

# BIOMASS – THE REST OF THE STORY

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# THE CHANGING BIOMASS INDUSTRIES

1. Existing Biomass Power Plants
2. New Influencing Factors
  - a. Traditional and Growing Waste Disposal
  - b. Renewable Energy Government Mandates
  - c. New Financial and Owner Groups Now Looking For Renewable Energy Business Deals.
  - d. Fossil Fuel (Natural Gas, Gasoline and Diesel) ABRUPT Current & Future Price Increases
3. Acceleration In Development Of New Biomass Technologies.

# BIOMASS KEY QUESTIONS

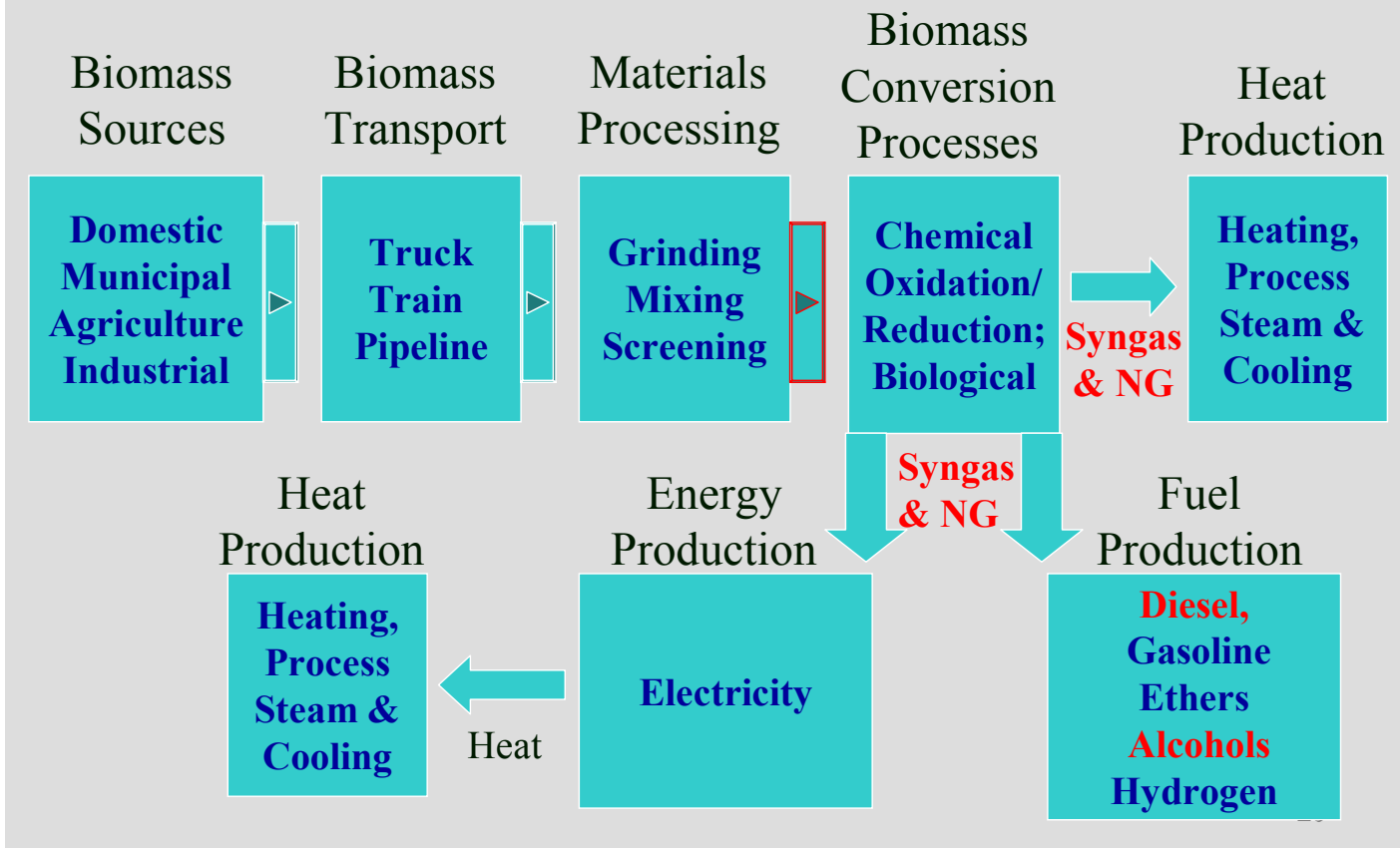
## Waste Biomass - Some Key Questions

**Can Waste Biomass to Renewable Energy and Fuels Conversion Processes:**

- **Be cost competitive with energy and fuels currently produced from fossil fuel resources?**
- **Become a significant source of hydrogen for the proposed future hydrogen infrastructure?**
- **Significantly reduce the rate of global fossil fuel depletion?**
- **Provide countries that have little or no fossil resources with a major source of energy and fuels?**
- **Serve as a future major strategy for the reduction of greenhouse gas emissions**

