

Biochar Properties & Production Techniques



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Environment Agency Biochar Workshop
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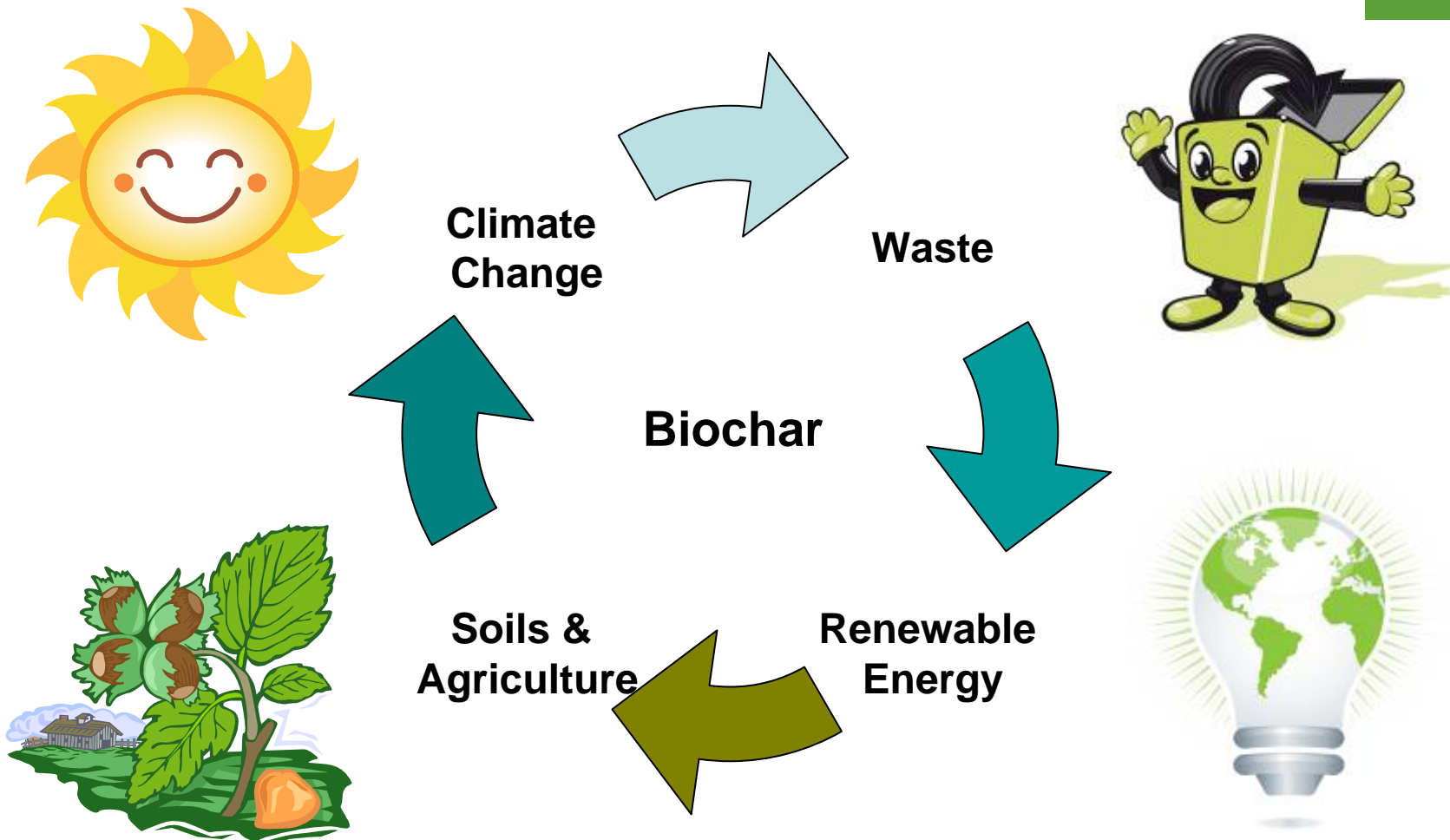
Presentation Outline

- Introduction & Overview
- Biochar Production Techniques
- Biochar Properties & Uses
- UEA Case Study
- Summary of Findings

