Local Clean Power

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SUMMARY CONCLUSIONS

Southeast states seeking solutions to current and future energy challenges have a major opportunity to use existing technology to harness local renewable energy resources. Our regional assessment, drawing on recent government and regional studies, suggests sufficient renewable energy resources to meet as much as 30 percent of the Southeast's electric power needs within the next 15 years.

National, regional, and state renewable energy potential studies in the Southeast show that available biomass, solar, wind, and hydroelectric resources can play a significant role in meeting the region's 21st century electric power needs. Sustainably developed biomass resources can be an alternative to new coal and nuclear baseload electric power plants. Solar, wind, and low-impact hydropower can be integrated to meet intermediate and/or peak electricity demands.

These resources also offer the opportunity to increase energy independence and realize economic and environmental benefits if policies are designed to ensure regional renewable energy development. States seeking solutions to energy challenges can identify and capitalize on available renewable resources to attract more local investment and new jobs, as well as protect water availability and improve air quality. National economic analyses suggest policy options for developing these renewable resources would have modest impacts for electricity costs and considerable co-benefits (lower natural gas prices and overall consumer savings).

Policy Priorities

Policymakers—at both the state and federal level—can begin to capitalize on the benefits of renewable energy by taking the following steps:

- Establish firm targets and flexible market frameworks with a renewable electricity standard (RES) that requires utilities to generate or source an increasing percentage of their power from renewable resources. A target of 25 percent renewable electricity by 2025 is an achievable goal.
- Provide flexible tax credits, investment rebates, low-interest loans, and market pricing for third-party renewable electric power production.
- Demonstrate leadership by adopting renewable energy requirements for state and federal facilities.
- Develop interconnection and net metering rules, along with advanced grid infrastructure and clear and predictable permitting processes.
- Work with stakeholders to create environmental performance criteria, definitions, and incentives for sustainable biomass energy resources. Provide research and resource monitoring support to ensure adequate supplies and best management practices.
- Commission comprehensive state-level economic analyses of renewable energy opportunities and tradeoffs, with in-depth assessments of resource sustainability and job impacts.

Challenge: Meet Southeast Electricity Demand with Local, Renewable Energy Resources

The Southeast currently accounts for one-fifth of total U.S. energy consumption and this share is expected to grow over the next several years. Today's policy and investment decisions will shape the energy and economic future of the Southeast (see companion briefs on the energy challenge and efficiency opportunities in the Southeast: www.wri.org/publication/southeast-energy-policy). At the beginning of the last century, the United States sought to build a network to provide reliable electric service across the country. Today, the country is facing a challenge of a similar scale as it seeks to develop and expand the use of clean, affordable renewable electricity resources. To meet this challenge, the Southeast should act promptly to identify and develop regional solutions.

States in the Southeast are facing increasing demand for electricity, driven by rapid population growth and higher per capita energy use. Energy efficiency improvements will be a critical part of the solution to the region's energy challenge (see companion brief on energy efficiency opportunities in the Southeast: www.wri.org/publication/southeast-energy-policy). Beyond efficiency, the region also has a portfolio of renewable energy options (see Box 1) that can be developed to meet current and future electricity needs.

State and federal policymakers can help ensure the Southeast is able to rely on local supplies of clean electricity to help meet future energy demands. To achieve these objectives, public officials should seek answers to the following questions:

1. How much of the Southeast's electricity needs can be met with regional renewable resources? Are these resources sustainable? What are the relevant constraints?
2. How do renewable energy resources compare to conventional electricity resources (especially with respect to economic and environmental performance)?
3. What policy steps can help overcome barriers and capitalize on regional renewable energy opportunities?

BOX 1 Renewable Electricity Resources in the Southeast

Renewable energy is derived from natural sources that replenish themselves over short periods of time. States can develop these resources, together with efforts to enhance energy efficiency, to ensure adequate, affordable long-term local electric power supplies. Renewable electric power options available in the Southeast include:

- **Biomass.** Renewable biomass resources—available throughout the Southeast—include energy derived from plant and organic waste materials. Various processes can generate power by burning biomass, either with other fuels (co-firing) or on its own. Biomass resources can include sawdust, forestry scraps, energy crops (woody shrubs or grasses), and gas from landfills, sewage treatment, food processing, and animal waste. (We did not include municipal solid waste in our estimates though portions of those waste streams can be a renewable biomass resource. Emerging technical analyses may be able to measure what portion comes from natural, renewable sources as opposed to synthetic or non-renewable waste.)
- **Wind.** In various parts of Tennessee, Virginia, North Carolina, South Carolina, and Georgia with sufficient wind, spinning turbines can generate electricity. Current technology can capture onshore wind resources and emerging technologies may offer future opportunities to potentially tap into abundant offshore wind resources in the Southeast.
- **Low-impact hydropower.** Available in various parts of all Southeast states, small, non-intrusive power systems can tap energy from moving water (rivers and large streams) with lower environmental impacts than hydroelectricity from new large dams or other structures. (We did not include additional large hydropower projects as part of our estimates, but incremental hydropower from upgrades to these existing structures is included.)
- **Solar.** Heat or radiation from the sun can be captured and converted into electricity with solar thermal or photovoltaic (PV) power systems. Solar thermal applications are likely to be limited to Florida, but ground-mounted and rooftop solar PV opportunities are available throughout the Southeast.

Future renewable opportunities in the Southeast could include emerging technologies that seek to capture energy from the earth's heat (geothermal) and from ocean currents.

Other clean, cost-effective energy resources include energy efficiency and small-scale renewable thermal power production, including solar water heating systems. Energy efficiency is the cheapest, most abundant, and cleanest energy option in the Southeast. Combined heat and power (CHP) technologies and other efficiency gains can help reduce electricity and natural gas demands in the Southeast. Similarly, commercial and residential solar hot water technologies offer energy savings with a combination of renewable energy and efficiency. They use heat from the sun, in place of electricity or gas, to heat water for homes or commercial buildings (for more information on these opportunities, see the companion briefs on energy efficiency and water-energy links in the Southeast: www.wri.org/publication/southeast-energy-policy).

Renewable Resources in the Southeast: Assessing Availability and Sustainability Imperatives

Resource Availability

Our estimate of renewable resources in the Southeast—drawing on recent assessments by state experts, regional stakeholder groups, and national laboratories—suggests substantial untapped renewable energy supplies (see appendix and additional notes at www.wri.org/publication/southeast-energy-policy). Our analysis suggests the region could develop a portfolio of renewable resources over the next several years to meet more than 30 percent of its electric power needs (see Figure 1).[1]

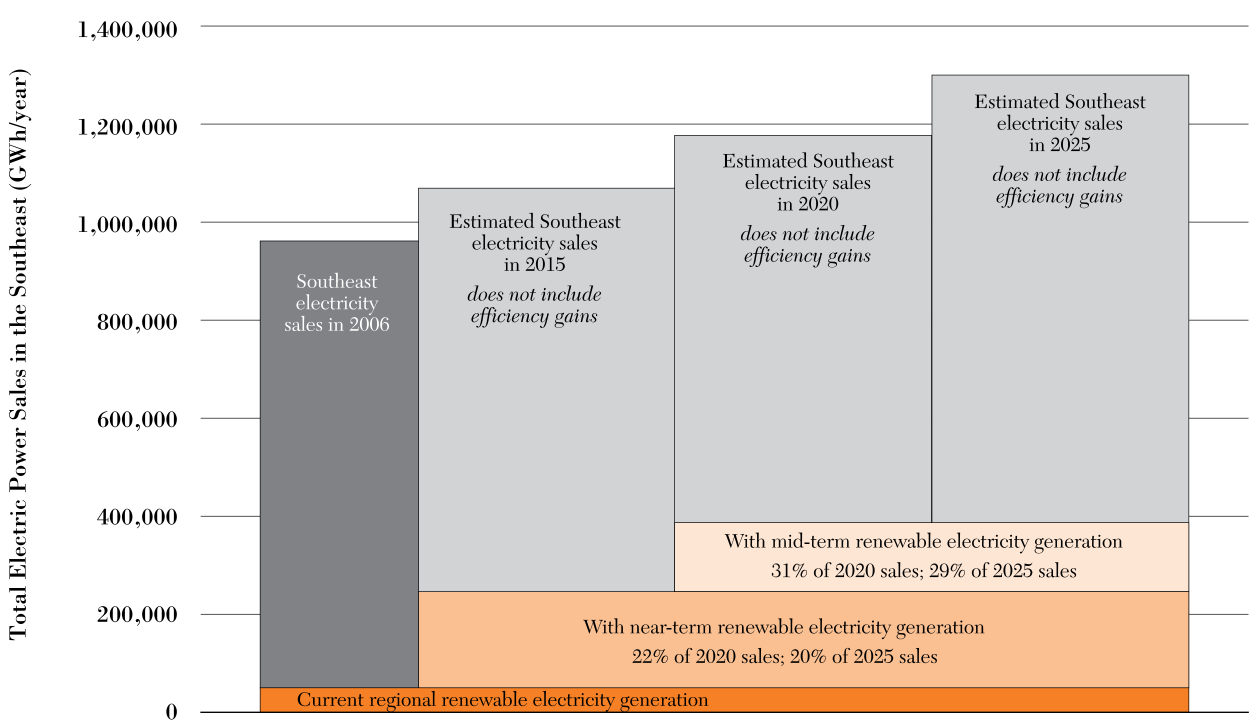
This estimate does not incorporate all renewable resources in the Southeast. It attempts to quantify "feasible" resources that can be developed with available technologies and at reasonable costs—that is, no more than the most expensive conventional electric power options.[2] Our feasibility estimate reflects important near- and mid-term constraining factors, discussed in more detail later.

