



GIANT KING™ GRASS

**For Biomass Electricity Generation, Biogas
Production & Cellulosic Biofuels**

World Re-Energy Tech 2010 Conference

New Delhi, India

March 18-20, 2010

Dr. Carl Kukkonen, CEO

VIASPACE Inc.

Irvine, California USA

www.VIASPACE.com Kukkonen@VIASPACE.com

Tel. +1-626-695-9250

VIASPACE is a Biomass Provider



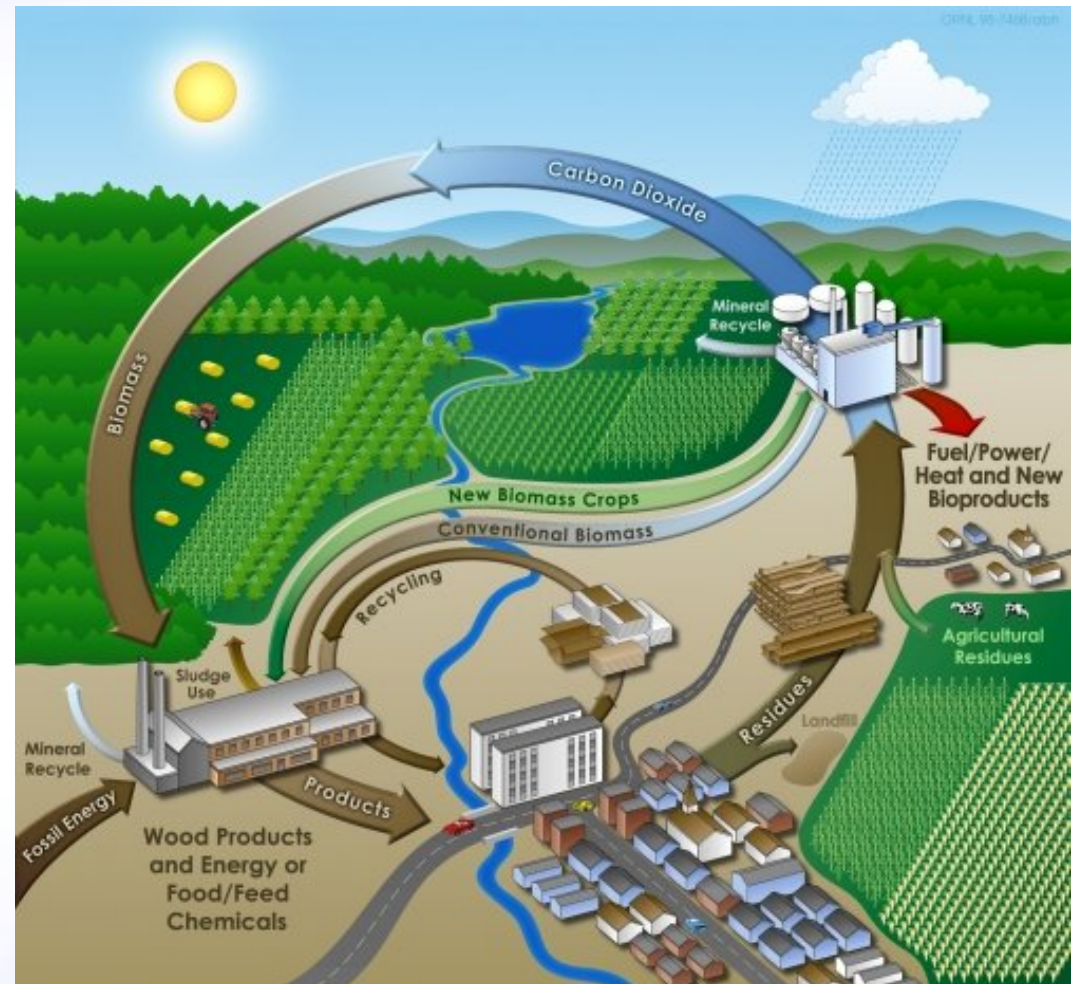
- Giant King Grass, a natural hybrid, non-invasive, non-food, very high yield grass



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

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



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	\$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 cellulosic biofuels
- Natural gas is next
 - Cleanest fossil fuel
 - Much electricity from natural gas
- Oil is most expensive

Gigajoule=278 kilowatt-hr

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 Needs grid back-up
Thermal	4-5	31	0	0.26	
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- Feedstock Is Key



