

# **GIANT KING™ GRASS**

**High Yield Feedstock for Biofuels, Biogas,  
Biochemicals and Fuel for Electricity Production**

**World Congress of Industrial Biotechnology 2010**

**Dalian, China July 25-27, 2010**



# VIASPACE



**Dr. Carl Kukkonen, CEO**

**VIASPACE Inc., Irvine, California USA**

**[www.VIASPACE.com](http://www.VIASPACE.com) [Kukkonen@VIASPACE.com](mailto:Kukkonen@VIASPACE.com)**

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

**Safe Harbor Statement:** Information in this presentation includes forward-looking statements which relate to future events or performance, and involve known and unknown risks, uncertainties and other factors that may cause our actual results, levels of activity, performance or achievements to be materially different from those expressed or implied by these forward-looking statements. Such factors include, without limitation, risks outlined in our periodic filings with the U.S. Securities and Exchange Commission, including Annual Report on Form 10-K for the year ended December 31, 2009, as well as general economic and business conditions; and other factors over which VIASPACE has little or no control.



# Giant King Grass

## Dedicated Feedstock



- High yield, non-food, not genetically modified
  - High yield leads to low cost
  - Can meet feedstock & fuel cost targets



# Industrial Biotechnology



- Application of biotechnology (often using enzymes or cells) for industrial purposes
  - Manufacturing (food processing, bioremediation)
  - Alternative energy or “bioenergy”
  - Biomaterials (bio plastics, cosmetics, textiles)
- Green biotechnology is agricultural
- Red biotechnology is pharmaceuticals and medicine
- White biotechnology is industrial uses

# Feedstock for Industrial Biotech



- Much of industrial biotechnology focuses on converting biomass into bioenergy, biochemicals, biomaterials, etc.
- Many assume the biomass will be there when needed in plentiful amounts at reasonable prices
  - This has not been the case for bio electricity
- Agricultural and forestry wastes have become scarce and expensive
  - In India and China, biomass power plants are closed or running at partial capacity because of the lack of biomass

# Feedstock for Industrial Biotech



- High yield dedicated biomass crops needed
  - Provide large quantities w/20 year supply agreement at known acceptable cost
  - Efficient use of land
- Feedstock or fuel supply contract probably needed to obtain project financing
- Competition with food will not be allowed
- Logistics much simpler and low transportation costs if processing facility and biomass plantation are co-located



# Giant King Grass



- Very high yield and therefore low-cost
  - 375 wet metric tons/hectare (167 t/acre) suitable for biogas production
  - Sun dry to 25% moisture suitable for power plant reduces yield to 125-180 mt/ha (56-80 t/acre)
  - 100–135 bone dry mt/ha (45-60 t/acre) suitable for pellet production
- Perennial in subtropical & tropical areas
  - Plant once, grows for many years
- Can be grown as an annual crop
  - 67.5 dry mt/ha (30/t/acre)
  - But must be replanted every spring