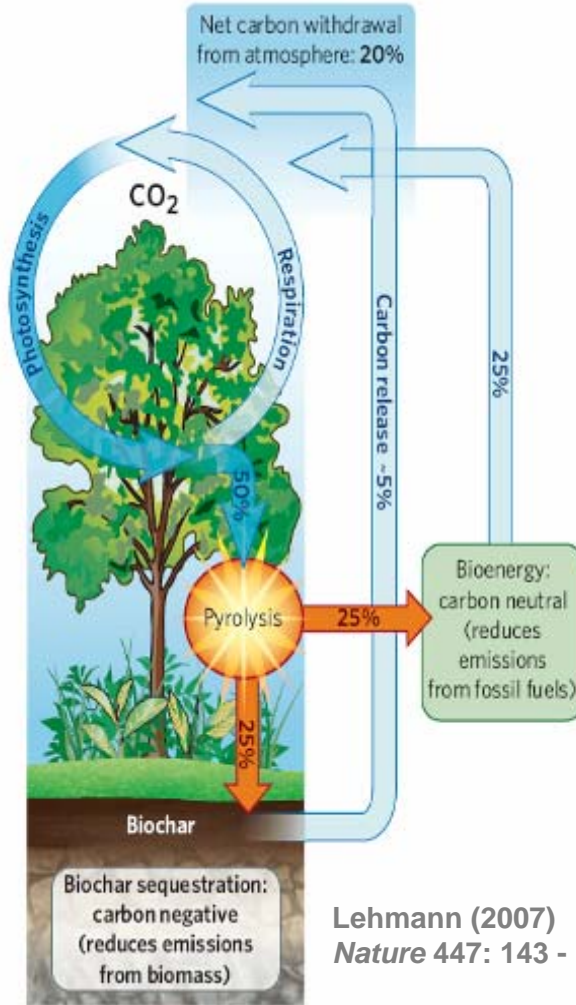
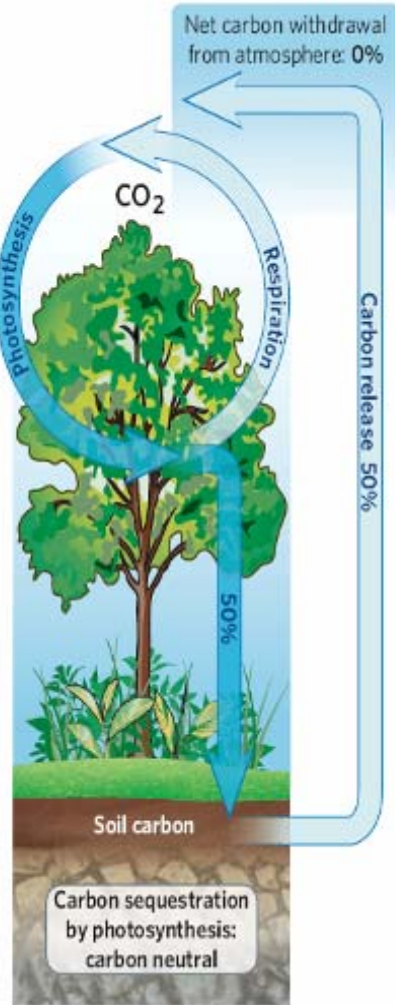


UEA's Biomass Gasification
CHP Plant

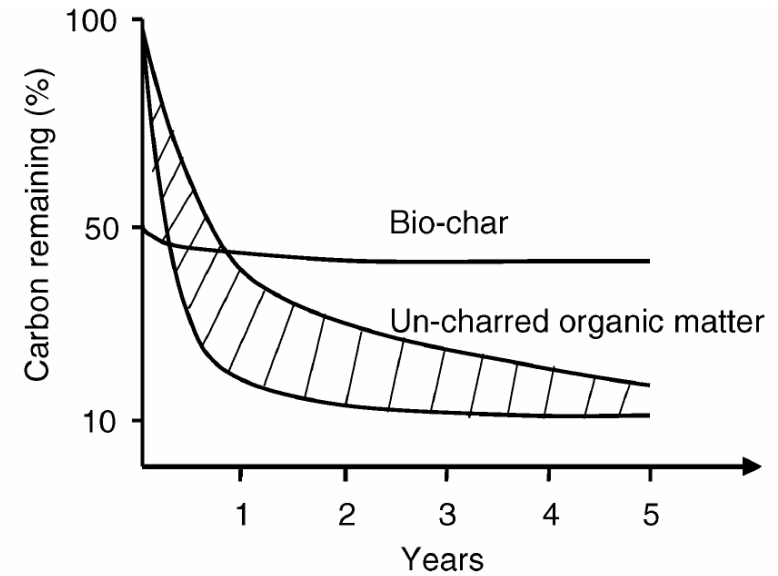
What is Biochar & Why is it Important?



