



GIANT KING™ GRASS

Energy Crop for Direct Combustion in Power Plants, Biogas Production & Cellulosic Biofuels



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VIASPACE is a Biomass Provider



- Giant King Grass, a non-food energy crop
 - Can meet fuel & feedstock cost targets in Asia



GIANT KING GRASS 3.5 m (12 ft) tall five months after first planting

VIASPACE



- Headquarters in Irvine, California USA
- Operations in Guangdong Province China
- A public company listed on the US OTC Bulletin Board with stock symbol VSPC

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Compare Biomass Costs to Fossil Fuel



Coal US	27GJ /mt	\$50 /mt	\$1.85 /GJ
Coal Max.	27GJ /mt	\$100 /mt	\$3.70 /GJ
Oil	6.1GJ /barrel	\$70 /barrel	\$11.48 /GJ
Nat. Gas		\$5.00 /Mbtu	\$5.27 /GJ
Bio-mass	18.4 GJ/mt	\$42 /mt China	\$2.31 /GJ

- Coal is cheapest fuel
 - Most electricity is from coal
 - But most carbon dioxide and other pollutants
- Biomass is next cheapest
 - With near zero net carbon dioxide emissions
 - Generate electricity and produce cellulosic biofuels
- Natural gas is next
 - Cleanest fossil fuel
- Oil is most expensive

Gigajoule=278 kilowatt-hr
mt=metric ton=tonne=2204 lb

Biomass, Solar & Wind



	Capital Cost (\$M/MW)	Utilization (%)	Fuel Cost (\$/kwhe)	Electricity Cost \$/kwhe	Comment
Solar Photovoltaic	5-6	22	0	0.40	Day only
Thermal	4-5	31	0	0.26	Needs grid back-up
Wind	1.9	34	0	0.15	Windy only Needs grid back-up
Biomass	1.4	83	0.025	0.09	24 hr/day
Coal	1.2	85	0.024	0.08	24 hr.day

...” without a significant decline in the cost of storage, the intermittency and unreliability of wind and PV prevents them from meeting the needs of base-load power generation.” Vinod Khosla March 15, 2010

Biomass Fuels- Key Considerations



- High-yield, large scale crops are needed for efficient use of land and low cost
- Competition with food will not be allowed
- Agriculture and forestry waste are important sources, but not enough available for large scale
 - Price of agricultural waste has tripled in China and India with increasing demand
- Difficult to get project financing without long-term fuel supply contract
 - Spot market for agricultural waste is unpredictable
- Dedicated energy crops required
 - Dependable, consistent quality supply at a known price
 - Not being tied to a food crop can have major logistical advantages such as just-in-time harvesting

Giant King Grass



- Very high yield and low-cost
 - 375 wet metric ton/hectare (167 t/acre) suitable for biogas production
 - 125-180 mt/ha (56-80 t/acre) at 25% moisture suitable for power plant
 - 100–135 dry mt/ha (45-60 t/acre) suitable for pellet production
- Perennial in subtropical & tropical areas
- Can be grown as annual crop
 - 67.5 dry mt/ha (30/t/acre)
 - But must be replanted every spring



Direct Combustion in Biomass Power Plant



- Giant King Grass energy content 18.4 MJ (megajoule) per dry kilogram
 - 5.1 kilowatt hours thermal/kg
 - 7900 BTU per pound
 - Physical and chemical properties similar to corn straw (stover)
- 1 kWh electrical requires 0.72 kg of Giant King Grass
 - 27% generation efficiency



Giant King Grass for Bio-Methane



- Giant King Grass has very high bio-methane yield
 - 91 liters methane/kg of fresh grass
 - 0.36 m³/kg volatile solids
 - Compared to 0.22 for municipal solid waste, 0.21 for rice straw
 - Organic fertilizer is byproduct



1 MW electricity generation using anaerobic biodigestion and corn as feedstock

Giant King Grass Pellets as Coal Replacement



- Giant King Grass pellets to be co-fired up to 20% with coal
 - requires small modification to existing coal power plant
 - Dry & press into pellets
 - Requires shipping to port
- Large global demand for pellets
 - Particularly in Europe where coal power plants must reduce carbon emissions



