# Alternative Energies For Future Needs . . .

By Gary Gumz

*"Renewable resources are those which, when coupled with proper management, are of inexhaustible supply."*

As late as 1900, North Carolina was basically "energy independent." Families fueled their homes with wood and sun while factories powered their looms by harnessing the flow of water. Communities relied on whatever resources were available in their backyards for heat and fuel.

But with the steam turbine and automobile came progress. Water wheels disappeared as service stations were built. Large-scale centralized units began producing and distributing electricity far cheaper than could small, individually-owned systems. Home furnaces and air conditioning arrived, adding comforts and conveniences never experienced before. This 75 years of progress led to an unprecedented energy dependence. Today, North Carolina imports 99% of its conventional fuel sources from out of state.

Since the first oil embargo of 1973, the dangers of such fuel dependence have become graphic. No longer can we depend on cheap oil or coal. The long range future of nuclear power remains more clouded than ever. Rising energy costs and a recognition of the limits of conventional energy supplies have stimulated a cry for conservation — carpooling, weather-stripping, and lower thermostats. "The energy crisis" has become a catchphrase for our time.

State officials, homeowners, and utility executives would all like to reduce the 99% import dependence. Renewable resources available in North Carolina offer the primary hope for more energy independence. Existing energy systems can be remodeled (retrofitted) to utilize indigenous resources. Technologies available from earlier eras (like hydroelectricity) can be "rediscovered" as applicable for today. And new energy systems can be developed and implemented.

### WHAT'S BEING DONE

In other states which face many of the same problems, large-scale efforts are showing that such dependence can be reduced. In California, for example, San Diego County requires by ordinance that all newly constructed homes have solar water heating units. A homeowner, the county has determined, will pay less to install and operate a solar system than to use a typical gas-fueled water heater. The city of Davis, California, has enacted strict building codes requiring passive solar features and insulation as well as extensive tree plantings in new developments, which greatly reduce air-conditioning demands.

Closer to home, the Tennessee Valley Authority (TVA) has launched several pilot projects to utilize solar power. In Memphis, 1000 homeowners have low interest, long-term loans for the purchase, installation, and maintenance of solar hot water heating systems. To finance the system, participants will pay $13-$17 per month for ten years as part of their electric bill. Customers currently pay $16-$17 per month for water heating. TVA expects the program to assist small businesses to invest in solar equipment and to reduce peak load demand. TVA has also launched the "Nashville 10,000" program to solarize the hot water heating systems of 10,000 existing homes.

North Carolina is beginning to make some advances in large-scale planning for lowering fuel needs. Wilson, N.C., for example, is exploring planning policies that will encourage conservation and utilization of renewables. The 1979 General Assembly approved two tax credits to advance the use of alternatives. One encourages the use of industrial waste heat for generating electricity (a process called cogeneration). The second facilitates the conversion of industrial boilers to burn wood and/or waste wood fuel. The N.C. House of Representatives extended the existing solar tax credit, and the bill now awaits Senate action. Unfortunately, the Legislature defeated an extension of the credit for home insulation.

In October, 1979, the North Carolina Coalition for Renewable Energy Resources (NCCRER) and the North Carolina Land Trustees of America sponsored a statewide conference, "Renewable Energy on the Rise." The U.S. Department of Energy funded a series of such efforts across the nation through the Center for Renewable Energy Resources in Washington, D.C. to promote a wider understanding of the potentials of renewable energy sources. Conference participants such as James Gibson, director of the state Energy Division, Robert Gruber, general counsel for the state Utilities Commission, and Dr. Louis Centofonti, southern regional representative, U.S. Department of Energy, indicated the desirability to conserve and to move towards a greater dependence on renewables. The conference sponsors compiled a catalogue called the *North Carolina Notebook of Renewable Energy Projects,* which currently is the most comprehensive publication on renewable energy resources and appropriate technology in North Carolina.□

