CharlestonWISE Market Assessment

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Prepared by the Environmental Finance Center for the City of Charleston, SC

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About the Environmental Finance Center at the University of North Carolina, Chapel Hill

The Environmental Finance Center is part of a network of university-based centers that work on environmental issues, including water resources, solid waste management, energy, and land conservation. The EFC at UNC partners with organizations across the United States to assist communities, provide training and policy analysis services, and disseminate tools and research on a variety of environmental finance and policy topics.

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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EXECUTIVE SUMMARY

Key findings from the analysis:

Retail space, shopping centers, and office buildings have high cost-savings potential through energy-efficiency upgrades
These three commercial subsectors in Charleston have been identified as prime targets for energy efficiency upgrades based on the large share of building stock these subsectors occupy as well as their high annual energy expenditures. Low-cost efficiency upgrades that are specific to retail space, shopping centers, and office buildings include adopting new lighting technologies, upgrading buildings' thermal envelopes, and HVAC system updates.

Food sales and food service industries provide a large opportunity for improved efficiency and a multi-pronged financing approach
Charleston's large food service and sales sector show large room for energy-efficiency gains and presents a unique opportunity for a program targeting both restaurant operators and property owners for energy financing. Although the majority of energy used in food sales and service is generated by refrigeration, energy for HVAC amounts to 29% of restaurants' average end use. Targeting restaurant property owners for HVAC and thermal envelope efficiency loan packages presents an opportunity to design and market low operating cost, "green-niche" restaurant spaces, while a rebate program for energy-efficient refrigerators will appeal to restaurant operators.

Focus industrial loan program on the organic chemical and pharmaceutical manufacturing cluster.
Annual energy costs for Charleston's 8 chemical and pharmaceutical manufacturing plants average $1.6 million per year. As the U.S. pharmaceutical industry looks to reduce energy consumption in a cost-effective manner, proving large scale rebate and energy efficiency financing mechanisms presents an attractive economic development incentive to grow this burgeoning sector in Charleston.

Charleston's religious organizations present a large opportunity for a focused marketing and energy efficiency finance program.
With over 260 religious organizations within the County, religious leaders across Charleston have expressed interest in integrating energy efficiency into both facilities upgrades and their respective organizational missions. Given the unique characteristics of religious communities, in terms of their outreach potential and their high likelihood of investing in building renovations, developing energy efficiency packages and financial mechanism congregation presents a great channel through which to promote CharlestonWISE and reach a large and diverse market.

Marketing efforts directed towards commercial businesses need to make the "business case" for investments in energy-efficiency
Sell energy-efficiency improvements by showing property owners the reduced energy costs that result from efficient buildings and processes. Other selling points for efficiency upgrades include: reputational advantage in the "green–niche" market, higher tenant retention, and improved productivity.

INTRODUCTION

The CharlestonWISE Energy Efficiency Program, referred to as the CharlestonWISE Program in this report**,** for the City of Charleston is a municipal energy-efficiency pilot program that coordinates the energy improvement transaction process, offers low interest rate financing options, as well as provides material and equipment rebates and other incentives to households and commercial and institutional entities. Assessing the market for energy-efficiency upgrades prior to launching the program helps administrators identify subsectors and geographies with high potential demand for energy-efficiency upgrade financing and rebate packages. This Market Assessment will help guide the ultimate structuring of the CharlestonWISE Program and will be used as a sales management tool for a targeted marketing campaign.

This Market Assessment first measures structural and financial characteristics that influence demand for cost-effective energy-efficiency solutions in Charleston's commercial, religious, and industrial sectors. It then details the energy-efficiency upgrade project potential for each sector. By identifying particular property types and subsectors with demonstrated demand for energy-efficiency solutions, the Market Assessment provides a starting point for efforts to market the plan to specific geographies and subsectors within Charleston. A separate market assessment for Charleston's residential sector was completed in August 2010.

In the Appendix to this report is a listing of companies within each of the high-energy intensity clusters identified. This listing is compiled from the Reference USA database and includes size, contact details, and a credit rating score for each business. The credit rating scores are based on business firmographic factors and provide a rough assessment of each firm's probable ability to pay for capital investments. This listing is provided to guide the CharlestonWISE sales team in targeting firms with both energy-saving potential and ability to repay a loan.