The Southeast currently harnesses a little more than one-tenth of its feasible renewable power potential—approximately 43,000 of 360,000 gigawatt hours (GWh).[3] Over the next 6 to 12 years, the Southeast can deploy existing, cost-effective renewable power technologies to meet more than 20 percent of its projected electricity needs. As more projects come online through 2025, the renewable electric power generation in the region could exceed 30 percent of total electric power production (see Box 2). The same amount of renewable electricity could represent an even greater percentage if the region can successfully capture energy efficiency opportunities (see companion issue brief on energy efficiency opportunities in the Southeast: www.wri.org/publication/southeast-energy-policy).

To achieve the region's renewable power potential, our estimates suggest that Southeast states can draw on a portfolio of regional energy resources (see Figure 2).

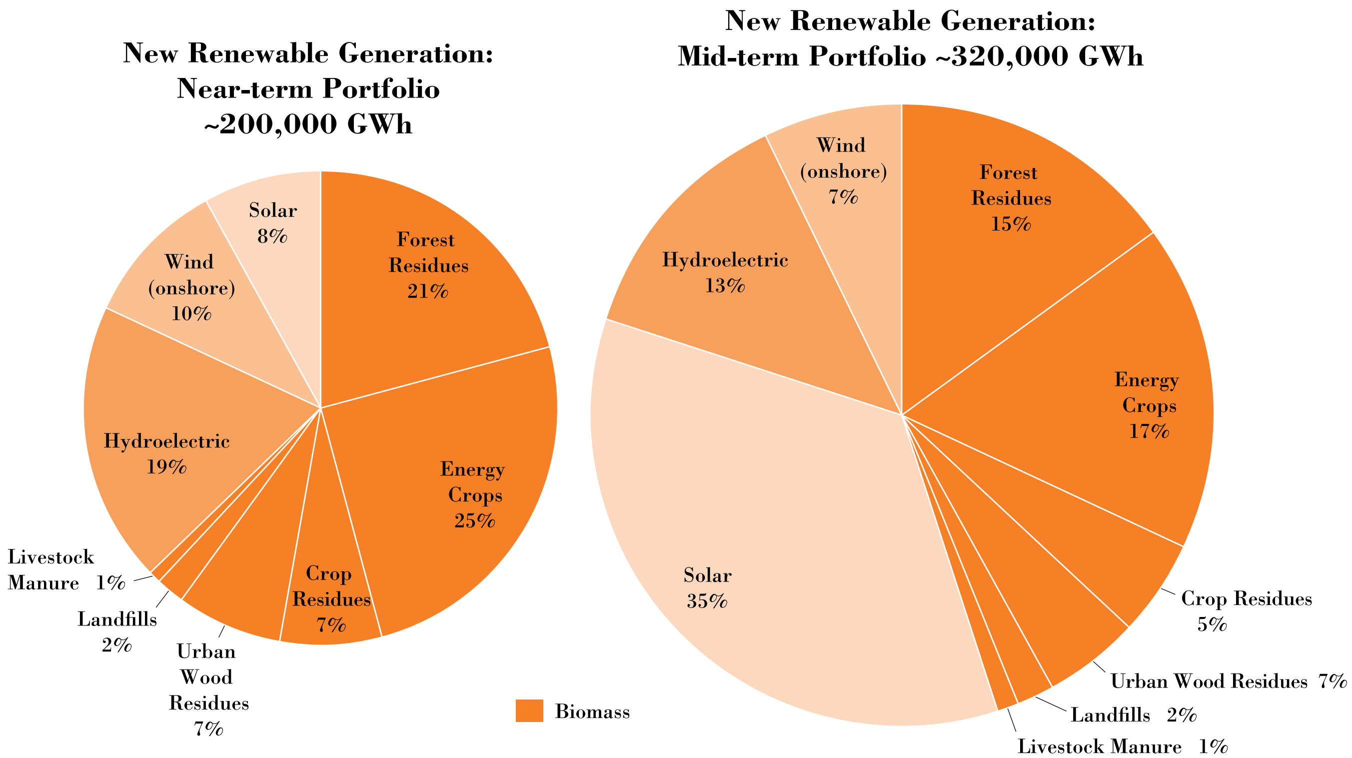
Our estimates suggest biomass resources can help generate much of the region's near-term renewable electricity. These resources are available throughout the Southeast and biomass

FIGURE 1 Renewable Electric Power Potential Compared to Estimated Sales in 2015, 2020, and 2025



Note: Assumes 1.7 percent annual electricity sales growth; not including potential energy efficiency gains. Assumption based on informal review of recent planning assumptions, such as: Navigant's 2008 report for the Florida Public Service Commission "Florida Renewable Energy Potential Assessment." See: www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/Assessment.aspx

FIGURE 2 Estimates for feasible near-term and mid-term portfolio of new renewable electric power (based on a review of recent studies by national laboratories, regional stakeholder groups, and state energy commissions).



Note: Assumes 1.7 percent annual electricity sales growth; not including potential energy efficiency gains. Assumption based on informal review of recent planning assumptions, such as: Navigant's 2008 report for the Florida Public Service Commission "Florida Renewable Energy Potential Assessment." See: www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/Assessment.aspx

power projects are under way in several states. Capturing biomass opportunities for power generation, however, will require close attention to resource constraints and sustainability issues (discussed in the next section).

As for other near-term opportunities, there are various locations in several states (especially North Carolina, Virginia, and Tennessee) that can support cost-effective onshore wind power without imposing burdens on local communities or infringing on national parkland. Low-impact hydroelectric power is another proven technology; with the development of a regional industry to install and maintain these systems, the region can draw power from rivers and streams without costly dam construction or damage to surrounding ecosystems.[4] Large-scale solar water heating and methane gas from landfills (biogas) also offer cost-effective near-term power resources.

Solar resources are expected to meet an even greater portion of the Southeast's electricity needs through 2020 and

TABLE 1 State-by-state renewable energy potential, as a percentage of 2006 total electric power sales

	Feasible renewable electric power potential (as % of 2006 sales)		
	Current generation	**Near-term potential**	**Mid-term potential**
Alabama	12	41	61
Florida	3	11	20
Georgia	4	25	39
Mississippi	3	77	113
North Carolina	5	29	42
South Carolina	3	21	33
Tennessee	7	31	44
Virginia	3	20	31
Southeast Total	**5**	**26**	**40**

Note: Several states with relatively lower electricity demands have renewable resources that amount to significant portion of total sales.

BOX 2 Phasing in a Portfolio of Renewable Electricity in the Southeast

Renewable energy resources in the Southeast can be separated into three general portfolios, based on how resources can be phased in to meet regional electric power demands:

Existing renewable electricity generation includes current electric power production in the region, based on Energy Information Administration data (averaged over 2005-07) for the following categories: hydroelectric conventional, municipal solid waste and landfill gas, other renewables and waste, wind, and wood and wood waste.

The near-term portfolio includes additional renewable energy resources that can be developed today and would begin producing power within the next 6 to 10 years. It assumes development of most of the region's feasible onshore and coastline wind, low-impact hydroelectric, and biomass energy resources, and 15 percent of feasible solar resources (assuming a longer timeline to phase in cost-effective solar power).

The mid-term portfolio includes renewable energy resources that can be deployed through 2025 assuming robust state and federal policies. The portfolio includes all feasible new biomass, wind, low-impact hydroelectric, and solar power resources. In the mid-term, the Southeast can potentially meet approximately 30 percent of its total electricity needs with renewable resources, with biomass and solar PV playing particularly important roles. The cost-effectiveness of Southeast resources compared to resource development in other parts of the country was not evaluated in available research resources.

Beyond 2020, several emerging technologies could dramatically expand the role of renewable energy in the Southeast. Many states—such as Georgia, North Carolina, South Carolina, and Virginia—have abundant offshore wind power resources. A recent U.S. Department of Energy (DOE) study explores the potential for offshore wind technologies to play a major role in powering the Southeast.[1] Based on these and other state potential studies, the Southeast could double or even triple its renewable power production by harnessing regional offshore wind capacity. Moreover, new technologies are being tested that can potentially tap into ocean power along the coasts. There are still unanswered questions about costs, siting, and transmission, but policy action and technology breakthroughs over the next several years will help provide answers.