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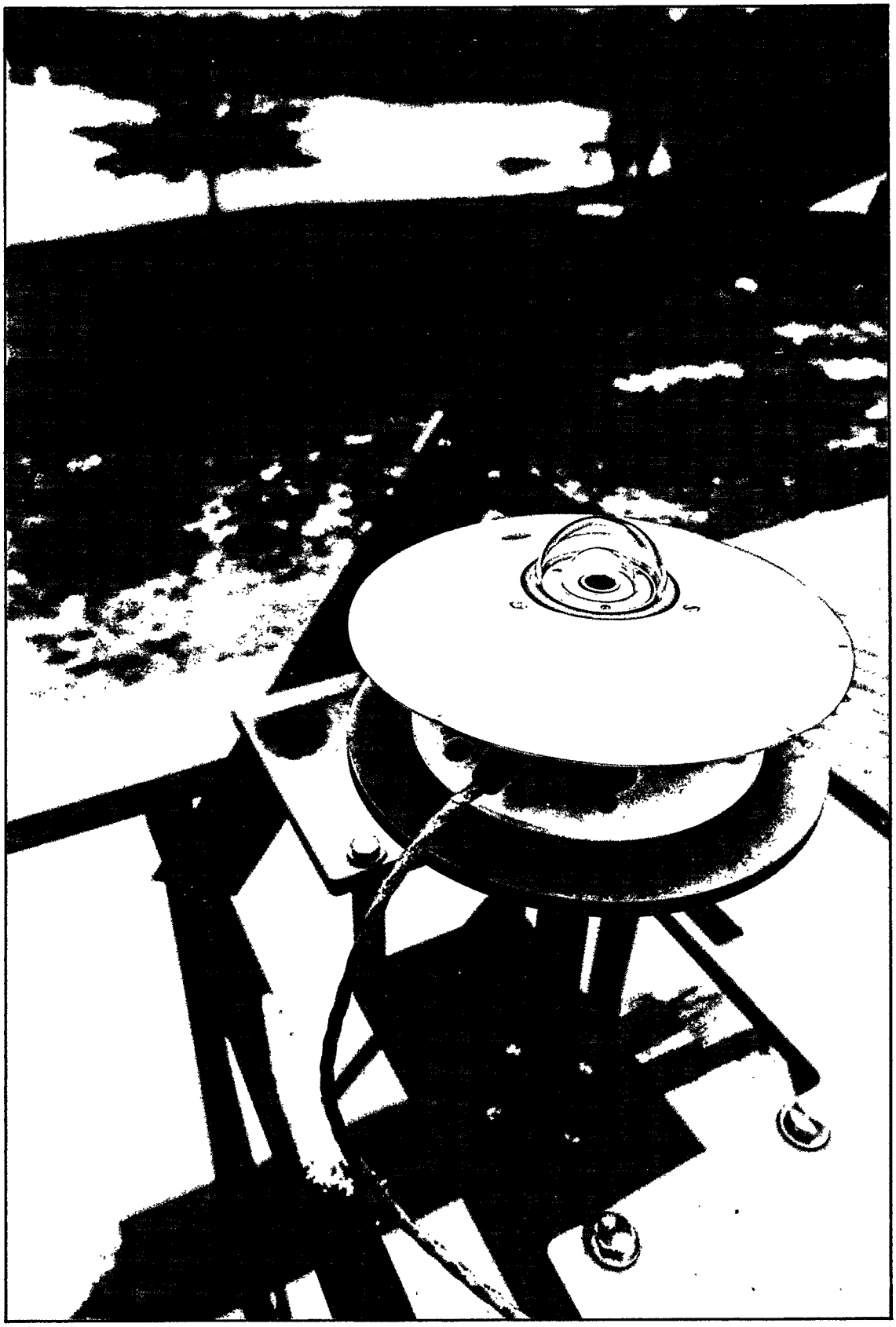
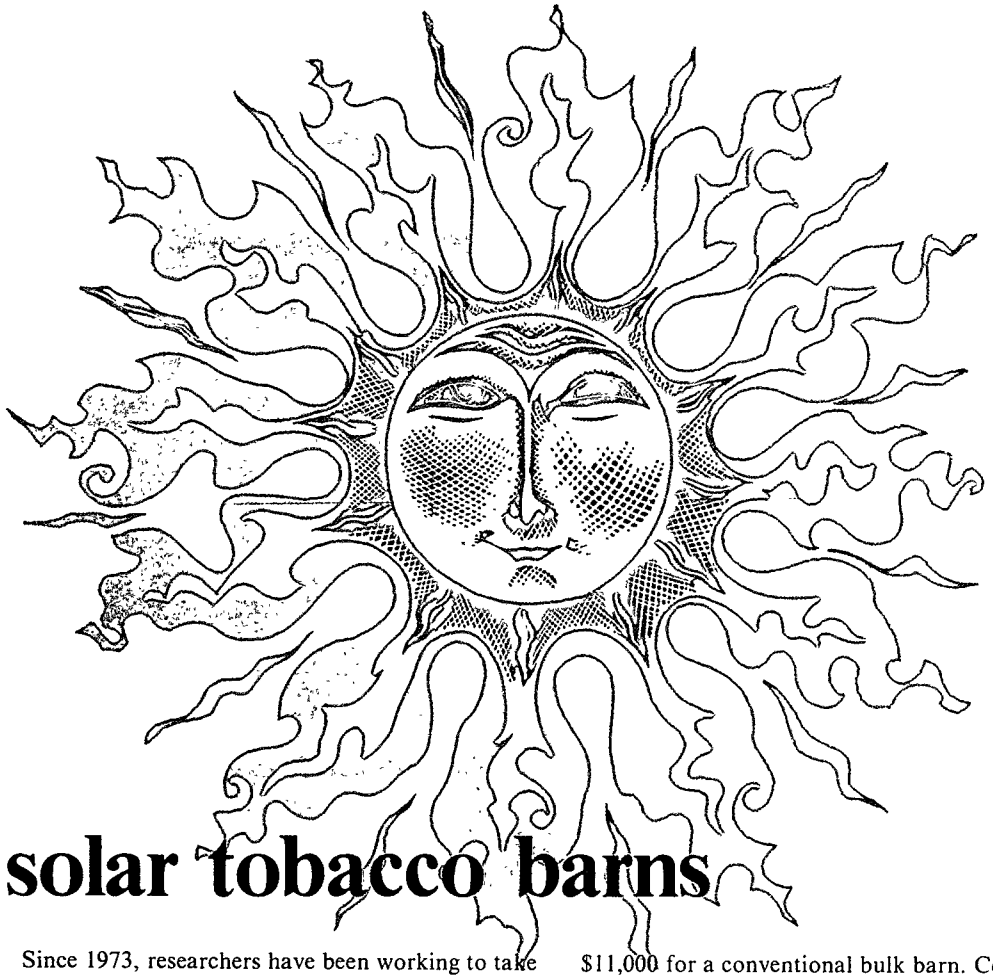