Charleston has high concentrations of commercial and religious buildings, with a smaller number of industrial buildings. Sector-specific market assessments can be found on the following pages:

Table 1 Breakdown of non-residential parcels inside and outside of Charleston, SC city limits

Location	Number of commercial parcels				Number of religious organizations[a]	Number of industrial parcels
	office space	restaurants and food sales	retail	other commercial	all	all
Inside city limits	1,087	377	1,129	5,106	262	49
Within county, outside city	256	116	287	2,466		30
	1,343	**493**	**1,416**	**7,572**	**262**	**79**

Data source: Charleston County Assessor's Office (2010) *Parcel-level data for Charleston County;*

[a] Data from American Factfinder 2009, US Cnensus, only available at the county level.

COMMERCIAL MARKET ASSESSMENT

Overview

Commercial buildings in South Carolina fall under the 2006 International Energy Conservation Code (IECC) that mandates baseline levels of energy-efficiency. The role of energy-efficiency in commercial businesses, however, goes beyond state mandates or a building's environmental footprint. The business case for energy-efficiency and renewable-energy retrofits includes the following cost-effective reasons to invest:[1]

- Reduced operating costs through energy savings
- Increased reputational advantage in the "green–niche" market
- Creation of new markets and economic expansion
- Stronger tenant retention, leading to lower vacancy and turnover rates
- Mitigated business risk associated with energy price volatility

Promotion of financing mechanisms for energy-efficiency loans should address the business incentives of energy efficient investments for commercial buildings.

Methodology

To identify the potential market for energy-efficiency upgrade financing in the City of Charleston's commercial sector, we used a variety of data sources. Parcel tax data was used to analyze the saturation of each subsector in Charleston. The U.S. Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) was used to assign energy intensities to each subsector. Lastly, retail prices to commercial customers for electricity were obtained from U.S. Energy Information Administration databases. For the calculation of energy intensities and ranking of subsectors, the following methodology was used:

1) Using heated-area square footage and heating fuel type data for commercial parcels, we assigned an energy intensity index based on the 2003 CBECS end-use energy consumption tables.
2) Next we created an energy-dollar intensity for each subsector by multiplying U.S. EIA energy price information by the CBECS energy-intensity index for the type of fuel used at each commercial parcel.
3) Then we aggregated each parcel into one of 34 subsectors based on parcel data use codes, and 8 larger sectors based on CBECS principal building activities. We then calculated annual energy expenditures per sector, subsector, and unit to illustrate the commercial building composition and energy use in Charleston.
4) Lastly we grouped and ranked subsectors in terms of annual energy expenditures to ascertain the ones most likely to respond to cost savings from energy-efficiency investments.

[1] U.S. Department of Energy: Energy-efficiency and Renewable Energy. "Energy-efficiency Trends in Residential and Commercial Buildings." October 2008.

Overview of Commercial Building Composition in Charleston

Charleston's commercial building sector contains a diverse stock of buildings and subsectors – with multiple opportunities for energy efficiency retrofits and improvements which require a variety of financing and rebate mechanisms. Table 2 presents a summary of building characteristics for parcels that are classified as commercial by the primary use code of the facility by the Charleston parcel level data. Using these data, building characteristics within a land-use group are determined to assess which subsectors would be most likely to invest in energy-cost reductions.

Table 2: Premise-level characteristics of commercial buildings in Charleston, SC

Premise Level Characteristics							
	Heating/Cooling System						
	Forced Air	Heat Pump	None	Other	Average Number of Floors	Average Build Year	Average Value
Retail	16%	49%	13%	22%	1.25	1978	$84,225
Shopping Centers	13%	55%	1%	31%	1.04	1989	$496,828
Office Space	12%	64%	7%	18%	1.48	1973	$86,706
Service	11%	38%	19%	32%	1.07	1983	$32,438
Warehouses/storage	6%	32%	45%	17%	1.06	1989	$116,250
Food Sales/service	21%	42%	4%	32%	1.10	1985	$65,806
Lodging	21%	47%	3%	29%	2.40	1975	$440,495
Other Commercial	7%	40%	4%	48%	1.16	1987	$71,218

Source: Charleston County Tax Parcel Data, 2010

One way to assess potential response and uptake of energy efficiency and retrofit programs is to look at the structural characteristics of the building stock. Table 2 lists building characteristics within each subsector, such as the average number of floors, average build year, and average tax value of commercial property in Charleston. For all subsectors except lodging, the average number of floors is between 1 and 2, an indication that the majority of commercial property in Charleston is comprised of small, single-level units. Further, most buildings in the commercial sector were built prior to 1990, and over 150 buildings were built before 1900! Commercial property constructed over 20 years ago is likely to contain outdated lighting, aging HVAC systems, and failing building envelope technology (i.e. windows, roofs).[2] Designing energy retrofit upgrade packages and equipment rebate offers specific to Charleston's unique subsectors will be key factors in developing a successful CharlestonWISE Program.

