Green Jobs from Industrial Energy Efficiency[1]

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ABSTRACT

Reducing unemployment is the most significant issue on the national agenda, and efforts to improve energy productivity in industry can protect jobs and create new employment opportunities. While numerous studies have addressed the potential for green jobs through stimulus spending or carbon cap and trade proposals, long-term policies for energy efficiency in industry are uniquely able to save energy while stabilizing or increasing the industrial labor force. This paper uses input-output modeling to look into how policies to promote process improvements, incentivize plant utility upgrades, and deploy combined heat and power in industry in the South could lead to higher levels of employment through 2030 in a region that accounts for more than half of the nation's industrial energy consumption.

As policy-makers and concerned citizens from the southern United States evaluate the costs and benefits of comprehensive climate and energy legislation, the current unemployment situation dominates the discourse. This paper will look into how policies to promote process improvements, incentivize plant utility upgrades, and deploy combined heat and power (CHP) in industry in the South Census Region could lead to higher levels of employment through 2030 in a region that accounts for more than half of nation's industrial energy consumption. Energy Efficiency in the South (Brown et al. 2010) presented a suite of nine energy efficiency policies in the residential, commercial and industrial sectors, which could cost-effectively save 5.6 quadrillion BTUs from the reference forecast and generate 520,000 jobs in 2030. Of the energy savings, 41 percent were from the three industrial policies. A breakdown by sector of the macroeconomic effects of these policies, using cost and benefit results from the National Energy Modeling System (NEMS) and IMpact analysis for PLANning (IMPLAN) multipliers in an input-output analysis, will provide a comparison of the role of improved energy productivity in industry relative to other sectors for green jobs potential. The refined input-output methodology for industry will assess which policies and states within the region may have the most beneficial employment impacts over the next two decades.

Overview of Green Jobs

"Green Jobs" have been a priority on the political agenda throughout the campaign and presidency of Barack Obama. Ahead of the passage of the American Reinvestment and Recovery Act, which included allocations to foster employment in clean energy and environmental organizations, Vice President Joe Biden (2009) wrote of the promise of reducing greenhouse gas emissions and concurrently facilitating the growth of new jobs for middle-class Americans. The White House created a special senior-level advisory position, the "Green Jobs Czar," to oversee the policy and programs across the federal government that could foster job growth and reduce carbon. Van Jones, who briefly served in this role, wrote the 2008 book *The Green Collar Economy*, which highlights the economic, environmental and social justice benefits

[1] Funding for this research was provided by the Energy Foundation, Kresge Foundation, and Turner Foundation. The support of these sponsors is greatly appreciated. Any errors are strictly the responsibility of the authors.

of expanding this sector. Advocacy groups such as the Blue Green Alliance (2010), an organization that represents a coalition of labor and environmental groups, and RePower America have championed this cause as part of the solution to the two salient problems of climate change and the global financial crisis. According to Vice President Biden (2009), green jobs "provide products and services that use renewable energy resources, reduce pollution, and conserve energy and natural resources." This paper will focus on the green jobs generated through energy efficiency services, as well as the additional macroeconomic benefits from policies that reduce energy expenditures.

Clean energy economics is a developing and contentious field in which there remains debate over the benefits or consequences of directed investment. CRA International (Montgomery et al. 2009), in a report for the National Black Chamber of Commerce, conducted economic modeling that showed 3 million fewer jobs in the American economy in 2050 (compared to the business as usual forecast) assuming the provisions of the American Clean Energy and Security (ACES) Act of 2009. ACES, also known as Waxman-Markey, which passed the House of Representatives in 2009 but has not gained support in the Senate, would have offered a disincentive to fossil fuels through a price on carbon. The job losses, according to CRA International, occur because ACES may change investments away from the optimal market equilibrium, and the price changes and technological development will hinder the expansion of the American economy to meet labor needs. On the other hand, ACEEE (2009a) provides analysis that shows the energy efficiency provisions alone in ACES would grow the economy by 600,000 jobs by 2030. A model from the University of California at Berkley provides output showing that the country could gain 918,000 to 1.9 million jobs through climate and clean energy policy by 2020 depending on the rigors and effectiveness of the provisions (Roland-Holst & Karhl 2009)

