-tuned. We assume a cost of $158 for this measure, based on a $35/ton labor cost (CEC 2005) and an assumed 4.5-ton unit.

Retrocommissioning

Measure Description: Commercial building performance tends to degrade over time, and many new buildings do not perform as designed, requiring periodic upgrades to restore system functions to optimal performance. Undertake retrocommissioning (RCx), which is a systematic process to optimize building performance through O&M tune-up activities and diagnostic testing to identify problems in mechanical systems, controls, and lighting. The best candidates for RCx are buildings over 50,000 sq. ft..

Base Case: Electricity intensity of 10 kWh/sq. f.t. for HVAC and lighting end uses in buildings greater than 50,000 sq. ft., which is based on regional data from CBECS (EIA 2006).

Data Explanation: We assume 10% savings for HVAC and lighting end uses (Sachs et al. 2004) in all commercial floor space for buildings greater than 100,000 sq. ft., and 50% of floor space in buildings 50,000 sq. ft. or greater, based on data from CBECS (EIA 2006). We assume an average useful life of 7 years (York et al 2013). We assume a $0.14/sq. ft. cost (Sachs et al. 2004). The cost is shared with gas savings.

Water Heating Measures

Heat Pump Water Heater

Measure Description: Replacement of electric resistance water heater upon burnout with a heat pump water heater. The latter uses electricity to move heat from one place to another, and the heat source is the outside air or air where the unit is located.

Base Case: Standard electric water heating, with electricity consumption of 28,310 kWh/year (derived from energy savings and percent savings). Baseline electricity intensity for this end use, 0.3 kWh/sq. ft., is the estimated water heating consumption in commercial buildings in Louisiana.

Data Explanation: We assume a 50% savings, based on a simple coefficient of performance ratio. The assumed 14,155 kWh savings, $4,067 incremental cost, and 12-year lifetime estimates are from NYSERDA 2003. Percent applicable is based on engineering estimates for NYSERDA 2003, which assumes the measure is applicable to 70% of food service floor space and 30% of lodging, education, and health care floor space. Percent applicable is multiplied by 2, since these building types are more energy and hot-water intensive than the average commercial building.

Efficient Commercial Clothes Washer (Water Heating Portion)

Measure Description: Installation of a commercial clothes washer that achieves higher efficiency than the 2013 federal standard, with a weighted average MEF of 2.2.

Base Case: Clothes washer that meets DOE’s 2013 federal efficiency standard of 1.74 MEF (weighted average of top- and front-loading models). An average unit consumes 600 kWh/year for water heating (DOE 2009). Baseline electricity intensity for this end use is 0.34 kWh/sq. ft. /year (water heating portion only).

Data Explanation: Savings on electric water heating from this measure assumes a 2.2 MEF clothes washer uses an average 360 kWh/year, for a 40% savings, derived from DOE 2009. We assume the measure is applicable to the 17% of units that have electric water heating, and assume a 20% market share of efficient products. The overall stock estimate is based on national stock data (DOE 2007) and prorated to Louisiana based on commercial building floor space. We assume an incremental cost for an efficient unit of $63 and an 11-year measure life (DOE 2007).

Refrigeration Measures

Efficient Walk-In Refrigerator and Freezer

Measure Description: Walk-in refrigerators and freezers are medium- and low-temperature refrigerated spaces that can be walked into and are used to maintain the temperature of pre-cooled materials (not to rapidly cool down materials from warmer temperatures). Replacement of inefficient units with high-efficiency walk-in, which is defined as meeting the 2004 CEC standard for walk-ins. This includes prescriptive requirements such as higher levels of insulation, motor types, and the use of automatic door-closers (Nadel et al. 2006).

Base Case: Average walk-in is 18,859 kWh/year (Nadel et al. 2006). Baseline electricity intensity, 1.4 kWh/sq. ft., is the estimated refrigeration end-use in commercial buildings in Louisiana.

Data Explanation: For a high-efficiency walk-in unit, we assume 44% savings over a baseline unit, or 8,220 kWh/year, $957 incremental cost, and 12-year measure lifetime, which are based on PG&E 2008. We estimate percent applicable as the 18% of refrigeration energy use attributed to walk-ins (ADL 1996) and estimate a 50% current market share of high-efficiency products (ACEEE estimate).

Efficient Reach-In Cooler and Freezer

Measure Description: Replacement of inefficient units with high-efficiency packaged commercial reach-in refrigerators and freezers with solid doors, and refrigerators with transparent doors such as beverage merchandisers. High-efficiency units are those that meet the CEE Tier 2 performance standard, as estimated in PG&E 2005.

Base Case: We assume a baseline unit that meets that upcoming (2009 or 2010) federal standard. We estimate a baseline unit uses 4,027 kWh/year, which is weighted by sales of unit type PG&E 2004. Baseline electricity intensity for this end-use, 1.4 kWh/sq. ft., is the estimated refrigeration energy consumption in commercial buildings in Louisiana.

Data Explanation: The savings estimate for a high-efficiency unit, 31% savings or 1,268 kWh/year, is a weighted average of different types of reach-ins that meet CEE's Tier 2 performance standard (PG&E 2004). We estimate an average lifetime of 9 years and an incremental cost of $177, both per PG&E 2004a. We estimate percent applicable as the percentage of refrigeration energy use attributed to reach-ins and beverage merchandisers, or 17% (ADL 1996), and assume a 10% current market share of high-efficiency products per PG&E 2004a.

Efficient Ice Maker

Measure Description: Commercial ice makers, which are used in hospitals, hotels, and food service and preservation, have energy savings potential largely in their refrigeration systems. We assume an efficient ice maker meets CEC's Tier 2 level of energy savings, which incorporates improved compressors, heat exchangers, and controls, as well as better insulation and gaskets.

Base Case: The baseline energy use, 3,338 kWh/year, is a weighted average of different types of ice makers that meet the 2010 standard. Baseline electricity intensity for this end use, 1.4 kWh/sq. ft., is the estimated refrigeration energy consumption in commercial buildings in Louisiana.

Data Explanation: The 16% savings estimate for a high-efficiency unit, or 542 kWh/year, is a weighted average of different types of ice makers that meet CEE's Tier 2 energy savings (PG&E 2004). We estimate an average lifetime of 10 years and an incremental cost of $100, both per PG&E 2005. We estimate percent applicable as the percentage of refrigeration energy use attributed to ice makers, or 10% (ACEEE Estimate), and assume a 10% current market share of high-efficiency products per PG&E (2004) and ACEEE judgment.

Efficient Built-Up Refrigeration System

Measure Description: Built-up or supermarket refrigeration systems are primarily made up of refrigerated display cases for holding food for self-service shopping, as well as machine room cooling technologies. More efficient built-up systems include improved machine room technologies (evaporative condensers, mechanical sub-cooling, and heat reclaim), high-efficiency evaporative fan motors, hot gas defrost, liquid-suction heat exchangers, anti-sweat control, and defrost control.

Base Case: The measure baseline is 1,600,000 kWh for a 45,000-sq. ft. supermarket with a built-up refrigeration system. Baseline electricity intensity, 1.4 kWh/sq. ft., is the estimated refrigeration end use.

Data Explanation: Per-unit savings of 336,000 kWh (21%) is from ADL 1996 and assumes an average new 45,000-sq. ft. supermarket. We estimate percent applicable as the percentage of refrigeration energy use attributed to built-up refrigeration, or 33% (ADL 1996). Incremental cost ($37,000) and lifetime (10 years) are from ADL 1996.

Efficient Vending Machine

Measure Description: ENERGY STAR vending machines must consume 50% less energy than standard machines. Under the Tier 2 ENERGY STAR level, this translates to a maximum energy consumption of 6.33 kWh/day for a 600-can machine.

Base Case: Tier I ENERGY STAR–level vending machine, which uses 2,823 kWh/year, per EIA estimates. Baseline electricity intensity, 1.4 kWh/sq. ft., is the estimated refrigeration end use.

Data Explanation: Per-unit savings of 18% (507 kWh/year) estimated from ASAP 2007 based on ENERGY STAR calculator estimates. Likewise, an incremental cost of $30, and a lifetime estimate of 10 years are from ASAP 2007. We estimate percent applicable as the percentage of refrigeration energy use attributed to built-up refrigeration, or 13% (NYSERDA 2003).

Vending Miser

Measure Description: A vending miser is an energy control device for refrigerated vending machines. Using an occupancy sensor, the control turns off the machine’s lights and duty cycles the compressor based on ambient air temperature.

Base Case: An efficient vending machine that meets the ENERGY STAR Tier 2 level and uses 2,323 kWh/year, per EIA. Baseline electricity intensity is for the refrigeration end use (1.4 kWh/sq. ft.).

Data Explanation: We assume 35% savings for this measure based on manufacturer data (USA Technologies 2008), an incremental cost of $167 (NYSERDA 2003), and a measure life of 10 years (NYSERDA 2003).

Appliances

Efficient Hot Food Holding Cabinets

Measure Description: Commercial hot food holding cabinets are used in the commercial kitchen industry primarily for keeping food at a safe serving temperature, without drying it out or further cooking it. These cabinets can also be used to keep plates warm and to transport food for catering events. High-efficiency models differ mainly in that they are better insulated.

Base Case: An uninsulated cabinet that consumes 5,190 kWh/year. This was calculated from PG&E 2004b using a simple average of three sizes of cabinets, and then weighting the average using figures for insulated cabinets.

