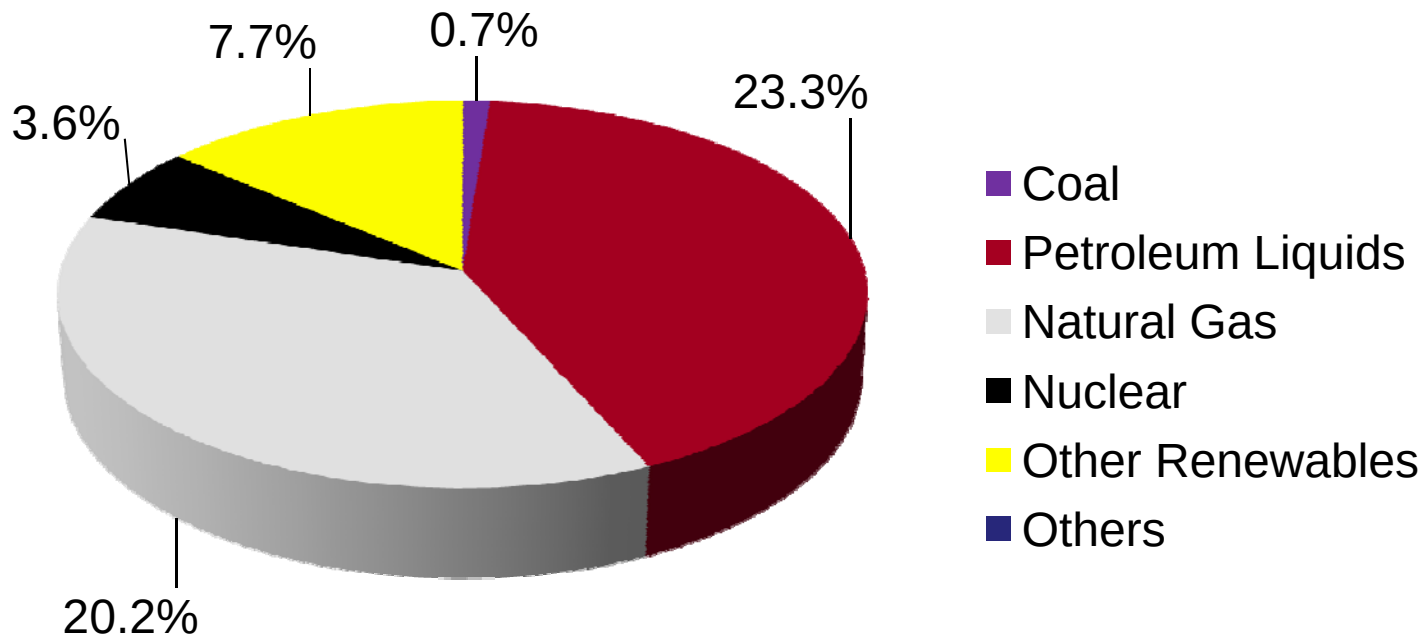
# The Energy Market: How Great is the Potential?

C&D Recycling Forum
Baltimore, MD
October 4, 2010

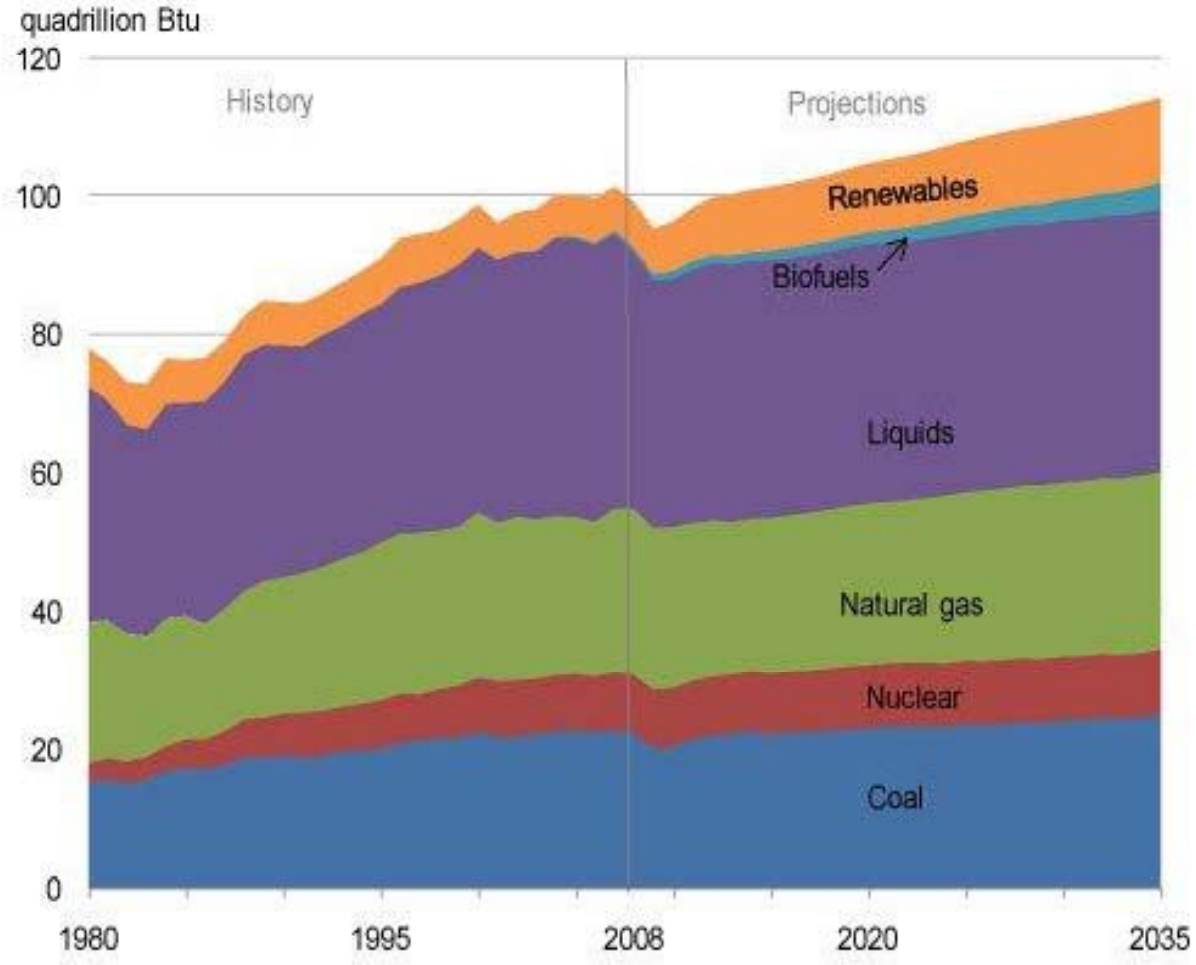
Presentation by:
Bob Brickner, Executive Vice President
Gershman, Brickner & Bratton, Inc.
Fairfax, VA

