

***Quantification of  
Climate Neutral & Greenhouse Gas  
Emissions Using ASTM D6866***

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Verification of Biogenic Carbon / Carbon-neutral CO<sub>2</sub>

# Climate Neutral CO<sub>2</sub> (biogenic CO<sub>2</sub>)

*It's recently respired CO<sub>2</sub>*

*Plants recently removed it from the air*

*It's a byproduct of biomass incineration*

*It doesn't count toward GHG inventories*

*It can be subtracted from GHG inventories*

*It has value in the trading markets*

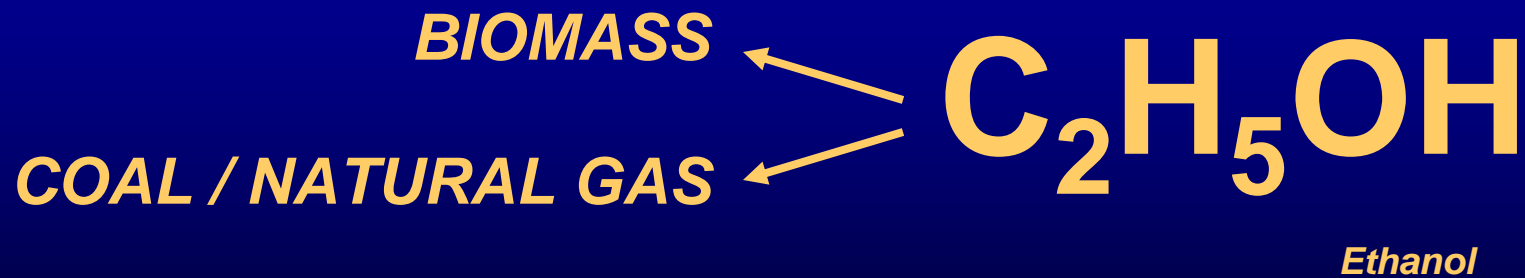
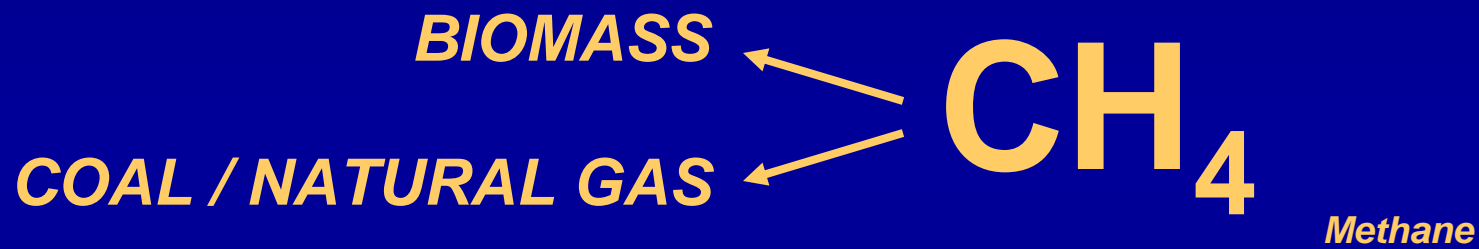
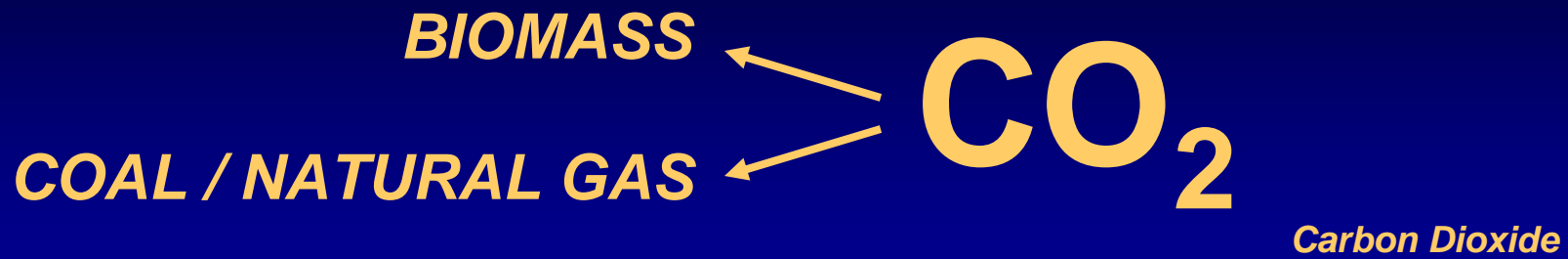
*(Precedence in definition is set : RFS – bioethanol industry)*

