

Computing & Reporting the Carbon and Environmental Footprint of BioProducts

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WHAT IS THIS ALL ABOUT?

Framing the Question

CARBON!!

- WHAT IS THE CARBON FOOTPRINT/PROFILE OF YOUR PRODUCT?
 - Developing your carbon footprint
- WHAT ARE YOU DOING TO REDUCE YOUR PRODUCTS CARBON FOOTPRINT OR PROFILE
 - Moving towards a zero or neutral carbon footprint
- Total environmental footprint/profile needed, in addition to carbon footprint/profile

The “VALUE PROPOSITION”

- Using bio/renewable feedstock:
 - Reduces our carbon footprint and moves us to zero carbon or carbon neutral footprint
 - Provides or potential to provide a positive environmental footprint/profile using LCA tools

TOOLS to compute and report on carbon and environmental footprint

- Biobased carbon content determination
 - Narayan, ACS Symp Ser, *Biobased & Biodegradable Polymer Materials: Rationale, Drivers, and Technology Exemplars*; ACS (an American Chemical Society publication) Symposium Ser.939, Chapter 18, pg 282, 2006
 - Narayan, *Rationale, Drivers, Standards, and Technology for Biobased Materials*; Ch 1 in *Renewable Resources and Renewable Energy*, Ed Mauro Graziani & Paolo Fornasiero; CRC Press, 2006
- Use biobased carbon content to document carbon footprint reduction – **INTRINSIC VALUE PROPOSITION**
- Codified in ASTM D6866 to determine biocarbon content
- Total environmental footprint (the carbon footprint is part of that!) using LCA tools

NATURE MANAGES CARBON??

“ Through its **BIOLOGICAL CARBON CYCLE** ”

SO NEED TO UNDERSTAND

&

BECOME PART OF NATURAL CARBON CYCLE

ISSUE OF CARBON MANAGEMENT – REDUCING CARBON
FOOTPRINT

BY

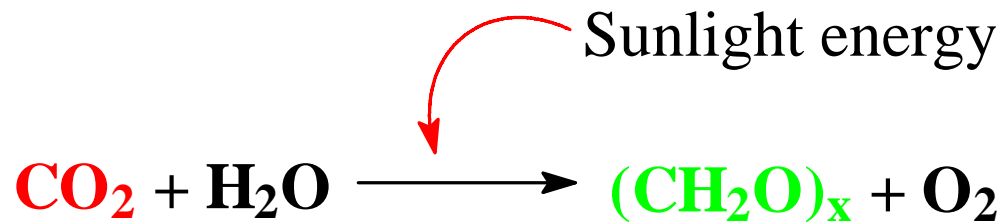
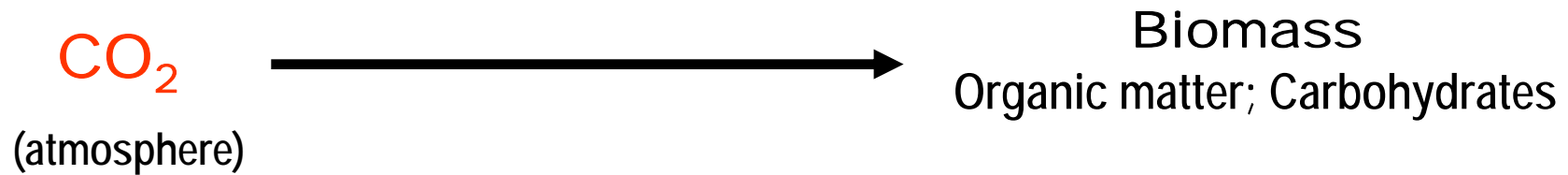
INTEGRATING WITH NATURE'S CARBON CYCLE

