Mitigating & Adapting to Climate change: Extreme Weather Events, a Worldwide Energy Revolution and Geoengineering options

Week 8: May 15th , 2017

Part A: Geoengineering – an intro

Part B: Ron Larson – on biochar

Part C: personal options

Part A: Geoengineering

Geoengineering:

1. Solar Radiation Management (SRM) and
2. Carbon Dioxide Removal (CDR) / Greenhouse Gas (GHG) Capture
   - Focus on: Biochar vs. Bio-Energy with Carbon Capture and Storage (BECCS) solutions
   - Direct Air Capture (DAR) also in this category
   - Reducing Enteric Methane (BURPED stomach gases from Ruminants) too
   - SEE MY BIOCHAR web page LINK: http://denverclimatestudygroup.com/?page_id=28

Extras to investigate outside of class

SEE February 15, 2016 discussion on EEE tab:
http://denverclimatestudygroup.com/?page_id=683

- **National Academy of Science (NAS) Climate Intervention: Preface and links (Click here); detailed reports below:**
  - **NATIONAL ACADEMY OF SCIENCES (NAS) ONLINE: *CLIMATE INTERVENTION: REFLECTING SUNLIGHT TO COOL EARTH* (2015), AT HTTP://WWW.NAP.EDU/READ/18988;**
  - **AND *CLIMATE INTERVENTION:* CARBON DIOXIDE REMOVAL AND RELIABLE SEQUESTRATION (2015), AT HTTP://WWW.NAP.EDU/READ/18805.**

Terminology

- No terminology is going to be complete
- Despite NAS efforts Geoengineering as a term is still currently the most common term used

