



PACIFIC
PYROLYSIS

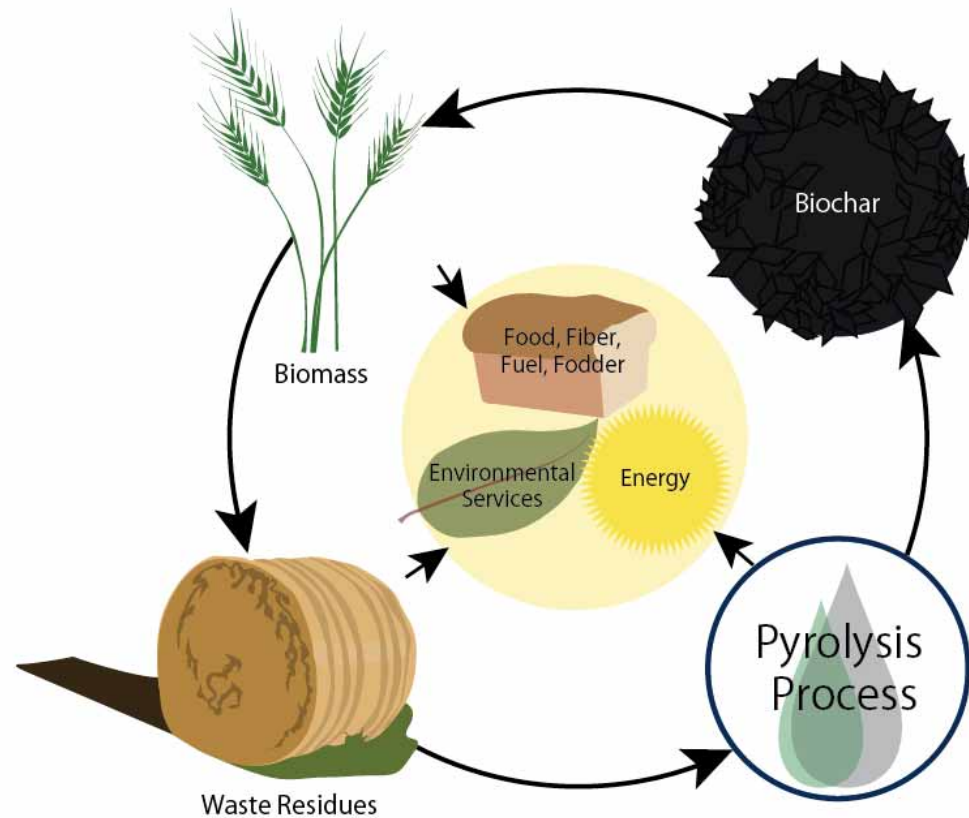
Biochar and Bioenergy: Carbon Negative Energy

Adriana Downie

All-Energy 2009



Working with the carbon cycle.