Photo by Jackson Hill

Device on solar tobacco barn monitors heat. In background is a barn painted black for curing.



# solar tobacco barns

Since 1973, researchers have been working to take the sun from the tobacco field into the curing barn. Thirty-six thousand commercial curing barns exist in North Carolina. If all of them were adapted to solar, 140 million gallons of fuel would be saved each year.

For the last four years, the North Carolina State University Department of Biological and Agricultural Engineering has been operating demonstration solar curing barns. "The barn is designed as a multi-use structure," explains Research Assistant Paul Oppenheim. "We use solar as a first priority energy source for curing and for seedlings and vegetables in the winter." The project has produced excellent germination rates and much lower mortality for tobacco seedlings. "The barn definitely works," says Oppenheim, "and it can save a farmer money." Through four years of field tests, N.C. State's demonstration units saved 40-51% in fuel costs compared to conventional curing systems.

Traditionally, eastern North Carolina farmers cured their tobacco with wood-burning systems. In the 1960s, farmers converted, by and large, to oil or propane-powered curing systems in tightly-enclosed aluminum structures known as bulk curing barns. The solar tobacco barn is a hybrid of this conventional barn and a large greenhouse.

A solar barn costs $11-15,000 to build compared to $11,000 for a conventional bulk barn. Converting an existing barn to solar (retrofitting) costs approximately $3,000. The outer walls are made of corrugated clear fiberglass that trap the sun's rays. A series of ducts and fans distribute the heat. During the day, surplus heat passes through a gravel layer beneath the floor. The gravel and small air spaces retain the heat for use during the night. Solar heat is sufficient for the first four to five days of the seven-day curing cycle. A booster of some sort is necessary for the 165 degrees necessary on the last day.

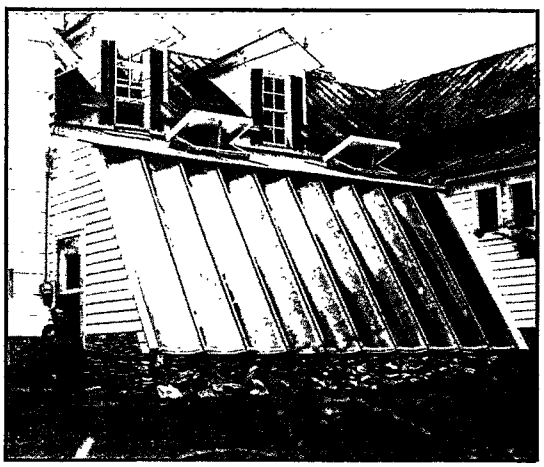
Joe Fowler, an engineer, inventor and farmer from Reidsville, N.C., is attempting commercialization of solar assisted tobacco barns. A $55,000 Department of Energy grant allowed Fowler to monitor solar barns, new and converted, during the 1978 curing season. On farms from Florida to Virginia, Fowler recorded an average fuel savings of 50%.

The solar assisted curing system is a proven method to reduce dependence on fuel sources outside the state. Because of the capital investment necessary, federal and state incentives are needed to encourage commercialization of solar curing. In the meantime, local farmers can at least paint their aluminum barns black, as the N.C. State program has. Retaining the solar heat through black paint begins the conversion process for curing the state's number one cash crop.□

# attached solar greenhouses

Five years ago, an average homeowner identified the direction in which his house faced for geographical reasons — "we face south, towards town." Today, though, a homeowner talks about his "southern exposure." An energy-conscious era has changed the way we look at the compass.

If a home has good southern exposure — nothing shielding it from the sun on the south side — capturing and retaining solar heat can save up to 35% in heating costs. This can be done without expensive mechanical



collectors, heat transfer fluids, or sophisticated electrical equipment — by passive systems. New homes are now being designed with large windows on southern exposures to bring in the winter sun and with carefully angled roof overhangs for summer shade. For existing homes — and for new designs — building a greenhouse on the south side of a house can achieve the same results.

The sun provides all the heat and light in a solar greenhouse. The greenhouse collects heat and stores it, which can be used to warm a portion of the adjoining house. An effective solar greenhouse must receive uninterrupted sunlight throughout a winter day. Foundation insulation, caulking, and double glazing (double glass walls) can best reduce heat loss to the outside. The heat storage system — water, rocks, or bricks — must be adequate. Finally, summertime ventilation, usually a roof vent, must be included in design. Almost as a bonus, the greenhouse serves as a horticulture system for growing vegetables and flowers and for drying fruit and herbs throughout the year.

Mark Burham, a planner with Triangle J Council of Governments, built an 8′ x 12′ greenhouse from recycled materials. One-gallon, water-filled plastic milk jugs — 240 of them — store the heat. The heat buildup during the day keeps the temperature well above freezing at night. Through two winters, Burham has added heat to his house and at the same time raised spinach, lettuce, onions, and geraniums. He has now decided to make the greenhouse permanent by replacing the plastic siding with fiberglass.

In rural Rutherford County, David Cameron converted the porch of an 80-year old farmhouse to a heat-producing greenhouse. The 16′ x 25′ greenhouse cost $1000, even when Cameron used primarily recycled materials. "But the house definitely gains heat," says Cameron, "and the greenhouse does not drop below freezing at night." Two-liter plastic soda bottles filled with water — 950 of them — store the heat.

