Renewable Energy Research

Georgia Power and Southern Company have been active in renewable energy research for many years. Over the last five years we have invested six million dollars in renewable energy research, include such options as biomass, wind and solar.

Georgia Power received regulatory approval recently for its green energy program and will begin offering electricity generated from renewable sources by early 2004. The major energy resource will be landfill methane gas, though we also plan to use solar and wind resources.

The company has supported many renewable energy research projects such as:

- the Georgia Tech Natatorium, where the company funded about $1 million for photovoltaic solar cells to help heat the Olympic pool
- the Solar Total Energy Project (STEP) located in Newnan, including photovoltaic research for large utility-scale applications.
- Future I and Future II – both solar and demand-side demonstration project homes
- 241 Ralph McGill – the corporate headquarters, which was built with active and passive solar features
- power generation research with photovoltaics including lighting, water pumping and cathodic protection

These are just a few examples and don't include the millions of dollars invested by Southern Company on cleaner fuel technologies, including gasified coal, clean coal, biomass in the form of an award-winning switchgrass program (being tested at Georgia Power's Plant Mitchell), and the additional monies invested through the Electric Power Research Institute (EPRI).

All of this said, there are some key misconceptions about the viability of renewable energy:

- Capacity: All the gadgets in our homes and businesses require tremendous amounts of power. Most small-scale renewable sources, such as solar panels for a household room, can provide only a fraction of the power needed for a residence.
- Cost: In the case of solar panels on a household roof, you'd have to pay thousands, perhaps tens of thousands, of dollars for such a system. Our fossil and nuclear plants produce energy at a cost of less than 4 cents/kWh compared to 10 - 25 cents/kWh for some renewables.
- Environmental Impact: Many types of renewable sources require large amounts of land. The reality is – at least so far – every form of energy production that we know has an impact on our environment. Windmills make noise and kill birds; solar cells take up space; biomass must be incinerated like fossil fuels; hydro plants dam up rivers and streams.

Solar

Solar photovoltaic (PV) involves converting sunlight directly to electricity with solar panels. Depending on the technology, commercially available cells convert about 7% to 13% of the incoming sunlight to electricity. The solar power is DC and has to be converted to AC to be put on the electric grid. Advantages of solar power include low emissions, no fuel and no moving parts. Other solar power issues include:

- Solar panels have excellent applications in remote, non-grid locations
- Power from solar panels is expensive, 20-30 cents per kwh depending on the site location, compared with 3.5 cents per kwh for a new coal plant or about 4 cents per kwh for a gas combined cycle plant
- Because solar power is intermittent, energy storage or backup generation also is required to meet customer demand, further increasing the costs

The intensity of solar energy resources is stated in watt-hours per square meter per day and is typically displayed on maps such as Figure 1. Because of the relative low intensity of this energy source in the southeastern U.S., solar is not commercially viable for large-scale power generation in this region.