&

Adopting the **RATE** and **TIME** constants of the Natural
Carbon cycle

GLOBAL CARBON CYCLING

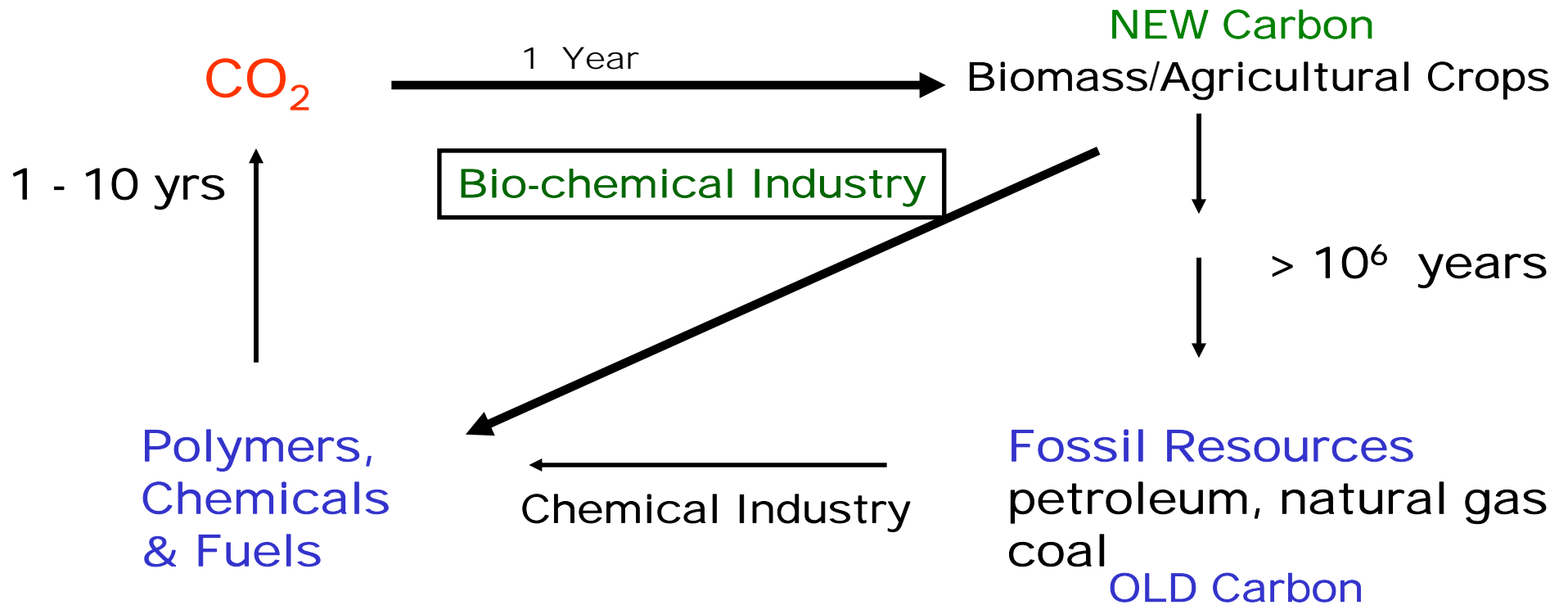
Inorganic to Organic carbon conversion



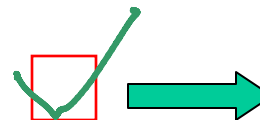
photoautotrophs -- algae, plants, and some bacteria fix inorganic carbon to **organic matter** (carbohydrates) using sunlight as the energy