***The solution to systematically monitoring, regulating, trading and calculating califoric value from carbon based inventories is obvious.***

***Nature has embedded carbon with a tracer.***

***ASTM D6866 measures this natural tracer.***





**They're not the same!**

*Nature's*

*“carbon tracer”*

*is the difference*

**BETA**

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# Carbon-14

*It's naturally occurring.*

*It's in all biomass.*

*It's absent in fossil fuels.*

*ASTM D6866 measures it.*

*They're NOT the same!*

carbon-14

*Biomass*  $\text{CO}_2$

*Coal*  $\text{CO}_2$

No carbon-14



***Carbon-14 is ubiquitous in all living things.***

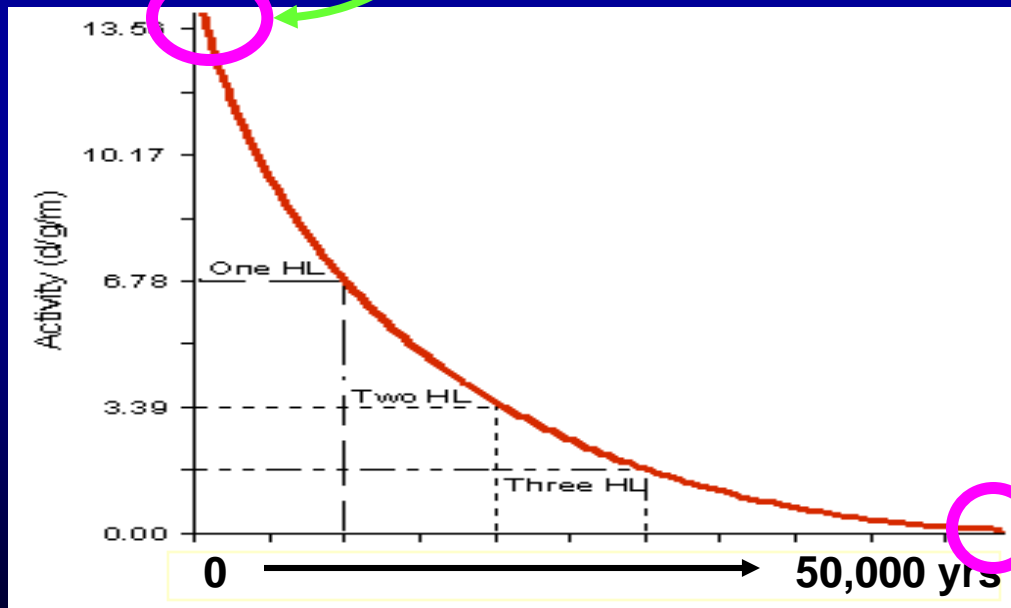
***But it doesn't stick around.***

***It slowly and gradually decays away after death, so that by 50,000 years there's none left.***

***Ergo....coal and natural gas don't have any carbon-14 whereas biomass does.***



100% renewable



0% renewable

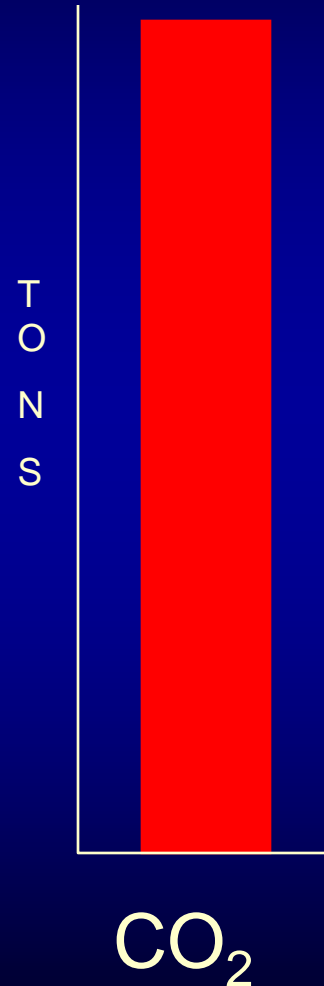
### The Radiocarbon Decay Curve



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# Conventional biomass – CO<sub>2</sub> inventory accounting

(WTE, co-firing facilities)



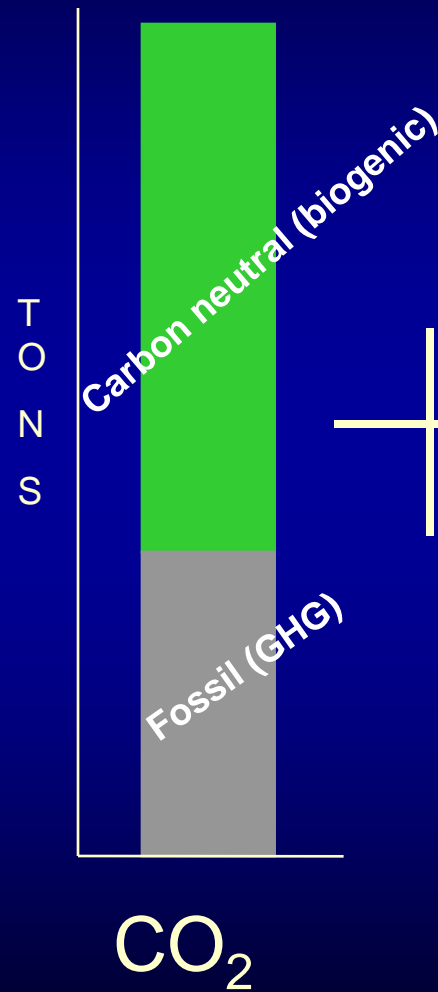
Complicated physical characterization of the feed stock