[2] Urban Land Institute. *New Tools. New Rules. Climate Change, Land Use, and Energy 2010*.

Table 3: Percentages of electricity end-uses for commercial building subsectors

Percentages of Electricity End-uses for Commercial Building Categories										
	Space Heating	Cooling	Ventilation	Water Heating	Lighting	Cooking	Refrigeration	Office Equipment	Computers	Other
Retail										
Other than Mall	3%	11%	8%	2%	53%		10%	2%	2%	10%
Enclosed/Strip Malls	10%	16%	10%	7%	38%	1%	5%	1%	1%	12%
Office Space										
All Office Buildings	5%	14%	9%	1%	39%		5%	4%	10%	13%
Service										
All Service	5%	9%	16%		41%		7%		2%	18%
Warehouses/storage										
All Warehouse/Storage	1%	6%	8%	1%	54%		14%	1%	1%	13%
Food Sales/service										
Food Sales	3%	7%	3%		23%	2%	57%	2%	2%	5%
Food Service	5%	13%	11%	5%	19%	6%	32%		2%	6%
Lodging										
All Lodging	6%	10%	6%	4%	52%	1%	4%		3%	10%
Religious Worship										
All Religious Worship	6%	17%	11%		28%		11%			28%
South Atlantic										
All Commercial Buildings	*4%*	*18%*	*11%*	*4%*	*36%*	*1%*	*11%*	*2%*	*4%*	*10%*

Source: EIA Commercial Building Energy Consumption Survey (Table E5A)

Table 3 presents data from the Energy Information Administration's Commercial Buildings Energy Consumption Survey (CBECS) to profile the end-uses of electricity in different types of commercial buildings. In analyzing these data it becomes clear that specific types of energy efficiency retrofits and improvements can be tailored to subsectors that devote a high proportion of energy to a specific use.

A prominent end-use of electricity in commercial buildings includes cooling and ventilation, especially for areas in the South Atlantic region, like Charleston. Such data indicate that energy efficiency upgrades for HVAC systems have large potential to increase energy-cost savings.

Lighting comprises the proportionally highest end-use of electricity in commercial buildings for all subsectors except food sales and food service. A piece-by-piece or whole-building energy-efficiency package for commercial buildings in Charleston should include a rebate or other financing mechanism to upgrade lighting fixtures.

Within Charleston, the food industry has particular characteristics that warrant a particular focus in energy efficiency improvements. The food sales and food service subsectors use a large amount of energy for refrigeration to keep food products cold. By adopting efficient refrigeration appliances, the food industry has the potential to reap large energy-cost savings.

Commercial Targets and Upgrade Project Potential

Top Target Commercial Subsectors in Charleston

Charleston's commercial properties, while diverse, also share common features that an energy efficiency program should target to be most effective. According to the report, "Untapped Potential of Commercial Buildings, Energy Use and Emissions," commercial buildings can realize no or low-cost energy savings by adopting climate controls and new equipment, updating lighting fixtures, implementing changes to the building's thermal envelope and HVAC system, as well as promoting behavioral changes with regards to energy use. The most effective program would be one that targets all of these efficiency upgrades within a comprehensive program tailored to the particular features of each commercial subsector.

Top commercial subsectors in Charleston are: shopping centers, office space, service, warehouses and storage, food sales and service, and lodging. Based the methodology mentioned previously, Table 4 lists the number of units of each commercial subsector in Charleston, the average unit size, the total floor space within the city, the energy-dollar intensity of using electricity for each type of building, and an estimate of the annual energy expenditures for each primary building use and subsector as a whole. Using these metrics, retail buildings, shopping centers, and office space display the highest annual energy expenditures in the City of Charleston. Further, food sales and service display a relatively modest overall annual energy bill, but the energy-intensity within this sector exceeds that of all other commercial building uses.