GLOBAL CARBON CYCLING

Carbon Management Nature's Way

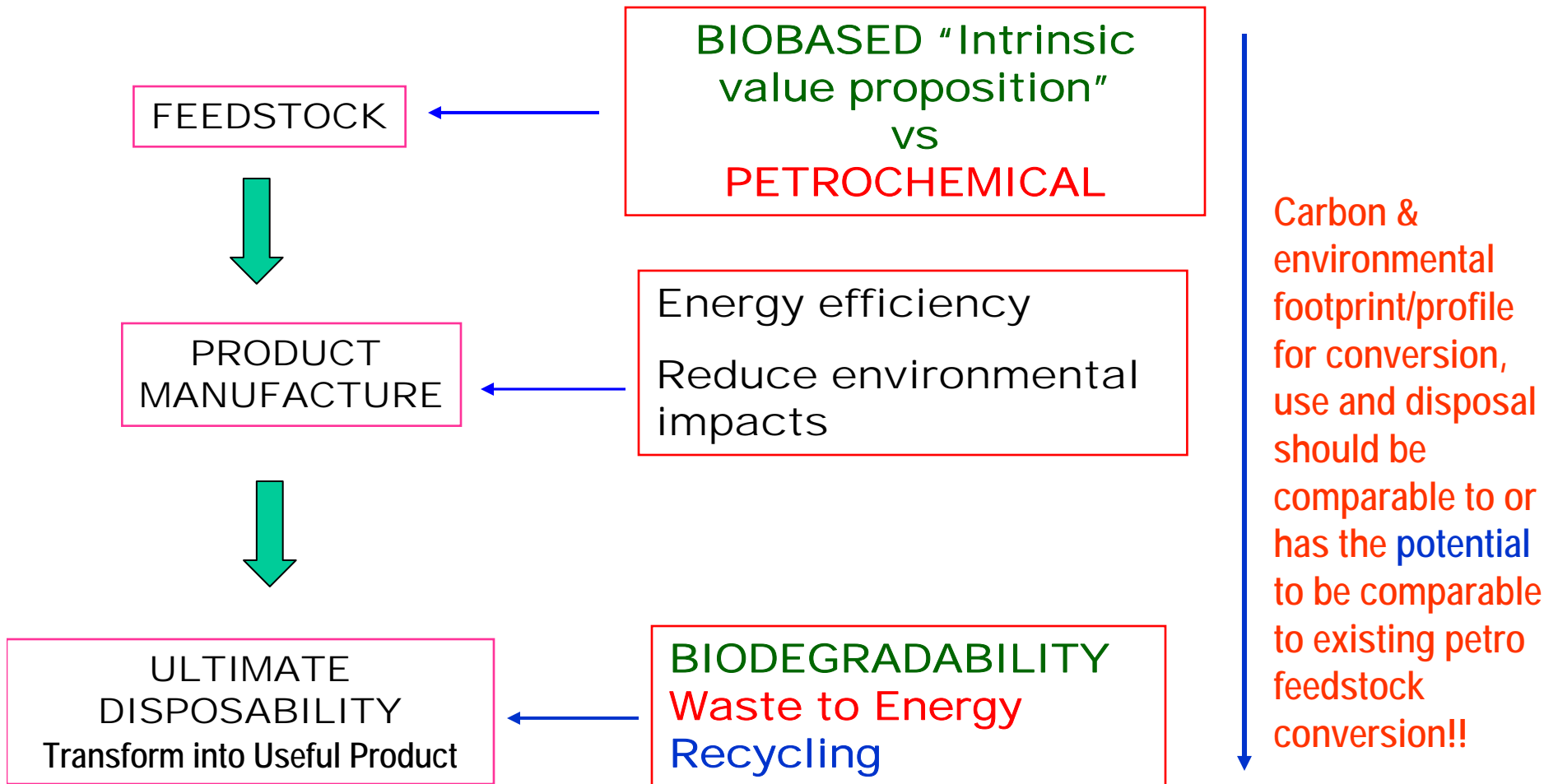


NEW (Renewable) Carbon Feedstock
Vs
OLD (FOSSIL) Carbon Feedstock



ZERO CARBON
FOOTPRINT
Intrinsic
"Value Proposition"

MATERIALS DESIGN PRINCIPLES FOR THE ENVIRONMENT



Develop a carbon and environmental footprint/profile using Life Cycle Assessment (LCA) tools" -- ASTM D7075

