WORKING PAPER

Myths and Facts about Electricity in the U.S. South

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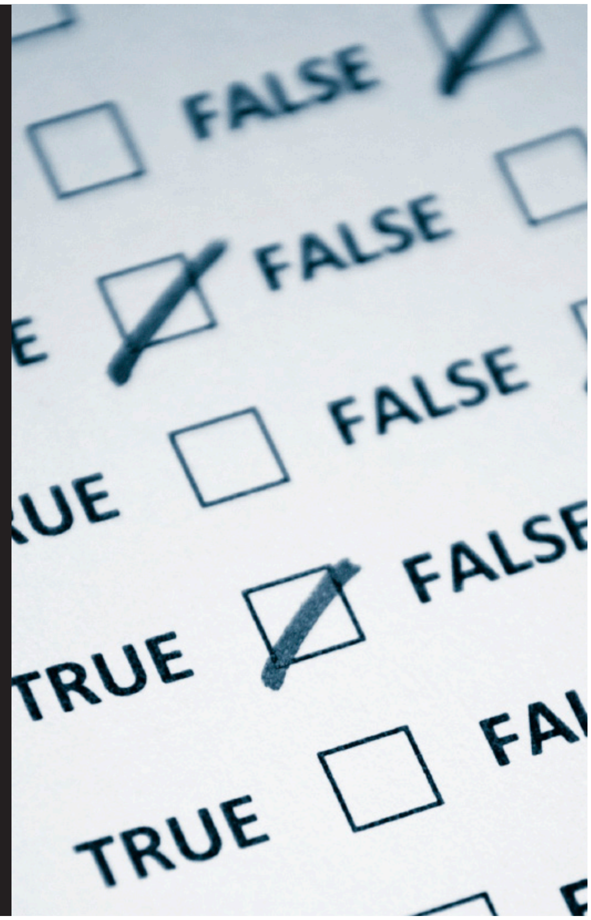

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ABSTRACT

This paper identifies six myths about clean electricity in the southern U.S. These myths are either propagated by the public at-large, shared within the environmental advocacy culture, or spread imperceptibly between policymakers. Using a widely accepted energy-economic modeling tool, we expose these myths as half-truths and the kind of conventional wisdom that constrains productive debate. In so doing, we identify new starting points for energy policy development. Climate change activists may be surprised to learn that it will take more than a national Renewable Electricity Standard or supportive energy efficiency policies to retire coal plants. Low-cost fossil generation enthusiasts may be surprised to learn that clean generation can save consumers money, even while meeting most demand growth over the next 20 years. This work surfaces the myths concealed in public perceptions and illustrates the positions of various stakeholders in this large U.S. region.

1. Introduction

Shortly before embarking on his trip to the United Nations Climate Change Conference in Copenhagen in December 2009, President Obama announced a target for reducing U.S. greenhouse gas emissions. The goal was to bring U.S. emissions 17 percent below 2005 levels in 2020, with an ultimate reduction of 83 percent by 2050. In his 2011 State of The Union speech, President Obama proposed an even more ambitious clean energy future for the country: 80 percent of America's electricity will come from clean energy sources by 2035, including nuclear, high-efficiency natural gas generation, renewables and clean coal. These targets may seem particularly challenging for the U.S. South[1] because of its unique electricity consumption and production profile.

1.1 Profile of electricity consumption and production in the U.S. South

In 2009, the South accounted for 42% of U.S. energy consumption and 45% of U.S. electricity use (Energy Information Administration, 2011a, Table-2, 2011b, Table 5-7), but is home to only 37% of the nation's population. Half of the nation's industrial energy use occurs in the South, and the region also has higher-than-average per capita consumption of residential energy and transportation fuels (Energy Information Administration, 2011a, Table-2; 2011b, Table 5-7). Availability of reasonably priced and reliable energy has been a value to businesses and industry in the South and has helped to drive the region's economic development. For example, in 2009, the South enjoyed an average electricity-sales-weighted residential electricity price of \$0.107/kWh (in 2009\$) (Energy Information Administration, 2011b, Table 73-120), compared with a national average of \$0.115/kWh (in 2009\$) (Energy Information Administration, 2011a, Table 8). Looking ahead, electricity demand in the South is expected to grow more rapidly than in the rest of the country reflecting the region's relatively strong

[1] The U.S. Census Bureau definition of the South includes 16 states and the District of Columbia, stretching from Delaware down the Appalachian Mountains, including the Southern Atlantic seaboard and spanning the Gulf Coast to Texas. In contrast, the North American Electric Reliability Corporation (NERC)'s definition of the South, includes four sub-regions – Southeastern Electric Reliability Council (SERC), Florida Reliability Coordinating Council (FRCC), Southwest Power Pool (SPP), and Electric Reliability Council of Texas (ERCOT) are used in the electricity supply modeling summarized in this paper. The Census South is used for demand-side analysis and the NERC South is used for supply-side analysis. These differences do not materially affect the results.

economy. While electricity rates are expected to rise in every region of the U.S., the South's rates are expected to remain below the national average.

These low rates have made it difficult to promote an ethic of energy conservation and efficiency. Sales data suggest a low market penetration of energy-efficiency products in the South. For each of the five ENERGY STAR appliances with sales data that are tracked by EPA – air conditioners, clothes washers, dishwashers, refrigerators, and water heaters – the South has a lower-than-average rate of market penetration (Swope, 2011). Further evidence of a relatively weak energy conservation ethic is provided by the results of a poll conducted in January 2009 by Public Agenda. The poll suggests that Americans are divided geographically in terms of their views on energy conservation and regulating energy use and prices versus exploring, mining, drilling and construction of new power plants. Conservation is supported by a large majority nationwide; however, it is close to even with exploration, drilling, and power plant construction in the South, at 48% to 45%. Energy policies in the South reflect these preferences. For example, as of August, 2011, 27 states nationwide have implemented Energy Efficiency Resource Standards or targets to encourage more efficient generation, transmission, and use of electricity. Only six of these states are located in the South.[2]

Coal dominates the power sector in the South as it does nationwide, accounting for 47% of electricity generation in both the region and the nation in 2009 (Energy Information Administration, 2011b, Table 73-120). However, the South depends less on renewable sources of electricity than any other region, with only 4.9% (Energy Information Administration, 2011b, Table 73-120) of its electricity generation coming from renewables compared with 10.4% nationwide (Energy Information Administration, 2011a, Table-8). With a comparable percentage of nuclear power and a greater use of natural gas for electricity, the carbon intensity of electricity in the South is high. Southern energy policies reflect these differences. For example, as of August 2010, 29 states and the District of Columbia have promulgated Renewable Electricity Standards (RES), and an additional eight states have renewable energy goals. Among the Southern states, only four states along with the District of Columbia have an RES: Delaware, Maryland, North Carolina, and Texas. In addition, Oklahoma, Virginia, and West Virginia have

[2] http://www.pewclimate.org/what_s_being_done/in_the_states/efficiency_resource.cfm

set voluntary renewable energy goals. The remaining nine Census South states represent the largest contiguous block of U.S. states without goals or standards for renewable power.[3]

When the greater intensity of energy consumption in the South is compounded by the carbon intensity of its power generation, the Region's carbon footprint expands well beyond the national average. A study by Brown, Southworth and Sarzynski (2009), for example, estimated the per capita carbon footprint of the nation's largest 100 metropolitan areas, measured in terms of the metric tons of carbon emissions per capita from the consumption of residential electricity and other forms of residential energy, as well as transportation fuels for light duty vehicles and freight trucks. Eleven of the 20 metropolitan areas with the largest carbon footprints were found to be located in the South (Figure 1).