Additional Markets for Giant King Grass

- Grassoline, cellulosic liquid biofuels
- Clean process heat and steam for industry
- High-temperature gasification
- Torrefaction, pyrolysis, other densification
- Anhydrous ammonia
- Biomass derived chemicals and bio plastics



Planting in Southern China





Giant King Grass planted late April 2009



Giant King Grass in early August 2009



10 days after planting



First Year Harvest November 10, 2009



Harvesting November 10, 2009



Mechanical Harvesting-Corn



Video at <http://www.youtube.com/watch?v=MqDQjpdM98I>

Giant King Grass



**Cut at 1m and wet every
30 days for biogas**



**Cut at 4 m and dry for direct
combustion & pellets**

Giant King Grass

- Natural hybrid
 - Not genetically modified
 - Not an invasive species
- Productive in first year
- Needs >100 days sunshine and >800mm rain or irrigation
- Can be grown in acidic or mildly saline soil
- Modest fertilizer requirement
- No pesticide required in China



Seedlings planted less than three months ago



30 MW Biomass Power Plant in China

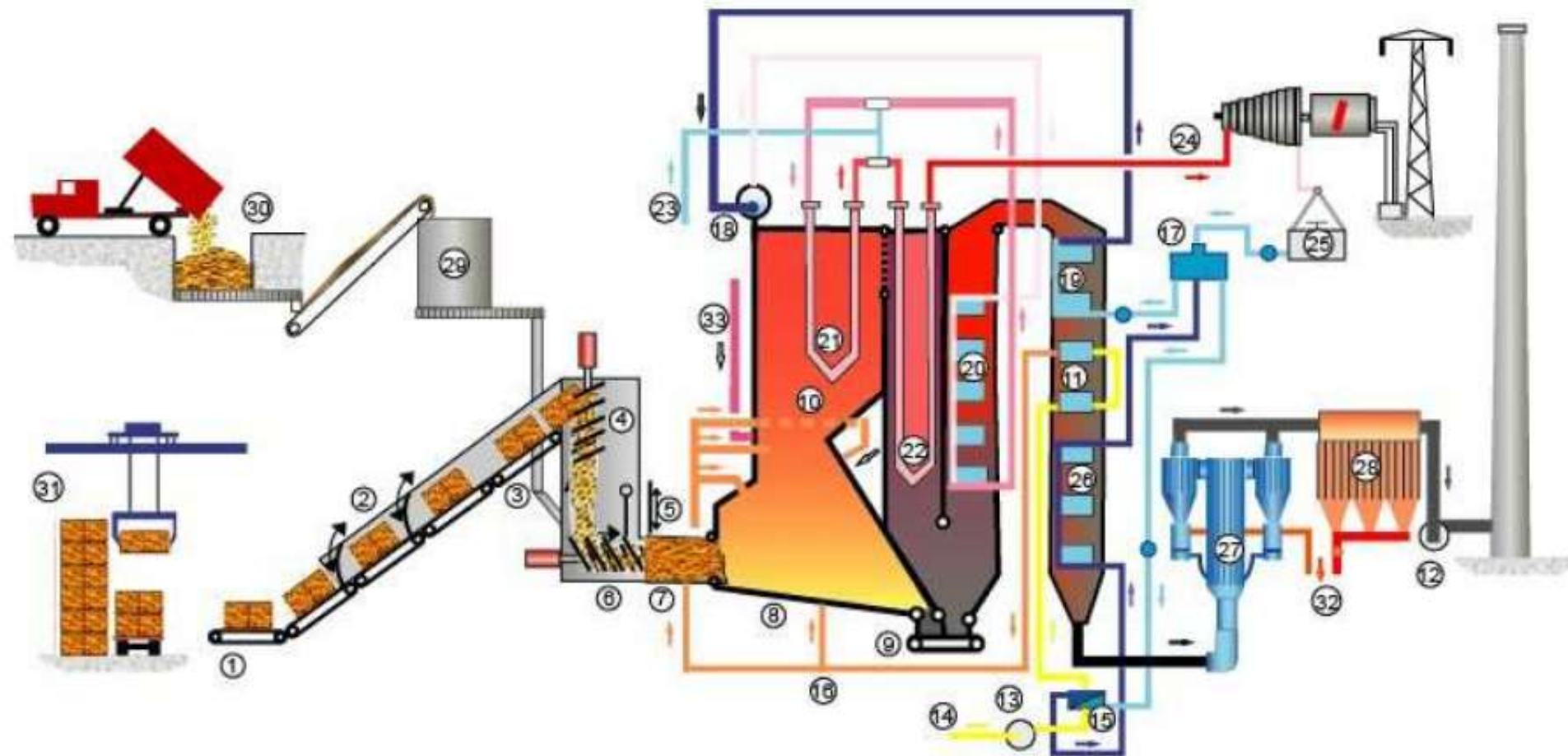
- Corn straw and rice husks as fuel
 - 50 km collection radius
 - 600 metric tons fuel/day
 - 186,000 mt/year year
- 1500 ha (3705 acre) if Giant King Grass
 - 2-3 km collection radius
- \$36 US/mt paid in China for agricultural waste today
 - At 25% moisture
 - Price increasing



