Sustainable Farm Scale Income producing Carbon Negative Fuels, Fertilizer, Food and Co-Products.

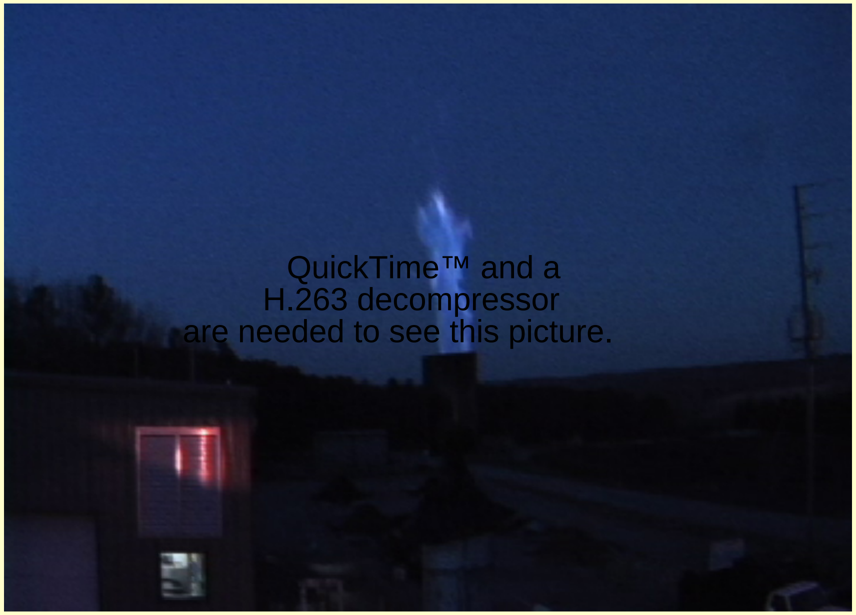
May 7, 2007

United Nations Commission on Sustainability

Danny Day

President

EPRIDA, Inc.



Clean Renewable Fuels

Bob Evans, National Renewable Energy Laboratory, Golden, CO

James Lee, Oak Ridge National Laboratory, Oak Ridge, TN

Don Reicosky, USDA Soil Conservation, Morris, MN

K.C. Das, University of Georgia, Athens, Ga

Matthew Realf and Ling Zhang

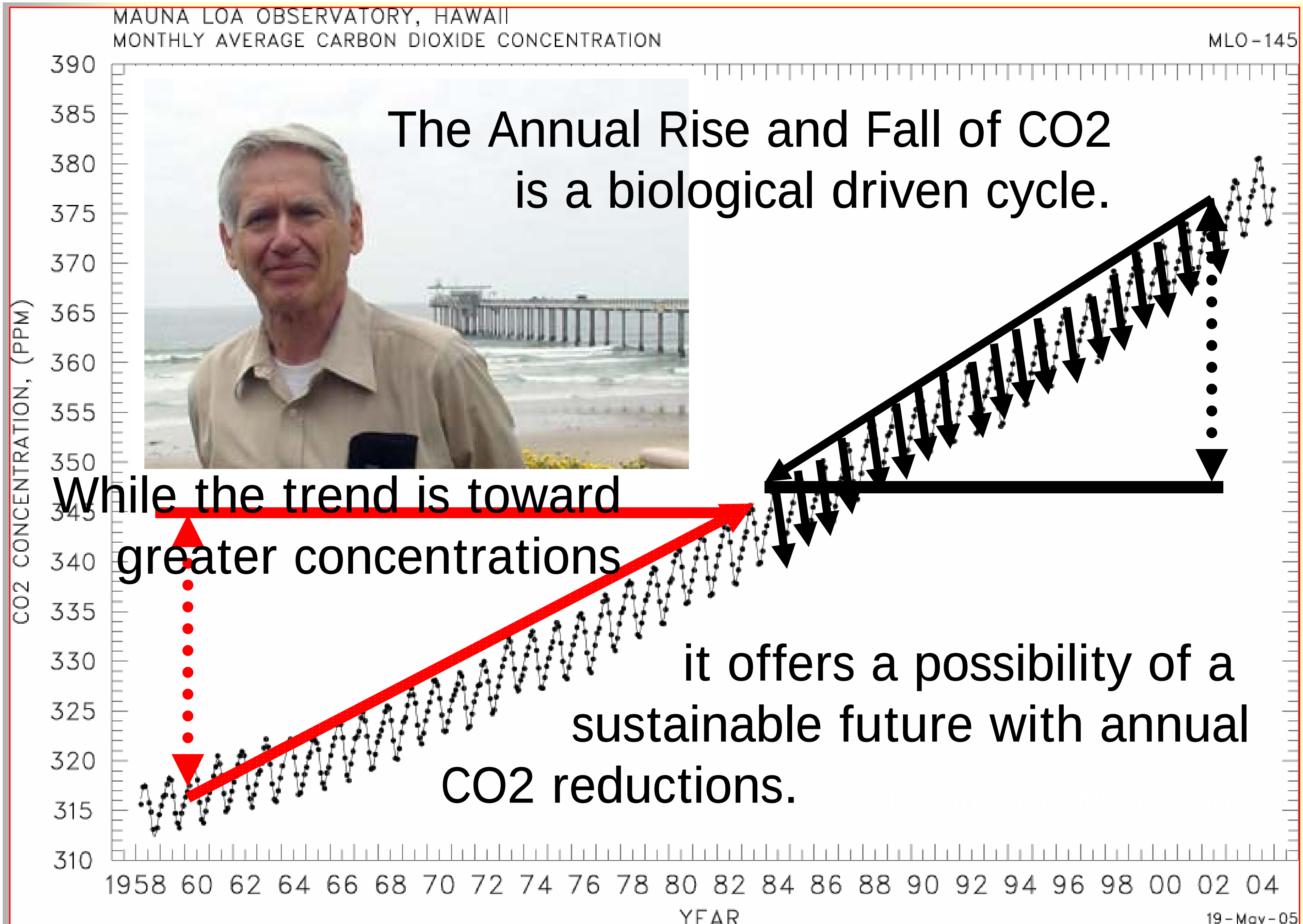
Georgia Institute of Technology, Atlanta, GA

Who is Eprida?

- It is a for-profit social purpose enterprise with non-profit ownership and philanthropic support focusing on developing solutions which are global in scope.
- It is a private research partner providing in-kind and commercial support for universities and research institutes for developing greenhouse gas (GHG) reducing technologies.
- It provides nominal non-exclusive licensing of its GHG reducing technologies to insure fair access.
- It is a innovation partner in business as well as technology, supporting the growth and creation of for long term social purpose business strategies.

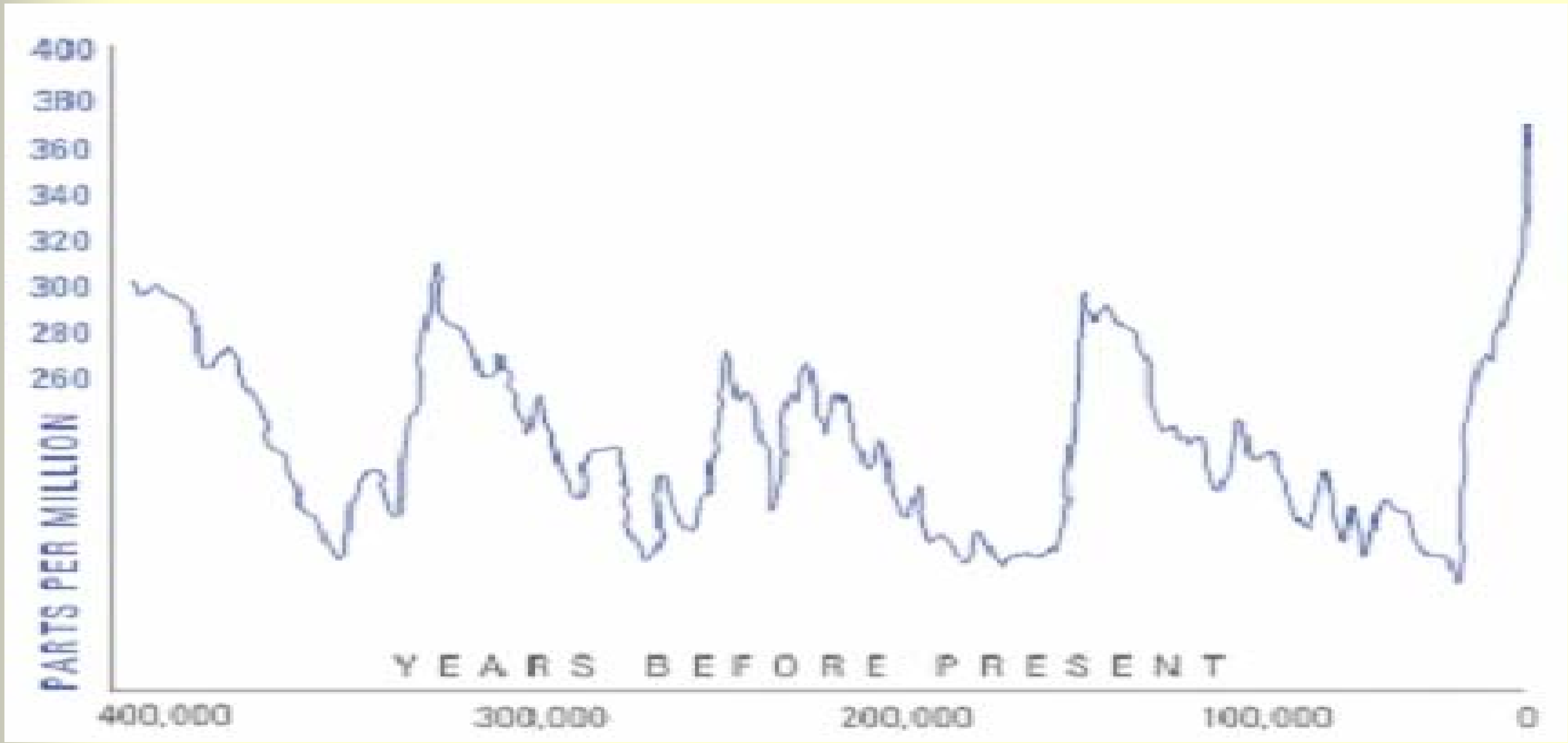
Small farms can reverse global warming by

- Producing the fuels needed to grow their food crops.
- Improving soil productivity on existing crop land.
- Improving biodiversity to increase farm co-product income.
- Taking part in producing terra preta soils.



MAUNA LOA OBSERVATORY, HAWAII
MONTHLY AVERAGE CARBON DIOXIDE CONCENTRATION
MLO-145
The Annual Rise and Fall of CO2 is a biological driven cycle.
While the trend is toward greater concentrations
it offers a possibility of a sustainable future with annual CO2 reductions.
CO2 CONCENTRATION, (PPM)
390
385
380
375
370
365
360
355
350
345
340
335
330
325
320
315
310
1958 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 00 02 04
YEAR
19-May-05

Is the problem really anthropogenic greenhouse gas buildup?



or the stumbling steps of a brand new species evolved to stabilize this recurring imbalance?

To change to climate of the world, how do we transform the daily habits and thoughts of billions people.

