

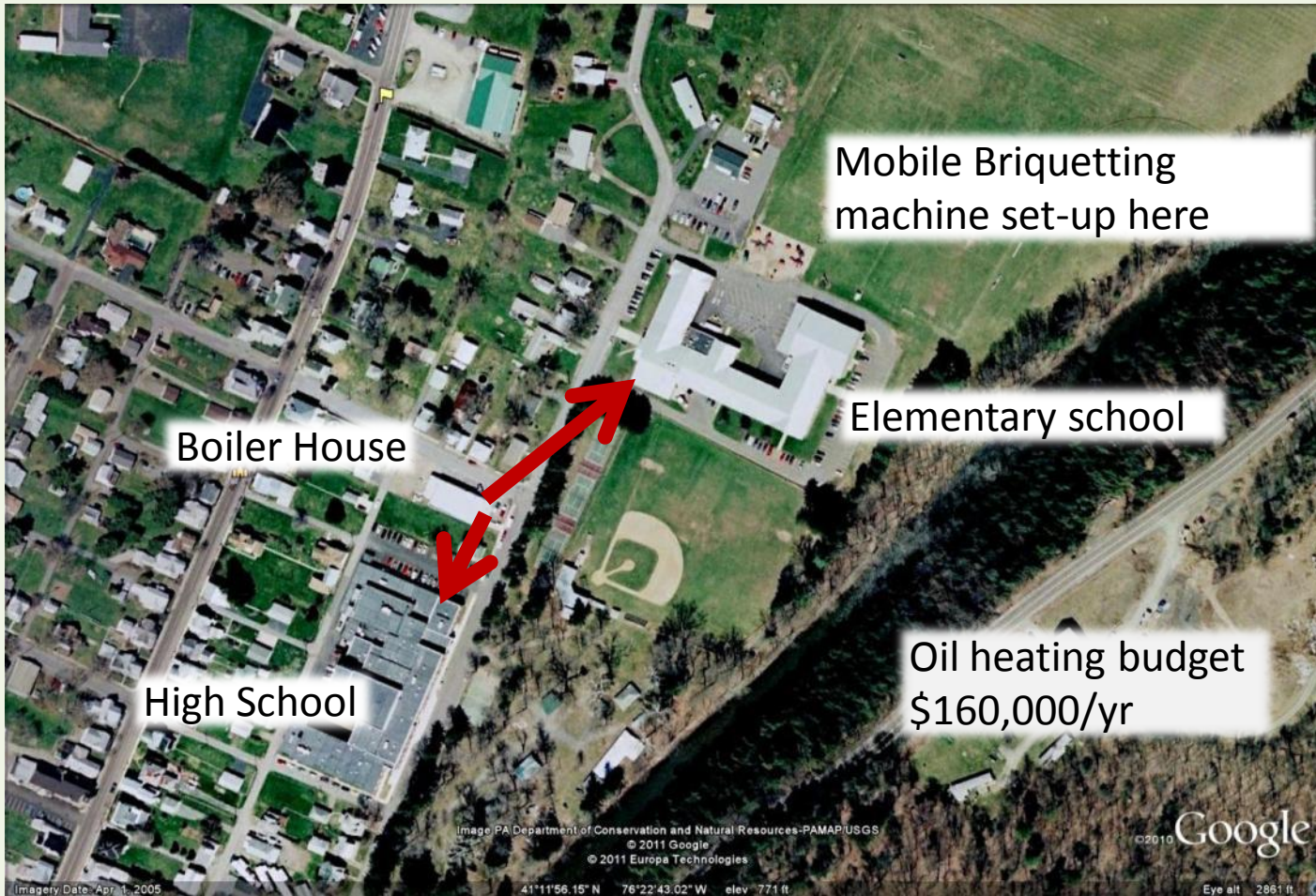


# **Economical & Practical Considerations for Crop Biomass**

**John Bootle**

**Renewable Energy Resources**

# Case study



Project to supply Switchgrass biomass heat for Benton School, PA



# Biofuel Fuel Choices

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Fuel type	Cost/ton	Total cost
Wood Pellets	\$215	\$86,600
Switchgrass	\$161	\$69,200
Wood Chips	\$40	\$40,000



