Miscanthus for Biomass
Aloterra Energy

• Management team brings deep knowledge and experience in
  – Farming
  – Energy
  – Commodities markets
• Secured the largest stock of sterile Illinois clone Miscanthus X Giganteus ("Miscanthus") rhizomes in the U.S.
• Owns a fleet of state-of-the-art miscanthus rhizome harvesting and planting equipment
• Provides farmers
  – Miscanthus rhizome source
  – Rhizome harvesting and planting equipment
  – Biomass harvesting equipment
  – Biomass processing facilities (pellets, packaging)
  – Market for harvested biomass
• Uses available commercial processing technologies to refine harvested miscanthus into currently profitable products
• Well positioned to control the largest reserves of biomass in the world to supply the multitude of developing liquid fuel technologies
The Aloterra Energy Business

• Plant Miscanthus X Giganteus
  – Non-invasive, high yielding, low input, 20 year perennial grass
  – Grows on marginal soils
• Use harvested miscanthus fibers to replace existing products using off-the-shelf equipment
  – Fuel Pellets
  – Paper Based Packaging
• Profitable today without government subsidy
• Sustainable growth strategy to prepare for eventual liquid fuel technology developments

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Miscanthus needs precipitation > 30 inches annually (area) and average low temperatures >-10°F and <32°F (area).
Benefits of Growing Miscanthus

• Perennial with ≥ 20 years crop life
• Non-invasive\(^1\)
• High yields (10-15 short tons (ST)/acre)
• High energy content (7900 BTU/lb)
• Improves soil conditions\(^2,3\)
• Carbon Mitigation (see next slide)
• Water use
  – High yield stands require >30 inches per year
  – Moderately drought tolerant
• Low nutrient requirements

\(^1\) Lewandowski et al. 2000 / Jorgensen 2011
\(^2\) Clifton-Brown, Breuer, and Jones 2007
\(^3\) Curly, O’Flynn, McDonnell 2009
Carbon Mitigation Using Miscanthus Pellets

- Replacing coal with miscanthus pellets reduces CO₂ emissions by 85%

![Graph showing lifecycle CO₂e emissions per MWh](http://www.ofgem.gov.uk/Sustainability/Environment/RenewableObl/FuelledStations/bbcc/Pages/bbcc.aspx)
Soil Improvements

• 1:1 Root to shoot ratio
  – 10 t above ground = 10 t below ground
  – Carbon credit market development

• Restructuring of soil
  – Roots 6+ feet deep
  – Improves drainage
Corn

12 inch depth

36 inch depth
Pasture

12 inch depth

36 inch depth
Miscanthus Lifecycle

- Rhizome Planter
- First Emergence of Miscanthus
- Bale Storage in Field
- Miscanthus Harvest
- Mature Miscanthus
- 2 Year Old Field in June
- Finished Miscanthus Products
Propagation

- Sterile hybrid, doesn’t produce viable seed
- Must be propagated vegetatively
  - Rhizome division
- Find the windows
Preparation for Planting

• Soil test
  – pH between 5.5 and 7.5
  – Nitrogen not recommended during establishment
  – Supplemental fertilizer as needed
    • Removes only 1.5 lbs Phosphorus, 8 lbs Potassium, and 8 lbs Nitrogen per ton of biomass
Tillage

• Basis for maximum tillage recommendations
  – Excellent soil to rhizome contact
  – One time event in 20 yr lifespan

• Strip-till is the future
  – Reduced soil erosion
  – Earlier planting window
Planting
Establishment Phase: Year 1

- Weed control essential
- Crop usually not harvested
Establishment Phase: Year 2

- Weed control likely needed
- Crop harvested
Mature Crop: Year 3+

- No weed control necessary
Field Monitoring
Field Monitoring

Tracking all aspects of a field allows for efficient crop monitoring, yield prediction, and farming logistics: prior land use, last farming activity performed, weather history, planting date, herbicide application, field counts, and soil sample averages.
Soil sampling at high rates during the early years of production allows for more effective fertilizer application and establishes the basis for yield predictions.
Frequent aerial monitoring during the growing season using inexpensive and off-the-shelf RC aircraft allows for effective crop health monitoring and yield prediction for entire fields, not just what can be seen from the road.
With a few more refinements, these aerial photographs can be processed using photogrammetry software to mathematically quantify growth and yield.
Harvest
Thank You