Data Explanation: The energy savings from an insulated holding cabinet are 1,815 kWh/year (35% savings), with an incremental cost of $453, and an estimated 15-year lifetime (Neubauer et al. 2009). Percent applicable refers to the 25% of holding cabinets that are currently uninsulated (Neubauer et al. 2009).

2013 Efficient Commercial Clothes Washer (Excluding Hot Water Energy)

Measure Description: Replacement upon burnout with a commercial clothes washer that achieves higher efficiency than the 2013 federal standard, with a weighted average MEF of 2.2.

Base Case: A clothes washer that meets DOE’s 2013 federal efficiency standard of 1.74 MEF (weighted average of top- and front-loading models). An average unit consumes 1,294 kWh/year for non-water-heating uses (DOE 2009).

Data Explanation: Electric savings from this measure assume a 2.0 MEF clothes washer uses an average 1,107 kWh/year, for a 14% savings, derived from DOE’s TSD (DOE 2009). We assume the measure is applicable to the 37% of units that have electric dryer heating (removal of moisture from clothes), and assume a 20% market share of efficient products. The overall stock estimate is based on national stock data (DOE 2007) and prorated to Louisiana based on commercial building floor space. We assume an incremental cost for an efficient unit of $63 and an 11-year measure life (DOE 2007).

Lighting Measures

Fluorescent Lighting

Measure Description: Replacement of existing fluorescent lighting with extra-efficient ballasts and high-lumen lamps that are installed with the ballast factor of new ballasts chosen to provide the right amount of light for an application.

Base Case: 4.2 kWh/sq. ft., which is the estimated energy intensity of the lighting sector in Louisiana. This assumes the large majority (88%) of fluorescent lighting in the commercial sector comprises T8 and T12 bulbs (Navigant 2012).

Data Explanation: We assume a percent savings of 27%. The incremental costs are $2 extra per ballast, and $1 extra for each of two lamps. The percent applicable (72%) is the percentage of total commercial lighting kW attributable to fluorescent lighting (Navigant 2012).

HID Lighting

Measure Description: Metal halide lamps produce light by passing an electric arc through a mixture of gases. Efficiency improvements in metal halide lamps include pulse start lamp technology, electronic ballasts, and improved fixtures.

Base Case: 4.2 kWh/sq. ft., which is the energy intensity of the lighting sector in Louisiana. This assumes that the majority (87%) of HID lighting in the commercial sector comprises metal halide bulbs (Navigant 2012).

Data Explanation: The new measure savings and costs are from a PG&E CASE study on metal halide lamps and fixtures (PG&E 2004c). Energy savings were 447 kWh/year (26%), and incremental costs were $60. Percent applicable (14.2%) is the percent of total commercial lighting kW attributable to HID lighting (Navigant 2012).

2013 Compact Fluorescent Lighting

Measure Description: Replacement of 70% of current incandescent lighting with CFLs, 2013-2019. We assume that 4.8% of installed lighting wattage in the commercial sector is incandescent (Navigant 2012).

Base Case: As federal standards phase in, the base case load for incandescent lighting falls to 0.15 kWh/sq. ft. This represents the amount of energy used for incandescent lighting in the average commercial building, and is based on data from Navigant 2012.

Data Explanation: Energy savings are 0.07 kWh/sq. ft./year, or 61%. This equates to per-unit savings of 72 kWh/year. Incremental costs include $5 in the cost of a CFL, but savings in labor are $8 for replacing every four bulbs. ACEEE estimates that 70% of sockets are applicable for the new measure. This measure is applicable 2013 through 2019.

2020 Compact Fluorescent Lighting

Measure Description: Replacement of 70% of incandescent lighting with CFLs, 2020 - 2030. We assumed that 4.8% of installed lighting wattage in the commercial sector is incandescent (Navigant 2012).

Base Case: Based on expected 2020 lighting standards, the base case load for incandescent lighting is further reduced to 0.11 kWh/sq. ft. This represents the amount of energy used for incandescent lighting in the average commercial building, and is based on data from Navigant 2012.

Data Explanation: Energy savings are 0.04 kWh/sq. ft./year, or 49%. This equates to per-unit savings of 37 kWh/year. Incremental costs include $5 in the cost of a CFL, but savings in labor are $8 for replacing every four bulbs. ACEEE estimates that 70% of sockets are applicable for the new measure. This measure is applicable 2020 through 2030.

Replace Incandescent Lamps with LED Lighting (2013 and 2020)

Measure Description: Replacement of incandescent lamps with LED lighting. The new measure assumes that the 20% of current incandescents (10% low-wattage and 10% miscellaneous) that are used for display lighting and 5% of general service incandescents can be replaced with LEDs.

Base Case: (2013) As federal standards phase in, the base case load falls to 0.13 kWh/sq. ft. This is derived from the average wattage of quartz halogen, low-wattage, and average incandescents; the average number of each type of bulb in a commercial building; and the average annual operating time (Navigant 2012). (2020) Based on expected 2020 lighting standards, we estimate the base case is further reduced to 0.11 kWh/sq. ft.

Data Explanation: Energy savings are 0.2 kWh/sq. ft./year, or 88%, assuming LED replacement wattages as indicated by Navigant 2008. Incremental costs include $0.05 per sq. ft., a weighted average of the costs of each bulb, and including a $32 labor savings for replacing each bulb. The LED prices were calculated using average efficacy and $/klm projections for 2010 (Navigant 2008). Percent applicable assumes that 100% of these specific bulbs are replaceable (Navigant 2008). Between this measure and the previous two measures (replacing incandescents with CFLs), 95% of incandescents are assumed to be replaceable, allowing 5% of incandescents (for specialty applications) to remain.

Occupancy Sensor for Lighting

Measure Description: Installation of occupancy sensors to greatly reduce lighting energy demands in commercial spaces, by automatically turning off lights in unoccupied spaces.

Base Case: Same base case as for fluorescent lighting improvements.

Data Explanation: Energy savings of 361 kWh/year (NYSERDA 2003) assume 30% energy reduction in individual offices and rooms and 7.5% reduction in open spaces (ACEEE estimate). Incremental cost ($48) is from NYSERDA 2003 and lifetime (16 years) is from DEER. Percent applicable (38%) is from Sachs et al. (2004).

Daylight Dimming System

Measure Description: Installation of a daylight dimming system that automatically dims lights to take advantage of natural daylight.

Base Case: Same base case as for fluorescent lighting improvements.

Data Explanation: Energy savings are estimated to be 143 kWh/year, or 35% (NYSERDA 2003). Savings apply for lamps on the perimeters of buildings (25% applicable—PIER 2003). Incremental cost ($68) and lifetime (20 years) estimates are from NYSERDA 2003.

Outdoor Lighting—Controls

Measure Description: This measure includes a variety of lighting control technologies for exterior lights.

Base Case: No base case data were available for this measure.

Data Explanation: We assume a savings of 174 kWh, or 20%, from lighting controls. Incremental costs of $43 are from DEER and assume each control on average controls three fixtures. Percent applicable of 30% is an ACEEE estimate.

Miscellaneous

Office Equipment

Measure Description: This measure assumes a high-efficiency fax, printer, computer display, internal power supply, and a low-mass copier.

Base Case: Baseline electricity use is 2,886 kWh/year (NYSERDA 2003). Baseline electricity intensity for this end use, 1.1 kWh/sq. ft., is the estimated office equipment energy consumption in commercial buildings in Louisiana.

Data Explanation: Energy savings are 1,410 kWh/year (49%), lifetime is 5 years, and incremental costs are $20. Percent applicable is estimated to be 50% (NYSERDA 2003).

Plug Load Controls

Measure Description: This measure involves turning off, or putting into a low-power state vending machines, computers, monitors, printers, and copiers using smart power strips.

Base Case: Baseline electricity use is 1.1 kWh/sq. ft., based on data from CBECS, LBNL, and ENERGY STAR.

Data Explanation: Energy savings are 6,763 kWh/year (40%), lifetime is 10 years from DEER database, and incremental costs are $1,364. Percent applicable is 100%, as data for the savings took into account the number of buildings that already shut down equipment after hours.

New Construction

Incorporating energy efficiency into building design is best achieved at the time of construction. Pacific Northwest National Laboratory (PNNL) and National Renewable Energy Laboratory (NREL) have produced a series of studies illustrating how a recommended set of design features could achieve energy use 50% below ASHRAE-90.1-2004. Our analysis assumes three distinct measures for tiers of savings (%) beyond base case consumption, in line with current advanced new buildings that are striving for up to 50% savings.

Efficient New Building (15% Savings)

Base Case: 8.8 kWh/sq. ft. is an estimate of HVAC, water heating, and lighting end-use electricity intensity for new buildings in Louisiana, derived from data for buildings built 2000–03 (EIA 2006). This assumes that 15%-savings buildings achieve savings in these end uses only.

Data Explanation: Incremental cost of $0.35/sq. ft. and measure life of 17 years are from NGRID 2007. The cost is shared with gas savings from the same measure, so the actual cost for electric savings is $0.24. Percent applicable of 24% for this measure assumes that 30% and 50% new buildings savings are phased in 1–2 years prior to enactment of codes in the policy scenarios.

Efficient New Building (30% Savings)

Base Case: 14.2 kWh/sq. ft. is an estimate of total electricity intensity for new Louisiana buildings, derived from data for buildings built 2000–03 (EIA 2006). We assume these advanced new buildings target total usage.