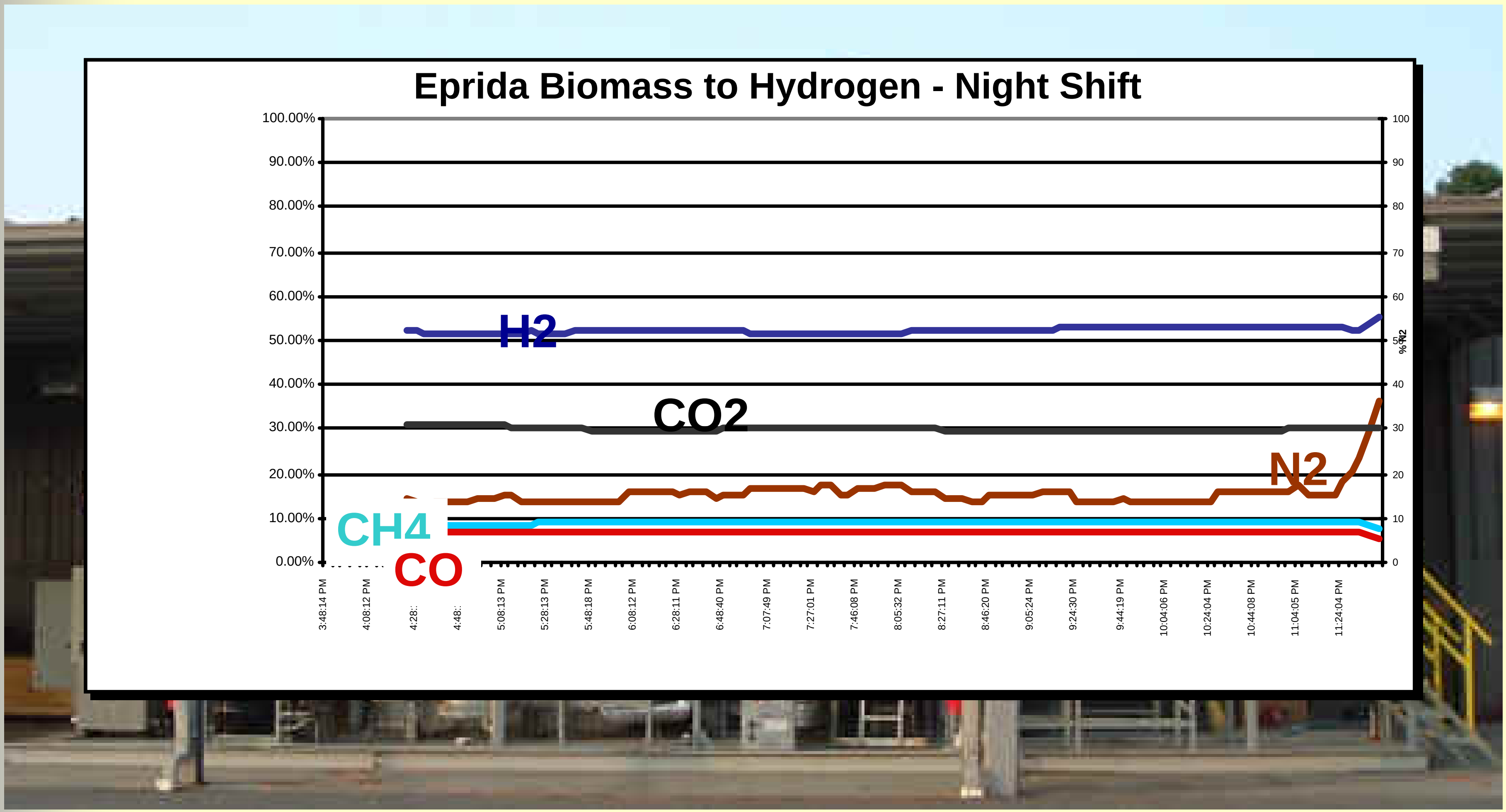
- Choosing those systems which create local income and stability at the lowest possible economic rung.
- By adopting those technologies which retain profits/gain inside local communities
- By supporting those which can be scaled in numbers rather than size.
- By supporting those which are multi-purpose, cost-effective, people-centered using local initiatives and skills.

This system is part of a regional farm/coop capability. This allows testing of biomass feed stocks to produce fuel, a soil fertility enhancing fertilizer and high-value extractable organic molecules.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

2007 Bio-refinery Conversion Project at University of Georgia

1000-Hour Demonstration of Hydrogen by Biomass Catalytic Steam Reforming and co-products (2007)



DOE estimates that hydrogen production from biomass is one of the most cost competitive

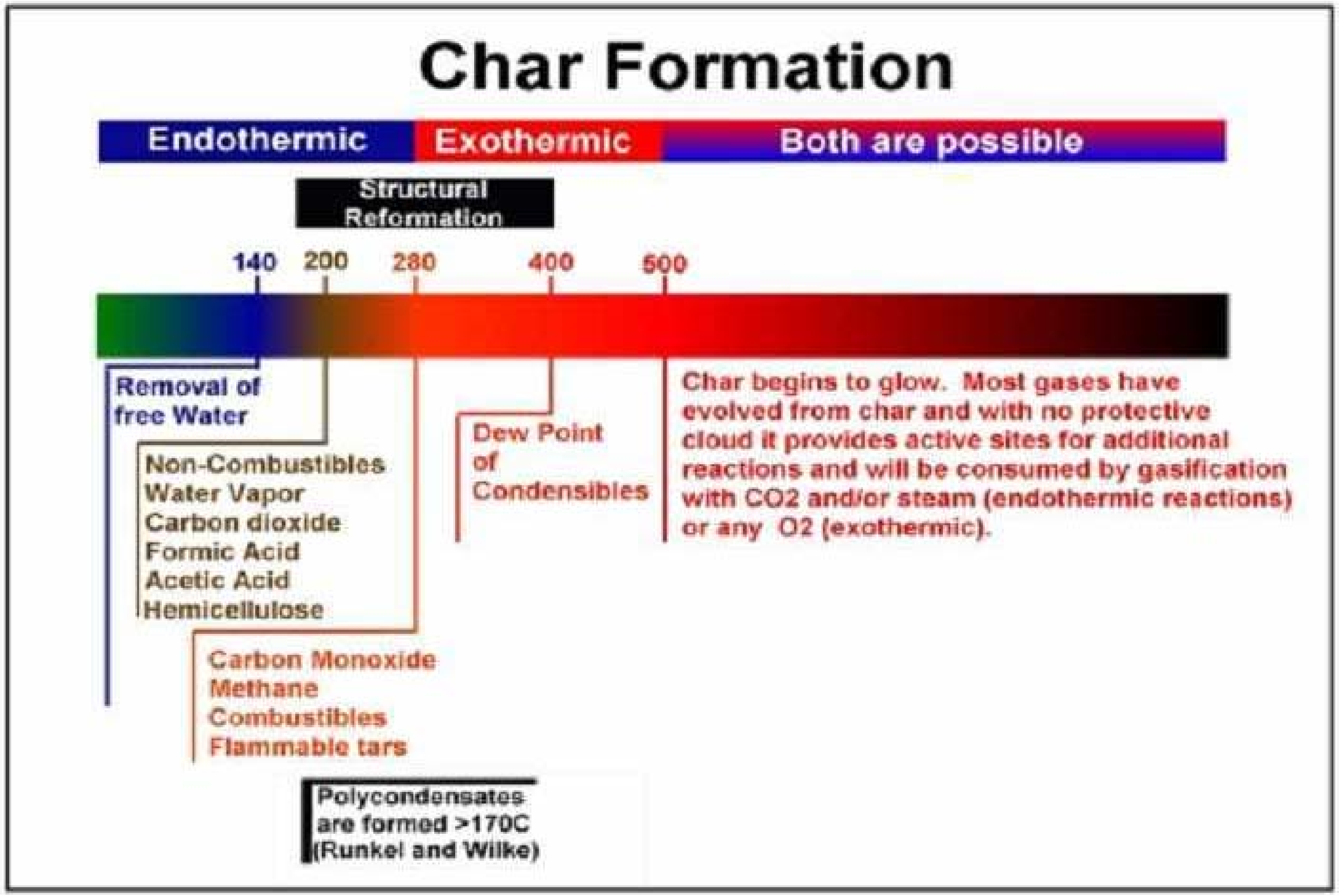
Pyrolysis Conversion and Hints

- 50kg per hour feed
- Used a inert gas generator to maintain bed temperature profiles
- Start-up procedure included filling unit with cool charcoal as inert media to distribute heat.

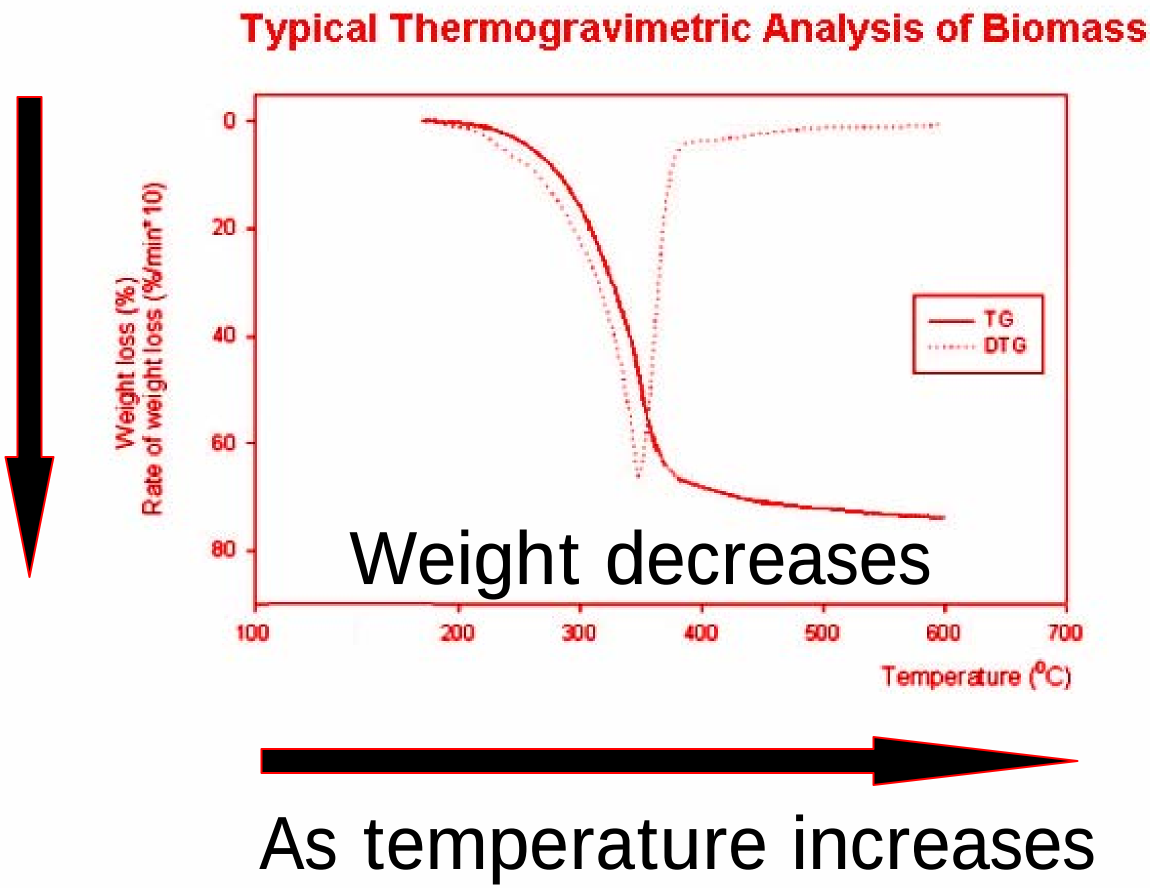
Nature has always used fire

Charcoal is made during one part of this natural process. It is called pyrolysis or heating in the absence of air.