# Direct Combustion in Biomass Power Plant



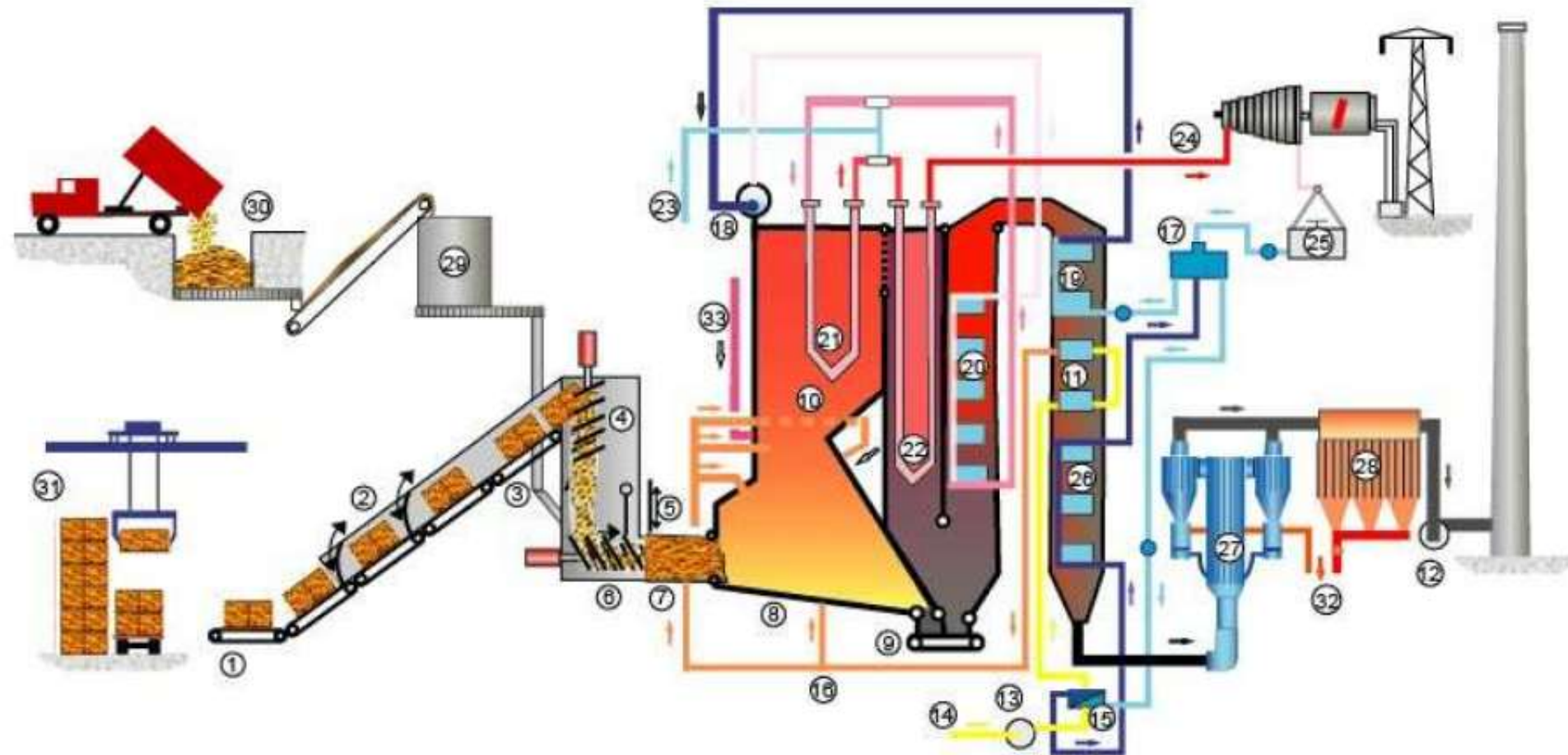
- Giant King Grass has excellent energy content of 18.4 MJ (megajoule) per dry kilogram equivalent to
  - 5.1 kilowatt hours thermal/kg
  - 7900 BTU/pound
  - 4400 kcal/kilogram
- Properties similar to corn straw (stover)
- 1 kWh electrical requires 0.72 kg of Giant King Grass
  - 27% generation efficiency





# 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

# 30 MW Biomass Power Plant in China

- Corn straw and rice husks as fuel today
  - Large 50 km collection radius
  - 600+ metric tons fuel/day
  - 186,000 mt/year
  - Seasonal crops, must transport & store for months
- 1500 ha (3705 acre) if Giant King Grass
  - 2-3 km collection radius
  - Just in time harvesting simplifies logistics



Cut at 4m tall for burning<sup>10</sup>

# Giant King Grass Energy Analysis



<b>Proximate Analysis</b>	<b>Unit</b>	<b>Sun Dried As Received</b>	<b>Giant King Grass Bone Dry</b>
Total Moisture	%	14	0
Volatile Matter	%	65.68	76.37
Ash	%	3.59	4.17
Fixed Carbon	%	16.74	19.46
Total Sulfur	%	0.11	0.13
HHV	MJ/Kg	15.85	18.43
LHV	MJ/Kg	14.52	-



# Giant King Grass Energy Analysis



Ultimate Analysis	Unit	Bone Dry
Carbon	%	46.64
Hydrogen	%	5.66
Nitrogen	%	0.43
Chlorine	%	0.548
Total Sulfur	%	0.13
Oxygen	%	42.97

# Giant King Grass Pellets as Coal Replacement



- Giant King Grass pellets co-fired up to 20% w/ coal
  - Requires small modification to existing coal power plant
  - Dry & press into pellets
- Preserves existing power plant CAPEX & meets carbon reduction targets
- Large global demand
  - Particularly in Europe
  - Japan & Korea emerging
- Dedicated energy crops favored over waste



# Biomass Briquettes



- Replace oil, natural gas & coal in boilers to provide industrial heat and steam
- Cement, ceramics, brick, chemical, food processing, ethanol, textile, rubber, etc.