The Political Economic Research Institute (PERI) at the University of Massachusetts at Amherst has also produced numerous positive economic forecasts of clean energy policy that have received the attention of the media and policy-makers (Office of the Speaker et al. 2009). In a report for the Center for American Progress, PERI economists estimate that a $100 billion stimulus investment in clean energy could create 2 million jobs in the United States (Pollin et al. 2008). In a further analysis, Pollin, Heintz and Garrett-Peltier (2009) estimate that a $150 billion spending move away from fossil fuels to clean energy would lead to a net gain of 1.7 million jobs (2.5 million gained in the clean energy sector, with 800,000 jobs lost in the fossil fuel industries). According to their assumptions, this would reduce the national unemployment rate by one full percentage point.

The US economy has undergone structural changes over the course of its history from changes in innovation, technology, demand patterns and other developments. The nation has moved from an agricultural economy to one that focuses on industrial goods and services (Spulber 1995). Going from a fossil fuel energized economy to a clean energy economy could be another shift in the American trajectory.

Most of the analysis of the short and long-term costs and benefits of this transition relies on Input-Output (I-O) modeling techniques. Nobel laureate Wassily Leontief (1966) formalized this method of economic analysis based on the "flows of goods" and the "fundamental relationship" of inputs and output in the economic structure. The goal is to study at the economy to make better decisions for risky, large-scale capital investments. While Berck & Hoffman (2002) identify other means of analyzing employment effects of relevant policies, they note that I-O models are relatively clear in their application for researchers and widely accepted. Pollin, Heintz & Garrett-Peltier (2010) indicate that the linearity and static nature of these models makes them useful and transparent without too many assumptions or “black box” calculations.

Energy Efficiency in the South

The South Census Region, which serves as the focal point for this analysis includes 16 states and the District of Columbia (see Figure 1). The fastest growing region of the country, the South has been slow to embrace policies and programs to reduce the nation’s carbon footprint. In fact, southern states ranked low on the American Council for Energy Efficiency’s (ACEEE) state scorecard for energy efficiency policy, with nine of the 12 lowest ratings for 2009 (ACEEE 2009b). ACEEE evaluated states on utility and public benefits, transportation, building energy codes, combined heat and power, state government initiatives, and appliance efficiency standards. While these are not the full slate of potential carbon mitigation policies available to governors and legislatures, not having these regulations and incentives in place limits the opportunity for green job growth. In addition, of the 12 companies with headquarters in this region in the top 50 on the Fortune 500 list for 2010, four are in the fossil energy business, including the world’s second largest company, ExxonMobil (CNN Money 2010). The South also boasts coal reserves in Appalachia and on-shore and offshore oil production in the Gulf Region.

Researchers at the Georgia Institute of Technology and Duke University used the Southeast NEMS Users Group- National Energy Modeling System (SNUG-NEMS) to analyze the energy savings potential of nine residential, commercial and industrial energy efficiency policies in the region. Table 1 shows the nine policies and that the SNUG-NEMS results indicate that seven of them could be financially cost effective, with CHP systems achieving cost effective savings when one considers the social benefits of reduced carbon dioxide emissions. A subsequent analysis of policies to promote industrial CHP that nationwide benefits could far exceed costs (Brown et al. 2011).

The focus of this paper is on the economic impact of the industrial energy efficiency policies. The SNUG-NEMS modeling found that industrial plant upgrades, industrial process improvement policy, and CHP incentives would save industry in the South $180 billion in net-present values (2007 dollars) through 2030, at a cost of only $53.2 billion in public and private investment. Utility bills for industry would decrease over time and be 16 percent lower than baseline forecasts by 2030, with continued savings from installed equipment and processes out to 2050. The West South Central division would see the most significant growth in industrial energy efficiency, as the large manufacturing sectors along the Gulf Coast benefit from this implementation. Further details of these policies and results are in Chapter 5 of *Energy Efficiency in the South* (Brown et al. 2010).