Intrinsic Value Proposition – PLA example

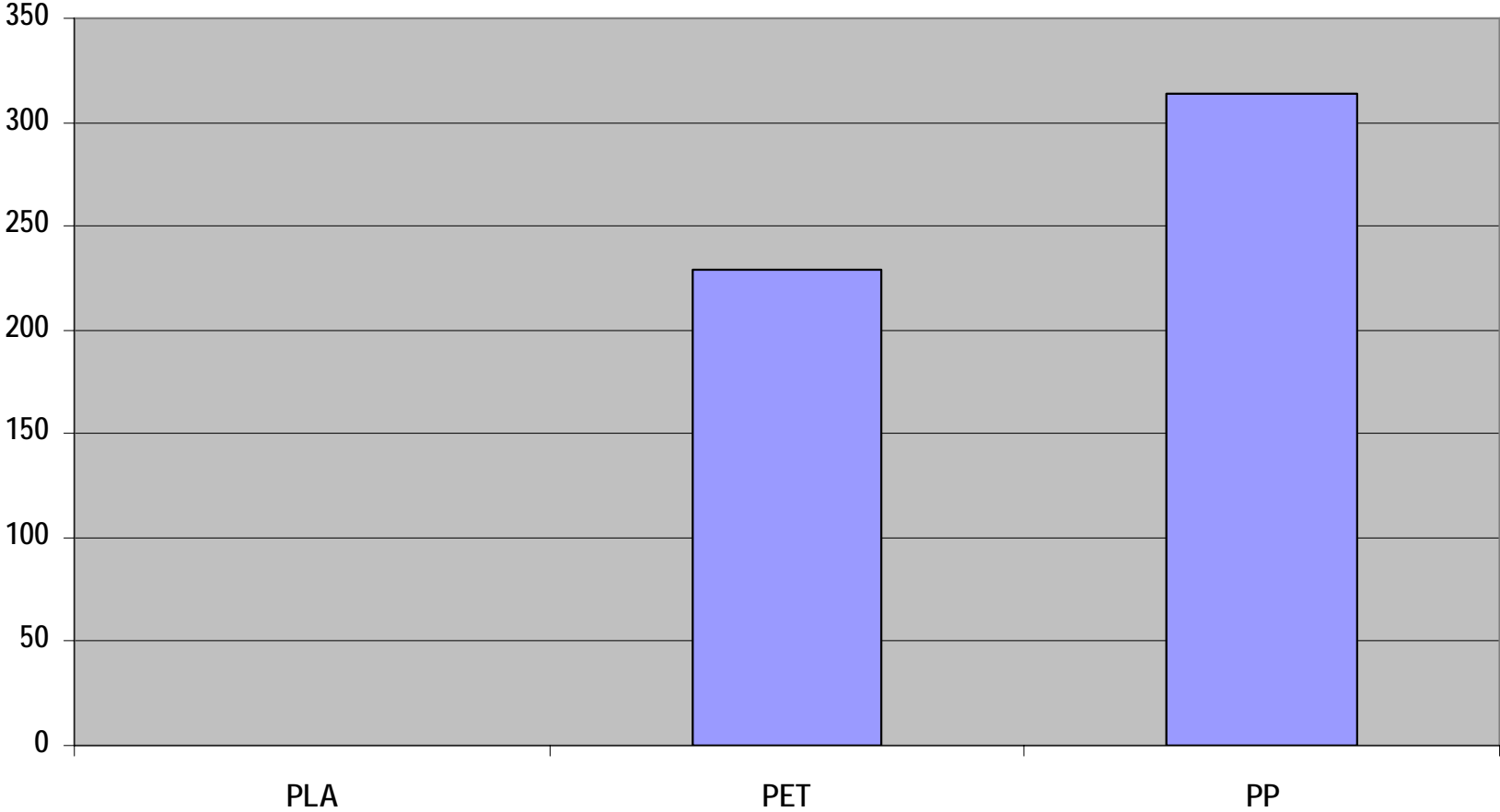
Webinar Oct 7 2007 – www.natureworksllc.com