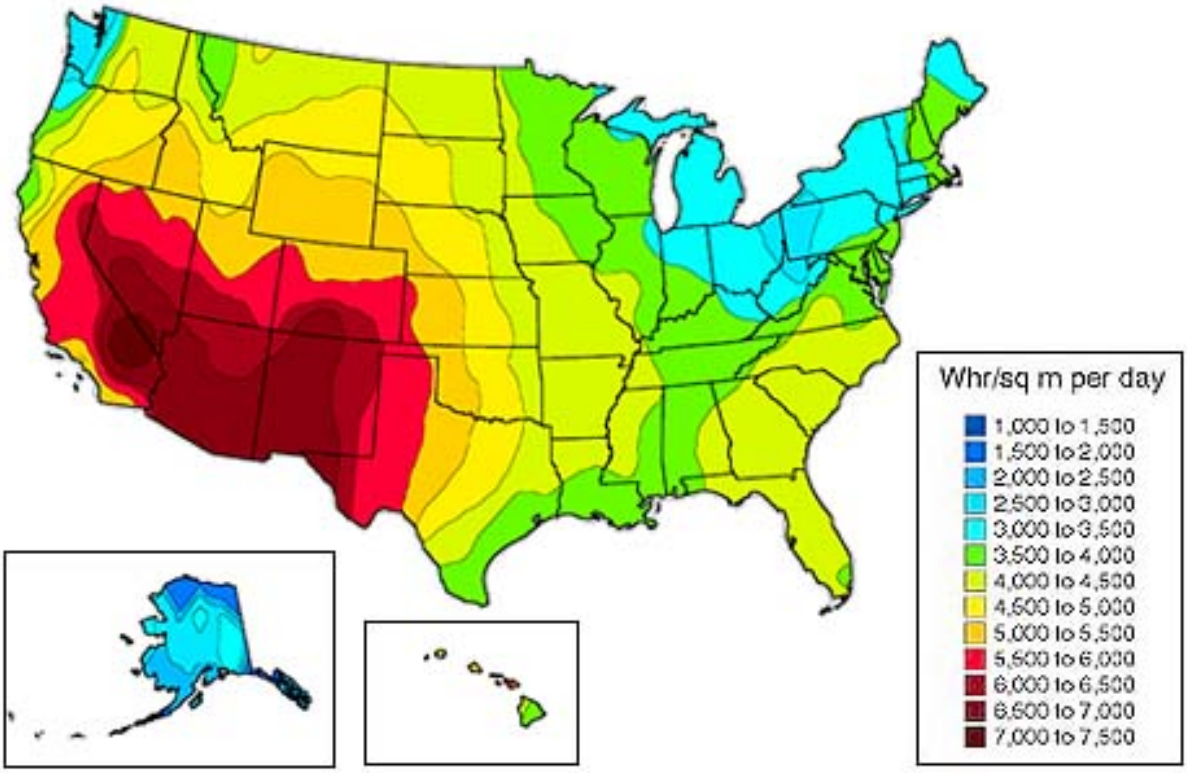

Figure 1. *U.S. Solar Energy Resources*

Biomass

Biomass is a more cost-effective option than solar for renewable energy in the southeast. With partners, including the U.S. Department of Energy (DOE), Southern

Company is studying switchgrass, a rugged and fast-growing grass, as a renewable fuel for co-firing with coal in existing power plants. Pilot scale test results show promise for reducing emissions.

In the initial tests burning switchgrass with coal led to lower emissions of carbon dioxide and sulfur dioxide and also mercury. In addition, there were no operational problems. As a result, Southern Company committed to a three-year demonstration of biomass co-firing at Plant Gadsden (Alabama Power) – using switchgrass and other biomass fuels, with the expectations of improving the initial results and gaining more knowledge.

Georgia Power is also actively evaluating substituting pelletized switchgrass for coal. We hope to be able to use this compressed form of the grass, mixing it with the coal without having to inject the grass separately as required in the initial testing. Two tests using the pelletized switchgrass have already been conducted at Plant Mitchell.

From our ongoing testing we hope to learn how co-firing other types of biomass work with coal; what the long-term effects are on plant operations; what's involved in procuring biomass fuels; and how we can reduce handling and operating costs?

Benefits for Farmers: Switchgrass is a native prairie grass grown easily in the South. It is hardy, grows up to 10 feet on marginal farmland and can be harvested with conventional farm equipment. If used as an energy crop, switchgrass could provide farmers with maximum yields and returns at minimal costs.

Switchgrass has about 50 percent of the heating value of coal per pound. Shredded switchgrass weighs about six pounds per cubic foot – or about 10 percent of the density of crushed coal. It takes about one acre of switchgrass to provide a kilowatt of power – or about two-thirds the power a typical home uses in a year.

Southern Company is also collaborating in a $2.4 million combustor and computer model study to reduce NO_x emissions through biomass co-firing. Since 1992, Southern has routinely co-fired sawdust in small percentages with coal at power plants. To date, co-firing over 120,000 tons of wood has reduced power plant CO_2 and SO_2 emissions, decreased landfill disposals and reduced landfill methane emissions.

Wind

According to the National Renewable Energy Lab, "areas potentially suitable for wind energy applications are dispersed throughout much of the United States. Estimates of the wind resource…are expressed in wind power classes ranging from class 1 to class 7, with each class representing a range of mean wind power density or equivalent mean speed at specified heights above the ground.

Areas designated class 4 or greater are suitable for advanced wind turbine technology under development today. Power class 3 areas may be suitable for future

generation technology. Class 2 areas are marginal and class 1 areas are unsuitable for wind energy development."

Most of the Southeastern U.S. is designated as a class 1 area.