# US Net Generation, by Energy Source




Source: U.S. Energy Information Administration, Form EIA-906, “Power Plant Report”

# Primary Energy Use by Fuel 1980-2035




Source: USDOE

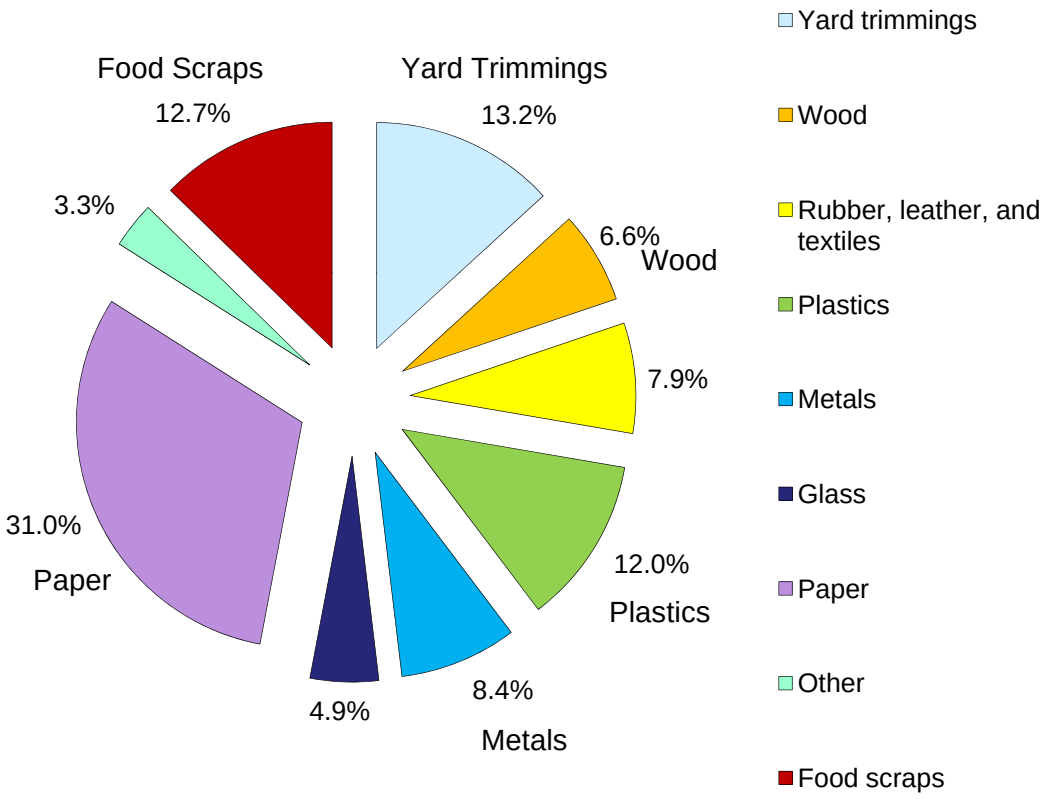
# What is 15 quadrillion BTU'S/Yr.

- 1 Quad = 10^15 = 1,000,000,000,000,000
- 15 Quad = 15 x 10^15 = 15,000,000,000,000,000
- 1 Ton Wood =7,500 Btu's/Lb. x 2000 Lbs/T=15,000,000 Btu's
- Thus, renewable demand of 15 quads = 1 billion Tons of Wood .....1,000,000,000 Tons of Wood Equivalent
- Total Mixed C&D Stream, even if w/Urban Wood Waste:
  - say <200,000,000 million tons ...and if wood = 30%, the impact is only 60,000,000 Tons ; about 6% of indicated energy demand in the USA as "Renewable"!
- Thus, in theory, there is plenty of potential demand – issues may be actual quantity available, term of availability, pricing and the location (state programs vary) to name a few, plus competition.