Data Explanation: We estimate incremental costs based on NBI data for “core performance” buildings (30% savings). NBI found incremental costs are $0.70–3.43/sq. ft. (in New England); we estimate $1.50/sq. ft. for this analysis, given that construction costs are lower in Louisiana (e.g. http://www.thecommercialrealestatespecialists.com/cpsf.html). These costs are equivalent to about 1–2% of total building costs. Measure life of 17 years is from NGRID 2007. Percent applicable of 41% assumes that 30% new buildings savings are phased in 1–2 years prior to enactment of codes in the policy scenarios.

Efficient New Building (50% Savings)

Base Case: 14.2 kWh/sq. ft. is an estimate of electricity intensity for new Louisiana buildings, derived from data for buildings built 2000–03 (EIA 2006). We assume these advanced new buildings target total usage.

Data Explanation: We estimate $3/sq. ft. incremental cost based on the NBI data referenced above. Measure life of 17 years is from NGRID 2007. Percent applicable of 35% is an estimate assuming that 50% new buildings savings are phased in 1–2 years prior to enactment of codes in the policy scenarios.

Table A-6. Commercial Building Electricity Measure Characterizations

Measures	Measure Life (Years)	Annual kWh svgs per unit	kWh svgs per sq. ft.	Incremental cost per unit	Incremental cost per sq. ft.	Cost of Conserved Energy (2007$/kWh saved)	Adjustment Factor	% Turnover	Interaction Factor	Cost-Effective Savings in 2030 (GWh)
Existing Buildings										
Building Shell										
Cool roof	20	5,513	0.19	$ 3,750	$ 0.38	$ 0.05	80%	95%	100%	226
Roof insulation	25	NA	0.28	NA	$ 0.08	$ 0.02	35%	100%	100%	155
Low-e windows	25	NA	0.52	NA	$ 0.53	$ 0.07	18%	76%	100%	110
Window film	10	NA	0.46	NA	$ 0.29	$ 0.08	75%	100%	**100%**	552
										1,043
HVAC										
Duct testing and sealing	10	24,828	0.58	$ 3,375	NA	$ 0.02	25%	100%	100%	230
Efficient ventilation fans & motors w VFD	10	21,977	0.43	$ 6,650	NA	$ 0.04	40%	100%	93%	253
HVAC Load-Reducing Measures Subtotal										**482**
High-effic. unitary AC & HP (65-135 kBtu)	15	1,070	0.36	$ 629	NA	$ 0.06	33%	100%	85%	161
High-effic. unitary AC & HP (135-240 kBtu)	15	3,371	0.55	$ 1,415	NA	$ 0.04	15%	100%	85%	109
Packaged Terminal HP and AC	10	155	0.50	$ 75	NA	$ 0.04	5%	100%	85%	34
2014 Efficient room air-conditioner	13	51	0.11	$ 28	NA	$ 0.06	4%	77%	85%	5
High-efficiency chiller system	23	30,347	1.01	$ 9,900	NA	$ 0.02	33%	83%	85%	370
HVAC Equipment Measures Subtotal										**683**
Dual Enthalpy Control	10	3,040	0.55	$ 890	NA	$ 0.04	46%	100%	75%	312
Demand-Controlled Ventilation	15	8,000	0.33	$ 3,450	NA	$ 0.04	54%	100%	75%	218
HVAC tuneup (smaller buildings)	3	920	0.54	$ 160	NA	$ 0.06	22%	100%	75%	145
Retrocommissioning	7	NA	0.91	NA	$ 0.10	$ 0.03	32%	100%	75%	352
HVAC Control Measures Subtotal										**1,027**
HVAC Subtotal										**2,192**
Water Heating										
Commercial clothes washers	11	240	0.00	$ 63	NA	$ 0.01	14%	100%	100%	1
Heat pump water heater	12	14,155	0.17	$ 4,067	NA	$ 0.03	16%	100%	100%	44
										45
Refrigeration										
Walk-in coolers & freezers	12	8,200	0.61	$ 957	NA	$ 0.01	9%	100%	100%	88
Reach-in coolers & freezers	9	1,268	0.44	$ 177	NA	$ 0.02	15%	100%	100%	109
Ice-makers	10	542	0.23	$ 100	NA	$ 0.02	9%	100%	100%	33
Supermarket (built-up) refrigeration system	10	336,000	0.29	$ 37,000	NA	$ 0.01	33%	100%	100%	153

Measures	Measure Life (Years)	Annual kWh svgs per unit	kWh svgs per sq. ft.	Incremental cost per unit	Incremental cost per sq. ft.	Cost of Conserved Energy (2007$/kWh saved)	Adjustment Factor	% Turnover	Interaction Factor	Cost-Effective Savings in 2030 (GWh)
Vending machines (to tier 2 ENERGY STAR level)	10	514	0.25	$ 30	NA	$ 0.01	13%	100%	100%	55
Vending miser	10	808	0.40	$ 167	NA	$ 0.03	13%	100%	100%	86
										524
Lighting										
Fluorescent lighting improvements	13	64	1.16	$ 54	NA	$ 0.01	72%	100%	100%	1,326
HID lighting improvements	2	447	1.11	$ 60	NA	$ 0.06	14%	100%	100%	250
Replace incandescent lamps with CFLs - 2013	13	72	0.07	NA	$ (0.03)	$ (0.04)	70%	0%	100%	0
Replace incandescent lamps with CFLs - 2020	13	37	0.04	NA	$ (0.03)	$ (0.08)	70%	31%	100%	13
Replace incandescent lamps with LEDs - 2013	9	160	0.10	$ 755	$ 0.05	$ 0.06	25%	69%	100%	28
Replace incandescent lamps with LEDs - 2020	13	160	0.08	$ 755	$ 0.05	$ 0.07	25%	31%	100%	9
Occupancy sensor for lighting	16	361	0.80	$ 48	NA	$ 0.01	38%	100%	74%	353
Daylight dimming system	20	143	1.48	$ 68	NA	$ 0.04	25%	95%	69%	373
Outdoor Lighting Controls	14	174	NA	$ 43	NA	$ 0.03	30%	100%	**100%**	**-**
										2,374
Office Equipment										
Office equipment	5	1,410	0.55	$ 0.01	$ 20	$ 0.003	50%	100%	100%	441
Turn off office equipment after-hours	5	6,763	0.44	$ -	$ 1,364	$ 0.026	100%	100%	76%	533
										972
Appliances/Other										
Hot Food Holding Cabinets	15	1,815	NA	$ 453	NA	$ 0.02	25%	100%	100%	6
Energy Star Commercial clothes washer	11	339	NA	$ 316	NA	$ 0.03	29%	100%	100%	4
										10
Existing Buildings Subtotal										**7,162**
New Buildings										
Efficient new building (15% savings)	17	NA	1.31	NA	$ 0.23	$ 0.02	24%	100%	100%	183
Efficient new building (30% savings)	17	NA	4.26	NA	$ 1.50	$ 0.05	41%	100%	100%	845
Tax credit eligible building (50% svgs)	17	NA	7.10	NA	$ 3.00	$ 0.06	35%	100%	100%	1,208
										2,236
									TOTAL	**9,362**

Natural Gas Analysis

To estimate the cost-effective resource potential for natural gas efficiency in Louisiana's commercial buildings, we first developed a disaggregate characterization of baseline electricity consumption in the state for current electricity use and a reference load forecast (see Table A-7 below). Unfortunately, highly disaggregated commercial natural gas consumption data is not available at the state level. To estimate these data, we started with current natural gas consumption for the Louisiana commercial sector and a forecast out to 2030 based on AEO 2012 regional forecasts (see statewide reference case), and we disaggregated by end use using average regional data from CBECS 2003 (EIA 2006) and AEO 2012.

Table A-7. Baseline Commercial Natural Gas Consumption by End Use (BBtu)

End Use	2011	%	2020	%	2030	%
Heating	16,606	52%	19,800	51%	20,200	49%
Cooling	169	0.6%	180	0.5%	230	1%
HVAC subtotal	*13,775*	*53%*	*20,000*	*51%*	*20,400*	*50%*
Water Heating	5,274	20%	7,900	20%	8,700	21%
Cooking	2,743	10%	4,000	10%	4,400	11%
Other	4,436	17%	7,300	19%	7,700	19%
Total	**26,228**	**100%**	**39,300**	**100%**	**41,100**	**100%**

Next, we estimated commercial square footage in the state using natural gas intensity data (MBtu per square foot) by census region from CBECS (EIA 2006). We used the West South Central census region to estimate overall natural gas intensity of 33 MBtu per square foot for the state of Louisiana. Total natural gas consumption in the state divided by the natural gas intensity provides an estimate of commercial floor space. Using this methodology, we estimated 765 million square feet of commercial floor space in the state.

Measure Cost Effectiveness

We then analyzed 20 efficiency measures for existing commercial buildings and 3 whole-building measures for new construction to examine the cost-effective energy efficiency resource potential. For each efficiency measure, we estimated natural gas savings (annual savings per measure) and incremental cost (measure cost) in a "replacement on burnout" scenario, which assumes that the product is replaced at the end of its useful life. Savings and costs are incremental to an assumed baseline measure. We estimated savings (MMBtu) and costs ($) on a per-unit and/or per-square foot commercial floor space basis. For each measure we also assumed a measure lifetime, or the estimated useful life of the product.

A measure is determined to be cost-effective if its levelized cost of saved energy, or cost of conserved energy (CCE), is less than $11.08/MMBtu, the estimated current average commercial cost of natural gas in Louisiana. The estimated CCE for each efficiency measure, which assumes a discount rate of 5%, is shown in the measure descriptions below. Equation 1 shows the calculation for cost of conserved energy using the payment function in Excel.