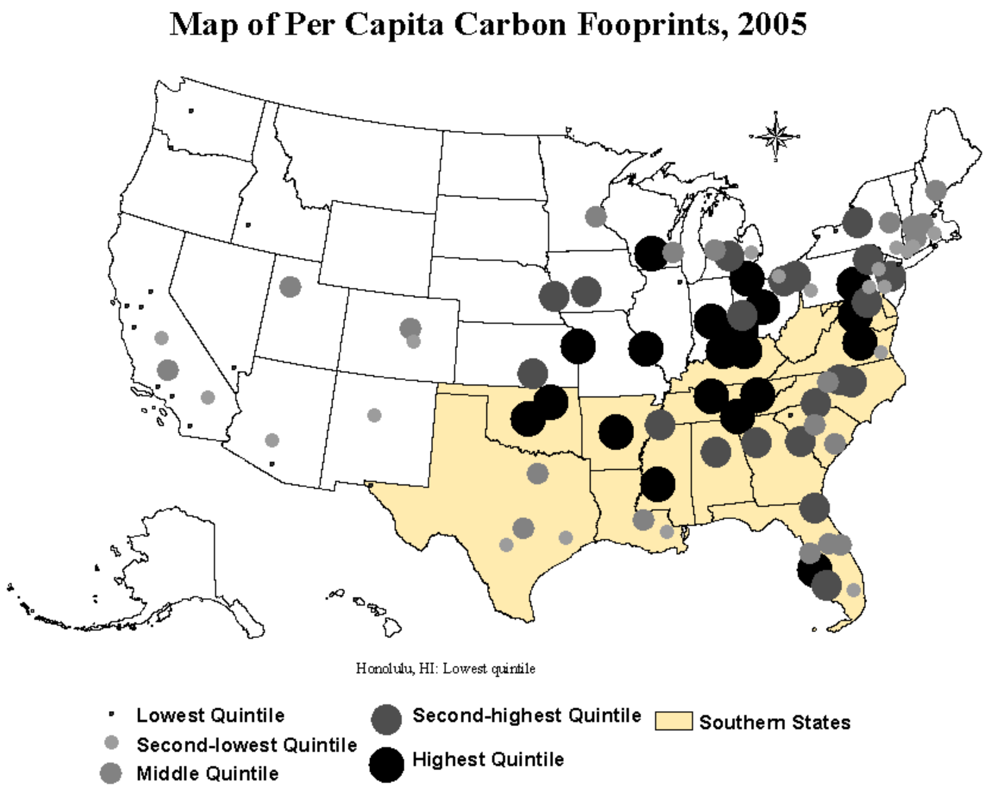

Figure 1. Per Capita Carbon Footprints of Metropolitan Areas in the South, 2005

(Map drawn from data published in Brown, Southworth, and Sarzynski, 2009)

[3] http://www.dsireusa.org/summarymaps/index.cfm?ee=1&RE=1

1.2 The role of myths and misconceptions

Clean energy, defined as energy efficiency and renewable energy in this study, can be an important way to meet growing demand while minimizing pollution. However, adoption and development of efficiency programs and renewable resources in the South are constrained by myths and misconceptions on both sides of the clean energy debate.

Myths serve to restrain thought and behavior and can become powerful tools for sustaining the status quo. As Mark Twain said: "It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so." Understanding myths as well as the belief system behind them is not only an important step to improve the clean energy situation in the South but also a key component of democratic decision-making. The process of identifying stakeholder beliefs and interests can promote a common understanding of dominant agendas and can help incentivize collaboration. Conversely, it can identify incommensurable views among stakeholders that must be resolved for consensus to occur. Also, by making some stakeholders belief systems more visible, our analysis of prevailing myths can improve social responsibility and foster desirable change. Numerous examples abound of organizations and stakeholders altering their practices in response to a more nuanced understanding of social views . From a social construction perspective, the integration of diverse perspectives will foster social learning among stakeholders, which has been associated with trust building, increased perceptions of transparency, and accountability.

Myths are folklore, drawn from historical repetition that acquire symbolic value and gradually come to constitute reality. Their great appeal lies in their ability to reduce the growing complexity of the world into a simple, knowable, and memorable idea. However, over time they also become engrained ways of thinking that can prevent stakeholders from recognizing alternative solutions . Both the strongest proponents and those most wary of clean energy seem to be constrained by myths, and with limited progress on energy policy, the South struggles to move beyond the status quo. Currently, it is easy for opposing groups to argue for the status quo and against a future where we build so much expensive renewable generation that emissions decline but electricity rates and bills escalate. A much more productive future could be one where investing in clean technologies leads to emissions reductions accompanied by only modest energy rates and bill effects. In fact, in two previous studies , we found that the South possesses substantial energy efficiency and renewable energy potentials to accomplish those goals.

Following a description of our methodological approach, we examine six clean energy myths in an effort to illuminate opportunities for collaboration that can benefit a diverse mix of stakeholders. These myths merge from different origins. The first three myths are commonly accepted by the general public and they deal with alternative paths to meet growing electricity demand, the sufficiency of renewable resources, and impacts on electricity rates. The next two myths, which address the tradeoff between energy efficiency and renewable power and the retirement of existing coal plants, are shared within environmental advocacy groups. The last myth addresses the impacts of power resource decisions on water consumption, which has historically gone unnoticed in the energy industry. The paper ends with a discussion of our findings.

2. Methodology

The six myths are examined analytically using an energy-economic modeling tool known as SNUG-NEMS (the Southeast NEMS User Group version of the widely accepted National Energy Modeling System). NEMS models U.S. energy markets and is the principal modeling tool used by the U.S. Energy Information Administration (EIA) to forecast future energy supply and demand. Twelve modules represent supply (oil and gas, coal, and renewable fuels), demand (residential, commercial, industrial, and transportation sectors), energy conversion (electricity and petroleum markets), and macroeconomic and international energy market factors. A thirteenth "integrating" module ensures that a general market equilibrium is achieved among the other modules. Beginning with current resource supply and price data and making assumptions about future consumption patterns and technological development, NEMS carries through the market interactions represented by the thirteen modules and solves for the price and quantity of each energy type that balances supply and demand in each sector and region represented (Energy Information Administration, 2009a). Outputs are intended as forecasts of general trends rather than precise statements of what will happen in the future. As such, NEMS is highly suited to projecting how alternative assumptions about resource availability, consumer demand, and policy implementation may impact energy markets over time.

The NEMS "Reference case" projections are based on federal, state, and local laws and regulations in effect at the time of the analysis. The baseline projections developed by NEMS are published annually in the *Annual Energy Outlook*, which is regarded as a reliable reference in the field of energy and climate policy. We have used SNUG-NEMS to perform scenario analysis under a consistent modeling framework in order to compare policy options to the Reference case projections. Four policy scenarios, described below, and a few policy combinations make the eight scenarios that were used to evaluate the myths.

2.1 The Energy Efficiency (EE) scenario

In "Energy Efficiency in the South" (Brown et al., 2010a), we examined the energy-saving potential of nine energy efficiency policies in the residential, commercial and industrial sectors in the South. In the residential sector, an appliance incentives and standards policy gives a 30% subsidy for the capital cost of the most efficient appliance to residential consumers to promote the adoption of high-efficiency appliances. At the same time, federal equipment standards for dishwashers and clothes washers and dryers were modeled. In terms of residential retrofits, consumers would receive a retrofitting incentive equal to 30% of the capital cost if they decide to replace their old equipment with the most efficient technology available under the context of a federal equipment standard. Finally, an expanded Weatherization Assistance Program (WAP) would operate on a national budget allocation of $1.7 billion per year (in $2007) through 2030. In order to tighten building codes, building equipment covered by the most stringent building code would receive a 30% subsidy of the installation cost, and in addition, the least stringent building code would be eliminated every six years.

In commercial buildings, tighter appliance standards are modeled that would eliminate the least efficient technology in each of seven appliance categories, in each decade. A second policy, heating, ventilation, and air conditioning (HVAC) retrofit incentives, are offered to accelerate the installation of nine higher efficiency technologies for space heating, space cooling and ventilation. Seven technologies are incentivized by 30%, while the two ventilation technologies receive only a 9% incentive because their relative costs are closer among vintage classes. A 2% annual efficiency improvement is assumed for the three other end uses not included in the technology input file: personal computers, other office equipment, and all other miscellaneous uses.