# Waste Facts – The MSW Sector

## Total: 250 Million Tons (Before Recycling)

- Each person in U.S. today generates 1,643 lbs. per year
- What is in our waste?
  - Recyclables
    - Feasible now to recycle up to 50-70%
  - Energy content of remainder: 5,500 BTUs/#
    - Coal at 9,000 BTUs/#




Source: US EPA, 2008 data

# U.S. WTE Plants by Technology Generating approx. 2,700 MWs

| Technology | Operating Plants | Daily Design Capacity (TPD) | Annual Capacity (1) (Million Tons) |
|---|---|---|---|
| Mass Burn | 64 | 71,354 | 22.1 |
| Modular | 7 | 1,342 | 0.4 |
| RDF - Processing & Combustion | 12 | 15,428 | 4.8 |
| RDF - Processing Only | 2 | 6,075 | 1.9 |
| RDF – Coal Combustion | 2 | 4,592 | 1.4 |
| Total U.S. Plants (2) | 87 | 98,791 | 30.6 |
| WTE Facilities | 83 | 92,716 | 28.7 |

(1) Annual Capacity equals daily tons per day (TPD) of design capacity multiplied by 365 (days/year) multiplied by 85 percent. Eighty-five percent of the design capacity is a typical system guarantee of annual facility throughput.

(2) Total Plants includes RDF Processing facilities that do not generate power on site.

Source: IWSA (now Energy Recovery Council), 2007 Directory

# Est. Quantity of C&D Materials

- Concrete Pavement.…75-100 million TPY
- Asphalt(RAP)……70-80 million TPY
- Mixed C & D Waste…125-135 million TPY

