

Albert Bates

Global Village Institute

*for appropriate
technology*



Getting to 260

Biochar's Misunderstood Potential

20 -23 August 2018



ecosystem restoration
camps



eCO₂
Capt.Design

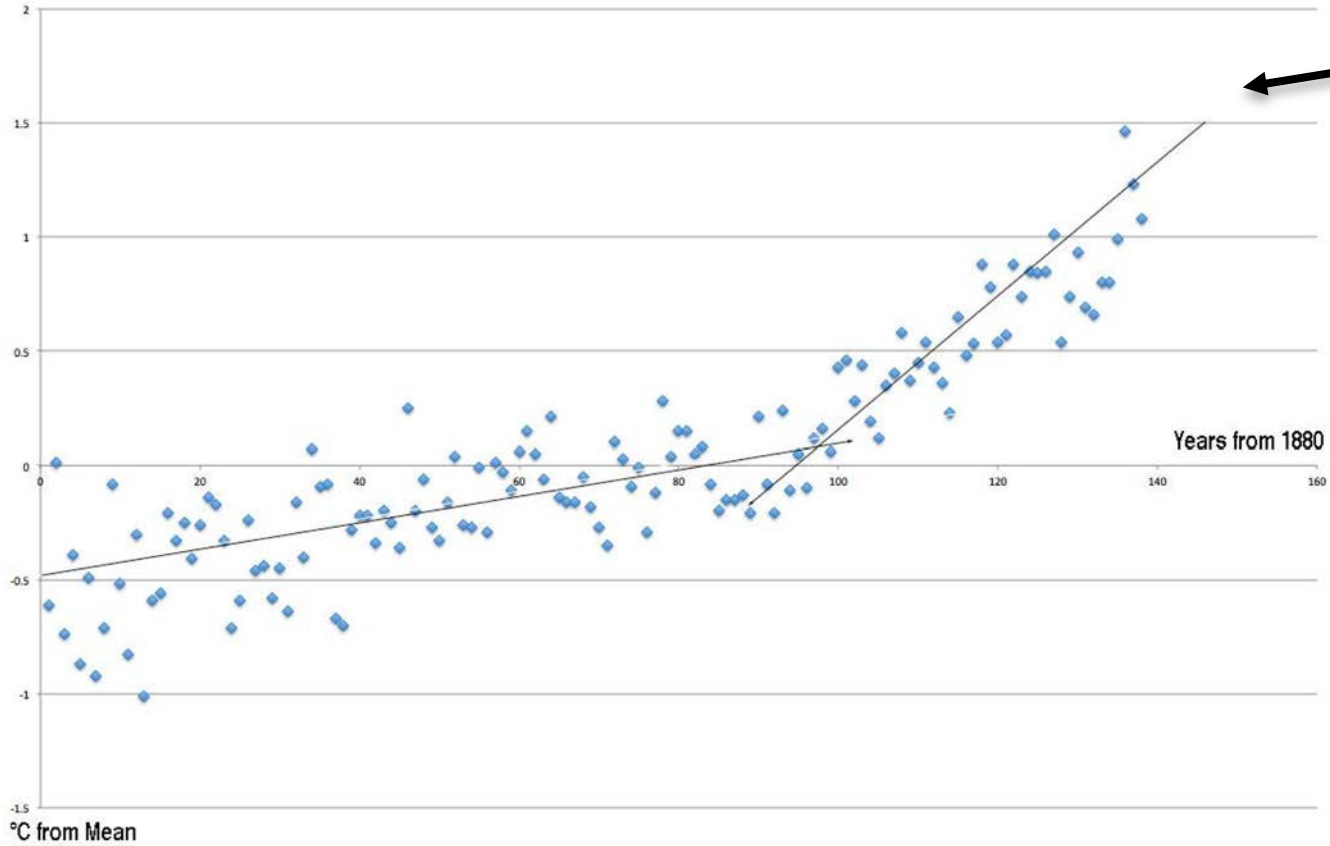
cloudburst

Global Village Institute
for
Appropriate Technology





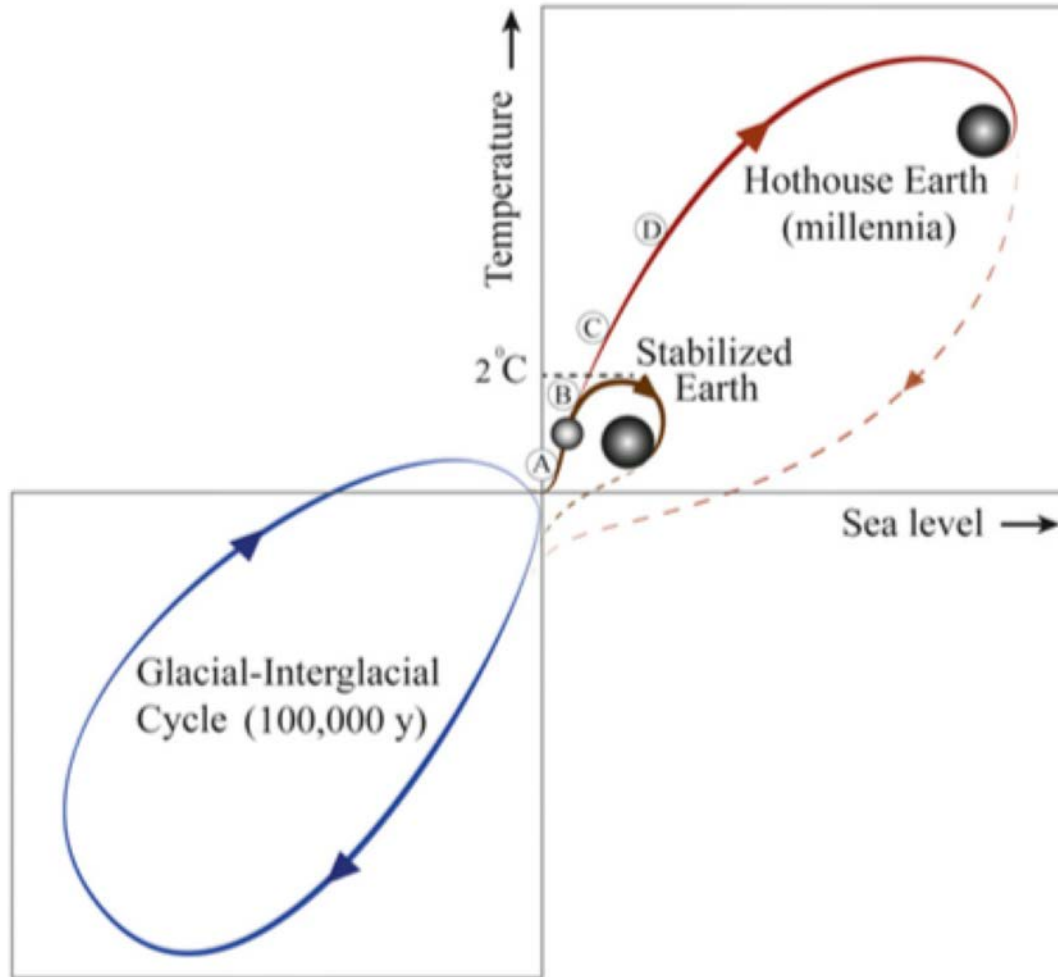
Global Mean Estimates of Land-Surface Air Temperature Anomalies from 1880 to Present (Meteorological Station Data)



