

Giant King® Grass Biomass Power Projects in Caribbean & Central America



Clean Energy for a
Cleaner Tomorrow



Giant King Grass Dedicated Energy Crop



**Example Biomass Power Plant
Under Construction**

Dr. Carl Kukkonen
CEO VIASPACE Inc., USA
kukkonen@viaspace.com
www.viaspace.com

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- VIASPACE is a publicly traded company
 - Fully reporting to SEC and audited
 - VIASPACE stock symbol VSPC
- Giant King® is a registered trademark of VIASPACE Inc.
- Giant King® Grass is proprietary to VIASPACE

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Dr. Carl Kukkonen

CEO Biography



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1998-PRESENT VIASPACE Inc. CEO—Originally products came “VIA” the “SPACE” program
VIASPACE now focuses on renewable energy and animal feed using its proprietary
Giant King Grass

1984-1998 NASA/Caltech Jet Propulsion Laboratory (JPL)
Director, Center for Space Microelectronics Technology
and Manager of Supercomputing

- Led staff of 250 with \$70 million annual budget
- On review boards of 14 leading universities
- NASA Exceptional Achievement Award 1992
- Space Technology Hall of Fame 2001

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





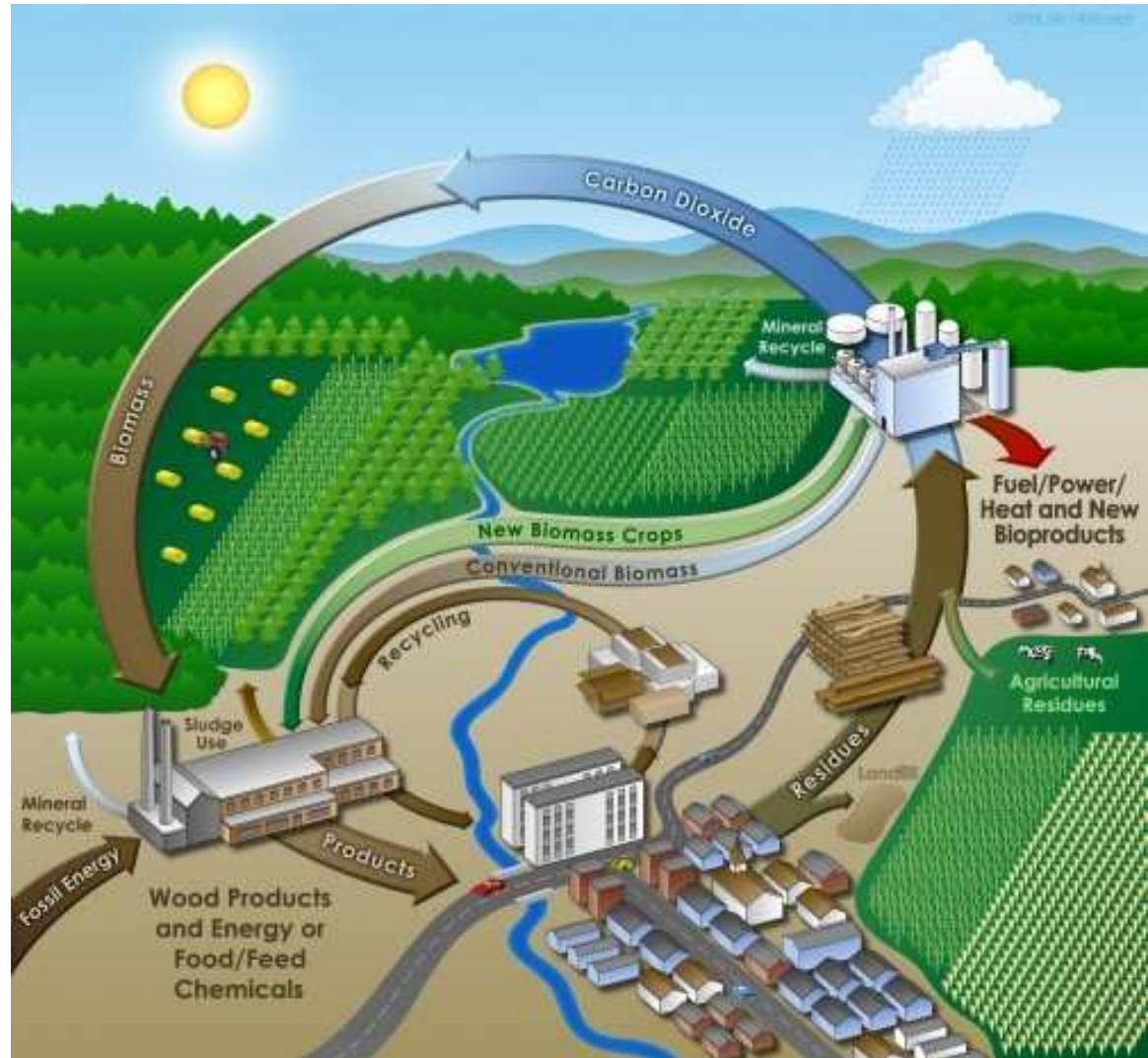
Mature 6 month old Giant King Grass ready to harvest

Biomass is Renewable & Low Carbon Plants Breathe Carbon Dioxide



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- Plants use sunlight & CO_2 to grow. Carbon is stored in the plant
- Burning biomass or biofuels simply recycles the CO_2 stored in the plant
 - Time can be 6 months - grass to 20 years-trees
- Biomass is carbon neutral except from
 - Fertilizer, harvesting, & delivery