Some states, utilities and universities in the Southeast are already looking at opportunities to develop these longer-term resources. Below are a few examples of ongoing efforts across the region:

- The University of North Carolina is studying the feasibility of wind energy in the state's sounds.
- Santee Cooper, Coastal Carolina University and the South Carolina Energy Office are measuring offshore wind potential off the coast of Georgetown and Little River.
- Georgia is studying regional transmission infrastructure for ocean-based renewable energy.
- Southern Company has been awarded a federal government lease to monitor and collect site-specific wind data in waters off the coast of Georgia in collaboration with Georgia Tech.
- Florida Atlantic University's Center for Ocean Energy Technology is receiving state funds to explore ocean energy by placing a turbine in the Gulf Stream and studying the generation of energy from extreme temperature differences that naturally occur in the ocean.
- The North Carolina Solar Center and the Future Renewable Electric Energy Delivery and Management Systems Center at North Carolina State University are studying new renewable power technologies and systems.
- The Virginia Coastal Energy Research Consortium is studying offshore wind potential, as well as wave power and marine biomass opportunities.

Note

1. U.S. Department of Energy. 2008. "20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply." Available online: www1.eere.energy.gov/windandhydro/wind_2030.html; www.20percentwind.org/.

beyond as photovoltaic (PV) technologies become more cost-effective.[5] The majority of feasible solar PV contributions are from ground-mounted systems, but there are also important rooftop PV and, to a relatively lesser extent, large-scale solar thermal opportunities. Several states—notably North Carolina and Florida—are currently positioning themselves to capitalize on these opportunities.

States that begin developing these resources today will be in a strong position to capitalize on a growing market for clean, renewable electric power. Without assuming any energy efficiency improvements, each state can meet at least 10 percent of its projected electric power needs with near-term renewable energy resources. With action to capture feasible mid-term resources (particularly solar PV), our assessment suggests each state can generate renewable electricity equal to at least 20 percent of its current electric power sales (see Table 1).

Our analysis of renewable energy resources in the region show the Southeast has just begun to tap into its full resource potential. Utilities and third-party power suppliers are starting to take advantage of renewable energy opportunities. A few examples are listed below from across the region (see Box 3 for additional examples):

- The Tennessee Valley Authority has announced it will purchase 2,000 MW (by 2011) from renewable energy providers offering to supply wind, biomass, and solar power.

BOX 3

Southface Spotlight: Southeast-based Companies Seeking to Capitalize on Renewable Energy Opportunities

Electric power utilities are not the only potential investors and providers of renewable power in the Southeast. There are many large commercial and industrial energy users and renewable energy developers seeking to develop renewable energy supplies. The U.S. Environmental Protection Agency's Green Power Partnership now includes more than 1,000 members from across the country, purchasing more than 15,000 GWh of renewable energy annually—approximately equal to the electricity needed to power 1.5 million homes (www.epa.gov/greenpower).

In the Southeast, there are examples of commercial and industrial investments in renewable energy. Manufacturers in the forest products industry, for example, have harnessed biomass fuels, like sawdust and bark, to help power their facilities. Supportive policies and incentives that encourage industrial combined heat and power systems could lead to expanded opportunities. Other Southeast companies, like Interface, Inc., are seeking to develop renewable energy supplies. In fact, this Georgia-based company has been aggressively pursuing clean energy for 15 years. Interface has been able to utilize regional renewable resources, including a landfill gas (LFG) project for a manufacturing plant in LaGrange, Georgia. However, a lack of regulatory support for third-party renewable power production in the Southeast has limited the scale of regional projects and forced Interface and others to locate major renewable energy investments in other parts of the United States.

Coca-Cola, UPS, Michelin, and Kimberly-Clark are among several other large Southeast-based energy users that are seeking renewable energy opportunities. These and other companies have found the business case for renewable energy to be very strong.[1] While some are driven by internal environmental goals, others are driven by stakeholder or shareholder pressure to reduce climate and energy risks. Most are seeking to take advantage of the clean electricity and stable prices that renewable energy can provide for their commercial and industrial facilities. Policy support can further attract renewable project developers, leading to additional commercial and industrial investments that can build clean energy markets in the Southeast.

By Paul Bostrom

Note

1. Hanson, C. 2005. "The Business Case for Green Power." Corporate Guide to Green Power Markets: Issue #7. Available online: www.wri.org/publication/corporate-gpm-guide-7-business-case-green-power.

- Georgia Power has requested regulatory approval to convert a Georgia coal plant to a 96 megawatt (MW) woodwaste biomass plant with reduced fuel and operating costs, and has contracted for half the output of a similar privately built 110 MW plant.
- Oglethorpe Power is planning two to three 100 MW biomass power plants in Georgia.
- Coastal Carolina Clean Power is converting a small coal-fired power plant (~32MW) in Kenansville, North Carolina, to run on biomass fuels.
- Several other renewable energy producers are launching 50 MW biomass projects in Fitzgerald, Georgia; LaGrange, Georgia; Ahoskie, North Carolina; and Newberry, South Carolina.
- Duke Energy contracted with SunEdison for a 16 MW solar generation facility and also received regulatory approval to install 10 MW of solar panels on residential and business rooftops in North Carolina.
- Progress Energy has announced three 1 MW solar PV projects in North Carolina.
- Vanir Energy announced a 1.5 MW solar heating and cooling project to serve a North Carolina business park.
- Florida Power & Light (FP&L) is planning a 14 MW wind farm on Hutchinson Island, as well as a 75 MW solar thermal facility that will be the world's first hybrid solar / natural gas power plant; FP&L is also pursuing two large solar PV projects in Florida (10 MW and 25 MW).
- A new biogas project in Winder, Georgia, will be producing 243,000 cubic feet of natural gas daily from a landfill in Barrow County—capturing one of many landfill gas (LFG) opportunities in the region (see Figure 3).

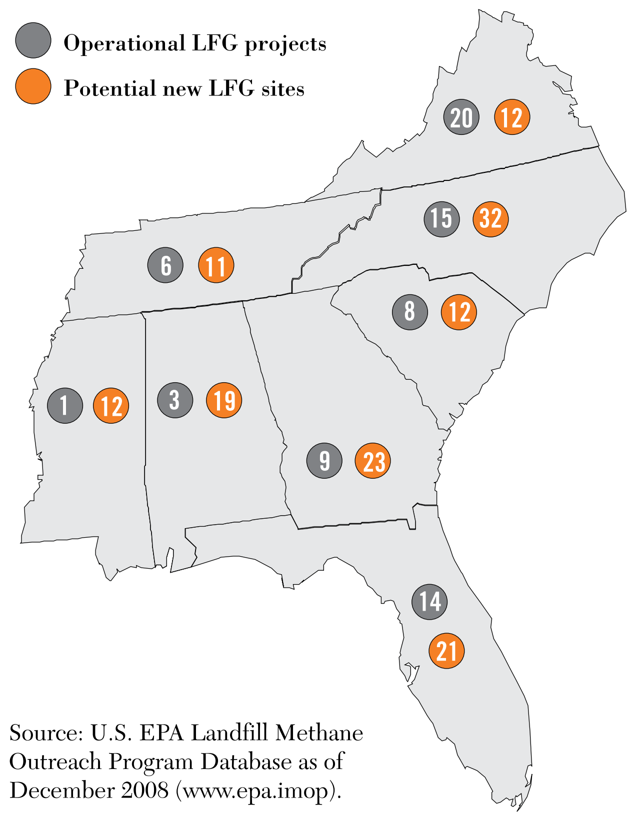
Resource Sustainability Imperatives

During the early stages of renewable energy development, the Southeast should ensure that the transition to renewable resources follows a sustainable and responsible path. By understanding the impacts of new markets for renewable resources, and creating appropriate incentives and safeguards, policymakers can help ensure the region maximizes benefits and minimizes adverse impacts.

Building the Southeast's energy future on the sustainable use of its renewable energy resources opens the door to new jobs, new investment, and new value for natural resources. However, if sustainable resource use is not ensured, then such a future could threaten to undermine social, environmental, or economic conditions.

Renewable energy resource development can enhance local economies by keeping energy dollars within a community. Communities should have a meaningful role in determining how local resources are developed and additional local factors, such as protection of high-value habitat and tourism areas, should be considered as well. Environmental priorities should be part of decision criteria and investments should seek to minimize impacts on water quality and availability, soil qual-

FIGURE 3 Current and Potential Landfill Gas (LFG) Sites



Source: U.S. EPA Landfill Methane Outreach Program Database as of December 2008 (www.epa.imop).

ity, food or energy prices, wildlife and biodiversity, air quality and the climate.

The ecological impact of renewable energy resource development introduces opportunities as well as risks. For example, the need for woody biomass feedstock could add value to existing forest lands and even encourage additional forest growth. Similarly, the economic impact of renewable energy resource development offers new jobs for the Southeast and business opportunities for new and existing companies.