# CONVERTING BIOMASS

## Key Processes Under Development for the Conversion of Biomass to Energy and Fuels



# BIOMASS TECHNOLOGIES

## **Categories of Biomass Conversion Technologies Under Evaluation**

**Thermal Gasification (Syngas Production)**

**Thermal Pyrolysis and Steam Reforming (Syngas Production)**

**Thermal Oxidation (Energy Production)**

**Integrated Thermal Gasification and Oxidation (Energy Production)**

**Thermophilic Anaerobic Digestion (Biogas Production)**

**Hydro-Gasification (Syngas Production)**

# TECHNOLOGY ASSESSMENT

## Technology Assessment Approach

- ✓ **Biomass conversion systems from TSS Biomass Technology Data Base of approximately 450 suppliers/developers have been critically assessed.**
- ✓ **Five candidate systems** have been chosen for “in-depth” comprehensive technical and business analyses using the “**4E LCA**” models for quantifying their potential economic viability (E1), energy efficiency (E2), environmental friendliness (E3) and effectiveness (E4) for the conversion of waste biomass to energy and fuels.
- ✓ **The search for other viable, emerging candidate systems will continue into the future**

# CURRENT FINDINGS

## Current Findings

### Conversion Efficiencies for Candidate Biomass Conversion Systems

Biomass Conversion Technologies	Product Thermal Conversion Efficiency (%TE)		%TE with IC Engine(40%), Gas Turbine(GT)(35%), Steam Turbine(ST)(21%)		Fuel Conversion (Gallons/Ton Biomass)	
	Products (SG: Syngas)	Heat Output	Electricity	Combined Heat & Electricity	Ethanol	Diesel
1). Thermal Gasification	70% SG	12%	25% (GT)	42%	Not Determined	Not Determined
2). Thermal Pyrolysis/ Steam Reforming	75% SG	10%	30% (IC)	45%	78	35
3). Thermal Oxidation (Incineration)	Heat	80%	17% (ST)	54%	Not Applicable	Not Applicable
4). Integrated Thermal Gasification/Oxidation	Heat	80%	17% (ST)	56%	Not Applicable	Not Applicable
5). Thermophilic Anaerobic Digestion	30% Biogas	0%	12% (IC)	18%	Not Determined	Not Determined
6). Hydro-gasification/ Steam Reforming	75% SG	10%	30% (IC)	45%	Not Determined	Not Determined

# PRODUCT VALUES

## Economics for Conversion of Waste Biomass to Energy and Fuels (ACT/BCT System Using Wood @ 8,000 BTU/Ton)

Conversion Product	Wholesale Value	Carbon Content (wgt.%)	Mass Density (lbs/gal.)	Energy Density (BTU/lb)	Yield (Per Ton Biomass)	Economic Value (\$/Ton Biomass)
Electricity	\$0.05/ KWH	-	-	-	1010 KWH	\$51
Diesel (Partially Refined)	\$1.50/ Gallon	88	6.75	18.7	35 Gallons	\$53
Gasoline (Fuel Grade)	\$1.70/ Gallon	84	6.23	18.3	40 Gallons	\$68
Methanol (Fuel Grade)	\$0.90/ Gallon	38	6.54	8.5	102 Gallons	\$92
Ethanol (Fuel Grade)	\$1.60/ Gallon	52	6.60	11.5	78 Gallons	\$125

Conclusion - The production of ethanol from biomass potentially provides a higher economic return than diesel, gasoline or methanol



# SUMMARY

- 1. Existing Biomass Electric Industry have struggled to survive.
- 2. New Biomass Technologies coming into the market place.
- 3. Strong Interest by the Financial Markets in Renewable Energy Projects.
- 4. Public Benefits are justifying new taxpayer investments; domestic energy, waste disposal problems, rural economic development, higher fossil fuel prices.
- 5. Fossil Fuel Prices have changed the private market place dynamics.