My Best Guess Total C&D Waste…..
250 - 300 million tons per year

# What is the C&D Wood Waste?

# Segregated Pallets and Crates When Delivered are Easy to Isolate!

# Clean Wood and C&D-Derived Wood Separate Receiving Areas

# Separated Mixed Wood Sources

# Receive Wood Waste in Foreground and Background

# Turning C&D Waste....

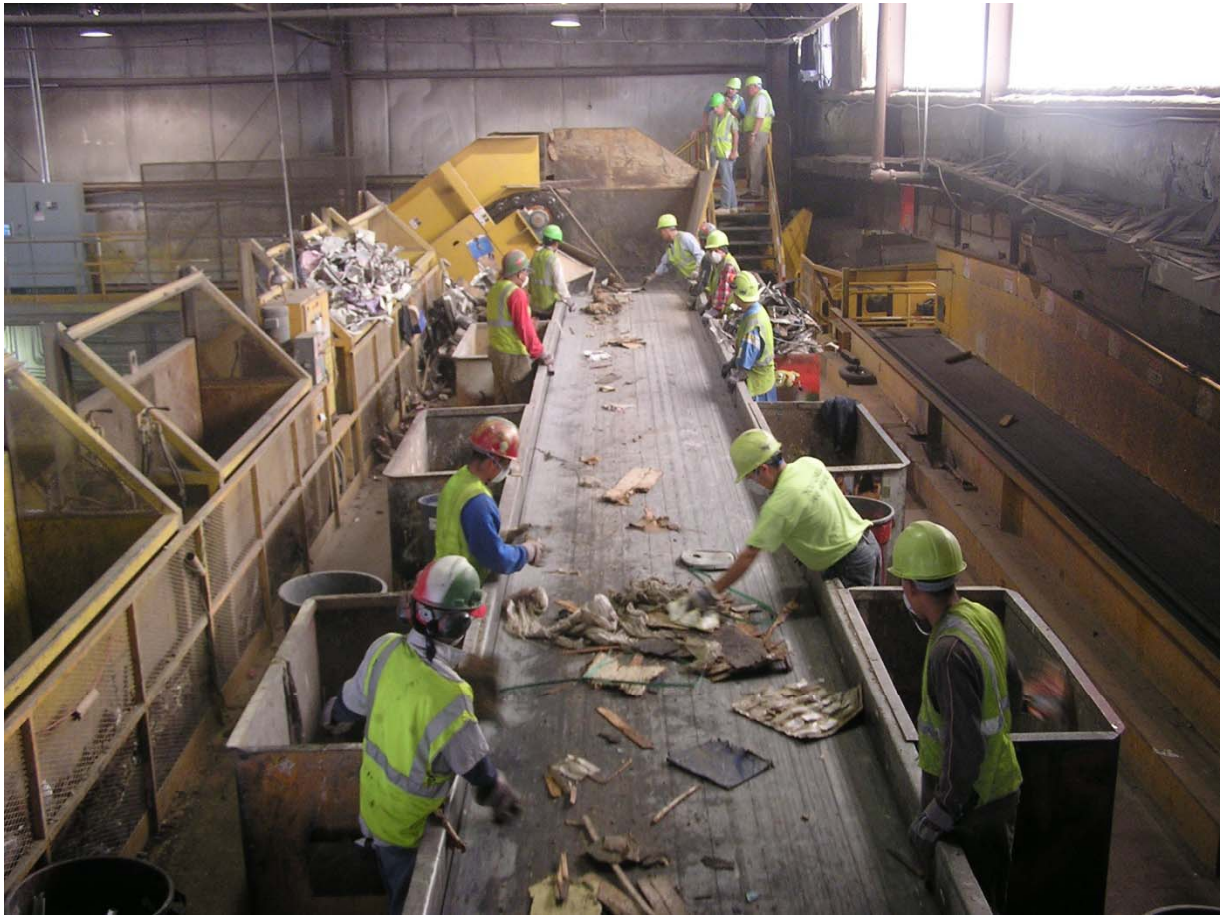
C&D recycling forum

GBB SOLID WASTE MANAGEMENT CONSULTANTS

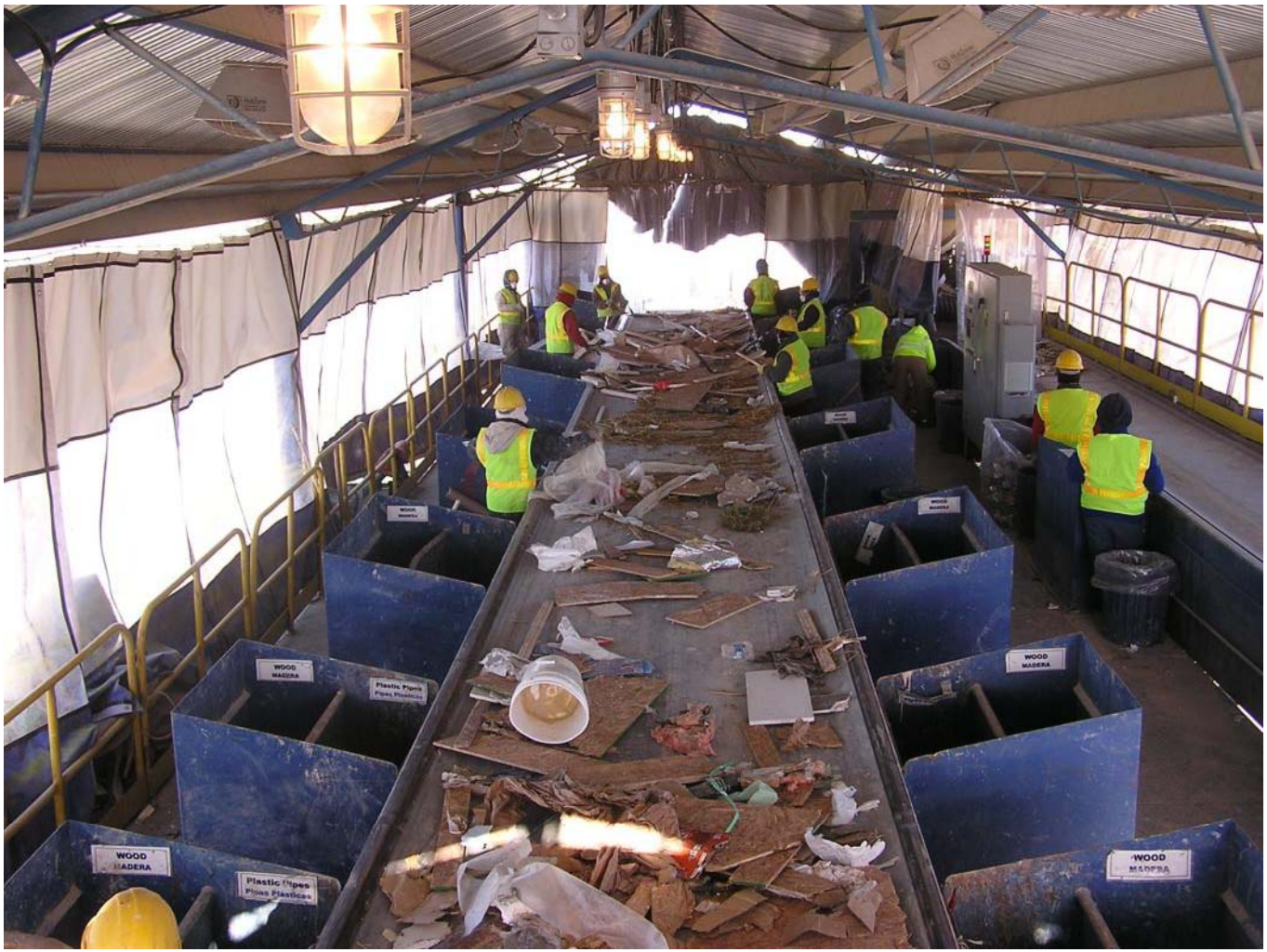
# ....Into C&D-Derived Wood Waste

# Original Sorting Belt Look – One Chance to Grab the Wood!

# Retrofit To Allow Multi-Wood Sorting



# Sorting Line & Crew w/Double Chutes



# Double Conveyors for WoodChutes

C&D recycling forum

GBB

SOLID WASTE MANAGEMENT CONSULTANTS

# Wood Discharge Zone

# Mixed Wood Supply

# Wood Processing Building

# Exclusive Wood Grinding Step

# Removal of nails and other tramp metal w/overhead magnet

# Screen and/or Feeder Step

# Wood Chip Options - Colorizer

# Multiple Colors – But, Seasonal Use

# Potential Quality Control Issues

# Diversification – Fuel & Mulch


C&D recycling forum

GBB
SOLID WASTE
MANAGEMENT
CONSULTANTS

# La Crosse Co. WI – Wood Chips & RDF

Wood Chips Delivery Truck

Wood Chips Delivery Area

# La Crosse Co. WI – Wood Chips & RDF

Wood Chip Trailer Tipper