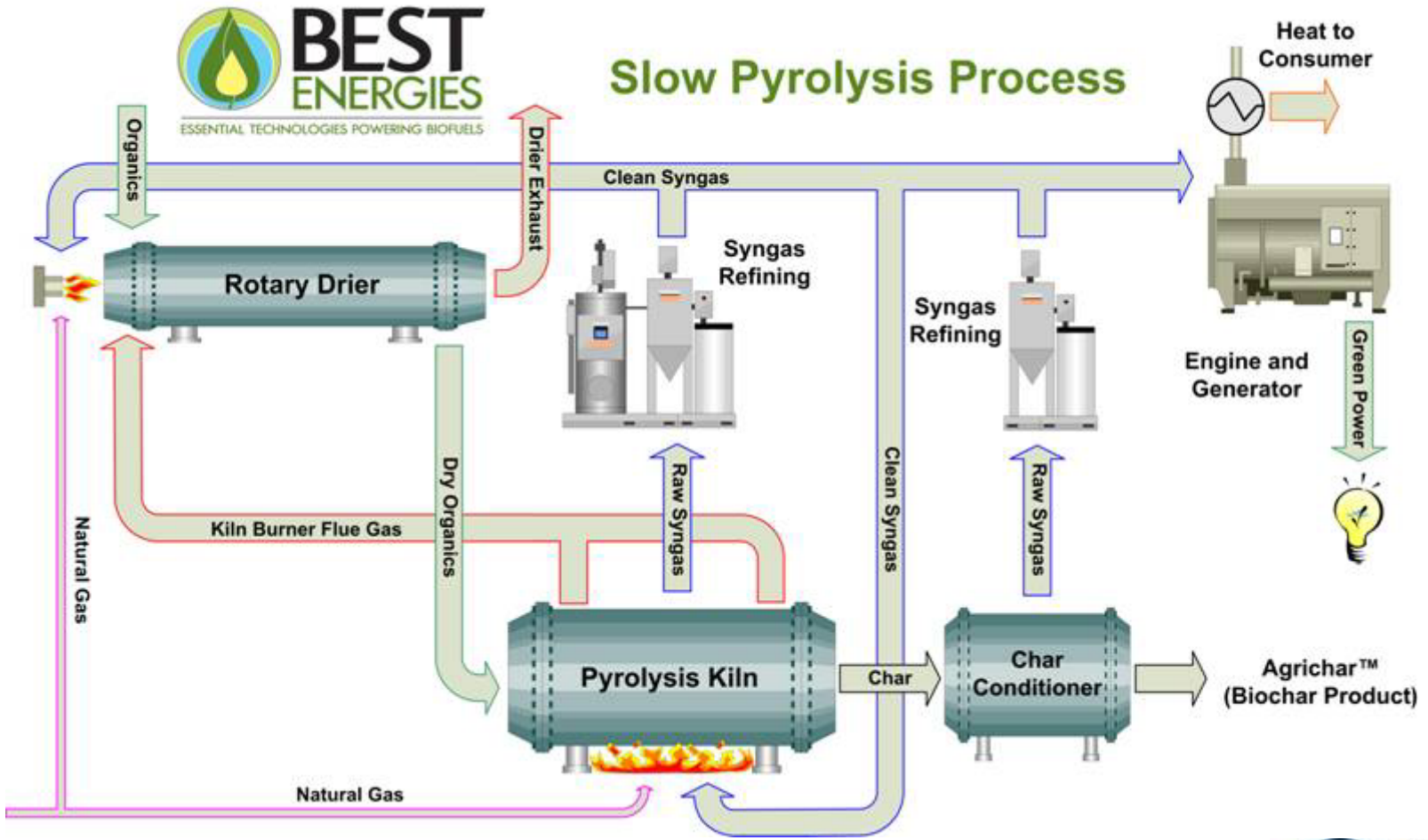




Future Technology Environment

- Energy Security – Peak Oil, Price, Political Stability
- Greenhouse Gas Emissions – Climate Change
- Air Quality – Urbanisation of Increasing Populations
- Land Use – Urban, agricultural and marginal.

Sustainability



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Slow Pyrolysis

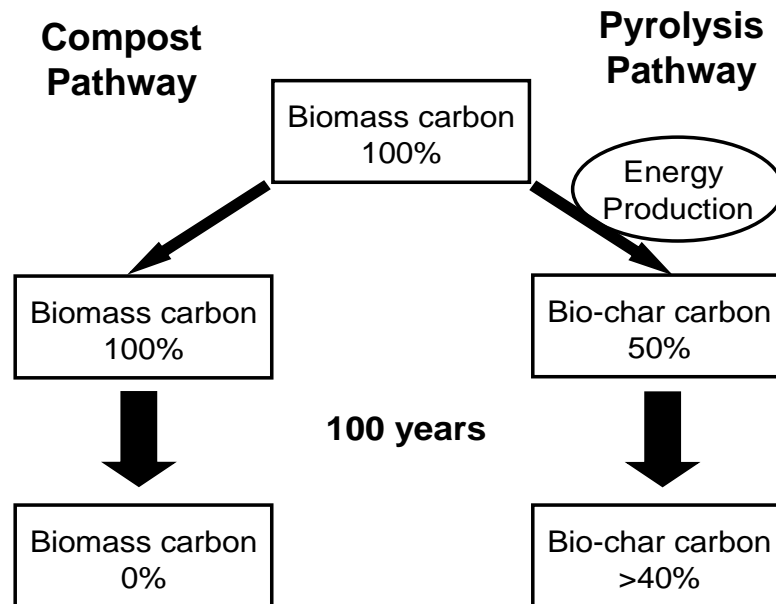


- Creates clean electrical and thermal energy
- Solves waste problems
- Reduces landfill & waste hauling
- Increases sustainability and productivity of agriculture
- Mitigates Greenhouse Gases
- Sequesters atmospheric carbon long-term