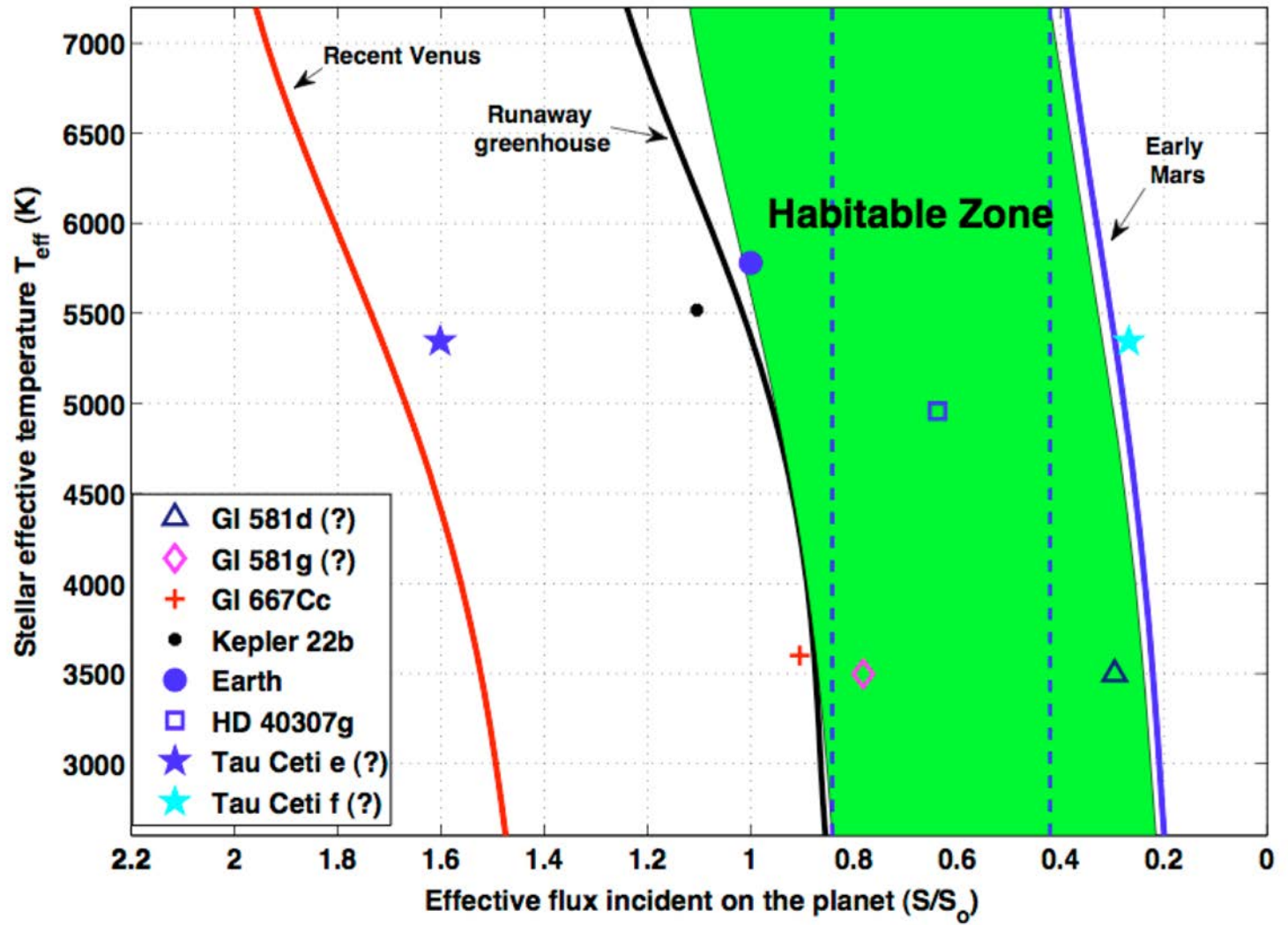
2015 was already almost 1.5°C

Source: NASA Goddard, GISTEMP Team 2018





Steffin, PNAS 2018



HABITABLE ZONE



Base time ▾

Area ▾

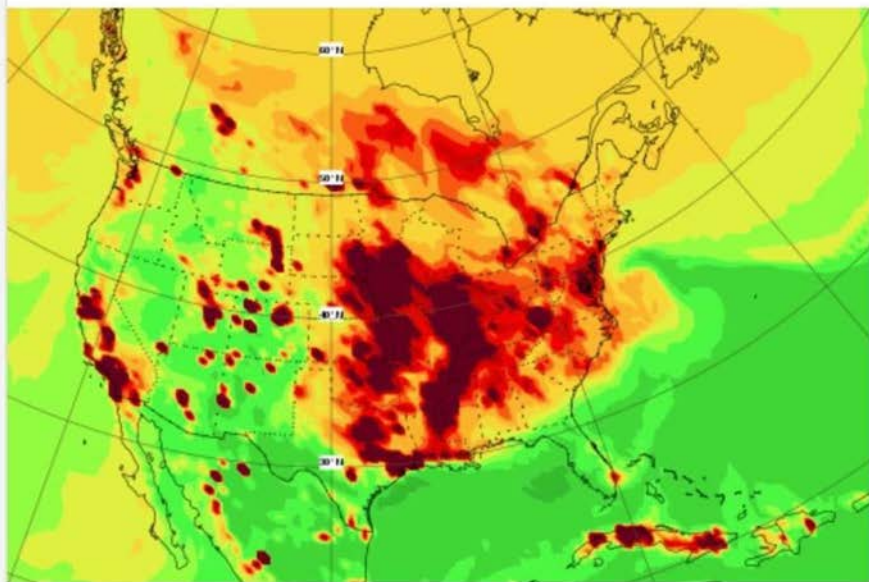
Level ▾

Filter results ▾

+

Methane at surface [ppbv] (provided by CAMS, the Copernicus Atmosphere Monitoring Service)

Saturday 2 Jun, 00 UTC T+60 Valid: Monday 4 Jun, 12 UTC



< > VT: Sun 03 Mon 04 Tue 05 Wed 06 ▶

0 1680 1740 1800 1860 1920 1980 2040 75600



Days per year when the heat and humidity could be so high that it will be unsafe for humans to remain outdoors (HHSI >92°F)

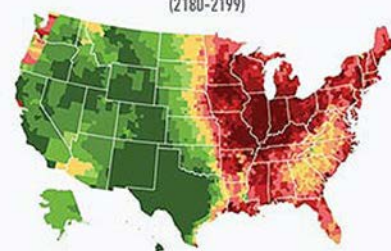
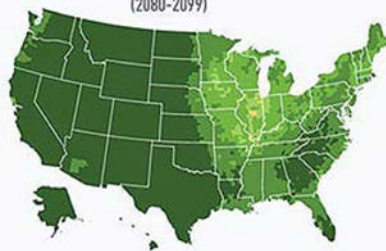
By 2100

(2080-2099)

By 2200

(2180-2199)

Business as usual



Impacts of Shifting Bell Curves

- 1. Increase of regional climate extremes**
 - Greater heat, drought, fire in dry regions
 - Greater rain, floods in wet regions/times
- 2. Summer outdoor livability & livelihoods**
 - > half non-household labor is outdoors
 - measurable impact on national economies
- 3. Conflicts, Violence (Hsiang et al., 2013)**
 - interpersonal: +4%/standard deviation
 - groups, nations: +14 %/standard deviation

If climate change were a dude



CLIMATE IN CRISIS

by
Albert K. Bates

*The Greenhouse Effect
And What We Can Do*

Foreword by Senator Albert Gore, Jr.