Table 4: Estimated energy intensity and expenditures by commercial building use

	Number of Units[1]	Average Unit Size[1]	Total Floor Space in Charleston[1]	Energy-Dollar Intensity[2,3]	Annual Energy Expenditures per unit	Group Total Annual Expenditures
		(SQ FT)	(SQ FT)	($ / SQ FT)	($/unit)	($)
Retail						
Misc. Retail	1,416	3,923	5,554,389	$1.13	$4,431	
Building Material	123	21,749	2,675,118	$1.76	$38,315	
Big Box Retail	17	121,856	2,071,545	$1.76	$214,673	
Department Stores	24	46,893	1,125,441	$1.76	$82,612	
Category Retail	76	12,835	975,426	$1.13	$14,499	
Drug Retail	30	10,707	321,212	$1.13	$12,096	**$18,084,491**
Shopping Centers						
Community SC	229	24,512	5,613,147	$1.13	$27,691	
Neighborhood SC	204	12,995	2,650,882	$1.13	$14,680	
Regional SC	34	59,294	2,016,012	$1.13	$66,985	**$11,613,362**
Office Space						
Small Office Building	1,216	2,871	3,490,759	$1.37	$3,923	
Large Office Building	151	22,253	3,360,158	$1.37	$30,413	**$9,363,148**
Warehouses/storage						
Large Warehouse/Storage	521	24,007	12,507,508	$0.60	$14,414	
Mini Warehouse	359	6,466	2,321,187	$0.60	$3,882	**$8,903,148**
Food Sales/service						
Fast Food	317	3,277	1,038,963	$3.03	$9,943	
Restaurants	176	3,917	689,309	$3.03	$11,881	
Grocery Stores	47	18,836	885,275	$3.90	$73,508	**$8,697,760**
LODGING						
Hotels	329	14,300	4,704,589	$1.07	$15,251	**$5,017,444**

Sources: 1 -- Charleston Tax Parcel Data, 2 -- EIA Commercial Building Energy Consumption Survey (Table E6A), 3 -- EIA Retail electricity price to customers (http://www.eia.gov/cneaf/electricity/epm/epmxlfile5_3.xls)

Retail and Office Space Cluster

1) Large retail (annual energy cost: $61,104 per building); 2) Shopping centers (annual energy cost: $36, 102 per building); 3) Office buildings (annual energy cost: $17,168 per building).

These building uses are grouped together because they have similar features. Large retail buildings, shopping centers, and office buildings are composed of big box retail stores, department stores, regional shopping centers, and large office buildings with three floors or more. These buildings are relatively small in quantity in the City of Charleston, but each individual unit is very large. This results in a very high energy bill per building (ranging on average from $215k/year for big box retail to $30k/year for large office buildings). Thus, these large-scale operations are likely to benefit significantly from energy efficiency improvements in terms of energy-cost reductions.

Upgrade Recommendations: Retail, Shopping Centers, and Office Buildings:

Upgrading outdated heating, ventilation, and air conditioning (HVAC) systems in commercial buildings can improve HVAC system performance as well as decrease energy bills. For example, Energy Star certified HVAC products use up to 20% less energy per year than conventional models.[3]

A building's thermal envelope makes up the barrier between its internal and external space – its composition directly affects the efficiency of a building's heating and cooling system. In Charleston's retail, shopping centers, and office buildings upgrading building insulation to DOE's recommended levels could produce up to a 30% reduction in energy costs.

Installing electronic ballasts, as opposed to traditional magnetic ballasts found in fluorescent lights, can produce a 30% increase in energy-efficiency in retail, shopping centers, and office buildings.[4] Currently, electronic ballasts saturate the lighting market, but older buildings that have not yet implemented them could see drastic energy cost savings. Further, compact fluorescent light bulbs and LED exit signs are low-cost upgrades that possess significant energy savings.

Lastly, changing the way energy is used in commercial buildings can lead to significant reductions in energy costs. Improving climate-control equipment and ensuring that systems are installed properly can improve the use of energy for the City of Charleston's commercial buildings. For example, the use of occupancy-sensor lighting systems can reduce lighting costs in office buildings by up to 45%.[5]

[3] *Energy Star for Light Commercial HVAC: Fact Sheet for Building Owners and Property Managers*. (Last Accessed 8/23/11: http://www.energystar.gov/ia/partners/manuf_res/LCHVACFS3.pdf)

[4] U.S. Department of Energy: Energy-efficiency and Renewable Energy. "Energy-efficiency Trends in Residential and Commercial Buildings." October 2008.