Locking up the Carbon

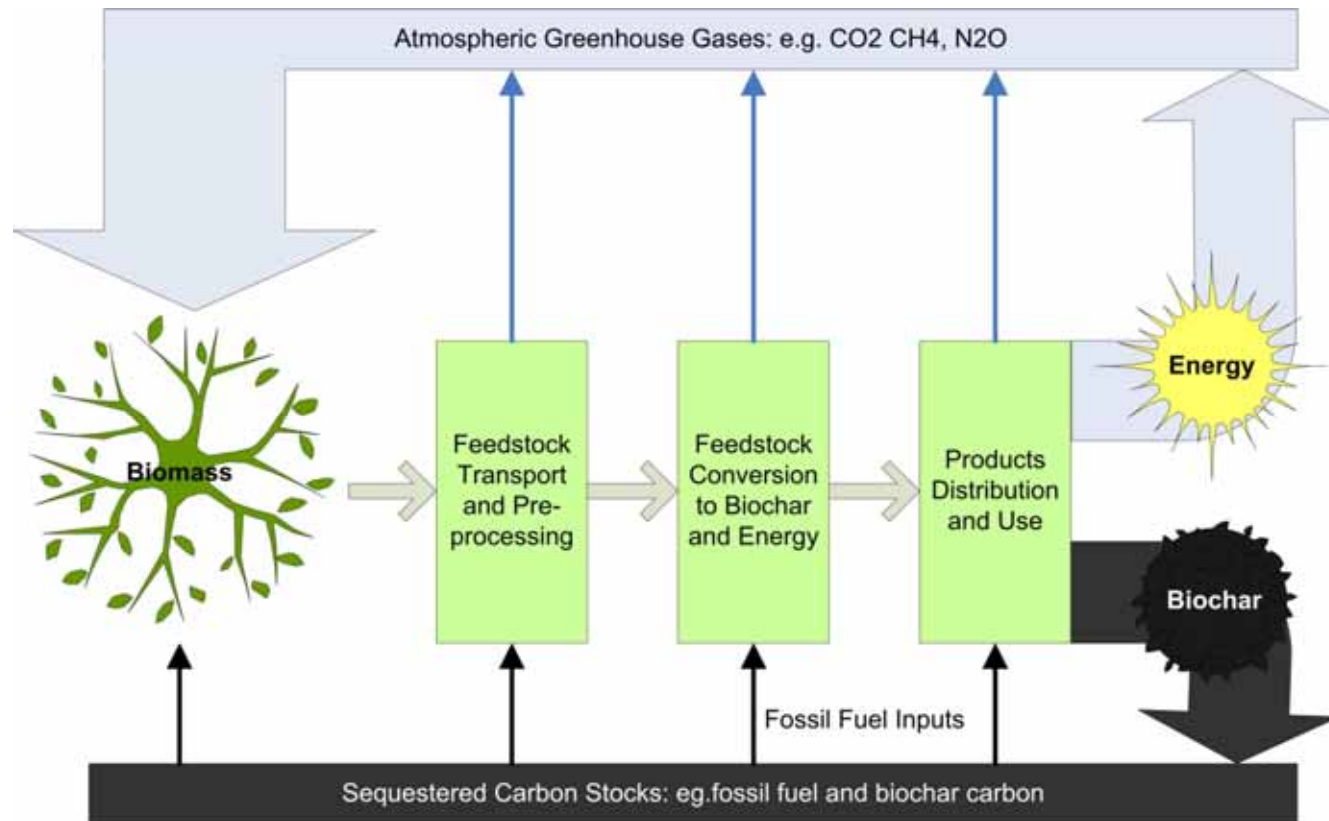


Lehmann et al., 2006, *Mitigation and Adaptation Strategies for Global Change*





Carbon Negative Greenhouse Balance





Traditional Charcoal Kilns

- Environmental,
- Health and safety,
- Quality control issues.