The Biochar Solution

CARBON FARMING AND CLIMATE CHANGE

ALBERT BATES
FOREWORD BY VANDANA SHIVA



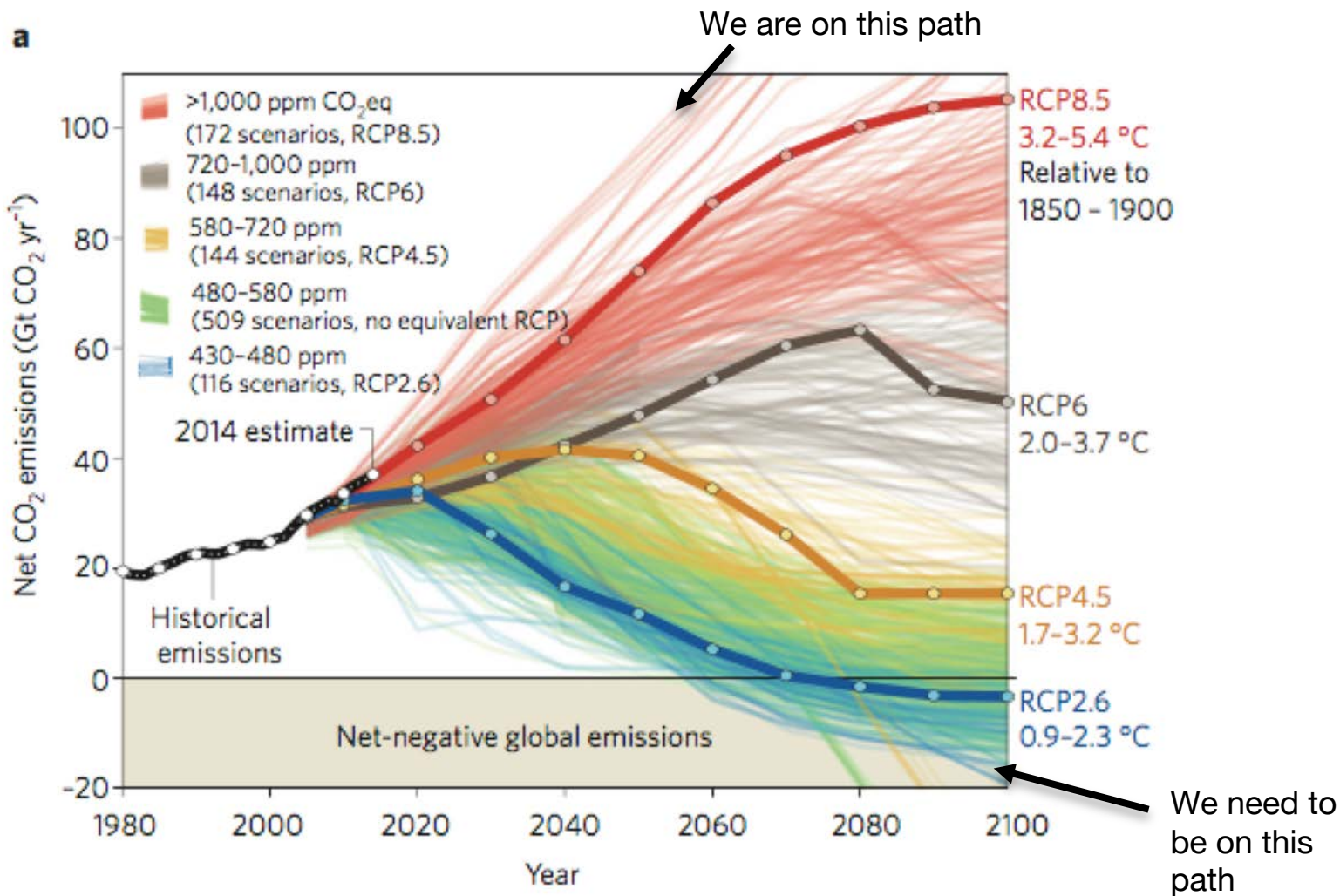
ALBERT BATES

The Paris Agreement



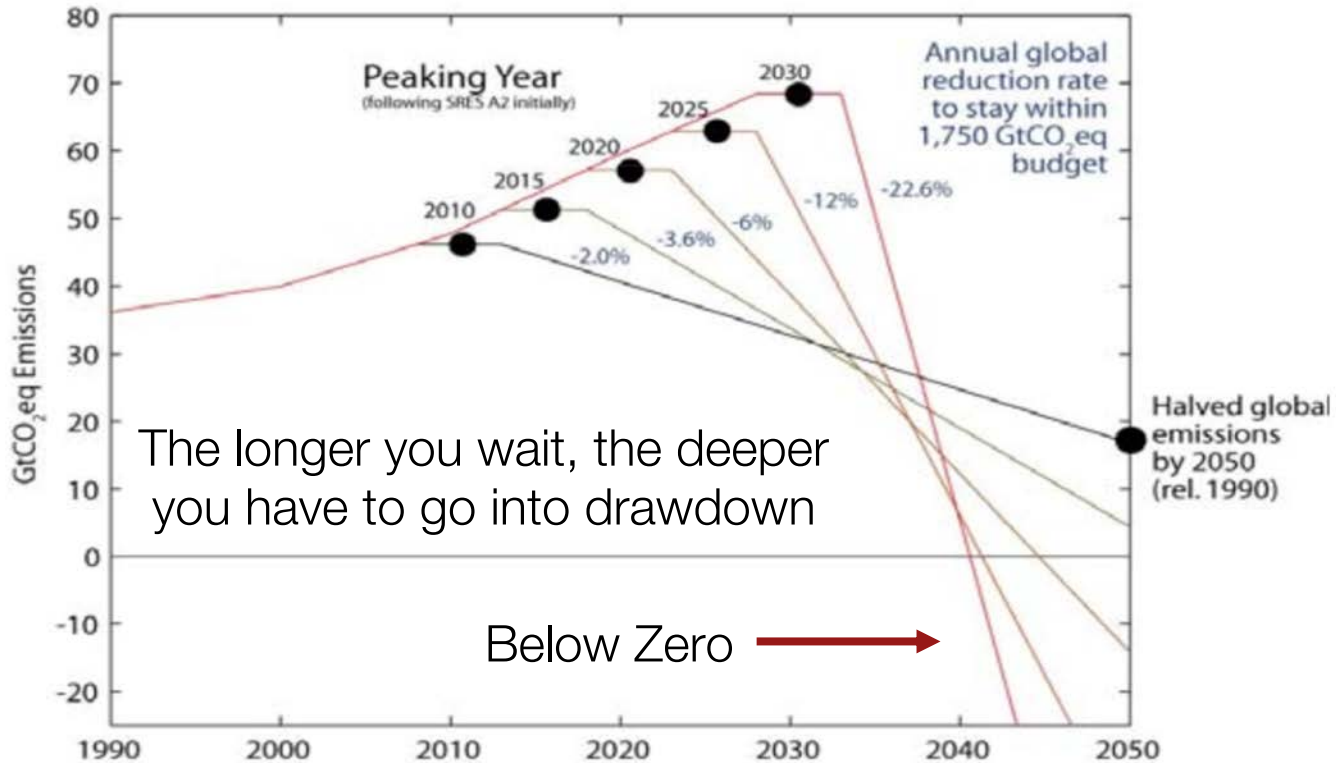
*the best chance we have to
save the one planet we've got*

an ecovillage imprint



IPCC 2014

Emissions Peaking After 2020: More than 1 Kyoto per Year



(Meinshausen et al. 2009b)

Drawdown

SOLUTIONS LAND USE (and Ocean)