In the industrial sector, three policies promote improved energy efficiency. An expanded level of activity is modeled for DOE's Industrial Assessment Program, focusing on small and medium-sized enterprises, resulting in 1.4% decrease in their industrial energy consumption in 2030. Higher energy efficiency through industrial process improvements are modeled as the result of expanded Save Energy Now (SEN) assessments, targeting large energy-consuming firms, leading to a 5.9% reduction of their electricity and natural gas use in 2030. The current Investment Tax Credit (ITC) for electricity produced by combined heat and power (CHP) plants is modeled to extend through 2030, and an expanded research, development and demonstration (RD&D) program is assumed to generate an additional 0.7% annual improvement in the energy efficiency of eight types of CHP systems from 2011 to 2020.

Table 1 summarizes the nine energy efficiency policies. The results indicated that aggressive energy efficiency policies can prevent energy consumption growth over the next twenty years, resulting in less demand for new power plants and significant water savings. In this paper, all nine energy efficiency policies from the earlier work implemented together are defined as the EE scenario.

2.2 The Renewable Energy (RE) scenario

In "Renewable Energy in the South" (Brown et al., 2010b), we assessed both utility-scale renewable generation and customer-owned renewable resources after updating resource availability, revising RD&D assumptions, and introducing policies supporting renewable resources. The RE scenario in this study uses the same assumptions, resource updates and policies, as described below.

We estimated an increased wind resource availability by updating wind resources to those measured at 80-meter heights instead of those at 50-meter heights used in NEMS, reflecting industry's move to higher turbine heights and wider rotor diameters.

Policies that stimulate biopower include state sales tax exemptions for biomass and an extended Production Tax Credit (PTC) of 9¢/kWh for biopower from 2011 to 2030. We also extend the assumption of improved heat rates for biomass integrated gasification combined cycle (IGCC) plants, allows them to continue decreasing at 1.76% annually until 2030, rather than only until 2022.

Instead of assuming that 50% of municipal solid waste is recycled every year between 2010 and 2030 (the Reference case assumption), we increase the recycling rate by 1% annually between 2011 and 2030, starting at 50% in 2010. This rate of growth is slower than the annual growth rate that has occurred over the past decade.

Regarding hydropower, the new assumption sets a universal levelized cost of 10¢/kWh for every feasible hydro project located in the South, based on an inventory of sites where dams already exist in the absence of power generating facilities. This resource availability is updated based on a report by Hall et al. (2004).

New assumptions about residential and commercial solar photovoltaic (PV) system reduce the capital cost for PV modules and rooftop PV systems relative to NEMS assumptions. From 2011 to 2030, the residential system costs would decrease by 53% while the commercial system costs decrease by 57% in SNUG-NEMS. In addition, a 30% tax credit that is set to expire in 2016, is extended to 2030 for rooftop PV, and the same tax credit extension is given to solar water heaters, and heat pump water heaters.[4] Utility-scale solar also has a new assumption that increases the sunlight to electricity conversion rate by an additional 2% every five years from 2011 to 2030.

Table 1 summarizes the RE scenario updates, policies and RD&D. The results suggested that customer-owned renewables have significant low-cost potential, and utility-scale renewables could grow in the South with supportive policies.

Table 1 Portfolio of Energy Efficiency and Renewable Energy Policies and Assumption Updates	
Energy Efficiency	**Renewable Energy**
Residential Buildings • Appliance Incentives and Standards • Residential Retrofit and Equipment Standards • Expanded Weatherization Assistance Program: • Building Codes with Third Party	• **Wind:** resource availability updates based on 80-meter hubs. • **Biopower:** tax incentives and IGCC heat rate assumption update • **Municipal Solid Waste**: recycling rate increases 1% annually • **Hydropower:** levelized cost assumption

[4] The EE and RE scenarios both model CHP policies. The incentive and efficiency levels are higher in the latter scenario.

Verification **Commercial Buildings** • Commercial Appliance Standards • Commercial HVAC Retrofit Incentives **Industry** • Industrial Process Improvement: • Assessments of Plant Utility Upgrades • Combined Heat and Power Incentives	and resource availability updates • **Residential and Commercial Solar Photovoltaic (PV) systems:** capital cost assumption update and tax incentive • **Utility PV systems:** experience increased efficiencies • **Solar Water Heater:** tax incentive • **Heat Pump Water Heater:** tax incentive • **Combined Heat and Power (CHP):** tax incentive, system efficiency assumption update and advanced R&D efforts

2.3 Renewable Electricity Standard (RES) and Carbon-Constrained Future (CCF) scenarios

Two additional policies are modeled separately, and then combined with the EE and RE scenarios. These scenarios are based on federal policies that have periodically been debated in bills proposed by the U.S. Congress.

- The RES scenario represents a future with a Federal Renewable Electricity Standard that requires 25% renewable electricity production by 2025. The EIA released a report in 2009 entitled "Impacts of a 25-Percent Renewable Electricity Standard as Proposed in the American Clean Energy and Security Act Discussion Draft." For the purpose of this study, we use the same code for modeling a national RES as was used in the EIA report (Energy Information Administration, 2009b).
- The CCF scenario was chosen because instituting any of the most recently proposed market-based approaches to regulation of greenhouse gases would drive how energy efficiency and renewable energy policies are perceived and implemented. This scenario is modeled by assuming a price on carbon of \$15 per metric ton of CO_2 in 2012 (in \$2007) increasing linearly to \$51 per metric ton CO_2 in 2030 (in \$2007).

The combined scenarios that will be discussed later in this report are EE with RE (EERE), RE+RES, EERE+RES, and EERE+CCF.

Myths are often transmitted and reinforced via publications and media. In the remainder of the paper, our analytical results are paired with media evidence documenting the reality of the myths. In addition, we reviewed the Integrated Resource Plans (IRPs) of seven major utility companies in the region for evidence of the existence of the myths. The IRP process is used by utilities to identify optimal mixes of supply- and demand-side resources to meet their customers' electricity needs. Most electric utility companies produce an integrated resource plan approximately every five years, and it typically involves considerable public participation through public hearings and other opportunities for experts, business leaders, and other stakeholders to express their points of view. The following seven IRPs were examined for evidence relevant to each of our six myths.

- Duke Energy Carolinas, LLC, *The Duke Energy Carolinas Integrated Resource Plan (Annual Report)*, 2010
- Entergy Louisiana, LLC, *An Integrated Resource Plan (2009-2028),* 2009
- Dominion North Carolina Power and Dominion Virginia Power, *Dominion North Carolina Power's and Dominion Virginia Power's 2010 Report of Its Integrated Resource Plan*, 2010
- Florida Power and Light, *Ten Year Power Plant Site Plan (2011-2020),* 2011
- Georgia Power Company, *2010 Integrated Resource Plan*, 2010
- Progress Energy Carolinas, *Integrated Resource Plan*, 2009
- Tennessee Valley Authority, *Integrated Resource Plan, TVA's Environmental and Energy Future*, 2010

In the following section, we use this combination of qualitative and quantitative research methodologies to characterize and evaluate six myths about clean energy in the South.

3. Myths and facts

Numerous myths about clean energy have been promulgated by policymakers, business leaders and advocacy groups in the South are explored. We evaluate six of these, which address alternatives to meeting the region's growing demand for electricity, the sufficiency of renewable resources, impacts on electricity rates, tradeoffs between energy efficiency and renewable power, policies that lead to the retirement of existing coal plants, and the impact of clean energy investments on water resources.

Myth 1: Energy efficiency and renewable energy by themselves cannot meet the South's growing electricity demand.