# Full Tractor Trailer Tipper

C&D recycling forum

GBB

SOLID WASTE

MANAGEMENT

CONSULTANTS

C&D recycling forum

GBB

SOLID WASTE

MANAGEMENT

CONSULTANTS

C&D recycling forum


GBB

SOLID WASTE

MANAGEMENT

CONSULTANTS

C&D recycling forum


GBB
SOLID WASTE
MANAGEMENT
CONSULTANTS

C&D recycling forum

GBB

SOLID WASTE MANAGEMENT CONSULTANTS

# La Crosse Co. WI – Wood Chips & RDF

Bulk Chip Storage Auger Feed

# Wood Burns!

# 14 MW Wood Fired Plant in Florida

SOLID WASTE MANAGEMENT CONSULTANTS

# 14 MW Wood Fired Plant in Florida


C&D recycling forum

GBB
SOLID WASTE
MANAGEMENT
CONSULTANTS

# **Ecostrat** |(Canadian Broker)

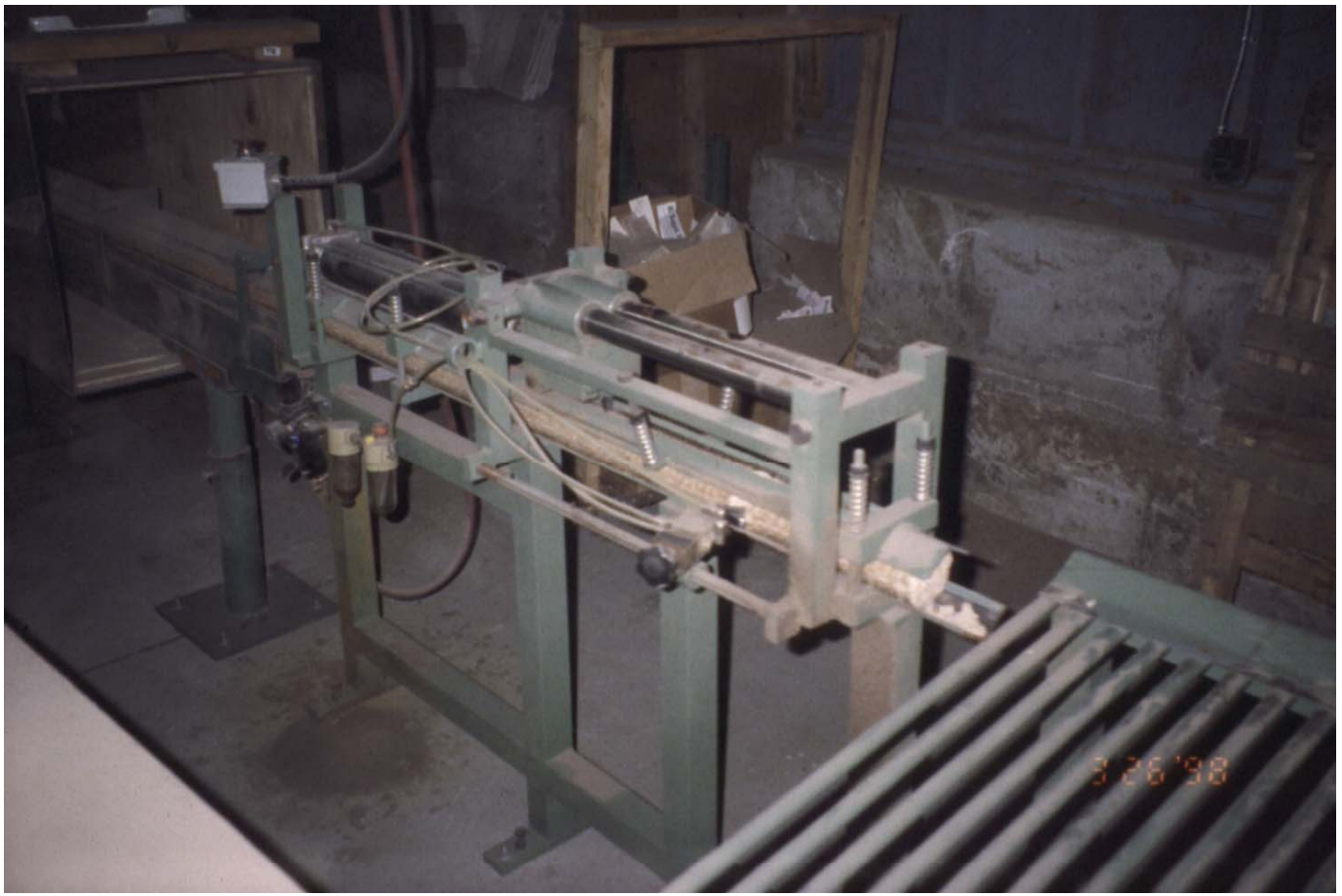
## Sample Specifications, Excerpts for Comparison

| | Composite Wood Fuel | Green Virgin Wood | Green Virgin Fuel |
|---|---|---|---|
| Heating Value (Btu's/#) | 7000 +/- 500 (Post Ind'l Mfg) | 4500 +/- 500 | 4000 to 5000 +/- 500 |
| Species | Mixed Composite | Mixed Hardwood & Softwood | Landclearing to pallets (Various Types |
| Moisture Content | 25% Max | 47% Max | 40-50% (as received) |
| Ash Content | 2-4 % | 1% | |
| Sizing (1 Dimension) | <3" | <2" | Sawdust to 5" minus. |
| % Over Size Noted | <2" | <5% | |
| % Fines Below Noted | <2" | <5% | |
| Rot | 0% | 1% Max. | |
| Contamination: | No CCA or Creosote | No CCA or Creosote | |