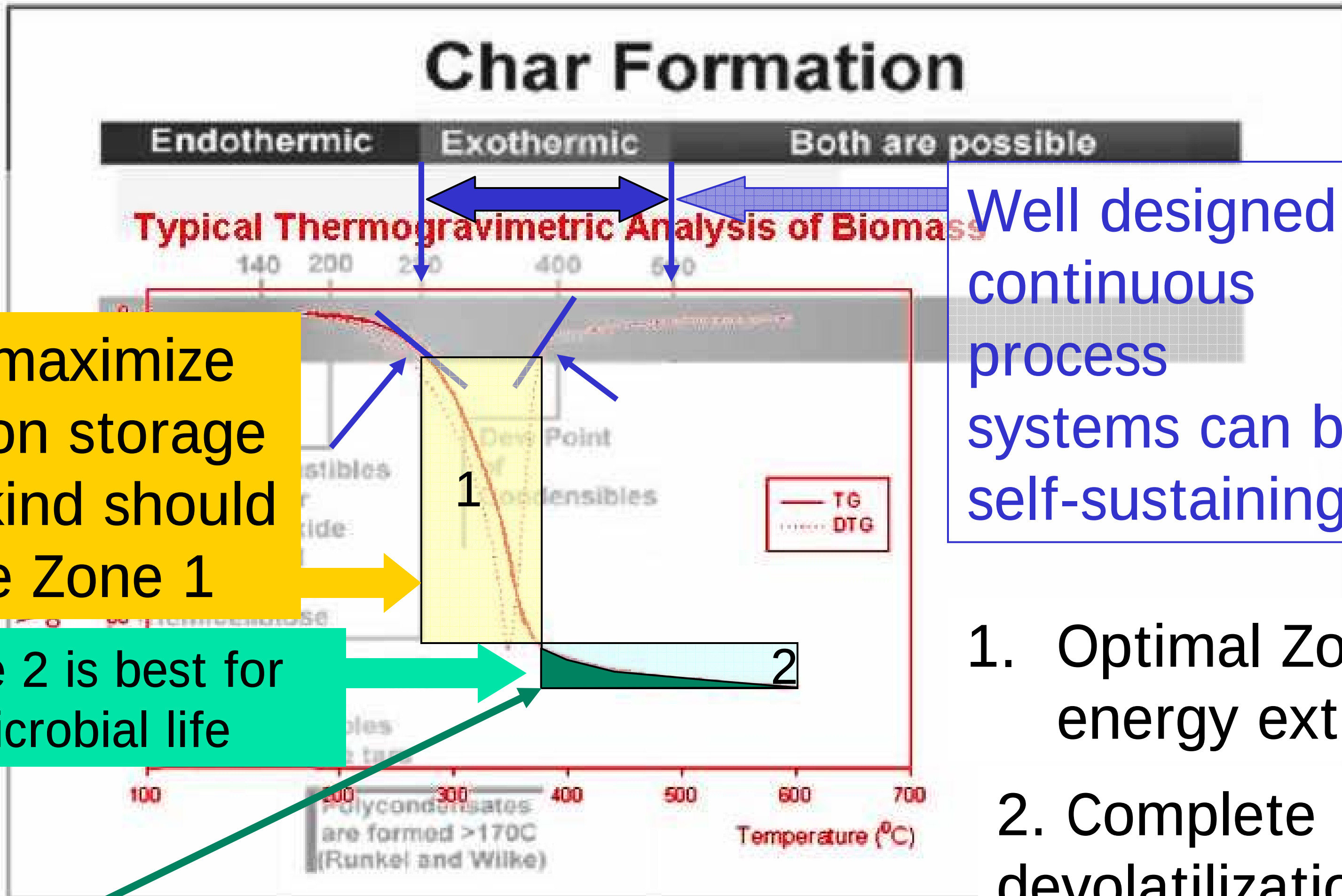
Progression of Pyrolysis



Typical TGA of Pyrolysis



Progression of Pyrolysis



To maximize carbon storage mankind should use Zone 1

Zone 2 is best for microbial life

Well designed continuous process systems can be self-sustaining

1. Optimal Zone for energy extraction

2. Complete devolatilization

Requires addition of energy (and/or oxygen)

Our investment for a sustainable planet

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Science Magazine

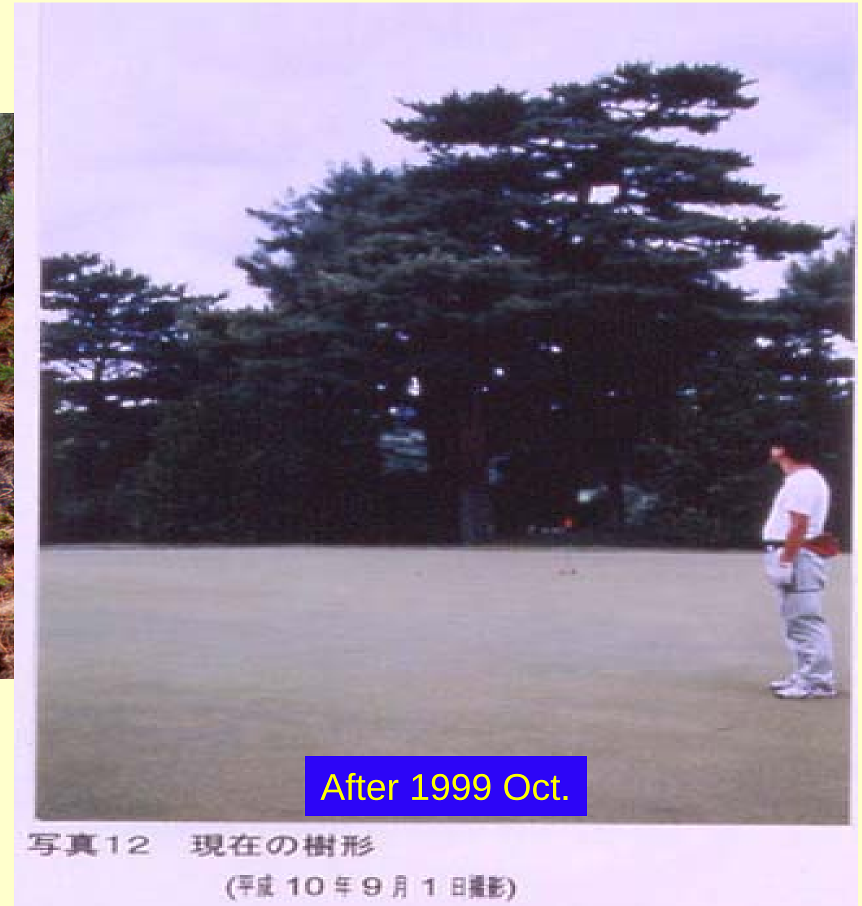
August 2002

Charcoal has Benefits for Existing Forests

Recovering of Pine Tree from Wilting by Charcoal Treatment after a year

Ogawa 1999, Kansai Environmental

Charcoal has Benefits for Existing Forests
Results of Charcoal Treatment after a year



Ogawa 1999, Kansai Environmental

The growth of pine root and mycorrhiza formation started at 5 to 6 months after treatment

Adding Charcoal to the ground seems easy enough but the impact is far from simple.

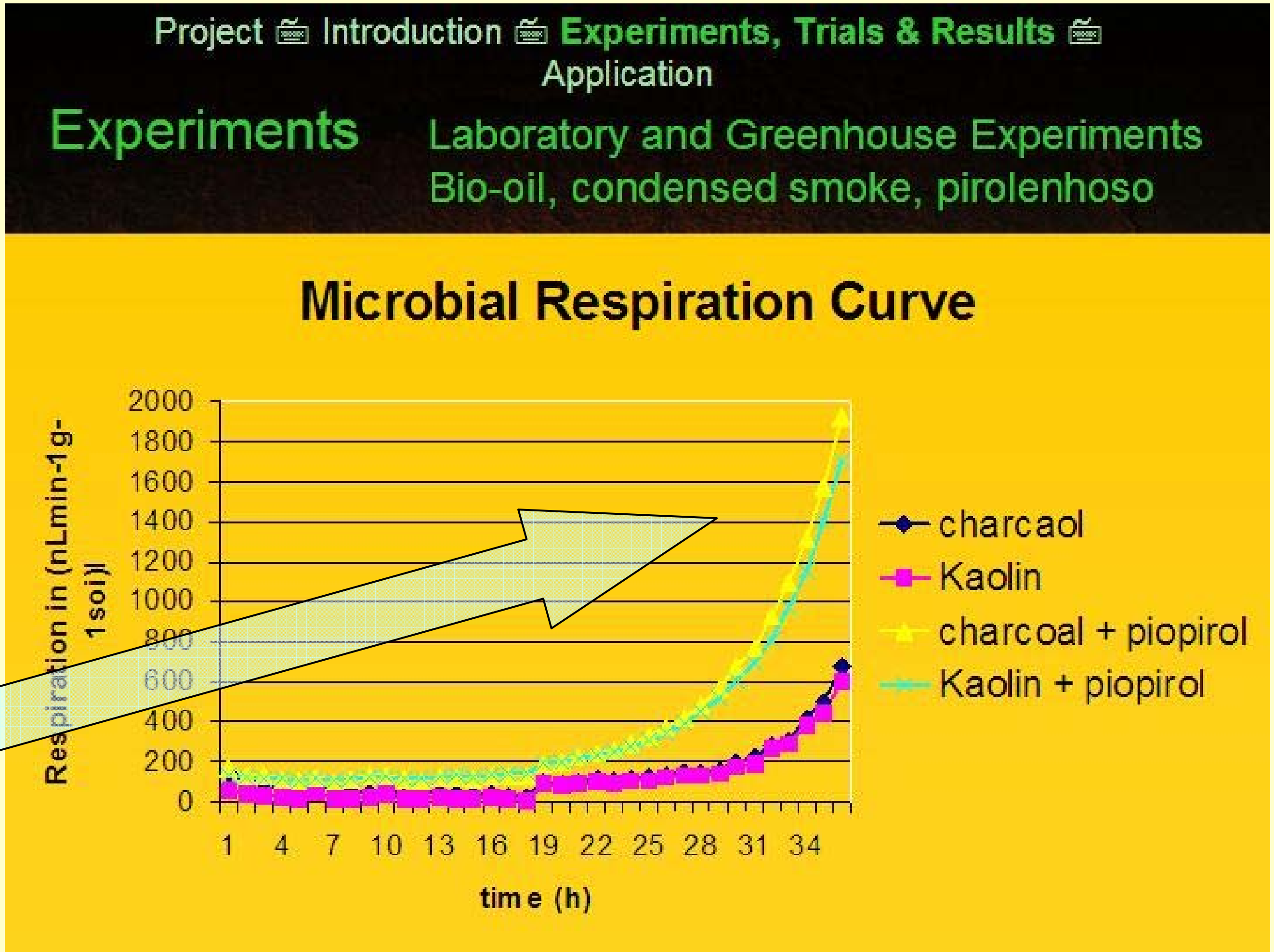
Nature has spent billions of years evolving ecosystems to utilize charcoal and its byproducts.

We are just now uncovering the science behind this fascinating story and the possibilities may yet provide solutions to many of our most intractable problems.

The answer is in the smoke

In this experiment, condensed smoke was added to charcoal and kaolin.

The impact was the same as adding glucose to these materials.