However, increasing biomass demand from biopower plants could compete directly with some non-energy industries that rely on forest resources to produce other high-value goods, such as timber and paper products. Southeast forest resource prices are currently low relative to the global market, so the impact of renewable energy demand on these markets is likely to be complex due to the international market dynamics.

Our estimates for regional renewable energy resources attempt to account for such constraints based on available data and research. However, a detailed policy framework is needed to achieve sustainability goals as the Southeast taps into its renewable energy potential.

Forest resources – Regional power production from biomass, even at the highest level outlined in our estimates, would require annual harvests of no more than 0.2 percent of current forest resources. It is important to recognize the following regional forest conditions: (a) ecological stress on Southeast forests (resulting from unsustainable management practices, fragmentation and invasive species); (b) regional demand for forest and agricultural resources; and (c) potential future biomass energy resource demands, including both biopower as well as biofuels for transportation. To address these conditions, policies should recognize and balance competing expectations for forest resources with careful definitions, research, and monitoring.

Agricultural resources – An area roughly equivalent to 4 percent of today's regional farmland would be needed to grow the energy crops required at the highest level outlined in our estimates. This is not an insignificant footprint, but energy crops can be grown in areas of marginal productivity or disused land where their planting is most beneficial and least disruptive to other land uses. States should ensure that land use decisions provide proper incentives to balance energy and food crop planting. Similarly, our estimates for energy from crop residues are equal to approximately 1 percent of total crop production, but complementary safeguards will be important. Environmental performance criteria for biomass resource development can help support conservation goals, reward best management practices, and minimize negative impacts from land use change.[6]

Wind resources – Wind development feasibility is largely determined by cost-effectiveness, ecological concerns (especially the necessity to avoid bat and bird migration patterns), and impacts on scenic vistas. Each of these concerns can be met at the highest level of resource potential outlined in our estimates. For example, the studies we rely upon exclude the development of wind in national and state parks. From a cost-effectiveness point of view, we assume onshore wind development will be limited to resources rated Class 3 or higher—effectively greater than the pilot wind farm developed for the Tennessee Valley Authority at Buffalo Mountain. For the longer term, investments in targeted transmission grid expansions and new storage technologies can harness additional onshore wind power or tap into offshore resources.

Low-impact hydroelectric resources – Hydroelectric energy development in the Southeast can contribute economic benefits without causing ecological harm. This can be accomplished by limiting the scope of development to small and low-power hydro options that minimize ecological disruptions and are close enough to existing electric power infrastructure to be a cost-effective resource. We base our estimates on the Idaho National Laboratory studies on state-specific potentials that attempt to apply these criteria.

Solar resources – Although the primary constraint to solar power has been cost, the early start already underway in Florida and North Carolina will encourage markets to develop and provide the necessary experience to expand PV technology throughout the southeast. Resource potential data potential data from the National Renewable Energy Laboratory do show that Southeast states have adequate solar energy densities to generate a significant amount of electricity from the sun. New market demands that spur additional research in solar technologies, however, represent an opportunity to capture solar radiation more efficiently and bring costs down. Our estimates assume, however, that solar power deployment in the Southeast is likely to lag behind biomass, wind, and hydropower.

Distributed power generation, for example PV systems on rooftops across the region, can be both a challenge as well as an opportunity. Utilities and grid operators will need to plan carefully for how much solar will be available at certain times during the day. They can also reap significant rewards using the sun to help meet expensive peak electricity demand in summer months.

A Comparison of Electric Power Options in the Southeast

Securing energy supplies for a strong economy in the Southeast involves weighing the costs and benefits of the aforementioned renewable resources as well as other available electric power options. Public officials must evaluate the current and long-term role of various energy resources. In general, energy supply options must be evaluated on whether they will:

- Keep the lights on and costs affordable.
- Attract local investment, create jobs, and spur economic development.
- Improve air quality, protect land and water resources, and reduce climate change risks.

A strong electric power supply mix will balance these goals to meet both immediate and future energy and economic needs. Traditional energy policy considerations focus on con-

TABLE 2 Comparative Assessment of Electric Power Resources with Respect to Energy, Economic, and Environmental Criteria (light grey = low; medium grey = moderate; black = high)

RESOURCE *power supply, output*[1]	LEVELIZED COSTS[2]	WATER USE[3]	AIR QUALITY IMPACTS[4]	CLIMATE CHANGE RISKS[5]
Energy Efficiency	low	low	low	low
Biomass (Baseload, firm)	moderate	moderate	moderate	low
Natural gas (Baseload, firm or peak)	moderate	low	moderate	moderate
Coal (Baseload, firm)	moderate	moderate	high	high
Nuclear (Baseload, firm)	moderate	high	low	low
Low-impact hydro (Intermediate, variable)	low–moderate	low	low	low
Wind (onshore) (Intermediate, variable)	moderate	low	low	low
Solar PV (Peak/intermediate, variable)	high	low	low	low

The above table focuses on electric power options and attempts to compare relative impacts of various energy resources based on the metrics noted below. It does not include other commercial clean power technologies, such as solar hot water systems, that can help meet certain energy demands in the Southeast. For discussion about regional solar hot water opportunities, see companion brief on water-energy links in the Southeast: www.wri.org/publication/southeast-energy-policy.

1. Adapted from slide 212 in Navigant. 2008. "Florida Renewable Energy Potential Assessment." Prepared for the Florida Public Service Commission, Florida Governor's Energy Office, and Lawrence Berkeley National Laboratory. Available online: www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/Assessment.aspx
2. Based on cost estimates (in $/MWh) from Lazard. 2009. "Levelized Cost of Energy Analysis – Version 3.0." Note that cost assessment does not include transmission and distribution costs, future regulatory costs for greenhouse gas emissions, or externalities, such as air pollution and public health impacts.
3. Based on water consumption ranges (in gal/MWh) from Myhre, R. 2002. "Water & Sustainability (Volume 3): U.S. Water Consumption for Power Production—The Next Half Century." Prepared for the Electric Power Research Institute. Available online: mydocs.epri.com/docs/public/000000000001006786.pdf
4. Based on emissions of criteria air pollutants (in pounds/MWh), such as sulfur dioxide, nitrogen oxides, and particulate matter. See U.S. Environmental Protection Agency's Clean Energy Program: www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html and Emissions Factors & AP 42: www.epa.gov/ttn/chief/ap42/index.html.
5. Based on life-cycle emissions of greenhouse gases (in pounds/MWh). Does not include carbon capture and storage. See U.S. Environmental Protection Agency's Clean Energy Program: www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html and Emissions Factors & AP 42: www.epa.gov/ttn/chief/ap42/index.html.

sumer costs, reliability, and air quality impacts. Several other crucial factors should also be part of the decision criteria, including fuel and construction costs, impacts on water and land resources, financial and political risks, and greenhouse gas emissions. Many of these less-recognized factors have become more important amid uncertain fossil fuel costs and population growth, which is expected to put increasing strains on regional water resources and energy infrastructure (see companion briefs on energy challenges and water-energy links in the Southeast: www.wri.org/publication/southeast-energy-policy).

State regulators and policymakers can review their portfolio of energy options to assess how potential resources score against such criteria (see Table 2):

- *Power Supply, Output*. Scale and variability of resources. "Baseload" refers to continuously operated electric power resources, while "intermediate" and "peak" refers to resources that can meet incremental additional demand and periods of high demand, respectively. "Firm" power is from sources for which output can be controlled, while "variable" power comes from sources that fluctuate (for example, wind speed and sunlight).
- *Levelized Costs*. Expenditures for plant construction, fuels, operation, maintenance, and other costs involved in new electric power investments, expressed as the cost averaged over the lifetime of energy output.
- *Water Use*. Freshwater required for power production (including cooling processes) and resource development or extraction.
- *Air Quality Impacts.* Pollutants, such as sulfur dioxide, nitrogen oxide, and particulate matter emitted during power production.
- *Climate Change Risks.* Environmental impacts from greenhouse gas emissions and financial risks related to regulatory action to restrict such emissions.

States should also consider other important direct and indirect consequences of energy options, including:

- *Local Investment Benefits*. Investment stimulated in local fuel resources, jobs, and manufacturing.
- *Land Use*. Potential benefits (added values, protections), risks or burdens (emissions, waste, fuel extraction, land requirements) to ecosystems and other natural resources.