- Need very high-yield, large scale crops 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 waste historically rises with increasing demand
- 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
- Biomass is bulky & difficult to ship long distances
 - Electric power plant, biogas facility, pellet mill or biofuel plant should be located near the plantation
 - Ship the electricity or processed product to the market

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**

Multiple Energy Markets for Giant King Grass



- Direct combustion in 100% biomass power plants (5-30 MW)
 - 30 MW power plant requires 600 tons of grass per day
- Dry and press into pellets to be co-fired with coal in existing coal power plants
 - Up to 20% co-firing

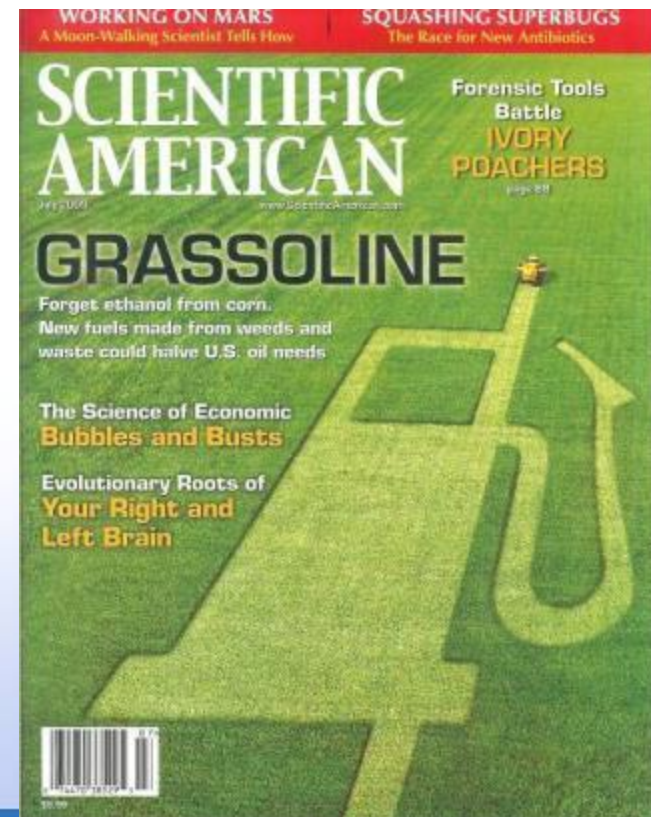


Multiple Energy Markets for Giant King Grass

- Feedstock for making bio-methane through anaerobic digestion
 - 1-4 MW
 - Organic fertilizer is very valuable byproduct



- Feedstock for liquid cellulosic biofuels
 - Ethanol, methanol, green gasoline, diesel



Additional Markets for Giant King Grass



- Clean process heat and steam for industry
- Pressed “wood” products, paper
- Industrial Biotechnology including biomass derived chemicals and bio plastics



Why Giant King Grass?



- Highest yield of any energy crop
 - Extremely fast-growing, produces in the first year
 - Other crops may take 2-4 years before harvest
 - High yield means low cost
- Independently analyzed
 - Suitable to be burned in biomass power plants
 - Bio-methane production is excellent



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



- Perennial grass with very high yield
 - 375 metric ton/hectare (167 t/acre) (wet) suitable for biogas production
 - 125-180 mt/ha (56-80 t/acre) at 25% moisture suitable for power plant
 - 100–135 mt/ha (45-60 t/acre) dry suitable for pellet production
 - Much higher than other energy crops
- Best in tropical and subtropical areas
 - Does not survive long freeze
- Excellent energy of 18.4 MJ per dry kilogram (4402 kcal/kg=7900 Btu/lb)