[5] *Collaborative Economics for Next 10*. "Untapped Potential of Commercial Buildings, Energy Use and Emissions. 2010

Food Sales and Service Cluster

1) Fast food and restaurants (annual energy cost: $10,912 per building); 2) Grocery stores (annual energy cost: $73,508 per building).

Food sales and service is singled out because of this group's high energy-dollar intensity relative to that of other commercial buildings. This group is comprised of fast food service, restaurants, and grocery stores. There are many relatively small fast food buildings and restaurants in the City of Charleston. On average, a restaurant in Charleston pays an annual energy bill ranging from $10,000 to $12,000. There are also a small number of grocery stores in Charleston that have larger average annual energy bills (roughly $73,500). These stores illustrate potential for larger energy efficiency investments -- and larger energy cost-savings.

Upgrade Recommendations: Food Sales and Service

Charleston's large food service and sales sector show large room for energy-efficiency gains and presents a unique opportunity for a program targeting both restaurant operators and property owners for energy financing.

In addition to the previous recommendations that can be applied generally to all commercial buildings, the EPA best practices for food sales and service include the following five steps for restaurant operators:

- Install compact fluorescent lamps,
- Install a high-efficiency pre-rinse spray valve,
- Fix water leaks immediately,
- Perform walk-in refrigerator maintenance, and
- Replace worn-out cooking and refrigeration equipment.[6]

To illustrate the last point above, Table 5 presents estimated cost savings for businesses in the food sales and service industry from adopting one of the listed appliances. Replacing outdated, inefficient appliances with efficient appliances has the benefit of increasing productivity as well as inducing energy-cost savings.

Table 5: Estimated annual electricity savings from adopting energy star appliances in food service

Annual Electricity Savings from Adopting One of the Following Energy Star Appliances									
	Steamers	Fryers	Convection Ovens	Griddles	Holding Cabinets	Reach-in Refrigerators	Reach-in Freezers	Ice Machines	Dishwashers
Annual Electricity Savings	$1,000	$100	$190	$190	$310-880	$55-70	$175-325	$130	$720

Source: Energy Star for Light Commercial HVAC: Fact Sheet for Building Owners and Property Managers. (Last Accessed 8/23/11: http://www.energystar.gov/ia/partners/manuf_res/LCHVACFS3.pdf)

As restaurants are typically leased from property owners, energy efficiency upgrades for improving the HVAC or thermal envelope must target the landlords and property owners. Targeting restaurant property owners for HVAC and thermal envelope efficiency loan packages presents an opportunity to design and market low operating cost, "green-niche" restaurant spaces, while a rebate program for energy-efficient refrigerators will appeal to restaurant operators.

[6] *Energy Star Guise for Restaurants: Putting Energy into Profits.* November 2010. (Last Accessed 8/23/2011: http://www.energystar.gov/ia/partners/publications/pubdocs/restaurants_guide.pdf)

RELIGIOUS FACILITIES MARKET ASSESSMENT

Overview

Known as the Holy City, Charleston's houses of worship comprise their own market for energy efficiency upgrades. With over 260 religious organizations within the County, religious leaders across Charleston have expressed interest in integrating energy efficiency into both facilities upgrades and their respective organizational missions. Given the unique characteristics of religious communities, in terms of their outreach potential, their organizational structure, and their financial governance, we have created a separate section to assess the market for energy efficiency upgrades and financing for houses of worship.

Results of the *Assessing Drivers for Energy Efficiency Retrofits in the Religious Community Survey*

In order to assess the drivers of demand for energy efficiency upgrades in Charleston's religious congregations, the Sustainability Institute and the Environmental Finance Center developed a web-based survey to be completed by decision makers across the city's congregations. The survey included 20 questions, and covered three main topics, Financing Drivers of Energy Efficiency Retrofits, Financing Drivers of Energy Efficiency Retrofits, and General Information about the Congregation.

