Installation of a Biomass Boiler for Wintertime Heating of Broiler Chicken Production Houses

USDA NRCS CIG Project
Number: 69-3A75-12-245

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Poultry Production

• U.S. poultry production/consumption
  – Leading consumer
  – Leading producer
  – Second leading exporter

• Tennessee poultry production
  – $454 million in farm income (15%)
  – ~200 million broilers
  – ~1 billion lbs

Wintertime Heating Expense

Production weak link
• Propane heats ~85% of TN broiler houses
• Historically high and volatile costs
• ~38% of grower yearly cash expenditures

Biomass Heating Fuels

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Price, $/million BTUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>$0.69-$3.25/gallon</td>
</tr>
<tr>
<td>Corn</td>
<td>$3.5-$7/bushel</td>
</tr>
<tr>
<td>Residue</td>
<td>$40-$60/ton</td>
</tr>
<tr>
<td>Litter</td>
<td>$15-$25/ton</td>
</tr>
<tr>
<td>Wood</td>
<td>$5-$25/ton</td>
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</tbody>
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Objectives

1. Demonstrate affordability, effectiveness, and usability of a whole farm hydronic heating system for broiler chicken production houses.
2. Utilize readily available biofuels.
3. Demonstrate environmental impact.
4. Transfer the knowledge gained.

Cooperating Farm Overview
Hydronic Heat Delivery System

FUEL DELIVERY SYSTEM

FUEL DELIVERY SYSTEM

FUEL DELIVERY SYSTEM

Finished Boiler/Fuel Buildings

Fuel Types Used

Switchgrass Pellets

Furniture Waste
Fuel Types Used

- Municipal Road Clearing Waste

Cost for Fuel 2014-2015

- Furniture Waste
  - $550/100 yd³ (walking floor trailer)
  - ≈ 432 lbs/yd³
  - ≈ 8,000 BTU/lb
  - $1.59 per million BTUs

- County wet wood waste — **FREE**
  - Some limbs, may need screening/re-grinding
  - Lower efficiency, 35-50% moisture
  - Problems with ash?

Power and Instrumentation

- Startup 12-03-2014

- Boiler Running

- Heat Exchanger Operating
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Fuel Bin Operating

Fuel Conveyor Operating

Major Startup Challenges

Ash Auger Fiasco

Poor Ash Scraper Performance

“Minor” Startup Challenges

Most Serious Challenge

- Propane prices plummeted during 2015
- Mr. Conley’s production cut way back
- Warm weather
  - Economically: not possible to run the system in 2015-2016 and 2016-2017 wintertime
  - 2016-2017 Field Day & In-Service Training - Cancelled because of Avian Influenza
Payback period

- Boiler $230,000
- Boiler Enclosure $60,000
- Heat Exchangers $50,000
- Labor: $50,000
- PEX Pipe and fittings: $30,000
- Steel Pipe & Fittings: $25,000
- Pumps and Fittings: $10,000

≈ 8 years @ +$2/gallon propane