Sorting, cutting, sectioning, and weighing raw fuel

Labor intensive, expensive, burdensome

# ASTM D6866 biomass – CO<sub>2</sub> inventory accounting

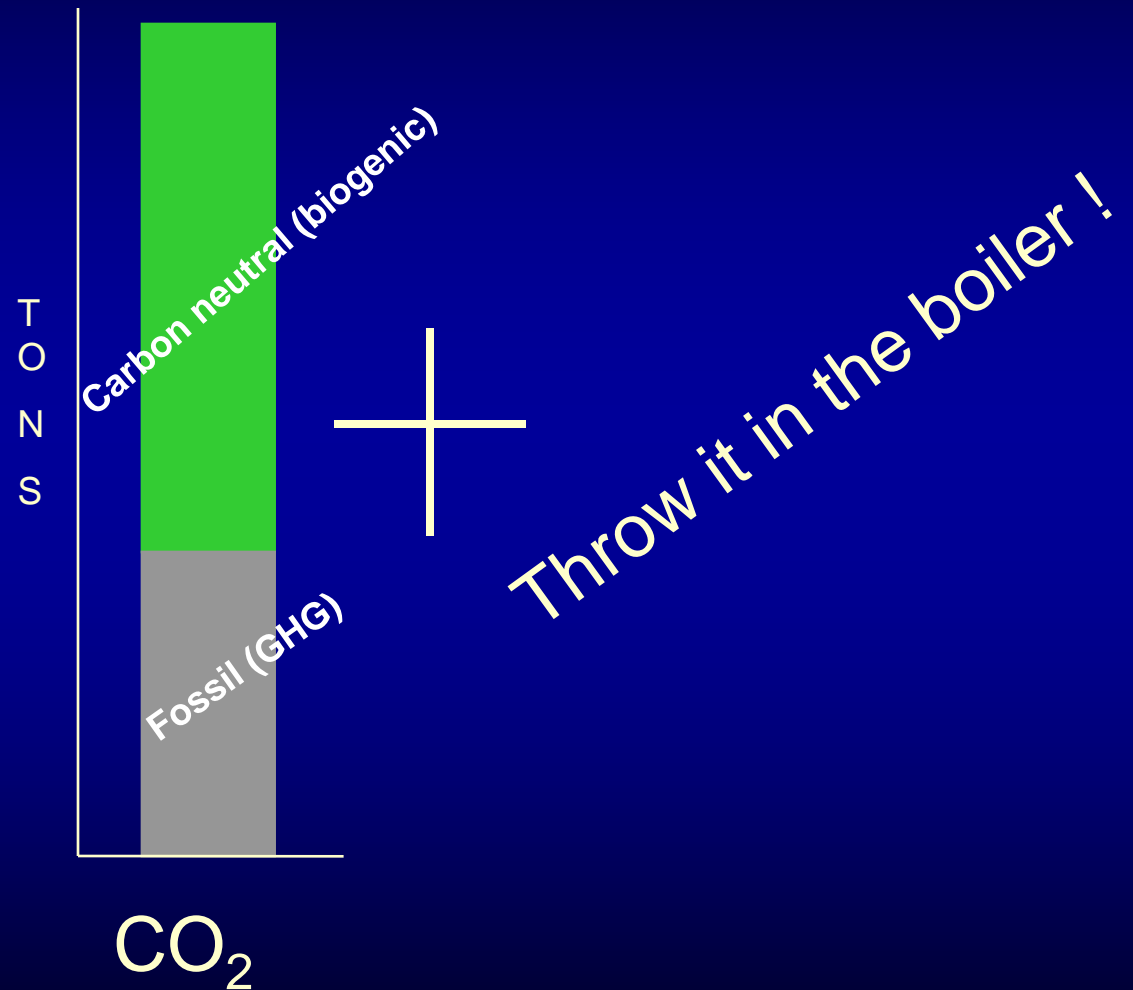
(WTE, co-firing facilities) Measure CO<sub>2</sub> in the stack effluent



~~Complicated  
physical  
characterization  
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Labor intensive,  
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# ASTM D6866 biomass – CO<sub>2</sub> inventory accounting