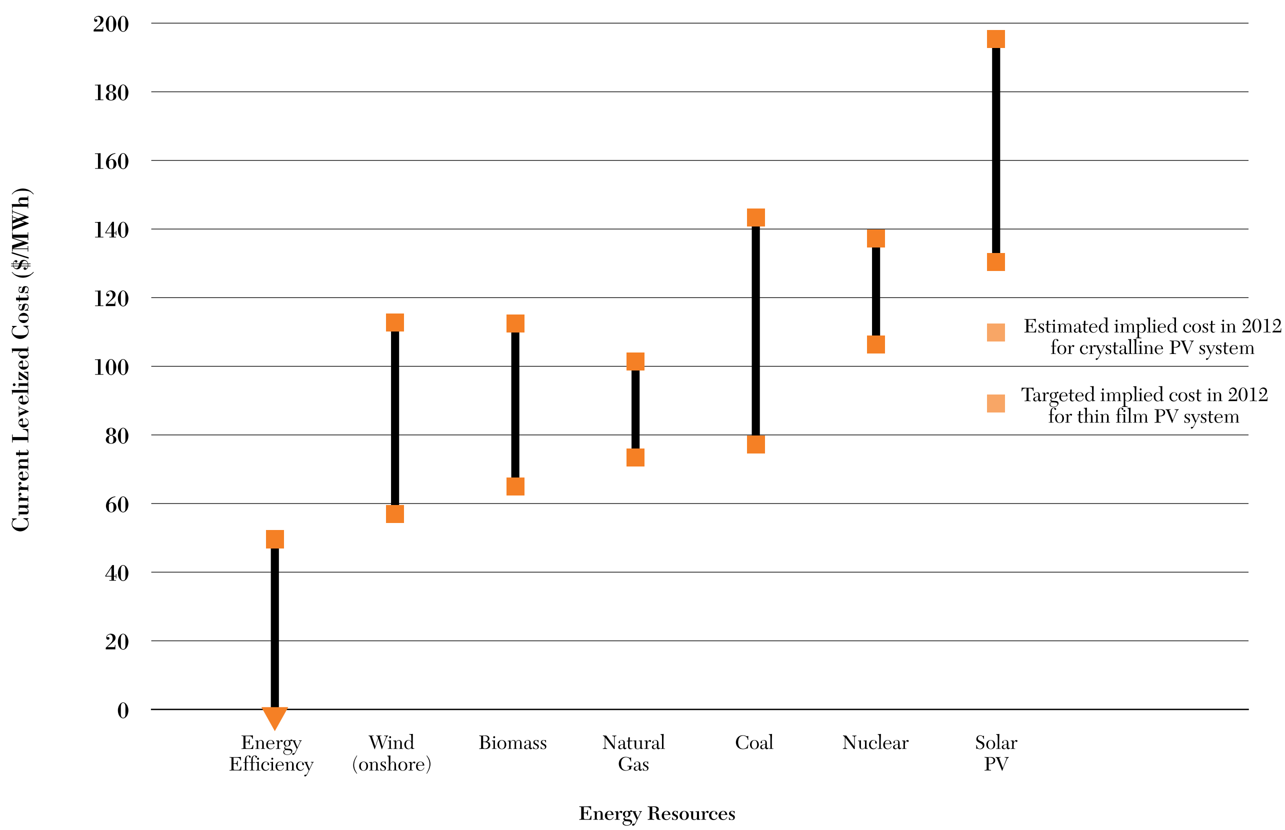
Energy efficiency is the most cost-effective energy resource and rates favorably with respect to all economic and environmental factors. Energy efficiency can often have negative levelized costs, indicating a net savings (see Figure 4). As technologies improve, there are continuous opportunities to capitalize on energy efficiency resources. Estimates suggest these efficiency gains can help meet most of the increasing energy demand in the Southeast and should be a priority for energy investment in the region (see companion issue brief on energy efficiency opportunities in the Southeast: www.wri.org/publication/southeast-energy-policy).

For new power supply options, the assessment of existing energy technologies in Table 2 reveals important factors to consider in plans for meeting future electricity needs not met through improved energy efficiency. One key characteristic to account for is the type of power supply and output. Biomass, coal, natural gas, and nuclear options provide firm, reliable sources of baseload electric power. Other resources are currently best suited for peaking or intermediate roles in an energy portfolio due to variability in sunlight and wind speeds. Progress in grid management (including so-called "smart grid" upgrades) and emerging technologies like compressed air energy storage suggest that solar and wind resources can play an expanded role in meeting future regional power needs.[7]

Levelized costs for each energy technology option are mostly in ranges that overlap (see Figure 4).[8] Costs will vary with individual projects, but it is important to note that technology advancements have closed the price gap between renewable energy and conventional power. Nuclear and solar PV are currently the most costly energy resources to develop, though recent forecasts suggest solar costs will continue to decline in coming years with the addition of new manufacturing capacity.[9] Looking ahead, it can also be expected that electric power generators will face increasing costs if they use significant amounts of water or produce emissions that impact the climate or local air quality.

Several electric power options present risks relating to water availability and air quality. Nuclear power plants require significant amounts of water, as can coal or biomass power production, depending on the technology used at the power plant.[10] In the Southeast, approximately two-thirds of all freshwater withdrawals currently go to thermoelectric power plants (see companion issue brief on water-energy links in the Southeast: www.wri.org/publication/southeast-energy-policy). This is a particular concern for Southeast states dealing with droughts and increasing populations. Natural gas-fired power plants typically require less water and solar and wind power use little to no water.

FIGURE 4 Costs of Various Electric Power Resources



Source: Adapted from Lazard's 2009 "Levelized Cost of Energy Analysis – Version 3.0."
Notes: Figure does not include costs for low-impact hydropower resources as figures are highly variable and dependent on the specific project and location. Cost assessments can be expected to change over time. Estimates do not include transmission and distribution costs, nor do they factor in a future cost on greenhouse gas emissions or externalities, such as air pollution and public health impacts.

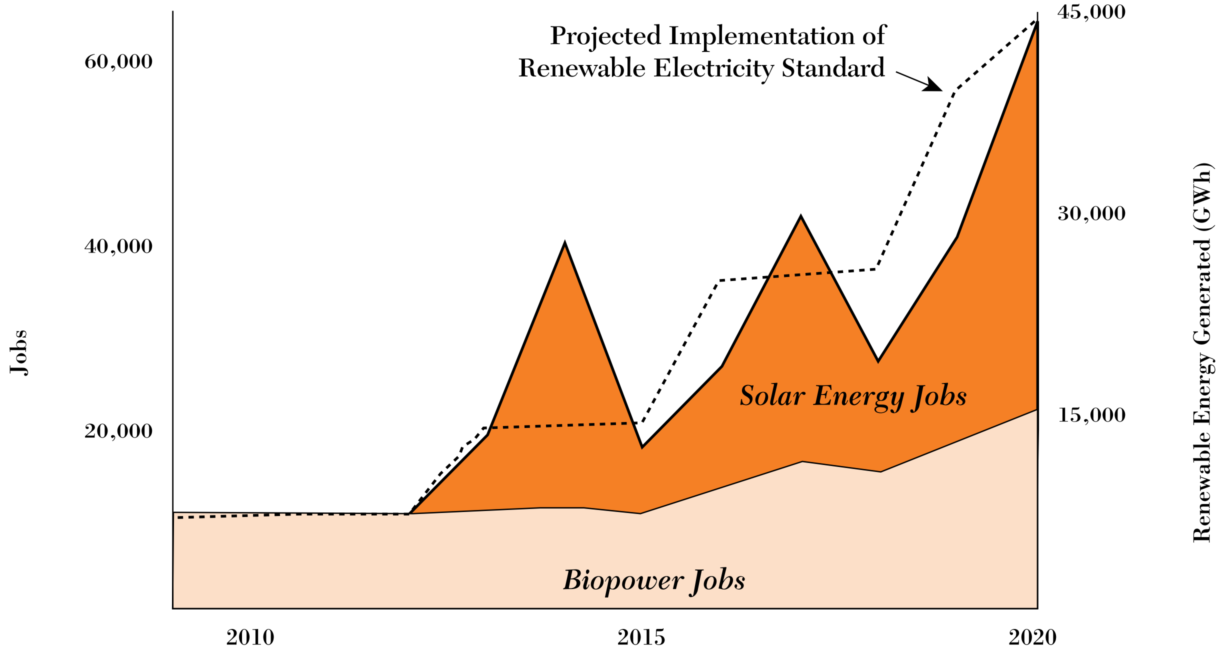
Air quality risks are highest for coal, though natural gas and biomass combustion also contribute to air pollution. Other renewable resources do not have significant impacts on air quality. Emissions relating to the transport and delivery of fuels are beyond the scope of this analysis, but can also lead to additional air quality risks.

In terms of other key factors to consider, regulators and policymakers should recognize how energy investment decisions will influence regional economics and land use. Investments in conventional power resources (coal, natural gas, and nuclear power) generally require fuel or other imports from regions outside the Southeast. According to the Union of Concerned Scientists, states in the Southeast spent more than $1 billion dollars in 2006 on coal imports from Columbia, Indonesia, Poland, and Venezuela.[11] A focus on developing regional renewable energy resources—particularly biomass and solar—would help focus energy investments and job development in Southeast states (see Figure 5).[12] Various studies suggest numerous economic benefits with renewable resource development, including:

- Investments in renewable resources would lead to more jobs than investments in conventional power production.[13]
- Southeast states could be a major supplier of the components and equipment for the solar and wind power industries.[14]
- Biomass investments could spur additional job growth and economic development in other sectors.[15]

Potential land use impacts are a concern for all electric power resources except energy efficiency, though efforts can be

FIGURE 5 Renewable Energy Job Growth Potential in Florida



Source: Based on analysis in Navigant's "Florida Renewable Energy Potential Assessment" and job estimate data from University of Florida's "Wood to Energy Fact Sheet." (edis.ifas.ufl.edu/pdffiles/FE/FE69700.pdf) and Navigant's "Economic Impacts of Extending Federal Solar Tax Credits" (http://www.seia.org/galleries/pdf/Navigant%20Consulting%20Report%209.15.08.pdf).

