Alabama Energy Revolving Loan Fund Market Assessment

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Prepared by the Environmental Finance Center for Abundant Power and the State of Alabama

AUTHORS

CHRISTINE E. BOYLE
MICHAEL CHASNOW
**ABOUT THE ENVIRONMENTAL FINANCE CENTER AT THE UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL**

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The EFC at UNC is dedicated to enhancing the ability of governments to provide environmental programs and services in fair, effective, and financially sustainable ways.

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Environmental Finance Center, School of Government
Knapp-Sanders Building, CB# 3330
University of North Carolina at Chapel Hill
Chapel Hill, NC 27599-3330
Web: www.efc.unc.edu

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EXECUTIVE SUMMARY

The purpose of this Demand Analysis is to help focus the Alabama Energy Revolving Loan Fund rollout in areas of Alabama that have potential high demand for industrial and commercial efficiency upgrade loans, in the range of $250 thousand to $4 million. To locate geographic and sectoral concentrations of demand for energy efficiency upgrades across Alabama, the UNC Environmental Finance Center created a set of metrics and measures to identify key industries and sectors to strategically target marketing campaigns.

This analysis generated several findings to inform the Alabama Energy Revolving Loan Fund rollout, which will be administered by Abundant Power, including:

Alabama’s most energy intensive manufacturers are concentrated in 3 counties: Jefferson, Mobile and Morgan counties. Clusters of four of the highest energy intensive sectors worldwide -- steel production, paper and pulp mills, petroleum refining, and chemical production -- are heavily concentrated in these counties. For example, Jefferson County has twelve steel and iron factories, 27 cement plants, and several aluminum and fabricated metal factories. As noted below, the energy saving potential within these factories present large cost savings for the firms. The relatively low cost of energy in Alabama however, explains some of the locational decision making for these firms, and influences the cost-effectiveness of energy efficiency investments.

Steam generation and motor systems are big energy efficiency opportunities across industries. Taken together, 80% of industrial energy use in industrial manufacturing comes from steam generation and motor systems, and within each of these processes there is considerable room for energy efficiency improvements. The Alabama Energy Revolving Loan Fund should focus on these two key processes, to create consistency across Loan Fund marketing and to help participants make cost-effective energy efficiency improvements.

Iron and steel mills present big cost-savings opportunity. Within the industrial sector, iron and steel mills present very attractive energy savings opportunities. As of 2006, there were 12 such mills in Alabama, and their average annual energy cost came to $4.74 million. Research shows that potential energy savings in the typical iron or steel factory ranges from 30-40%, which, using the more conservative 30% figure, translates to over $1.4 million in annual energy savings for the typical factory.

Shopping malls and scientific laboratories are large sectors in Alabama, with large potential for energy savings. Enclosed retail and laboratories face high average annual energy costs, relative to other commercial subsectors, and present potential for cost-effective energy efficiency gains. 24-7 operations and energy intensive processes drive high energy costs for laboratories, while lighting and HVAC drive high expenditures for enclosed malls.
INTRODUCTION

The recently initiated commercial and industrial energy efficiency loan program for the State of Alabama aims to provide financing solutions for energy efficiency and renewable energy projects. An initial task prior to the loan fund launch is assessing the market for such loans in order to identify industries and geographies in the State of Alabama with high potential demand for the Alabama Energy Revolving Loan Fund. This demand analysis will help guide the ultimate structuring of the Loan Fund Program and will be used as a sales management tool and roadmap for a targeted marketing campaign.

This analysis identifies sectoral clusters with potential high demand for energy efficiency projects, and locates geographies with concentrations of these businesses in Alabama. To accomplish this, we develop metrics to measure business characteristics identified as influencing demand for cost-effective energy efficiency solutions, then cross reference metrics with parcel-level GIS data identifying industrial and commercial businesses statewide. By identifying particular industries in specific counties with demonstrated demand for energy efficiency solutions, the Demand Analysis provides a starting point for targeted sales and marketing campaigns aimed at specific geographies and industries.

The State of Alabama has several unique characteristics that will influence the structuring of the loan fund. First, Alabama’s manufacturing sector, which accounts for 30.4% of the State’s industrial and commercial activity, contains four of the most energy intensive industries worldwide: steel production, paper and pulp mills, petroleum refining, and chemical production. Next, although Alabama recently passed a building energy efficiency policy for new residential and commercial construction (passed March 2010), energy specific codes have yet to be implemented. New building code policy could impact the demand for energy retrofits, making cost-effectiveness all the more important for demand forecasting.