Biochar Carbon Cycle

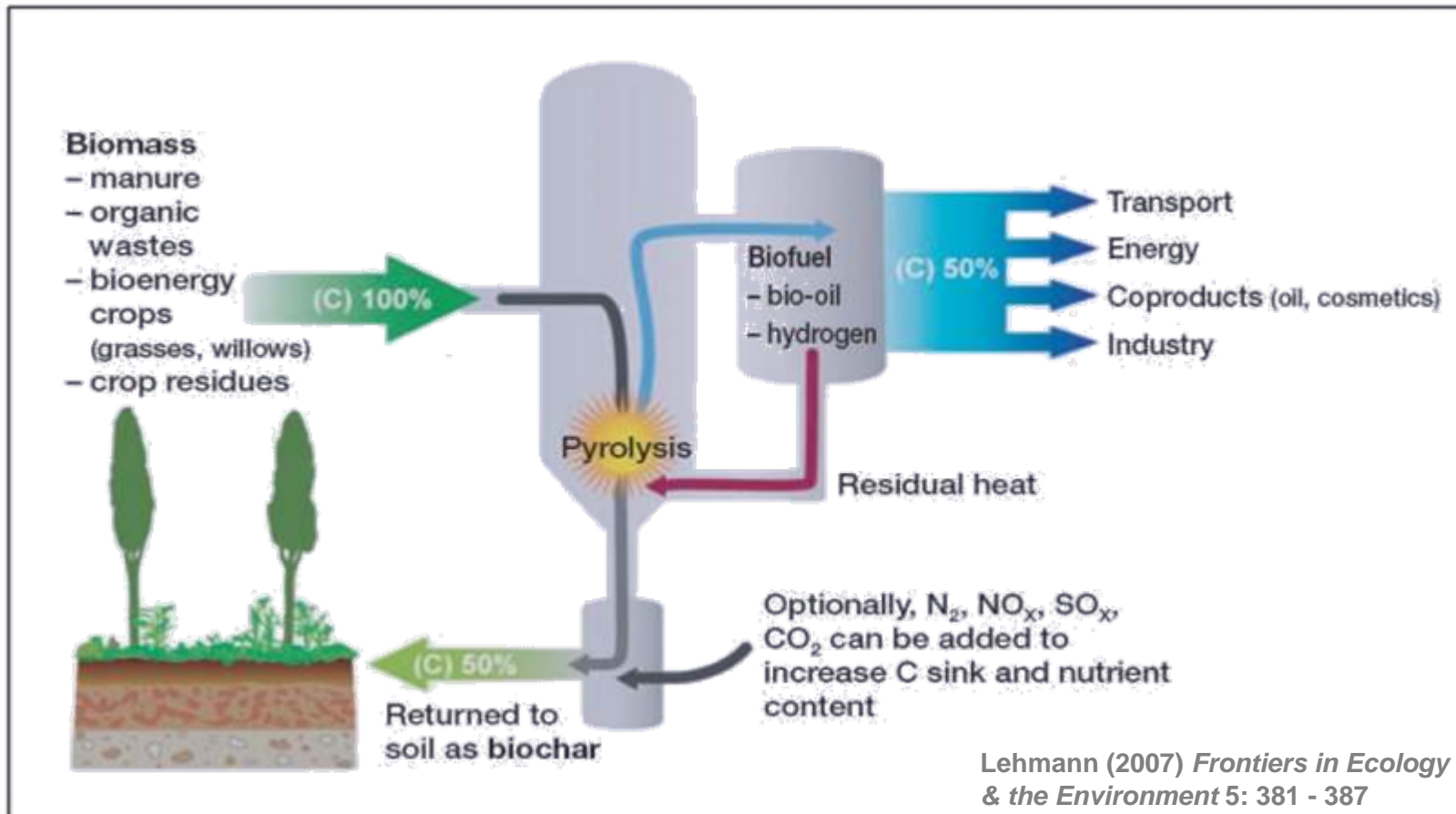


Lehmann (2007)
Nature 447: 143 - 144



Lehmann et al (2006)
*Mitigation & Adaptation Strategies
for Global Change* 11: 403 - 427

Thermal Conversion of Biomass



Thermal Conversion of Biomass

Overall an **endothermic** process:

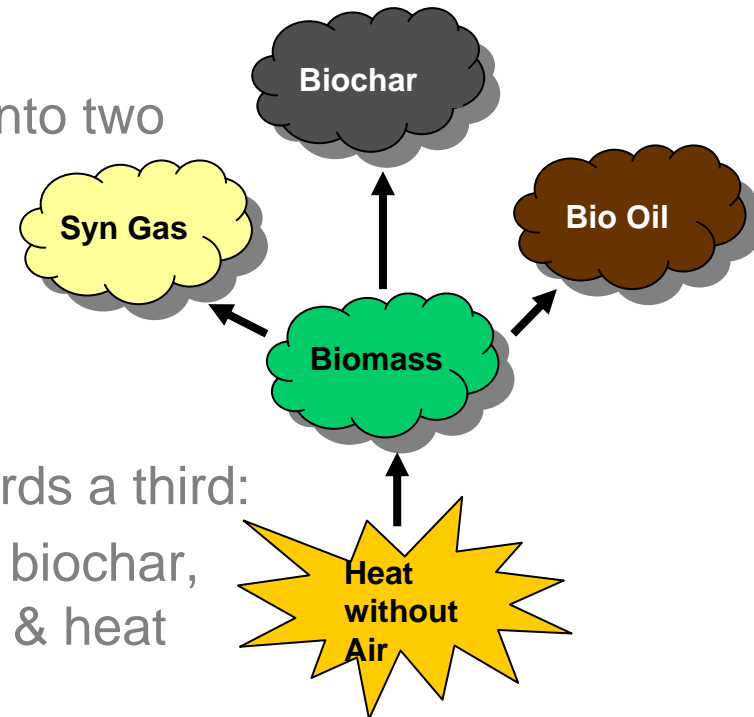
- Energy is required to initiate the process

At present the technologies can be split into two distinct categories:

- Charcoal production
- Bio oil or syn gas production

However, there is potential to move towards a third:

- “**Tri-generation**” that makes use of the biochar, energy-rich co-products (bio oil, syn gas) & heat



Biochar Production Techniques



CHP Gasification



Slow Pyrolysis (retort)



Slow pyrolysis (kiln)

	Temp & Duration	Solid (Biochar)	Liquid (Bio oil)	Gas (Syn Gas)
Slow Pyrolysis	~500°C Days	35%	30%	35%
Fast Pyrolysis	~500°C Seconds	12%	75%	13%
Gasification	>800°C Hours	10%	5%	85%



Fast Pyrolysis

Biochar Production

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**Dynomotive:
Bio oil via
Fast Pyrolysis**