Vink et al

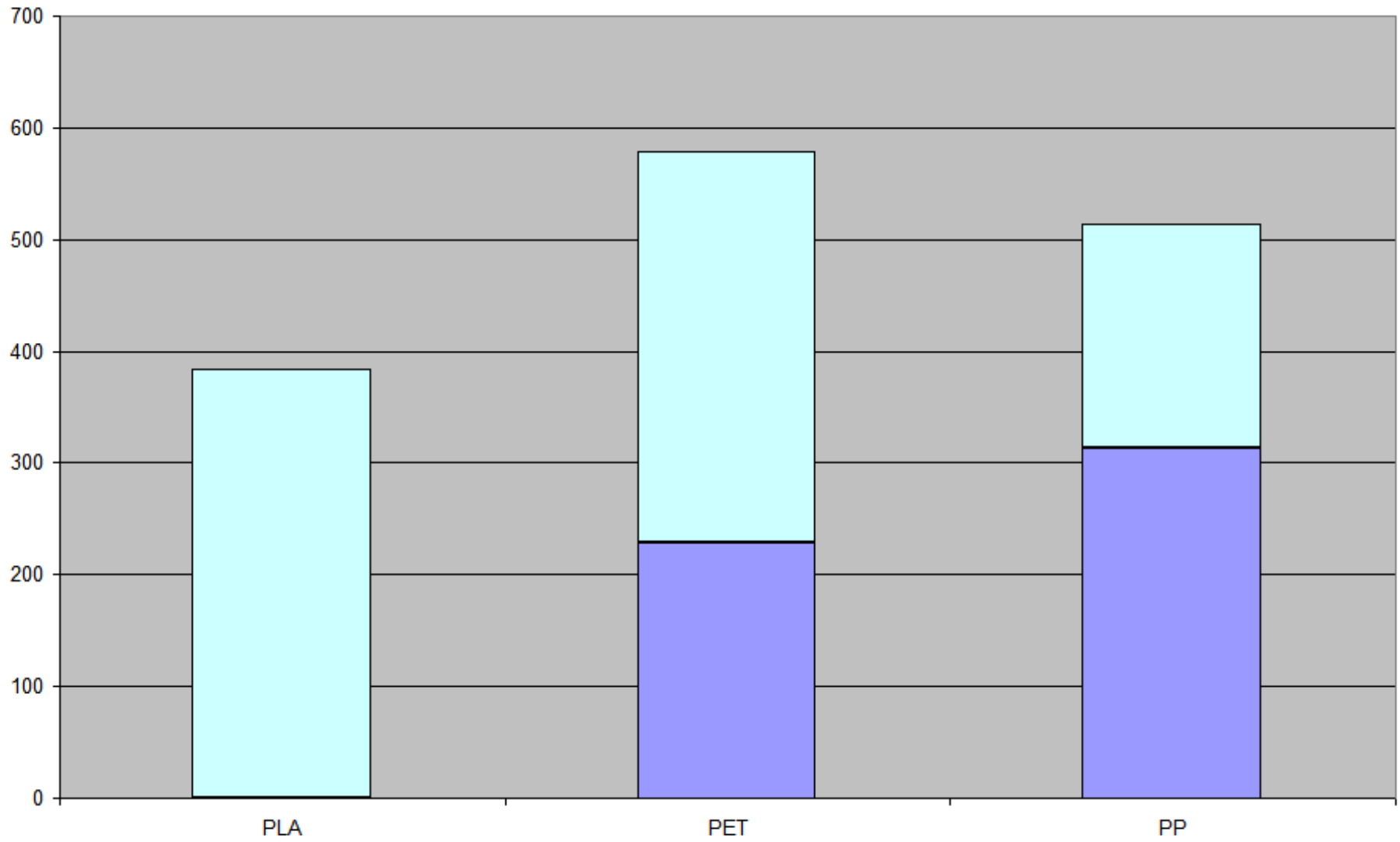
www.natureworksllc.com/our-values-and-views/life-cycle-assessment.aspx