Notes: Estimates based on a scenario where four large investor-owned utilities in the state are required to meet a goal of 20 percent renewable electricity by 2020. Assumes 25 percent of solar manufacturing occurs in Florida. Job estimates include construction and operation jobs relating to biomass and solar power only (other renewable resources in Florida would create 500 additional jobs).

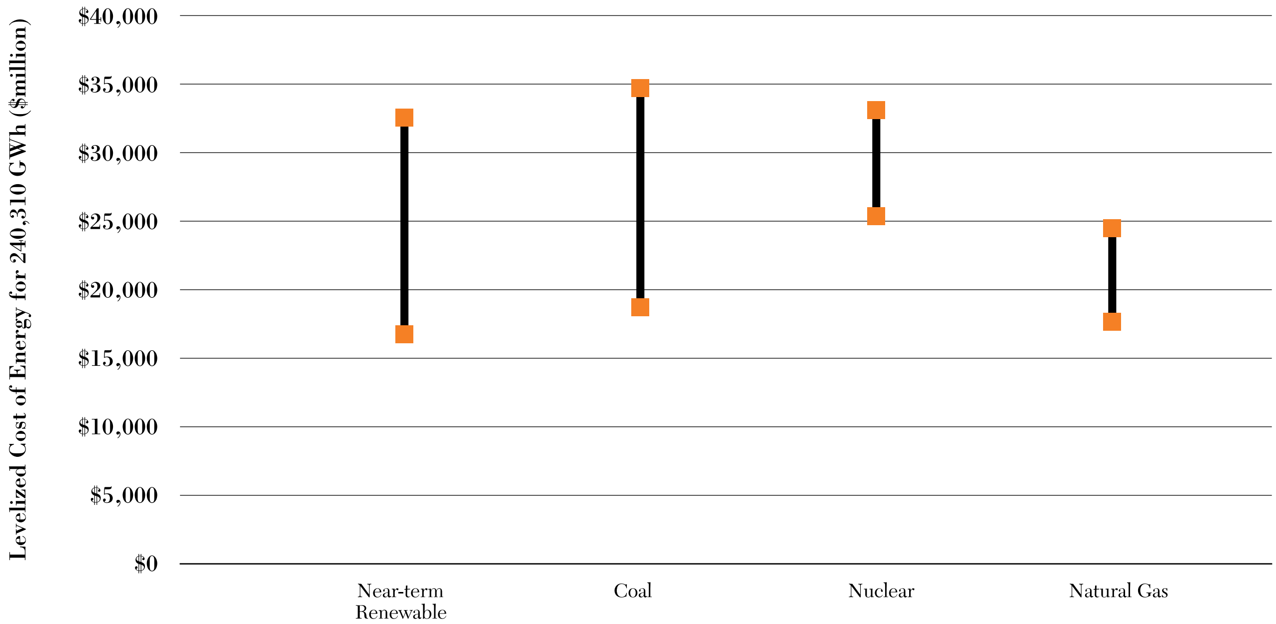
made to minimize negative direct and indirect impacts and capture opportunities to realize land use benefits. Life-cycle land use impacts are a primary concern for biomass power production.[16] A significant amount of land can be impacted in the process of growing and combusting the fuels, leading to issues such as erosion, deforestation, or degraded land or water quality. Extracting raw materials and disposing waste related to coal, nuclear, and natural gas power can lead to similar issues for land and water resources.[17] Land use concerns for wind, solar, and hydro power are focused on the point of energy production.[18] Here the issues are related either to the amount of land required (for wind turbines or solar panels) or impacts to the local ecosystem (hydropower). In many cases, there are options for minimizing these impacts.[19] Energy resource demands can also increase land values, which presents an opportunity to focus development on marginal or neglected lands, for example leveraging this increased value to encourage additional sustainable forest management.

Overall, renewable resources compare favorably to traditional power supplies in many categories. The comparative assessments suggest there can be appropriate and valuable roles for renewable resources in the Southeast. Biomass resources can help meet baseload electricity needs and wind, solar, and hydropower can help serve intermediate and peak power demands. These economic and environmental benefits suggest the Southeast should take advantage of opportunities to integrate renewable resources into the regional power grid.

Policy Roles: Navigating a Transition to Renewable Electricity in the Southeast

Policy has traditionally played a critical role in advancing electric power. When the United States deployed regional electric power grids to power homes and businesses throughout the country, a supportive policy framework helped meet that challenge. Today, a new suite of policies are needed to develop renewable energy resources across the country. States that tackle

FIGURE 6 Illustrative Comparison of Costs for the Southeast's Near-term Renewable Electricity Portfolio (approximtely 240,000 GWh) with Equivalent Power Generation Using Conventional Electricity Resources



Note: Chart presents costs of power production, but it should be noted that energy efficiency opportunities are the cheapest alternative for addressing future electric power needs in the Southeast. Estimates suggest energy efficiency can reduce electricity demand across the region by 110,000 GWh by 2015. See companion brief on energy efficiency opportunities in the Southeast: www.wri.org/publication/southeast-energy-policy.

this new challenge can enhance their energy independence and encourage new markets and jobs to support clean energy industries. States across the country are implementing policies to develop renewable power supplies, providing several best practice examples for other states.[20]

For the Southeast to be well-positioned in emerging markets for clean energy, states will need to take prompt policy action to develop local renewable resources. The Southeast must confront barriers that previously prevented broader development of renewable electricity.

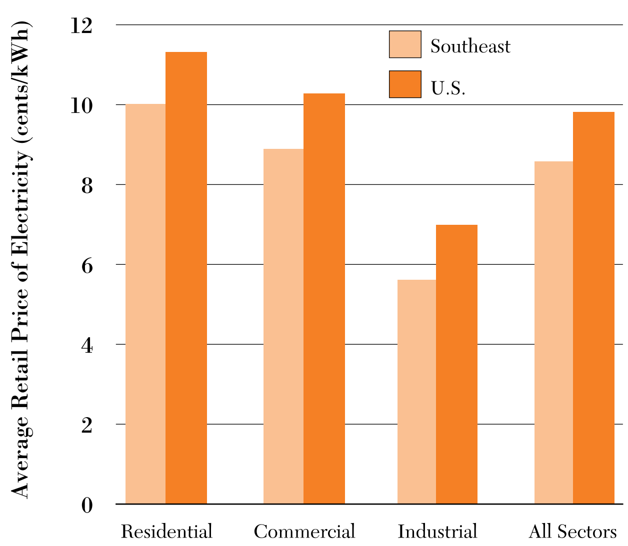
Economic challenges: What will renewable electricity cost? How will it impact jobs?

The economic impact of a transition to renewable electricity resources is a commonly cited concern. A detailed economic modeling assessment for such a transition in the Southeast is beyond the scope of this brief. However, we can apply the levelized cost figures in Figure 4 to estimate the cost of producing the electricity (240,000 GWh) from the Southeast's near-term portfolio of renewable resources (outlined earlier). Costs are comparable to those for new conventional electric power options (see Figure 6).

The range of costs for near-term renewable resources is comparable to new conventional power generation. It is important to note that these estimates reflect current levelized costs. They do not account for future or indirect factors, which also influence economic impacts. Transmission and distribution costs, or a cost on greenhouse gas emissions from fossil fuels, can increase the overall price tag for some options. Other trends, such as fuel or water availability and technology advancements, can also increase or decrease total costs. These and other conditions will ultimately determine delivered prices for consumers.

Consumer cost concerns are of particular interest in the Southeast. Although low electricity rates have been a perceived barrier to greater renewable power development, current retail electricity prices (see Figure 7)[21] are generally not the primary market obstacle. Electric power pricing rules are a more significant barrier. Under current electric power regulatory structures, third-party renewable power suppliers must supply power at or below utility fuel costs—often well below the retail price. Allowing these generators to provide power at prices closer to retail rates would support development of cost-effective renewable electricity in the Southeast.