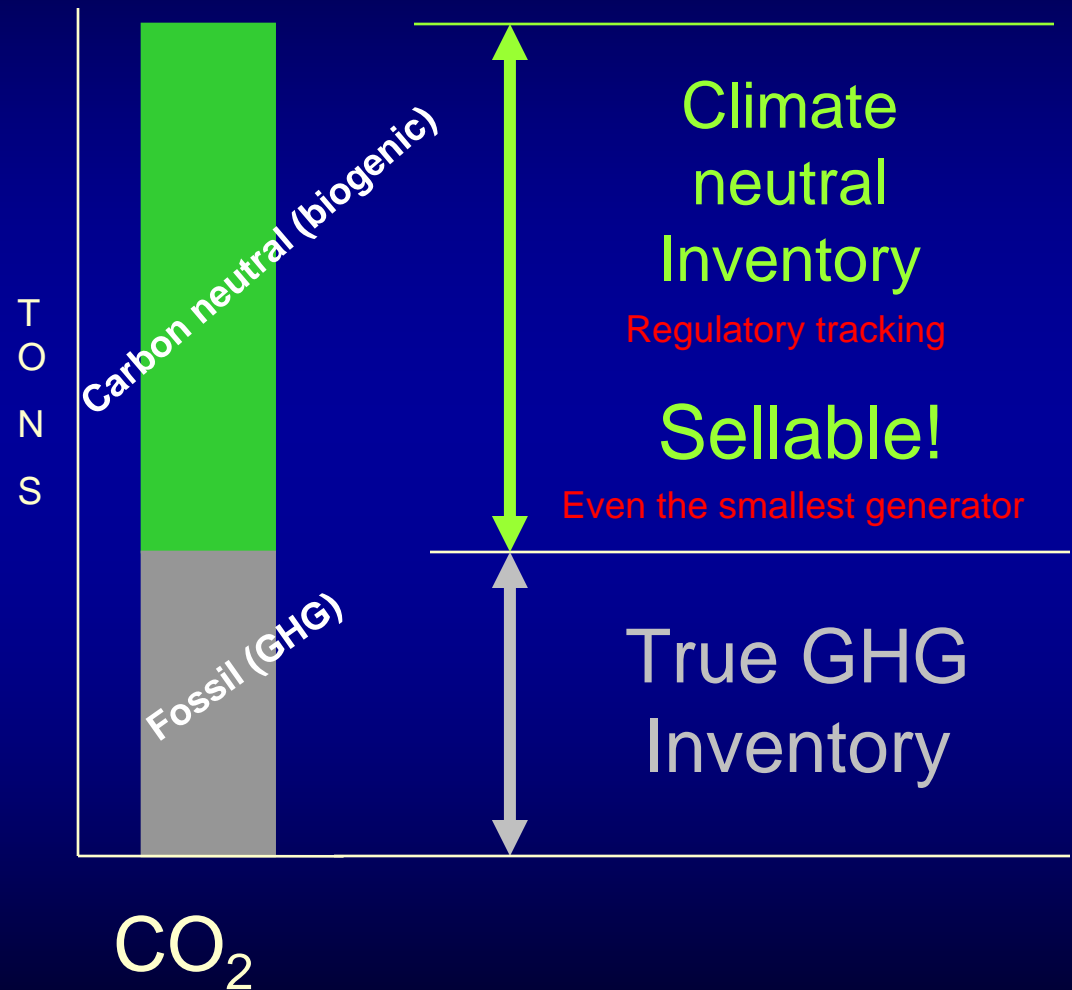
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