DP Cleantech has 19 Biomass Power Plants Operating in China



Power Plant Optimized for Agricultural Waste/Corn Straw



Giant King Grass Has Properties Almost Identical to Corn Straw

Biomass

Power Plant Partner



- DP Cleantech has built and operates 20 power plants in China --all running on 100% biomass
 - One of the most experienced in the world
 - High efficiency technology from Denmark designed and optimized for biomass
 - Now fueled by agricultural waste such as corn straw, wheat straw, woodchips or rice husks
 - Giant King Grass is suitable for fuel
- DPCleanTech will build a cost effective power plant anywhere in the world– contact VIASPACE
 - Turnkey--EPC including biomass fuel handling, storage, and staff training at operating plant in China

Biomass Logistics

- Power/processing plant uses loose biomass
- Baling is for transportation and storage only
- Bales are debaled as first step
- Not being tied to a food crop allows just-in-time harvesting and less storage if weather permits



Giant King Grass

Environmental Benefits



- High yield allows minimal land impact
 - Grows on marginal land
 - World Wildlife Foundation estimates that “250-800 M Ha of additional agricultural land could be brought into production without encroaching upon areas of high ecological or social value”
- Minimal need for pesticides and modest fertilizer use are good for the environment
- Can be block intercropped with Jatropha or oil palm for biodiversity
- Low-carbon fuel with less sulfur, mercury and arsenic emissions than coal

Economics of Giant King Grass



- VIASPACE has model for the cost of growing Giant King Grass in China, India and Indonesia
 - Using local land, labor, crop establishment and other costs
- Also cost model for power plant & pellet mill

<i>Activity/ Key drivers</i>	<i>Cellulosic biomass</i>
Growing Biomass	Biomass productivity (BDT/acre/year), rotation length, plantation (Crop) establishment and maintenance, carbohydrate content, land value investment
Delivery, storage	Harvesting window, harvesting, freight, biomass bulk density, storage
Conversion process	Biomass (raw material costs), enzymes, fuel, labor, depreciation (CAPEX)

Table 1. Key variables in ethanol production from biomass

Giant King Grass

Economic Benefits



- Fuel and feedstock costs are crucial for power, biogas or biofuel plant profitability
- Giant King Grass can **meet cost targets** for direct combustion, pellets, bio-methane and cellulosic biofuel production in Asia
- Giant King Grass provides consistent quality and a reliable source
 - Can be used in combination with agricultural waste for fuel security
- Energy projects generate carbon credits