# Reason to use Switchgrass

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- **Keep \$\$ in local community**
  - School tax dollars stay in community
  - Supports local farmers
  - Switchgrass grown within 20 miles
- **Environmental benefits**
  - Improves
    - Water quality
    - Wildlife habitat & associated recreation
    - Soil stability
  - Fastest method to become carbon neutral

# Budget



<b>Before Biomass</b>	
<b>Oil budget</b>	<b>\$160,000</b>
<b>With Biomass</b>	Based on '09 costs
<b>Oil</b>	<b>\$23,905</b>
<b>Switchgrass</b>	<b>\$69,230</b>
<b>Total</b>	<b>\$93,135</b>
<b>Saving</b>	<b>\$66,865</b>
	<b>42%</b>

It is expected that oil prices will increase faster than crop prices so % saving will increase over time

# Switchgrass Biomass

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RER inspecting the switchgrass prior to cutting  
Ideally the switchgrass will be left in wind rows to leach out minerals prior to baling  
Farm-gate prices \$80-\$90 ton

# Baling

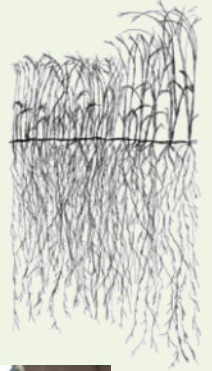
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Measuring the moisture content of the bales  
Ideally between 10-13%  
Sisal is preferred to nylon baling twine



# Mobile Briquetting

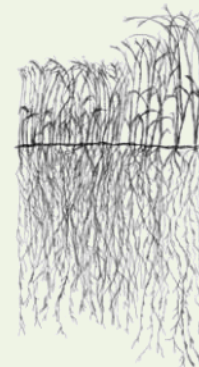


Bales are busted---- (density 2-3 lb/ft<sup>3</sup>)  
Switchgrass is compacted into briquettes--- (density 30-35 lb/ft<sup>3</sup>)  
Briquetting reduces the storage volume & improve handling  
Need to achieve 2 ton/hr



# Delivery

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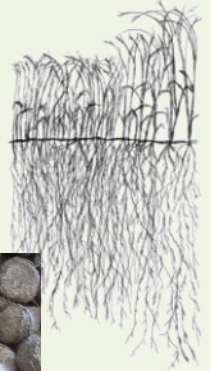


Briquettes are dumped into storage pit  
Augers transport to fuel to the boiler  
Briquettes are easier to handle than loose chopped

# Compacting costs

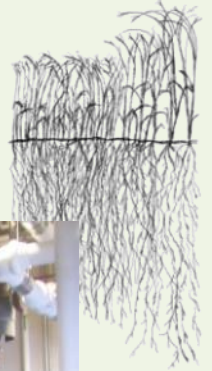
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- Rough guidelines
  - Briquetting
    - Lower energy
    - Typically 60lb/hr/hp
    - \$60/ton
  - Pelletting
    - Higher energy
    - Typically 20 lb/hr/hp
    - \$110/ton





# Typical Boiler Systems



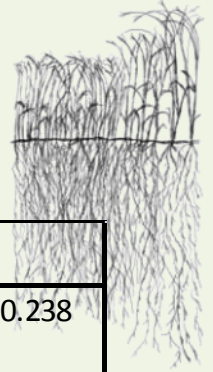
- 45 yr old biomass boiler
  - 220 HP
- 10 tons/day
  - Chopped switchgrass
  - Chopped miscanthus
- Fixed grate
- Clear ash by hand
  - 1 time per day
- No slagging or fouling issues



- 2 yr old biomass boiler
  - 225 HP
- 3.5 tons/day
  - Briquetted switchgrass
    - Cleanest burn
  - Chopped switchgrass
- Firing on demand
- Automatic ash removal augers
- No slagging or fouling issues