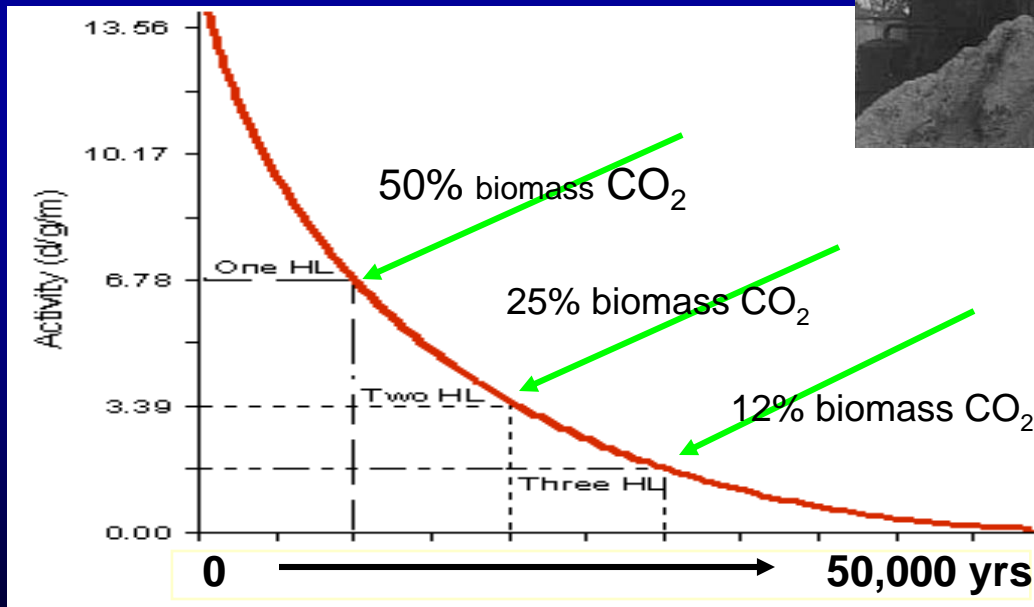
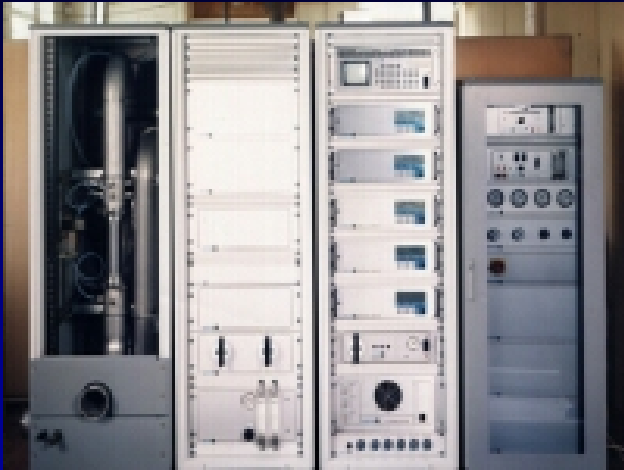