In the 2009 *Annual Energy Outlook* the EIA estimates that the total amount of electricity generated nationally will increase by 27% between 2010 and 2030. In 2030, 70% of the demand is expected to be met with fossil fuels and 17% by nuclear (EIA, 2009a, Table A8). Industry leaders have raised doubts about whether energy efficiency and renewable energy by themselves can meet the nation's growing demand for electricity. The former chief executive officer of ExxonMobil, Lee Raymond, commented that alternative energy resources are merely "fashionable" and claimed that "with no readily available economic alternatives on the horizon, fossil fuels will continue to supply most of the world's energy needs for the foreseeable future." (Raymond, 1997) Similarly, the Center for Energy and Economic Development, an organization supported by the coal and utilities industries, stated that non-hydro renewable energy is "limited to a niche role for peaking power because it is an intermittent resource." (Sovacool and Brown, 2007). Confidence in energy efficiency and renewables is especially weak in the South. In its 2010 IRP filing, Duke Energy Carolinas plans a resource portfolio that includes 1,267 MW of Demand Side Management (DSM) and 633 MW of energy efficiency. However, Duke Energy Carolinas concluded that "Even if the Company fully realizes its goals for EE and DSM, the resource need grows to approximately 6000 MWs by 2030." That is, the planned investments in energy efficiency and DSM by Duke Energy Carolinas are judged by the utility to be unable to offset all of its anticipated growth in electricity demand. Entergy Louisiana expressed a similar view about renewable energy in its 2009 IRP stating that "it is not realistic to assume that renewable generation will be able to technically or economically satisfy all or even most of ELL's incremental needs." (Entergy Louisiana LLC, 2009, p.18).

In contrast, our analysis shows that investments in energy efficiency and renewable energy over the next two decades could meet incremental growth in electricity demand and eliminate the need to expand fossil-fueled electricity generation. In the EE and EERE scenarios, future energy consumption would see a slight increase and then decline to a level below 2010 consumption (Figure 2). Contrary to this myth, the Southern demand growth of 17% projected in the EIA Reference case, by 2030, could entirely be met by energy efficiency. Among the three sectors studied here, industry leads the energy savings. In the EE scenario in 2030, 41% of the total energy savings comes from the industrial sector, followed by 33% from the commercial sector. Residential retrofit and equipment standards, aggressive commercial appliance standards and industrial process improvements are particularly cost-effective policies.

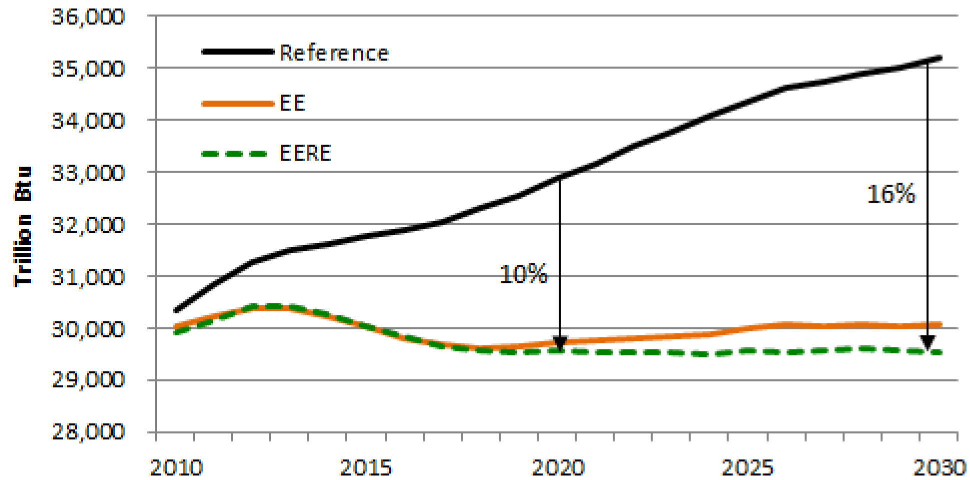

Figure 2. Energy Consumption in the Residential, Commercial, and Industrial Sectors in the South

Besides the energy saving from energy efficiency policies, the growth of renewable energy also produces energy savings. In particular, customer-side renewable energy such as combined heat and power and heat pump water heaters could reduce future consumption significantly. On the supply side, renewable generation such as wind and biomass are forecasted to grow significantly to meet future demand in a cleaner way.

In summary, our analysis suggests that efficiency and renewables can meet future demand, contrary to the conventional thinking that the growing demand for electricity requires expanding the current generation capacity. These results echo our previous findings.

Myth 2: The South does not have sufficient renewable energy resources to meet a Federal Renewable Electricity Standard.

A federal RES would require a certain amount of electricity generation coming from renewable resources. Among the 16 Southern states and Washington D.C., only five of them (Delaware, Maryland, Washington D.C., North Carolina, and Texas) have established a mandatory RES. In addition, Virginia has a voluntary RES goal and West Virginia has an Alternative and Renewable Energy Portfolio Standard that is similar to an RES but does not require a minimum contribution from renewable resources. As a result, West Virginia's standard could be met solely by alternative resources such as energy efficiency, coal bed methane and synthetic gas. Of the 34 states located outside of the South, 25 have RES's, and five of the other nine have voluntary goals.

In the South, one major concern regarding RES legislation is that renewable energy resources are insufficient to meet the requirements being debated, such as 25% of the electricity demand in 2025 met by renewable resources, and this myth has gained impressive momentum. Georgia Public Service Commissioner Stan Wise has stated that "Georgia simply doesn't have the wind, solar or biomass resources required to meet proposed new federal regulations for renewable energy generation." (The Atlanta Journal-Constitution, 2009). Senator Lindsay Graham of South Carolina has stated that "we can't meet the targets in the Southeast," referring to a potential nationwide standard for renewable energy (The New York Times, 2010). Similarly, the Southeastern Association of Regulatory Utility Commissions expressed their concern that their utility members would be forced to buy renewable energy credits from the federal government due to "the limited availability and cost-effectiveness of traditional renewable energy resources." (United States Senate Committee on Energy & Natural Resources, 2007). Such comments create the perception that there are not enough renewable energy resources in the South to meet a state or federal RES.

According to EIA's Reference scenario, only 12% of the total electricity generated in the South in 2025 would come from renewable resources (Figure 3). However, EIA's reference scenario project is limited by the renewable resource availability and the capital cost assumptions that are inherent to NEMS. In SNUG-NEMS analysis, we update the resource availability for wind and hydropower and the capital cost for residential and commercial solar PV according to recent studies. These updates, along with a set of other new assumptions and policies described in the methodology section, reflect the up-to-date understanding about renewable resources and their ability to penetrate the market.

The results indicate that if an RES is implemented, the share of renewable electricity generation would increase significantly, to 22% in 2025, due to the strong growth of wind and biopower on the utility side as well as the customer-side renewable generation such as CHP and solar photovoltaics. The RES program described in the American Clean Energy and Security Act of 2009 includes provisions that would allow credits for qualified state energy efficiency programs to satisfy up to 20% of the RES requirement, which translates into requiring only 20%

of the total electricity demand in 2025 to be met by renewable sources. As such, the South as a whole would have sufficient resources to comply with the standard.

