BIOMASS AND FLORIDA'S FUTURE

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Carrying Capacity of Biomass

In the next 30 years, as non-renewable fuels run out and become more expensive because of the increasing work required to process inaccessible residuals, the economy of Florida, like that of many parts of the world, must draw increasingly from renewable energy flows of sun, wind, rain, and soil resources, mainly through the plant production of biomass. We have called this the green future. The essential human needs for food, clothing, housing, winter heating, electrical service, and transportation are given in Fig. 1, and these are primary requirements of the economy to be obtained through biomass, probably starting as a supplement becoming an increasing fraction with time as those coal resources that are easily mined become scarce.

The means for conversion of the products of plants to human needs for food, clothing, housing, etc., are already known. The problem, however, is that the total amount of biomass which can be produced is limited by the amount of land area with its share of sunlight, rain and soils. The basic efficiency of plant biomass production is fixed and has never been increased by all the years of scientific research. It is apparently a limit inherent in the nature of sunlight being a dilute form of energy. Much of the sun's energy is required by the plants to maintain green structure and concentrate the energy into harvestable biomass.

Increased yields of plants have been developed by diverting the plants' own biomass production away from some of its own maintenance into yield, but this only works when the plants' needs are supplied by technology, using other energy sources. When other energies are not available, the yield of biomass is inherently small, less than that in fuel-supplemented agriculture. Attached to this testimony is a reprint detailing further the limits to biomass production. See also a book (Odum and Odum, 1976, 1980).

As land areas go, Florida's green potentials are relatively high with good sunlight, rain, and phosphate fertilizers close at hand. Many of Florida's present farm practices are high energy and the crops that utilize bare sandy soils readily leach nutrients. However, the potentials are higher for forests and pasture grasslands, which hold and recycle nutrients better where technological inputs are smaller. When phosphates are in excess, plants that fix their own nitrogen are favored.

Table 1 summarizes the energy basis of Florida now, showing large components from renewable sources, from fuels, and from energy used elsewhere to develop goods and services. Of this, a small part is renewable, which means only a small part of the present activity could be supported on renewable energy. Either less people or less energy per person will be required ultimately after the fossil fuels are no longer available. In the near future, we will be in a gradual trend from the present high energy position to the one entirely on renewable energy in the later part of the next century. The carrying capacity for Florida at present standard of living through biomass, the green way, is a million people. If the needs per person are trimmed way down by using smaller houses, less winter heat, less transportation and electrical demands, then the carrying capacity is 2.3 million people. It is doubtful if the present population can be supported with a comfortable standard of living entirely on renewable resources in Florida.

Florida's Renwable Energy Potential
Hearing before the subcommittee on Energy Development and Applications
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Table 1. Perspectives on present energy basis of Florida compared with a renewable energy basis.

Energy basis of Florida in 1978	
Solar and other renewable energies expressed as coal equivalents (CE)*	116×10^{12} Coal equiv. Calories/yr
Outside electricity and fuels as coal equiv.	460×10^{12} Coal equiv. Calories/yr
Imported goods and services which carry embodiment of energy required to deliver	300×10^{12} CE Cal/yr
Total energy in coal equivalents per year	876×10^{12} CE Cal/yr
Population of Florida in 1978 estimated	8.966×10^{6} people
Energy per person in coal equivalents per year	97.8×10^{6} CE Cal/person
If on renewable energies only:	
Energy per person in coal equivalents per year	12.9×10^{6} CE Cal/person
Energy per person in percent of present if based on renewable sources - or % of population on present energy levels	13%
Energy per person if energy demand is reduced by eliminating most air conditioning, private transportation, and enough of goods and services to reduce energy demand to half	49×10^{6} CE Cal/person
Carrying capacity if energy per person is half	2.3 million people

* This is based on a net conversion of sunlight received to biomass of .1% before collection and to coal of .05%.

Since complete dependence on biomass will not be required of us until after the coal period, there is ample time for population levels to fall so that a moderate level of population can be sustained at a moderate level of energy per person, but less than the present.