# ASTM D6866 biomass CO<sub>2</sub> determination

(WTE, co-firing facilities)

## CO<sub>2</sub> analysis of stack effluent





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# 142083 tons - CO<sub>2</sub> emissions

## Conventional Analysis

75000 tons biofuel  
25000 tons fossil fuel

## ASTM D6866

Biomass CO<sub>2</sub> = 48.4 %

Tons combined fuel	100000	100716
Tons carbon neutral CO <sub>2</sub>	68750	69252
Tons greenhouse gas	73333	73830
Tons bio-fuel	Known	75547
Tons fossil fuel	Known	25169
% biomass CO <sub>2</sub>	48.4 %	Known
% greenhouse gas	51.6 %	Known

Method of determination

Sorting,  
characterizing,  
weighing raw fuel

Single analysis of  
1000cc's of bulk  
stack effluent

**BETA**

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## ***Calorific Value (CV) from biomass CO<sub>2</sub> content***

***Citing Dr. Nicholas Themelis, Director Earth Engineering Center  
Columbia University, and Chair of the Waste to Energy Research  
and Technology council (WTERT)***

**“The C14 test will show what fraction of the carbon in the MSW is biogenic. Then by using an assumed average chemical formula for the biogenic fraction (e.g., WTERT uses C<sub>6</sub>H<sub>10</sub>O<sub>4</sub>) and one for the petrochemical fraction, and also the fraction of these materials in the MSW, one can arrive at a Net Calorific Value per ton of MSW”**