Our assumed baseline measure, annual savings per measure, measure cost, measure lifetime, and CCE are reported for each of the efficiency measures in the list of measure descriptions below. We group the 20 efficiency measures for existing commercial buildings by end use and list the 3 new building measures last.

Equation 1. CCE = PMT ((Discount Rate), (Measure Lifetime), (Measure Cost)) / (Annual Savings per Measure (kWh))

Total Statewide Resource Potential

For each measure, we derived annual savings per measure on a per-square-foot basis (MMBtu per square foot) for the applicable end use. For measures for which we have only savings on a per-unit or per-building basis, we first derived the percentage of savings and multiplied by the baseline natural gas intensity for that end use. The assumed baseline intensities for each end use are shown in Table A-8. As an example, for a specific HVAC measure we multiplied its percentage of savings by the baseline gas intensity (MBtu per square foot) for the HVAC end use.

Table A-8. Commercial End-Use Baseline Natural Gas Intensities (MMBtu per sq. ft.)

End Use	2009
Heating	16.8
Cooling	0.2
Ventilation	0.0
Water Heating	6.7
Cooking	3.4
Other	6.2
HVAC Subtotal	16.9
Total	**33.2**

To estimate the total efficiency resource potential in existing commercial buildings in Louisiana by 2025, we first adjusted the individual measure savings by an adjustment factor (See Equation 2). This factor accounts for two adjustments: the technical feasibility of efficiency measures, called “percent applicable” (the percentage of Louisiana floor space that satisfies the base case conditions and other technical prerequisites such as heating fuel type and cooling equipment); and the current market share, or the percentage of products that already meet the efficiency criteria. These assumptions are outlined in each of the efficiency measure descriptions below.

Equation 2. Adjustment Factor = Percent Applicable x (1-Current Market Share)

We then adjusted total savings for interactions among individual measures. For example, we adjusted HVAC equipment savings downward to account for savings already realized through improved building envelope measures (insulation and windows), which reduce heating and cooling loads. Similarly, we adjusted water heating equipment savings to account for reduced water heating loads from the use of more efficient clothes washers. The multiplier for these adjustments is called the interaction factor.

Finally, we adjusted replacement measures with lifetimes more than 7 and 17 years to account only for the percentage turning over in 7 and 17 years, which represents the benchmark years of

2015 and 2025, respectively. Note that the multiplier, “percent turnover,” is applicable only to products being replaced on burnout and not retrofit measures such as insulation. These retrofit measures therefore have 100% of measures turning over.

We then calculated the resource potential for each measure in the state using Equation 3, which takes into account all of the adjustments described above. The sum of the resource potential from all measures is the overall energy efficiency resource potential in the state’s commercial buildings sector.

Efficiency Measures

Table A-9 shows the 38 efficiency measures examined for this analysis, grouped by end-use costs, savings (MBtu) per product or square foot, percent applicable, interaction factor, percent turnover, and total savings potential (MMBtu) in 2030. Detailed descriptions of each measure are given below, grouped by end use.

Building Envelope Improvements

Roof Insulation

Measure Description: Addition of fiberglass or cellulose insulation material in roof cavities where possible to reduce heat transfer.

Base Case: The base case electricity intensity for this measure was disaggregated from the post-savings electricity intensity and the percentage of savings.

Data Explanation: We assume 3% savings and a post-savings gas intensity 16.4 Mbtu/sq. ft./year, based on an average of four building types (ACEEE 1997). An average lifetime of 25 years (CL&P 2007) and an incremental cost of $0.12/sq. ft. were also assumed. The measure is shared with gas savings as well, so the portion of the incremental cost attributed to gas savings is $0.04/sq. ft. The levelized cost is $5.69/MMBtu.

Double Pane Low-Emissivity Windows

Measure Description: Replacement of existing single-pane windows with double-pane windows containing low-emissivity (low-e) glass. Double-pane windows have insulating air- or gas-filled spaces between each pane to resist heat flow, and low-e glass has a special surface coating to reduce heat transfer back through the window. A window’s R-value represents the amount of heat transfer back through a window. Low-e windows are particularly useful in climates with heavy cooling loads, because they can reflect anywhere from 40–70% of the heat that is normally transmitted through clear glass. The Solar Heat Gain Coefficient (SHGC) represents the fraction of solar energy transferred through a window. For example, a low-e window with a 0.4 SHGC keeps out 60% of the sun’s heat.

Base Case: The base case natural gas intensity for this measure was disaggregated from the post-savings electricity intensity and the percent savings.

Data Explanation: 3% savings applies to whole-building electricity consumption (ACEEE 1997). Incremental costs assume $2 per window (SWEEP 2002). As with roof insulation, this measure is shared with electricity savings. A measure life of 25 years is from SWEEP 2002. Percent applicable is an ACEEE estimate. The levelized cost is calculated to be $3.77/MMBtu.

Heating and Cooling: Equipment and Controls

Boiler Tune-Up

Measure Description: Regular tune-ups to keep the boiler system running at optimal efficiency.

Base Case: Same base case as for high-efficiency boilers (see below).

Data Explanation: A boiler tune-up saves 2% of the energy of a baseline unit annually, or 30 MMBtu, and has an incremental cost of $250/boiler (GDS 2005). Percent applicable of 13% was calculated using CBECS data of percentage of buildings with boilers that don’t perform regular maintenance (CBECS 2003). We assume a measure life of 2 years (GDS 2005). The levelized cost is $6.08/MMBtu.

Duct Sealing

Measure Description: Sealing of gaps in ductwork that allow conditioned air to escape.

Base Case: Standard heating and cooling energy intensity, 16.9 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA’s commercial building survey) and the AEO.

Data Explanation: This measure saves 18% (48 MMBtu) of heating and cooling energy annually, and has an incremental cost of $7,000 (Sachs et al. 2004). Percent applicable is 37% based on the number of buildings under 25,000 sq. ft., and the measure life is 25 years (Sachs et al. 2004). The levelized cost is $10.35/MMBtu.

Pipe Insulation

Measure Description: Insulation of accessible steam or hot water supply pipes in the boiler room.

Base Case: Standard heating energy intensity, 16.8 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA’s commercial building survey) and the AEO.

Data Explanation: This measure saves 2% (5 MMBtu) of heating energy annually (NYSERDA 2006), and has an incremental cost of $450, based on an ACEEE estimate of 75 ft. of pipe to insulate at $6/linear foot of pipe (RSMeans). Percent applicable is 48%, current market share is 75%, and the measure life is 15 years (NYSERDA 2006). The levelized cost is $8.41/MMBtu.

High-Efficiency Rooftop Furnace Unit

Measure Description: This measure involves technologies such as condensing units to capture latent heat from water vapor in the flue, and modulating units, which have a variable firing rate to match the output to heat load.

Base Case: The base case is a 10-ton gas-fired condensing rooftop packaged unit with 80% steady state efficiency. The average annual gas use is 179 MMBtu (Sachs et al. 2004).

Data Explanation: A high-efficiency rooftop unit uses 150 MMBtu/year, saves 16% of base case energy, and has an incremental cost of $1,000 (Sachs et al. 2004). Percent applicable is 35% based on the percentage of buildings less than 100,000 sq. ft. multiplied by the assumption that the following percentages of size buildings use rooftop units: 40% of buildings 1,000–5,000 sq. ft., 80% of buildings 5,000–25,000 sq. ft., and 66% of buildings 25,000–100,000 sq. ft. This assumption is based on CBECS data as well as ACEEE estimates. We assume a measure life of 15 years and 0% current market share (Sachs et al. 2004). The levelized cost is $3.42/MMBtu.

High-Efficiency Stand-Alone Furnace

Measure Description: Replacement of minimum-efficiency gas furnace with condensing furnace and/or furnace with modulating capacity (variable firing rate that matches the output to heat load).

Base Case: The base case is a 80 AFUE residential furnace. The average annual gas use is 142 MMBtu (ENERGY STAR figure modified by a factor of 1.45 to represent the slightly larger average size of a small commercial building than a residential building).

Data Explanation: A high-efficiency furnace with 90 AFUE (ENERGY STAR minimum) uses 126 MMBtu/year, saves 11% of base case energy, and has an incremental cost of $464 (ENERGY STAR; cost and savings modified as per base case). Percent applicable is 2% based on the percentage of buildings less than 5,000 sq. ft. multiplied by the assumption that 40% of smaller buildings use furnaces. This assumption is based on CBECS data as well as ACEEE estimates. We assume a measure life of 18 years and 35% current market share (ENERGY STAR). The levelized cost is $2.51/MMBtu.

High-Efficiency Boiler

Measure Description: Substitution of condensing boilers with outdoor reset or equivalent controls (including circulation pump time clocks) for base case non-condensing boilers without adaptive controls (just thermostats and equivalent).

Base Case: A case study of boilers with 68% efficiency was assumed. The average annual gas use is 1,106 MMBtu, which was modified from the original statistic (26,267 MMBtu) to account for the difference in the case study building size and the average commercial building size in Louisiana (Sachs et al. 2004).

Data Explanation: Boilers with 90% efficiency use 832 MMBtu/year in an average commercial building, save 50% of base case energy (Durkin), and have an incremental cost of $3,024 (Sachs et al. 2004). The cost reflects the incremental cost of a high-efficiency boiler as well as the cost of an outdoor temperature reset system. Percent applicable is 57% based on assumptions of percentage of buildings in each size class that use boilers and an assumption of 90% that can be easily replaced, per CBECS and ACEEE estimates. We assume a measure life of 24 years (Sachs et al. 2004). The levelized cost is $0.80/MMBtu.