FIGURE 7 Average Southeast and U.S. Retail Electricity Prices by Sector, 2008



Source: EIA, 2008. *Electric Power Monthly.*

Another key concern, particularly in the current economic environment, is how renewable energy development will impact jobs and industry in the Southeast. State-level studies across the country suggest renewable energy market development can result in 10 to 35 job-years per million dollars of investment.[22] The types of jobs created vary by resource. Biomass power plants typically require more jobs for ongoing operations and less new technology manufacturing or additional training programs. Meanwhile, solar resource development requires relatively less operational jobs, but can lead to new local manufacturing and installation jobs—high-wage opportunities—with supportive job training programs.[23]

As noted earlier, the availability and competition for biomass resources is another important issue to navigate in the Southeast. Careful monitoring of resource sustainability and availability over time will be critical to ensure that the region can meet its energy, economic, and environmental goals. Policymakers should engage stakeholders to develop appropriate definitions, inventories, and incentives for sustainable biomass production. The following are examples of stakeholder groups currently looking at these issues and can be a helpful resource for policymakers:

- Council for Sustainable Biomass Production (www.csbp.org)
- Pinchot Institute for Conservation and Heinz Center Bioenergy Dialogues (http://pinchot.org/current_projects/bioenergy)

As in any other transition, market shifts can result in gains in one industry and losses in another. Economic modeling for impacts in each state are beyond the scope of this brief, but such studies can be useful tools for evaluating options and managing the transition. States should assess macroeconomic impacts of increased renewable power production to help maximize net job creation and implement job training or retraining programs.

Infrastructure challenges: Where are the renewable resources? What new infrastructure is needed?

Aside from onshore wind, renewable electricity resources in the Southeast are distributed throughout each state. Table 3 shows each state's share of regional renewable resources.

Our feasibility estimates attempt to account for transmission and distribution barriers for resources located in remote locations. We focus on the resources that states can develop with existing commercial technologies and without significant electric power grid upgrades. Our estimates of feasible wind power generation, for example, attempt to account for the fact

TABLE 3 Estimates for Feasible Mid-term Renewable Resource Potential, by State, as a Percent of Total Regional Estimate

	Biomass	Low-impact hydro	Solar	Wind (onshore)	All available resources
Alabama	15	25	14	—	15
Florida	13	2	17	—	12
Georgia	15	10	15	14	14
Mississippi	20	6	13	—	15
North Carolina	11	15	13	46	15
South Carolina	8	6	8	3	7
Tennessee	9	28	10	18	13
Virginia	7	8	10	19	9

TABLE 4 Southeast state grades from a 2008 study of net metering and interconnection rules

	Net Metering	Interconnection
Alabama	n/a	n/a
Florida	A	D
Georgia	F	F
Mississippi	n/a	n/a
North Carolina	F	B
South Carolina	F	F
Tennessee	n/a	n/a
Virginia	C	F

Source: Network for New Energy Choices. "Freeing the Grid." Available online: www.newenergychoices.org/uploads/FreeingTh-eGrid2008_report.pdf.

Note: Grades indicate whether existing state policies and rules facilitate renewable electricity opportunities with distributed power generation. Grades range from "A" (encourages renewable energy resources, no major additional restrictions or barriers) to "F" (rules discourage renewable power production with significant additional regulatory and cost barriers). A grade of "n/a" indicates there is no statewide policy.

that much of the regional resources are located in mountainous regions. Our estimates for feasible mid-term onshore wind capacity are relatively conservative. For example, estimates represent approximately 30 percent of the total technical potential for North Carolina and 6 percent for Virginia.

To realize their full renewable energy potential, policy makers should recognize and address other infrastructure challenges. Renewable power generation, such as ground-mounted solar PV arrays and wind farms, can require significant tracts of land. As with siting for conventional power plants, it will be important to engage communities and develop clear processes for siting and permitting. Efforts to involve and inform local residents early in the process can help ensure community concerns are addressed. Clear project permitting rules for renewable electricity resources are needed to ensure timely and responsible resource development—and to expand the role of renewable electricity and achieve longer-term potential (such as offshore wind power).

In terms of other regulatory barriers, a recent study of electric power regulations in the United States suggests that several Southeast states have insufficient rules (or no rules at all) to integrate renewable resources into the electricity grid (see Table 4).[24] In particular, Southeast policymakers and regulators should advance strong interconnection policies that will enable stable electric power supplies from third-party generators. Similarly, states can encourage investments in renewable electricity with net metering rules that allow generators to receive retail credit for the electricity supplied.[25]

The barrier and issues noted above suggest a number of economic and infrastructure policy priorities. Action items outlined below can help capture renewable energy opportunities in the Southeast.

Policy Action Items

Develop Supportive Infrastructure and Complementary Safeguards

State and federal policymakers should take steps to ensure renewable opportunities are captured quickly and responsibly. State agencies and regulators involved in electric power or land use planning can advance streamlined, predictable permitting processes that emphasize environmental protection. Both state and federal legislators should develop careful legislative definitions for qualifying renewable resources that recognize sustainability limits and maintain balance with other competing economic and environmental demands.

In particular, efforts to tap biomass for electric power should include complementary policies that create environmental performance requirements and reward best management practices.[26] Legislators and regulators can develop incentives and rules to ensure sustainable forest and agricultural resource development. Additional research and monitoring will be needed as biomass power plays an increasing role in energy production, whether for electricity or transportation fuels. Frequent and accurate resource inventories at the local level are needed to help balance competing demands for available biomass supplies and assess direct and indirect economic and environmental impacts.

Meanwhile, Southeast states can benefit from policies to prepare the power grid for 21st century demands. States should establish comprehensive interconnection standards and net metering rules to encourage additional renewable electricity. To do so, states can build on regional experience in North Carolina (interconnection standards) and Florida (net metering). The city of Gainesville, Florida recently approved and implemented a "feed-in" tariff that sets a price for power from renewable energy generators.[27] Investments in transmission and distribution upgrades and "smart grid" technologies can help incorporate additional intermediate or variable electricity resources, like wind and solar. Finally, continued research and development efforts at government agencies and universities in the Southeast can help accelerate deployment of emerging offshore wind and geothermal technologies.

Address Market Barriers and Create Incentives to Capture Economic Opportunities

The economic opportunities with renewable energy are becoming well-recognized among Southeast states. A University of Florida study analyzed economic and job impacts of a woody biomass power plant. Results suggested that a moderate-sized biomass power plant (20-40 MW) could create approximately 170 to 370 jobs. It could also generate additional economic activity of $11.07 million (20 MW plant) to $23 million (40 MW plant).[28] Policymakers should review direct and indirect economic and environmental impacts. North Carolina, for example, commissioned a study to assess impacts of implementing renewable electricity targets for utilities and found that it would result in a net gain of approximately 2,000 jobs through 2021.[29]

Federal and state tax incentives, such as power production and investment tax credits or grants, can also help stimulate renewable energy projects.[30] The U.S. Congress recently extended and expanded federal tax credits for renewable power production and investments. It also provided funds for grants covering up to 30 percent of the cost of renewable energy projects.[31] Southeast states can supplement federal incentives with additional state-level policies and incentives. State and federal policymakers should also work to ensure tax credits and grants are refundable and transferable can help engage small- or medium-sized companies, as well as nonprofit organizations interested in developing renewable energy.

Some states and cities are finding that low-interest loans, rebates, or other incentives can be effective means of spurring renewable energy investments.[32] Tennessee, for example, attracted two $1 billion investments in manufacturing plants with a "green industries" credit that covers the costs of any future national fee for carbon dioxide emissions.[33] Other areas are providing loans to homeowners that install solar PV systems and allowing them to pay over time with the accrued savings. Virginia recently passed a law that authorizes localities to provide loans to property owners for the "acquisition and installation of clean energy improvements" to be paid back over time through real estate assessments or water and sewer bills.[34]

In general, as the Southeast states explore options for meeting future electricity needs, it will be important to consider external costs of power production (including air and water pollution).[35] Similarly, states should consider the potential costs over the lifetime of a new power plant—including fuel prices and regulatory costs—to determine whether the investment will be cost-effective.

BOX 4

Southface Spotlight: North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard

In August 2007, North Carolina became the first state in the Southeast to require that electric power be produced from renewable energy resources. Session Law 2007-397 (Senate Bill 3) established a Renewable Energy and Energy Efficiency Portfolio Standard (REPS). It requires electric utilities in North Carolina to use renewable energy, or energy savings due to implementation of efficiency measures, to meet an increasing percentage of retail sales. Investor-owned utilities must meet 3 percent of sales by 2012, 10 percent by 2018, and 12.5 percent by 2021. Rural electric cooperatives and municipal electric suppliers are subject to a 10 percent target by 2021. This represents a modest, but important step toward developing renewable energy resources in the Southeast.

Electric power suppliers may comply with the REPS requirement in a number of ways. Utilities can expand the use of renewable fuels at existing power plants or new facilities. Utilities subject to the requirement can purchase power, or certificates representing renewable power production, from facilities generating renewable energy (including residential, commercial, and industrial facilities). They are also allowed to count energy efficiency improvements toward a percentage of their REPS targets.

The policy support has already spurred project development in the state. Duke Energy is working with SunEdison to develop a 16 MW solar power facility and has received regulatory approval to install 10 MW of solar panels on residential and business rooftops throughout North Carolina. Progress Energy also announced several 1 MW solar PV projects and Vanir Energy is developing a 1.5 MW solar heating and cooling project to serve a North Carolina business park.