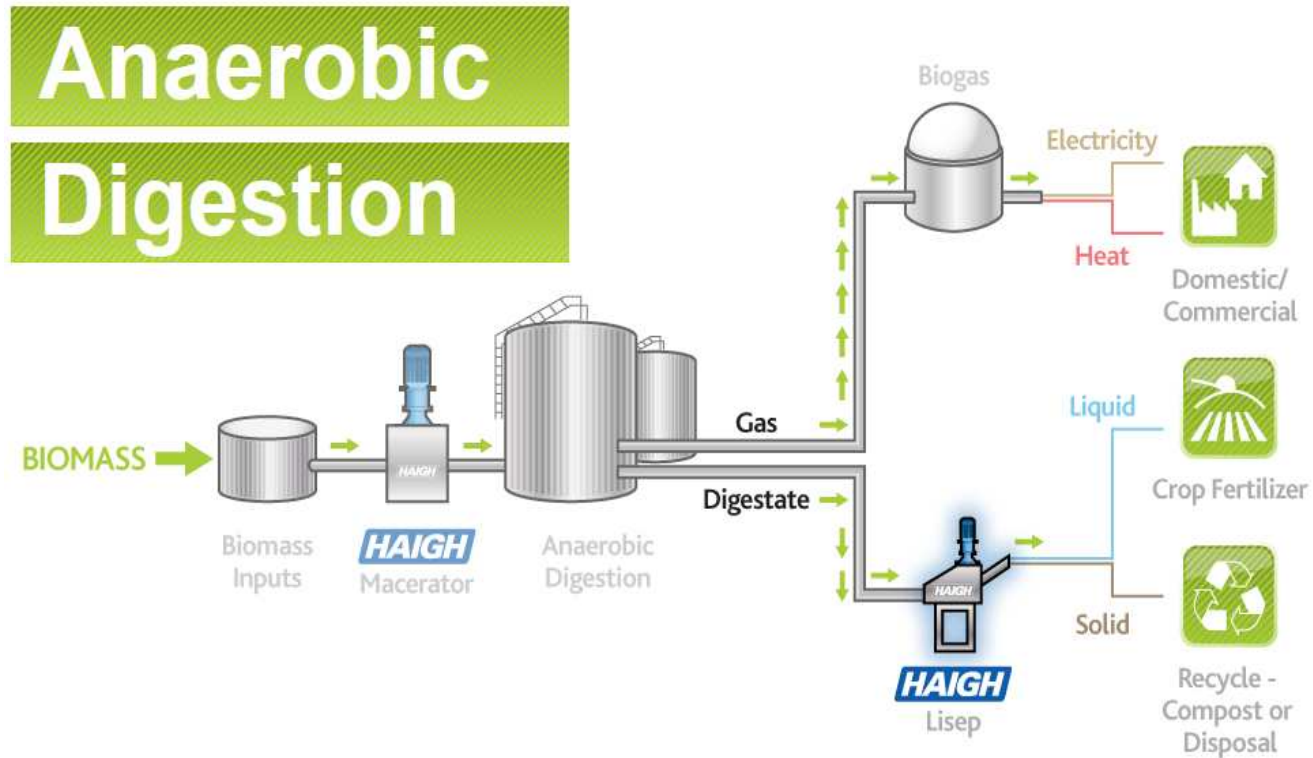
- Wood and wood waste
 - Best fuel, but limited availability and there are many other uses in addition to construction and furniture that have higher value
 - Pulp and paper
 - Sawdust for particle board (MDF)
- Sugarcane bagasse is already used by sugar mills to produce heat and electricity
 - Only available for 6-9 month crushing season
- Agricultural residues such as corn, wheat or rice straw and rice husk
 - Seasonal availability with uncertain pricing, and no long term contracts available
- Dedicated energy crops such as fast growing trees and perennial grasses
- Giant King Grass has highest yield by far which means lowest cost

- Direct combustion
 - Burn 100% biomass in power plant for zero carbon emissions
 - Co-fire with coal to reduce carbon emissions
- Proven technology
- Harvest Giant King Grass twice per year at 15 – 18 feet tall
 - Dry and chop for local power plant
 - Make pellets for export
- Reliable 24/7 base electricity



Generate Electricity from Biomass

- Anaerobic digestion
 - Biological process that mimics a cow stomach to make bio methane (biogas)
 - Organic fertilizer is a byproduct
- Biogas is used in engine which turns a generator
- Reliable 24/7 base electricity
 - 10,000 operational in Europe
- Giant King Grass is harvested 4-5 times per year at 8-12 feet tall
- Chop only, drying not necessary
 - Can be stored as silage
- Co-digestion with other organic matter such as manure or food processing waste



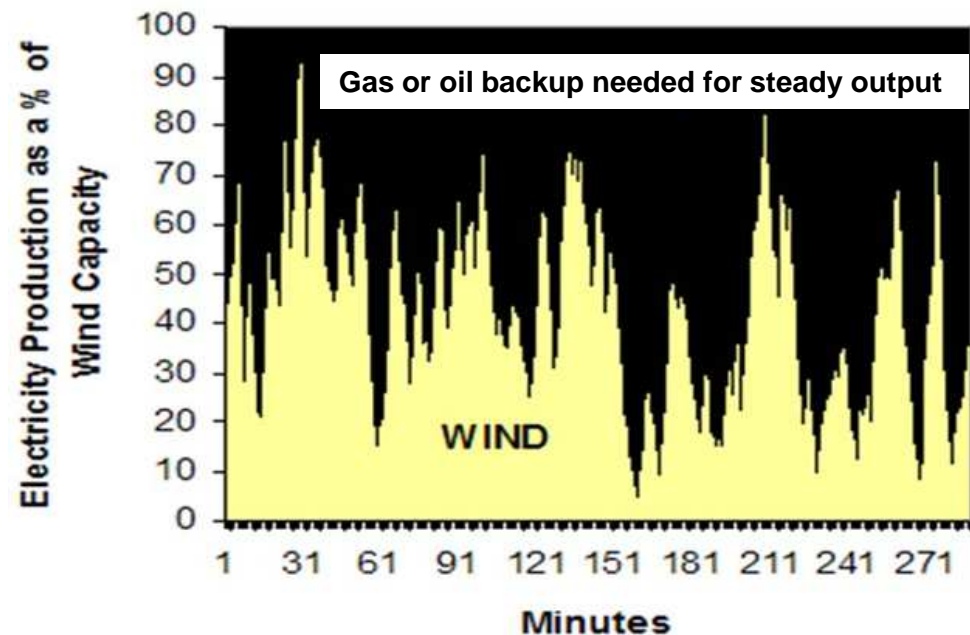
Biogas is 57% methane and 43% carbon dioxide and fuels an engine that turns a generator to make electricity

