

FREEDOM™ GIANT MISCANTHUS FOR BIOPOWER

From the ground up, it just makes sense:

- Produces up to 25 harvested tons per acre at maturity
- Around 8,000 BTU/lb, 16 mm BTU/ton, on dry matter basis
- Approximately \$3.75 per mm BTU at \$60/dry ton purchase price
- Moisture content at harvest of 10-15%
- Highly efficient at carbon storage
- Low ash content & mineral content—very clean burning

PERENNIAL. COST-EFFECTIVE FUEL.

Because FREEDOM is a perennial energy crop, it provides a persistent, steady annual supply of biomass. At full maturity, it yields up to 25 harvested tons at less than 15% moisture content. The stand life is expected to be at least 15-20 years. This provides for unmatched energy yield density for land utilization and transportation logistics.

At harvest, FREEDOM is baled and stored. Because of its low moisture content it can be reduced and sized very efficiently. The straw is easily densified into pellets or briquettes. FREEDOM requires less energy to reduce, saving on pre-treatment energy costs. And at 10-15% moisture content, drying requirements are significantly reduced or eliminated.

ENERGY CONTENT OF FREEDOM

BTU per pound, at harvest:	6,600-7,200
BTU per pound, dry basis:	7,800-8,200
BTU per dry ton:	16 million
BTU produced per acre:	320 million
Acres required per megawatt (MW):	500



THERE IS NO COMPARISON

Because FREEDOM goes dormant before harvest, the resulting crop contains more fuel and less mineral content. In the late fall, after a killing frost, the plant is senescing—it begins moving minerals, nutrients and moisture to the roots for storage over the winter. This results in an above-ground harvested crop that contains mostly cellulose. The specific composition of FREEDOM at harvest compared to other biomass crops:

MINERAL ANALYSIS OF ASH

Silicon Dioxide	53.78 wt%
Aluminum Oxide	2.53 wt%
Titanium Dioxide	0.21 wt%
Iron Oxide	1.60 wt%
Calcium Oxide	25.33 wt%
Magnesium Oxide	3.60 wt%
Potassium Oxide	2.41 wt%
Sodium Oxide	0.17 wt%
Sulfur Trioxide	3.85 wt%
Phosphorous Pentoxide	4.00 wt%
Strontium Oxide	0.08 wt%
Barium Oxide	0.16 wt%
Manganese Dioxide	0.13 wt%
Undetermined	2.15 wt%

Feedstock	Yield tons/acre per year*	Moisture Content at harvest	BTU Value/lb as harvested	Acres required per MW
FREEDOM Giant Miscanthus	20-25	10-15%	6,600 - 7,200	500
Giant Miscanthus (public variety)	10-15	10-15%	6,600 - 7,200	1000
Switchgrass	4-10	10-15%	6,600 - 7,200	1,500
Wood (in 24 year rotation)	4-8	40-55%	3,000 - 4,800	6,838 (in 24 year rotation)

**Yield information based on public data*

FUEL PROPERTIES

Moisture % as harvested	10-15%
BTU/lb as harvested	6,800-7,500
BTU/lb, dry-matter basis	7,800-8,200
Ash content	2.5-4%
Sulfur %	0.02-0.05
Bulk density, bales	10 lb/ft³
Bulk density, shredded	5 lb/ft³
Bulk density, pellets	45 lb/ft³

ASH FUSION

Reducing Atmosphere

Initial Def Temp	2210 °F
Softening Temp	2230 °F
Hemispherical Temp	2270 °F
Fluid Temp	2360 °F

Oxidizing Atmosphere

Initial Def Temp	2325 °F
Softening Temp	2345 °F
Hemispherical Temp	2385 °F
Fluid Temp	2475 °F