C. Steiner, M. Garcia, B. Förster and W. Zech

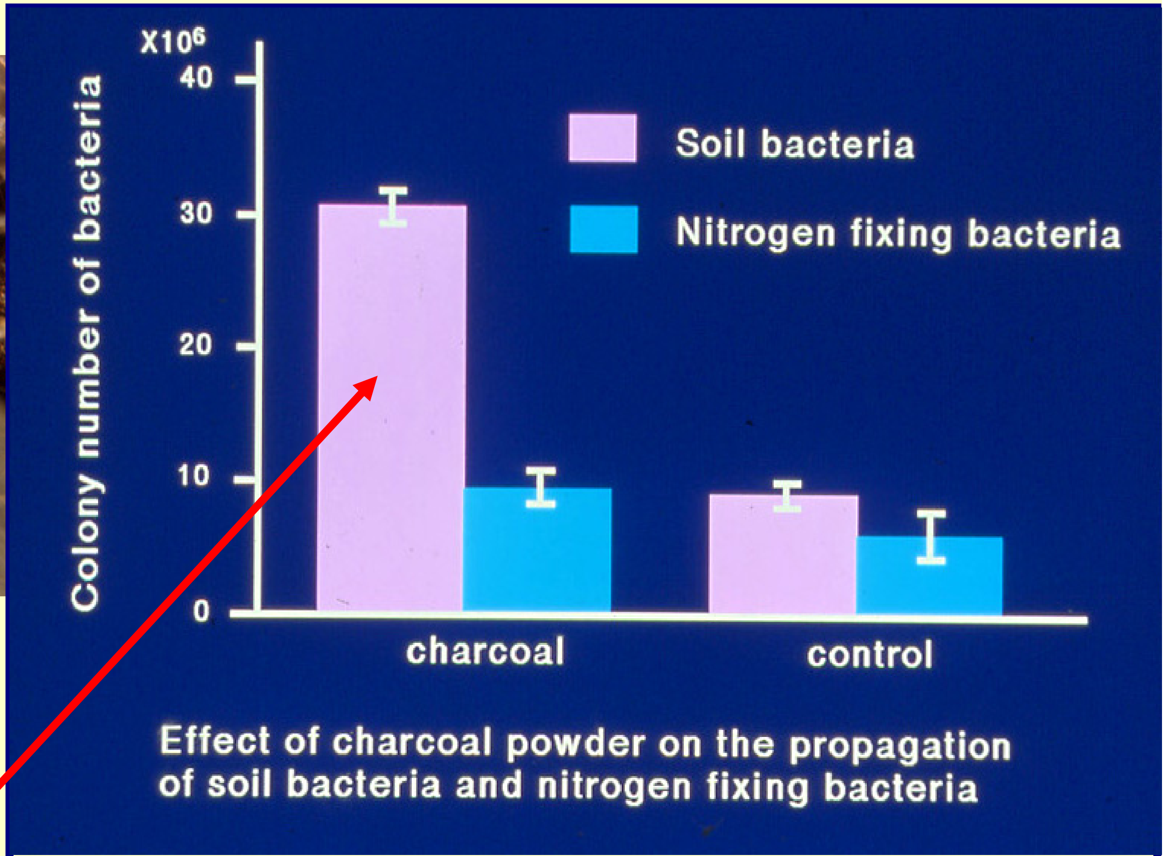
Nature’s Thermal Reactors

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Pressures up to 300psi
Results in highly diverse organic compounds
And the unknown multitude of evolutionary bacterial life forms which benefit from those compounds.

Charcoal provides a preferred habitat for soil micro organisms

The germination rate of G. margarita was higher than that on soil (Ogawa 1991)

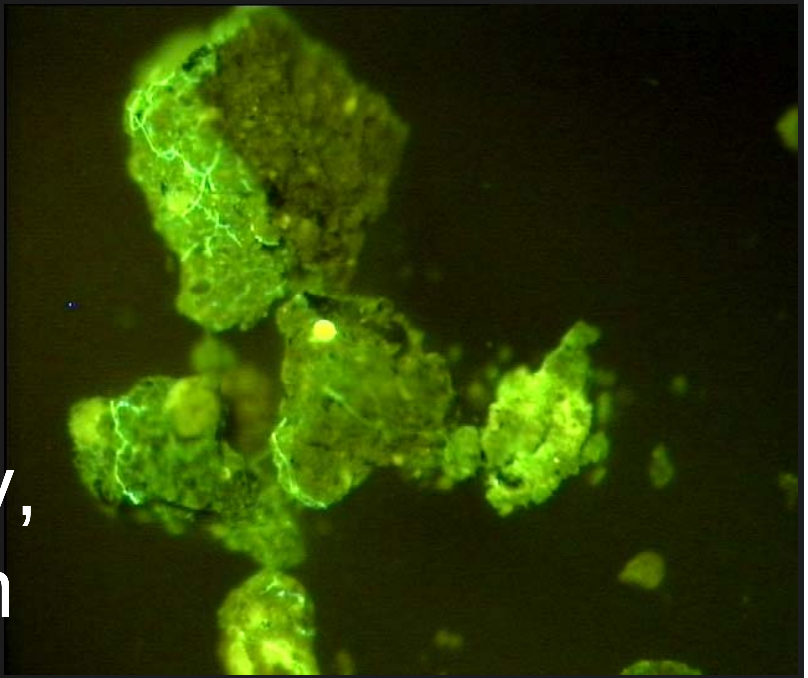


Bacterial populations show marked increase with charcoal addition (Beijerinckia, Ogawa 1992)

Note the 3 fold increase

Fertile Soil is “aggregated”

- AM Fungi produce a glue Glomalin, which aggregates small soil particles
- This increases water and air holding capacity, resulting in soil tilth with increased biomass yields.

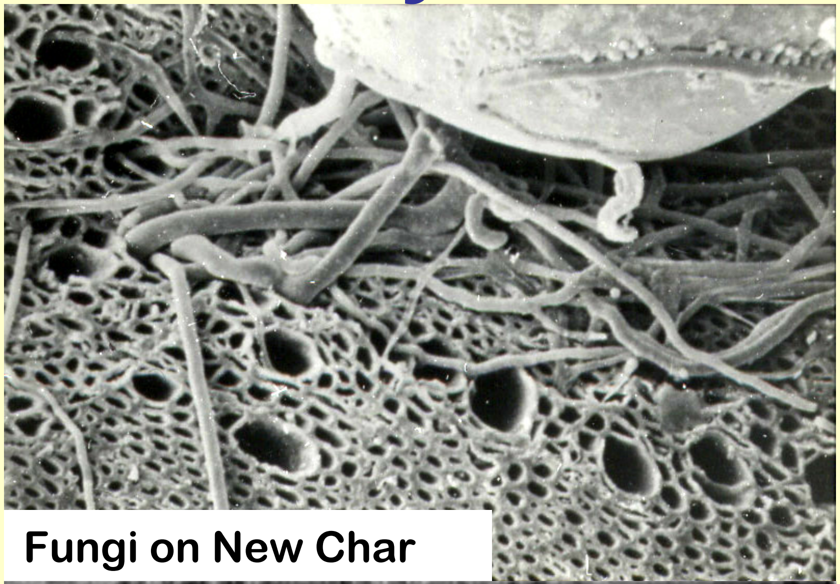


Charcoal is sought out by AMF

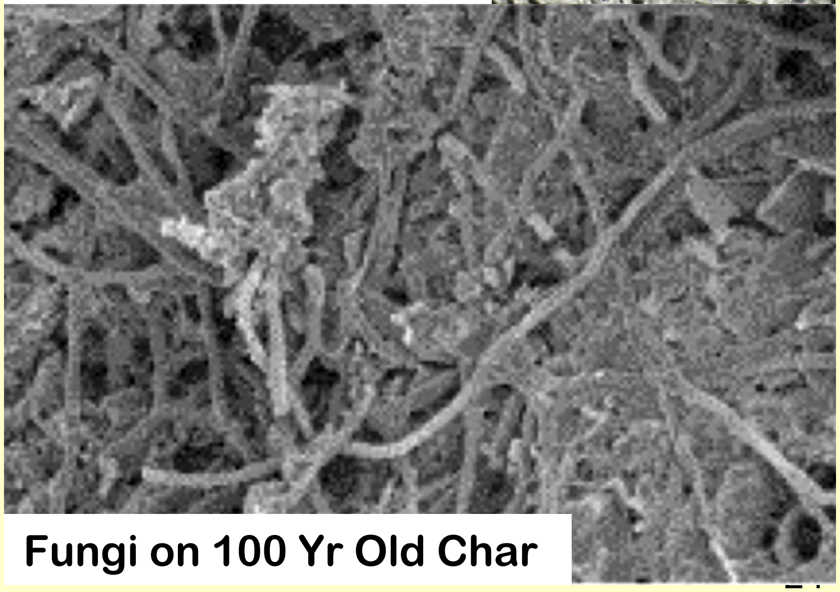
Charcoal addition to the soil provides nutrient and water storage center for mycorrhizal fungi

Their hyphae invade charcoal pores and support spore reproduction

Ogawa
Kansai Environmental



Fungi on New Char

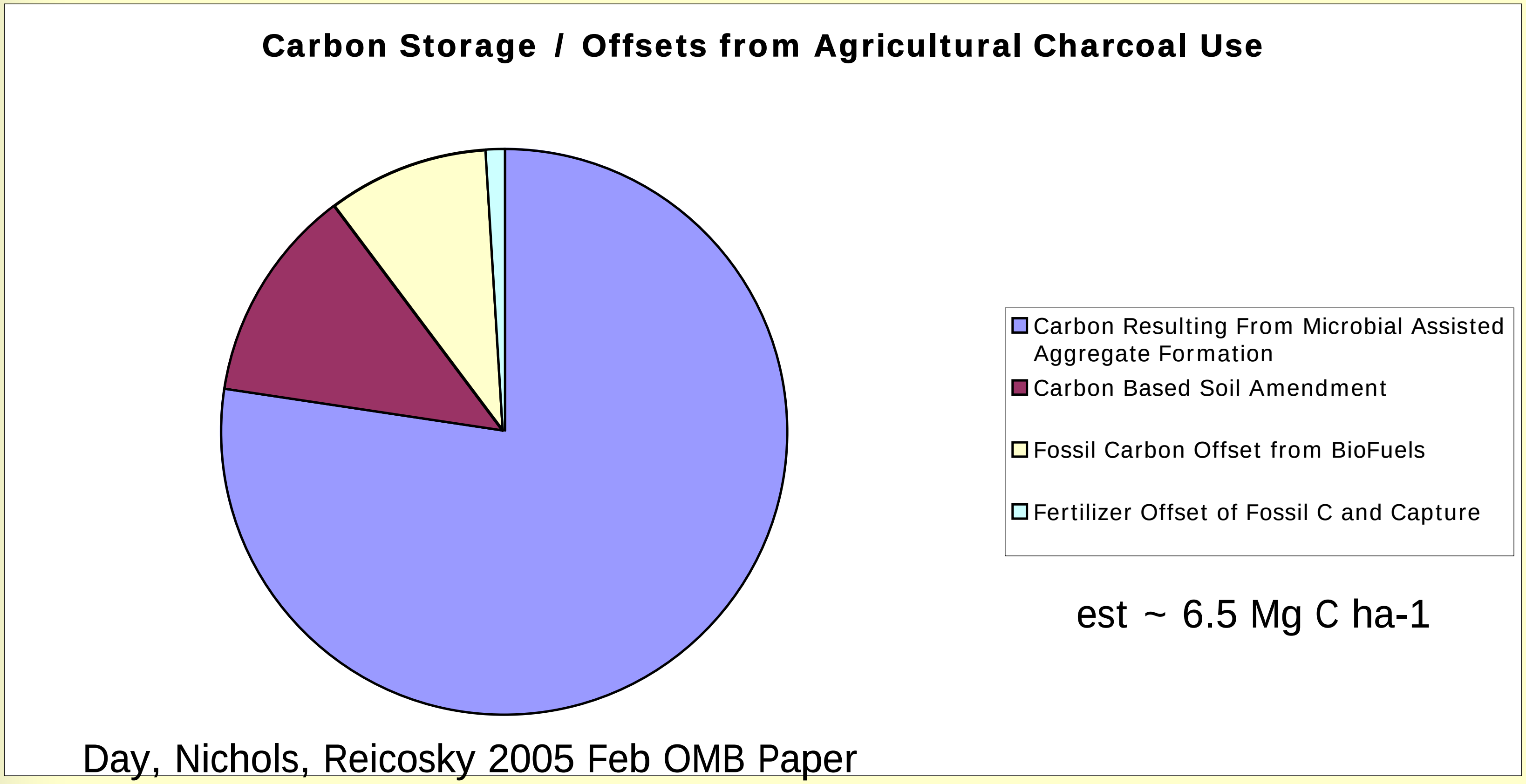


Fungi on 100 Yr Old Char

Char seeds aggregates formation which absorbs dissolved organic matter through wetting and drying cycles to build humus as a long term beneficial carbon storage

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Utilizing 1/3 of Crop Productivity for Bioenergy and Carbon based fertilizers and no-till



Land required to offset 1.9 Gt C/yr = 2.2E+8 ha (3xTexas)

What is the difference in ECOSS charcoals?


EPRIDA Process
Charcoal
爱普利瑞达过程使用木炭
No C
未使


EPRIDA Process Charcoal
爱普利瑞达过程使用木炭
No Charcoal
未使用木炭
Standard Charcoal
标准使用木炭

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.