Giant King Grass Application Sizes



Biomass Application	Size	Capital Cost Southeast Asia	Size of Giant King Grass Plantation
Power plant direct combustion	10-30 MW	\$14-42 million	500-1500 hectare 1235–3705 acres
Biogas power plant	1 MW	\$3-4 million	100 hectares 247 acres
Pellet mill	100,000+ mt/yr	\$TBD million	1000 hectares 2470 acres

Giant King Grass -Scalable & Sustainable Development



- Giant King Grass plantation co-located with a power plant, pellet mill, bio-methane or biofuel facility is a scalable business module that can be reproduced widely
 - Asia, India, Americas, Africa
- Provides local employment for farmers and power/processing plant operators
- Provides clean electricity for development
- Energy independence and security

New Planting September 28, 2009



New Planting November 10, 2009

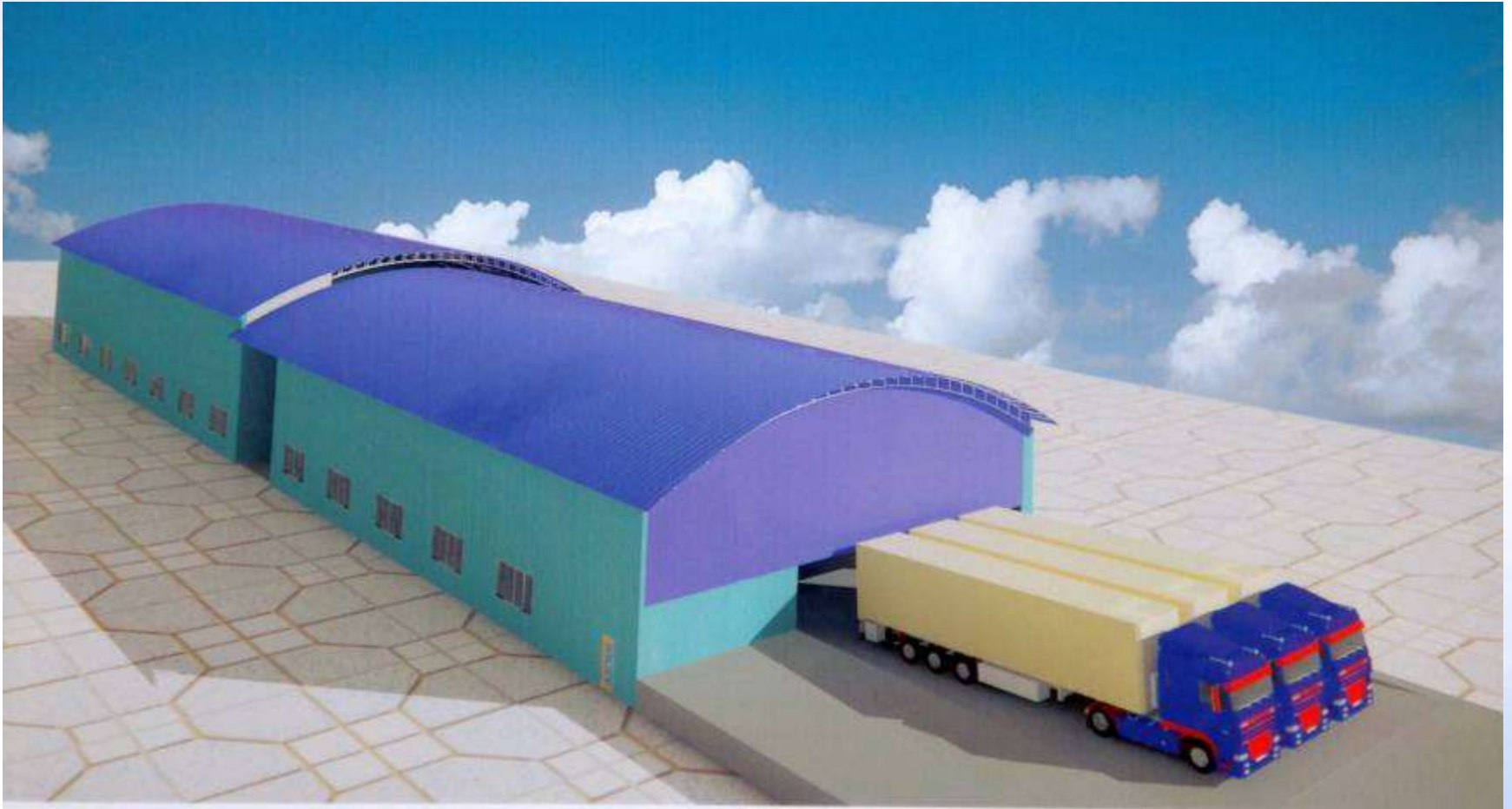


Giant King Grass

April 2010



Processing & Storage Building 9/28/09



Processing & Storage Building April 2010



VIASPACE Summary

- VIASPACE is seeking to expand Giant King Grass cultivation and introduce it in other warm climates around the world
 - Including Southern USA and Hawaii
- In China, VIASPACE is doing everything
 - Leasing the land
 - Hiring the farmers and workers
 - Processing the grass
 - Sales and marketing

VIASPACE Summary