Figure 1: Alabama’s Industrial and Commercial Sector Sizes (Sector Payroll as Percent of Total)

Source: 2008 County Business Profiles, US Economic Census
As part of the ARRA / Stimulus Package portfolio of green energy projects, the Alabama Energy Revolving Loan Fund will be implemented in a relatively short timeframe, and this accompanying analysis provides a rapid and initial assessment for the Revolving Loan Fund, by focusing on identifying demand for energy efficiency loans, in the range of $250 thousand to $4 million. As the Fund begins to penetrate the industrial and commercial markets, additional analysis assessing questions around businesses’ appetite for Energy Revolving Fund loans, will aid in refining the Revolving Loan Fund’s strategic focus. At this point several interesting questions have not been fully answered around the calculus of demand for energy-efficiency loans, such as: What types of businesses are looking to borrow? Will a 2% subsidized interest rate attract businesses and sectors that have not been able to borrow for upgrade projects in the past? What are the target conditions for borrowing capital for retrofit projects (end of equipment life cycle, energy cost speculations, etc)?

**DATA**

This analysis draws from the following data sources:


**STATE OF ALABAMA’S INDUSTRIAL MARKET FOR ENERGY EFFICIENCY RETROFITS AND RENEWABLE ENERGY LOANS**

A large manufacturing base in Alabama presents a diverse market for achieving energy efficiency gains. Recent studies have found that energy intensity for four of Alabama’s top 20 most energy intensive subsectors is at least 50% higher than the theoretical minimum. Given the large concentration of energy intensive manufacturing in Alabama including steel production, paper and pulp mills, petroleum refining, and chemical production, at what point are energy efficiency upgrades the cost-effective solution for Alabama’s factories? In this section, we identify and locate clusters of energy intensive manufacturers in Alabama, then provide a costing effectiveness framework to evaluate potential loan recipients, based on energy usage characteristics.

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2 Additional loan criteria include a company’s financials and credit-worthiness. In this report’s appendix is a list of contact details and credit scores for 500 businesses within the identified ‘high potential demand’ NAICS codes.
Methodology
To identify concentrations of high energy intensity manufacturers in Alabama, and potential loan recipients, we used several data sources to measure Alabama's top 10 manufacturing subsectors, and their energy intensity and geographic concentration at the county level. We followed these steps:

1) Categorize and rank Alabama's top 10 manufacturing subsectors by NAICS codes using the 2002 Economic Census;
2) Calculate each subsector's energy intensity ratio by dividing [net electricity, 1,000 kWh (purchased + generated-sold in 2006)] by [Value of product shipments, 2006]. This produces an energy intensity ratio, per subsector, ranging from 1.14 to 0.03. We define a high energy intensity ratio as greater than or equal to 0.2634.
3) Using the Reference USA database of all businesses in Alabama, we locate concentrations of energy intensive subsectors per county for the state.
4) Load energy intensity per subsector concentrations into GIS county shape files to create a map of high energy intensity manufacturers in Alabama.

FIGURE 2. ENERGY INTENSITY CALCULATIONS FOR TOP 10 MANUFACTURING SUBSECTORS IN ALABAMA -- SORTED BY ENERGY INTENSITY RATIO (HIGH TO LOW)