# High Temperature Gasification



- Producer gas to replace oil, natural gas & coal in boilers and engines that cannot directly burn biomass for process heat & steam



- Syngas to produce chemicals such as ammonia & liquid biofuels incl. methanol and gasoline & diesel via the Fisher Tropsch process

# Giant King Grass for Bio-Methane

- Giant King Grass has very high bio-methane yield
  - 91 liters methane/kg fresh grass
  - 0.36 m<sup>3</sup>/kg volatile solids
  - Compared to 0.22 for municipal solid waste, 0.21 for rice straw
  - Organic fertilizer is byproduct



**Biogas plant generates 1 MW electricity and 1 MW heat for greenhouse using anaerobic digestion and corn as feedstock. Can use Giant King Grass**



**Cut at 1m Tall Every  
25-30 Days for Biogas**



**1 MW biogas plant requires 70 ha of Giant King Grass**



# Giant King Grass Bio-Methane Yield

## Anaerobic Fermentation Test

Method : In accordance with DIN EN ISO 11 734 / VDI RL 4630.

<b>Substrate:</b>	Type/Origin:	King grass / China	
	Amount:	7,01	g
	Dry Matter (DM):	27,4	%
	Volatile Solid (VS):	93,4	% DM
<b>Inoculums:</b>	Origin:	ATRES	
	Temperature:	38	°C
	pH value:	7,8	-