Other Renewables--Wind Energy



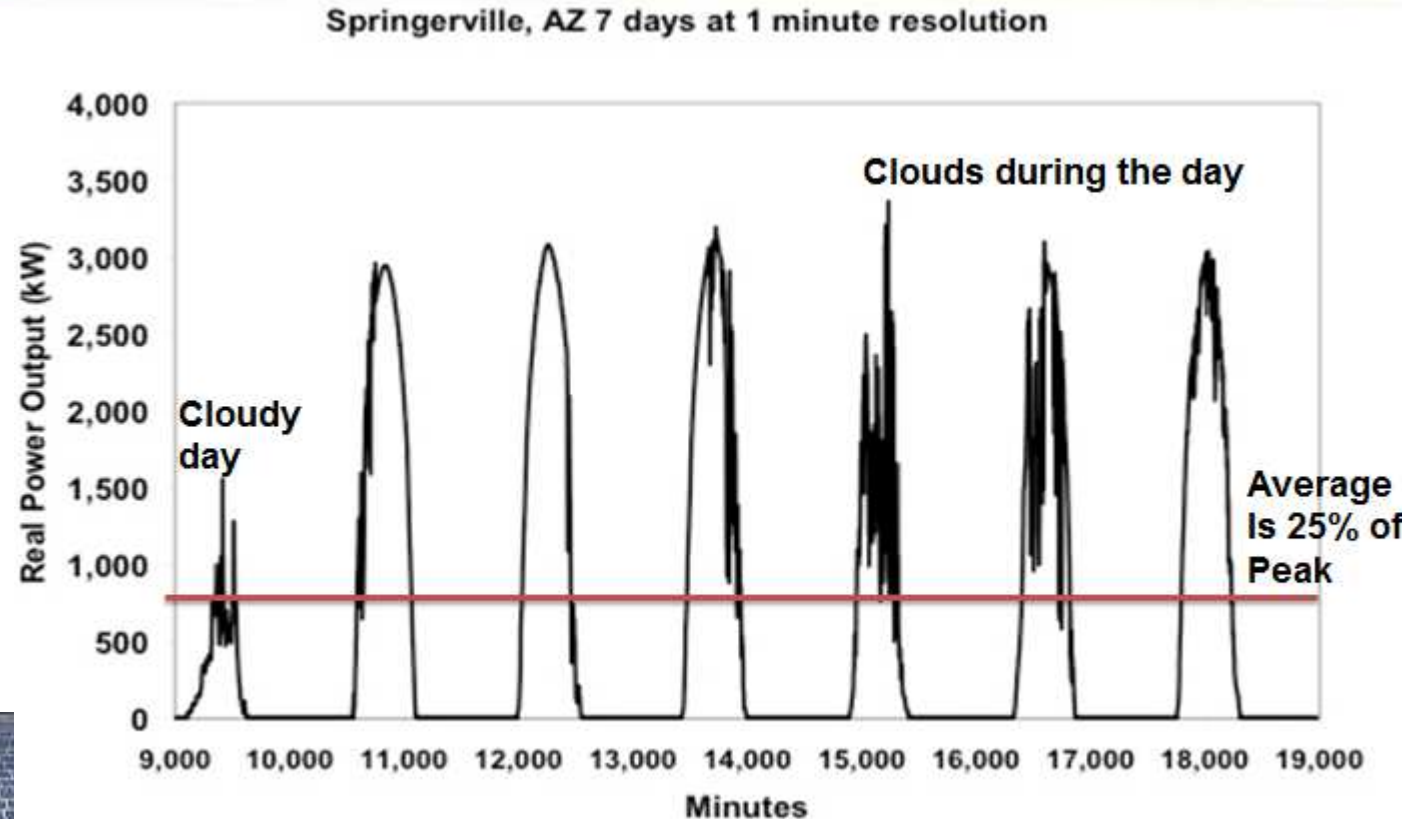
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- Fuel is free and no carbon dioxide emissions
- Intermittent energy
 - Wind speed varies greatly
 - Average is 34% of rated
- Fast responding backup generator fueled by gas or oil needed to provide constant electrical output
 - 1 MW of when requires 1 MW of backup
- Wind turbine and backup required to make system work
- Wind blows often at night when demand is low



Other Renewables--Solar Power

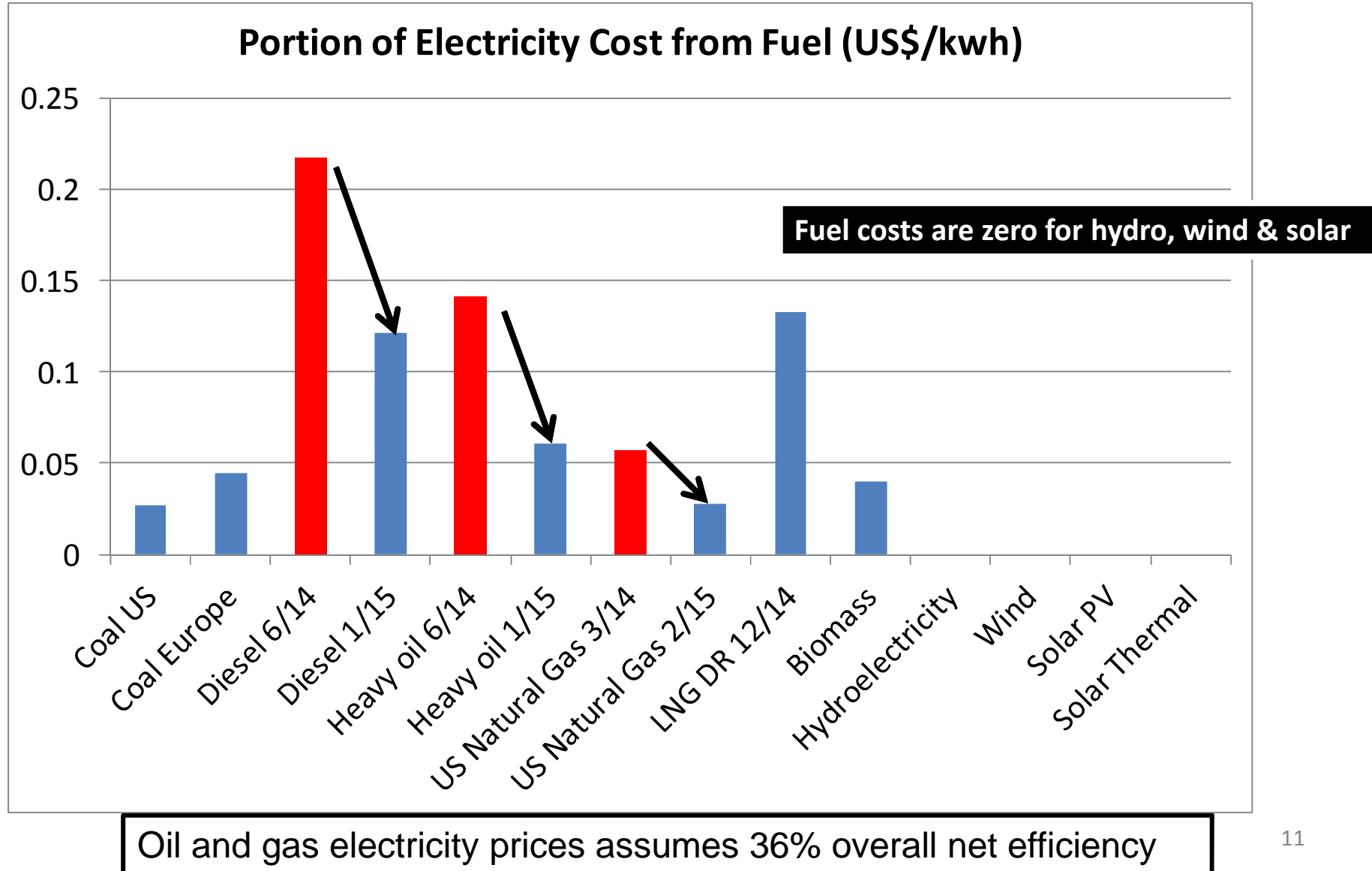
- Fuel is free and no carbon emissions
- Need backup for night and cloudy days
- 1 megawatt of backup for one MW of solar
- Solar peak is at time of high demand