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Traditional Charcoal Kilns



Capacity : 5 m³



Okimori, Y. et al., 2004, Energy and Agricultural Carbon Utilization Symposium , Georgia

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Technology Development

Daisy ~ 10kg batch dry biomass

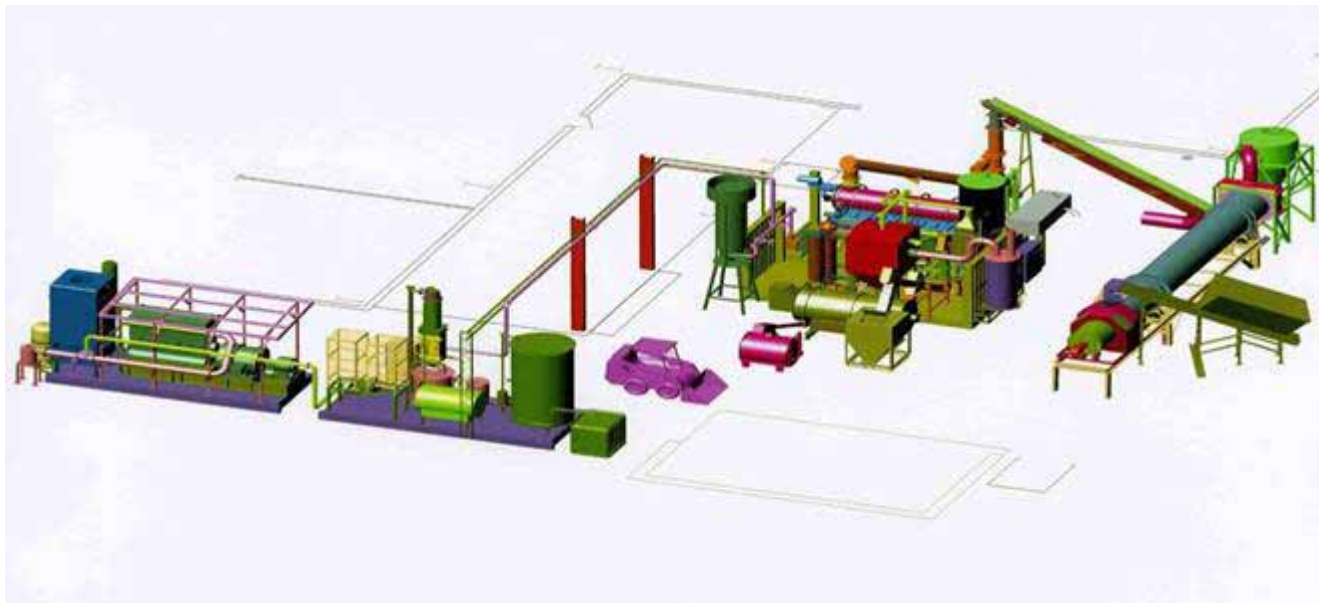


El Torro ~ 40kg/hr dry biomass





Continuous Pilot Plant



C4H4 ~ 300kg/hour continuous biomass (dry basis)

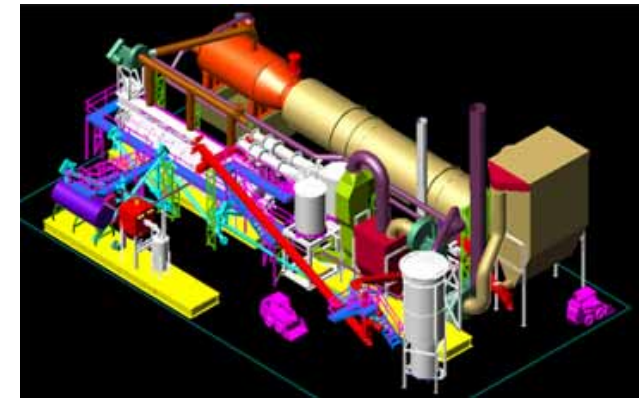
Acknowledgement; This pilot facility was partly funded by the NSW State Gov.

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Commercial Biochar Production



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Biomass Feedstocks

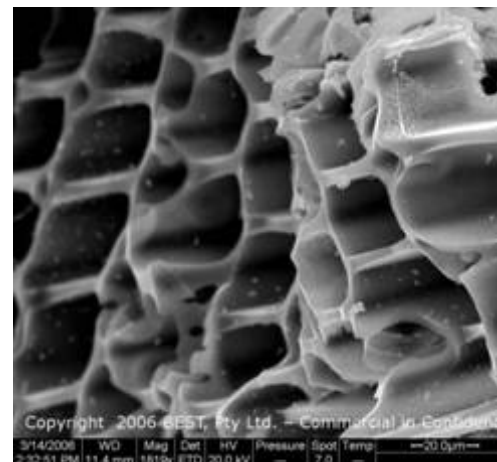
A diverse range of biomass feedstocks have been trialled

- Feedlot Manure
- Poultry Litter
- Paper Sludge
- Green Waste
- Corn Trash
- Sawmill Residue
- Straw
- Pig Manure
- Cotton Trash
- Nut Shells
- Woody weeds
- Giant Reed
- Wood Waste
- Rice Hulls
- Distillers Grain
- Switch Grass
- Bagasse
- Biosolids





Agrichar™ Soil Amendment



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BioChar as a Soil Amendment

Improvements To Soil Health

- Cation exchange capacity
- Water holding capacity
- Soil permeability
- Soil structure (tensile strength)
- Enhance soil carbon
- Liming value
- Available nutrient content (NPK)
- Nutrient retention – nitrous oxide, leaching



Biochars are not biochars!