Six congregation leaders completed the survey, with congregation sizes ranging from 25 to 3,000 members. Of the six respondents, two (33%) had made energy efficiency investments to their facility in the last five years, one for the worship center restroom renovations and one in general renovations. Sixty-seven percent (4/6) of respondents replied that potential savings on their energy bill factor was highly important in their ministry's decision to replace or upgrade their facility(s) and/or HVAC equipment. Only 33% (2/6) report that Social Ministry played an important role in their congregation's decision to replace or upgrade their facility(s) and/or HVAC equipment. Sixty percent (3/5) of respondents thought their members would be very interested in including energy efficiency in the facility's future building upgrades, and one pastor reported that he thought members would also be interested in making energy efficiency retrofits in their homes.

All but one of the congregations reported that they would be investing in capital improvements over the next five years, and of the five, three reported that they would finance the improvements. Regarding improvements specific to increasing energy efficiency, 67% (4/6) of the religious leaders report that they would consider financing energy-efficiency improvements if the interest rate fell between 3% and 5%, and only 50% (3/6) the religious leaders report that they would make an energy efficiency improvement that took longer than the financing period to recover the costs.

Although a sample of six does not adequately represent the Charleston religious community, this survey begins to build a repository of data and knowledge about how congregations make decisions around capital expenditures in general, and energy efficiency upgrades more specifically. The Charleston respondents overall exhibited great interest in making energy efficiency upgrades and in borrowing money. In particular, pastors said they would borrow money in the case where they received a low interest rates or where they could leverage a full renovation loan with an energy-efficiency rebate.

INDUSTRIAL MARKET ASSESSMENT

Overview

Known more as a trading center than an industrial hub, manufacturing plays a relatively small role in Charleston's economy and presents a limited market for energy efficiency upgrades or financing. However, although manufacturing remains small as a share of the total county economy, this should not downplay the opportunity for substantial energy savings present with county's more than 280 manufacturing establishments. Within these 280+ manufacturing establishments, two industrial clusters emerge that are relatively large in size and high in energy usage.

In this section, we identify and locate clusters of energy-intensive manufacturers in Charleston. We then provide a general framework to evaluate potential CharlestonWISE Program participation, based on energy usage characteristics and potential upgrades. As the most significant energy savings in industry are often manufacturing process retrofits – not structural retrofits – loan fund specifications should be reviewed to make sure process retrofit customers qualify for participation.

Methodology

To identify concentrations of high-energy-intensity manufacturers in Charleston -- i.e., potential loan recipients -- we used several data sources to identify Charleston's top 10 manufacturing subsectors and measure their energy intensity. We followed these steps:

1) Categorize and rank Charleston's top 30 manufacturing subsectors by NAICS codes using the 2006 Economic Census;
2) Calculate each subsector's *energy-intensity ratio* by dividing [*net electricity, 1,000 kWh purchased + generated-sold in 2009]* by [*value of product shipments, 2009].* This produces an energy intensity ratio, per subsector, that ranges from 1.14 to 0.03. For Charleston, we define a high *energy-intensity ratio* as greater than or equal to 0.1.
3) Using the Reference USA database of all manufacturing businesses in Charleston, we locate concentrations of energy-intensive subsectors within the City; specifically identifying the number of establishments in a given subsector (minimum of 10 establishments is needed to qualify for analysis).

Table 5: Energy Intensity Calculations for Top 4 Manufacturing Subsectors in Charleston, SC (2009 Data)

Industrial Clusters (2007 NAICS codes)		Avg. Net Electricity Usage (1,000 kWh)	Avg. Value of product shipments, per establish-ment ($1,000)	Energy Intensity Ratio	Number of Establish-ments	Annual Energy Cost per Establishment*	Energy Cost as a Percentage of Annual Product Shipments
Chemical manufacturing							
3251	Other basic organic chemical manufacturing	49,158	$94,959	0.52	5	$2,885,571	3.04%
3254	Pharmaceutical and medicine manufacturing	6,089	$92,094	0.07	3	$357,453	0.39%
Printing Presses							
3231	Printing presses & support-related activities	417	$2,374	0.18	27	$24,466	1.03%
Fabricated metal product manufacturing							
3327	Machine shops	390	$2,543	0.15	9	$22,885	0.90%
3323	Architectural & structural metals mfg	594	$6,911	0.09	10	$34,882	0.50%
Transportation equipment manufacturing							
3366	Ship and boat building	1,862	$18,237	0.10	17	$109,277	0.60%
3364	Aerospace product and parts manufacturing	8,161	$109,450	0.07	6	$479,074	0.44%

Source: DOE-EIA (2009) Economic Census Industry Series. NOTES: * Using U.S.-wide net electricity usage and product-shipment value numbers from 2009. Average net usage is a national average for each sub sector.