- Outside of China, VIASPACE is seeking to partner with established growers and customers that have a long-term need for Giant King Grass as a fuel or feedstock
 - VIASPACE does not sell Giant King Grass seedlings, but will enter into long-term business relationships
- Grass plantation co-located with
 - Biomass power plant
 - Bio-methane facility
 - Biofuel plant
 - Pellet mill

Additional Information

CEO Background



Kukkonen with Al Gore

Dr. Carl Kukkonen

- 2005 – present**
VIASPACE Inc. CEO
 - Publicly traded on the OTC BB symbol VSPC
- 1998-2005**
ViaSpace Technologies (incubator)
 - Founded and led 7 startup companies
- 1984-1998**
NASA/Caltech Jet Propulsion Laboratory
Director, Center for Space Microelectronics & Manager of Supercomputing
 - Led staff of 250 with annual budget of \$70M
 - On review boards of 14 leading universities
- 1977-1984**
Ford Motor Company,
Principal Research Scientist and Engineer
 - Ford's expert on hydrogen as an alternative motor fuel
 - Developed new direct injection diesel engine
- 1975-1977**
Purdue University
Postdoctoral Research Fellow
- 1975**
Cornell University
PhD, Physics

Compare Energy Crops



ENERGY CROP	YIELD (mt/ha)	ENERGY (MJ/kg)	PRICE (\$US/mt)	ENERGY YIELD (GJ/ha)	CASH YIELD (\$US/ha)
Switchgrass	25	17.9	50	448	1250
Miscanthus	39	17.9	50	698	1950
Jatropha	1.6-2.0	42	700	67-84	1120-1400
Palm Oil	3.5-5.0	42	700	147-210	2450-3500
Giant King Grass	100-135	18.4	50	1840-2484	5000-6750