Electricity Cost Comparison-- Fuel Contribution



Clean Energy for a
Cleaner Tomorrow

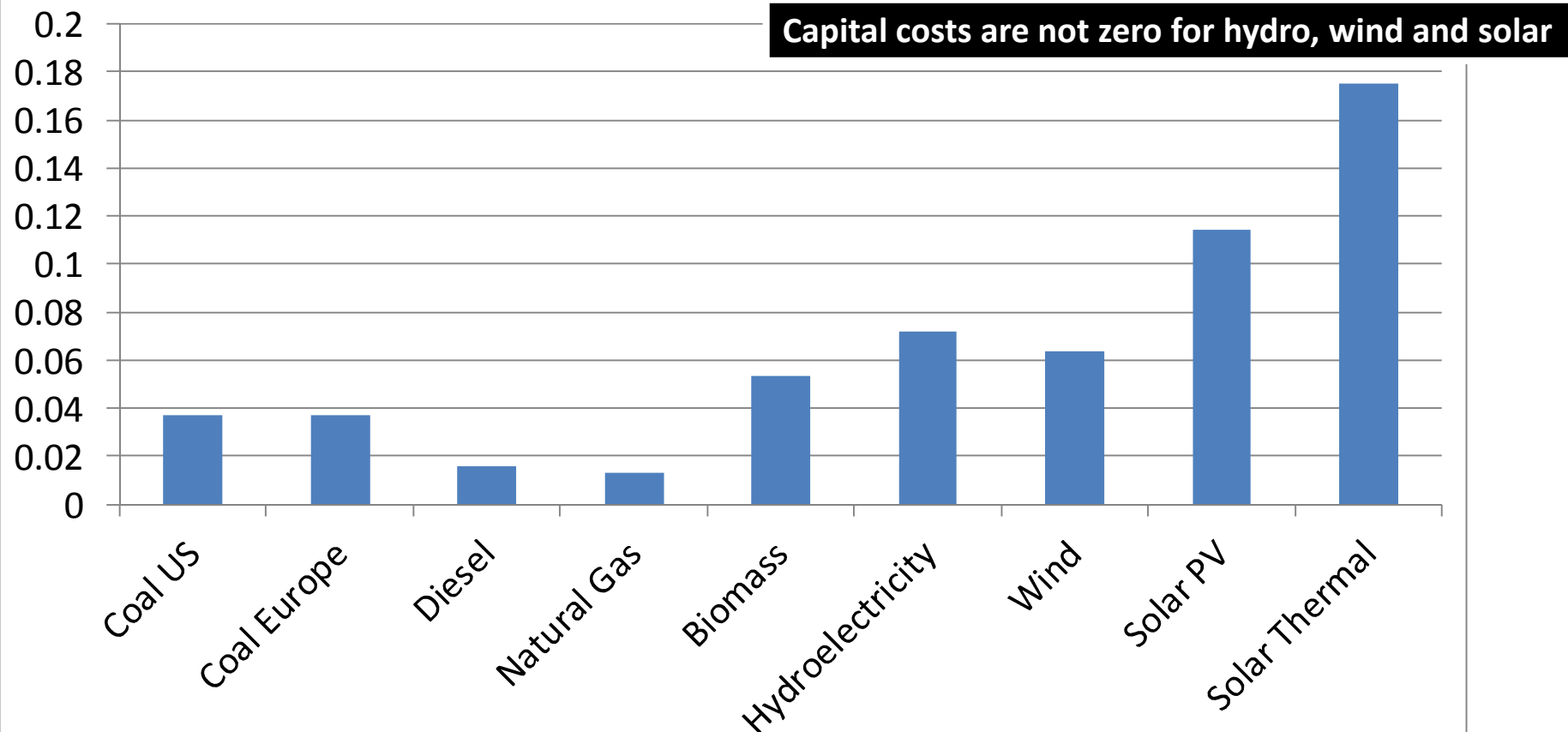


Electricity Cost Comparison-- Portion from Capital Expense



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**Crude Estimate* of Portion of Electricity Cost from CAPEX
(US\$/kwh)**