<table>
<thead>
<tr>
<th>NAICS-based code</th>
<th>Meaning of NAICS-based code</th>
<th>Net Electricity Usage (1,000 kWh)</th>
<th>Value of Product Shipments ($1,000)</th>
<th>Energy Intensity Ratio</th>
<th>Number of Establishments</th>
<th>Annual Energy Cost per Establishment*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3221</td>
<td>Pulp, paper, &amp; paperboard mills:</td>
<td>89,020,152</td>
<td>77,853,819</td>
<td>1.143</td>
<td>18</td>
<td>4,945,564</td>
</tr>
<tr>
<td>3313</td>
<td>Aluminum production &amp; processing:</td>
<td>38,274,383</td>
<td>40,794,590</td>
<td>0.938</td>
<td>15</td>
<td>2,551,626</td>
</tr>
<tr>
<td>3251</td>
<td>Basic chemical mfg:</td>
<td>115,443,942</td>
<td>184,495,077</td>
<td>0.626</td>
<td>64</td>
<td>1,803,812</td>
</tr>
<tr>
<td>3311</td>
<td>Iron &amp; steel mills &amp; ferroalloy mfg:</td>
<td>56,855,980</td>
<td>92,505,356</td>
<td>0.615</td>
<td>12</td>
<td>4,737,998</td>
</tr>
<tr>
<td>3315</td>
<td>Foundries:</td>
<td>17,901,268</td>
<td>32,696,561</td>
<td>0.547</td>
<td>65</td>
<td>275,404</td>
</tr>
<tr>
<td>3252</td>
<td>Resin, syn rubber, &amp; filaments mfg:</td>
<td>39,677,454</td>
<td>93,499,662</td>
<td>0.424</td>
<td>22</td>
<td>1,803,521</td>
</tr>
<tr>
<td>3211</td>
<td>Sawmills &amp; wood preservation:</td>
<td>10,139,069</td>
<td>30,800,982</td>
<td>0.329</td>
<td>138</td>
<td>73,472</td>
</tr>
<tr>
<td>3261</td>
<td>Plastics product mfg:</td>
<td>55,220,105</td>
<td>168,377,407</td>
<td>0.328</td>
<td>154</td>
<td>358,572</td>
</tr>
<tr>
<td>3273</td>
<td>Cement &amp; concrete product mfg:</td>
<td>19,066,017</td>
<td>61,098,112</td>
<td>0.312</td>
<td>229</td>
<td>83,258</td>
</tr>
<tr>
<td>3262</td>
<td>Rubber product mfg:</td>
<td>9,492,204</td>
<td>35,118,668</td>
<td>0.270</td>
<td>55</td>
<td>172,586</td>
</tr>
</tbody>
</table>


*Using 2010 average electricity price for Alabama's industrial sector

http://www.eia.doe.gov/electricity/epm/table5_6_b.html
Geographic Concentrations of *High Energy Intensity* Industries in Alabama

Based on the methodology described above, we develop a map locating counties in Alabama where *High Energy Intensity Manufacturing* subsectors are located. When viewing this map (see Page 7), look for the red and orange colored counties, indicating high numbers of Energy Intensive factories and plants. The primary high energy intensity manufacturing clusters in the counties are as follows:

**Jefferson County:** Aluminum production (15), cement production (27), steel and iron factories (12)

**Mobile County:** Chemical manufacturing (15), wood preservation (20), paper and pulp factories (2)

**Morgan County:** Chemical manufacturing (8)
**Number of High Energy Intensity Manufacturers in Alabama**

**Legend**
- 0 - 16
- 17 - 33
- 34 - 50
- 51 - 68
- 69 - 84

**METHODOLOGY:**
This map displays the count by county of businesses with an "energy intensity" (EI) ratio greater than or equal to 0.2634. An EI ratio was calculated by dividing the net electricity consumed by the value of product shipments for 2008 of Alabama's 21 industries with the highest value of product shipments. The 11 industries with the highest EI ratios are included in the count shown on this map. The three industries with the highest EI ratios were: Pulp, paper, & paperboard mills (1.1434); Alumina & aluminum production & processing (0.9382); and, Basic chemical mfg (0.6257). Source: DOE-EIA (2008) Economic Census Industry Series

**Concentration of High Energy Intensity Manufacturers in Alabama**

The municipal limits of cities with population >= 35,000 are shown.

The three counties with the highest concentrations are labeled.
Industrial Upgrades and Project Potential

In 2006, the International Energy Agency found that “the energy intensity of most industrial processes is at least 50% higher than the theoretical minimum”. Using more direct language, this means energy efficiency upgrades have considerable potential to reduce industrial manufacturing energy costs, saving companies many thousands of dollars while also reducing CO₂ and other GHG emissions. Some technologies are broadly applicable across multiple industries. In the following section, we first outline these general upgrade opportunities. Then, our analysis hones in on energy efficiency upgrades specific to target industries within Alabama.

General upgrade opportunities: Motor systems and steam generation

65% of the energy used by industrial manufacturers comes from the use of motors systems, and there are several upgrades that can increase the efficiency of motor-driven systems, saving companies 20-30% of energy consumption from motor systems. Key motor system upgrades include the following:

- Reduction of losses in motor windings
- Use of better magnetic steel
- Improved aerodynamics of the motor
- Improved manufacturing tolerances

15% of industrial energy use comes from steam generation. The efficiency of current steam boilers can be as high as 85%, but many steam boilers, especially older ones, possess lower efficiency levels in the 55-70% range. Increasing efficiency of steam boilers can yield energy savings potential of up to 18-20%, through improvements including:

- General maintenance
- Improved insulation
- Combustion controls and leak repair
- Improved steam traps
- Condensate recovery