Programmable Thermostat

Measure Description: Replacement of conventional thermostats with programmable thermostats. This measure is appropriate only for smaller buildings.

Base Case: 34 MBtu/ft2 is the standard heating and cooling intensity modified by the overall intensity ratio of small buildings to average-sized building (EIA 2006 and 2007).

Data Explanation: This measure saves 5% (3 MMBtu) of heating energy annually based on ACEEE estimates. The measure has an incremental cost of $100 (CEC 2005) and a percent applicable of 14%. The percent applicable derives from the percentage of West South Central commercial buildings under 2,000 sq. ft. and the fact that 80% of these buildings do not have an EMS (EIA 2006). The measure life is 12 years, which is an ACEEE estimates, and the levelized cost is $4.55/MMBtu.

Demand-Controlled Ventilation

Measure Description: Often, HVAC systems are designed to supply ventilated air based on assumed occupancy levels, resulting in over-ventilation. Install demand-controlled ventilation, which monitors CO_2 levels in different zones and delivers the required ventilation only when and where it is needed.

Base Case: 215 MMBtu/year, or the estimated portion of commercial gas heating attributable to ventilation (Sachs et al. 2004).

Data Explanation: Demand-controlled ventilation saves 20% of ventilation energy a year (43 MMBtu), and has an incremental cost of $575/zone (six zones were assumed as an average, for a total cost of $3,450) (Sachs et al. 2004). Estimates for percent applicable is 54%, and the measure life is 15 years (Sachs et al. 2004).

Outdoor Temperature Boiler Reset

Measure Description: Normally, boilers heat water to a fixed temperature. With an outdoor air reset system, the maximum temperature the boiler operates at is variable, depending on the outdoor temperature. The warmer the outdoor temperature, the lower the boiler temperature needs to be, saving energy over the standard fixed (high) temperature operation of a conventional boiler.

Base Case: Standard heating energy intensity, 16.8 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA's commercial building survey) and the AEO.

Data Explanation: This measure saves 2% (5 MMBtu) of heating energy annually (NYSERDA 2006), and has an incremental cost of $600 (GDS 2005). Percent applicable is 5%, based on the percentage of boilers not included in the high-efficiency boiler measure. The current market share is 60% (NYSERDA 2006), and the measure life is 15 years (ACEEE 2006). The levelized cost is $11.03/MMBtu.

Water Heating

Tank Insulation

Measure Description: Installation of commercial water heater insulation, available either by the blanket or by square foot of fiberglass insulation with protective facing.

Base Case: Standard water heating energy intensity, 9.1 MBtu/sq. ft. This is the average of data for the Mid-Atlantic region (from the EIA's commercial building survey) and the AEO.

Data Explanation: This measure saves 2% (4 MMBtu) of water heating energy annually (NYSERDA 2006), and has an incremental cost of $11.95/sq. ft. (RSMeans) with an assumed 180 sq. ft. of tank surface area. Percent applicable is 50%, current market share is 53%, and the measure life is 15 years (NYSERDA 2006). The levelized cost is $11.91/MMBtu.

Smart Circulation Pump Controls

Measure Description: This measure involves shutting down the DHW recirculation pump during periods when there is little or no demand for hot water. These periods are determined by the controls from historical use patterns. This leads to savings from heat loss through piping, as well as savings associated with the running of the pump.

Base Case: Standard water heating energy intensity, 6.7 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA's commercial building survey) and the AEO.

Data Explanation: This measure saves 3% (3 MMBtu) of water heating energy annually, and has an incremental cost of $143 (GDS 2005). Percent applicable is 5% based on the percentage of buildings with boilers that are not covered in the high-efficiency boiler measure, and the measure life is 15 years (GDS 2005). The levelized cost is $4.48/MMBtu.

Condensing Domestic Hot Water (DHW) Stand-Alone Tank

Measure Description: Installation of a new high-efficiency residential-sized tank-type condensing gas water heater for smaller commercial operations.

Base Case: Standard water heating energy intensity, 6.7 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA's commercial building survey) and the AEO.

Data Explanation: This measure saves 36% (37 MMBtu) of water heating energy annually (NYSERDA 2006), and has an incremental cost of $1,100 (Sachs et al. 2004). Percent applicable is 35%, current market share is 5%, and the measure life is 15 years (NYSERDA 2006). The levelized cost is $2.87/MMBtu.

Indirect-Fired DHW Off-Space Heating Boiler

Measure Description: DHW cylinders are heated indirectly with water from the boiler.

Base Case: Standard water heating energy intensity, 6.7 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA's commercial building survey) and the AEO.

Data Explanation: This measure saves 30% (30 MMBtu) of water heating energy annually (NYSERDA 2006), and has an incremental cost of $4,000. Percent applicable is 5%, the current market share is close to 0%, and the measure life is 25 years (NYSERDA 2006). The levelized cost is $9.38/MMBtu.

Instantaneous High-Modulating Water Heater

Measure Description: Installation of instant, or tankless, water heater, which heats water on demand. Advanced units have modulating burners with electronic controls to maintain constant outlet temperature despite variations in inlet temperature and variable demand.

Base Case: Standard water heating energy intensity, 6.7 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA's commercial building survey) and the AEO.

Data Explanation: This measure saves 21% (21 MMBtu) of water heating energy annually (NYSERDA 2006), and has an incremental cost of $650 (Sachs et al. 2004). Percent applicable is 4%, the current market share is 26%, and the measure life is 15 years (NYSERDA 2006). The levelized cost is $2.98/MMBtu.

Cooking

Direct-Fired Convection Range/Oven

Measure Description: Convection ovens use a small fan to circulate hot air within the oven cavity. Circulating air can heat food more efficiently than the still air found in conventional ovens.

Base Case: A conventional range/oven uses approximately 160 MMBtu/year (Food Service Technology Center 2002).

Data Explanation: This measure saves 35% (56 MMBtu) per year per unit (GDS 2005), and has an incremental cost of $2,625 (RSMeans 2008). The measure life is 8 years and the percent applicable is 5%, which accounts for weighted applicability in only the commercial sectors that would have ovens (NYSERDA 2006). The levelized cost is $7.25/MMBtu.

High-Efficiency ENERGY STAR Fryer

Measure Description: Installation of an ENERGY STAR fryer, which can save 15–25% of the energy used by a conventional model. High-efficiency gas fryers utilize technology such as heat pipes, infrared burners, recirculation tubes, power burners, and pulse combustion.

Base Case: A conventional fryer uses 163 MMBtu/year on average (EPA 2007).

Data Explanation: An ENERGY STAR fryer saves 31% (51 MMBtu) per year per unit, and has an incremental cost of $3,795 (ENERGY STAR). Current market share is 11% (EPA 2007), and the Louisiana stock data (80,000 units) was derived from national annual shipments (EPA 2007), measure life (12 years—ENERGY STAR), and the ratio of commercial buildings that include cooking equipment using natural gas (CBECS). The levelized cost is $8.48/MMBtu.

High-Efficiency ENERGY STAR Steam Cooker

Measure Description: Installation of an ENERGY STAR steam cooker, which is better insulated to reduce heat loss, has a more efficient steam delivery system, and can be up to 50% more energy efficient than a conventional steamer.

Base Case: A conventional steamer uses 91 MMBtu/year on average (data derived from ENERGY STAR and Food Service Technology Center data).

Data Explanation: An ENERGY STAR steam cooker saves 50% (45 MMBtu) per year per unit (ENERGY STAR), and incremental cost is a net savings of $1,995 (CEC 2005). Current market share is 8%, and the Louisiana stock data (33,000 units) was derived from national annual shipments (ENERGY STAR) , measure life (10 years—Food Service Technology Center 2002), and the ratio of commercial buildings that include cooking equipment using natural gas (EIA 2006). The levelized cost is a net savings of $5.63/MMBtu.

High-Efficiency Griddle

Measure Description: Replacement of a conventional griddle with a high-efficiency griddle, which takes advantage of technologies such as double-sided griddles, chrome finishes, snap-action thermostats, infrared burners, heat pipes, and thermal fluid or steam to reduce energy consumption.

Base Case: A conventional griddle uses 112 MMBtu/year on average (Food Service Technology Center 2002).

Data Explanation: A high-efficiency griddle saves 14% (15 MMBtu) of energy per year per unit (GDS 2005), and has an incremental cost of $50 (CEC 2005). Percent applicable is 90%. The levelized cost is $0.37/MMBtu.

Miscellaneous

Retrocommissioning

Measure Description: Undertake retrocommissioning, which results in optimized energy usage of buildings through better operations and maintenance, control calibration, and facilities staff training.

Base Case: Average heating, cooling, and water heating energy intensity, 23.6 MBtu/sq. ft. This is the average of data for the West South Central census region (from the EIA's commercial building survey) and the AEO.

Data Explanation: This measure saves 10% (36 MMBtu) of heating, cooling, and water heating energy (Sachs et al. 2004), and has an incremental cost of $0.25/sq. ft. This cost is shared with electric savings from the same measure, so the actual cost of gas savings is $0.11. Percent applicable is 54%, and the measure life is 7 years (Sachs et al. 2004). The levelized cost is $7.89/MMBtu.