Table 1- Total Resource Cost Test for Energy Efficiency Policies in the South Census Region (in Million 2007$)

Residential Sector Policies			
	NPV Cost	NPV Benefit	B/C Ratio
Building Codes with Third-Party Verification	$10,000	$41,400	4.1
Appliance Incentives and Standards	$25,500	$7,060	0.3
Expanded Weatherization Assistance Program	$5,840	$6,420	1.1
Residential Retrofit and Equipment Standards	$86,600	$119,000	1.4
Combined Policies	**$115,000**	**$143,000**	**1.3**
Commercial Sector Policies			
	NPV Cost	NPV Benefit	B/C Ratio
Tighter Commercial Appliance Standards	$26,300	$109,000	4.6
Commercial Retrofit Incentives	$8,540	$20,900	2.4
Combined Policies	**$31,500**	**$126,000**	**4.0**
Industrial Sector Policies			
	NPV Cost	NPV Benefit	B/C Ratio
Industrial Plant Utility Upgrades	$10,800	$48,400	4.5
Industrial Process Improvement Policy	$36,000	$128,811	3.6
Combined Heat and Power Incentives	$16,900	$11,400 $17,600*	0.67 1.04*
Combined Policies	**$53,200**	**$179,000**	**3.4**

* Includes the environmental benefits from CO_2 emissions avoided by CHP systems.

Employment and Macroeconomic Methodology

To evaluate how the nine energy-efficiency policies might impact levels of employment and economic activity in the South, we use an Input-Output Calculator developed by ACEEE for evaluating macroeconomic and job impacts of investments in energy efficiency (Laitner & Knight 2009). The key data for the calculator are the South Census Region's impact coefficients for 2008 provided by IMPLAN. IMPLAN is an econometric modeling system developed by applied economists at the University of Minnesota and the U.S. Forest Service. Currently in use by more than 500 organizations, IMPLAN models the trade flow relationships between businesses and between businesses and final consumers (IMPLAN 2009).

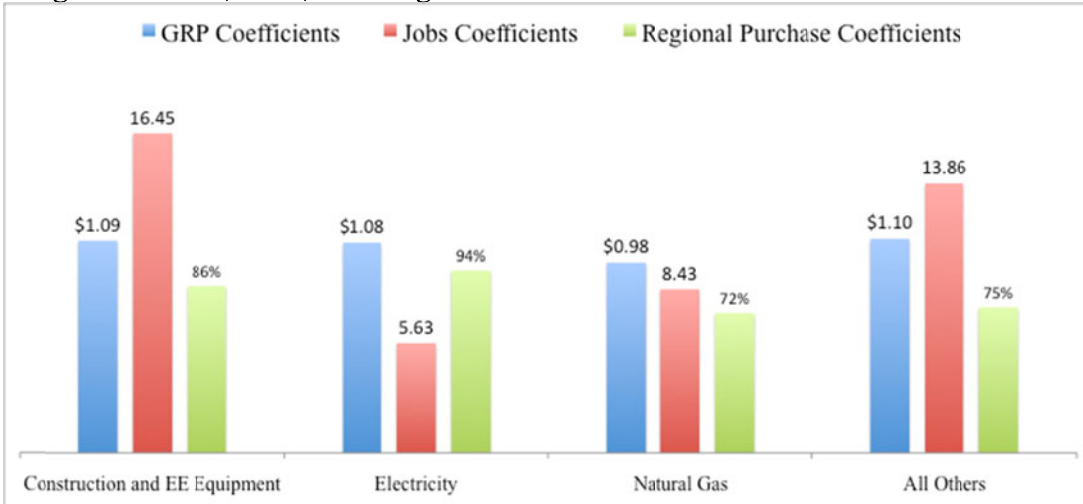
To determine the Key Impact Coefficients for the region, the research team aggregated and modeled the data sets analyzed in this study were for the sixteen states and the District of Columbia for 2008. Table 2 shows the IMPLAN sector aggregations for this report. The Construction and Energy Efficiency Equipment sector is the source of the direct growth for the investments in energy efficiency. The Electricity and Natural Gas sectors decline due to a decrease in consumption, while the other sectors of the economy also benefit from increased demand as consumers and businesses have increased capital to purchase items other than energy.