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



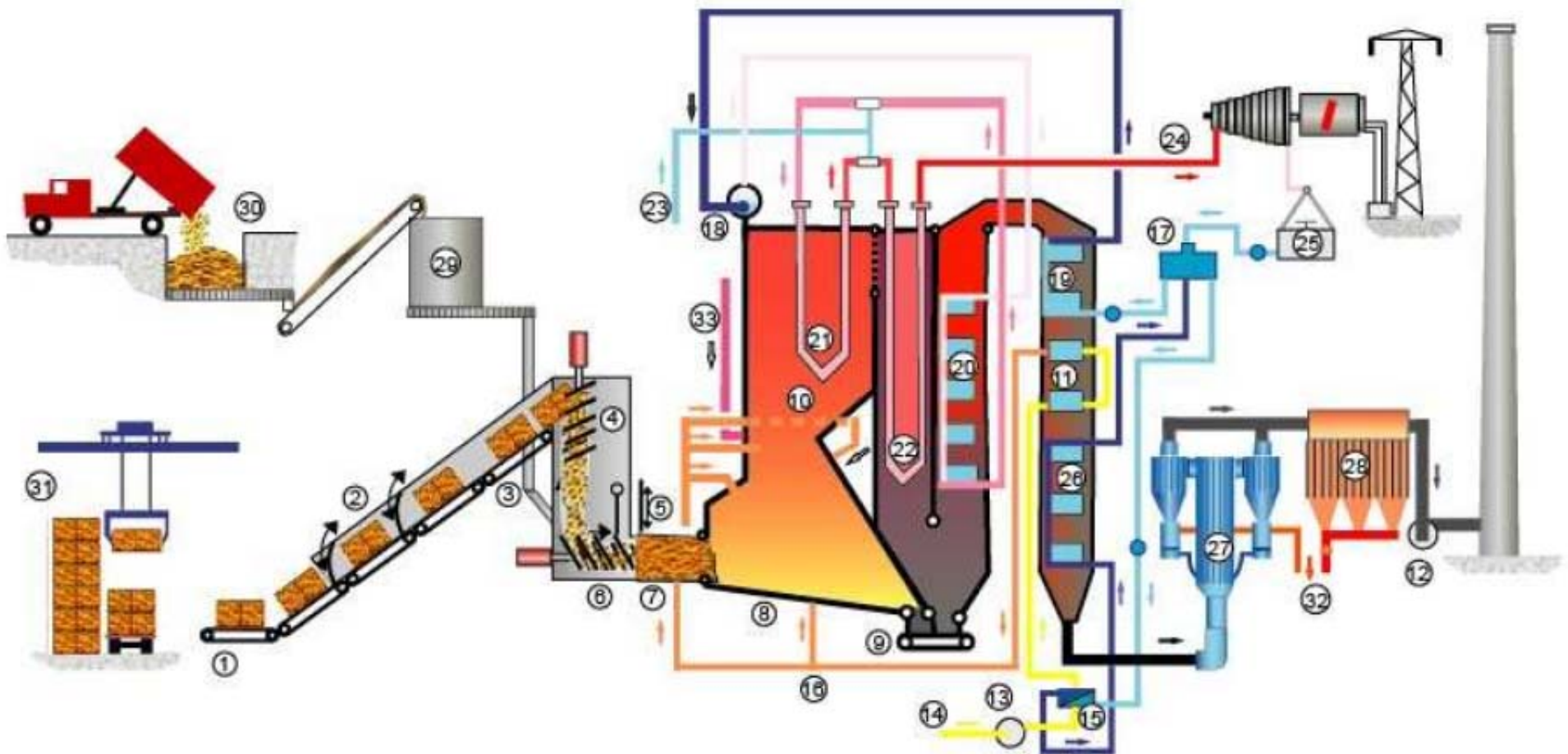
Biomass Power Plant Co-located with Grass



- Sell Giant King Grass to co-located 30 MW biomass power plant
 - 600 tonnes/per day grass
 - 186,000 tonnes per year
- 1500 hectares needed
- \$36 US/tonne in China for agricultural waste
 - At 25% moisture for burning
 - Price has gone up as demand increased
- Stable fuel costs desired



Power Plant Optimized for Agricultural Waste/Corn Straw



Giant King Grass Has Properties Almost Identical to Corn Straw



Power plant collects corn waste from 50 km radius and transport requires baling. Baling may not be needed with co-located Giant King Grass plantation

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

Co-firing Coal & Giant King Grass Pellets



- An existing coal-fired electrical power plant can be modified to burn biomass instead of coal for up to 20% of its fuel
 - Grass or wood pellets
- Carbon dioxide smokestack emissions are the same as 100% coal, but the next crop of grass as it grows absorbs the carbon dioxide emitted from the burned grass
- Co-firing is simplest and fastest way to partially clean up coal power plants and introduce renewable biomass fuels on a large scale
 - Converting existing coal power plants is much less expensive compared to building new power plants