Intrinsic Value Proposition for "Bio" feedstock

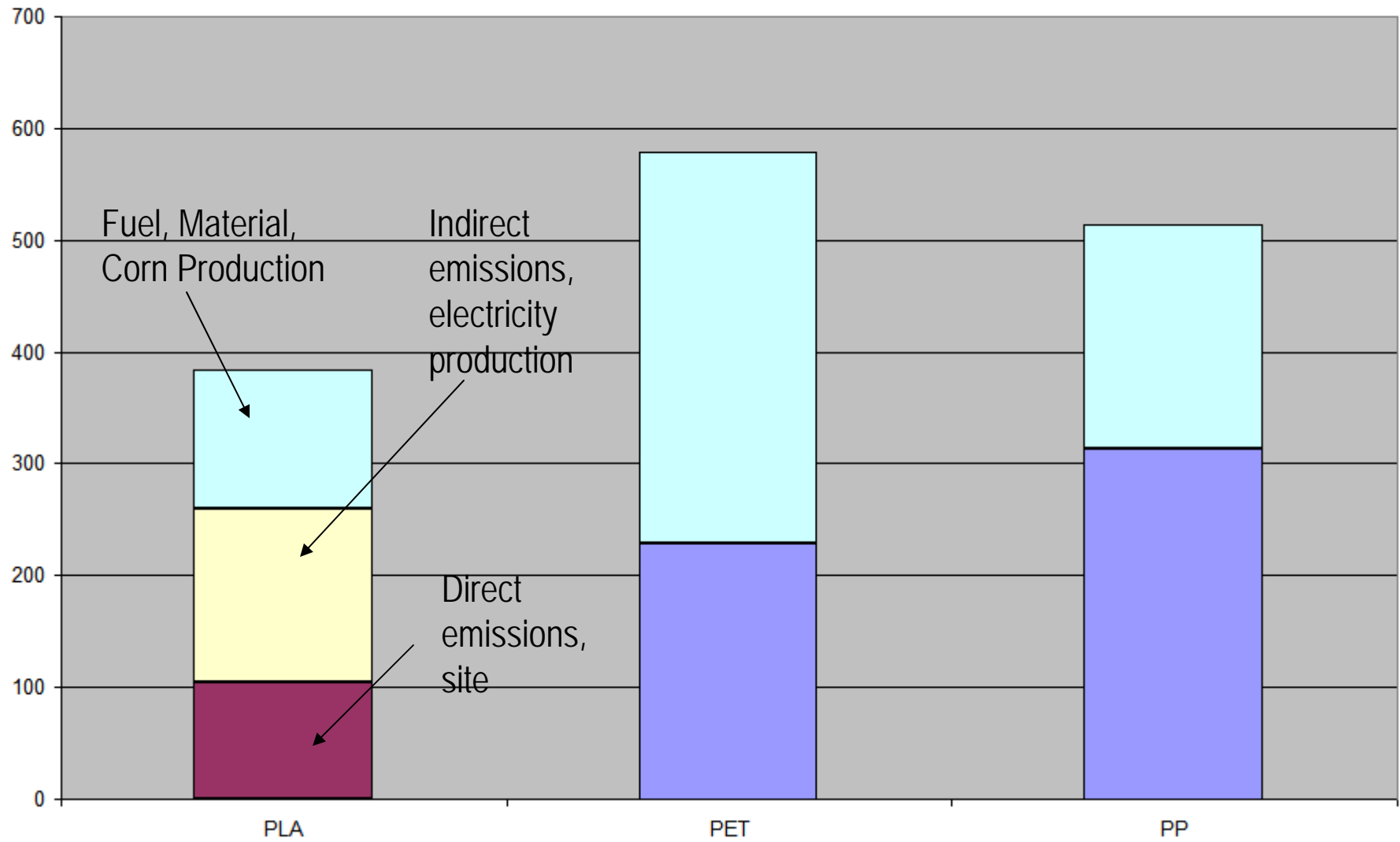
CARBON FOOTPRINT
kg of CO2 per 100 kg of plastic