Table 2- Aggregation of Sectors for ACEEE Calculator

Category	IMPLAN Code	Description
Construction and Energy Efficiency Equipment	34	Construction of new nonresidential commercial and health care structures
	35	Construction of new nonresidential manufacturing structures
	36	Construction of other new nonresidential structures
	37	Construction of new residential permanent site single- and multi-family structures
	38	Construction of other new residential structures
	39	Maintenance and repair construction of nonresidential structures
	40	Maintenance and repair construction of residential structures
	205	Construction machinery manufacturing
	216	Air conditioning, refrigeration, and warm air heating equipment manufacturing
	259	Electric lamp bulb and part manufacturing
	260	Lighting fixture manufacturing
	261	Small electrical appliance manufacturing
	262	Household cooking appliance manufacturing
	263	Household refrigerator and home freezer manufacturing
	264	Household laundry equipment manufacturing
	265	Other major household appliance manufacturing
	322	Retail Stores - Electronics and appliances
Electricity	21	Mining coal
	31	Electric power generation, transmission, and distribution
	428	Federal electric utilities
Natural Gas	32	Natural Gas
Other	N/A	Other sectors of the economy

The critical statistics for estimating employment impacts are the jobs coefficients, which represent the number of jobs generated by an investment of $1 million in a particular industry. These coefficients indicate that an investment of $1 million in the construction and energy-efficient product manufacturing sectors (which includes both new building and retrofitting) generated 16.45 jobs in 2008. For the electricity and natural gas sectors, $1 million generated only 5.63 and 8.43 jobs, respectively. All other sectors of the economy had an average impact coefficient of 13.86 jobs per million dollars in 2008 (Figure 1). The higher labor intensity indicated by the large jobs coefficient for construction and energy-efficient manufacturing is one of the indicators that investing in energy efficiency is an engine for job creation. The critical statistics for estimating impacts on economic activity are the Gross Regional Product (GRP) Coefficients, which represent the value added to the economy per dollar of investment. In 2008 the IMPLAN GRP coefficients for the South Census Region were $1.09 for construction and energy-efficient product manufacturing, $1.08 for electricity, $0.98 for natural gas and $1.10 for all other sectors. Thus for each dollar spent in the construction industry, the economy of the region will grow by $1.09, while each dollar spent on natural gas generates only $0.98 for the South.

Figure 1- GRP, Jobs, and Regional Purchase Coefficients of Economic Sectors



Jobs calculations going forward in time use the same coefficients, but also account for an annual 1.9% increase in labor productivity, based on Bureau of Labor Statistics (2009a) estimates.

Also worthwhile for understanding regional employment impacts are the Regional Purchase Coefficients (RPCs), which are imbedded into the Key Impact Coefficients. An RPC is the proportion of the total demand for commodities by all users in the region that is supplied by producers located within the region. Of the four sectors examined here, the RPC in the South is highest for electricity (0.96) followed by construction and energy-efficiency product manufacturing (0.86), other sectors (0.75), and natural gas (0.72) (Figure 1). Thus, 86% of the demand for construction and energy-efficiency product manufacturing in the South is supplied by producers located in the South, while 14% of the demand is satisfied by imports. Investment in goods with significant "local" content (i.e., larger RPC's) leads to greater local job creation.

Residential, Commercial, and Industrial Integrated Results

The ACEEE calculator indicates that 127,000 jobs could immediately be added to the Southern economy, with 380,000 jobs added by 2020 and as many as 520,000 by 2030 (See Table 3). The calculator estimates that direct investment associated with the nine energy-efficiency policies in 2020 could create 220,000 jobs, while that number could rise to 243,000 a decade later. One limitation with the direct investment method is that it is not clear what employment these dollars have forgone to invest in efficiency. The remainder of the job increases will be growth in employment created from homeowners and businesses that shift spending away from utility expenditures into more productive sectors. The calculator also estimates that the nine energy-efficiency policies could improve the GRP by $1.2 billion in 2020 rising to $2.1 billion in 2030 based on changing spending patterns away from electricity and natural gas expenditures.

Table 3- ACEEE Calculator, Inputs from SNUG-NEMS Leading to Job and GRP Effects for RCI Sectors

		2020	2030
Inputs (in Millions of 2007 Dollars)	Total Productive Investment	$16,800	$22,400
	Change in Electricity Demand	-$48,500	-$83,100
	Change in Natural Gas Demand	-$7,710	-$9,940
Effects	Overall Increased Employment	380,000	520,000
	Increased Employment from Direct Investments	246,000	243,000
	Additional Gross Regional Product (in Millions of 2007 Dollars)	$1,230	$2,120

ACEEE's calculator indicates a higher rate of job growth than other recent methodologies estimating the employment impacts of energy efficiency in the United States. A Center for American Progress (CAP) study (Pollin et al. 2008) estimated that $100 billion in clean energy investment could create 2 million additional jobs. For programs of the American Recovery Reinvestment Act – including Weatherization, the State Energy Program and other efficiency efforts – the President's Council of Economic Advisors (2009) estimated that $92,000 of spending would generate 1 job. Table 4 compares these ratios to the input-output methods.