Eprida: Hydrogen & Char Fertiliser via Pyrolysis



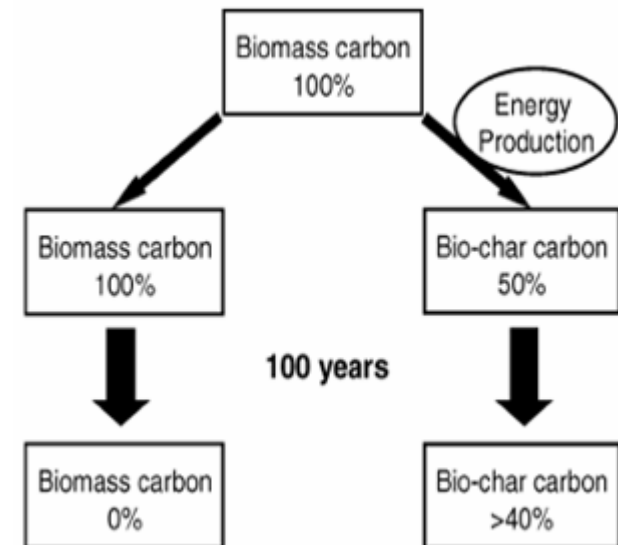
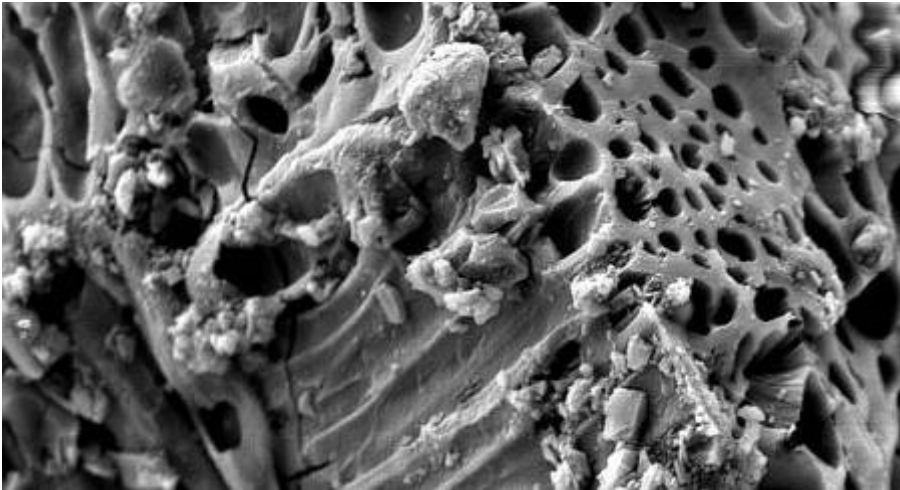
**University of Hawaii:
Flash Carboniser (Fast Pyrolysis)**



BEST Energies: Biochar via Slow Pyrolysis

Biochar Properties

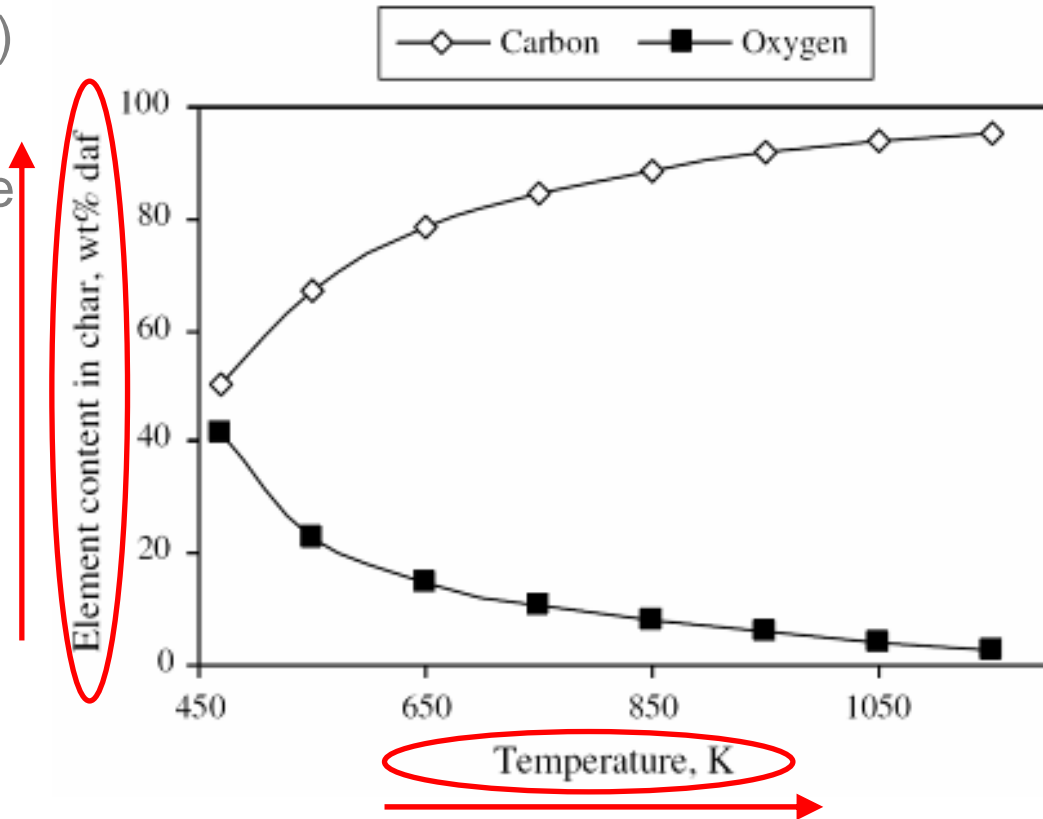
- High carbon content (60 – 95% C)
- Resistant to biodegradation
- Significant adsorptive qualities (similar to activated carbon)
- Nutrients (& contaminants) essentially lock on to the structure
- Increases moisture holding capacity
- Enhances microbial biomass