Passive systems can save energy without large capital investments. Without assistance, however, initial costs can be prohibitive. The N.C. House of Representatives has passed a bill which expands the solar tax credit to include passive systems. The bill is now before the Senate. The financial institutions, however, have not made low-interest loans available for solar greenhouses. Rural electric cooperatives, originally formed to be responsive to rural communities' needs, could also help the large-scale implementation of attached solar greenhouses with low-interest loans.□

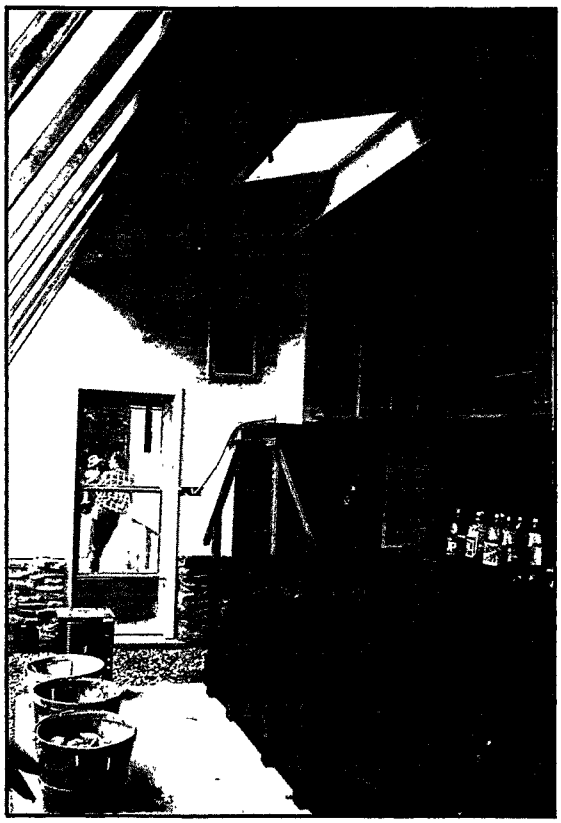


Photo by Ann Barrick

David Comeron's solar greenhouse in Union Mills, N.C. Note the the roof vents on the outside view and the storage bottles inside.

# hydroelectricity . . . it's flowing again

In 1978, Consolidated Knitting Mills outside Charlotte saved $50,000 in fuel costs with their 450-kilowatt, hydroelectric turbine. But waterpower was nothing new to Consolidated. The company has been harnessing the energy from falling water for the last 50 years. In an age of conglomerates, the savings from hydropower has enabled this small concern to stay in business.

Photo by John Warren, Research Triangle Institute

Dam on the Cullasaja River, Highlands, N.C.

Over 3,000 dams exist in North Carolina. Many of them date from the turn of the century when flour and textile mills depended on water for power. But hardly any of these are currently being used for hydroelectric power. The advent of the steam engine, cheap fossil fuels, and large-scale hydroelectric facilities made small-scale hydro systems obsolete. It was easier to depend upon a centralized power source than to maintain a decentralized source for a single community or mill.

As Consolidated Knitting continues to demonstrate, these dams retain the potential for producing cheap power. Faced with higher fuel costs, more dam owners are now considering tapping this source. But returning to what was once the state's premier power source is not so easy.

"The major barrier to the development of small hydroelectric plants," says the Research Triangle Institute's (RTI) John Warren, "has been the initial financing."

The U.S. Department of Energy (DOE) is currently providing dam owners with low-risk, low-interest loans to determine whether their dams have potential for power production. Funds are also available to help defray costs of preparing an application for a license from the Federal Energy Regulatory Commission.

With funds from the North Carolina Energy Institute, RTI is assisting small dam owners take advantage of this opportunity. RTI first identified 300 sites out of the 3000 existing dams for further analysis. Detailed studies determined 20-30 locations that have the greatest potential for receiving DOE funding. The dams must have an estimated capacity of less than 15 megawatts, those that have never been used for hydropower production or those previously used but now idle. RTI is working with those who plan to apply for a DOE loan to help them minimize institutional and regulatory delays. North Carolina is the only state that has initiated such a comprehensive program to encourage development of small-scale hydro plants.