Table 4- Increased Employment Resulting from the Energy-Efficiency Polices Using Three Different Methods

	2020	2030
ACEEE Input-Output Calculator	380,000	520,100
Center for American Progress (CAP) Ratio (2 million jobs per $100 billion)	347,000	461,000
Council of Economic Advisors (CEA) ($92,000 for 1 job)	119,000	251,000

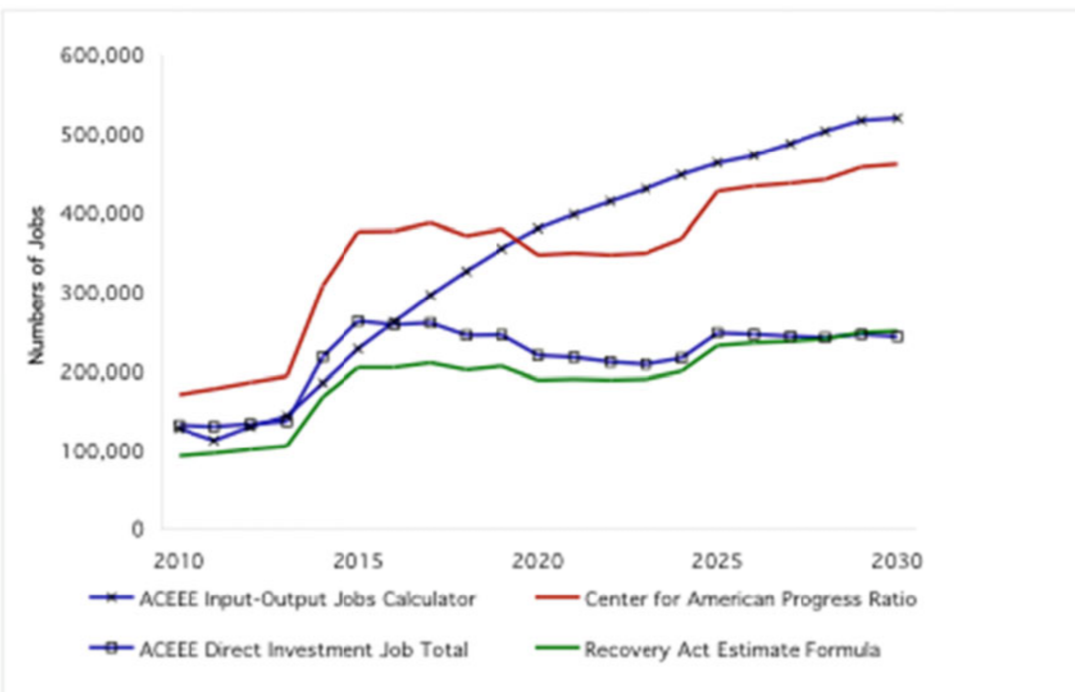
Note: In the calculations for the Center for American Progress Ratio and the Council of Economic Advisors, the authors include both total productive investment as well as non-incentive administrative costs, which were $17.35 billion in 2020 and $23.05 billion in 2030.

The most notable reason why the ACEEE Input-Output Calculator estimates higher job growth is that the saved expenditures on utility bills for electricity and natural gas customers foster long-term growth in other productive sectors of the economy. Both the CAP Ratio and the Council of Economic Advisors (CEA) formula, rely exclusively on the direct investments, focusing on short-term impacts of the economic stimulus provided by the American Recovery and Reinvestment Act (ARRA). Meanwhile this report considers two decades of implementation. The CEA job estimate is not a perfect comparison, as it is derived from all forms of spending, not just cost-saving energy efficiency improvements.