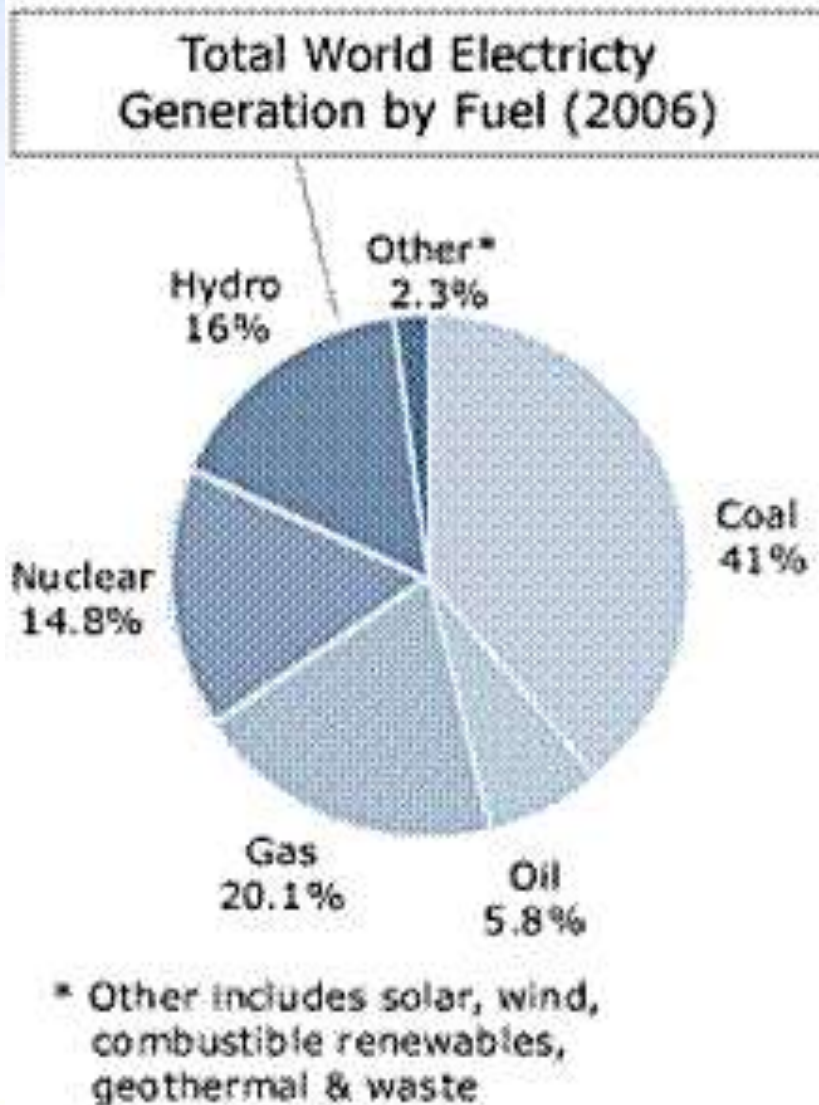
Giant King Grass has highest mass, energy & financial yields

Grass yields are dry metric tons per hectare. Switchgrass and Miscanthus are grown in temperate regions. Giant King Grass is grown in tropical and subtropical regions with two or more harvests per year. Jatropha and Palm Oil are grown in tropical and subtropical regions. The grasses are suitable for direct combustion, bio-methane production and cellulosic biofuels such as ethanol. Jatropha and Palm Oil are used for bio-diesel. Comparison is illustrative only. All of these biomass crops are needed. **1 hectare=2.47 acres; 1 mt/ha=0.445 ton/acre**

Is There Enough Land for Energy Crops?



- Question--Is there enough land to grow biomass to provide 41% of global electricity and replace coal which is most polluting fossil fuel
- World electricity use is 0.72×10^{20} joules
- Total world land 13 billion hectares
- Total cropland 1.5 billion ha
 - 11.5% of total world land
 - Do not want to grow on existing cropland, but the next best land



Is There Enough Land for Energy Crops?



- Energy crop yield depends on crop type, climate, rainfall, soil and fertilizer
- Biomass energy content of 15.6 MJ/kg at 25% moisture
- Biomass power plant efficiency 31%
- Simple calculation shows importance of high yield for the future of biomass energy
- Yield in metric tons/hectare-year
 - Metric ton=2200 lbs, Hectare=10,000 m²= 2.47 acres