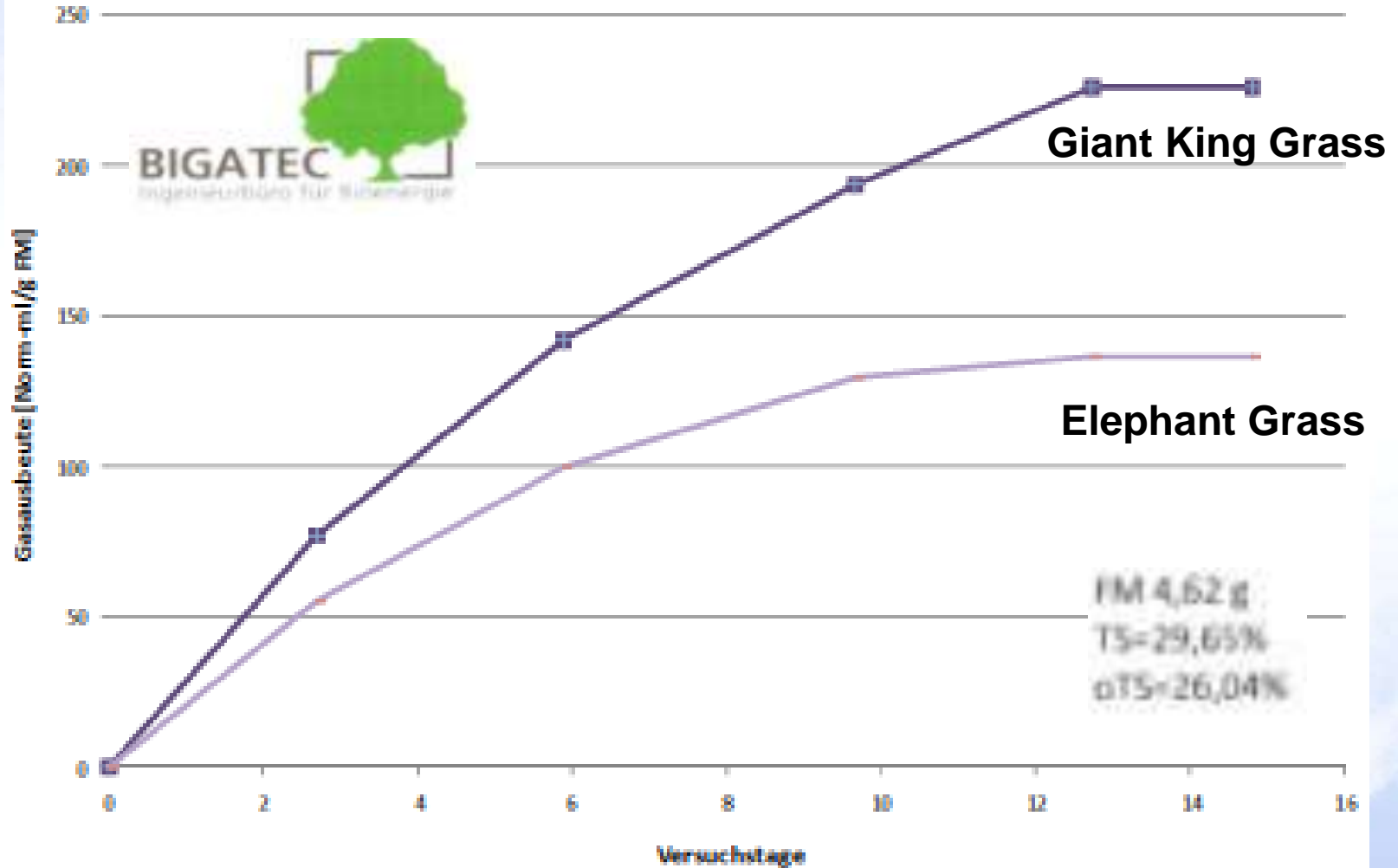
**ATRES**  
engineering biogas



1.5 MW biogas engine/generator

Nr.	Parameters	Unit	Results
1	Duration of the experiment	d	27
2	Methane content	%	57
3	Biogas production of the substrate (fresh substrate)	l <sub>N</sub> /kg	160
4	Methane production of the substrate (fresh substrate)	l <sub>N</sub> /kg	91
5	Specific biogas production (based on volatile solid of the substrate)	l <sub>N</sub> /kg-VS	626
6	Specific methane production (based on volatile solid of the substrate)	l <sub>N-CH<sub>4</sub></sub> /kg-VS	357

# Biogas Yield per Gram of Fresh Grass



Anaerobe Gasproduktion in Anlehnung an DIN 38 414 S8

# Additional Markets for Giant King Grass

- Grassoline, cellulosic liquid biofuels
- Torrefaction, pyrolysis, other densification
- Anhydrous ammonia
- Biomass derived chemicals and bio plastics
- Pressed “wood” products





# Land-Use Efficiency Example



- Biomass with yields above 10 tonnes/hectare/year exceed the land efficiency of corn to produce ethanol
  - Cellulosic ethanol is not yet commercially viable
- Perennial crops such as grasses lead to less soil depletion and erosion
- High yield of Giant King Grass makes most efficient use of land

Assumes 85 gallons ethanol per dry ton (353 l/mt) for cellulosic ethanol

Feed-stock	Yield Mt/ha	Ethanol Liter/ha	Ethanol Gallon /acre
Corn US	9.4	3500	375
Corn-straw	9.4	3320	355
Switch-grass	25	8835	945
Giant King Grass	100	35340	3785

# 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**

# 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



# Giant King Grass Cultivation



- Non-freezing climate
- Adequate rainfall or irrigation for high yield
  - But tolerates dry season
- Modest fertilizer needed for high yield
  - But fixes nitrogen from atmosphere





# Giant King Grass

- Natural hybrid of two grasses
  - Not genetically modified
  - Not an invasive species
- Productive in first year
- Needs >100 days sunshine and >800mm rain or irrigation
  - Does better with more of both
- Can be grown in acidic or mildly saline soil
- No pesticide required



# New Planting September 28, 2009





# Giant King Grass & Factory July 2010





# Green Log Factory



## NATURAL RENEWABLE Grass Fire Log



Single 5-Pound (2.27 kg) Logs



Carton of Six 5-pound (2.27 kg) Logs



# Giant King Grass Green Log



5 lb Green Log



Green Logs





# Advantages of Giant King Grass



- Low cost because of extremely high yield
  - Can meet the cost targets for all energy applications
- Perennial crop, simple to grow
  - Do not have to plant every year, just harvest
- Is harvested in the first year
  - Other crops can take 2-4 years
- Provides a reliable fuel or feedstock
  - Required for project financing

# Biomass Feedstock Prices



Application	Current prices	Price per gigajoule (\$/GJ)
Biogas production	\$10-13/mt (75% moisture)	\$2.17-\$2.83
Direct combustion power plant	\$30-40/mt (25% moisture)	\$2.17-\$2.90
Pellet/briquette production	\$30-50/mt (20% moisture)	\$2.04-\$3.40
Biofuels feedstock	\$50-55/mt (20% moisture)	\$3.40-\$3.74

Prices being paid today for agricultural waste in China, Thailand and India

**Giant King Grass can meet or beat current feedstock prices**

**Plus provide a reliable, consistent source of supply for the lifetime of the project**

# VIASPACE Summary



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



# VIASPACE Summary



- VIASPACE will work with existing or planned projects requiring a minimum of 100 ha of Giant King Grass
- VIASPACE will provide Giant King Grass, supervise crop establishment, train local farmers and provide technical support
- VIASPACE and partners can develop and deliver an integrated plantation and power plant, biogas facility, briquette or pellet mill at your location