Figure 2 shows that the ACEEE job total from direct investments falls within the range of the other two formulas. For the first five years of the study, the ACEEE Input-Output calculator returns a lower increase in employment than the ACEEE projected job total exclusively based on direct investment. This is because the projected job creation from utility bill savings lags behind the decline in revenue for electricity and natural gas businesses.

A more complete analysis of the non-energy or productivity benefits of energy efficiency investments would likely increase the overall GRP impacts. There is a growing literature that documents several categories of "non-energy" financial benefits including reduced operating and maintenance costs, improved process controls, increased amenities or other conveniences, water savings and waste minimization, and direct and indirect economic benefits from downsizing or elimination of other equipment (Worrell et al. 2003). Combined heat and power offers the additional benefits of increased grid reliability from the introduction of distributed generation (Casten & Ayres 2007).

Figure 2- Increased Employment Impacts from Energy-Efficiency Policies for the Region



Shifting revenues from the non-labor intensive energy production industries to more labor intensive industries can create long-term job growth prospects, particularly during periods of high unemployment when labor is underutilized. The seasonally adjusted unemployment rate in the South Census Region was 8.8% in April 2011 (Bureau of Labor Statistics 2011). While this was lower than the national rate of 9.0%, Florida, Kentucky, and Mississippi all had over 10% unemployment. While energy-efficiency policies may not be an instantaneous or complete solution to the current financial difficulties of the South, our analysis suggests that the public and private investments stimulated by the nine energy-efficiency policies could have a positive impact on employment and macroeconomic growth over the next two decades.

Job and Macroeconomic Growth from Industrial Policies

Introducing just the three industrial sector policies will lead to greater job opportunities and a stronger economy in the South from initiation of the implementation through the continued period of investment, growing over time. In just the first year, these three policies could create or save 50,200 jobs and increase the economy of the South by $260 million. As shown in Table 5, by 2030 there would be 124,600 additional jobs in the South Census Region, with an $820 million in GRP from the baseline forecast. The peak year, however, is 2029, when there would be over 128,000 additional jobs and approximately $1 billion added to the economy of the South.

Table 5- ACEEE Calculator, Inputs from SNUG-NEMS Leading to Job and GRP Effects for the Industrial Sector

		2020	2030
Inputs (in Millions of 2007 Dollars)	Total Productive Investment	$3,500	$5,800
	Change in Electricity Demand	-$15,000	-$19,600
	Change in Natural Gas Demand	-$4,000	-$3,600
Effects	Overall Increased Employment	119,800	124,600
	Additional Gross Regional Product (in Millions of 2007 Dollars)	$830	$820

The industrial efficiency policies do not account for proportionately as much of the increased employment, from jobs created or saved, as they do for the overall energy savings in the three sectors. The energy savings in industry are 41 percent of the total, but the industrial sector only accounts for 32 percent of the jobs created in 2020 and just 24 percent in 2030. This is due to the funding mechanisms and streams in the policy design, the lower cost of electricity for industrial customers (meaning that their cost savings are not as proportionally significant as for the residential and commercial sectors), and the lower investment per unit of energy saved for energy efficiency improvements in industry. The same multipliers were used for the industry analysis, since sector specific “bills of goods” have not yet been developed. Industry, with its prominent role in the southern economy, still accounts for a greater ratio of the increase in GRP than its ratio of jobs created or saved.

Conclusion

Investing in energy efficiency will help contribute to the manufacturing base of the South and maintain the macroeconomic and domestic employment opportunities in this sector. By shifting investments away from conventional fuels and towards other more productive areas in the manufacturing process, the economy of the South could be able to continue to support its industry and achieve the environmental and social benefits associated with energy efficiency. As these investments are cost-effective for firms and taxpayers, building and supporting the implementation of these and other industrial policies will help the South, and the United States as a whole, compete in a world economy, where production is shifting to low-cost, less regulated developing countries (Intergovernmental Panel on Climate Change 2007)

This paper represents an initial attempt to evaluate the macroeconomic and employment impacts specifically as they relate to industry, an area for which researchers have not focused adequate attention. Building the partnerships and programs to save energy in industry will foster new opportunities for growth as a co-benefit of environmental protection and carbon mitigation. Further analysis of this area can explore how to build policies that take industry, the engine of the American economy, and make it a leader in economic expansion through energy efficiency.

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