There is Enough Land for High Yield Crops



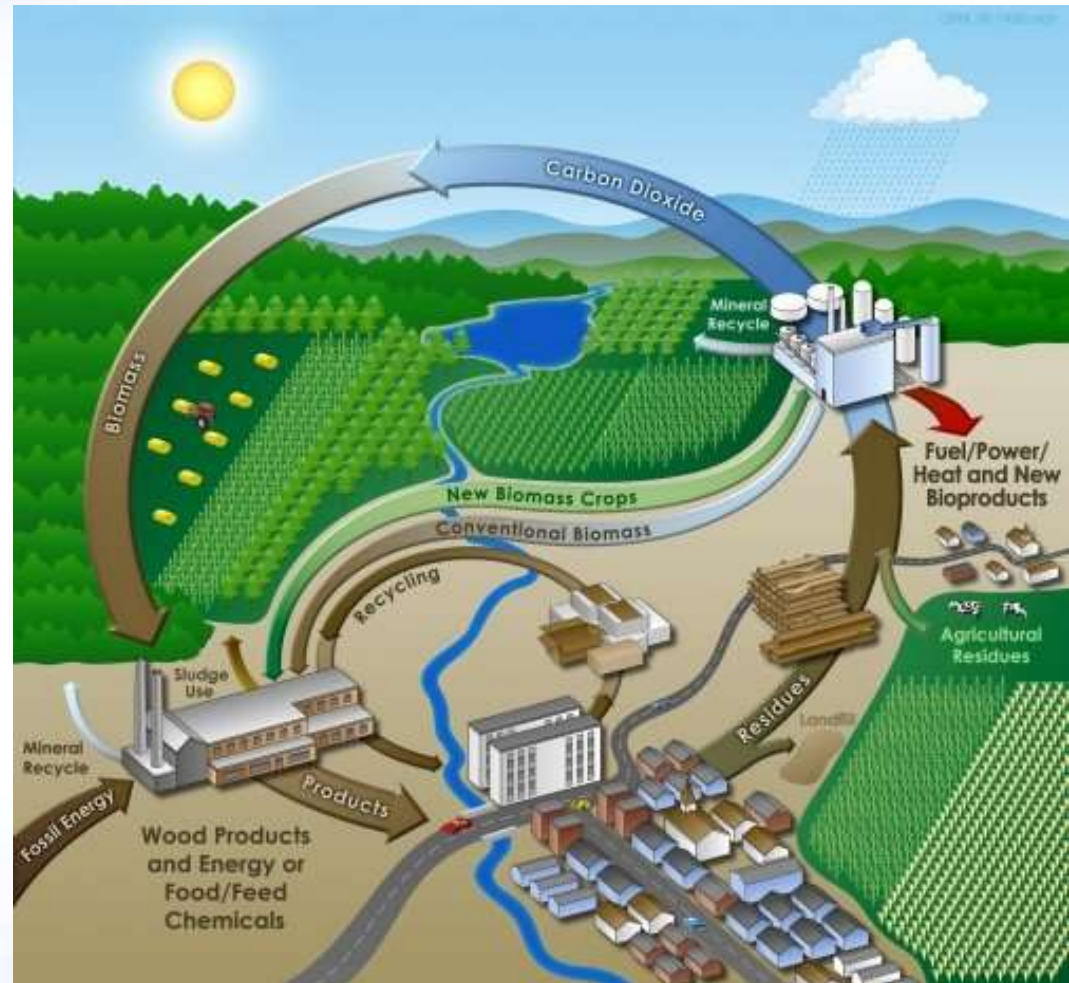
- The percentage increase in world cropland needed to replace coal for electricity generation worldwide is given by