# Grind, Metals Removal, Deck Screen and Regrind

# Size & Look of the Wood Product Based on Hardware Selected

# Ex: Facility made 2” Dia.Fuel Logs



# Ex: Facility made ¾” Fuel Pellets

# Wood Pellets Energy and Cost (Example: Small Family Pellet Stove)

- The energy content of wood pellets is approximately 7450 BTU/lb.
- To get 1 million Btu's delivered = 132 lbs. pellets
- 132 lbs. pellets x 7450 BTU/lb = 1 million Btu's
- In 2008, the cost for heating with pellets was $19.59 per million BTU generated by the energy source. This corresponds to a price of $5.14 per 40 pound bag, or $257 per ton.

# U.S. DOE Funds
## 19 "Biorefinery" Projects for $564 million, December 2009

| | Company | Funding | | Location | Description |
|---|---|---|---|---|---|
| | | DOE Grant | Non-fed/Other | | |
| 1 | Bluefire Ethanol | $ 81,134,686 | $ 223,227,314 | Fulton, MS | Facility will be constructed to produce ethanol from woody waste, mill residue, and sorted municipal solid waste |
| | BioEnergy International | $ 50,000,000 | $ 89,589,188 | Lake Providence, LA | Process biologically produces succinic acid from sorghum, the process displaces petroleum |
| 2 | Enerkem | $ 50,000,000 | $ 90,470,217 | Pontotoc, MS | the project will be sited on an existing landfill and use feedstock's such as woody biomass in a gasification and catalytic process |
| 3 | INEOS New Planet BioEnergy | $ 50,000,000 | $ 50,000,000 | Vero Beach, FL | The facility will combine biomass gasification and fermentation to process wood, vegetative residues and construction and demolition material |
| | Sapphire Energy | $ 50,000,000 | $ 85,064,206 | Columbus, NM | The project will cultivate algae in ponds the will be converted into green fuels using the Dynamic Fuels refining process |
| | Algenol Biofuels | $ 25,000,000 | $ 33,915,478 | Freeport, TX | The project will make ethanol directly from carbon dioxide and seawater using algae |
| | American Process | $ 17,944,902 | $ 10,148,508 | Alpena, MI | The project will produce fuel and potassium acetate and the plant will have the capacity to produce up to 890,000 gallons of ethanol per year |
| | Amyris Biotechnologies | $ 25,000,000 | $ 10,489,763 | Emeryville, CA | The project will produce a diesel substitute through the fermentation of sweet sorghum and will have the capacity to co-produce lubricants, polymersand other petro-chemicals substitutes |
| 4 | Archer Daniels Midland | $ 24,834,592 | $ 10,946,609 | Decatur, IL | the project will use acid to break down biomass which can be converted to liquid fuels or energy. The facility will produce ethanol and ethyl acrylate |
| 5 | Clearfuels Technology | $ 23,000,000 | $ 13,433,926 | Comerce City, CO | The project will produce renewable diesel and jet fuel from woody biomass by integrating ClearFuel's and Rentech's conversion technologies |
| | Elevance Renewable Sciences | $ 2,500,000 | $ 625,000 | Newton, IA | The project was selected to complete preliminary engineering design for a future facility producing jet fuel, renewable diesel substitutes, and high-value chemical from plant oils and poultry fat |
| 6 | Gas Technology Institute | $ 2,500,000 | $ 625,000 | Des Plaines, IL | The project was selected to complete preliminary engineering design for a novel process to produce green gasoline and diesel from woody biomass, agricultural residues, and algae |
| 7 | Haldor Topsoe | $ 25,000,000 | $ 9,701,468 | Des Plaines, IL | The project will convert wood to green gasoline by fully integrating and optimizing a multi-step gasification process |
| | ICM | $ 25,000,000 | $ 6,268,136 | St. Joseph, MO | The project will modify an existing corn-ethanol facility to produce cellulosic ethanol from switchgrass and energy sorgghum using biochemical processes |
| 8 | Logos Technologies | $ 20,445,849 | $ 5,113,962 | Visalia, CA | The project will convert switchgrass and woody biomass into ethanol using a biochemical conversion process |
| 9 | Renewable Energy Institute International | $ 19,980,930 | $ 5,116,072 | Toledo, OH | The project will produce high quality green diesel from agriculture and forest residue using advanced pyrolysis and steam reforming |
| | Solazyme | $ 21,765,738 | $ 3,857,111 | Riverside, CA | The project will produce algae oil that can be converted to oil-based fuels |
| 10 | Honeywell's UOP | $ 25,000,000 | $ 6,685,340 | Kapolei, HI | The project will integrate existing technology from Ensyn and UOP to produce green gasoline, diesel, and jet fuel from agricultural residue, woody biomass, dedicated energy crops , and algae |
| | ZeaChem | $ 25,000,000 | $ 625,000 | Boardman, OR | The project will use purpose grown hybrid poplar trees to produce fuel-grade ethanol using hybrid technology |