Afforestation

Agricultural Intensification

Avoided Deforestation

Bamboo

Biochar

Carbon Farming

Composting

Coastal Wetland Protection

Conservation Agriculture

Farmland Restoration

Grazing and Pasture Management

Indigenous Land Management

Marine Permaculture

Microbial Farming

Multistrata Agroforestry

Ocean Farming

Pasture Cropping

Peatland Restoration

Perennial Bio Energy Crops

Regenerative Agriculture

Silvopasture

System of Rice Intensification

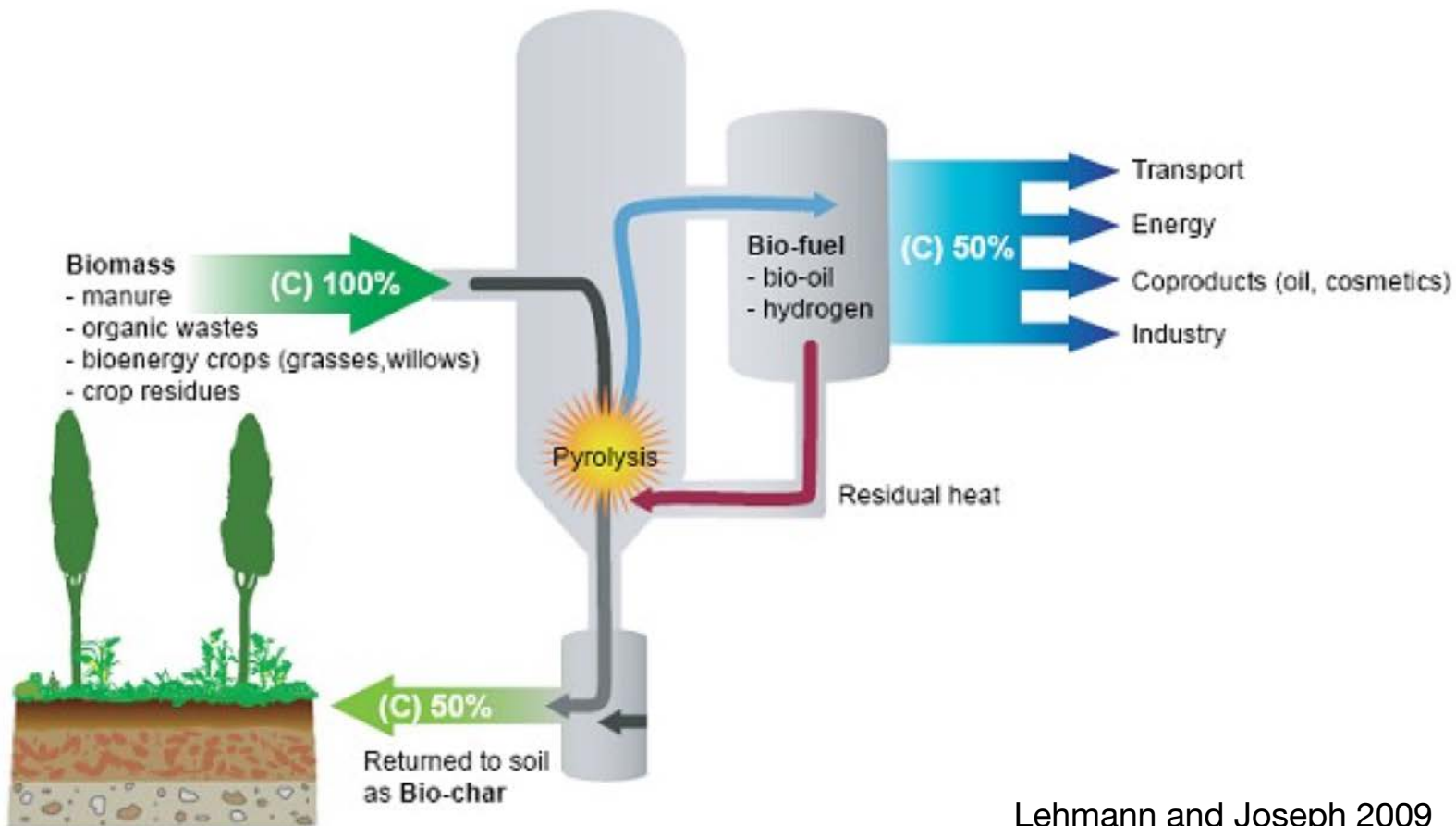
Temperate Reforestation

Stable Tropical Tree Crops

Tree Intercropping

Tropical Reforestation

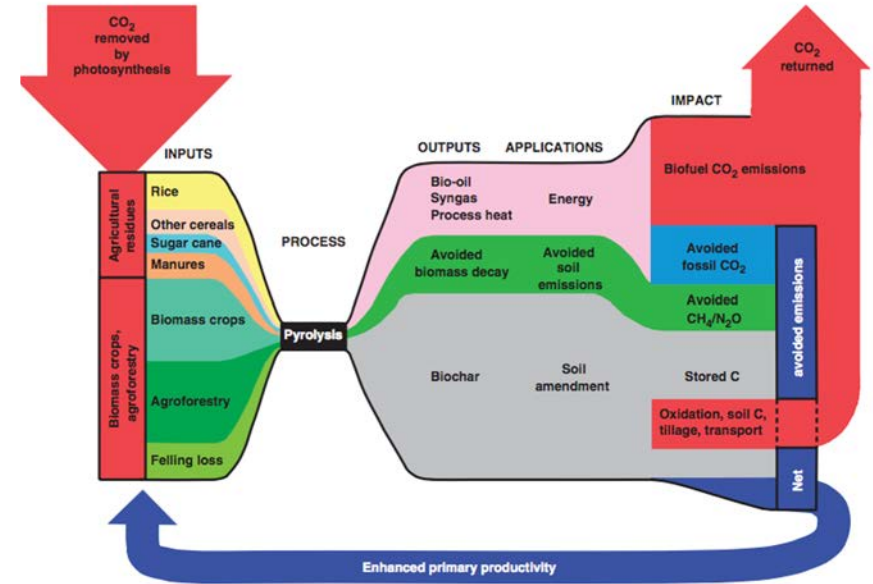
Wetland Restoration



Summary of Biomass Availability Scenarios

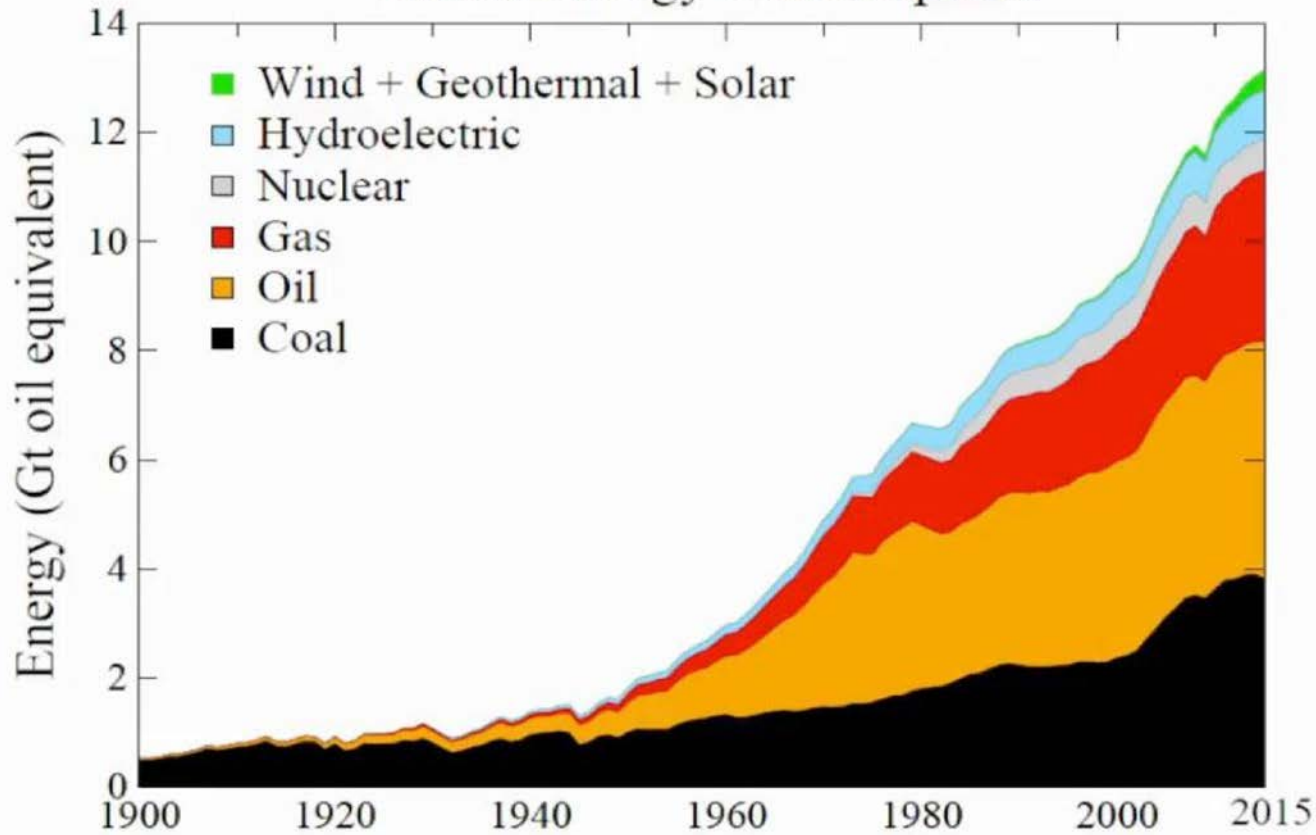
Feedstock	Biomass availability in scenario (Pg yr ⁻¹)					
	Alpha		Beta		MSTP	
	DM	C	DM	C	DM	C
Cereals excluding rice	0.17	0.07	0.29	0.13	0.42	0.18
Rice	0.52	0.22	0.60	0.25	0.67	0.28
Sugar cane	0.20	0.09	0.24	0.11	0.27	0.13
Manure	0.31	0.10	0.45	0.14	0.59	0.19
Biomass crops	0.63	0.30	0.94	0.60	1.25	0.60
Harvested wood	0.05	0.03	0.13	0.07	0.21	0.10
Forestry residues	0.29	0.14	0.29	0.14	0.29	0.14
Agroforestry	0.13	0.06	0.70	0.34	1.28	0.62
Green waste	0.01	0.004	0.05	0.02	0.07	0.04
Total	2.3	1.0	3.7	1.6	5.1	2.3

JE Amonette 08Nov2010

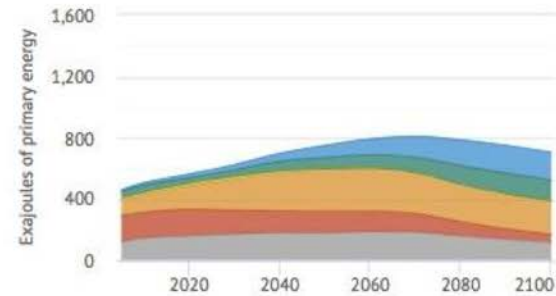
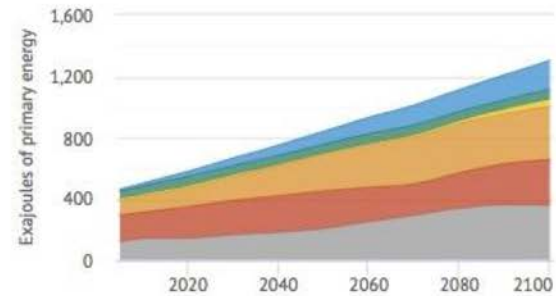
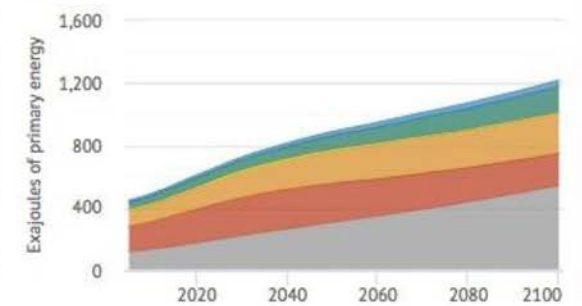
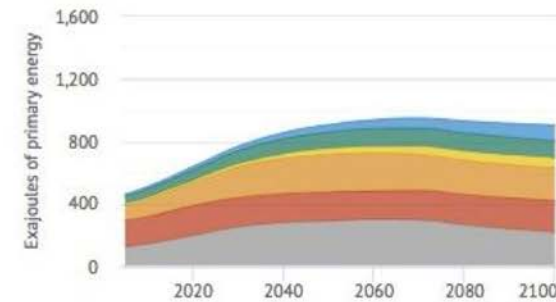
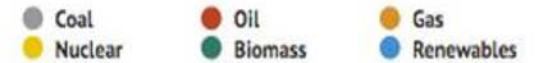
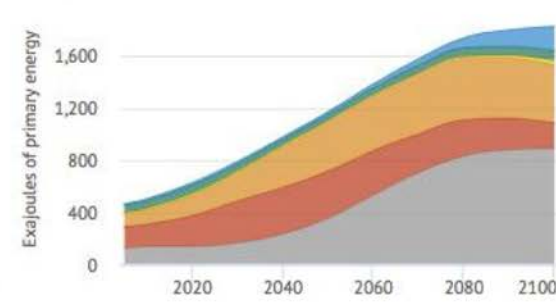


Woolf, et al 2010

Global Energy Consumption



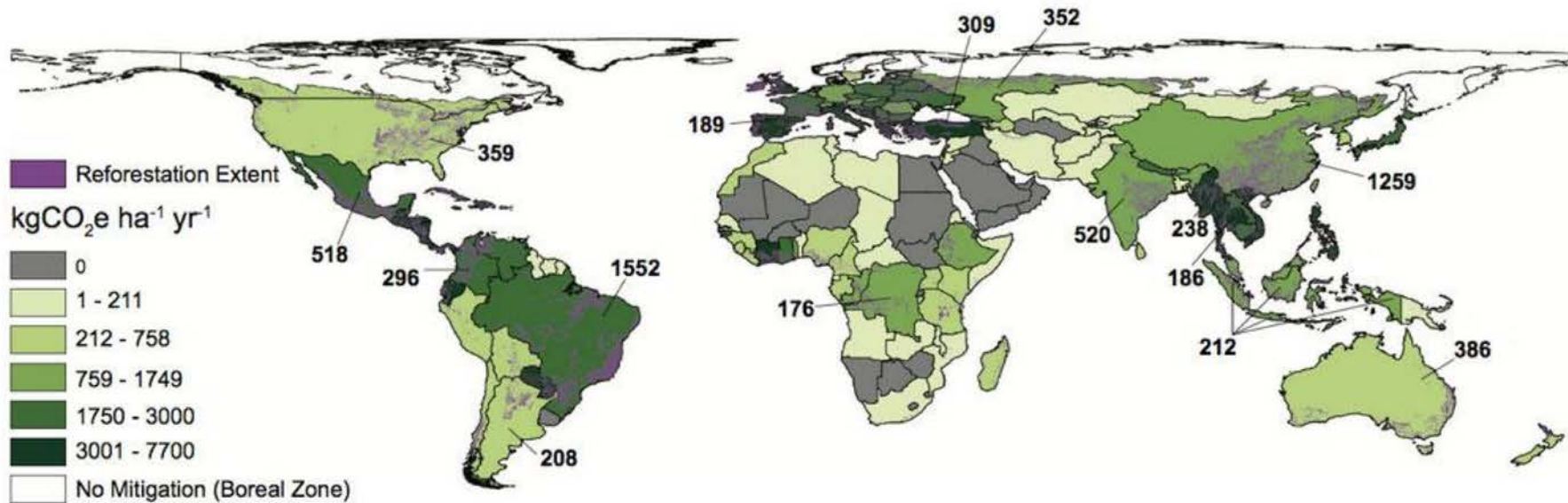
Hansen, 2018

SSP1**SSP2****SSP3****SSP4****SSP5****CB**

Global primary energy use by fuel type between 2005 and 2100 in exajoules (EJ) for each SSP baseline marker scenario (IMAGE for SSP1, MESSAGE for SSP2, AIM for SSP3, GCAM for SSP4, and REMIND for SSP5). Data from the [SSP database](#) and [Riahi et al 2017](#); chart by Carbon Brief using [Highcharts](#).