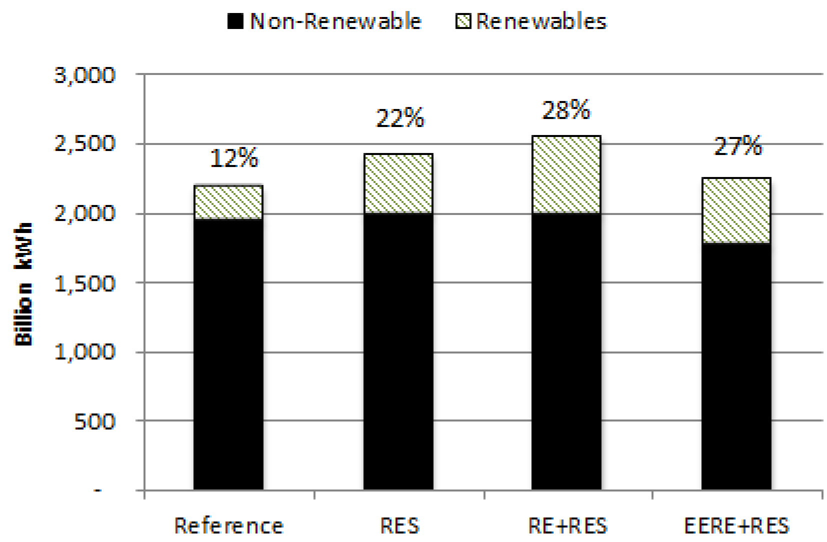

Figure 3. Renewable Resources as a Percentage of Electricity Generation in the South in 2025

If the RE scenario is implemented together with an RES (RE+RES), renewable generation could ramp to 28% of the electricity generation in 2025. In addition, when energy efficiency policies are jointly implemented with RE and RES (EERE+RES) scenarios, the overall demand for electricity would shrink while the percentage of renewable electricity would remain almost the same compared to the RE+RES scenario. In either case, the South does not need to rely on state energy efficiency programs to fulfill the RES goal. Wind, biomass, and combined heat and power are the three major renewable resources that would be used in the South. Together, they account for 80% of the renewable electricity generation in the EERE+RES scenario.

Some question the feasibility of large-scale increases in renewable generation given the intermittency of wind and solar power. SNUG-NEMS accounts for this issue by discounting the capacity credit of a plant as intermittent resources are expanded in a region, thereby invoking a gradual cost penalty that reflects how much intermittent capacity a region can absorb without jeopardizing reliability. Assuming that these cost penalties are sufficient, the scale-up in renewable generation projected in the renewable scenarios (EERE and others) should be technically feasible.

We also evaluate the concern that individual states could not meet an RES without purchasing a significant amount of Renewable Electricity Credits (RECs). Although NEMS has a regional-focused methodology, we can examine the state of Florida's domestic renewable potential since Florida Reliability Coordinating Council (FRCC) represents its own region. Because the territory of FRCC almost coincides with the state of Florida, except for a portion of northwest Florida, the results for FRCC approximates those of the state.

Florida is a good test case because it does not possess significant commercial level wind. Instead, in the SNUG-NEMS modeling of the RES scenario, Florida purchases large amounts of wind from the Southeastern Electric Reliability Council (SERC) to offset its high electricity costs from natural gas-fired generation. To explore how much the Florida RES relies on its purchase of SERC wind, we ran an additional scenario to evaluate what happens when the sale of wind power across NERC regions is disallowed. The results suggest that under an RE+RES no wind trading scenario, Florida could meet up to 21% of its electricity generation in 2025 using local renewable resources. If state energy efficiency programs contribute another 4% of electricity demand, Florida could fulfill the RES goal without purchasing any out-of-state RECs. When interstate wind trading is excluded, biomass, which accounted for 20% of renewable generation in the unconstrained RE+RES scenario, becomes the primary renewable resource in Florida, constituting 85% of its renewable generation in 2025.

In summary, in contrast to the myth that the South does not have sufficient resources to meet a federal RES, our analysis indicates the opposite. The region has good wind and biomass resources as well as customer-owned renewable resources. If the energy efficiency and renewable energy policies are implemented together with an RES, the South as a region could comply with the RES goal.

Myth 3: Renewable energy cannot be promoted without escalating electricity rates.

In recent years, Southern lawmakers and utilities operating in the South have claimed that the expansion of renewable electricity generation would cause electricity rates to rise in the region. Senator Jeff Sessions of Alabama claimed that passing a federal RES would cause consumers to "pay more for their electricity to meet this standard. And they are going to have to pay a lot more." (Sessions, 2007). In a discussion of renewable energy in its 2009 IRP, Entergy Louisiana states that "If enacted, a federal RPS likely will result in higher cost for customers.

Renewable generation alternatives generally are more costly than conventional generation alternatives." (Entergy Louisiana LLC, 2009, p.6). In addition, Duke Energy Carolinas, Progress Energy Carolinas and Georgia Power Company also claim in their planning documents that renewable energy would come at a cost premium (Duke Energy Carolinas LLC, 2010; Georgia Power Company, 2010; Progress Energy Carolinas, 2009). This idea of higher priced electricity is another major reason lawmakers and utilities in the region have opposed legislation that would establish an RES and other incentives for renewables and energy efficiency. Our analysis of electricity rates under different future scenarios suggests that large gains in renewable generation can be achieved without significantly affecting rates.

An important and often overlooked point is that electricity rates in the South are expected to rise over time. In the Reference case, average residential electricity rates in the South are forecast to rise by 17% over the next two decades, from \$0.094/kWh in 2010 to \$0.11/kWh in 2030 (Figure 4). The South's residential sector as a whole is projected to spend about \$40 billion more on energy in 2030 (in \$2007), than it spent in 2010.

Would promoting renewables inflate costs to consumers beyond the increases expected in the Reference Case? Our modeling results show that the effect of an RES on rates in the South could be negligible (Figure 4). For the average household in the South over the next two decades, monthly energy bills under an RES are expected to change by less than \$2 relative to the Reference case.

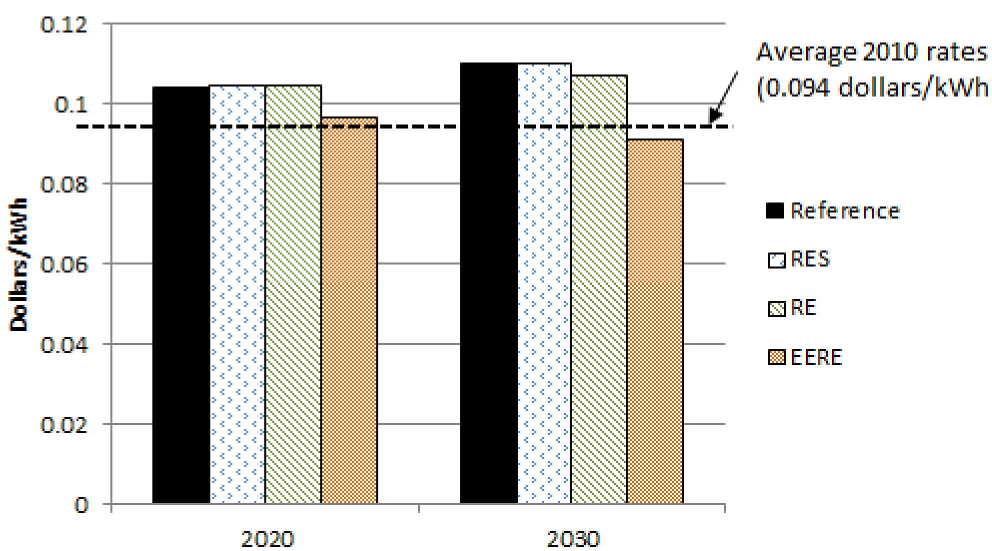

Figure 4. Average Residential Electricity Rate in the South in 2030

Moreover with complementary renewable policies and updated resource availability inputs, as represented in the RE scenario, forecasted rates in 2030 could be slightly lower than in the Reference case (Figure 4). These reductions are largely the result of greater renewable resource supply and increases in customer-owned renewable generation such as CHP, heat pump water heaters, and demand-side solar PV. As a result, the RE scenario could save the South's residential sector on the order of $100 billion over the next two decades, while driving a large expansion of renewable generation in the region. These results show that informed policy measures can promote renewable energy and yield energy bill savings to end users in the South at the same time.

In the EERE scenario, forecasted rates are reduced even further due to lower demand. Residential rates in 2030 under the EERE scenario are $0.091/kWh (Figure 4), which means that by 2030 the average household in the South could be saving about $50 per month on energy bills relative to the Reference case. When efficiency policies are enacted alone, residential electricity rates in 2030 are $0.095/kWh, a 14% reduction from the Reference case in 2030.