C&D recycling forum
GBB SOLID WASTE MANAGEMENT CONSULTANTS

# Alternative Conversion Technologies 2010

(400++ Different Companies with Technology and/or Developer Offerings)

- Biological
  - Aerobic Composting
  - Anaerobic Digestion/ Co-digestion
  - Biodiesel
  - Bioethanol
  - Biological Pretreatment
  - Vermicomposting
- Thermal/Chemical
  - Acid Catalysis & Distillation
  - Direct Combustion
  - Gasification/Pyrolysis
  - Microwave Processes
  - Plasma-Arc
  - Thermal Decomposition

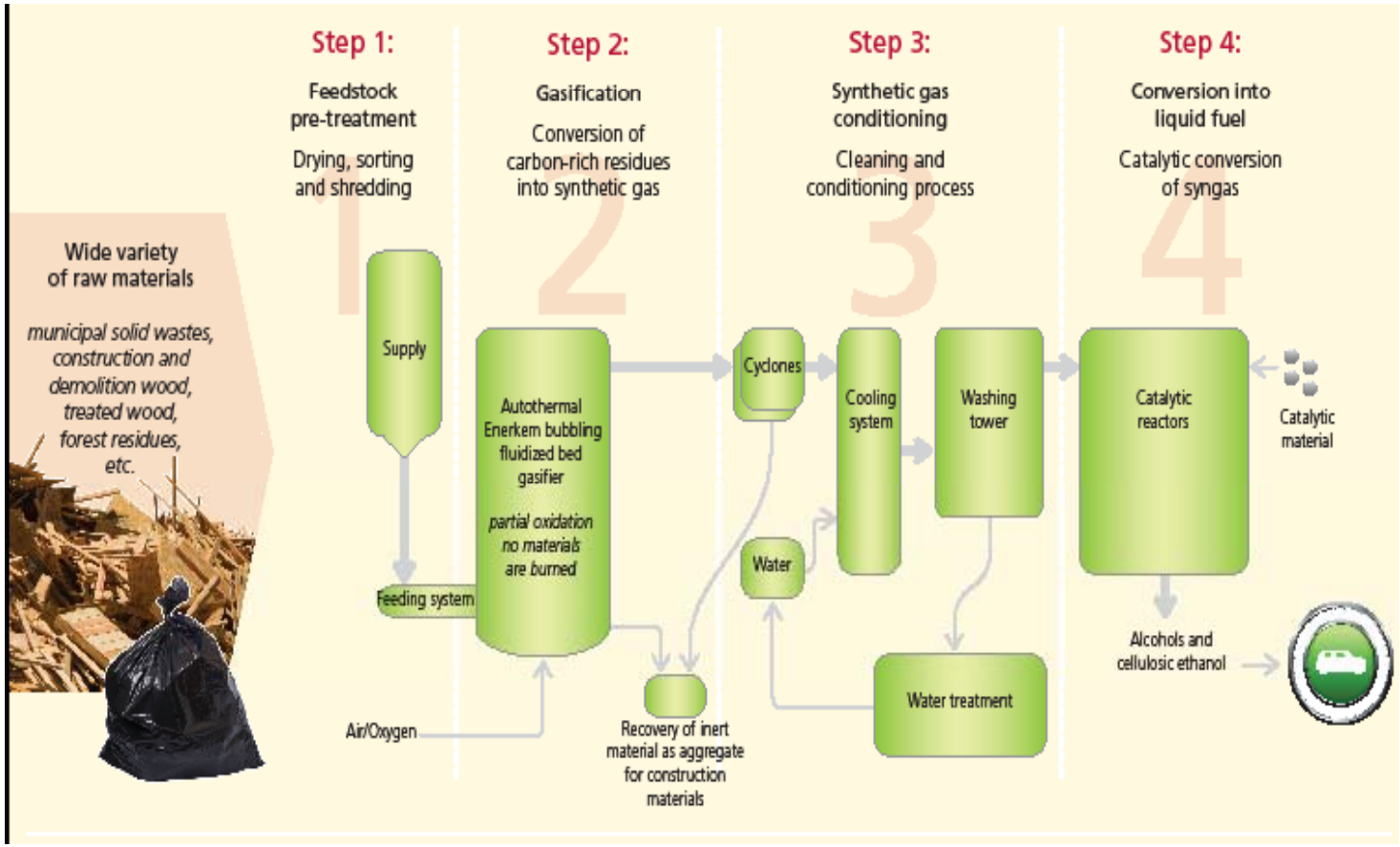
Source: Gershman, Brickner & Bratton, Inc., September 2010.