# **ADDITIONAL SLIDES**

# Dr. Carl Kukkonen

## CEO Biography



**1998-2005 VIASPACE Inc. CEO**

**1984-1998 NASA/Caltech Jet Propulsion Laboratory (JPL)**

**Director Center for Space  
Microelectronics Technology  
Manager of Supercomputing**

- Led staff of 250 with \$70 million annual budget
- On review boards of 14 leading universities

**1977-1984 Ford Motor Company**

- Developed direct injection diesel engine
- Ford's expert on hydrogen as an automotive fuel
- Research in Physics Department

**1975-1977 Purdue University postdoctoral fellow**

**1968-1975 Cornell University MS & PhD in theoretical physics**

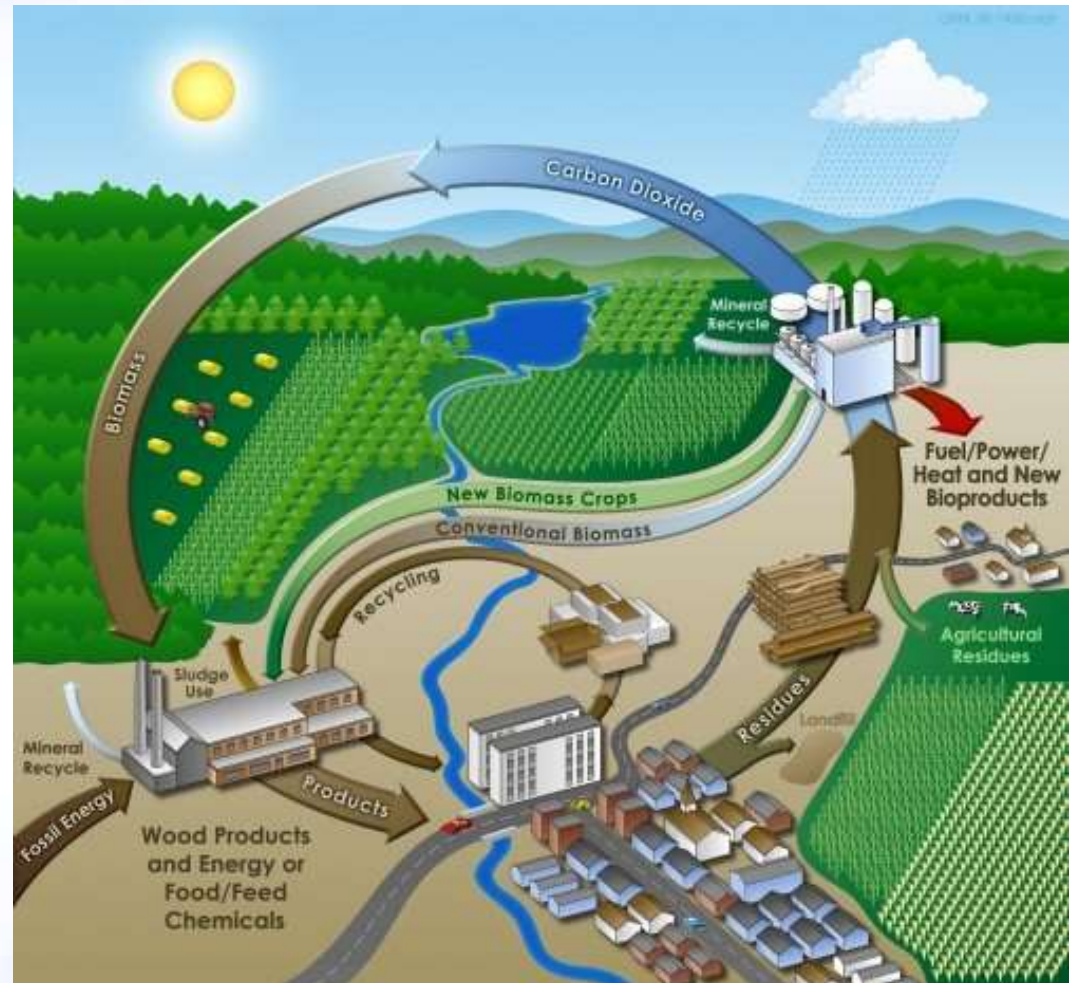
**1966-1968 University of California Davis BS physics**





# Biomass is Low Carbon Fuel

- Biomass energy is solar energy & CO<sub>2</sub> captured in plants by photosynthesis
- Burning biomass or biofuels simply recycles the CO<sub>2</sub> stored by the plant
- Carbon neutral except
  - Fertilizer, harvesting, & delivery contribute some carbon dioxide



# 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

# Compare Biomass Costs to Fossil Fuel



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

- 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