## ***Califoric Value (CV) from biomass CO<sub>2</sub> content***

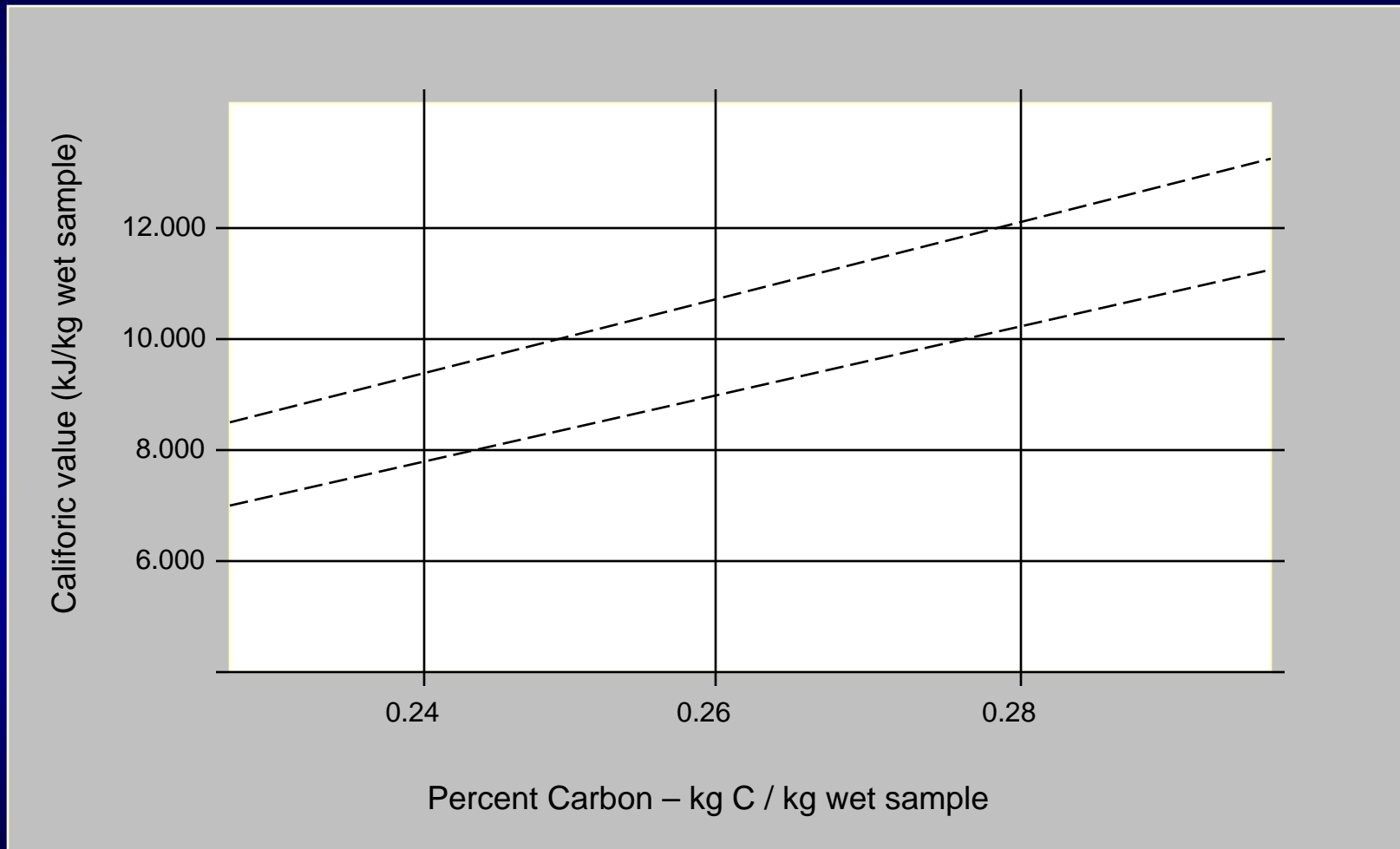
***Johann Fellner, et. al., “Balance Method” Institute for Water Quality, Resource, and Management, Vienna Austria***

***Operating data gathered from WTE plants shows that CV of wet samples exist within ranges directly correlating to carbon content.***

***For Example : CV from wet sample biomass feedstock with 25% carbon***

***8200 – 10200 kJ / kg***

## Califoric Value (CV) from biomass CO<sub>2</sub> content



## *Califoric Value (CV) from biomass CO<sub>2</sub> content*

Gross califoric value

% biofuel - % carbon

% fossil fuel - % carbon

Well characterized CV from the fossil fuel

$$\text{Net CV}_{(\text{biomass})} = \text{Gross CV} - \text{CV}_{(\text{fossil fuel})}$$

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# THE VALUE PROPOSITION

## REGULATORS

- *A direct measure of carbon to satisfy carbon directed legislation*
- *A single number-tracking parameter for comparison across industries*
- *Greatly simplified and understandable reports*



# THE VALUE PROPOSITION

## VERIFIERS

- *A greatly simplified auditing tool*
- *A single number value directly related to both climate neutral and greenhouse gas emissions*
- *Greatly simplified and understandable reports*



# *THE VALUE PROPOSITION*

## *TRADING MARKETS*

- *A simplification of basis for valuation*
- *A single number value directly related to carbon neutral inventory*
- *Greatly simplified and understandable reports*



## *THE VALUE PROPOSITION*

### *BIOMASS ELECTRICITY GENERATORS*

- *THROW IT ALL INTO THE BOILER*
- *COST SAVINGS!*
- *SIMPLIFIED REPORTING*
- *INCREASED EFFICIENCY*
- *ENHANCED FEEDSTOCK FLEXIBILITY*
- *A BETTER WAY TO MEET REGULATIONS!*