Biochar Properties: Process Conditions

Enhanced biochar yields from:

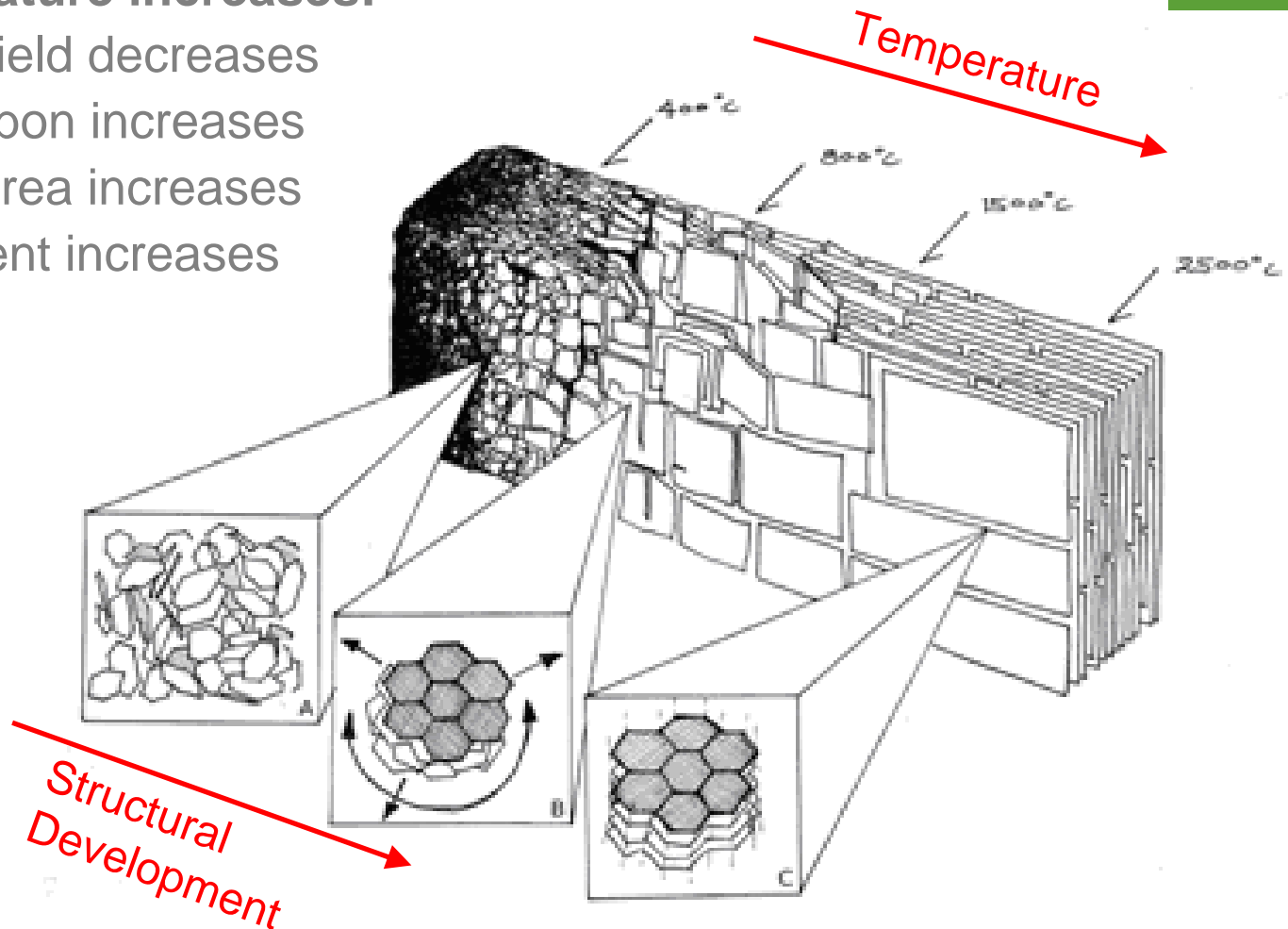
- Lower temperatures (<400°C)
- Higher pressures
- Longer vapour residence time
- Slower heating rate
- Larger particle size