The Appalachian Regional Commission (ARC) has also made funds available for developing hydroelectric power. The town of Highlands has recently received a $300,000 ARC grant to help rehabilitate a dam which produced hydroelectricity until the mid-1960s. The French Broad Electric Membership Corporation received a $100,000 grant for detailed engineering analysis of its existing dam.

"Small-scale units may be producing 100-500 megawatts by the year 2000," estimates John Warren. Hydropower might well be the cheapest and most environmentally sound source of energy in North Carolina for small industries, rural cooperatives, and small towns.□

# alcohol . . . modern day moonshine

Last August, George King, manager of King Brothers Farm Center in Ayden, N.C., called a gasohol meeting. "Gasohol" was a new word to most Pitt County farmers, but 160 people showed up — farmers and business leaders, federal, state and local officials — to hear King explain how gasohol can save farmers money.

The oldtimers there didn't need any tips on distillation technologies. Two generations before, prohibition had provided incentive enough for developing backyard methods. And no Pitt County farmer needed to be told that fuel costs for his tractor would be increasing. But farmers did want to know if they could run their tractors on moonshine.

King announced his plans for forming a corporation to distill and market alcohol fuel. Together with Pitt County Community College, King hopes to make the area a model for the state and nation for saving money on gasoline. The community college recently received a $10,000 grant from the U.S. Department of Energy to build an alcohol still and to conduct courses in the production of alcohol fuels. King is developing a farm-size pilot project.

More than 200 other North Carolinians have joined George King in applying for a permit from the Federal Bureau of Alcohol, Tobacco and Firearms to distill alcohol fuel for experimental use. No other southeastern state has half that many applications.

Escalating gas prices have revived an old idea— alcohol fuel. Henry Ford proposed the use of alcohol fuels in his early automobiles. Germany depended on alcohol fuels in the 1930s. Brazil intends to convert 75% of its motor fuel to alcohol by 2000.

Two kinds of alcohol can be used as a substitute and/or extender for gasoline: ethanol and methanol. Fermentation of sugars from grains and starch crops, followed by a distillation process, has traditionally produced ethanol. Anything that was or is plant material, however, can be used to create ethanol. Most methanol is produced from natural gas or oil by converting syngas under high pressure and temperature. It is possible, however, to use coal, wood, farm residues or municipal solid wastes.

Gasohol is a mixture of 10% alcohol (methanol or ethanol) and 90% gasoline. Gasohol use results in lower emissions of air pollutants and increased engine efficiency. Methanol blends can be economically competitive with current gasoline prices.

With only minor adjustments, engines can run on pure alcohol. General Motors and Volkswagen have found that pure alcohol corrodes some fuel systems, however. Fuel system corrosion and establishing separate storage and dispensing facilities at service stations make the widespread use of alcohol only a long range option for the average motorist.

Farm vehicles and private fleets of vehicles, however, could convert to pure alochol fuels immediately. In a study presented to the state Energy Division, "The Potential of Alcohol Derived from Waste Biomass in North Carolina," Phil Lusk estimates that four grains in the state (corn, wheat, sorghym, barley) could yield 330 million gallons of ethanol per year. Converting 60% of these crops into ethanol could replace, Lusk has found, all gasoline and diesel fuels now consumed in the agricultural sector.

The Pitt Community College project hopes to produce about 40 gallons of alcohol a day from 200 gallons of corn mash. And the distilling process does not extract the minerals and proteins from the grain. The left over grain, then, can be used as livestock feed.