*CAPEX/electricity produced in 10 years & LCOE from EIA

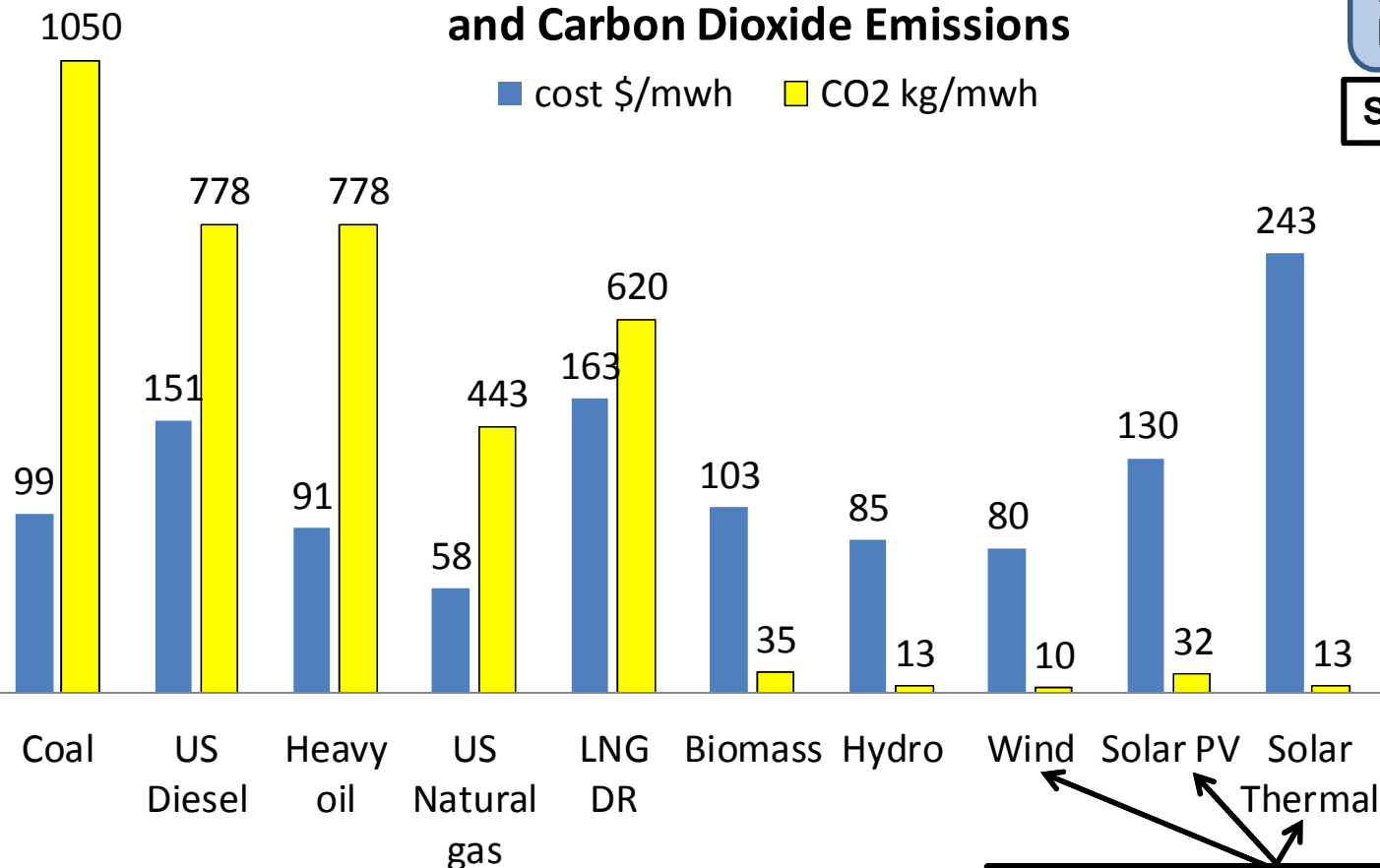
Compare Electricity Costs & CO₂ Emissions



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Estimated Cost of New Electricity in 2016-19 and Carbon Dioxide Emissions

■ cost \$/mwh ■ CO2 kg/mwh



Best options have both
Low cost electricity and
Low carbon emissions

Sales price 20+% higher

Require oil or gas backup
which adds cost

Sources: private communications and
[Benjamin K. Sovacool](#)., [Energy Policy](#), Vol. 36, 2008, p. 2950
www.eia.gov/forecasts/aeo/electricity_generation.cfm

Long Term Fuel Cost



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- Power plant investment is for 25+ years
- How long will oil price stay low?
- Lifetime fuel costs are much larger than power plant cost
- Giant King Grass provides predictable fuel price for lifetime of power plant
- Money stays in country, instead of going overseas to pay for oil

Base Power fuel	CAPEX per MW	Price (\$46 & \$100/bbl oil)	Price/kwh electricity	25 year fuel cost/MW	
Diesel	\$1.3M	\$1.64/gallon	\$0.109/kwh	\$23M	Likely to increase
		\$2.95/gallon	\$0.217/kwh	\$45M	volatile
Heavy fuel oil	\$1.3M	\$265/mt	\$0.061/kwh	\$13M	Likely to increase
		\$611/mt	\$0.141/kwh	\$29M	volatile
Giant King [®] Grass	\$2.5M	\$45/mt	\$0.04/kwh	\$8M	fixed cost No volatility

- First question from banker for biomass power plant is “show me your fuel supply agreement.”
 - We are “**growing our own electricity**”
- Power Purchase Agreement (PPA) from a creditworthy counterparty
- Proven technology
- Qualified EPC contractor that will guarantee cost, schedule and performance
- Management/operations team

- High yield dedicated energy crop
- Harvested twice a year at 4 m tall
- Perennial crop, cut and regrow for 7 – 10 years
- A natural proprietary hybrid, not genetically modified
- Sterile and noninvasive
- Propagated vegetatively like sugarcane
- Will grow on marginal land
- Tropical and subtropical grass
 - Will survive a frost, but not freezing weather
- Provides reliable, low cost fuel or feedstock for 24/7 operations 365 days/year

Giant King Grass is NOT for Everyone



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- Needs warm weather, sunshine and water
 - No freezing weather
- Need land availability (70 ha/MW)
- Need sufficient rainfall or source of water for irrigation
 - California has little rain, but rivers for irrigation
 - Nicaragua has rain, but a dry season with a lake for irrigation
 - Guyana has sufficient rain. No irrigation used
 - Islands may not have the water

Giant King[®] Grass Growth Cycle

Perennial Crop--Plant Once, Harvest Many Times



Mature 6 month old Giant King Grass ready to harvest

Giant King® Grass

March 17 – Just Harvested



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Surface or subsurface drip tape irrigation, row & furrow or flood irrigation can be used.

Giant King® Grass

March 27 – Regrowth in 10 days



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Giant King Grass in the left rear is 18 feet tall

Giant King® Grass

April 18 – One Month Old



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Giant King® Grass

May 13 – Two Months Old



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Ready for harvest for animal feed (14.9% crude protein)

For reference VIASPACE CEO Dr. Carl Kukkonen is 6'1" (185 cm) tall

Giant King® Grass

May 30 – 2 ½ Months Old



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Perfect for anaerobic digestion

Giant King® Grass

July 2 – 3 ½ Months Old



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Giant King® Grass

July 31 – 4 ½ Months Old



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Giant King® Grass

August 28 – 5 ½ Months Old



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Ready for propagation or harvest

Giant King® Grass

September 29 – 6 ½ Months Old



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Strong growth— ready for harvest or propagation
For reference VIASPACE CEO is 6'1" (185 cm) tall