New Buildings

Incorporating energy efficiency into building design is best achieved at the time of construction. Pacific Northwest National Laboratory (PNNL) and National Renewable Energy Laboratory (NREL) have produced a series of studies illustrating how a recommended set of design features could achieve energy use 50% below ASHRAE-90.1-2004. Our analysis assumes three distinct measures for tiers of savings (%) beyond base case consumption, in line with current advanced new buildings that are striving for up to 50% savings.

Efficient New Building (15% Savings)

Base Case: 14.5 MBtu/sq. ft./year, based on the HVAC and water heating energy intensities for commercial buildings built between 2000 and 2003 (EIA 2006).

Data Explanation See equivalent electricity measure. We assume that costs are apportioned among electricity and natural gas savings.

Efficient New Building (30% Savings)

Base Case: 14.5 MBtu/sq.ft./year, based on the HVAC and water heating energy intensities for commercial buildings built between 2000 and 2003 (EIA 2006).

Data Explanation: See equivalent electricity measure. We assume that costs are apportioned among electricity and natural gas savings.

Efficient New Building (50% Savings)

Base Case: 14.5 MBtu/sq. ft. is an estimate of HVAC, water heating, and lighting end-use electricity intensity for new buildings in Louisiana, derived from data for buildings built between 2000 and 2003 (EIA 2006).

Data Explanation: See equivalent electricity measure. We assume that costs are apportioned among electricity and natural gas savings.

Table A-10. Commercial Natural Gas Measure Characterizations

Measures	Measure Life (Years)	Annual MMBtu svgs per unit	Estimated Louisiana Stock	MBtu savings per sq. ft.	Incremental cost per unit (per sq. ft.)	Cost of Conserved Energy ($/MMBtu saved)	Adjustment Factor	% Turnover	Interaction Factor	Savings in 2030 (BBtu)
Existing Buildings										
Building Shell										
Roof insulation	25	8	NA	0.53	$ 0.04	$ 5.63	35%	76%	100%	146
Low-e windows	25	8	NA	0.51	$ 0.03	$ 2.31	75%	76%	100%	298
										444
HVAC										
Boiler tune-up	2	22	NA	1.44	$ 250	$ 6.08	13%	100%	100%	32
Duct sealing	25	49	NA	3.12	$ 7,000	$ 10.05	37%	68%	100%	898
Pipe insulation—heating	15	5	NA	0.34	$ 450	$ 8.19	12%	100%	100%	44
Load-Reducing Measures Subtotal										**971**
High-Efficiency rooftop furnace unit	15	28	NA	1.83	$ 1,000	$ 3.42	35%	100%	91%	585
High-efficiency standalone furnace	18	16	NA	1.03	$ 464	$ 2.51	1%	100%	91%	12
High-efficiency main/front-end boiler	24	110	NA	17.83	$ 3,024	$ 2.00	51%	79%	91%	1,124
HVAC Equipment Measures Subtotal										**1,721**
Programmable thermostat	12	3	NA	1.69	$ 100	$ 4.46	14%	100%	74%	174
Demand-controlled ventilation	15	43	NA	2.79	$ 3,450	$ 7.75	54%	100%	74%	1,123
Outdoor temperature boiler reset	15	5	NA	0.34	$ 600	$ 10.74	2%	100%	74%	5
HVAC Control Measures Subtotal										**1,302**
HVAC Subtotal										**3,994**
Water Heating										
Circulation pump time clock	15	3		0.20	$ 140	$ 4.48	5%	100%	100%	9
Control Measures Subtotal										**9**
Condensing DHW stand-alone tank	15	37	NA	2.40	$ 1,100	$ 2.87	33%	100%	100%	794
Indirect-fired DHW off space heating boiler	25	30		1.97	$ 4,000	$ 9.38	5%	76%	100%	80
Tankless high-modulating water heater	15	21		1.37	$ 650	$ 2.98	3%	100%	100%	41
Equipment Measures Subtotal										**915**
Water Heating Subtotal										**924**
Cooking										
Direct-fired convection range/oven	8	56	104,000	NA	$ 2,630	$ 7.25	5%	100%	100%	317
High-efficiency ENERGY STAR fryer	12	51	80,000	NA	$ 3,800	$ 8.48	11%	100%	100%	443

High-efficiency ENERGY STAR steam cooker	10	45	33,000	NA	$ (1,960)	$ (5.63)	8%	100%	100%	118
High-efficiency griddle	12	15	19,000	NA	$ 50	$ 0.37	5%	100%	100%	15
										893
Miscellaneous										
Retrocommissioning	7	36	NA	2.36	$ 0.11	$ 8.74	54%	100%	100%	980
										980
Existing Buildings Subtotal										**9,490**
New Buildings										
Efficient new building (15% savings)	17	NA	NA	2.17	$0.12	$ 4.63	24%	100%	100%	307
Efficient new building (30% savings)	17	NA	NA	4.35	$0.23	$ 4.67	41%	100%	100%	1,076
Tax-credit eligible building (50% savings)	17	NA	NA	7.25	$0.47	$ 5.61	35%	100%	100%	1,537
										2,920
									TOTAL	**10,156**

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APPENDIX B. INDUSTRIAL SECTOR

B.1. Overview of Approach

According to *2006 Manufacturing Energy Consumption Survey (MECS)* (EIA 2009), industrial energy use in the South region (which includes Louisiana) is broken down as follows: electricity (15%), natural gas (34%), fuel oil (3%), coal and coke (5%), and other (43%). This analysis focuses on the electricity and natural gas savings potential. It was accomplished in several steps. First, the industrial market in Louisiana was characterized at a disaggregated level and energy consumption for key end uses was estimated. Then cost-effective energy-saving measures were selected based on the projected average retail industrial electricity and natural gas prices. The economic potential savings for these measures were estimated by applying the efficiency measures to end-use energy consumption. The following sections describe the process for estimating the savings potential in Louisiana.

B.2. Market Characterization and Estimation of Base Year Electricity Consumption

The industrial sector is made up of a diverse group of economic entities spanning agriculture, mining, construction, and manufacturing. Significant diversity exists within most of these industry subsectors, with the greatest diversity within manufacturing. The various product categories within manufacturing are classified using the North American Industrial Classification System (NAICS) (Census 2007).[35]

Comprehensive, highly disaggregated electricity or natural gas data for the industrial sector are not available at the state level. To estimate the electricity and natural gas consumption, this study drew on a number of resources, all using the NAICS system and a consistent sample methodology. Fortunately, a conjunction of the various economic censuses for each state allows us to use a common base year, 2007.

We then used national industry energy intensities derived from industry group electricity and natural gas consumption data reported in the *2010 Annual Energy Outlook* (AEO) (EIA 2010) and value of shipments data reported in the *2007 Annual Survey of Manufacturing* (ASM) (Census 2007) to apportion industrial energy consumption. These intensities were then applied to the value of shipments data for the manufacturing energy groups (three-digit NAICS) in Louisiana. These energy consumption estimates were then used to estimate the share of the industrial sector electricity and natural gas consumption for each subsector.

Preparation of Baseline Industrial Electricity Forecast

As is the case for state-level energy consumption data, no state-by-state disaggregated electricity or natural gas consumption forecasts are publicly available. Several alternate data sources were used to calculate estimated energy consumption growth rates for each state and subsector. We made the assumption that energy consumption is a function of gross state value of shipments. Electricity and natural gas consumption, however, do not grow at the same rate

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[35] The industry sector comprises four subsectors: manufacturing, mining, agriculture, and construction. Each subsector is further broken down into individual industry groups, reflecting the many different definitions for the term "industrial."

as value of shipments. This is because, in general, energy intensity (energy consumed per value of output) decreases with time.

Because state-level disaggregated economic growth projections are not publicly available, data were used from Moody's Analytics The average growth rate for specific industrial subsectors was estimated based on Moody's estimates of gross state product. We used this estimated industrial energy consumption distribution to apportion the EIA estimate (2010) of industrial energy consumption.

The industry sector comprises four subsectors: manufacturing, mining, agriculture, and construction. The manufacturing sector is broken down into 21 subsectors, defined by three-digit NAICS codes. In order to most closely match available data from the ASM and AEO, three subsectors were further broken down to four-digit NAICS codes: chemical manufacturing, nonmetallic mineral product manufacturing, and primary metal manufacturing. Table B-1, below, shows the estimated electrical and natural gas consumption for all these subsectors in Louisiana in 2010.