$$\% \text{ Increase in World Cropland} = 4.4/\text{Yield} \times 100\%$$

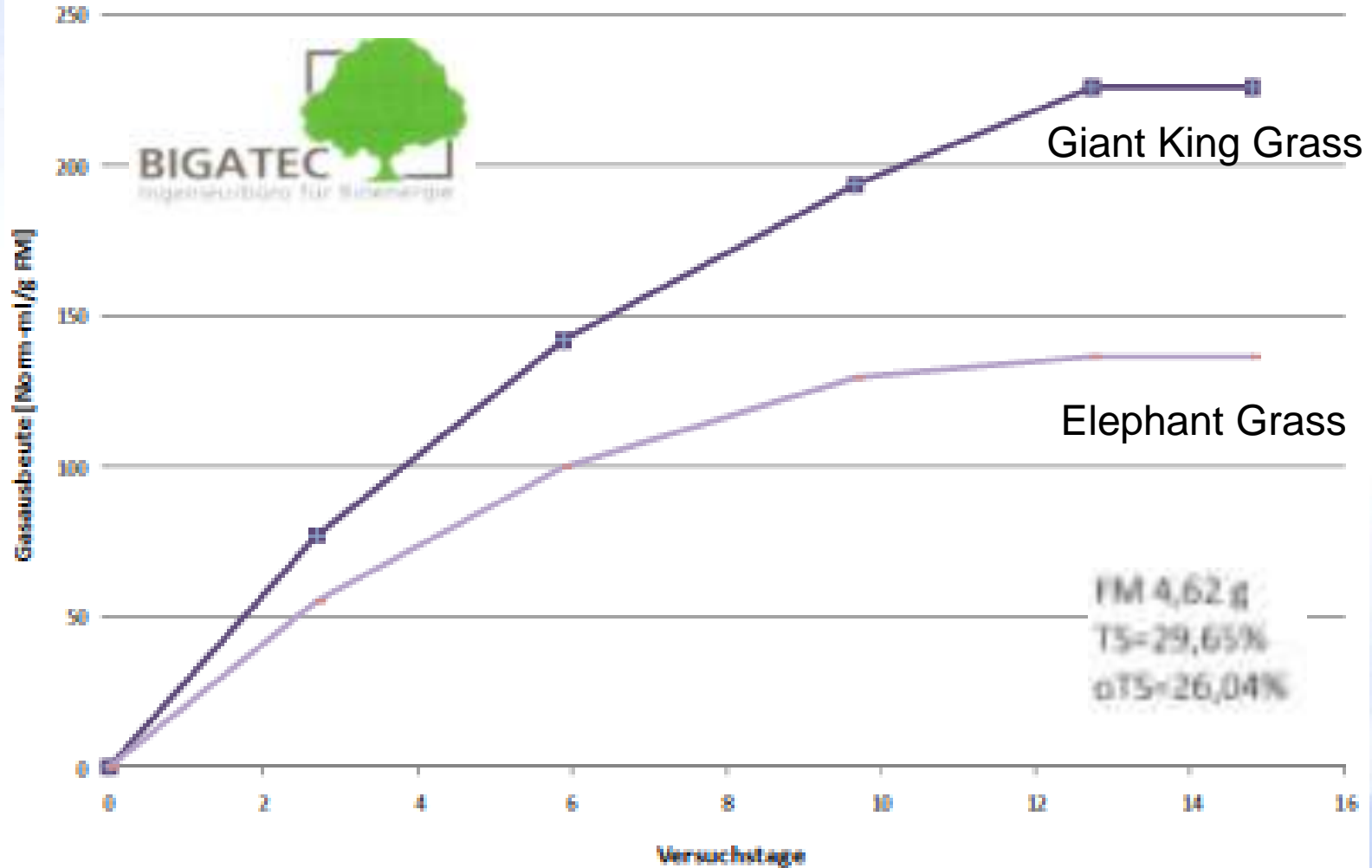
- Giant King Grass yield (at 25% moisture) is 125-180 metric tons/hectare-year
 - Switchgrass is about 25, corn straw is 10
- **Giant King Grass would only require a 2.4-3.5% increase in cropland to replace coal**
 - This amount of land should be available
 - Additional land could be used for liquid biofuels
- **High yield is key**

Biomass is Low Carbon Fuel

- Biomass energy is solar energy & CO₂ captured in plants by photosynthesis
- Burning biomass or biofuels simply recycles the CO₂ stored by the plant
- Carbon neutral except
 - Fertilizer, harvesting, & delivery contribute some carbon dioxide



Biogas Yield per Gram of Fresh Grass



Anaerobe Gasproduktion in Anlehnung an DIN 38 414 S8

Bio-Methane Yield/ Hectare of Land



- Biogas production uses fresh Giant King Grass with yield of 375 mt/ha
- Measured biogas yields are 160-190 cubic meters of biogas/tonne of fresh grass
 - Methane content is 57% of biogas
- Bio-methane yield is 94 -111 cubic meters per hectare per day
- Giant King Grass bio-methane yield is 3.4 - 4.0 million BTU per hectare per day