Comparison of Economic Systems on Biomass and Our Present Sources

Given in Fig. 1 is the energy system of Florida now. Energies of renewable and non-renewable sources are contributing both from within and by import. It would not take much funding to generate these perspectives for the future for expected proportions of renewable and non-renewable energies so as to predict and guide policy in transition. The economy can be just as vital, the circulation of money vigorous, and the modern features of living retained, except that the total quantity of energy for high energy aspects is less. We can retain technological aspects, but less quantity.

Gasahol

Gasahol is not a net energy yielder, and thus is not a way to solve energy shortages; it uses more fuel energy than it makes. It does not yield as much net energy as making fuels from coal or buying it from abroad, even at current prices or prices expected in the near future. Thus, it will not be economically competitive until all the fossil fuels are so remote or dilute that their net energy yield ratios are down to 2 for 1 or less. Currently, fuels are available with a net energy yield ratio of 4 received for 1 used to obtain the fuel.

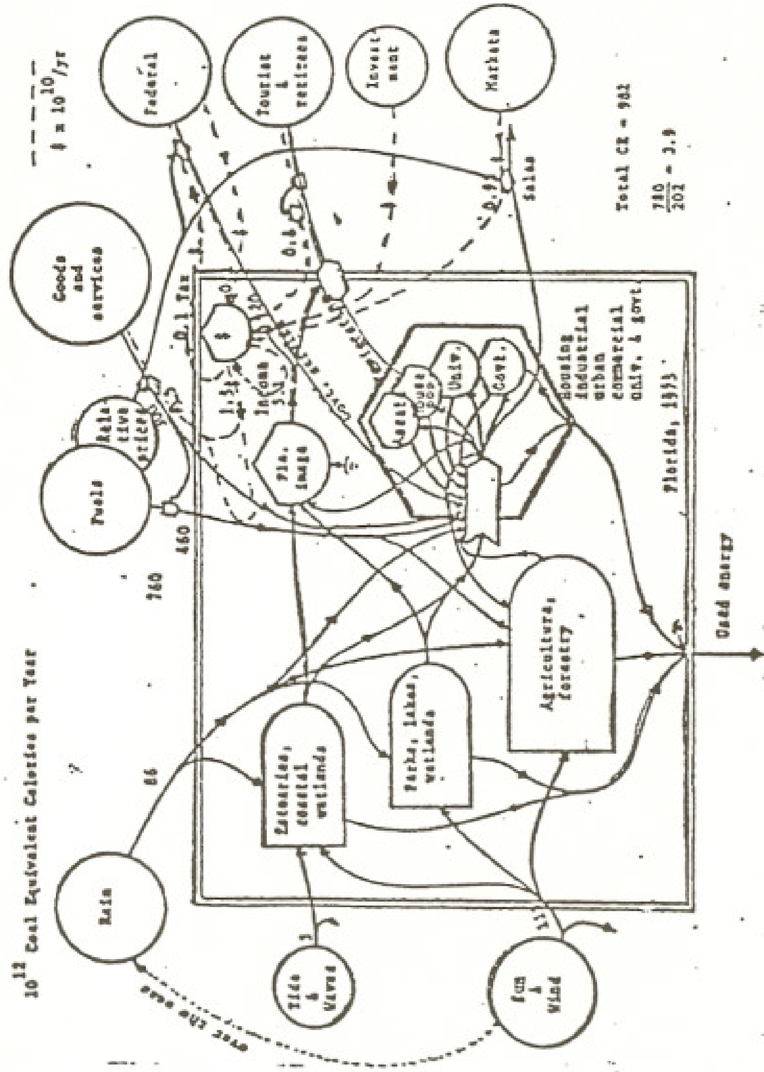

Fig. 1. Energy system of Florida with annual energy flows in Calories of coal equivalents per year.