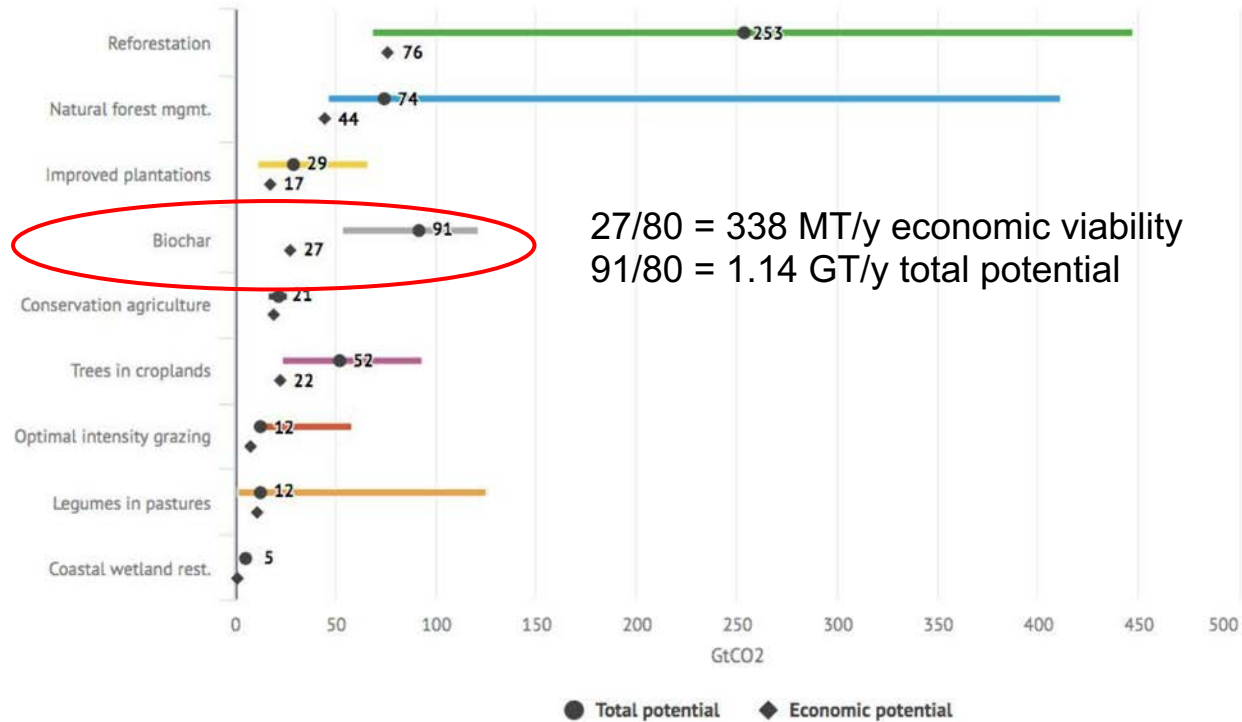
Negative Emissions Technologies (NET)

- changes to land use management
- accelerated weathering
- marine flora
- bioenergy with carbon capture and storage (BECCS)
- direct air capture (DAC).




Map of reforestation potential by country (in kilograms CO₂e per hectare per year), with areas suitable for reforestation highlighted in purple. Taken from Figure S1 in [Griscom et al. 2017](#).

Negative emissions potential of natural climate solutions



CB

Negative emissions potentials from different NCS, in cumulative GtCO₂ between 2018 and 2100. Bars show uncertainties in total potential, while black circles show best-estimates of total potential and diamonds show economic potential at a cost of less than \$100 per ton CO₂. Estimates are based on both the rate of sequestration and the time horizon over which the sequestration can continue from [Griscom et al. 2017](#).



ecosystem restoration
camps



**Without
Biochar**



With Biochar





Mixing biochar at 1% by volume to silage prevents the formation of mycotoxins, binds pesticides and suppresses the formation of butyric acid.

DELECTABLE CLIMATE SOLUTION



**Come & Learn about livestock emissions and experience
a show cooking with chef Marcella Pigni Maccia
at InKitchen Loft, via Adige, 12 Milan**

April, 4th 2017 - 11:30am



Biochar in Media to Improve Tree Health



Biochar + Compost
Biochar + Mycorrhiza, Composted



No Treatment (right) 5% biochar + compost top dressing
Tree roots at 18 months in compacted soils.
Photo: Morton Arboretum Soil Science Laboratory

- Increases disease & insect resistance
- Improves microbial activity and soil fertility
- Increases soil water retention, and available water to tree roots
- Stimulates tree growth
- Improves tree survival



Biochar to Help Re-vegetation, Environmental Remediation, and Urban Farming



BIOCHAR IN HYDROSEEDING AND FILTERS

www.permamatrix.com

T R Miles Technical Consultants, Inc.

URBAN FARMING

GREEN ANCHORS

www.facebook.com/greenanchorspd

**Soil is not the
only thing
biochar
improves**

CEMENT

LAST HOUSE STANDING



Sustainability Guidelines for Gulf Coast Reconstruction

Creating a Disaster-Resilient and Sustainable American Gulf Coast



U.S. Green Building Council Gulf Coast Reconstruction Charrette

Biochar Building materials



The Carbon Displacement Strategy



Steel & Aluminum



Carbon black



Sand



Precious metals



Asphalt



Tires



Rubber soles



Dry batteries



Inks

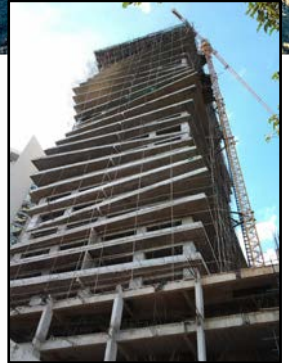


Chemicals & Polymers

Microbeads



Dessicants & Aerogels



Concrete



**Food
Grade
Biochar**

©Dentist Chef

Biochar Pickles

INGREDIENTS: Eggplant, Shiitake, Vinegar,
Olive Oil, Onions, Garlic, Cayenne Powder,
Garlic Powder, Onion Powder, Food-grade
Bamboo Biochar



Food Grade Char

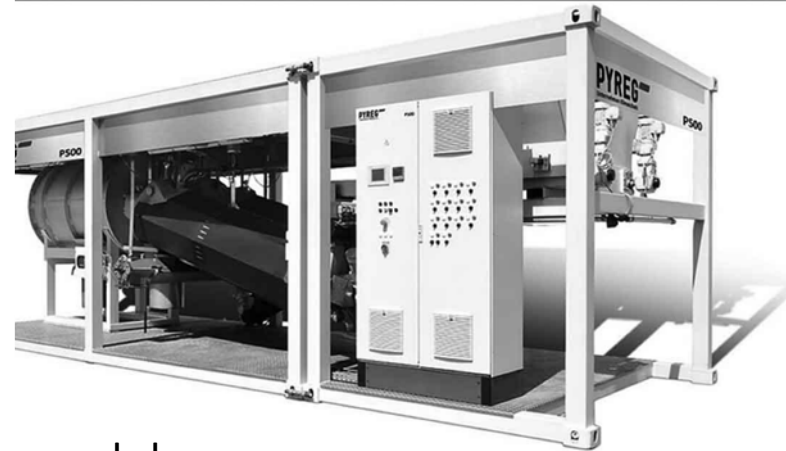
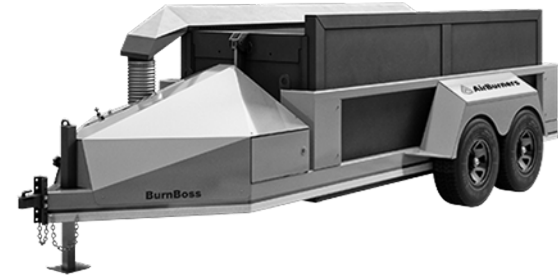


▲本產品含有... 保存期限 (年/月/日) 台灣製造
淨重量: 120 克
此日期前最佳: 如包裝上所示 (年/月/日)
▲為保持本產品之新鮮風味與營養, 包裝內附乾燥劑小包, 請勿食用。
Product Name: Bamboo Charcoal Peanuts
Ingredients: Peanuts, Wheat Flour, Bamboo Charcoal Powder, Palm Oil, Sugar, Salt.
▲Contains: Wheat, Peanut
Net Weight: 120g Shelf life: 300 days
Best Before: As shown on package(Y/M/D) Made in Taiwan
Warning: Please "Do Not Eat" the desiccant used in the package, and not to eat the food if the sachet of desiccant is found broken.





Technology is no longer a constraint



We have pyrolyzers of all sizes and shapes.

Supply is no longer an issue

In fact we have a glut

June 5: We handle 700T of biomass a day and we'd like to find markets for large quantities of biochar.

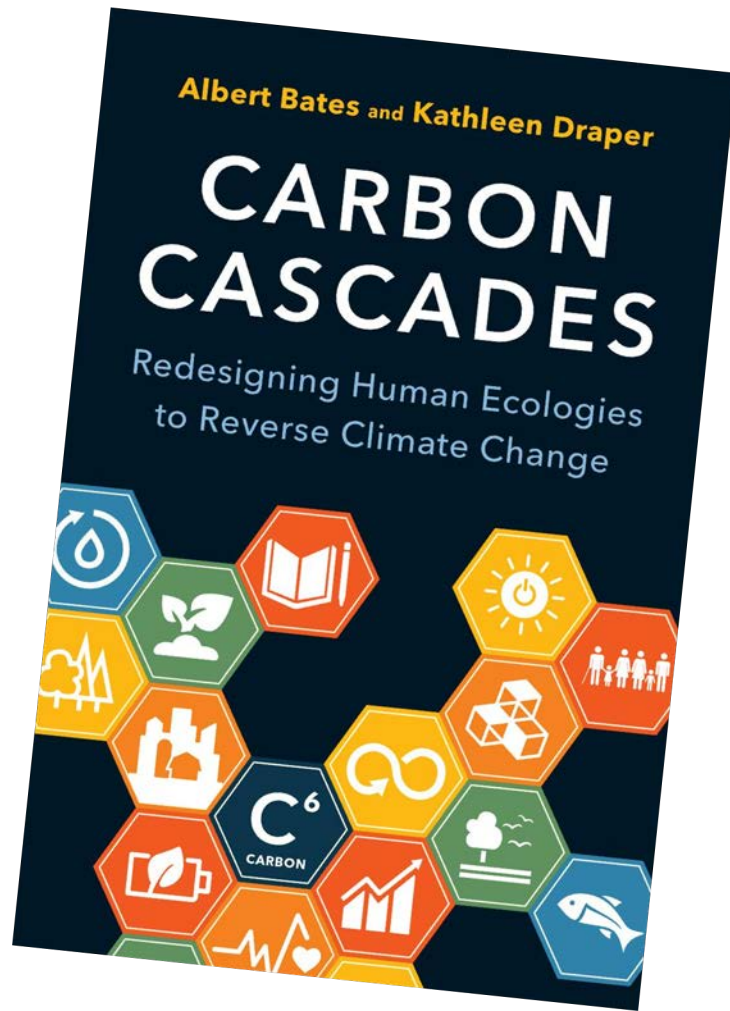
June 6: We are currently running every day and producing 2 to 3 tons of biochar a day - ultimately, that production level will be 10 to 12 tons per day.