Giant King Grass

Very High Yield

- 15 + feet tall in 6 months
- Harvest tall 2 times a year
- Growing in
 - US—California, Hawaii
 - St. Croix, US Virgin Islands
 - Nicaragua
 - Myanmar
 - South Africa
 - China
 - Pakistan
 - Guyana
 - Jamaica
 - Philippines



Giant King Grass Approved by US Department of Agriculture



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- US Department of Agriculture has grown Giant King Grass and found it to be free of disease and pests
- Approved for distribution in US and for export
- USDA will inspect Giant King Grass and issue phytosanitary certificate for export

No phytosanitary certificate can be issued until an application is completed (7 CFR 355)

DMIS NO. 0575-0052

<p>UNITED STATES DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT HEALTH INSPECTION SERVICE PLANT PROTECTION AND QUARANTINE</p> <p>PHYTOSANITARY CERTIFICATE</p>	<p>FOR OFFICIAL USE ONLY</p>	
	<p>PLACE OF ISSUE San Diego, California</p>	
	<p>NO. F-C-06073-03379890-7-N</p>	
<p>TO: THE PLANT PROTECTION ORGANIZATION(S) OF Myanmar</p>	<p>DATE INSPECTED September 03, 2013</p>	<p>CERTIFICATION</p> <p>This is to certify that the plants, plant product or other regulated articles described herein have been inspected and/or tested according to appropriate official procedures and are considered to be free from the quarantine pests, specified by the importing contracting party and to conform with the current phytosanitary requirements of the importing contracting party including those for regulated non-quarantine pests.</p>

- Giant King Grass
 - Very high yield
 - Non-invasive
 - Easy propagation—like sugarcane
 - Well characterized
 - Consistent quality
 - Used for energy & animal feed
- Arundo Donax
 - High yield
 - Listed as invasive
 - Difficult to propagate
 - Not animal feed
- Elephant grass
 - Pennisetum purpureum
 - Called King grass in region
 - 200 different types
 - Some have high yield
 - Some are good animal feed
 - Most not well characterized
- Miscanthus
 - Medium yield
 - Difficult to propagate
 - Not a tropical grass
- Switchgrass
 - Low – medium yield
 - Easily planted from seed
 - Not a tropical grass

Nicaragua Project Overview

- Largest country in Central America (in area)
- Large agriculture sector
- 5M people
- Now safest country in region
- Poorest country in region
- Tropical climate
 - Rainy & dry seasons
- Bunker oil provides base load for the electrical generation and about 50% of energy
 - Other 50%: hydro, wind, biomass and geothermal



- Needs more electricity
- Policy is 97% renewables by 2030
 - Will use any renewable with lower cost than oil
- But hydro is seasonal and wind intermittent
 - Grid cannot handle any more intermittent
- 7 year tax break & no import duty on renewable equipment
- Nicaragua has low labor costs and industry wants to move there
 - But needs competitive and reliable electricity
- Can sell electricity to grid and private industry delivered by grid

- Agro-industrial company in Nicaragua
- Mills, distributes and grows rice
- Has more than 50% of the rice market in Nicaragua
- Giant King Grass growing on AGRICORP plantation since 2012
- AGRICORP investors and VIASPACE have formed a special purpose company for the 12 MW power plant and Giant King Grass plantation
 - In development—not built
- “Energia Reino Verde”—Green Kingdom Energy

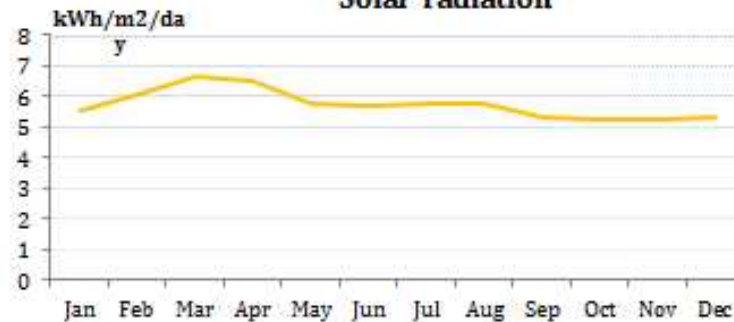


Tropical Weather is Suitable

Average monthly temperature



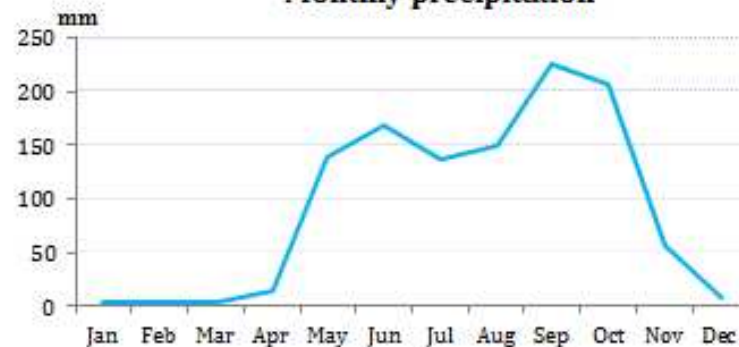
Solar radiation



Daylight hours



Monthly precipitation



Irrigation used during dry season

With sufficient rainfall or irrigation, Giant King Grass can be harvested twice per year

Energía Reino Verde Nicaragua Power Plant

- 12 MW gross electrical production
- High efficiency, 32% LHV of the fuel to electricity
 - 11% internal use
 - 90+% utilization--7884 hours/year
 - Lifetime 25 years
- 84 GWh saleable electricity
- Giant King Grass requirement
 - 9 dry equivalent metric tons/hour
- Operating costs/kWh
 - Fuel \$0.04, Total \$0.06
- Debt 70%
- Equity 30%
- Power plant ~\$2M/MW
- All-in capital ~\$3M/MW
 - EPC, civil works, short grid connection, legal, financing, plantation establishment on leased land, farm equipment



Feasibility Study Summary and Conclusions

- **The proposed integrated Energía Reino Verde 12 MW biomass power plant and 925 ha Giant King Grass plantation project is technically feasible and financeable**
- Validated costs and financial projections for the project
- Strong support team for the project including
 - Agricorp-one of the largest companies in Nicaragua
 - annual revenues exceeding \$150 million
 - IC Power (2nd largest IPP in Nicaragua)
 - Pro Nicaragua, the government investment promotion agency.
- Giant King Grass plantation is very similar to a sugarcane plantation
 - Will utilize best practices from the sugarcane industry.