Ironically, what was once this state's premier local industry — moonshining — might serve to move North Carolina more rapidly down the road towards developing alternative fuels. □

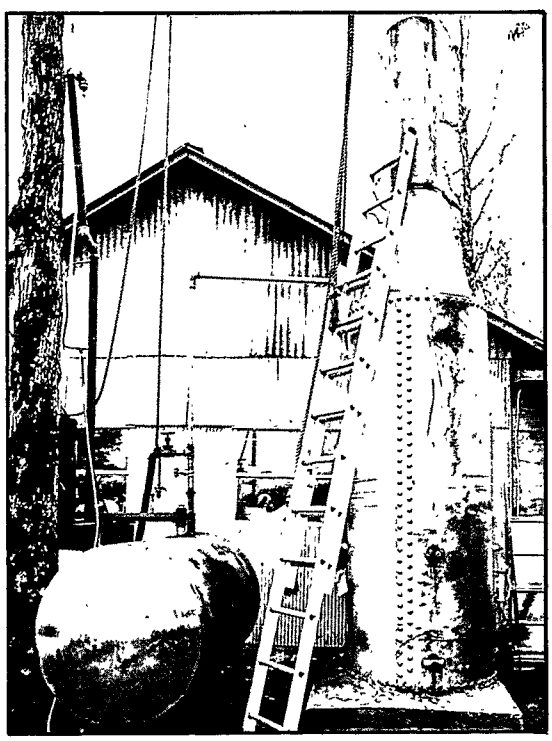


Photo by Dan Hulbert

Revenuers won't raid this moonshine still at Gatesville; Silas Fletcher Sr. plans to use it for backyard manufacture of gasohol.

# "inventing" appropriate technology

Do you have a neighbor who has rigged up a wood-burning device to his car or a milk gallon collector system for the sun? Can cost-saving innovations go beyond the backyard garage or workshop? In an age of bewildering energy costs, inventors and tinkerers are no longer obsolete.

In 1977, Congress instructed the Energy Research and Development Administration (now the Department of Energy) to fund grass roots initiatives. Congress said they wanted to support technology appropriate to:

> "the enchancement of community self-reliance...;
> the use of renewable resources and the conservation of non-renewable resources;
> the use of existing technologies applied to novel situations;
> applications which demonstrate simplicity of installation, operation, and maintenance."

In 1978, a nationwide "Appropriate Technology Small Grants Program" began, making $1.3 million available to an eight-state southern region. The North Carolina Energy Division funded Jon Parker of the North Carolina Coalition for Renewable Energy Resources to coordinate 12 workshops throughout the state, informing citizens of the grants programs and its possibilities for their area. Looking for help in developing creative ways to save energy, 179 North Carolinians submitted proposals requesting a total of $4.5 million.

On January 15, 1980, the Department of Energy awarded the one-year grants. (See box for list of North Carolina recipients.) In 1980, more funds are available for grants in this region.□

| RECIPIENT | PROJECT | AMOUNT |
|---|---|---|
| North Carolina State University (Raleigh) | Construction and demonstration of a solar-heated and energy-efficient house | $45,100 |
| Saddlecraft, Inc. (Cherokee) | Installation of an industrial wood-burning furnace | 21,055 |
| Integrated Energy Systems, Inc. (Chapel Hill) | Development and testing of wood-tunnel burner | 18,000 |
| Douglas L. Worth (Cary) | Construction of a demonstration, multi-purpose, solar water heater | 13,800 |
| Carolina Friends School (Durham) | Further development of an integrated energy system using solar and wood energy and conservation | 9,965 |
| Long Branch Environmental Education Center (Leicester) | Construction and demonstration of two passive solar composting toilets | 9,580 |
| Volunteer Fire Dept. (Brasstown) | Construction of a forced-air solar heating system | 8,069 |
| John C. Campbell Folk School (Brasstown) | Construction of a two-story solar-heated greenhouse on campus | 8,000 |
| Bernard Braduch (Marshall) | Construction of a small-scale hydroelectric generator using Mars Hill College students | 7,500 |
| Charlotte Area Fund, Inc. | Construction of four solar greenhouses to serve as heat sources for low-income homes | 6,000 |
| Long Leaf Farm (Durham) | Construction of a commercial-sized solar greenhouse for vegetable production | 1,987 |
| Coalition for Safe Energy (Greensboro) | Construction of a passive solar greenhouse for community center for appropriate technologies | 859 |