Grass Pellets-Coal Replacement Opportunity



- Sell Giant King Grass pellets to be co-fired with coal
 - Dry & press into pellets
 - Requires investment in pellet making plant
 - Requires shipping to port
- \$100 US/metric ton FOB port in Asia suitable for bulk shipment
- Large global demand for pellets



Bio-Methane (Natural Gas)



- Biogas generators use anerobic digestion of biomass and organic waste to produce biogas (57%) methane that can be burned to generate electricity and heat
 - Widely used today to treat organic waste
- Giant King Grass has very high methane yield
 - 91 L per kilogram of fresh grass
 - 0.36 m³/kg VS
 - Compared to 0.22 for municipal solid waste, 0.21 for rice straw
- Organic fertilizer is a valuable byproduct
 - Additional source of revenue

Giant King Grass

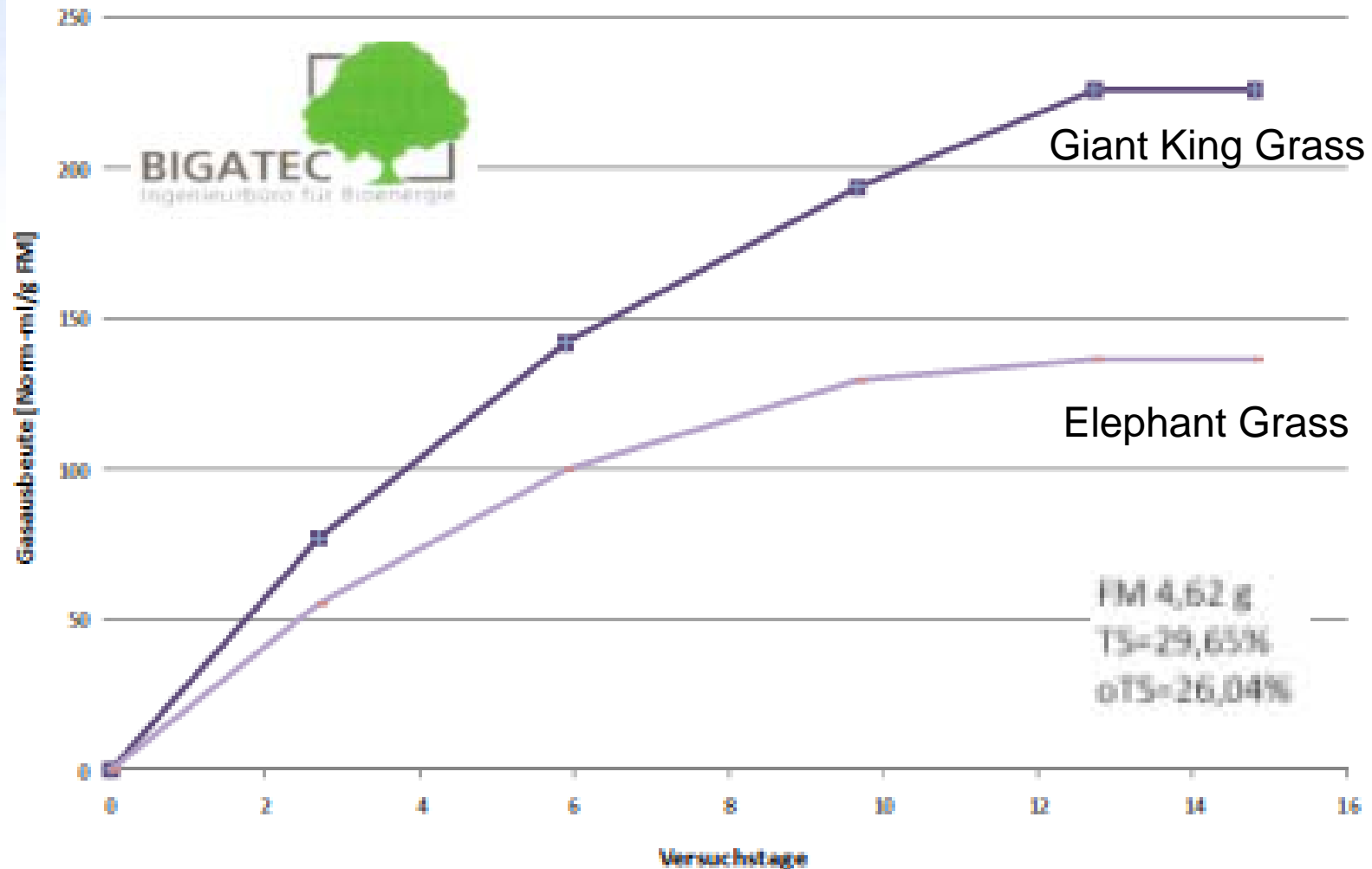


**Cut at 1m and wet every
30 days for biogas**



Cut at 4 m and dry for energy ²⁶

Biogas Yield per Gram of Fresh Grass



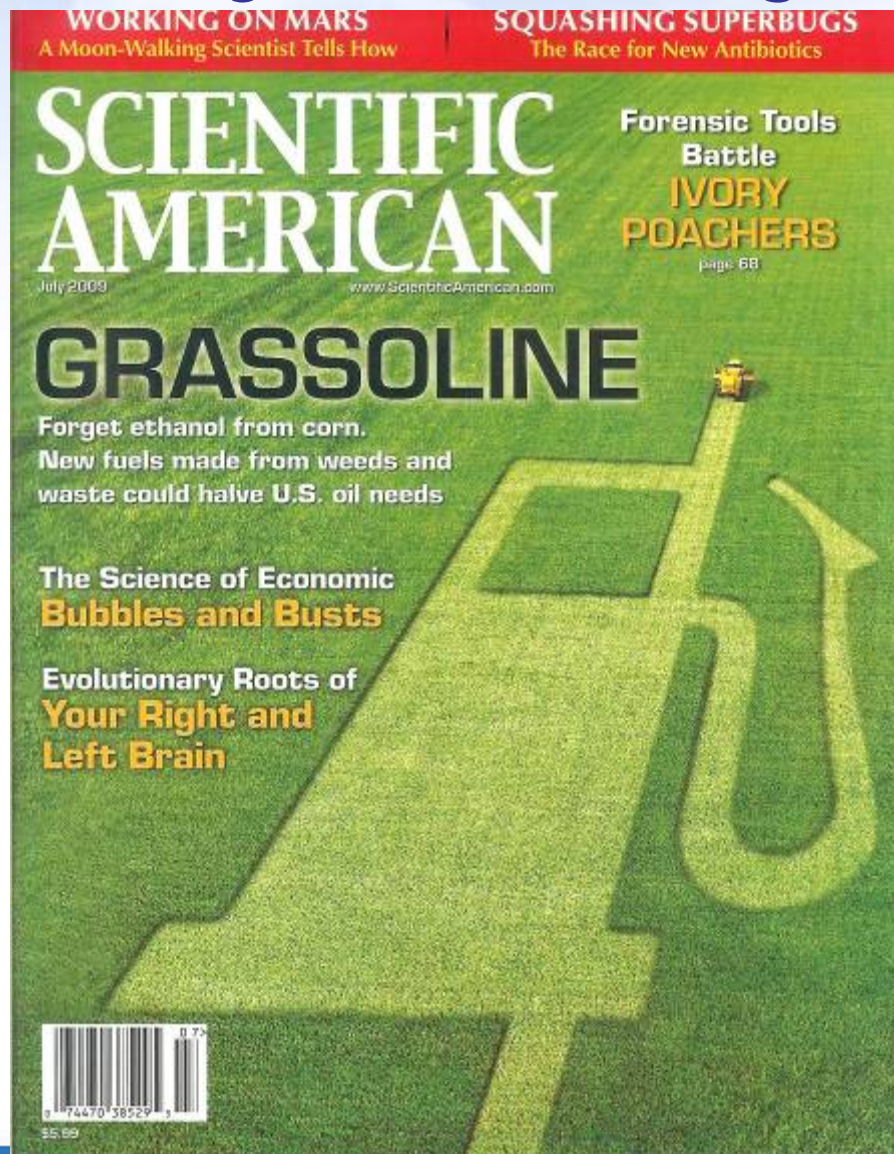
Anaerobe Gasproduktion in Anlehnung an DIN 38 414 S8

Grassoline



- Grassoline—a new term for renewable, low carbon liquid biofuels made from grass
- Examples
 - Cellulosic ethanol, methanol and green gasoline, even diesel if gasification is used
- Does not use food crops such as corn for its production
 - Does not cause high food prices and resulting world hunger
- Note: In 2008 one third of the US corn crop was used to make ethanol