Feasibility Study Summary and Conclusions

- **The Giant King Grass plantation will be located on the 4,200 ha (10,387 acre) Miramontes plantation that is currently growing rice on 2,800 ha.**
 - Irrigation from Lake Nicaragua is available
 - Plantation and power plant workers available in the region.
- In addition to Giant King Grass, the power plant will be fueled by rice husk as a secondary fuel (5-8%)
- Rice straw from the plantation is available as a backup fuel



Aerial view of rice plantation



Rice husk residue from milling

Giant King Grass Growing Well at Miramontes



AGRICORP Has Infrastructure and Experience



Feasibility Study Summary and Conclusions

- Co-location of power plant and plantation is a major advantage
- Average distance of field to power plant is 3 km
- Reduces transport costs
- Simplifies logistics



Power Plant Operations

- An experienced team will operate the power plant.
- A candidate operator is IC Power Nicaragua
 - Large independent power producer in Nicaragua with 185 MW installed from bunker oil and wind
 - Previous experience in sugarcane bagasse power plant



51 MW bunker oil power plant



63 MW of wind power

Feasibility Study Summary and Conclusions

- The biomass power plant is located 9 km from a grid connection point
 - Reasonable expense for the proposed size of the project.



Surveyed route shown in red

- ✓ Feasibility study completed
- ✓ SPV company established
- ✓ EPCs interviewed
- ✓ Initial presentations to investors (debt and equity)
 - Provisional generation license, power purchase agreement, permits and other contracting tasks in progress
 - PPA discussions underway
 - Financial closure
 - Construction and commissioning in 18-24 months

12 MW Giant King Grass Power Plant in Nicaragua



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- Provides renewable, low carbon, base electricity
 - Reliable 24 hours/day
 - Not intermittent like wind and solar
 - Complements hydro
- Lower cost than heavy fuel oil at ~\$60/barrel oil
- Plantation and power plant provide jobs
 - Construction employment
 - Ongoing rural employment—skilled and farmworkers
- Pays municipal and national taxes
- Electricity infrastructure for people and industry
- Utilizes the natural resources of Nicaragua— sunshine, warm weather and water
- Sustainable agriculture
- Money stays in Nicaragua rather than sending money overseas for oil

7 MW Tibbar Biogas Power Plant Project on St. Croix



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- Tibbar Energy USVI is developing an anaerobic digestion biogas power plant on St. Croix, US Virgin Islands
- Primary feedstock is Giant King Grass, which will be grown on a 1500 plus acres
- Biogas used to power engine generator set to produce 7MW of base load renewable electricity.
- Tibbar will be the only base load renewable energy project independent of fossil fuel in the USVI
- Giant King Grass is harvested 4-5 times a year at 8-10 feet tall for anaerobic digestion



Typical anaerobic digestion power plant



Giant King Grass on St. Croix ⁴⁷

Tibbar Energy St. Croix Project Status



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Tibbar Energy CEO Tania Tomyn

- Required permits will be in place by February 2015
- Giant King[®] Grass from its nurseries on St. Croix is ready for the production fields
- Completing financing
- Construction is scheduled to begin in second quarter of 2015

Giant King Grass in Guyana

- Customer plans to make energy pellets for export to Europe



- Giant King Grass planted on savannah with only rainfall—no irrigation
 - Growing well
- Vast areas available



- Also plan to use Giant King Grass to produce small-scale electricity for remote areas using anaerobic digestion to produce biogas
 - 0.5-3 MW
- Guyanese team is seeking partner



Anaerobic digester



Engine & generator

- Customer plans to use biogas from anaerobic digestion to produce low carbon liquid fuels
- Planted initial trial without irrigation. Drought in Jamaica negatively affected yield
- Plans to use irrigated former sugarcane land



Giant King Grass Is Growing Well in Hawaii



Water availability can be an issue on islands. Irrigation is used in Hawaii.

Additional Giant King Grass Applications

Giant King Grass Pellets as Coal Replacement



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- Giant King Grass pellets can replace up to 20% of coal in an existing coal-fired power plant
 - Burning coal and biomass together is called cofiring
 - Requires small modification
- Preserves large capital investment in existing power plant with 30 year additional life
- Meets carbon reduction targets
- 16M tons of pellets used globally today
 - 46M tons by 2020
- Grass is grown, dried and pressed into pellets and shipped in bulk like shipping grain
- Large global demand
 - Particularly in Europe
 - Korea, China, Japan emerging



Test Data on Giant King Grass Shows Consistency of Product



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Composition Determination

Parameter	Amount (a.r.)	Amount (o.d.)
Total Moisture	8,81	
Moisture Airdry		
Ash	4,66	5,11
Volatile matter incl. moisture.		
Volatile matter	70,34	77,14
Fixed Carbon	16,18	17,75
Gross Calorific Value	4055,2	4446,9
	16,978	18,618
Nett Calorific Value (cV)	3742,1	
	15,667	
	6735,7	
Nett Calorific Value (cP)	15,592	



国家煤炭质量监督检验中心
China National Coal Quality Supervision
and Testing Center



GKG is Good Feed for Dairy Cows, Cattle, Camels, Goats, Sheep & Horses



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**Cut at 5-7 ft tall at
45-60 days**

**Cut & carry, or
potentially
Intensive grazing**

**Fresh, silage, hay,
Meal or pellets**



**Part of
diet for
pigs,
rabbits
& fish**



Giant King Grass Nutrition



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- Excellent nutrition--ideal for ruminants-cattle, sheep, goats & camels
- Also for horses, pigs, rabbits and some fish
- Better than oat hay
- High yield means low cost
- Reduces need for expensive alfalfa, grains and concentrates in a mixed ration feed
- Can be used as fresh chop, silage, hay, meal or pellets

Dairy One

GIANT KING GRASS HOLTVILLE ROW 3

Analysis Results

Components	As Fed	DM
% Moisture	82.8	
% Dry Matter	17.2	
% Crude Protein	3.0	17.3
% Available Protein	2.8	16.4
% ADICP	.2	.9
% Adjusted Crude Protein	3.0	17.3
Soluble Protein % CP		45
Degradable Protein%CP		75
% NDICP	.6	3.7
% Acid Detergent Fiber	6.6	38.5
% Neutral Detergent Fiber	10.5	60.9
% Lignin	.6	3.6
% NFC	1.2	7.2
% Starch	<0.1	.2
% WSC (Water Sol. Carbs.)	1.8	10.5
% ESC (Simple Sugars)	1.5	8.7
% Crude Fat	.4	2.1
% Ash	2.15	12.53
% TDN	11	61
NEL, Mcal/Lb	.09	.55
NEM, Mcal/Lb	.10	.56
NEG, Mcal/Lb	.05	.31
Relative Feed Value		90

