Renewable Energy Options for Your Farm
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For more information on Small Farms, visit our website at: http://smallfarms.ifas.ufl.edu or contact your local County Extension Agent.

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Something Old is New Again
– Wood Gasification

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Basic energy terminology

- BTU – British Thermal Unit – (heat)
- KW – Kilo watt (electricity)
- HP – Horsepower (force or work)
Chemistry of Biomass

- Very simple – molecules of carbon, hydrogen and oxygen.

- The length of the chemical chain determines whether it is a cellulose, hemi cellulose, or lignin.

- Pressure, heat and time applied to biomass creates coal or oil. (higher btu content)
Discover of steam power

- Major changes in the way work was done.

- Beginnings of industrial revolution – early 1800’s – coal and steam power, crude engine design were developed. (Blast furnaces and the making of steel). First use of gases produced from organic fuels – coal, charcoal and peat.

- These became obsolete (steam) as gasoline and diesel became plentiful, practical and cheap.
When the German war machine ground to a halt in 1945, gasoline was all but a distant memory in occupied Europe.

The gasification of peat, wood and coal became of paramount importance to maintain societies need for basic transportation to maintains the flow of goods and services.

15,000 farm tractors were in operation.
First attempts

- The industrial utilization of combustible gases produced in the reduction of organic fuels occurred more than 175 years ago.

- Gas produced from the reduction of coal charcoal and peat, was used as early as 1840.

- Aside from industrial heat production the first air–gas to fuel engines came about in 1864 in England.
By 1890 the suction gas engines being produced were on par with steam engines of the day relative to power and number of engines produced.

Once diesel and gasoline engines proved more powerful and convenient, the gasification of wood and other biomass materials quickly lost favor.
WWII taxi in Scandinavia
What is Gasification

- Molecular thermal breakdown (also called partial combustion) of typically biomass materials – wood, grasses etc.

- It can be used for thermal distillation under higher temperature and gasifier design. Temperatures can range from 600–1000 degrees centigrade depending on what you are after. (Fisher–Troupe – not what we are talking about here)

- Gasification is a general term that includes many designs and fuel types.
Gasification

Simply by passing air over a glowing hot material (in a controlled fashion) gasification occurs. The chemical reactions occur between the gasification material and the air, and the product of this reaction is what’s called syngas, producer gas and various other names.
Gasifier types

- Down draft
- Side draft
- Fluidized bed
- Various modifications of each

The goal of the design is to optimize the type of gas you want with the type of fuel you have.
German Ambulance
The interests in the Midwest where grasses are the main fuel source are utilizing fluidized bed gasifiers and are focused on producing hydrogen.

We in the Southeast have abundant wood supplies and are more focused on producing a syn (synthetic) gas composed of H, CO, and methane.
What it looks like
Original reactor from RC&D
This is a downdraft type
Start Up

- We load the reactor with wood chips – preferably dry hardwood and very coarse.

- We then open the lighting port (that 4’ threaded pipe to one side near the bottom of the reactor) and light the wood using paper or lighter fluid – (whale oil 😊)

- We then have blower to force the fire to expand rapidly – after about ten minutes, we close the port and develop the low oxygen environment.
Loading
Starting – lighting chips
Once the wood burns 10–20 minutes – we port and flare the gas and see if it’s flammable indicating the gasification process is underway.

If the gas ignites the port is shut and directed to the motor. When the motor starts you’re in business.
Flaring gas
Engine modifications

- Carburetor is changed to allow syn gas unrestricted flow into the motor.
- Fuel injected, dual port motors much easier to convert to woodgas.
Irrigation motor ford 6cyl
What are the combustibles that come from wood/biomass?

- The purpose of gasification is to transfer solid fuels into gaseous ones, and to carry the largest amount of energy in the gas as possible.

**Combustibles:**
- Hydrogen 25%
- Carbon monoxide 20%
- Methane 5%
What’s left over? Exhaust? Char?

- Carbon neutral CO2?

- Chemical reaction – CO2 comes out + N

- Bio Char – soil applications, nutrients present
What’s the appeal of gasification technology?

- Wide range of application for heat and power needs – residential and farm – fixed base.
- irrigation
- Greenhouse heating
- Broiler hose heat
- Refrigeration
- Electrical generation
- etc
Cost – One barrel of oil is approximately equal to 1 cord of wood (BTU energy).

Oil has 19,335 BTU/lb

Wood has 8855 BTU/lb

With oil selling at $80 /barrel and wood chips selling at $25/ton the cost advantage for wood is its 1/10 the cost of oil.
Gasification is one of the main technologies being looked at to produce a bio oil from cellulosic materials – wood, cane, grass etc.

Fisher –Troupes gasification (higher temp) is being looked at for the production of various fuels and plastics currently made from petroleum.
Today we want to learn how to use in transportation
Wood gas is air cooled (condensed) then piped under the truck to motor.
3 tanks filter, condenser, gasifier
Air mixer (intro) in yellow air filter serves as wood gas intro.
Wood gas line, air mixer, blower
Some what more modern than this
Some Current Extension Research Demonstration with Land Grants – gasification projects

- Mississippi State – Bio oil from wood – down draft
- U of Arkansas at Little Rock – grasses – fluidized bed
- UF – Poultry litter / wood – down draft
- Auburn – Community Power Corp. machine
Resources

- Handbook downdraft of gasifiers.
- FEMA dealing with disruption of gas supplies
- Others
  - [http://taylor.ifas.ufl.edu](http://taylor.ifas.ufl.edu) – renewable energy
- U–tube wood gasification search
Gasification of cellulosic materials has real potential on the farm for energy and power needs.

The process could have major contribution to hydrogen generation – fuel cells.

Florida renewable portfolio standard will make renewable energy systems profitable for grid tied systems.
Questions?