Global Charcoal Research

With NPK and Charcoal — With NPK

Manaus, Brazil - Terra Preta Research, 2001
Christoph Steiner, University of Bayreuth
Institute of Soil Science and Soil Geography

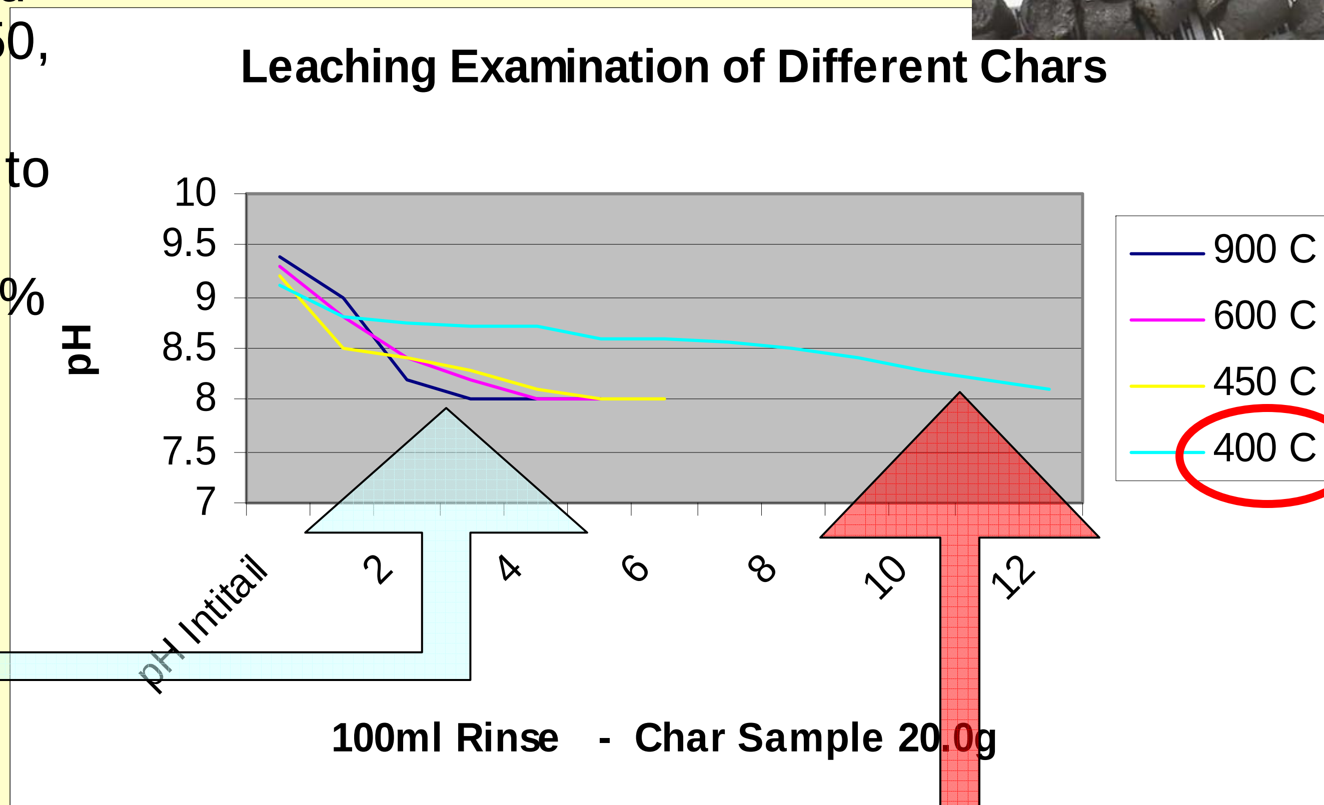
(Taiwan, 2001)
Food and Fertilizer Technology Center for the Asian and Pacific Region

Other charcoal benefits

- Surface oxidation of the char increased the cation exchange capacity (Glaser)
- Char increased available water holding capacity by more than 18% of surrounding soils (Glaser)
- Char experiments have shown up to 266% more biomass growth (2nd Yr Steiner) and 324% (Kishimoto and Sugiura)
- Plant nitrogen uptake doubled in charcoal amended soils (Steiner)
- Charcoal has proven to help reduce farm chemical runoff (Yelverton)

We conducted leaching experiments on a variety of chars

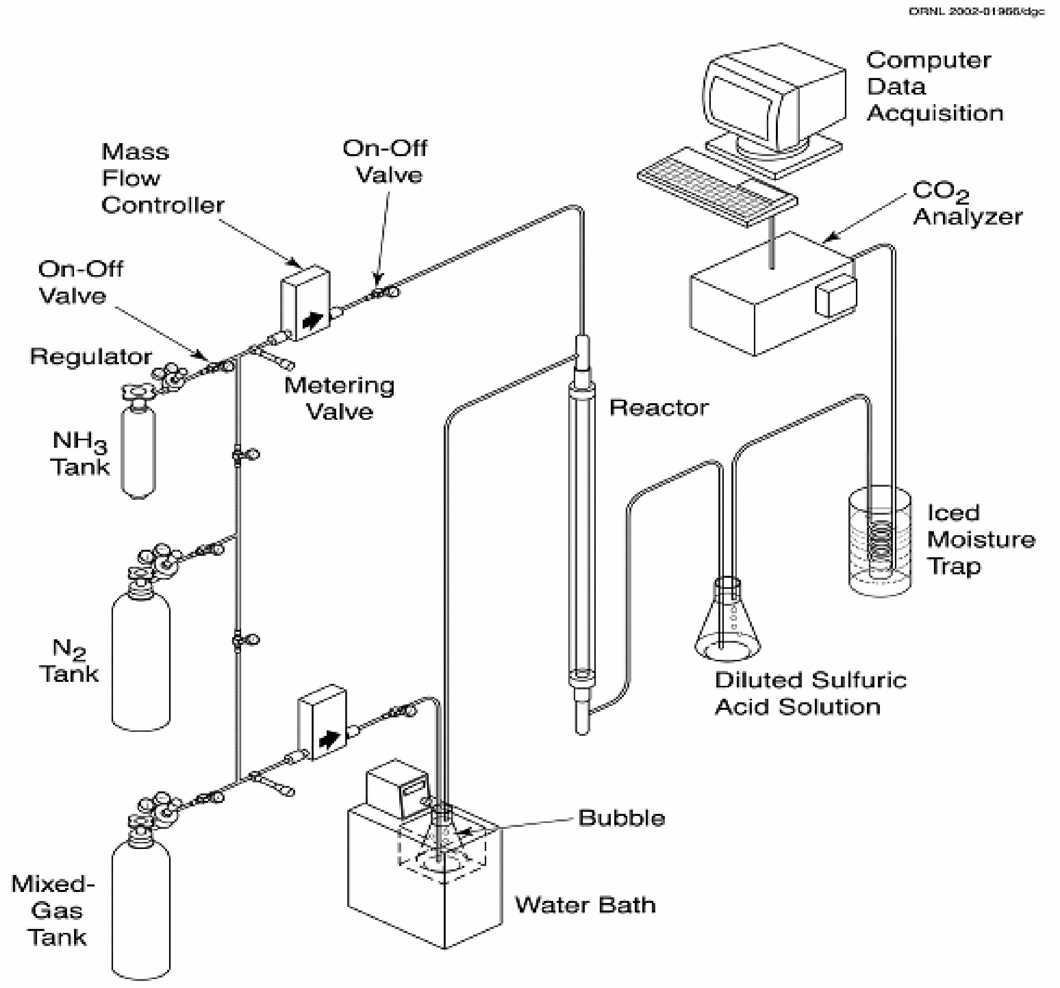
- Chars were produced at 900, 600, 500, 450, and 400C.
- Crushed and sieved to #30 mesh, wt 20g.
- Soaked 5 min. in 48% NH_4NO_3 solution.
- Each rinse = 100 ml water 8.0 pH



Most stabilized after a few rinses

But at chars produced 400 C very gradually released its ammonia

Bench Scale NH_3-CO_2-Char Experiment



CO2 +
H20*NH3
Solidifies
into
Am-Bi-Carb

Chemical Pathways for Simultaneous Removal of Major CO_2 and ppm Levels of NO_x and SO_x Emissions by Innovative Application of the Fertilizer Production Reactions