# Emissions



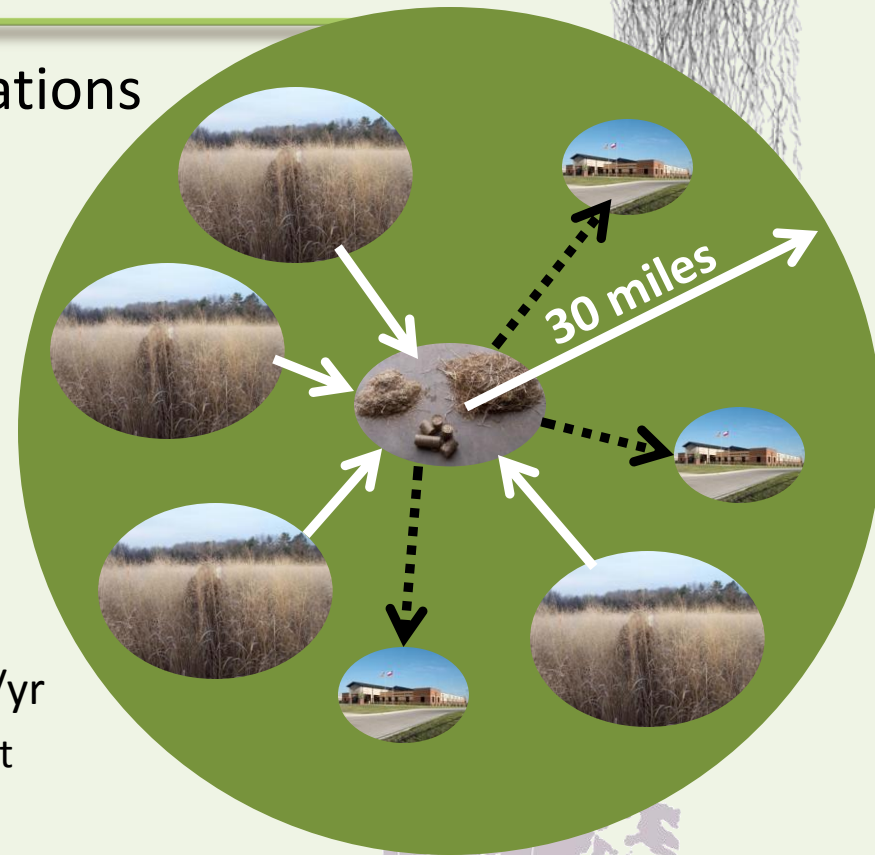
- Clean Air Permits
  - Particulate matter limited to 0.07 lb/MMBTU to comply with new EPA regulations
    - Future will require Multi-cyclone and bag-house to achieve new EPA levels
      - If existing systems where being built new today bag houses would be required
  - Monitor CO to ensure clean burn
- Emissions can be reduced
  - allowing rain to leach minerals
  - Harvesting standard

Emissions		
Filterable Particulate	LB/MBTU	0.238
Nitrogen Oxides	LB/MBTU	0.289
Carbon Monoxide	LB/MBTU	0.130
Switchgrass Consumed	LB/HR	420

Fuel analysis				
		Moisture & Ash Free	Mositue Free	As Received
Moisture Total	%			13.58
Ash	%		3.25	2.81
Volatile Matter	%	86.89	84.07	72.65
Fixed Carbon	%	13.11	12.68	10.96
Gross Heating Value	BTU/lb	8432	8158	7050
Sulfur	%	0.3	0.29	0.25
Carbon	%	49.98	48.36	41.79
Hydrogen	%	6.06	5.88	6.6
Nitrogen	%	0.38	0.37	0.32
Oxygen	%	43.26	41.85	48.23

# Business Model

- Crop biomass for heating applications
  - Provide long term fuel plans
    - In-house expertise
    - Strategic alliances
- Business growth
  - Market development
    - Operate mobile briquetting
  - Mature market
    - Once demand exceeds 8,000 tons/yr
      - Set up fixed base processing plant
- Growth
  - Multiple fixed bases
  - Franchising



# Lessons

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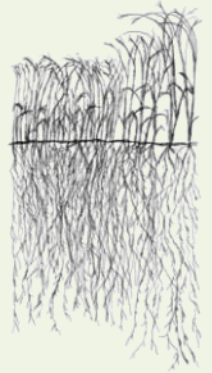


- Chop Biomass is essentially a local business
- Price to customer is important
  - But price may not be the driving factor
  - Farmers need to make \$\$
  - Presently wood chips are lowest cost
    - This is expected to change as demand increases
- Grass for biomass is different than grass to feed cows
  - Biomass standards are necessary
    - Time of harvest is important if grass harvested early then high emissions
- Mobile briquette/pellet machines
  - Need to produce at least 2 ton/hr
- Fixed plant
  - Need annual sales of at least 8,000 ton/yr



I will be pleased to hear your comments and answer any questions

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