Biochar Properties: Process Conditions

As temperature increases:

- Biochar yield decreases
- Fixed carbon increases
- Surface area increases
- Ash content increases



Biochar Properties: Feedstock Materials

The variable nature of the chemical constituents in the feedstock biomass influence the structure, properties & yield of biochar.



Woodchip



Roundwood



Rice Husks

Biochar Properties: Feedstock Materials



Manure



Poultry Litter



Hardwood



Biodegradable Waste



Softwood

UEA Case Study: Biomass Gasification CHP

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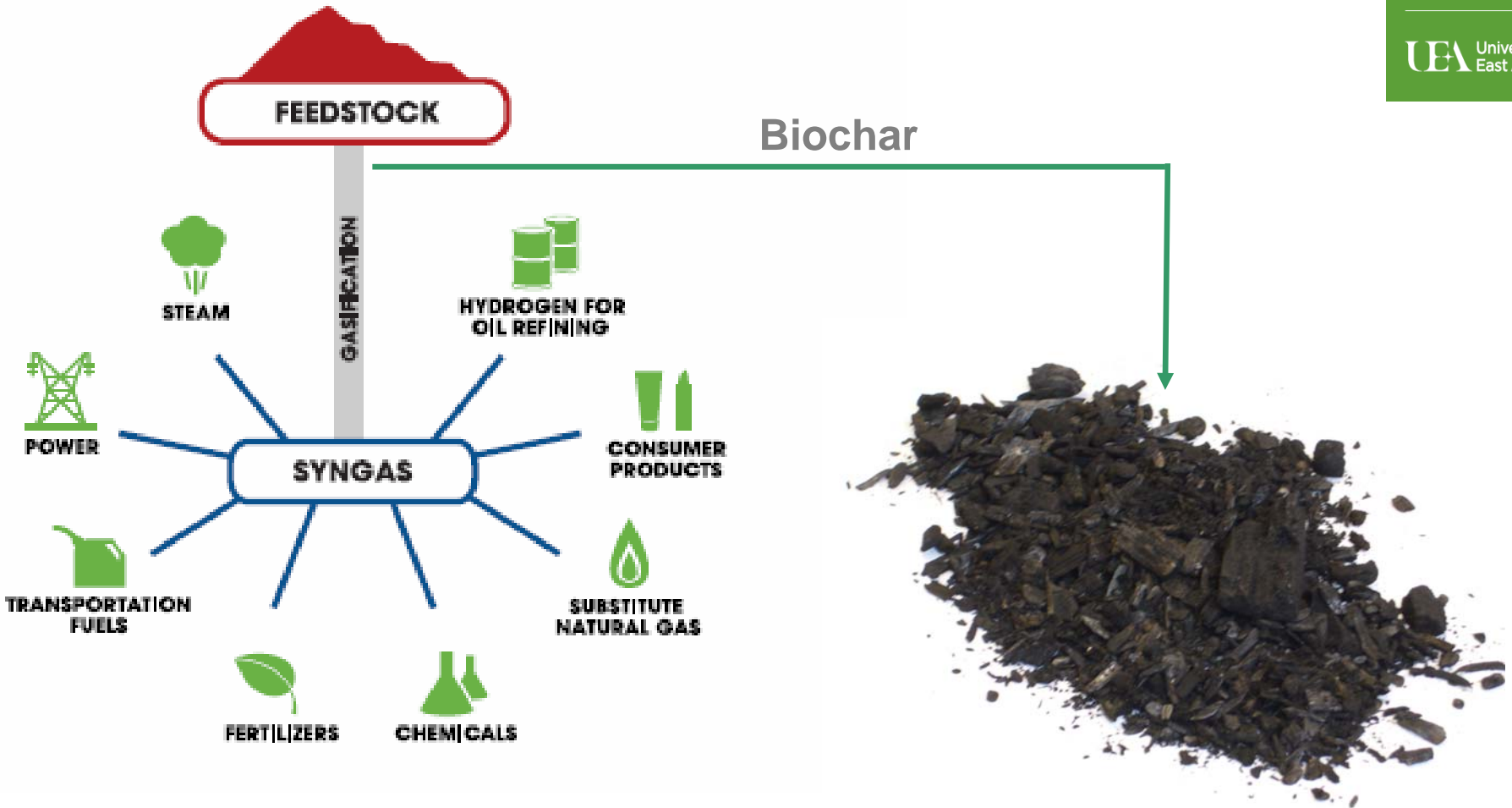
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UEA Case Study: Biomass Gasification CHP