**Using 2009 average electricity price for S.C.'s industrial sector of 5.87 cents per kilowatt hour (kWh).

Industrial Targets and Upgrade Project Potential

Top Target Industries within Charleston

As Table 5 (above) demonstrates, a number of industries within Charleston possess high annual energy costs and could potentially benefit from energy-efficiency upgrades. However, when initially rolling out the CharlestonWISE Program, it is important to target manufacturing subsectors that also exist in a relatively high density in Charleston. Targeting specific subsectors will enable program administrators to better relate to potential program participants and understand critical capital-improvement decision points.

Accordingly, we have equally balanced three critical characteristics – energy intensity, number of establishments within Charleston, and annual energy cost per establishment – for our calculations and recommend targeting three initial industries that fall within two clusters. These two clusters are the chemical manufacturing cluster and the printing and publishing cluster. Below, we examine these two industrial subsectors in Charleston.

In 2006, the International Energy Agency found that "the energy intensity of most industrial processes is at least 50% higher than the theoretical minimum"[7]. In more direct language, this means energy-efficiency upgrades have considerable potential to reduce industrial manufacturing energy costs, saving companies thousands of dollars while also reducing CO_2 and other GHG emissions. Some technologies are broadly applicable across multiple industries. In the following section, our analysis hones in on energy-efficiency upgrades that are specific to target industries within Charleston.

[7] Worrell, Ernst (2009) "Industrial Energy-efficiency and Climate Mitigation". Ernest Orlando Lawrence Berkeley National Laboratory, February Document.

Chemical Manufacturing Cluster

1) Basic organic chemical manufacturing (annual energy cost: $2,885,571 per plant); 2) Pharmaceutical and medicine manufacturing (annual energy cost: $357,453 per plant).
Within its relatively small manufacturing sector, Charleston's chemical manufacturing cluster stands out due to the high energy use characteristics of the organic chemical manufacturing plants, where energy costs make up over 3% of the value of shipments annually. Production processes for chemical manufacturing (NAICS 325) transform organic and inorganic raw materials through chemical processes to formulate products. The chemical industry uses energy both to supply heat and power for plant operations and as a raw material for the production of chemicals, plastics, and synthetic fibers.

Targeting the chemical manufacturers with low interest financing for energy efficiency process upgrades presents a potential large loan recipient, in addition to a great economic development strategy to attract similar businesses to the region.

Upgrade Recommendations: Chemical Manufacturing

The chemical industry's prime motivation for energy efficiency is controlling operating and production costs (e.g., fuel and raw material costs) in a competitive, worldwide market. Facility-wide approaches to energy efficiency, such as integrated heat exchanged networks to maximize the use of waste heat, present opportunities to reduce costs and remain competitive. While energy consumption in the chemical industry has increased in recent years (increasing 13.2% from 1994 to 2008, and 1.75% from 1998 to 2002), the pharmaceutical manufacturing sector alone spends roughly $1 billion in annual energy costs[8].

Heating, ventilation, and air conditioning (HVAC) are typically the most important energy end use in the pharmaceutical and organic chemicals manufacturing as significant temperature control is needed in labs and chemical storage facilities. It was estimated that the average percentage of electricity and fuel consumed by HVAC components in the pharmaceutical industry is around 65%[9], making it a key area to target for potential energy and cost savings. Upgrades for HVAC include installing microprocessor controls on HVAC systems, adjusting chiller temperatures, and using solar air heating. Additional increases in energy efficiency can be achieved by installing heat recovery filters in the HVAC system's air outlets. This improvement offers expected energy savings of approximately 5%.[10]

Other chemical and pharmaceutical manufacturing processes with high energy end uses include: centrifuges, sterilization, incubators, dryers, and separation processes. Improving motor and motor systems that drive these processes and machines translates into high energy savings. It is recommended to utilize a systems approach to optimize the energy efficiency of entire motor systems (i.e., motors, drives, driven equipment such as pumps, fans, and compressors, and controls),[11] not just the energy efficiency of motors as individual components. Energy-efficiency financing targeting system wide motor system upgrades may be an attractive economic development incentive to grow this burgeoning sector in Charleston.