CH_4 o

CO

$_2CO$↓

Typical Composition of the Resulting Nitrogen Compounds

97.5% Ammonium Bicarbonate
2% Ammonium Sulfate
0.5% Ammonium Nitrate

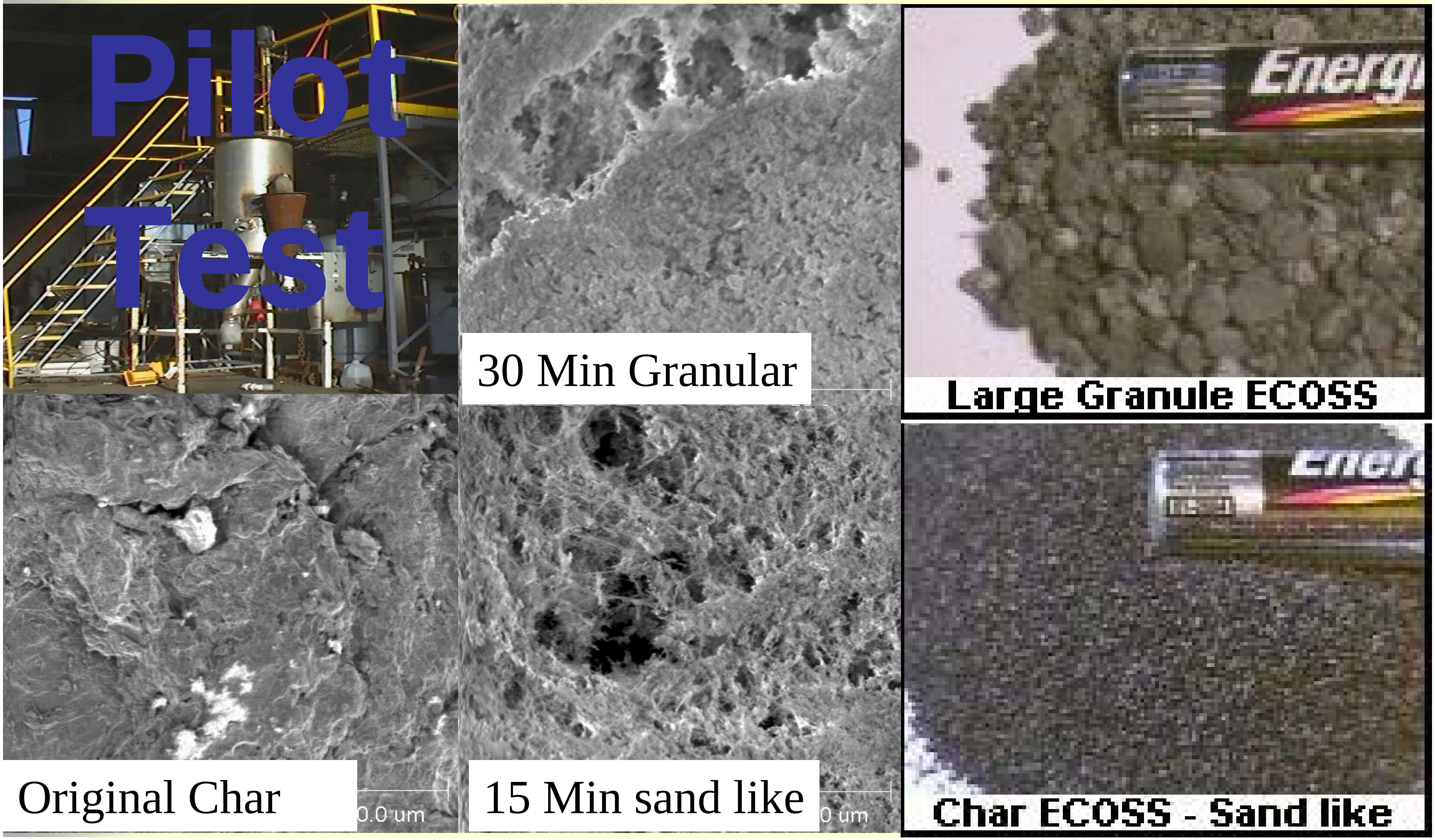
NO_x + S

$H_4)_2SO_4$↓

tory

US Patent 6,447,437

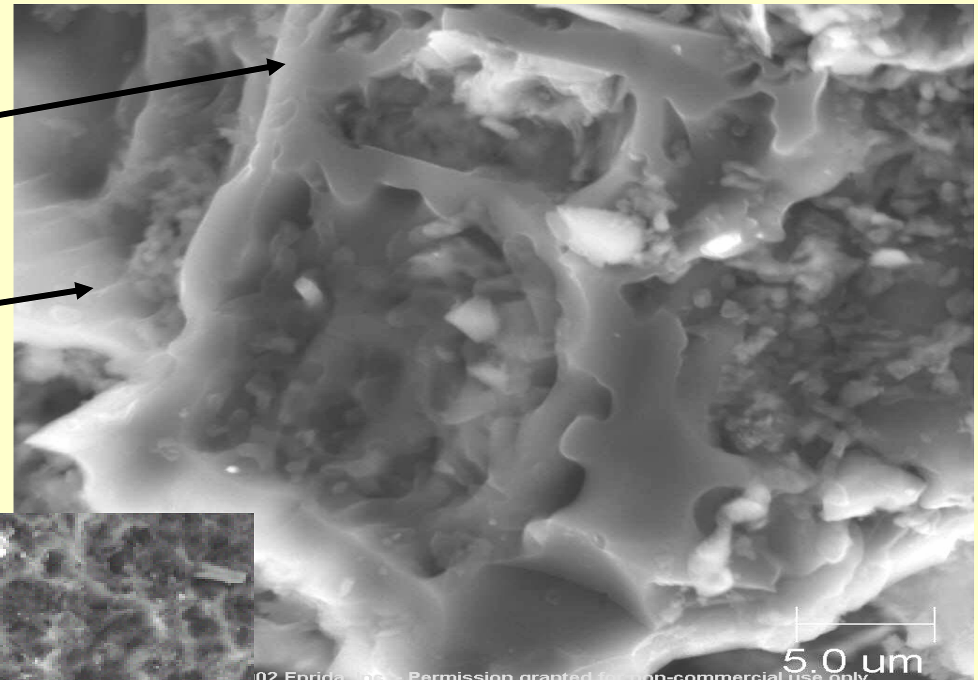
- Operated at ambient pressure and temperature
- CO_2 separation is not required



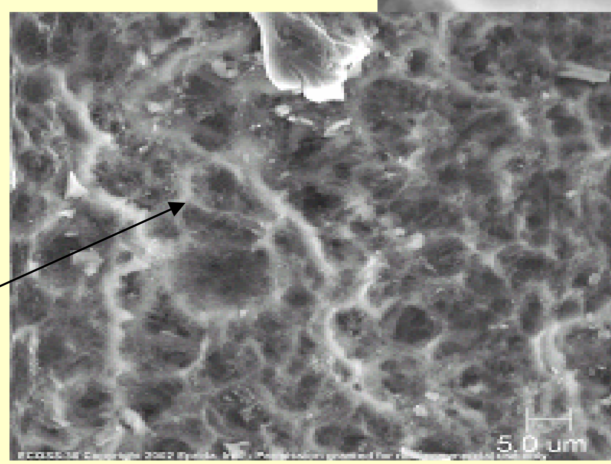
Crushed Interior 2000x SEM

The residual cell structure of the original biomass is clearly visible

The ABC fibrous buildup has started inside the carbon structure



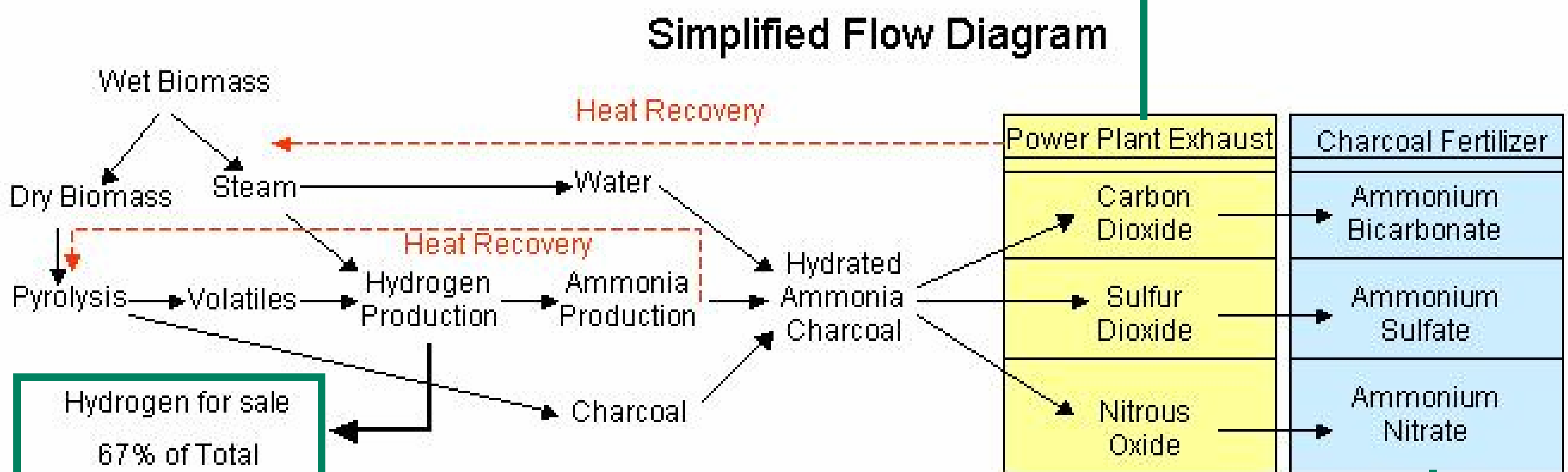
After complete processing, interior is full



Trace minerals are returned to the soil along with essential nitrogen.

A Simple System

Exhaust Scrubbing



2.7x H2 per CO

This can be used to produce a carbon negative Fischer-Tropsch Diesel

Fertilizer

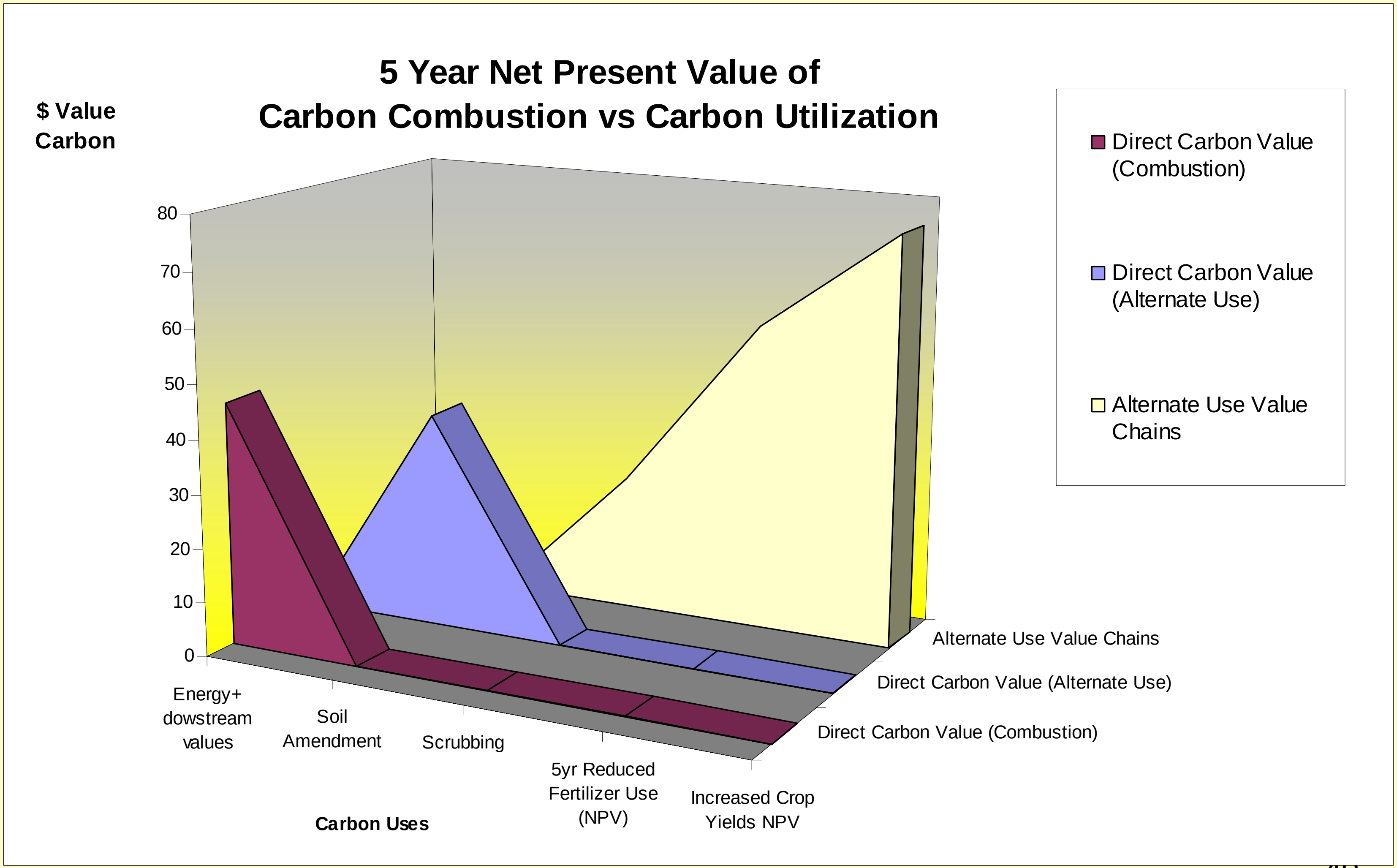
Profit Centers

But what is the tradeoff?

What are we giving up?

Carbon Combustion vs Carbon Use

Longer Term Valuation Analysis – 5 Year



Ok, it may be better to invest carbon in our soils.....

But what is the value of the volatile gas and bio-oil released?

What is the profit potential and competitive landscape?