Gasification Outputs



UEA Case Study

1.4 MWe
2.0 MWth
6,719 t CO₂ yr⁻¹
(34%↓)

3% Biochar Yield
300 t char yr⁻¹
195 t C yr⁻¹
716 t CO₂ yr⁻¹
(4% ↓)

...& this
particular
system
is optimised
for bioenergy
production!



Summary of Findings

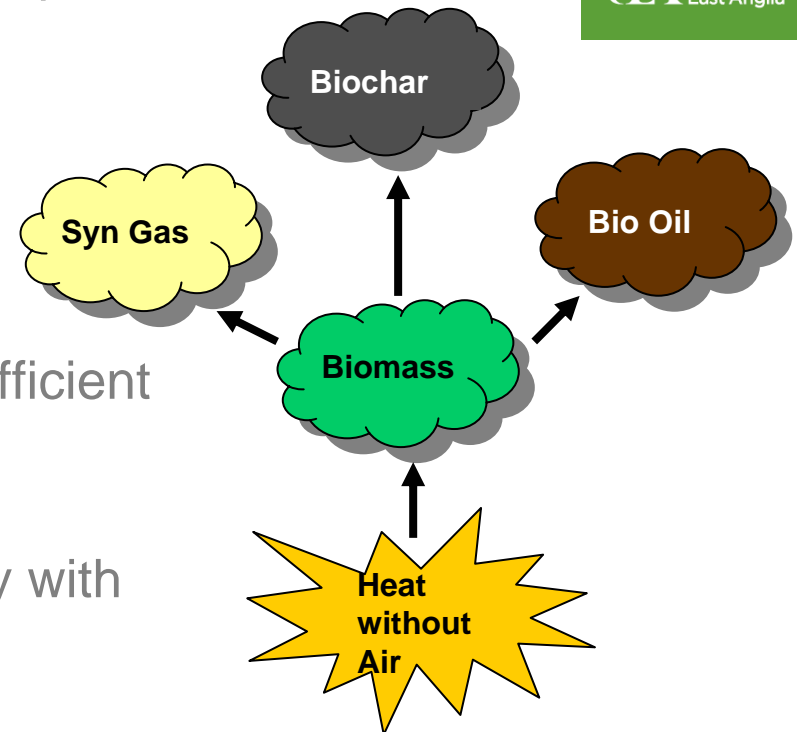
Biochar is produced by the thermal decomposition of biomass using:

- Slow Pyrolysis
- Fast Pyrolysis
- Gasification

Technology must be “closed-loop” with efficient product recovery

Biochar yield & quality varies significantly with feedstock type & process conditions

Biomass gasification CHP is currently viable & will produce modest quantities in the near-term





So, the future is in our
hands...

Thank you!

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