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[8] Galitsky, c. et al (2008) "Energy Efficiency Improvement and Cost Saving Opportunities for the Pharmaceutical Industry" Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-57260-Revision.

[9] *Ibid*

[10] Novartis AG. (2004). Target and Results - Energy and water consumption. Novartis Health, Safety, and Environment, Corporate Citizenship. Basel, Switzerland.
http://www.novartis.com/corporate_citizenship/en/hse_energy_water_cons.shtml

[11] Galitsky, c. et al (2008) "Energy Efficiency Improvement and Cost Saving Opportunities for the Pharmaceutical Industry" Ernest Orlando Lawrence Berkeley National Laboratory, LBNL-57260-Revision.

Printing Press Cluster

Printing & related support activities (avg. annual energy cost: $24,466 per establishment)
Although not a huge industry within the city, the printing press cluster in Charleston represents a decent sized industrial cluster, with 27 printing presses; this number stands out relative to other potential industrial clusters. Printing companies present a targeted local industry with potential appetite for low interest financing to reduce energy costs.

Upgrade Recommendations: Printing and Publishing Cluster
This cluster possesses several different types of businesses, but the core printing and publishing businesses typically utilize printing presses. Dryers, cooling systems, drive motors and air compressors all provide opportunities to reduce a printing press' energy consumption. Dryers account for 35% of power use within printing presses, so installing heat recovery systems or decentralizing steam supply can help reduce energy use.[12] The second-largest energy consumer within printing presses is the main drive motor, which consumes about 25% of the total power used. When making upgrades, selecting higher efficiency motors will save 3-5% of energy compared to standard motors, and installing variable-speed drivers through fan or pump systems can also be a cost-effective improvement.[13]

[12] "Heidelberg Designs Green Printing Press". *Compressed Air Best Practices.* 2011.
[13] "Paper products and printing". *Carbon Trust.* 2009.

KEY FINDINGS

This analysis generated several findings to inform the CharlestonWISE Program rollout, including:

Retail space, shopping centers, and office buildings have high cost-savings potential through energy-efficiency upgrades
These three commercial subsectors in Charleston have been identified as prime targets for energy efficiency upgrades based on the large share of building stock these subsectors occupy as well as their high annual energy expenditures. Low-cost efficiency upgrades that are specific to retail space, shopping centers, and office buildings include adopting new lighting technologies, upgrading buildings' thermal envelopes, and HVAC system updates.

Food sales and food service industries provide a large opportunity for improved efficiency and a multi-pronged financing approach
Charleston's large food service and sales sector show large room for energy-efficiency gains and presents a unique opportunity for a program targeting both restaurant operators and property owners for energy financing. Although the majority of energy used in food sales and service is generated by refrigeration, energy for HVAC amounts to 29% of restaurants' average end use. Targeting restaurant property owners for HVAC and thermal envelope efficiency loan packages presents an opportunity to design and market low operating cost, "green-niche" restaurant spaces, while a rebate program for energy-efficient refrigerators will appeal to restaurant operators.

Focus industrial loan program on the organic chemical and pharmaceutical manufacturing cluster.
Annual energy costs for Charleston's 8 chemical and pharmaceutical manufacturing plants average $1.6 million per year. As the U.S. pharmaceutical industry looks to reduce energy consumption in a cost-effective manner, proving large scale rebate and energy efficiency financing mechanisms presents an attractive economic development incentive to grow this burgeoning sector in Charleston.

Charleston's religious organizations present a large opportunity for a focused marketing and energy efficiency finance program.
With over 260 religious organizations within the County, religious leaders across Charleston have expressed interest in integrating energy efficiency into both facilities upgrades and their respective organizational missions. Given the unique characteristics of religious communities, in terms of their outreach potential and their high likelihood of investing in building renovations, developing energy efficiency packages and financial mechanism congregation presents a great channel through which to promote CharlestonWISE and reach a large and diverse market.

Marketing efforts directed towards commercial businesses need to make the "business case" for investments in energy-efficiency
Sell energy-efficiency improvements by showing property owners the reduced energy costs that result from efficient buildings and processes. Other selling points for efficiency upgrades include: reputational advantage in the "green-niche" market, higher tenant retention, and improved productivity.