Products you buy from petroleum/nat. gas companies

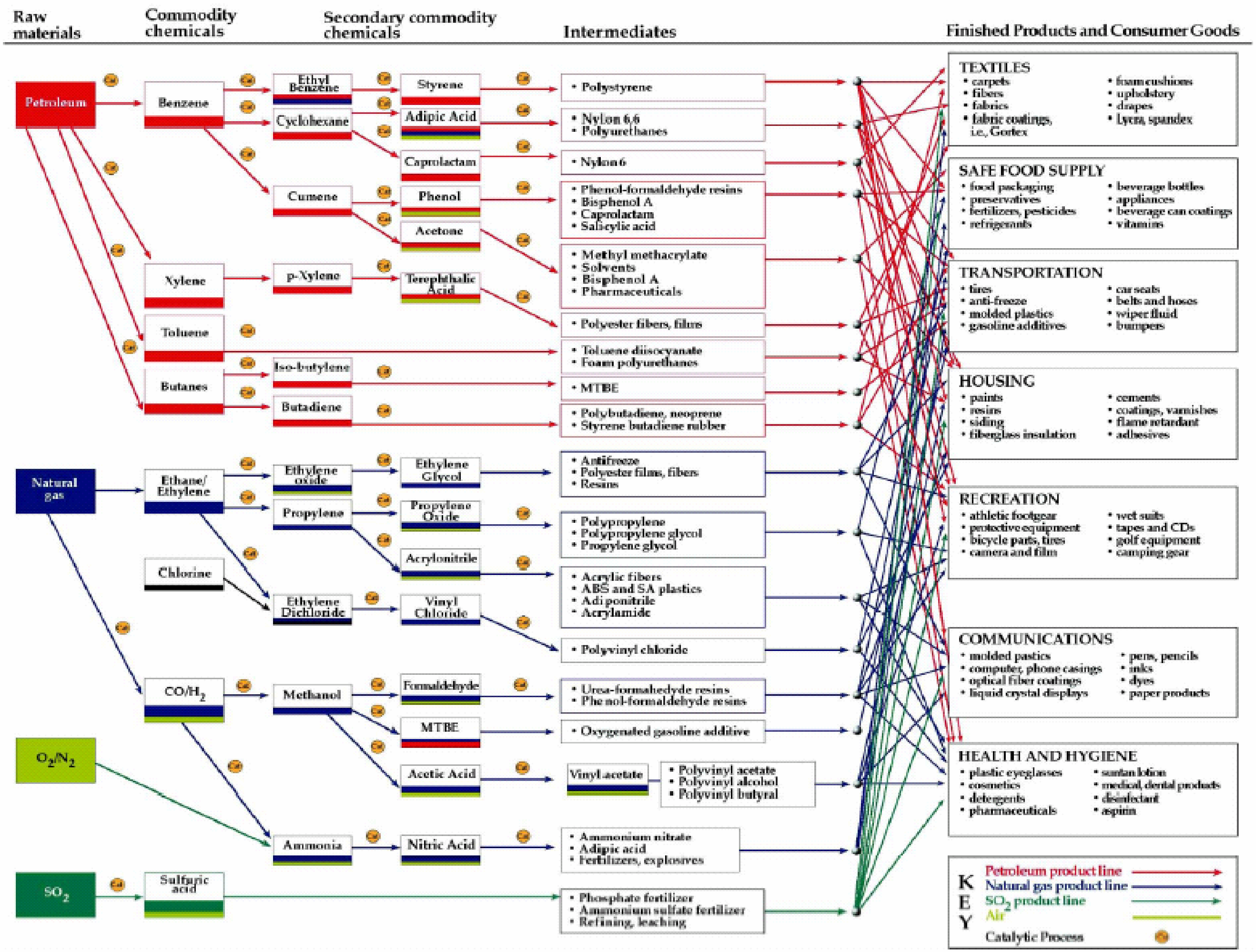


Figure 2 – An Example of a Flow-Chart for Products from Petroleum-based Feedstocks

Natures sustainable products you grow

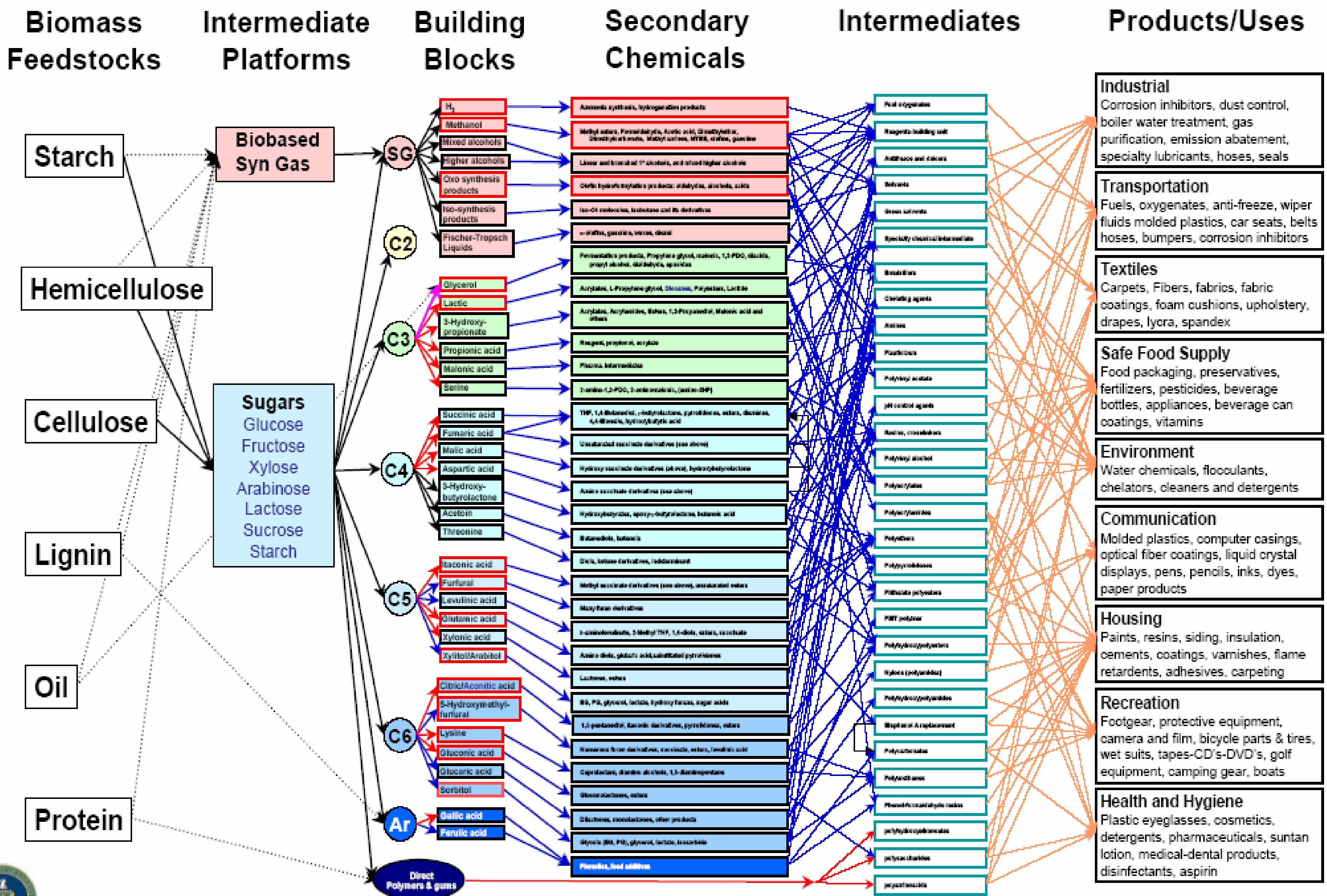
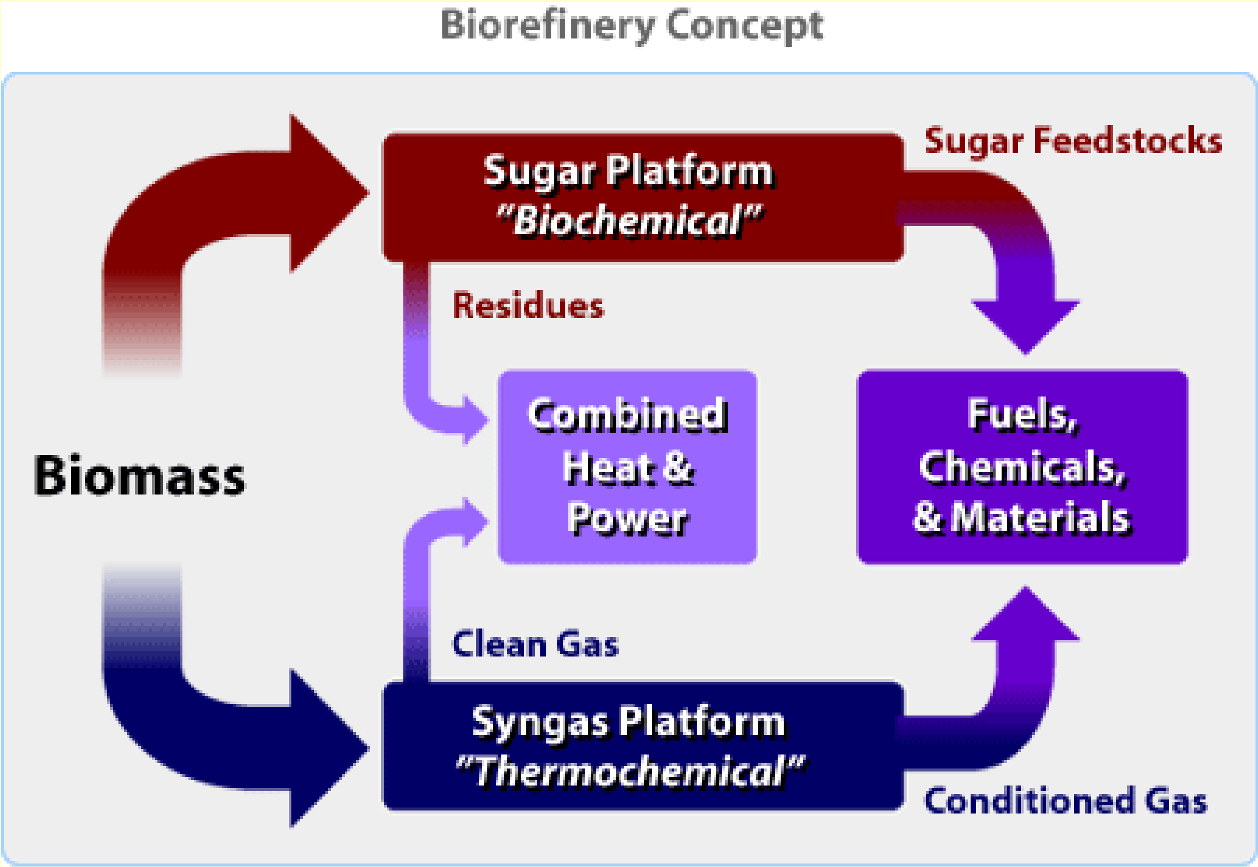


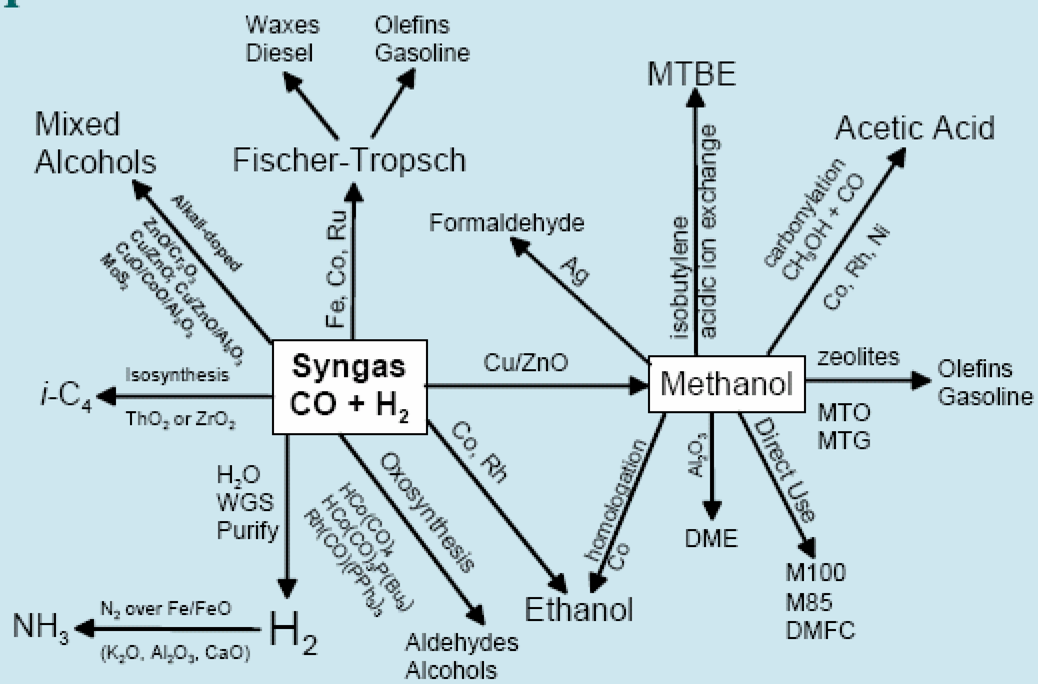
Figure 3 – Analogous Model of a Biobased Product Flow-chart for Biomass Feedstocks