Scientific American July 2009--Highlights



- Cellulosic biofuels offer the most environmentally attractive and technologically feasible near-term alternative to oil
- Grassoline will come from agricultural waste and dedicated energy crops such as fast-growing grasses
- The US can grow enough of these feedstocks to replace about one half the country's total consumption of oil without affecting food supplies

Giant King Grass Environmental



- 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 intercropped with Jatropha or oil palm for biodiversity
- Low-carbon fuel with less sulfur, mercury and arsenic emissions than coal

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
- 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 -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
- Hard cash from pellet exports

VIASPACE Summary



- VIASPACE is seeking to expand Giant King Grass cultivation and introduce it in other warm climates around the world under a joint venture or other arrangement
- Grass plantation co-located with
 - Biomass power plant
 - Bio-methane facility
 - Biofuel plant
 - Pellet mill

New Planting September 28, 2009



New Planting November 10, 2009

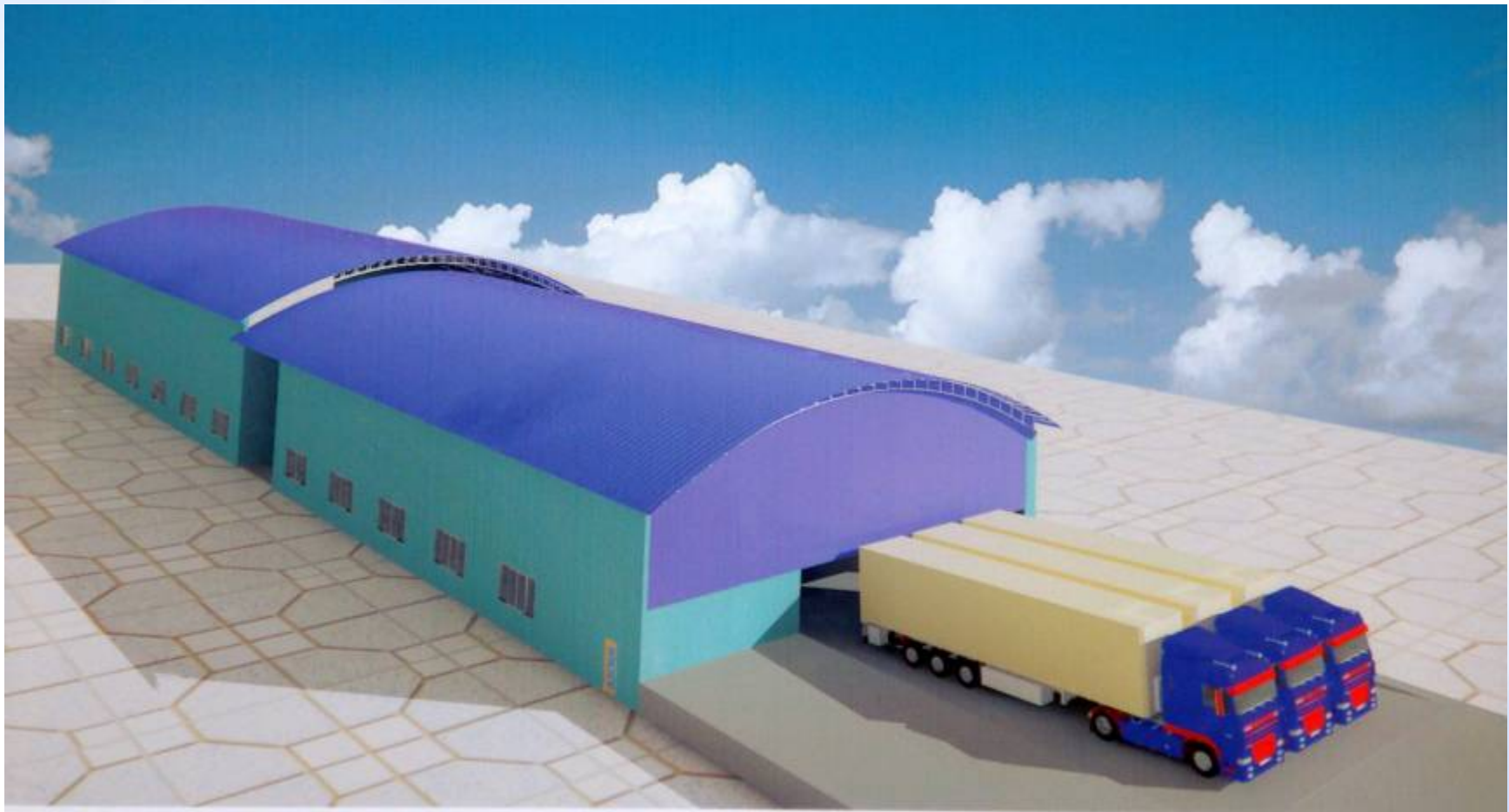


Giant King Grass

March 9, 2010