These comparisons highlight the tradeoffs inherent in energy policies with respect to program investments, costs to end users, and changes in the mix of resources used for electricity generation. Although such tradeoffs exist, they are not always intuitive and have sometimes been misread by decision makers. Contrary to conventional wisdom, our modeling shows that renewable generation can be stimulated without causing electricity rates to rise for consumers any more than is expected with increased fossil generation. Indeed, when energy efficiency is promoted at the same time, renewables can be expanded while also achieving substantial reductions in end-user electricity rates and bills.

Myth 4: Energy efficiency and renewable energy policies are not compatible.

The compatibility of energy efficiency and renewable energy policies is a topic of ongoing debate. On the one hand, some advocates call for emphasizing energy efficiency over renewable energy. A *Wall Street Journal* article in June 2009 stated that "The U.S. government is committing billions of dollars to support renewable energy such as wind- and solar-power plants. Some say it should use more of that financial clout to encourage less energy consumption in the first place." (The Wall Street Journal, 2009). Many policymakers and analysts agree with U.S. Rep. Peter Welch of Vermont that "We should have the policy of efficiency first"

(Efficiency First, 2011). On the other hand, analysts have argued that strong energy efficiency policy may undermine domestic renewable technologies and jobs. For example, the World Resources Institute suggested that the inclusion of energy efficiency in a federal Clean Energy Standard (CES) "reduces the ambition of the overall program, because it would displace new clean generation that would otherwise be required. Therefore, if the goal of enacting a CES (or RES) is to expand the domestic market for new, cleaner electric generation technologies (including the domestic manufacturing and other industry jobs associated with these policies), allowing energy efficiency to quality will actually undermine this core CES policy objective." (World Resource Institute, 2011). This myth about the competition of energy efficiency and renewable energy policies has lead people to believe that one must be pursued over the other.

Admittedly, there are tradeoffs between energy efficiency and renewable energy. According to our SNUG-NEMS analysis, RE policies without EE policies lead to 339 billion kWh of renewable generation in 2030 while EE policies without RE policies avoid 264 billion kWh of generation. Together, renewable energy and energy efficiency policies lead to less of each, 40 billion kWh less efficiency and 78 billion kWh less renewable generation. However, the idea that large-scale energy efficiency and renewable energy are incompatible is an oversimplification. In fact, they share a common goal which is to increase the share of clean generation overall.

What happens when energy efficiency policies act in concert with renewable policies? According to our SNUG-NEMS results, the main effect would be that less new fossil generation is needed. Though the EERE scenario leads to less new renewables in 2030 than seen in the RE scenario, renewable generation still increases significantly, while simultaneously displacing over 170 billion kWh of fossil generation (Figure 5). Furthermore, a comparison of the new incremental generation in 2030 shows that while the RE scenario reduces non-renewable energy growth by 50% relative to the Reference case, the EERE scenario leads to negative growth. Combining the policies would retire 80 billion kWh of existing natural gas generation in addition to avoiding 204 billion kWh of incremental fossil fuel generation.

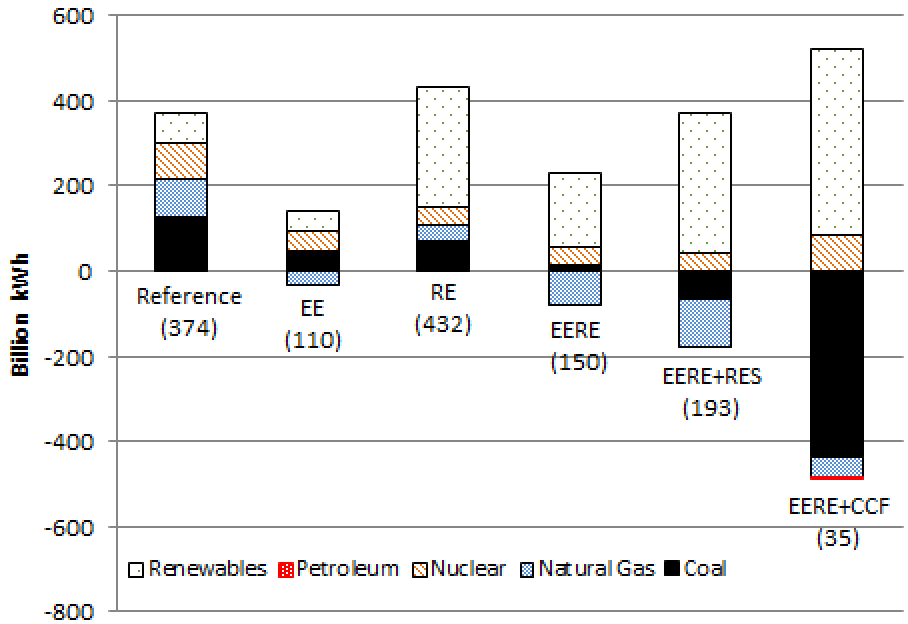

Figure 5. Net Generation Growth between 2010 and 2030 in the South

(Note: Numbers in parentheses are the difference between the billion kWh of new construction shown above the x-axis and the billion kWh of retired generation shown below the x-axis.)

Another way of illustrating how efficiency policies add to renewable efforts is to look at how much of the new incremental generation comes from non-fossil generation in the various scenarios. As shown in Table 2, clean generation accounts for 64% of the net generation growth in the RE scenario and 114% in the EERE scenario.

Does the expansion of renewable energy policies stunt energy efficiency? Comparing the EERE scenario to the EE scenario, the share of renewable electricity more than tripled, while efficiency gains dropped by only 40 billion kWh (Table 2). A modest decrease in cost-effective efficiency is to be expected, as encouraging renewables should improve renewable penetration vis-à-vis non-renewables as well as efficiency. Although efficiency proponents fear that promoting renewables would create a large amount of new demand for electricity, the EERE and EERE+RES scenarios show that policies promoting renewables lead to the displacement of coal and natural gas generation at twice the rate that efficiency is reduced (Figure 5).

Table 2 Electricity Generation Growth, 2010-2030 (Billion kWh)				
Energy Source	**Reference**	**EE**	**RE**	**EERE**
Total Generation Growth, Non-renewable Fuels	303	63	153	-20
Renewables	71	47	278	171
Efficiency (energy savings relative to Reference case)	-	264	-58	224
Total Clean Energy Growth (Renewables and Efficiency)	71	311	221	395
Net Generation Growth	374	110	432	150
Renewable Energy (as a percentage of Total Generation Growth)	19%	43%	64%	114%

The truth is that rather than being caught in rival relationships, energy efficiency and renewable energy are aligned. Certainly, there is less renewable growth over time when aggressive efficiency policies are adopted, but that is because there is less generation growth overall. They both work towards the same goal of realizing a clean energy future, and our scenario analysis indicates that they are compatible in this pursuit. If energy efficiency and renewable energy are implemented simultaneously, less electricity generation would be needed while a greater portion of the remaining demand could be met by cleaner sources of energy. This would reduce fossil fuel dependence and yield significant environmental and public health co-benefits as well.

Myth 5: Cost-effective energy efficiency and renewable energy policies are sufficient to retire existing coal plants and reduce air pollution.

Current forecasting expects that coal, natural gas and nuclear will remain the three largest sources of electricity generation over the next twenty years. Utility-side renewable generation is projected to increase slightly, from 6% in 2010 to 7% in 2030. New coal-fired power plants are the largest additional resource. As a result, CO_2 emissions in the region would increase steadily over the next two decades, reaching 2,650 million metric tons in 2030, which is 247 million tons more than in 2010.