June 8: I have 21 m lbs of feedstock, we can finance equipment if we have purchase orders. Need to find agricultural users to buy biochar.



**Social
inertia
is the
constraint**

- Historically, Agriculture and Forestry resist innovation.
- Even where there are clear economic advantages to innovate, adoption is very slow, usual taking several human generations.
- Agriculture and Forestry are large industries, and they have the potential to sequester enough carbon to reverse climate change, but they may not be the quickest way forward.



*memetic
engineering*

Permaculture

A Biochar Cascade

2010-2015

Adding complexity to multiply yields



Water Treatment

Silage Conditioner

Digestive Supplement

Litter Amendment

Manure Conditioner

Soil Amendment

Carbon Sequestration

Cool Energy

Cool Feeds

Cool Fertilizer

Cool Food

Cool Planet

Permaculture

A Biochar

Cascade

2016-2017

Adding complexity
to multiply yields

Nutrient-dense Organic

Baby Formula

Biofertilizers

Electricity

Heating & Cooling

Climate Finance

Ecological Restoration

Deodorizers

Green, Social, Fair Trade Funds

Aggregates & Composites

Drawdown Real Estate

Plasters, Insulation, Roof Media

Soaps, Shampoos & Scrubs

Fuel Cell Cathodes

N-fix Biomass Crop

Aquaponics

Leaf Protein from Residue

Gas & Fractions from Pyrolysis

Probiotics & Nutraceuticals

Potable and Mineral Water

Runoff Conditioner

Silage Conditioner

Human & Animal Digestives

Kitty Litter

Manure Conditioner

Geotextiles & Wallboard

Dessicants & Aerogels

Carbon Sequestration



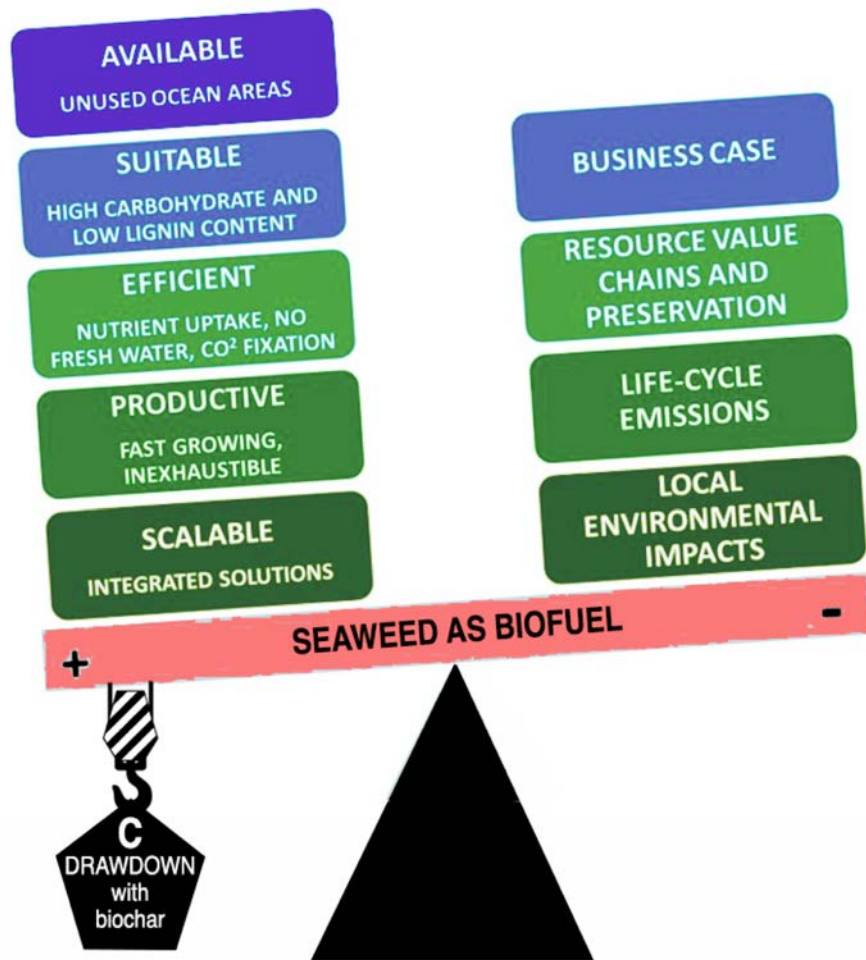
Permaculture

A Biochar Cascade

2020

Adding complexity to
multiply yields

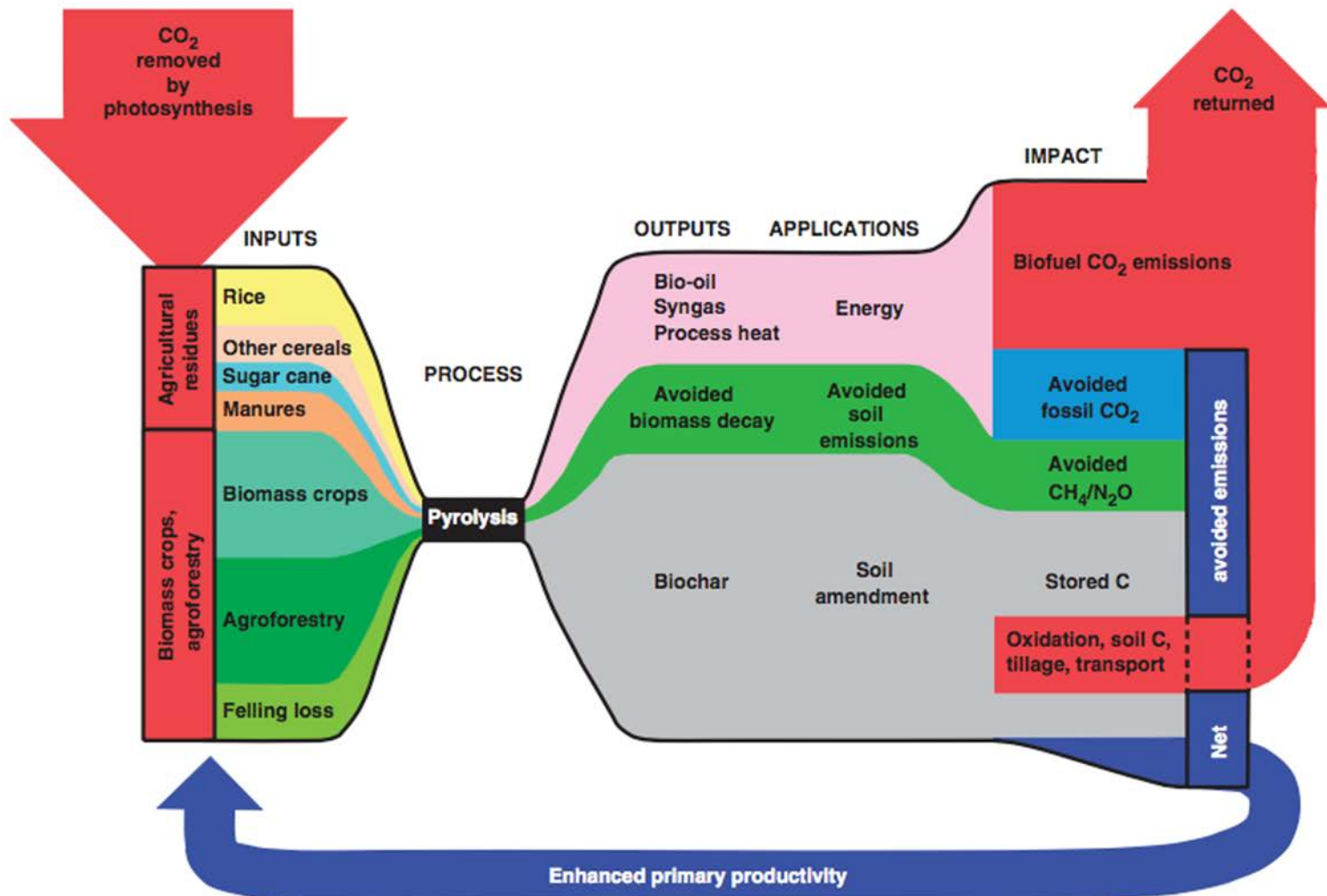




Contenders for the top 10 sources of underutilized biomass in the world:

1. Sewage sludge
2. Livestock waste
3. Invasive species
4. Beetle kill
5. Yard waste
6. Industry waste
7. Crop waste
8. Forestry thinnings
9. Storm debris
10. Papermill waste