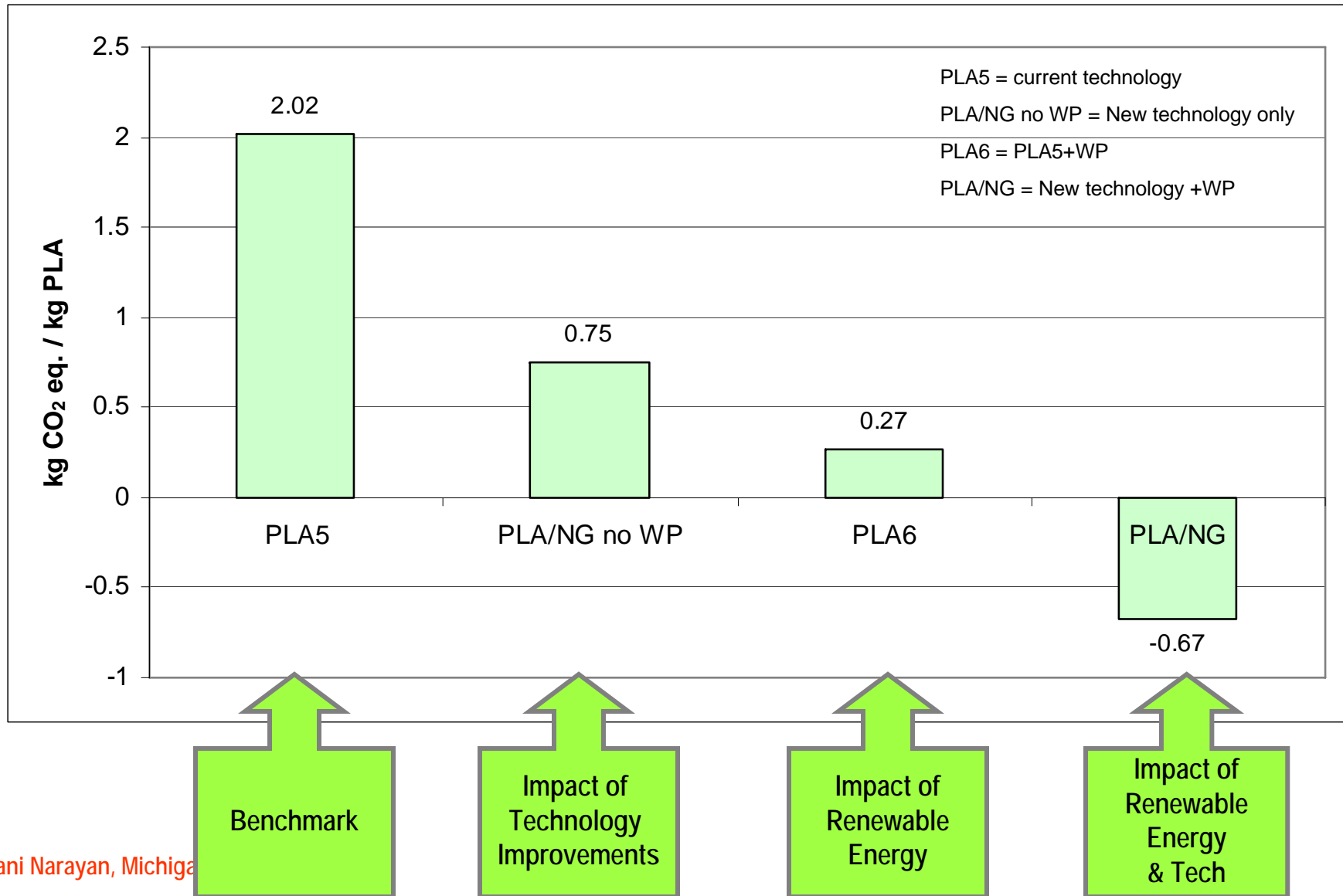
Carbon footprint includes conversion



Carbon footprint includes conversion

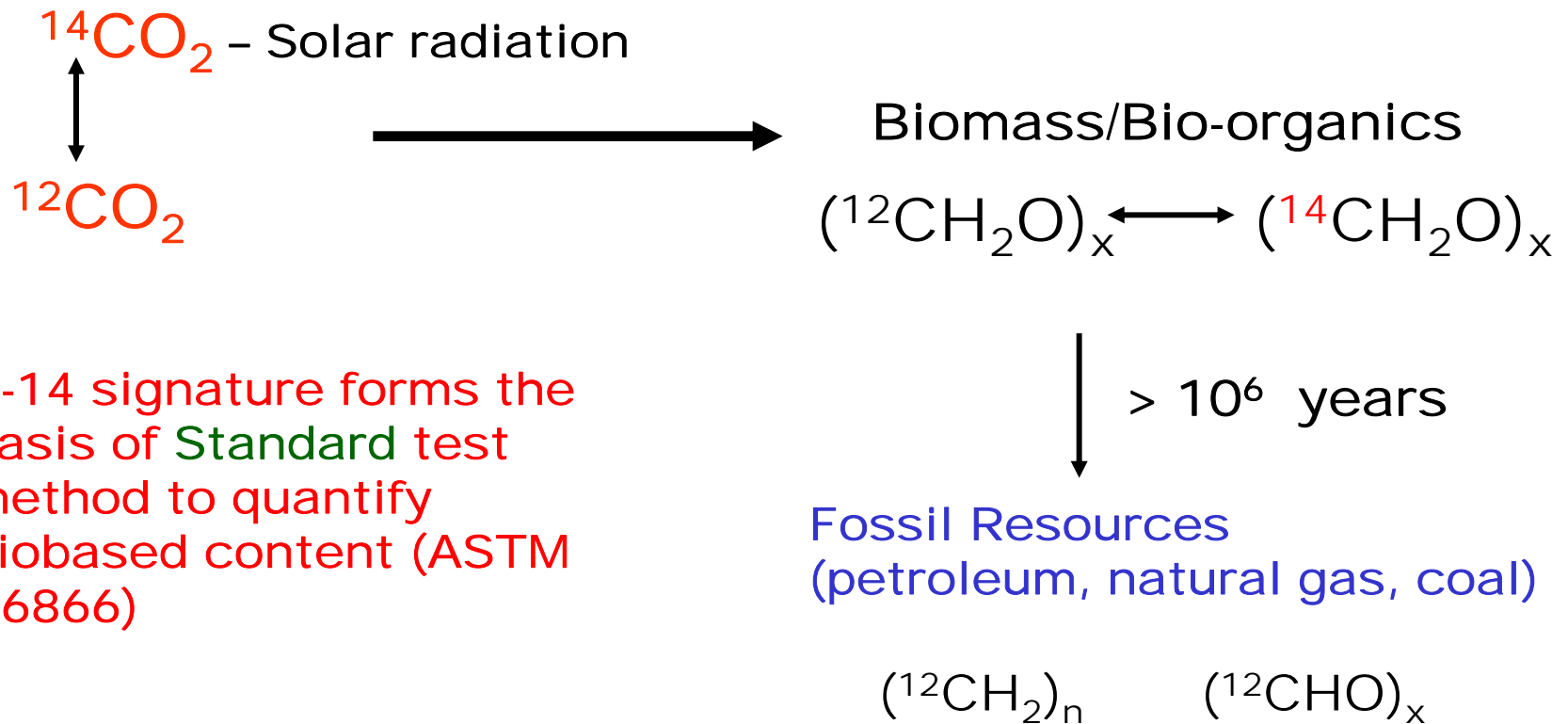


Results of the utilization of renewable energy and new technology on GHG



Standards -- Identify & Quantify Biobased Content

- How does one distinguish between new (contemporary) and old(fossil) carbon – identify biobased carbon?
- How does one quantify biobased carbon content?



C-14 signature forms the basis of Standard test method to quantify biobased content (ASTM D6866)

BIO OR BIOBASED CONTENT

Amount of **biobased carbon** in the material or product as fraction weight (mass) or percent weight (mass) of the total **organic carbon** in the material or product.

$$\% \text{ BIO or BIOBASED CONTENT} = \frac{\text{BIO (Organic) CARBON}}{\text{TOTAL (Organic) CARBON}} * 100$$

On a **carbon basis**, not weight or mole or any other measure.

Reducing carbon foot print is the driver for using a bio/renewable feedstock (new carbon) -- not oxygen or nitrogen or anything else

So biocarbon content is a true measure



U.S. Farm Security and Rural Investment Act of 2002
(P. L. 107-171), Title IX Energy, Section 9002
FARM BILL



- Federal Procurement of Biobased Products FB4P (www.biobased.oce.usda.gov)
 - develop guidelines for designating biobased products
 - PUBLISHED – FEDERAL REGISTER
 - publish a list & issue criteria for a designated biobased products list (DBL) for federal purchase;