Energy in Phosphate

The deposits of phosphate in Florida were generated by renewable energies of the natural sun developing shelled limestones with subsequent leaching by vegetation-based acids - also driven by the sun. Our calculations suggest that there are 224,000 Calories of sunlight or 112 Calories of coal embodied in each gram of phosphate rock. In other words, if we run out of phosphate, we will have to use at least this much energy to reconcentrate phosphate for our agricultural fertilizers. This means that phosphate must be looked at as energy when considering trade of phosphate for money abroad. At current prices, Florida receives money with an energy buying power that is only 3% of the energy that is embodied in the phosphate we send out. If this phosphate were put on the forests, fields, and homesteads of Florida, it would stimulate the economy 30 times more than it does when sold abroad. Perhaps the state should embark on a general program, partially private and partially governmental, to spread the unrefined calcium phosphate on top of the state generally, in place of selling it abroad. If the energy calculation is correct, it would increase the basic production of the economy and thus the state domestic dollar product 30 times that generated by sales abroad.

Biomass and Environmental Protection of Native Forest

During a time of changing energy basis, where the population will be under pressure to decrease, there will be exceptional pressures on our environmental reserves, parks, refuges, to supply biomass from wood and peat. This has already begun as people heat homes with wood that has grown back since massive cutting early in the century. Reserves are the sources for seeding the diverse living forms that make biomass areas self maintaining. The native forest, because of its association with well organized plants, animals, and microbes, is wholly self sustaining, so that any land not in direct economic use goes immediately into rebuilding soils, elimininating pests, and developing wild biomass that can be put back into use later. The highest net energy of all renewable resources is the native forest because it requires so little energy to sustain and use. If all the native environments are cut down simultaneously, the seeding is then too far away from lands that are abandoned, and there is a great loss of biomass potential for lack of the necessary seeding of multiple species. Wetlands should be retained at 10% of the landscapes as a way of saving energy in waste water recycling, conserving water, preserving aesthetic values, and generating high quality wood at least cost.

Wetlands and Recycling

As energies become scarcer, great savings and use of renewable energies may come from using wetlands for all waste recycling, using the solar energy of swamp trees and marsh plants to interface between the human wastes and the public water resources of lakes and streams. As documented in an attached paper, a number of ways of doing this are already known and have been studied. Other variations need to be studied so that every county of the state can utilize the green biomass of the wetlands for services of water recycling and conservation.

Center for Wetlands

The wetlands, when regained as 10% to 20% of a landscape, help maintain superficial water tables, lower microclimate temperatures, and reduce air conditioning costs. Wetlands can be used to restore mined phosphate lands. Many wetlands ecosystems help save water by transpiring less.

The Center for Wetlands, founded in 1973 with combined funds of the state, the Rockefeller Foundation, and the National Science Foundation, has been developing the concept of a better symbiotic balance of man and nature, fitting human settlements and wetlands together to save energy and contribute to economic vitality. This uses the biomass production process not only for

valuable quality biomass such as cypress wood for housing, but uses the solar energy for water conservation and waste disposal.

The Center has been developing the kind of overviews of energy and economics given in Fig. 1. These help estimate the energy savings to be obtained from good land use, and develop predictions of the future patterns in the state from declining energies outside. The attached Report of the Director summarizes some of the efforts of the Center. The Center is a solar energy center dedicated to the green way.

The efforts reported here were contributed to by DOE projects earlier (see annual report for 1979), but funds were cut off last year. Apparently our calculations of energy potentials for the U.S. cast doubts on the net energy yield and thus reality of usefulness of nuclear alternatives, solar technology, and synthetic fuels programs. Such news is not popular with either federal or state governments.

Appropriate Technology Program of NSF

Research showing the very large savings of energy and dollars to be obtained through use of wetlands as partners in the landscape and with a lower energy living pattern has been supported by what is now the Appropriate Technology Program of NSF. This program was mandated by Congress earlier, but is being left out of the budget for the future unless Congress makes a special effort to retain it. DOE has declined to support the work to show the energy importance of phosphorus because the officials involved don't understand that phosphorus is a high energy product. Congress needs to induce both NSF and DOE to support energy analysis of public policy alternatives, not only by the industries that are advocating high energy solutions, but by the academic and other independent research agencies whose results may show fault in the national policies.