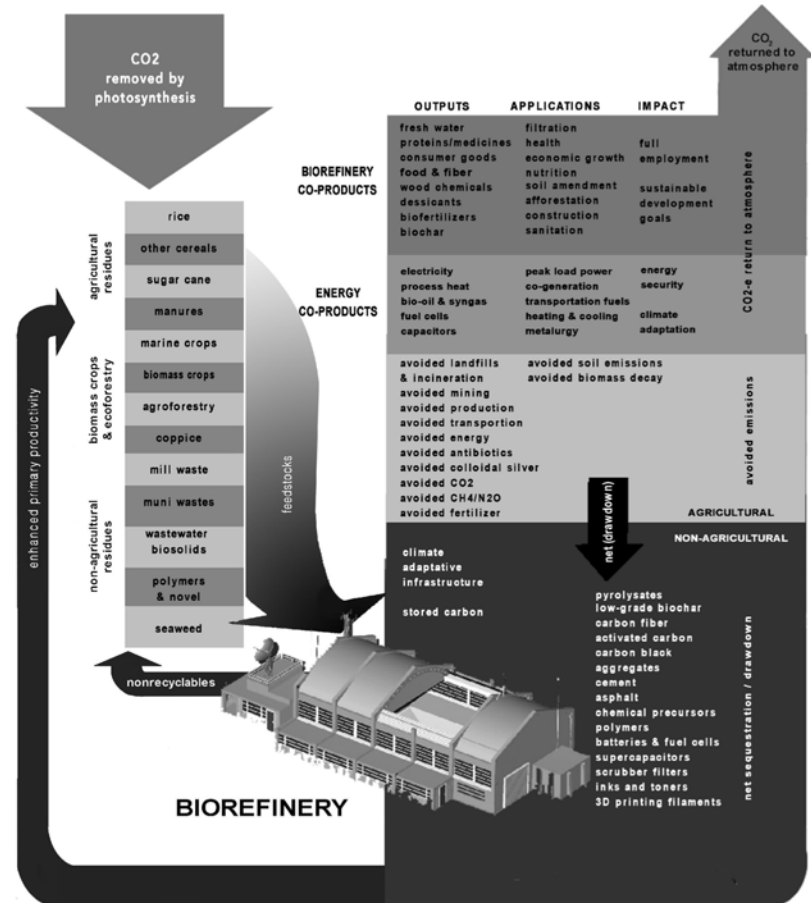


Woolf, Amonette, et al, estimate: **0.7 - 1.4 GtCO₂/y**

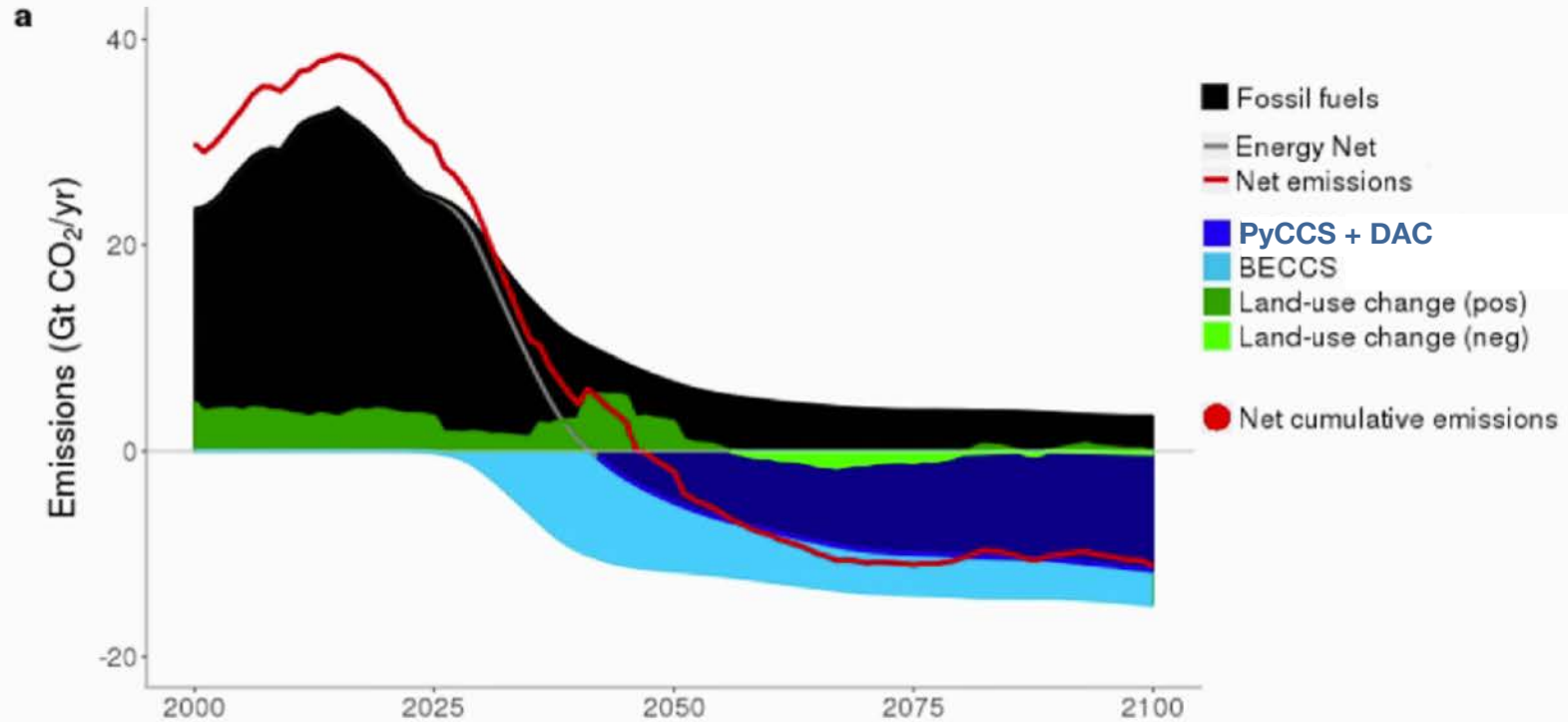
Potentials for atmospheric removal in gigatons of CO ₂ per year	
Construction Aggregates*	31.9
Sand	5.7
Asphalt	1.4
Soil Amendments	1.7
Other**	0.2
Total	40.9

* Crushed stone, dimension stone, bricks and rubble
 ** Diatomaceous & Fuller's earth, clay, kitty litter, wastewater filters, carbon black in tires, and activated carbon