Top target industries within Alabama

As Figure 2 on Page 5 demonstrates, there are multiple industries within Alabama with high annual energy costs that could benefit from energy efficiency upgrades. However, when initially rolling out the Revolving Loan Fund program, it is important to focus on specific manufacturing subsectors that have the greatest potential to benefit from energy efficiency upgrades, specifically:

Pulp, Paper, & Paperboard Mills (average annual energy cost of $4.95 million per factory)

Although fossil fuel use by the U.S. pulp and paper industry declined by more than 50% between 1972 and 2002, cost-effective measures have the potential to decrease energy use by another 14%. Also, the pulp and paper industry consumes large amounts of motor power and steam, and therefore the measures noted in the General upgrade opportunities section directly apply. Energy efficiency measures specific to the industry include:

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4 ibid
5 ibid
Energy efficiency improvements (e.g., motor systems, steam generation)
- Increased use of (self-generated) biomass fuel
- Co-generation
- Increased recycling of recovered paper

**Iron & Steel Mills (average annual energy cost of $4.74 million)**

Benchmarking energy efficiency of steel production to best practice performance, Kim and Worrell found that energy efficiency could be improved by 30-40% in the typical U.S. factory. A 30% reduction in energy use would translate to a little more than $1.42 million in annual energy savings for the typical factory in Alabama, which could be very beneficial to iron and steel mills’ operating margins. There are many possible levels of retrofitting, due to a range of factors including fuel mix and age/type of technology used. That said, common efforts to improve energy efficiency include:

- Increasing recovery of waste energy and process gases
- Enhancing continuous production processes to reduce heat loss
- Designing more efficient electric arc furnaces (e.g., scrap preheating, high-capacity furnaces, and foamy slagging)

**Aluminum Production & Processing (average annual energy cost of $2.55 million)**

Improving aluminum smelter technology and recycling capacity are the two best ways to improve energy efficiency specific to the aluminum production process. However, aluminum smelter retrofits are a large capital investment, and typically such changes are only made if new technology decreases ongoing costs per ton of metal production in a cost-effective manner, within the energy efficiency part of this calculation.

**Basic Chemical Manufacturing (average annual energy cost of $1.8 million)**

General upgrades, including steam generation and heating, cooling and process integration (HCP), offer large opportunities for energy efficiency savings (about 30% of the total opportunity). Moreover, there are process specific measures that could reduce energy use, including:

<table>
<thead>
<tr>
<th>Process</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethylene</strong></td>
<td>More selective furnace coils</td>
</tr>
<tr>
<td></td>
<td>Improved transfer line exchangers</td>
</tr>
<tr>
<td></td>
<td>Increased efficiency cracking furnaces</td>
</tr>
<tr>
<td><strong>Polymers</strong></td>
<td>Low pressure steam recovery</td>
</tr>
<tr>
<td></td>
<td>Online compounding extrusion</td>
</tr>
<tr>
<td></td>
<td>Re-use solvents, oils and catalysts</td>
</tr>
</tbody>
</table>


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STATE OF ALABAMA’S COMMERCIAL MARKET FOR ENERGY EFFICIENCY RETROFITS AND RENEWABLE ENERGY LOANS

Similar to the commercial sector nationwide, Alabama’s commercial businesses represent a wide array of business types and sizes, with a large range of commercial retrofit possibilities. Major commercial end-uses for energy such as space heating and cooling, water heating and lighting, are covered by federal efficiency standards, however Alabama has yet to implement state–level commercial building efficiency codes. At the point where Alabama does implement such codes, demand for retrofit upgrade financing could increase.

Within the fragmented and diverse commercial market, two main obstacles threaten to constrain the energy upgrade and building retrofit market:

- In a landlord-tenant relationship, the energy payer (tenant) has a separate incentive from the energy equipment investor (landlord). This dynamic presents a disincentive for capital improvements (as the landlord does not pay the energy bill). An exception to this case may be when a landlord or property manager is looking to distinguish themselves in the marketplace by developing a niche-green or energy efficient commercial space.

- Another potential obstacle is a lack of specialized expertise in the buildings and construction industry around energy retrofits. As energy–efficient construction is relatively new for Alabama, architects, engineers, builders and trades people may have limited access to training in new technologies, standards, regulations, and best practices. As part of the Alabama Energy Revolving Loan Fund program administration, Abundant Power will address this obstacle by building capacity in the green building sector by bringing in energy auditors and engineers, and developing workforce training programs for retrofits.