# Summary of Alternative Technology Companies

(Source: GBB as of September 2010)

| | Est. Companies |
|---|---|
| • Potential as Markets for C&D Products (Wood,Organics) | |
| – Ethanol Fermentation | 25 |
| – Gasification, General | 165 |
| – Plasma, General | 50 |
| – Pyrolysis, General | 40 |
| – WTE/Thermal Recycling | 30 |
| Subtotal | 310 |
| • Other (not prime candidates) | 140 |
| • Total Companies Tracked by GBB | > 450 |

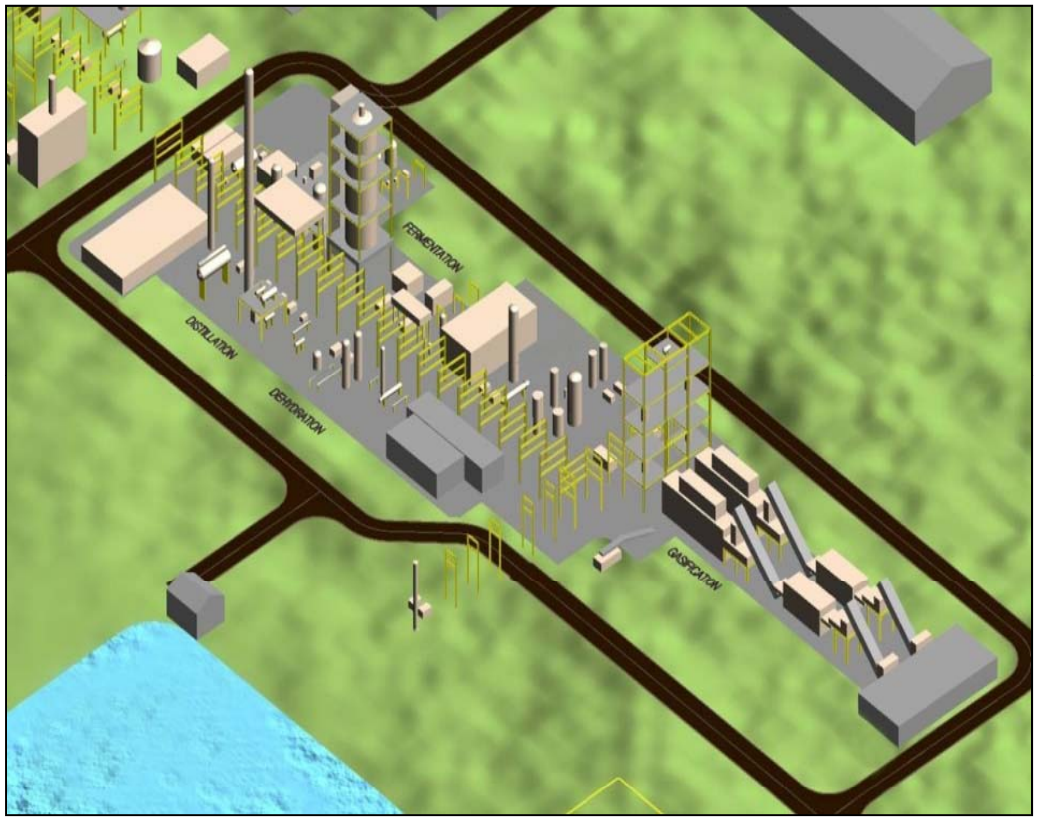
# Enerkem Technology
# Biofuel from Thermal Gasification




SOLID WASTE MANAGEMENT CONSULTANTS

# INEOS Bio Energy

- Vero Beach, Indian River County, FL
- In Dec. 2009, received $50 million DOE grant
- Feedstock: 300 TPD wood, vegetative residues, and C&D materials into ethanol




- 80-100 gallons of ethanol per dry ton of biomass
- Products: 8 million gallons per year and 1-2 MW power
- Completion target: 4th Qtr. 2011

# Conversion Technology Companies
# Ze-gen


## September 24, 2010 NE Business Bulletin

### Ze-gen looks to build $15M gasification facility in Attleboro

NEW BEDFORD, Mass. — After three years of testing its waste-to-energy technology in New Bedford, a Boston-based company is ready to launch its first commercial venture. Ze-gen Inc.'s "Attleboro Clean Energy Project" is looking to construct a $15 million gasification facility at the Attleboro Corporate Campus that would supply energy to the businesses in that industrial park.

The company has used the New Bedford plant to test the conversion of waste materials into synthesis gas, or "syngas," a hydrogen and carbon monoxide mixture. The process uses six materials — wood pallets, railroad crossties, utility poles, non-recyclable source-separated plastics, carpet fibers, and recycled coolant glycol (anti-freeze) residuals — that would otherwise have gone to landfills or incinerators, in a gasification process to produce syngas.

The syngas is then fed into a boiler to make steam and electricity to be sold to businesses at the industrial park.

# Conversion Technology Companies
# Taylor Biomass

## September 28, 2010 Time Heralds Record

### Taylor Biomass gets a boost

The Port Authority of New York and New Jersey is poised to buy nearly $50 million in renewable energy credits from the Montgomery Taylor Biomass project. On Tuesday, the New York Power Authority board is expected to approve a memorandum of understanding with the Port Authority for the purchase, an agreement that extends for 20 years at $2.4 million a year.

Taylor's project, which converts garbage into electricity, plans to power its own facility and put enough energy back in the grid to power 20,000 homes. "This multi-million-dollar contract with the Port Authority will help create jobs and ensure that the commercialization of technology developed at the Taylor Biomass facility is successful," said Sen. Chuck Schumer in a statement Monday.