Bates & Draper 2018



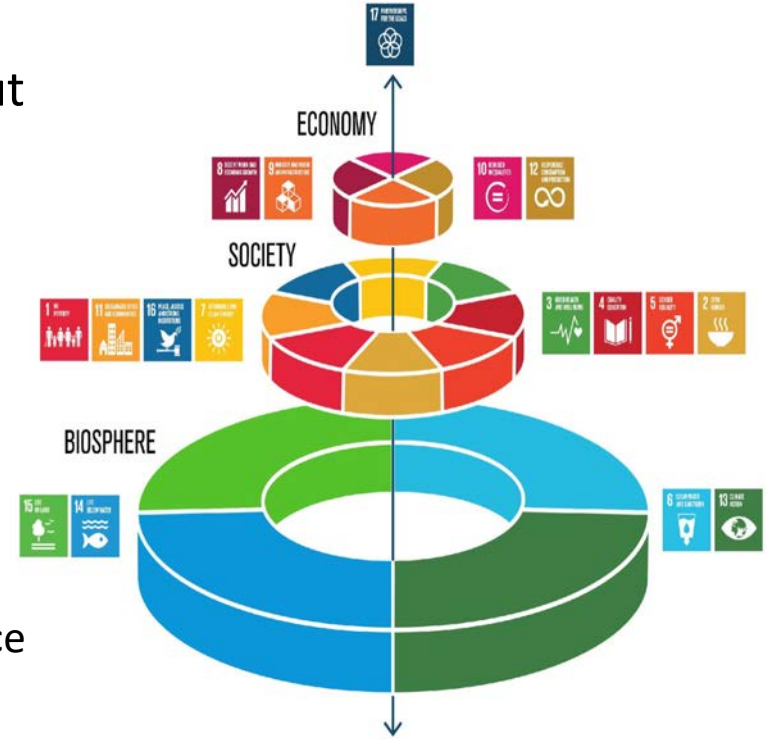
Hubbert + Drawdown

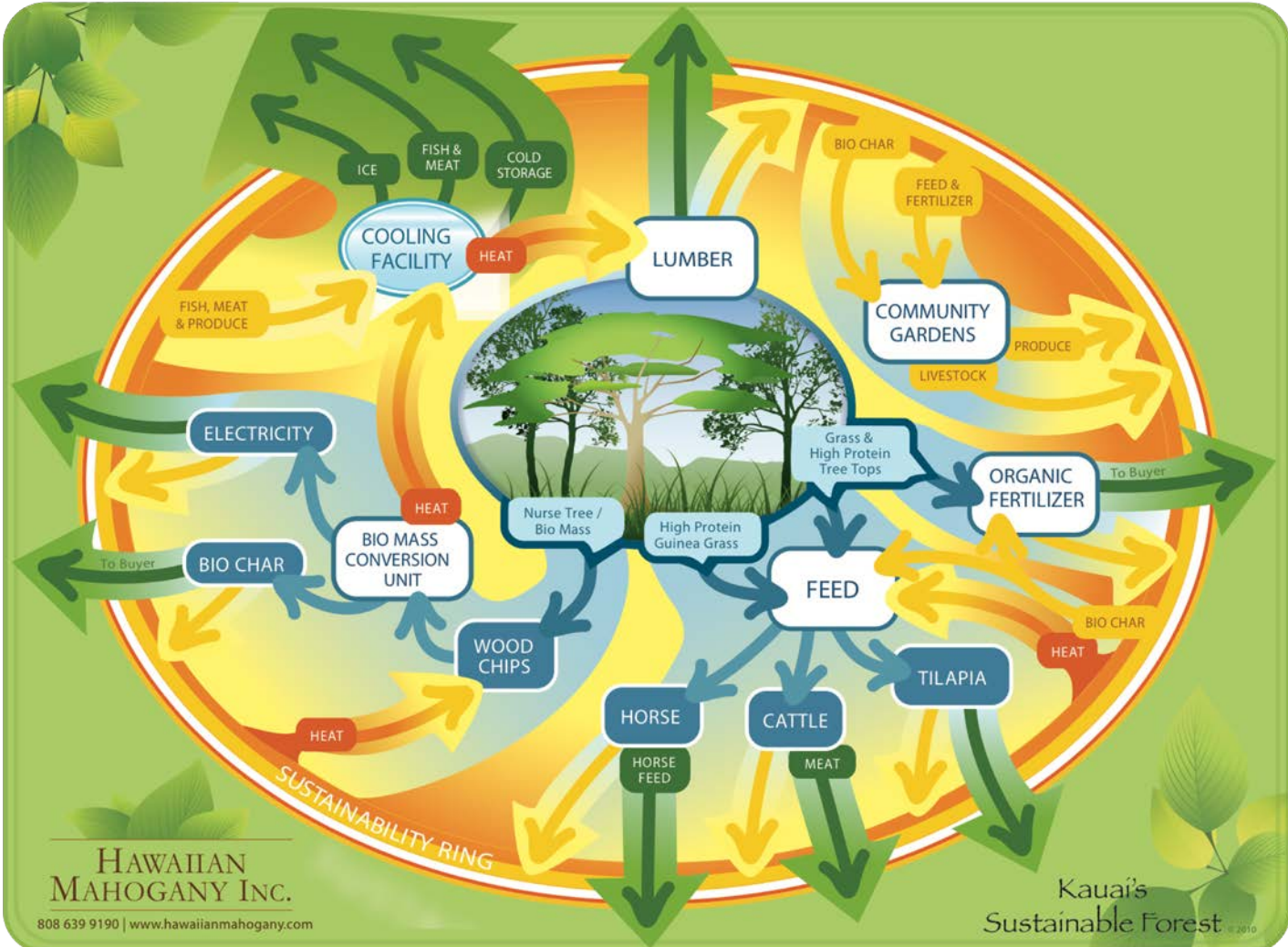


After Van Vuuren, 2018

It is technologically possible to redeem the atmosphere to its pre-industrial condition, but only by following these specifications:

- low-cost
- rapidly deployable
- hugely scalable
- capable of quick political and social acceptance
- without the requirement of carbon taxes or offset market subsidies
- antifragile
- have adequate incentives to function in the absence of the petroleum economy
- not endanger ecosystems
- not impoverish individuals, sectors or countries.



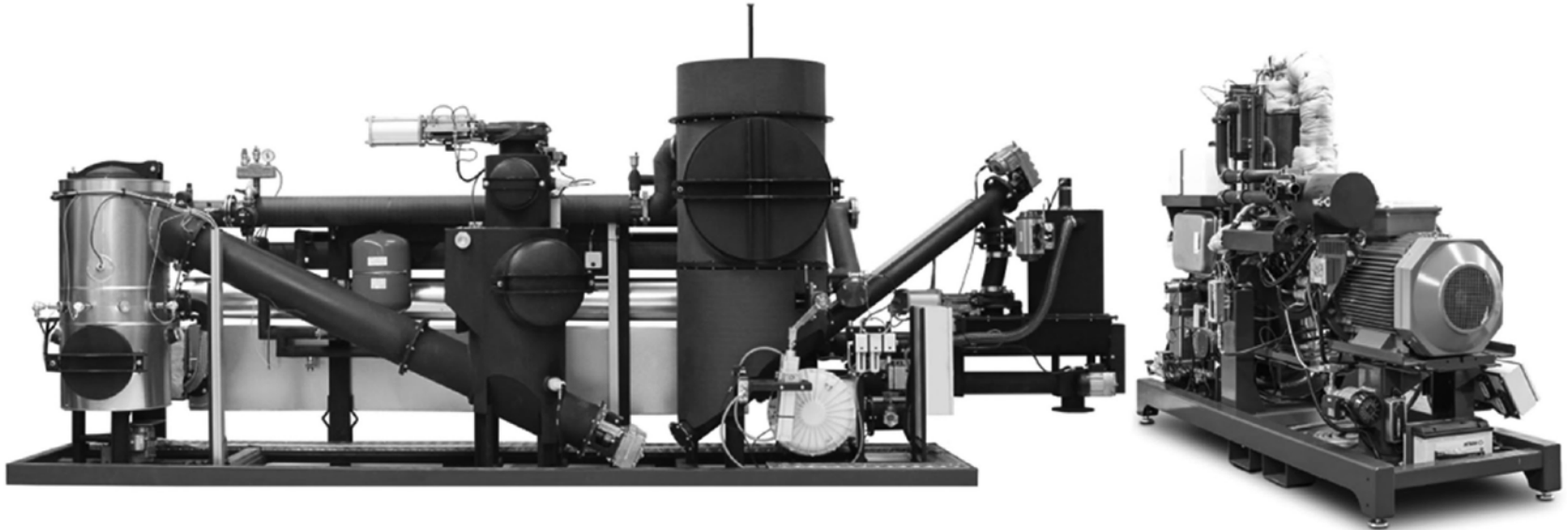


HAWAIIAN MAHOGANY INC.

808 639 9190 | www.hawaiianmahogany.com

Kauai's Sustainable Forest

Cool Lab



Crop Residue Pre-process

- Leaf Protein Extracts
- Nutraceuticals
- Medicinal Supplements
- Fish and Animal Feeds
- Glues and Laminates

Drying and Pelletizing

- Cooking Fuels
- Animal Supplements
- Fibers

Carbonization

- Process Heat
- Electricity
- Biofertilizer Blends
- Fish and Animal Feeds
- Wood Chemicals

- Polymers
- Carbon Fiber Filaments
- Fuel Cells
- Hydrogen
- Desiccants



closing the carbon circle

feedstocks from wastes
waste heat recapture
carbon sequestration
ecologically beneficial
high ROI

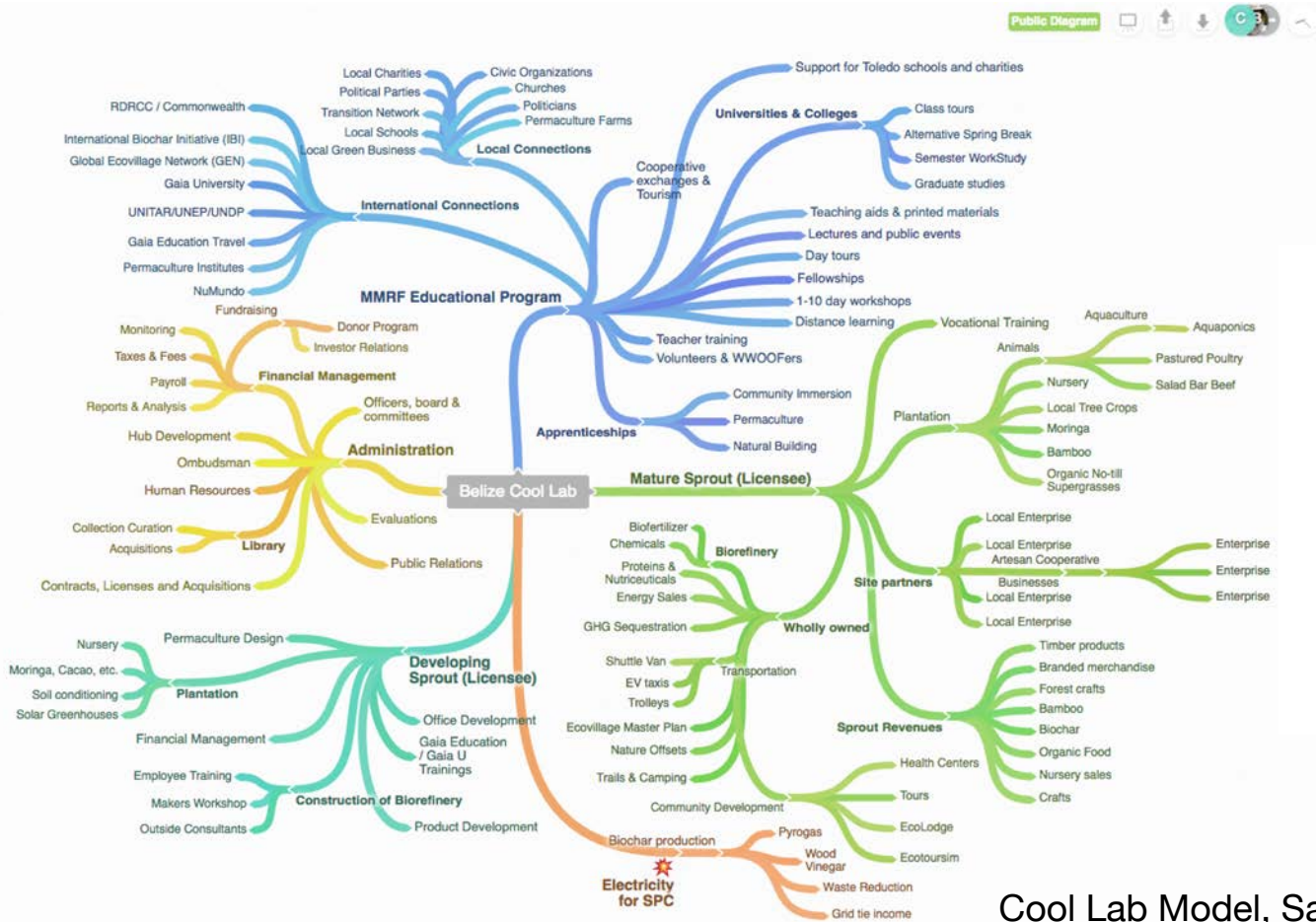
The Commonwealth and Cloudburst's Workshop on Regenerative Development to Reverse Climate Change

London, 28-29 October 2016



The Commonwealth





Cool Lab Model, San Pedro Columbia, Belize



- Urban project
- Rural project
- Intentional community
- Ecovillage project
- Tradicional village project
- Transition project
- Permaculture project
- Educational project
- Ecotourism project



JOIN US



Foundation for Collaboration



Investment Portfolio

Thank you!



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GVix.org

QI



ecosystem restoration
camps



eco2
CapitDesign

cloudburst

Global Village Institute
for
Appropriate Technology

IBI
Biochar
Certification