Alabama’s largest commercial subsectors are professional & scientific services and retail, comprising 17.8% of the state’s commercial sector. Across these subsectors, commercial appliance upgrades and HVAC retrofits are seen as being two of the most cost-effective strategies for cutting energy costs and curbing carbon emissions. Based on the average floor size and operational practices of the two subsectors, we calculate the energy intensity and estimate average annual energy usage within the two subsectors, and find the following:

- Enclosed retail (shopping malls) face high average annual energy costs, relative to other commercial subsectors, and present large potential for cost-effective energy efficiency gains. Lighting and HVAC drive high annual energy expenditures for enclosed malls.

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8 Murtishaw, Scott and Jayant Sathaye (2006) Quantifying the Effect of the Principal-Agent Problem on US Residential Energy Use
10 We also consider the health care industry, comprising 15.5% of Alabama’s commercial sector. We consider health care separately from retail and laboratories as health care has both public and private owners. Only private health care facilities will be eligible for the Alabama Energy Revolving Loan Fund Program.
Retail, other than malls, and offices have smaller building envelopes and thus represent smaller retrofit potential per project, but in aggregate, represent a large market share. Retail and offices are also competitive marketplaces, where property managers may be looking to distinguish their commercial space by retrofitting for the ‘Green Building’ niche in the property-leasing market.

Large scientific centers in Huntsville and Birmingham have the requisite size and energy intensity to be strong candidates for Alabama’s Energy Revolving Loan Fund.

Private healthcare facilities present an additional opportunity for energy cost savings and energy retro-fit loans.

**Figure 3. Commercial Buildings’ Energy Usage Characteristics in the Southeast**

<table>
<thead>
<tr>
<th></th>
<th>Total floor space in region (sq ft)</th>
<th>Average unit size (sq ft / unit)</th>
<th>Energy Intensity (annual kwh per unit)</th>
<th>Annual Energy Expenditures per unit$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Healthcare</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inpatient facilities</td>
<td>134,247,820</td>
<td>223,735</td>
<td>6,570,951</td>
<td>$664,980</td>
</tr>
<tr>
<td>outpatient facilities</td>
<td>84,302,985</td>
<td>8,000</td>
<td>127,972</td>
<td>$12,951</td>
</tr>
<tr>
<td>nursing homes</td>
<td>61,119,580</td>
<td>74,425</td>
<td>1,530,775</td>
<td>$154,914</td>
</tr>
<tr>
<td><strong>Retail</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>strip malls</td>
<td>269,245,589</td>
<td>21,959</td>
<td>518,666</td>
<td>$52,489</td>
</tr>
<tr>
<td>enclosed malls</td>
<td>56,130,174</td>
<td>279,338</td>
<td>5,056,676</td>
<td>$511,736</td>
</tr>
<tr>
<td>retail, other than a mall</td>
<td>352,667,803</td>
<td>8,399</td>
<td>100,312</td>
<td>$10,152</td>
</tr>
<tr>
<td><strong>Professional and Scientific Services</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>offices</td>
<td>481,154,716</td>
<td>11,595</td>
<td>218,426</td>
<td>$22,105</td>
</tr>
<tr>
<td>laboratories</td>
<td>29,601,440</td>
<td>13,132</td>
<td>1,014,116</td>
<td>$102,629</td>
</tr>
</tbody>
</table>


Notes: $^a$ these three subsectors fall under commercial sector, and therefore we apply 2010 commercial electricity prices in Alabama, to estimate average per unit electricity expenditures. Actual energy usage profiles may use a range of power sources, with a range of prices. Estimates presented here: 1) give a ballpark estimate of annual energy expenditures per subsector, and 2) allow for a relative ranking of energy intensities and annual energy expenditures for Alabama’s largest commercial subsectors. Classifications of subsectors are made according to the DOE-EIA classification system, based on NAICS codes.
KEY FINDINGS

Alabama’s most energy intensive manufacturers are concentrated in 3 counties: Jefferson, Mobile and Morgan counties. Clusters of four of the highest energy intensive sectors worldwide - steel production, paper and pulp mills, petroleum refining, and chemical production -- are heavily concentrated in these counties. For example, Jefferson County has twelve steel and iron factories, 27 cement plants, and several aluminum and fabricated metal factories. As noted below, the energy saving potential within these factories present large cost savings for the firms. The relatively low cost of energy in Alabama however, explains some of the locational decision making for these firms, and influences the cost-effectiveness of energy efficiency investments.

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