Energy efficiency and renewable energy both have great potential to mitigate climate change by replacing polluting generation. However, there are misconceptions about how successful these policies can be by themselves. A recent study from the Sierra Club states that wind, solar and energy efficiency alone have the potential to “eliminate demand growth and displace existing coal consumption" in certain regions in the U.S. (Sierra Club & Climate Recovery Partnership, 2011). McKinsey & Company estimated that the climate change mitigation potential from energy efficiency could be 1.1 gigatons of GHG emissions per year, equivalent to removing the entire fleet of U.S passenger vehicles and light trucks from the road (McKinsey & Company, 2010). These perspectives promote the belief that energy efficiency and renewable energy would be sufficient to retire existing coal plants.

Our SNUG-NEMS analysis indicates that even with strong policies to promote energy efficiency and renewable energy, fossil fuel generation would continue to expand in the next twenty years, though at a slower pace relative to the Reference scenario. Widespread deployment of energy efficiency measures would displace 32 billion kWh natural gas generation in 2030, and if coupled with renewable energy policies, together they would retire over 80 billion kWh of natural gas generation (Figure 5). However, in these scenarios, electric generation from coal and total CO_2 emissions continue to grow (Figure 5 & 6). We conclude that renewable and efficiency policies can reduce fossil demand growth and displace existing natural gas generation, but cost-effective policies alone will not displace existing coal generation.

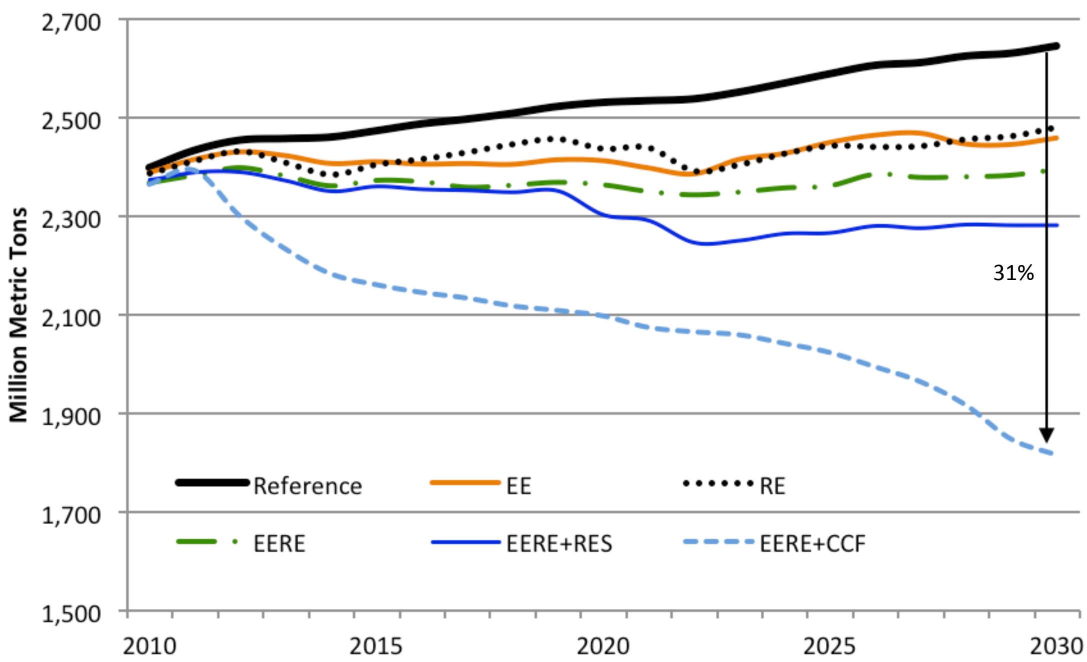

Figure 6. CO_2 Emission in the South

Recently, scholars have suggested that a price on carbon would need to be added to energy efficiency and renewable energy policies in order to displace existing coal generation (Arar and Southgate, 2009; Bird, Chapman, Logan, Sumner, and Short, 2011; Palmer, Paul, Woerman, and Steinberg, 2011; Energy Modeling Forum, 2011). Our EERE+CCF scenario represents such a situation. It adds a price on carbon to the energy efficiency and renewable energy policies and results in significant retirement of coal generation and much less overall demand for new generation by 2030 (Figure 5). The generation gap left by the retired coal-fired plants (437 billion kWh) is met almost entirely by new renewable generation (435 billion kWh). Moreover, CO_2 emissions in the South are projected to decrease by 31% in 2030 relative to the Reference scenario (Figure 6).

In order to evaluate the effect of alternative carbon prices on coal plant retirements and CO_2 emissions, we conducted a sensitivity analysis of the EERE+CCF scenario. Relative to our original CCF scenario, we tested two lower prices for CO_2 and one higher price to assess whether a price threshold exists below which coal plants are not significantly retired. These sensitivity cases include the following prices for CO_2 in addition to the assumptions that comprise the EERE scenario.

- A Low Tax scenario based on a proposal by Roger Pielke, Jr. intended to raise revenues for investments in innovation (Pielke Jr., 2010). Specifically, the tax per metric ton of CO_2 starts at approximately \$4 in 2015 and rises to approximately \$8 in 2030.
- A Moderate Social Cost of Carbon (SCC) scenario based on estimates made by the U.S. Government Interagency Working Group on the social cost of carbon (U.S. Environmental Protection Agency, 2010). These prices are based on estimates of the monetized damages associated with incremental increases in CO_2 emissions. These damage estimates are approximately \$23 per metric ton of CO_2 in 2015, rising to \$32 in 2030.
- A High Tax scenario loosely based on a carbon tax sensitivity side case that was published in conjunction with EIA's *Annual Energy Outlook 2011* (Energy Information Administration, 2011c). This scenario includes a carbon tax that is approximately 50% higher than that used in the CCF scenario, starting at about \$28 per metric ton of CO_2 in 2015 and rising to \$78 in 2030.

Table 3 shows that rising carbon prices are associated with reductions in both CO_2 emissions and coal generation. Modest levels of coal plant retirements not seen in the EERE scenario start to occur even with low carbon prices. The reason that energy efficiency and renewable energy resources are unlikely to replace current generation without a price on carbon is due to the different economics of existing and new generation. The largest expense of existing coal generation is the cost of fuel, which is relatively low and is likely to remain low in the absence of targeted policies to penalize coal for its human health and environmental costs. Energy efficiency and renewable resources typically cannot compete with such economics, particularly with older coal plants that have been fully amortized. In contrast, energy efficiency and renewables can be cost effective at meeting growing demand when compared with alternative new generation options.

Table 3 Impact of Alternative Carbon Price Scenarios on CO_2 Emissions and Coal Retirement

Scenario	Carbon Price ($07 / Metric ton of CO_2)	Change Relative to 2010	
	2015 - 2030	2030 CO_2 Emissions	2030 Coal Generation
Reference	$0	10%	15%
EERE	$0	1%	1%
+ Low Tax	$4 - $8	-2%	-5%
+ SCC Moderate	$23 - $32	-12%	-28%
+ CCF	$19 - $52	-22%	-55%
+ High Tax	$28 - $78	-33%	-87%

Since the U.S. has been reluctant to impose a tax on carbon to reflect its social costs (U.S. Environmental Protection Agency, 2010), the retirement of coal plants may instead be prompted by EPA regulations on air pollution (e.g., sulfur dioxide, nitrogen oxides, and mercury), water pollution, and solid combustion byproducts such as coal ash. A recent study by the National Research Council estimated that these non-climate damages from coal power plants exceed 3.3 cents per kWh in $2008 (National Research Council, 2010). Some EPA regulations that address these externalities have already been promulgated and their costs are embedded in electricity prices in the NEMS Reference case. Other regulations are poised for future implementation and are not modeled in the Reference case. Altogether, these regulations could require the retrofit, retirement or replacement of a substantial portion of the existing coal fleet in a short period of time. Cichanowicz (2011) estimates the potential for the near-term retirement of 50 GW or more of coal capacity and capital costs of approximately $100 billion. The point here is that energy efficiency and renewable energy policies are not going to precipitate such changes; rather, coal will be retired by policies that place an economic penalty on coal reflecting its negative externalities.