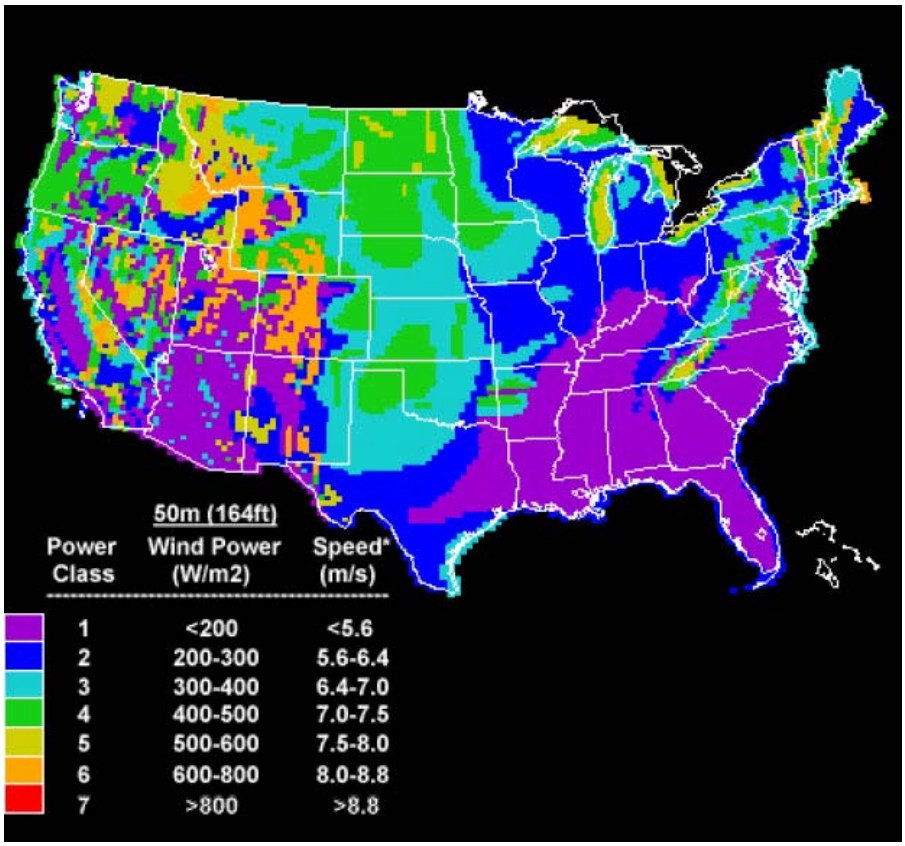

Figure 2. *U.S. Wind Energy*

Landfill gas

Landfill gas is accepted as a renewable green energy supply. This gas is about half methane, and can be cleaned and fired in reciprocating engines. Operators of large landfills were previously required by law to flare the gas, which helps to reduce the cost of the power. Issues related to landfill gas include:

- Landfill owners are interested in this option to help defray some of the costs of the well installations.
- The amount of power available is limited by the number of landfills available. A typical landfill can produce 3 MW to 7 MW.
- Permitting limitations near urban areas – where the greatest landfill gas resources are located – may restrict landfill gas development.

Renewable Energy Portfolio Regulation

You may have read that a pending proposal in Congress would require utilities to generate up to 10 percent of their energy from renewable forms. Here's an interesting analysis of the land requirements and other impacts for some of the more popular renewable sources:

- SOLAR: 230 sq. miles of photovoltaic cells would be needed to provide 10 percent of Georgia Power's generation – when the sun is out – and would cover the area contained within I-285. Now, think of all the hills, creeks, and trees in that area. To cram those solar cells in this space would require that you modify the land, leveling it to hold the panels and their structures. This means you'd also clear all of the trees and probably all vegetation. To prevent erosion, you'd cover the land in gravel; creeks and waterways would be re-routed, perhaps piped underground.

- BIOMASS: Similar land needs for biomass: 3,700 sq. miles of biomass to equate to 10 percent of Georgia Power's generation. To offer some prospective, 3,700 sq. miles of biomass is roughly two times the size of Delaware.

- WIND: To obtain commercial efficiencies from wind turbines, you generally need class 6 winds. There are no such winds in the Southeast. Even if we had class 6 winds, it would take 8,700 wind turbines (1 acre each) to equate to 10 percent of Georgia Power's generation capacity. That "wind farm" would be 2.5 times the size of Hartsfield airport.

Future Options

Georgia Power believes there are roles for renewable energy sources as supplemental forms of generation or for dispersed generation, and the company has spent millions of dollars over the years researching them. Georgia Power is still committed to this research.

The company suggests that instead of mandated requirements, renewable energy applications need to be defined by local conditions and economics.

Renewable Energy Options

Comparative Costs – 10%

Technology	Estimated Cost Cents/kWhr	Comments
Non-Renewable		
New Gas CC	3.6 – 4.0*	
New Coal	4.4 – 4.8*	
Local Renewables		Located in South East
Biomass Cofire	5 - 8	3,700 sq. miles***
Biomass Stoker	10	
Biomass GCC	11	
Wind	-	no local resource
PV Flat Plate	27**	230 sq. miles***
Optimal Renewables		Located at optimal US location
Wind Class 6	4.5 - 4.8**	8,700 machines***
Solar Thermal	8 - 11**	
PV Concentrator	18**	
PV Flat Plate	20**	86 sq. miles***

* Assumes 80% capacity factor, 2005 operation.

** This technology will probably require additional generation capacity to maintain system reliability. These costs are not included here.

*** Required to produce 5% renewable generation in Southern Co.