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Agrichar™ Trials



Agronomic Trials have been undertaken in collaboration with the NSW DPI and funding support from the NSW DECC.



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Laboratory Trials

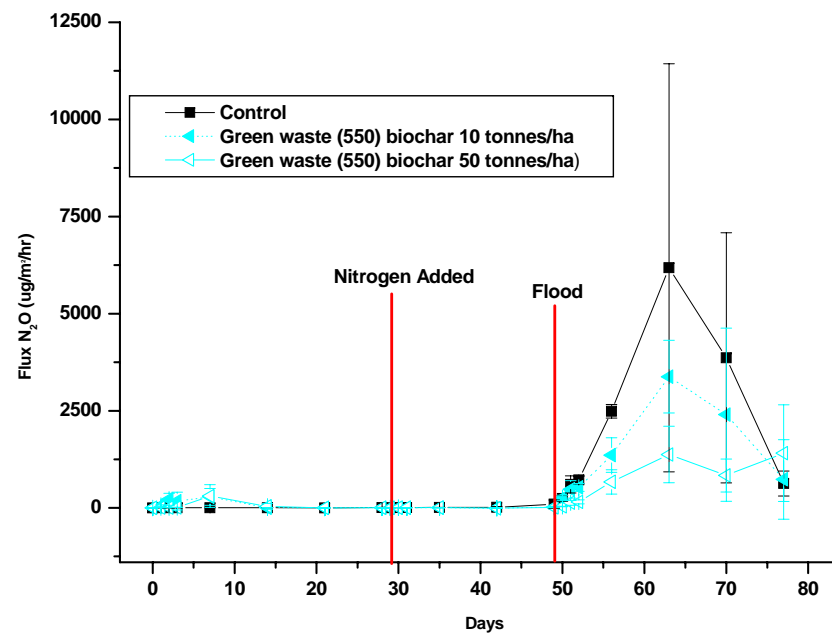
Incubations

Pot trials

Leaching Columns

Wet and Dry analytical methods

Detailed Characterisation





Setting Up



2 years on



Pasture Trial



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PRIMARY INDUSTRIES

Setup:

Factorial of 2 biochars, lime, and fertiliser

Biochars used: cow manure Agrichar™ and greenwaste Agrichar™

Analysis:

Soil chemistry, soil biology, plant tissue nutrition, soil greenhouse gas emissions, biomass yields

Key findings:

Carbon up by 0.5%

Increases CEC.

Increased yield response to N by 13%

N and P uptake increased by 23 and 36%

Opportunistic white clover in biochar treatments





Sugar Cane Trial



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15 Plots for commercial
harvesting

Biochars Used:
Papermill Agrichar™
Greenwaste Agrichar™



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Macadamia Nut Orchard



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45 trees amended in newly established orchard.

10t/ha - 40kg per tree.

Biochars used: Poultry litter Agrichar™ and
Greenwaste Agrichar™



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Food Crops



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Control corn (13t cob/ha)



Poultry litter biochar,
50t/Ha (35t cob/ha)

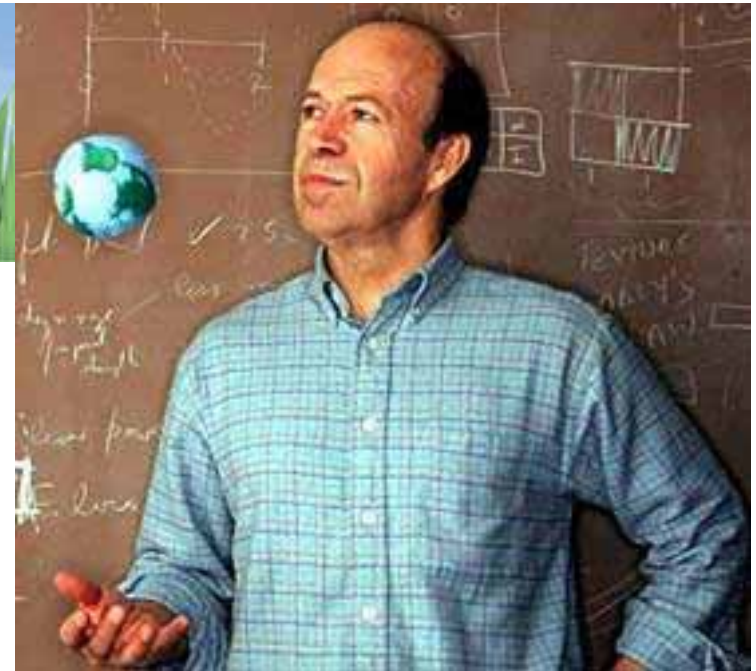
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Prof. James Hansen