Myth 6: Power Resource Decisions Have Little Impact on Water Resources.

States generally do not tie water efficiency to energy planning. In fact, most states in the South do not have water-energy legislation (Circle of Blue, 2010). While state water policies are principally developed as a way to reduce energy consumption, according to a survey of energy and water departments by the Center for Energy and Environmental Policy, energy impacts on water usage is often ignored (Belden et al., 2008). Additionally, utilities typically neglect water scarcity in their integrated planning. Five of seven southern IRP's reviewed for this paper, have no discussions of water requirements for power generation, while TVA and Duke Energy briefly mention water as one of many criteria to evaluate future energy portfolios. In contrast, water and energy legislation in California and eight states along the Great Lakes (NY, PA, OH, MI, IN, IL, WI, and MN) consider the water requirements of power production, declaring that "water consumption and diversions must keep energy impacts in mind (Circle of Blue, 2010)."

Georgia's *Water Stewardship Act of 2010* illustrates the myth in the South that power resource decisions have little impact on water consumption. This law requires higher efficiency standards for building fixtures and systems such as cooling towers in industrial construction, but nothing related to energy generation – it does not consider the water-energy connection. This is surprising given the significant impact electric generation has on water use. Next to agricultural irrigation, electricity generation accounts for the second most U.S. freshwater withdrawals, approximately 39% (Hustson et al., 2004). In the South, this figure is even higher – 54% of freshwater withdrawals are for thermoelectric generation, so water conservation through energy planning could have an even bigger impact in this region.

The reason power decisions can impact water quantity usage is that water withdrawal and consumption vary by the fuel type, the cooling system, the power generation technology and the extent of efficiency programs. The quantity of water required for power generation is significantly different for withdrawal versus consumption. Water withdrawal indicates water that is removed, heated and returned to its source; while the water consumed in this process may be modest, the impact on ecosystems can be significant. Water consumption refers to water losses due to evaporation, uptake by plants, or direct use by people. For example, the typical water withdrawal rate of open-loop coal-fueled plants is 75,000 to 190,000 liters per MWh generated. In contrast, coal plants with closed-loop technology require only 1,100 to 2,300 liters per MWh. Certain renewables barely withdraw any water, as electricity generated by photovoltaic solar and wind does not require the use of cooling water. Ultimately, the greatest reductions in water withdrawal occur when energy generation is reduced through efficiency measures.

To estimate the impact of power decisions on water scarcity, water consumption of the six scenarios were analyzed based on incremental generation. Figure 7 shows how much less water would be consumed in the South in 2030 relative to 2010 water consumption under six alternative future generation scenarios. Enhanced energy efficiency and renewable energy policies tend to reduce both water withdrawal and consumption. Using conservative assumptions, such as all new thermal electricity being generated by closed-loop cooling systems due to permitting restrictions on open-loop system, the six scenarios would contribute to water savings in the range of 674 to 1,293 billion liters in 2030. For example, rather than consuming an additional 520 billion liters of water to generate electricity in the year 2030, the CCF scenario would reduce water consumption in the South by 674 billion liters, resulting in a net savings of 1,293 billion liters. A total of 1,293 billion liters of water savings represents the equivalent amount of water to supply 34 days of indoor water use for households in the South and 13 days for all households in the United States in 2030.[5]

While the water co-benefits of clean energy policies attract little attention in energy and water planning today, states and utilities with growing populations and shrinking water resources should examine the water implication of their power decisions. Whether this amount of water is significant enough to change decision making associated with new power resources is an open question, but ignoring the relationship seems imprudent.

[5] To calculate equivalent effects, we used several indicators such as estimated population of the United States and the Southern states in 2030 by U.S. Census Bureau and about 265 liters of average daily indoor water use per capita, consisting of showers (16%), clothes washers (22%), dishwashers (1%), toilets (27%), baths (2%), leaks (14%), faucets (16%), and other domestic uses (2%) (Vickers, 2001).

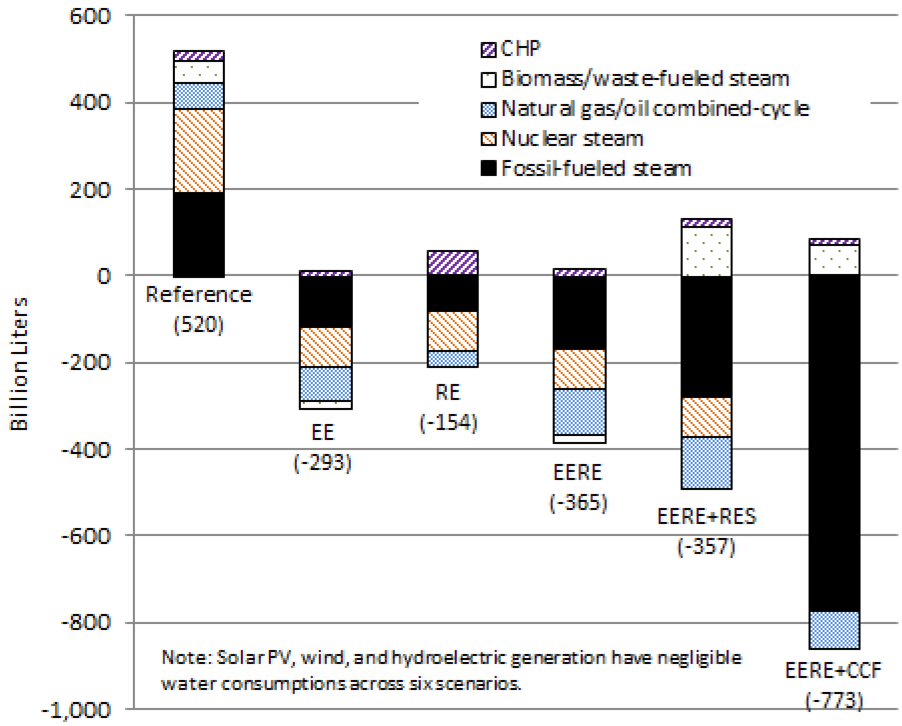

Figure 7. Estimated Water Consumption Savings in 2030 beyond 2010 in the South

(Note: Numbers in parentheses are the difference between the billion liters of additional water consumption required for new generation shown above the x-axis and the billion liters of water savings resulting from retired generating plants shown below the x-axis.)

4. Conclusions

Myths about clean energy exist in the South and have powerful influence on technology investment decisions and public policies. By providing alternative views and interpretations of six myths, this paper seeks to motivate a lively debate about the real options for a clean energy future in the southern U.S.

Energy policy analysis requires sophisticated energy-economic modeling. Spreadsheet analysis and simple economic logic have limited abilities to unravel complex, inter-linked relationships with feedback loops and iterative effects. As a result, they can fail to anticipate the first- and second-order effects of possible policy interventions and technological change. To design wise energy policies for the South, policymakers should acknowlege the risk and uncertainties associated with each decision, diversify their information sources, engage the public, utilize sophisticated modeling tools, and adopt an iterative risk management approach to minimize the adverse impact of drawing false conclusions for sustained periods of time.

Results of this paper suggest that with a suite of well-deployed measures, energy efficiency and renewable energy are able to work hand-in-hand to meet the projected growth of electricity demand in the South without escalating electricity rates. If policies such as a federal Renewable Electricity Standard and carbon taxes were to be implemented on top of other complementary policies, a considerable amount of coal-fired power could be displaced, significantly reducing CO_2 emissions. The water-saving benefits of a future focus on efficiency and renewables could also become increasingly salient as sub-regions of the South experience warmer climates and more severe droughts.

Illuminating energy myths and understanding the belief systems that underpin them, can help to explain a region's private investments and public policies. In so doing, productive public debate can be fostered and the status quo can be effectively challenged.

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