Table B-1. 2010 Electricity and Natural Gas Consumption by Industry in Louisiana

Industry	NAICS Code	Electricity		Natural Gas	
		(GWh)	(%)	(BBtu)	(%)
Agriculture	**11**	**128**	**0%**	**1,105**	**0%**
Mining	**21**	**5,064**	**18%**	**147,754**	**17%**
Construction	**23**	**134**	**0%**	**1,256**	**0%**
Food mfg	311	361	1%	7,158	1%
Beverage & tobacco product mfg	312	34	0%	679	0%
Textile mills	313	4	0%	40	0%
Textile product mills	314	7	0%	71	0%
Apparel mfg	315	4	0%	40	0%
Leather & allied product mfg	316	2	0%	20	0%
Wood product mfg	321	210	1%	1,104	0%
Paper mfg	322	889	3%	11,121	1%
Printing & related support activities	323	23	0%	255	0%
Petroleum & coal products mfg	324	6,628	24%	329,785	37%
Chemical mfg	325	12,581	45%	250,632	28%
Pharmaceutical & medicine mfg	*3254*	*268*	*1%*	*5,344*	*1%*
All other chemical products	*-3253,3255-*	*12,313*	*44%*	*245,288*	*28%*
Plastics & rubber products mfg	326	177	1%	907	0%
Nonmetallic mineral product mfg	327	596	2%	13,996	2%
Glass & glass product mfg	*3272*	*60*	*0%*	*1,878*	*0%*
Cement & concrete product mfg	*3273*	*462*	*2%*	*9,820*	*1%*
Other minerals	*3271,3274-*	*74*	*0%*	*2,298*	*0%*
Primary metal mfg	331	543	2%	3,905	0%
Iron & steel mills & ferroalloy mfg	*3311*	*66*	*0%*	*1,184*	*0%*
Steel product mfg from purchased steel	*3312*	*44*	*0%*	*789*	*0%*
Alumina and Aluminum	*3313*	*335*	*1%*	*1,390*	*0%*
Nonferrous Metals, except Aluminum	*3314*	*87*	*0%*	*362*	*0%*
Foundries	*3315*	*10*	*0%*	*179*	*0%*
Fabricated metal product mfg	332	331	1%	3,534	0%
Machinery mfg	333	123	0%	802	0%
Computer & electronic product mfg	334	17	0%	45	0%
Electrical equipment, appliance, & component mfg	335	20	0%	95	0%
Transportation equipment mfg	336	248	1%	1,937	0%
Furniture & related product mfg	337	15	0%	164	0%
Miscellaneous mfg	339	49	0%	533	0%
Natural Gas Feedstocks	xx	-	-	108,970	12%
Total Industrial Sector		**28,187**	**100%**	**885,906**	**100%**

B.3. Market Characterization Results

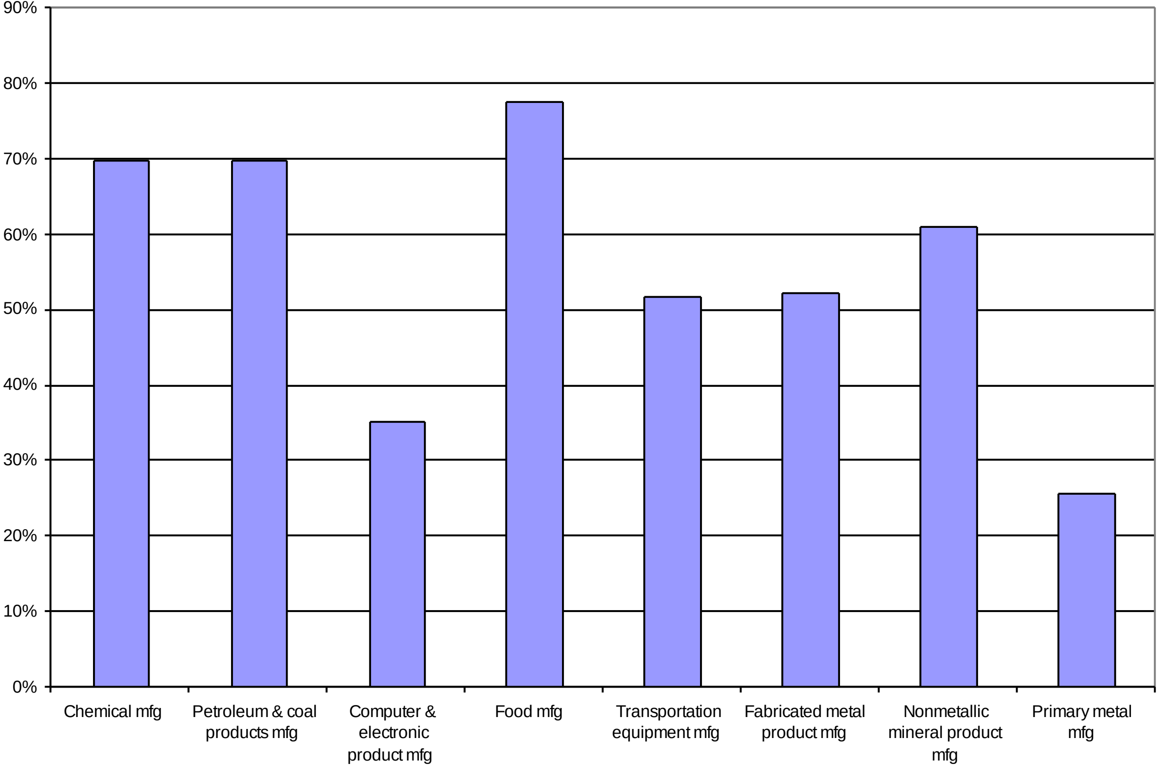
In 2010, Louisiana's industrial sector consumed 28,187 GWh of electricity and 885,906 billion Btus of natural gas. Within the manufacturing subsector, the chemical industry (including natural gas feedstock use) and the petroleum products manufacturing industry were the largest consumers of energy, accounting for 69% of electricity consumption and 77% of natural gas.

Industrial Electricity End Uses

In order to determine the electricity savings for any technology, the fraction of the electricity to which the technology is applicable must be determined. Much of the energy consumed by industry is directly involved in processes required to produce various products. Electricity accounts for about a third of the primary energy used by industries (EIA 2010). It is used for many purposes, the most important being to run motors, provide lighting, provide heating, and drive electrochemical processes.

While detailed end-use data is available only for each manufacturing industry and group through the MECS survey (EIA 2010), motor systems are estimated to consume 60% of the industrial electricity. The fraction of total electricity attributed to motors is presented in Figure B-1.

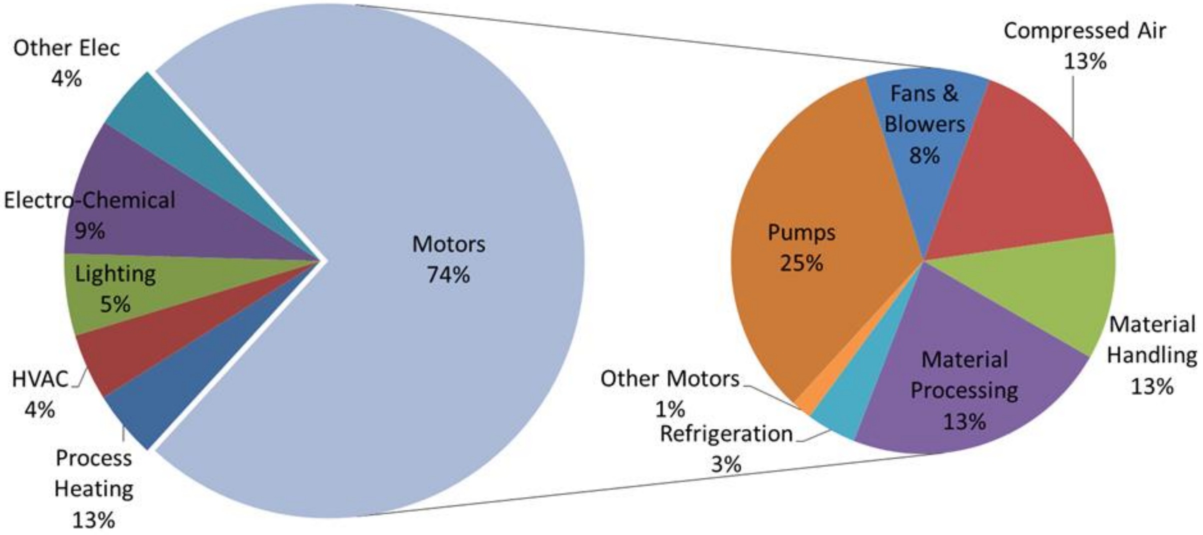
Figure B-1. Percent of Total Electricity Consumption by Motor Systems



Source: XENERGY (1998)

Motors are used for many diverse applications from fluid applications (pumps, fans, and air and refrigeration compressors) to materials handling and processing (conveyors, machine tools, and other processing equipment). The distribution of these motor uses varies significantly by industry, with material processing being the largest consumer in the sector. Figure B-2 shows the total weighted average of end-use electricity consumption in Louisiana with a breakdown of motor use in the state.

Figure B-2. Industrial Electricity End Uses in Louisiana with Breakdown of Industrial Motor System End Uses

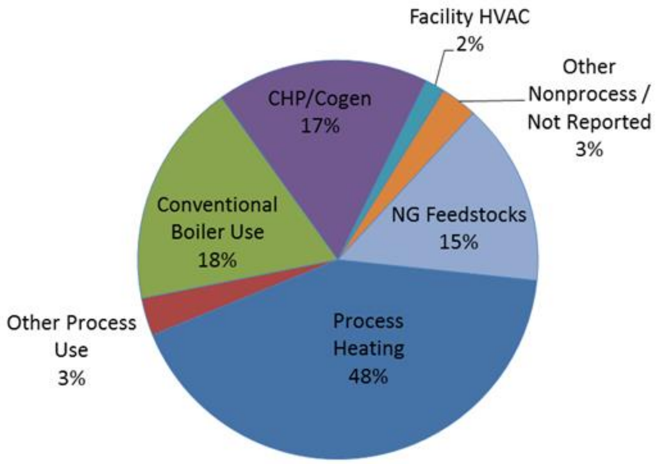


As discussed above, motors make up the majority of industrial electricity use. In Louisiana, this is driven by the large number of pumping systems in the chemical and petroleum industries.

Industrial Natural Gas End Uses

A similar methodology was used to determine industrial natural gas end use. The MECS survey (EIA 2010) provided both end-use categories and nationwide consumption by industry, which was then applied to the actual industry mix in Louisiana. The results are shown below in Figure B-3.