- Includes:
 - Definition, content verification, ASTM D6866
 - environmental profile using LCA – ASTM Standard
 - ASTM D7075 "Standard practice for evaluating and reporting environmental performance of biobased products". -- LCA TOOLS/BEES analysis
 - To incorporate life cycle costing
 - Biodegradability using ASTM D6400 and D6868 (paper coatings) D7021 (marine)
 - performance requirements; and
 - assurance that products are available.



ENERGY – FUELS AREA

- All biocarbon discussions applicable to fuels
- ASTM is writing a standard practice to sample the stack gases from power plants to analyze the bio content using ASTM D 6866
- Blends of biomass and coal as fuel in existing facilities
 - Wood waste, paper waste, waste oil – all carbon fuels!!

SUMMARY

- Report your carbon footprint reduction using biocarbon content calculations
 - need to clearly bring out the “intrinsic value proposition” offered by incorporating biocarbon content into fuel or material.
 - ASTM D6866
- Report total environmental footprint for fuel or product to your point of control using LCA tools
 - ASTM D7075

NOTE

LCA provides for continual improvement, new options, new material choices for reducing the environmental impact of your product

Practitioners and users of LCA need to be careful in comparative analysis of products because of the data used, the boundary conditions

Beware of skewed/misused LCA's because of data quality or imposed boundary conditions.