By showing the energy pattern and levels of activity to which we will be restricted in the future, research can help guide government policies. Since energy is the pervasive basis of our whole fabric of life, it is a fallacy to try to develop energy research of one type in an isolated manner.

Solar Energy Center

Solar technology is a way of conserving energy, but it is not an energy source, since none of the forms of solar technology are net energy yielders. Wholesale subsidy of solar technology is a way to use whatever excess energies above necessities that we still have, but it will not generate any new energy, whereas green biomass will, if it is not too intensively cultivated. Solar technology has too high a ratio of energy in the materials, goods, and services to that captured from the sun. To use sun well, one needs to concentrate its work over acres and acres, not in small expensive panels. Florida's faith in sunlight and its frustration at not finding anything effective to do about energy as a state comes out in its support of solar technology which will be used less and less as energy gets tighter and tighter, since it is mostly the application of fuel based goods, services, and equipment.

What is needed is a solar energy enterprise for the green way, organizing the landscape with wetlands, new homestead-farming for the unemployed, recognition of changing patterns to smaller houses, gradual decentralization of populations, a renewable pattern of biomass production in food, fiber, and forest, and a home utilization of the phosphate to maximize production here.

Energy systems view of public policies:

Energy Basis for Man and Nature by H.T. and E.C. Odum, McGraw Hill, 1976. (Second edition in press, 1980)

Energy Basis for the United States. A report to the Department of Energy, Contract ET-76-S-05-4398 by H.T. Odum et al., 1979.

Net Energy Analysis of Alternatives for the United States. pp. 254-304 in U.S. Energy Policy, Subcommittee on Energy and Power of the U.S. House of Representatives, 66-723. 1976.

Work of the Center for Wetlands in developing a lower energy pattern based on the green way, a balance of man and nature:

Report of the Director, Center for Wetlands.

A Historic and Current Energy Analysis of Florida. Master's thesis by Neil Sipe. 1978.

Solar energy potentials:

Odum, H.T. 1978. Net energy from the Sun. Pages 196-211 in Energy for a Livable Future Comes from the Sun! A Handbook for the Solar Decade. S. Lyons (ed.). Friends of the Earth. 124 Spear St., San Francisco.

Zucchetto, J. and S. Brown. 1977. Comparison of the fossil fuel energy requirements for solar, natural gas, and electrical water heating systems. Resource Recovery and Conservation. 2:283-300.

Mr. Ottinger. We are running way behind time. We certainly do want to hear from Mr. Sherrod, of Sherrod Lumber Co. We are glad to have you with us.

[A biographical sketch of Mr. Sherrod follows:]

Bobby Sherrod

Born March 2, 1924, in Thomasville, Georgia.

Reared in Madison, Florida, where I now reside.

Married to the former Miss Gloria Ray of Sycamore, Georgia.

Father to two children—Susan Evangelidi, Annandale, Virginia; Robert Julian Sherrod, Woodbridge, Virginia.

Veteran of World War II, serving in the European Theater for 2½ years.

Joined my father in the lumber business in 1946 after I was released from military duty.

W. L. Sherrod Lumber Company, Inc., is 62 years old operating in both Georgia and Florida before locating in Greenville, Florida, in 1950.

The business bears the name of my father who is now deceased.

STATEMENT OF BOBBY SHERROD

Mr. Sherrod. Thank you, Mr. Chairman, I will be brief.

It is an honor to be here to tell you of my success in the wood energy changeover from LP gas to the burning of wood. We are firing a dry kiln with it, and a dry kiln is important to the industry, it gives you a chance to dry your lumber within 24 hours and get it to the market, while you have a market. We have been firing this kiln with propane gas, and it burns approximately 1,200 gallons every 24 hours.

Gas had started getting too high. I decided to look for another source of energy. So I bought a gasification generator for a drying kiln and it did not work, and I worked a year trying to get it perfected.