For specific information on North Carolina's REPS, see: www.ncuc.commerce.state.nc.us/reps/reps.htm.

By Paul Bostrom

Build Frameworks and Create Targets to Develop Renewable Electricity Resources

States can build on existing efforts across the country to establish rules and frameworks to advance renewable energy. Federal agencies and military installations, for example, are required to purchase at least 7.5 percent of their power from renewable sources by 2013.[36] In the Southeast, both Florida and Virginia have state policies to encourage cost-effective solar power installations for public buildings.[37] Policymakers in the Southeast can adapt and strengthen these public sector targets to demonstrate leadership and support development of local renewable energy industry.

Another increasingly popular approach has been to create a renewable electricity standard (RES), also known as a renewable portfolio standard (RPS). These policies set targets for utilities to meet a certain percentage of their electricity needs with renewable resources.[38] As of March 2009, nearly 30 states (and the District of Columbia) have adopted RES policies with mandatory renewable power targets.[39] Five other states have non-binding renewable energy goals. Among Southeast states, Virginia currently has a voluntary renewable energy goal and North Carolina passed an RES in 2007 (see Box 4). Florida has adopted draft rules for an RES. Additional state action and/or a national-level RES could provide the framework needed to realize renewable energy opportunities across the Southeast.

Much of the recent growth in renewable energy markets has been concentrated in states with RES policies. In 2007, these states accounted for about 75 percent of non-hydro renewable electric power development and could drive development of more than 60 GW of renewable electricity by 2025 (not including new or expanded state RES policies passed in 2008).[40] This growth has helped fuel a boom in renewable energy industries, particularly those producing equipment to tap wind power resources.

In terms of costs, the impact to date on electric power rates has been minimal. Researchers at Lawrence Berkeley National Laboratory studied rate impact in 12 states with enough historical data to analyze, and found that rate increases only rarely exceeded 1 percent.[41]

As for challenges, existing state RES policies vary significantly from state to state and leave renewable energy opportunities in other states untapped. Although more than 60 GW of renewable energy capacity is expected from state RES policies in place in 2007, this represents only 6 percent of projected national electricity needs.[42] Federal policy action to stimulate renewable electricity with a national RES can lead to broad economic and environmental benefits:[43]

- Economic development – job growth and rural investment
- Energy security – diversified electricity mix with local energy resources
- Energy price stability – reduced pressure on natural gas rates and reduced volatility for electric power fuels
- Environmental quality – improved air quality and reduced greenhouse gas emissions

TABLE 5 UCS Estimates for Cumulative Savings on Electricity and Natural Gas Bills (in millions) with a National RES of 25 Percent by 2025

Alabama	$360
Florida	$1,770
Georgia	$1,070
Mississippi	$210
North Carolina	$970
South Carolina	$550
Tennessee	$390
Virginia	$810
Southeast Total	**$6,130**

Source: Union of Concerned Scientists Fact Sheet "Clean Power, Green Jobs" (www.ucsusa.org/assets/documents/clean_energy/Clean-Power-Green-Jobs-25-RES.pdf).

According to analyses by the U.S. Department of Energy (DOE) and others, a national RES policy would have modest impacts on electricity prices.[44] In 2007, DOE's Energy Information Administration evaluated the impacts of a national RES requiring 25 percent renewable electricity by 2025 and estimated average retail electricity prices would increase by about 6 percent ($0.005/kWh) in 2030.[45] More recently, the National Renewable Energy Laboratory (NREL) analyzed a proposal for a 20 percent RES target by 2021 and found it would result in a 1 percent increase in consumer electricity costs in 2030.[46] Both analyses suggested these impacts would be partially offset by natural gas cost savings and other studies have suggested the same. The Union of Concerned Scientists (UCS) recently released an analysis that estimated Southeast states could save more than $6 billion on electricity and natural gas bills by 2030 with a national RES calling for 25 percent renewable electricity by 2025 (see Table 5).

Studies by the Renewable Energy Policy Project suggest that creating national markets for renewable energy could lead to additional manufacturing jobs and investments in Southeast states. National demand for wind and solar power systems, they estimate could create more than 30,000 new jobs and more than $10 billion in total investment in the region.[47]

These analyses reinforce the opportunity to leverage federal policy action to increase national renewable electricity production. They also reinforce the urgency of advancing complementary policies and incentives to develop sustainable, renewable resources in the Southeast.

APPENDIX: Basis for Renewable Resource Estimates

Below is a brief summary of the resources used in assessing Southeast renewable resource potential. The primary authors and links to relevant studies are provided where applicable. Assessment is based on initial data and analysis in the March 2009 report "Yes We Can: Southern Solutions for a National Renewable Energy Standard" by the Southern Alliance for Clean Energy. For full discussion of methodology and data, see http://www.cleanenergy.org/images/files/SERenewables-022309rev.pdf.

BIOMASS ESTIMATES

The primary source for biomass data is the *Bioenergy Roadmap for Southern United States* by Alavalapati et al. 2009 (www.saferalliance.net/projects/roadmap.html). This report provides the technical potential in terms of resource volume and potential energy value for forest biomass, crop residues, urban wood residues, livestock manure, and methane from landfills. Energy crop figures are from Milbrandt 2005 (www.nrel.gov/docs/fy06osti/39181.pdf). Additional analysis to convert these data into potential electric capacity and develop feasible capacity and generation estimates assumes an 85 percent capacity and uses conversion factors from government or national laboratories. To determine feasible resource potential, factors from a Florida study by Mulkey 2008 (snre.ufl.edu/research/greenhouse.htm) were adapted to the resource categories used in this analysis.

SOLAR ESTIMATES

The most authoritative analysis of solar energy potential in the Southeast is the *Florida Renewable Energy Potential Assessment* by Navigant 2008 (www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/Assessment.aspx). All Florida data for the solar energy resource are derived from this study, which used three policy and forecast scenarios that resulted in different levels of renewable energy potential. Since there is no comparable data for any other Southeastern state, the Florida study findings were extended to other states using technology-specific adjustment factors. For a full discussion of the solar estimate, see online appendix at: www.wri.org/publication/southeast-energy-policy.

ONSHORE WIND ESTIMATES

A variety of resources were used to estimate onshore wind energy resource potential, including those by Appalachian State University in North Carolina and Tennessee, 2007 (Method for Estimating Potential Wind Generation in the Appalachians). For eastern North Carolina, data were obtained from a study of North Carolina's renewable energy resources by La Capra Associates 2006 (www.ncuc.commerce.state.nc.us/rps/rps.htm). For Tennessee, extensive data were provided to the Tennessee Valley Authority by Carson and Raichle 2005 (linkinghub.elsevier.com/retrieve/pii/S1364032108000373); these data required some analysis for purposes of summarization following methods used for North Carolina. AWS Truewind data were used for Georgia and South Carolina estimates (navigator.awstruewind.com/). Data for Virginia are from the Virginia Center for Coal and Energy Research (dls.state.va.us/GROUPS/elecutil/Reports/Incr_Use_Renew_Energy_VA.pdf). Florida data are from Navigant 2008. No studies have identified significant onshore wind resources for Alabama or Mississippi. Small, specialized wind generation opportunities might exist in these states, and there might be limited opportunities for utility-scale generation on ridgelines in northeast Alabama.

LOW-IMPACT HYDROELECTRIC

The potential hydroelectric generation is from an Idaho National Laboratory study (INL 2006: hydropower.inel.gov/resourceassessment/index.shtml).

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SOUTHEAST ENERGY ISSUE BRIEF SERIES

The World Resources Institute (WRI)—together with the Southeast Energy Efficiency Alliance (SEEA), Southern Alliance for Clean Energy (SACE), and Southface—compiled high-level overviews of regional opportunities to enhance energy efficiency, develop renewable electric power resources, and manage water-energy relationships. These briefs and supplemental state-level data are available at: www.wri.org/publication/southeast-energy-policy.

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Energy Foundation	Southern Energy Efficiency Center	U.S. Department of Energy
Oak Foundation	Turner Foundation	WestWind Foundation

NOTES

1. Estimates are based on recent state, regional, and national renewable energy resource assessments. See Appendix and full discussion in the Southern Alliance for Clean Energy's 2009 report "Yes We Can: Southern Solutions for a National Renewable Energy Standard." Available online: http://www.cleanenergy.org/images/files/SERenewables-022309rev.pdf.
2. Our assessment estimates the Southeast's "technical" renewable energy capacity to be about 1,200 GW and the "feasible" capacity to be about 280 GW. Feasibility refers to the amount of energy that can be produced by generation that is or soon will be technologically feasible, economically attractive, and environmentally sustainable, contingent on adoption of state and federal policies discussed in this report.
3. Our assessment estimates the Southeast's "feasible" renewable energy potential to be approximately 240,000 GWh/year in the near-term (6 to 12 years) and more than 360,000 GWh/year in the mid-term (through 2025).
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