# Reporting

An "Easy" Visual  
Easy Inter-comparison  
Instinctively Obvious

**BETA**

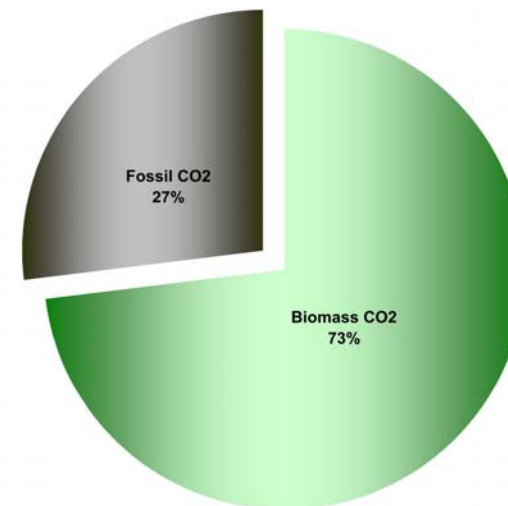
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## Report of Biomass CO<sub>2</sub> Content Analysis using ASTM-D6866

Submitter: ABC Company  
Submitter Label: Gas Bag 1  
Laboratory Number: Beta-00001  
Material Analyzed: CARBON DIOXIDE  
Date Received: October 13, 2006  
Date Reported: October 17, 2006

**Biomass CO<sub>2</sub>:** **73% \***  
(carbon-neutral CO<sub>2</sub>) (renewable carbon to total carbon)

Proportions Biomass CO<sub>2</sub> vs. Fossil CO<sub>2</sub>  
indicated by C14 content



\* ASTM-D6866 cites precision on the mean Biomass CO<sub>2</sub> Result as +/- 3% (absolute). This is the most conservative estimate of error in the measurement of complex biomass containing solids and liquids based on empirical results. Real precision for readily combustible and homogenous materials (e.g. gasoline) and especially samples received as CO<sub>2</sub> (e.g. flue gas or CEMS exhaust) can be as low as +/- 0.5-2%. The result only applies to the analyzed material. Fluctuations in carbon content within a batch of product, gasoline or flue gas must be determined separately (e.g. averaged measurements of multiple solids or liquids, and single measurement of the combination of gas aliquots collected over time). The accuracy of the result as it applies to the analyzed product, fuel, or flue gas relies upon all the carbon in the analyzed material originating from either recently respired atmospheric carbon dioxide (within the last few decades) or fossil carbon (more than 50,000 years old). "Percent biomass" specifically relates % renewable (or fossil) carbon to total carbon, not to total mass or molecular weight. Mean Biomass CO<sub>2</sub> estimates greater than 100% are assigned a value of 100% for simplification.

**BETA**

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## ***Who is looking at ASTM D 6866? - Regulatory***

***OFGEM (UK - regulating ROCs)***

***RGGI (Regional Greenhouse Gas Initiative)***

***RPS (Renewable Portfolio Standards)***

***EU (CEN) - Emissions Trading Directive***

***ARB (California Air Resources board)***

***EPA (RFS)***

## ***Who is looking at ASTM D 6866? – Industry***

***REA (UK – Renewable Energy Association)***

***All Party Climate Group (UK)***

***VCS (Voluntary Carbon Standard) – VCU***

***EPRI***

***Power plants (WTE, Co-firing, dedicated biomass)***

***Cement Industry***

***Biogenic Methane Industry***

***Industry Giants (Waste Management)***

***Verifiers***

***Trading Brokers – CDM – Clean Development Mechanism***

***Equipment Manufacturers***

**How much does it cost?**

***Expect ~ \$600.00 per analysis***

***(Off-setting labor, liabilities and hazards associated with feedstock characterization)***

**How long does it take to get a result?**

***As little as 2-3 days***



***Booth # 77  
in the main exhibit hall***

***Copies of this Presentation  
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