Affiliation: Climatologist and Head of the NASA Goddard Institute for Space Studies, New York; Adjunct Professor in the Department of Earth and Environmental Sciences at Columbia University, New York



http://www.windustrious.org/uploads/media/james_hansen.jpg

“Biochar [...] can be used to restore soil fertility while storing carbon for centuries to millennia [...] [and] could provide a CO₂ drawdown of ~8 ppm or more in half a century.”

Hansen, J., Sato, M., Kharecha, P., Beerling, D., Berner, R., Masson-Delmotte, V., Pagani, M., Raymo, M., Royer, D. L., & Zachos, J. C. (2008). Target Atmospheric CO₂: Where Should Humanity Aim? arXiv.org Retrieved 29/07/2008 from <http://arxiv.org/ftp/arxiv/papers/0804/0804.1126.pdf>, p. 14.





Prof. Tim Flannery

Affiliation: Professor in Earth and Life Sciences at Macquarie University in Sydney, Australia; Australian Humanist of the Year 2005; Australian of the Year 2007; Chairman of the Copenhagen Climate Council



<http://www.moonbattery.com/tim-flannery.jpg>

“Biochar may represent the single most important initiative for humanity’s environmental future.”

Flannery, T. (2008). An Open Letter on Biochar from Professor Tim Flannery. Retrieved 02/02/2009 from <http://www.biochar-international.org/timflannery.html>

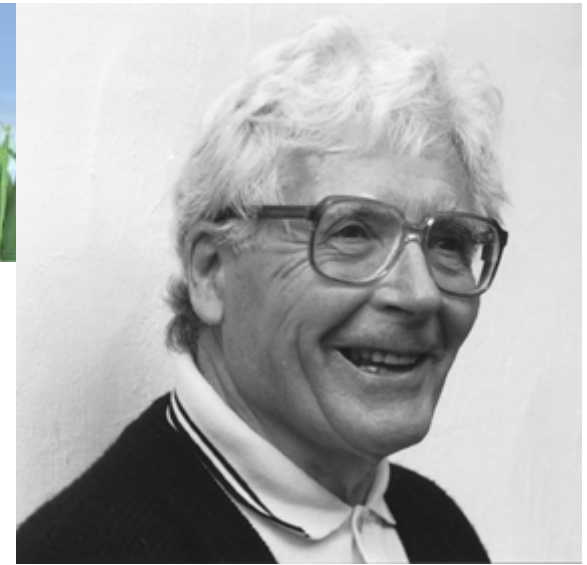
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Prof. James Lovelock

Affiliation: British chemist, inventor and environmentalist; originator of Gaia theory, inventor of the electron capture detector (which made possible the detection of CFCs and other atmospheric nano-pollutants) and of the microwave oven



http://www.ox.ac.uk/gazette/1996-7/weekly/060297/news/pic_6.gif

**“There is one way we could save ourselves
and that is through the massive burial of charcoal.”**

Vince, G. (2009). One last chance to save mankind. *NewScientist*(2692), 30-31.

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Prof. Timothy Lenton

Affiliation: Professor of Earth System Science and Tyndall Centre for Climate Change Research at University of East Anglia, Norwich, UK; Earth System Modelling Group



<http://www.tyndall.ac.uk/generate/staffprint/staff-view.php?id=112>

“Bio-char in soil offers the greatest potential for long-term carbon storage on land.”

Lenton, T. M., & Vaughan, N. E. (2008). The radiative forcing potential of different climate geoengineering options. *Atmos. Chem. Phys. Discuss.*, 9(1), 2559-2608; p.2591.



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www.bestenergies.com.au

www.anzbiochar.org



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