Giant King Grass Can Be Used As Feedstock for Biofuels, Biochemicals and Biomaterials

Giant King Grass is the Same as Corn Stover w/ Much Higher Yield



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<i>Composition Dry Weight %</i>	Giant King Grass	Corn Stover
<i>Glucan</i>	43.0	37.4
<i>Xylan</i>	22.3	21.1
<i>Arabinan</i>	2.9	2.9
<i>Lignin</i>	17.4	18.0
<i>Ash</i>	4.5	5.2

Composition- Glucan
Xylan & Arabinan
are sugars for cellulosic
ethanol. Lignin & ash
are byproducts

Notes and references:

Giant King Grass: average of samples cut at 4 m tall

Corn Stover: Aden et al. NREL/TP-510-32438, 2002

One dry ton of Giant King Grass is slightly better than corn Stover for cellulosic ethanol

Yield Dry Matter	Giant King Grass	Corn Stover
US ton/acre	44	3.5-4.7
Metric ton/ha	100	8.6-11.6

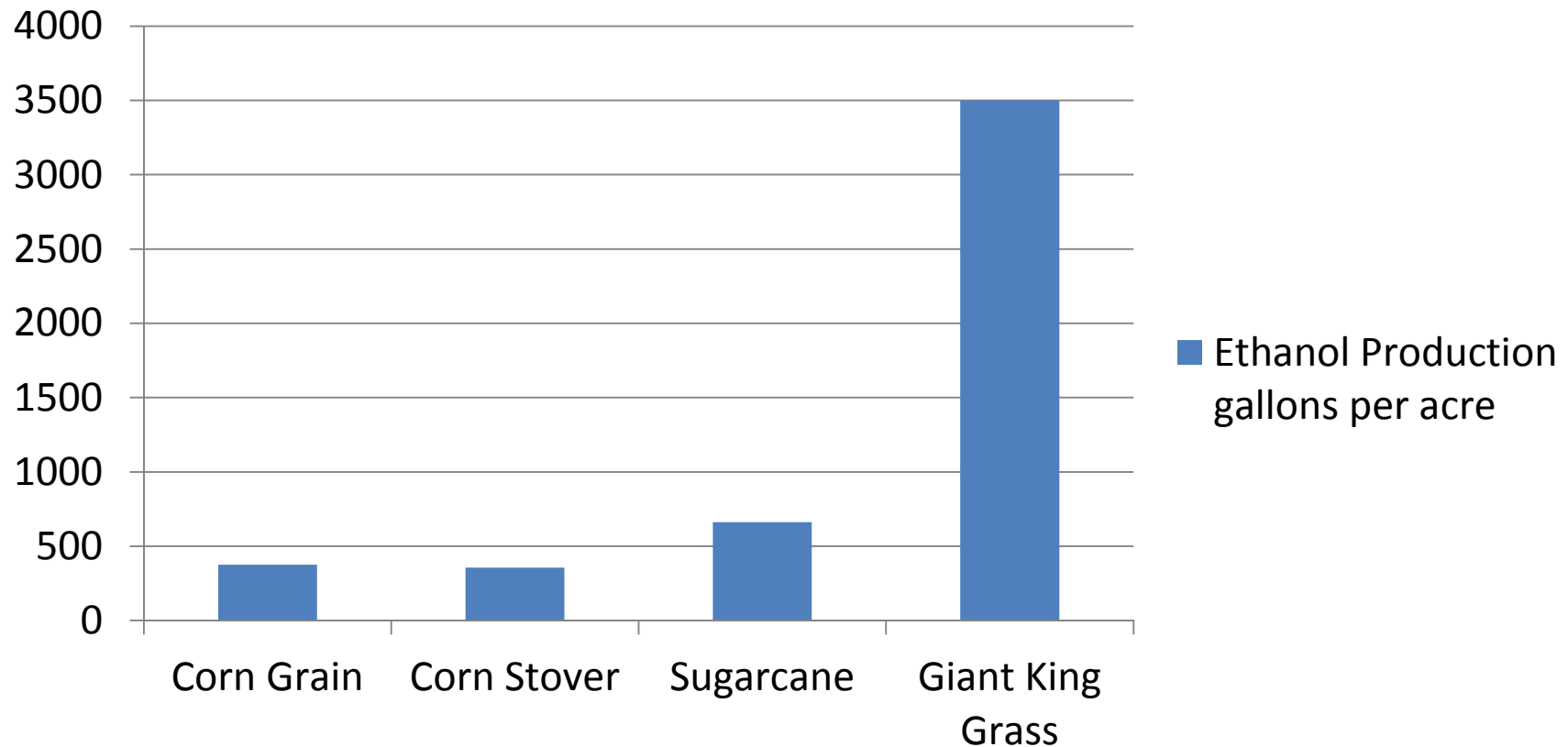
Giant King Grass has much higher yield per acre than corn Stover

High Yield of Giant King Grass Means High Ethanol Production



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Ethanol Production gallons per acre



Bioenergy Applications of Giant King Grass



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- **Direct combustion in electric power/heat/steam plant**
- **Pellets for co-firing with coal**
- **Briquettes for boilers**
- **Biogas /anaerobic digestion**
- *Cellulosic liquid biofuels--ethanol/butanol*
- *Biochemicals and bio plastics*
- *Pyrolysis to bio oil*
- *Catalytic conversion to bio diesel*
- *High-temperature gasification*
- *Torrefaction to bio coal*
- *Pulp for paper and textiles*

Applications that are commercial today with agricultural & forestry waste that can use Giant King Grass instead

Low cost of Giant King Grass will allow commercial applications in future

Advantages of Giant King® Grass



Clean Energy for a
Cleaner Tomorrow

- “Platform” energy crop for many bioenergy applications
 - Electricity, pellets, biofuels, biochemicals & bio plastics
- Excellent animal feed with high protein
- Lowest cost--Can meet cost targets for energy & biofuels applications because of high yield of Giant King Grass
 - Less expensive than agricultural waste
- Perennial crop
 - Do not have to plant every year, just harvest
 - Short rotation—first harvested in 6.5 months
- Provides reliable, well documented, consistent quality fuel or feedstock with predictable, affordable price
 - Fuel supply reliability required for project financing

What Are We Looking For?



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- VIASPACE intends to pursue additional projects in the region and worldwide
- Need local partners in each country

Thank You



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