Figure B-3. Industrial Natural Gas End Uses in Louisiana



Direct process heating is responsible for nearly half of natural gas use in Louisiana. The chemical industry uses a significant amount of natural gas as feedstock to make other products, including synthetic gases for other industrial applications, fertilizers, and pharmaceuticals.

B.4. Overview of Efficiency Measures Analyzed

The first step in our technology assessment was to collect limited information on a broad universe of potential technologies. Our key sources of information included DOE, Office of Industrial Technologies; Center for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET); Lawrence Berkeley National Laboratory (LBNL) and American Council for an Energy-Efficient Economy reports; information from NYSERDA; and Itron. We did not collect any primary data on technology performance.

Often, no one source provided all of the information we sought for our assessment (e.g., energy use, energy savings compared with average current technology, investment cost, operating cost savings, lifetime.). We therefore made our best effort to combine readily available information along with expert judgment where necessary.

We sought to identify technologies that could have a large potential impact on saving energy. These may be technologies that are specific to one process or one industry sector, or they may be “cross-cutting” technologies, which are applicable to a variety of sectors. In estimating energy savings, we first identified the specific energy savings of each technology by comparing the energy used by the efficient technology with the energy required by current processes. Our second step was to scale up this savings estimate to see how much energy savings—for industry overall—this technology would achieve. For the most part, we derived specific energy savings information from the various technology assessment studies noted above.

In scaling up the technology-specific energy savings, we relied on our general knowledge of the various industrial processes to which this technology could be applied. We also took into account structural limitations to the penetration of the technology. Additionally, we recognized that market penetration, in the absence of significant policy support, can take time given the slowness of stock turnover in many industrial facilities.

Electricity Measures

We identified 13 measures that were cost-effective at the average projected industrial electricity rates in Louisiana of $0.080/kWh (see Table B-12). The cost and performance of these measures have been examined over the past decade by ACEEE from research into the individual measures and review of past project performance. The cost of many of these measures has increased in recent years as a result of significant increases in the costs of key commodities such as copper, steel, and aluminum, as well as overall manufacturing costs due to energy prices and market pressures. The estimates presented in Table B-12 represent ACEEE's most current estimates. We present the full normalized installed measure cost (i.e., the full cost required to install a measure per unit of saved energy) as well as the levelized cost (i.e., the annual cost of the measure amortized over the life of the measure).

In addition, we estimated the average normalized cost of industrial energy efficiency investments to be $0.017/kWh saved. This cost was arrived at by estimating the sum of the annual incremental savings for each measure in each industry based on end-use energy distribution and dividing the corresponding total investment required.

Table B-2. Cost and Performance of Industrial Electricity Measures

Measure	Measure Life	Cost of Saved Energy		Annual Savings for End Use
		Installed Cost/kWh	Levelized Cost/kWh	
Sensors and Controls	15	$0.145	$0.014	3%
Duct/Pipe Insulation	20	$0.653	$0.052	20%
Electric Supply	15	$0.104	$0.010	3%
Lighting	15	$0.212	$0.020	23%
Advanced Efficient Motors	25	$0.491	$0.035	6%
Motor Management	5	$0.079	$0.018	1%
Lubricants	1	$0.000	$0.000	3%
Motor System Optimization	15	$0.097	$0.009	1%
Compressed Air Manage	1	$0.000	$0.000	17%
Compressed Air –Advanced	15	$0.001	$0.000	4%
Pumps	15	$0.083	$0.008	20%
Fans	15	$0.249	$0.024	6%
Refrigeration	15	$0.034	$0.003	10%

Natural Gas Measures

We identified 35 cost-effective measures at the average projected industrial natural gas rate in Louisiana of $5.24/MMBtu (see Table B-13). The cost and performance of these measures were taken from a 2006 Itron report. We present the full normalized installed measure cost (i.e., the full cost required to install a measure per unit of saved energy) as well as the levelized cost (i.e., the annual cost of the measure amortized over the life of the measure).

We estimated the average normalized cost of industrial energy efficiency investments to be $0.52/MMBtu saved. This estimate was arrived at by estimating the sum of the annual incremental savings for each measure in each industry based on end-use energy distribution and dividing the corresponding total investment required.

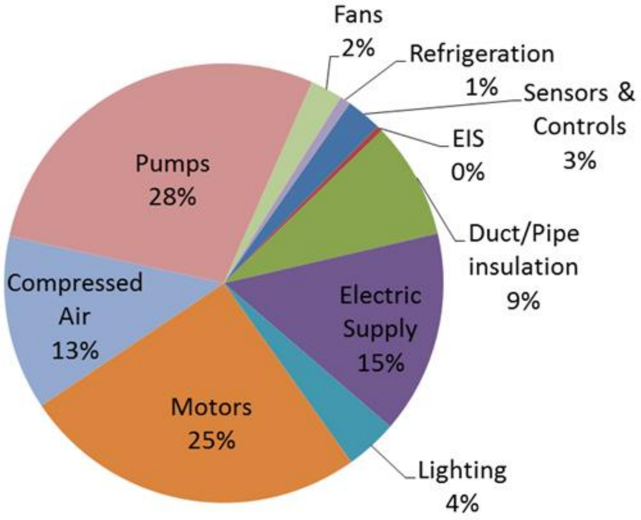
Table B-3. Cost and Performance of Industrial Natural Gas Measures

Measure	Measure Life	Installed Cost ($/MMBtu Saved)	Levelized Cost ($/MMBtu Saved)	Annual Savings for End Use
Boiler Measures				
Improved process control	15	$1.23	$0.12	3%
Maintain boilers	2	$0.02	$0.01	10%
Flue gas heat recovery/economizer	15	$3.48	$0.34	2%
Blowdown steam heat recovery	15	$3.06	$0.29	1%
Upgrade burner efficiency	20	$2.50	$0.20	1%
Water treatment	10	$0.63	$0.08	1%
Load control	15	$1.36	$0.13	4%
Improved insulation	15	$6.55	$0.63	8%
Steam trap maintenance	2	$0.84	$0.45	13%
Automatic steam trap monitoring	15	$3.41	$0.33	5%
Leak repair	2	$0.22	$0.12	4%
Condensate return	15	$9.57	$0.92	10%
HVAC Measures				
Improve ceiling insulation	20	$85.70	$6.88	24%
Install HE(95%) cond. furnace/boiler	20	$37.88	$3.04	18%
Stack heat exchanger	20	$18.41	$1.48	5%
Duct insulation	20	$3.52	$0.28	2%
EMS install	20	$31.79	$2.55	10%
EMS optimization	5	$0.30	$0.07	1%
Process Heat Measures				
Process Controls and Management	8	$3.33	$0.51	5%
Heat Recovery	20	$92.06	$7.39	20%
Efficient burners	10	$14.27	$1.85	18%
Process integration	15	$87.04	$8.39	17%
Efficient drying	20	$61.55	$4.94	17%
Closed hood	15	$34.82	$3.35	5%
Extended nip press	20	$92.59	$7.43	16%
Improved separation processes	20	$26.30	$2.11	10%
Flare gas controls and recovery	15	$87.04	$8.39	50%
Fouling control	5	$1.77	$0.41	7%
Efficient furnaces	20	$13.89	$1.11	6%
Oxyfuel	20	$63.13	$5.07	20%
Batch cullet preheating	15	$27.85	$2.68	16%
Preventative maintenance	5	$0.30	$0.07	2%
Combustion controls	8	$5.32	$0.82	8%
Optimize furnace operations	10	$9.52	$1.23	10%
Insulation/reduce heat losses	15	$29.79	$2.87	5%

B.5. Potential for Energy Savings

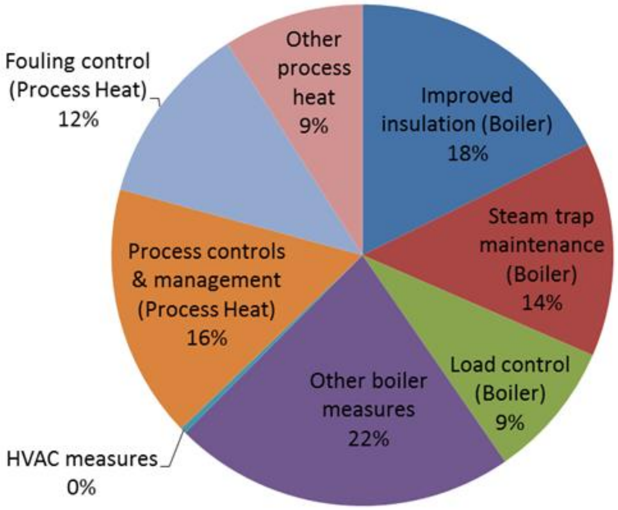
In Louisiana, a diverse set of efficiency measures will provide electricity savings for industry. The application of these measures contributes to total economic electric savings potential of 20%. These savings are distributed as presented in Figure B-4.

Figure B-4. Fraction of Electricity Savings Potential by Measure



The total natural gas savings potential for the state of Louisiana is about 16%. These savings are distributed as presented in Figure B-5.

Figure B-5. Fraction of Natural Gas Savings Potential by Measure



In addition, this analysis did not consider process-specific efficiency measures that would be applied at the individual site level, because available data do not allow this level of analysis. However, based on experience from site assessments by DOE and other entities, we anticipate an additional economic savings of 5–10%, primarily at large energy-intensive manufacturing facilities. Therefore, the overall economic industrial efficiency resource opportunity for electricity and natural gas is on the order of 25–30% and 21–26%, respectively.