Biomass / Biorefinery Options



Potential Syngas Products

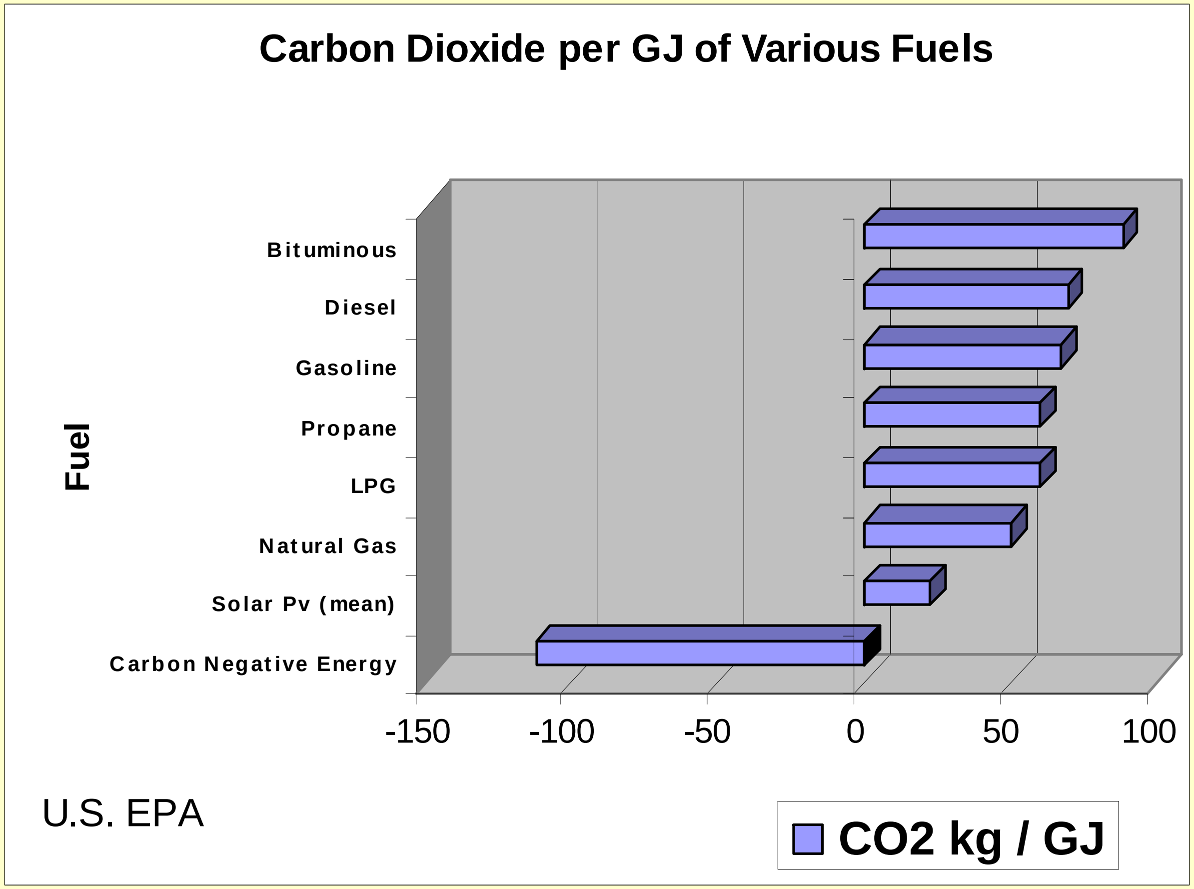
- Hydrogen
- Methanol and MeOH derivatives (NH3, DME, MTBE formaldehyde, acetic acid, MTG, MOGD, TIGAS)
- Fischer Tropsch Liquids
- Ethanol
- Mixed alcohols
- Olefins
- Oxosynthesis
- Isosynthesis
- **Ammonia**



Can your biomass streams be as competitive fossil fuels?
Yes, with all things being equal.

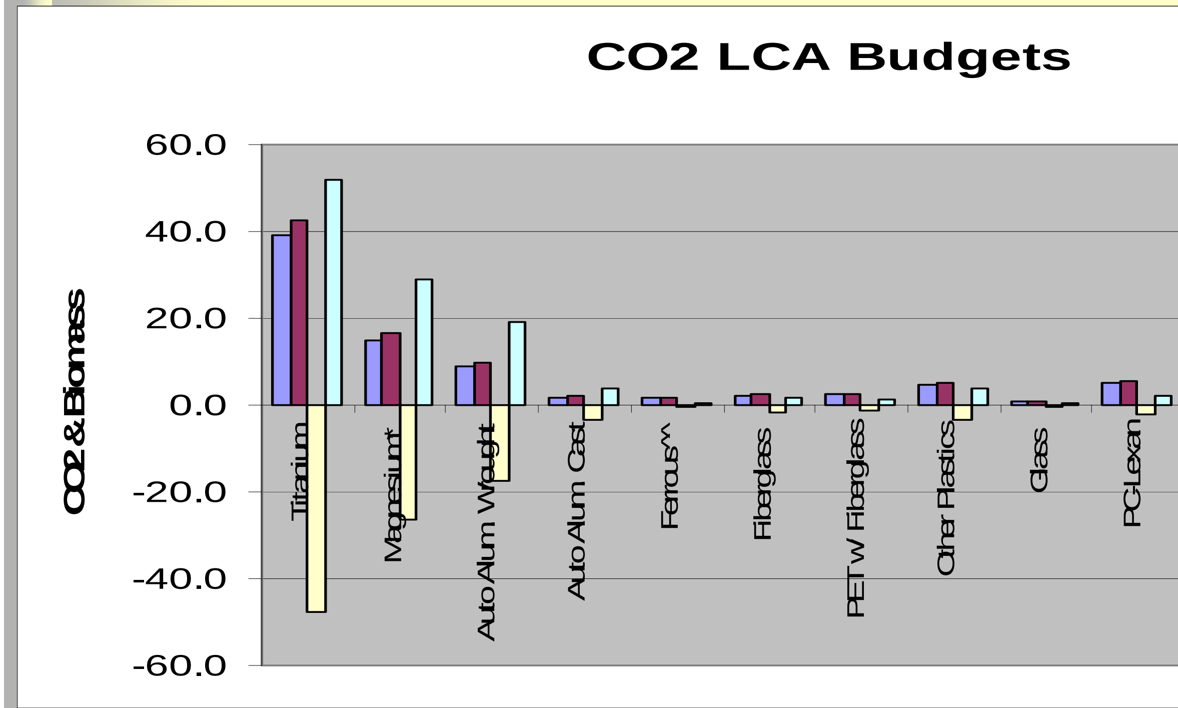
- Biomass becomes more competitive as as fuel prices rise
- Profits are made on co-products not just gasoline.
- Equal percent of your tax dollars in every gallon and pound of co-products.
- Proportionate funding of research and commercial support
- Homogenous standards and testing

Agricultural use offers Carbon Negative Energy



Special thanks to Stefan Czernick and Mathew Realff

The Opportunity



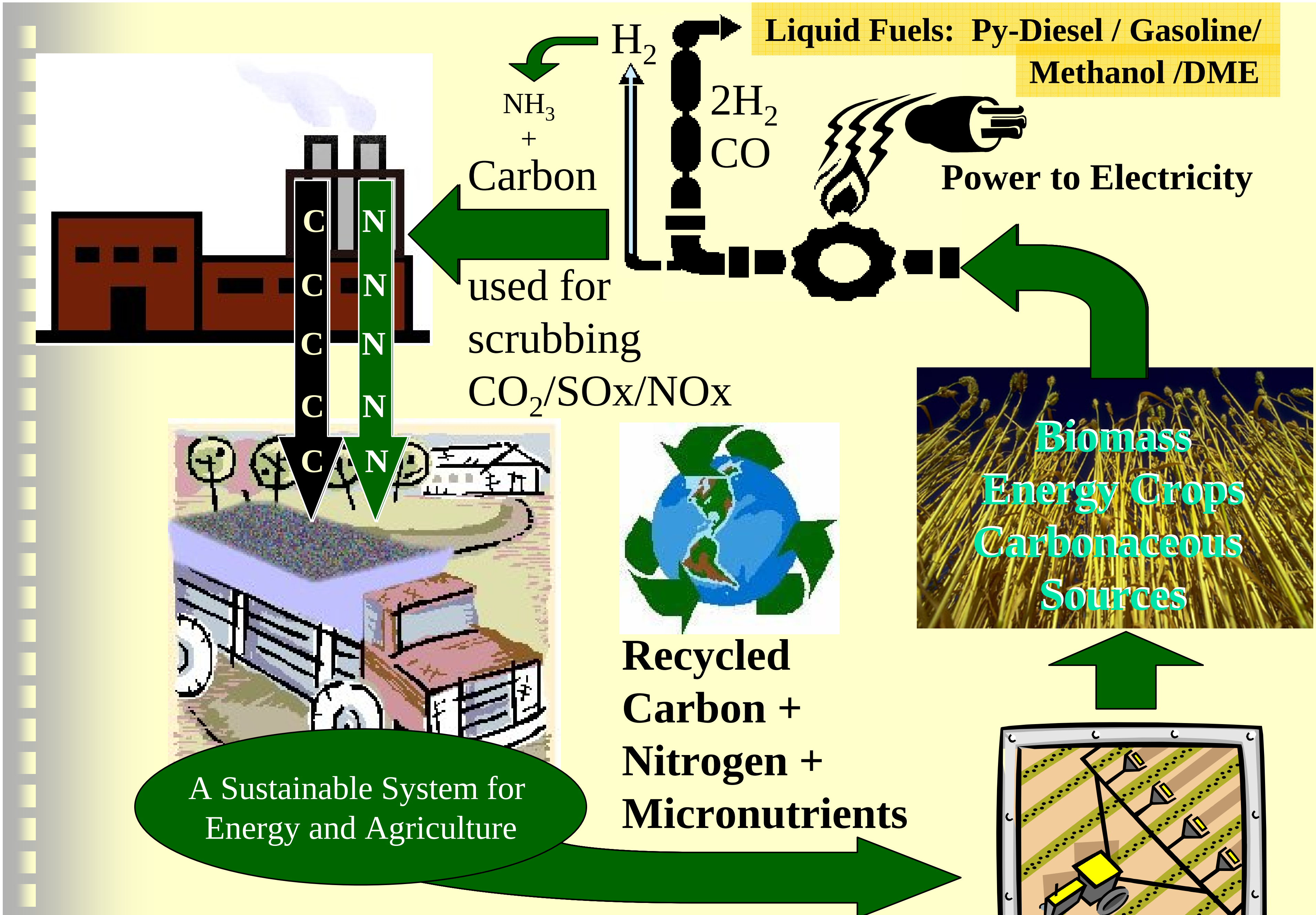
Materials that represent sequestered atmospheric carbon

Imagine.....

- If farmer can increase yields by up to 50%,
- And grow the raw materials for our fuel and fertilizers,
- And help power plants reduce their emissions,
- And help reduce the impacts of global warming,
- And help restore our top soils for future generations,
- And create new markets from people with disposable income,

- AND will change our appreciation for the essential function of producing food, fuel and petroleum replacement co-products.

- The irony is that those in rural poverty and most at risk from global warming are the ones we need to become the new sustainable affluent .....


H2
NH3
+
Carbon
used for
scrubbing
CO2/SOx/NOx
2H2
CO
Liquid Fuels: Py-Diesel / Gasoline/
Methanol /DME
Power to Electricity
C
C
C
C
C
N
N
N
N
N
Biomass
Energy Crops
Carbonaceous
Sources
Recycled
Carbon +
Nitrogen +
Micronutrients
A Sustainable System for
Energy and Agriculture

Thank You

Eprida

E*arth*
P*eople*
R*esearch*
I*nnovation*
D*evelopment*
A*cknowledgment*

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