Processing & Storage Building 9/28/09



Processing & Storage Building 1/2010



Processing & Storage Building 3/2010



Workers Dormitory



Additional Information

Fresh Sample for Bio-Methane Analysis



Fresh 1 m grass sample vacuum packed and sent to Europe for bio-methane analysis 42

Bio-Methane Yield/ Hectare of Land

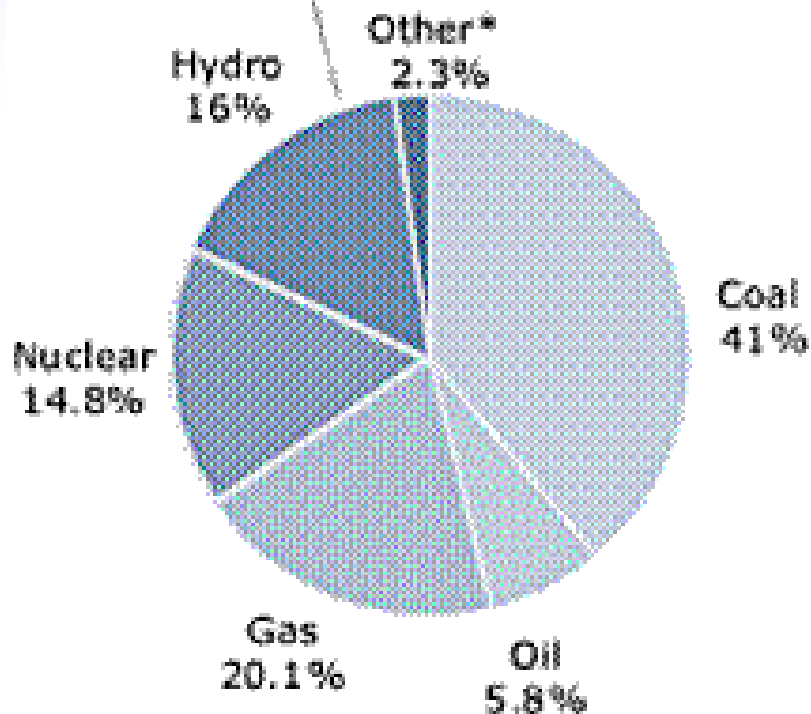


- Biogas production uses fresh Giant King Grass with yield of 375 mt/ha
- Measured biogas yields are 160-190 cubic meters of biogas/tonne of fresh grass
 - Methane content is 57% of biogas
- Bio-methane yield is 94 -111 cubic meters per hectare per day
- Giant King Grass bio-methane yield is 3.4 - 4.0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

Is There Enough Land for Energy Crops?



Total World Electricity Generation by Fuel (2006)



* Other includes solar, wind, combustible renewables, geothermal & waste

- 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

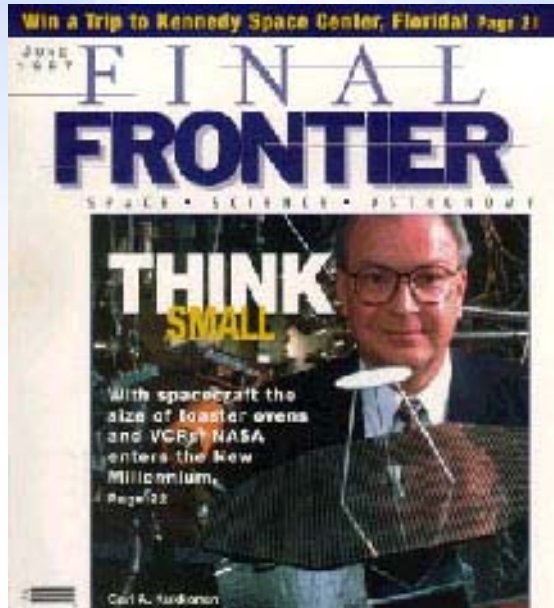


- The percentage increase in world cropland needed to replace coal for electricity generation worldwide is given by

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

- 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**

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