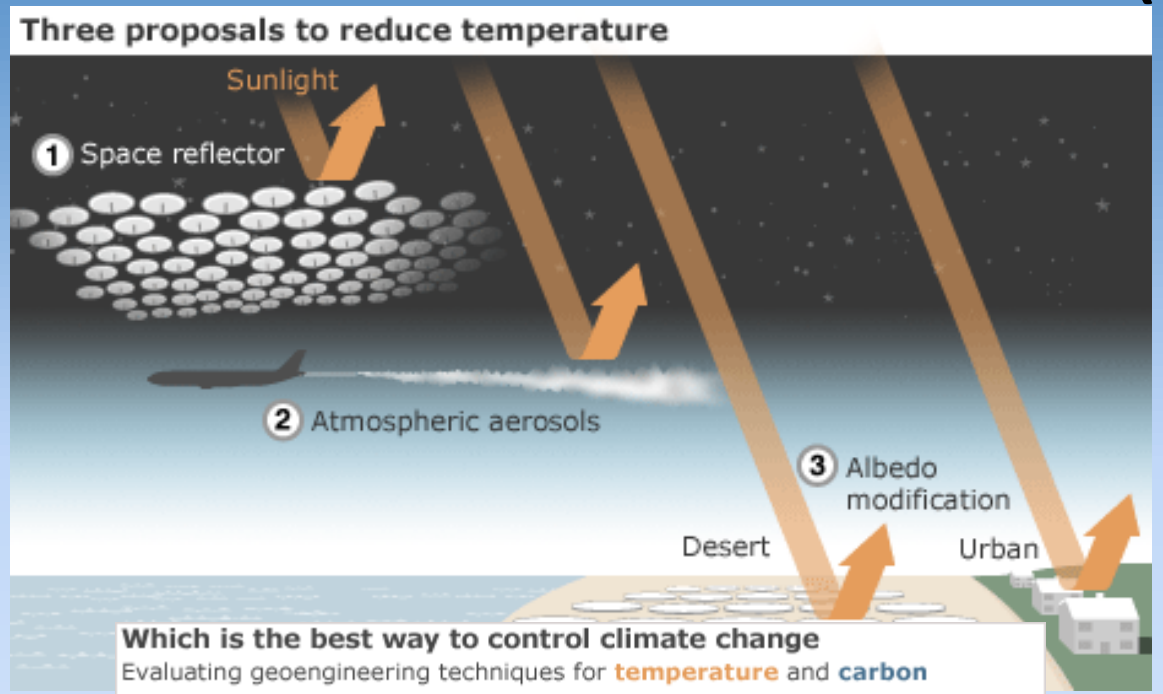
Extras to investigate outside of class

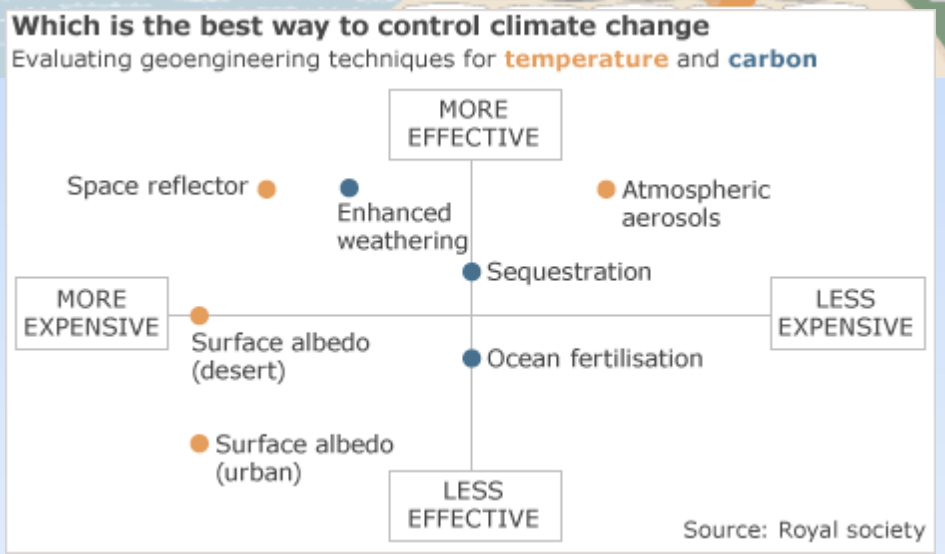
IPCC Assessment report-5 (AR5); Working Group III (WGIII): Mitigation

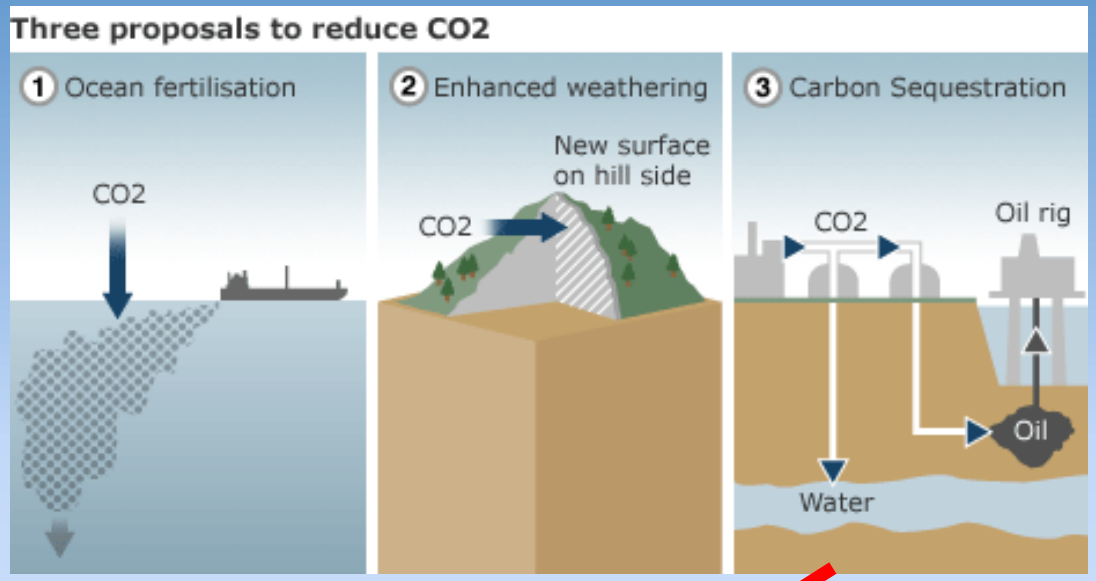
- WGIII_AR5_Presentation or in PDF format
- wg3_ar5_summary-for-policymakers_approved
- Video – the geoengineering dilemma 4.5 7.3 minutes
  https://www.futurelearn.com/courses/climate-change-challenges-and-solutions/1/steps/3297
- Are Ideas to cool the planet realistic

  http://news.bbc.co.uk/2/hi/technology/8338853.stm

Solar Radiation Management vs. Carbon dioxide Removal (SRM VS. CDR)







Biochar & Beccs

- https://en.wikipedia.org/wiki/Biochar
- https://en.wikipedia.org/wiki/Bio-energy_with_carbon_capture_and_storage

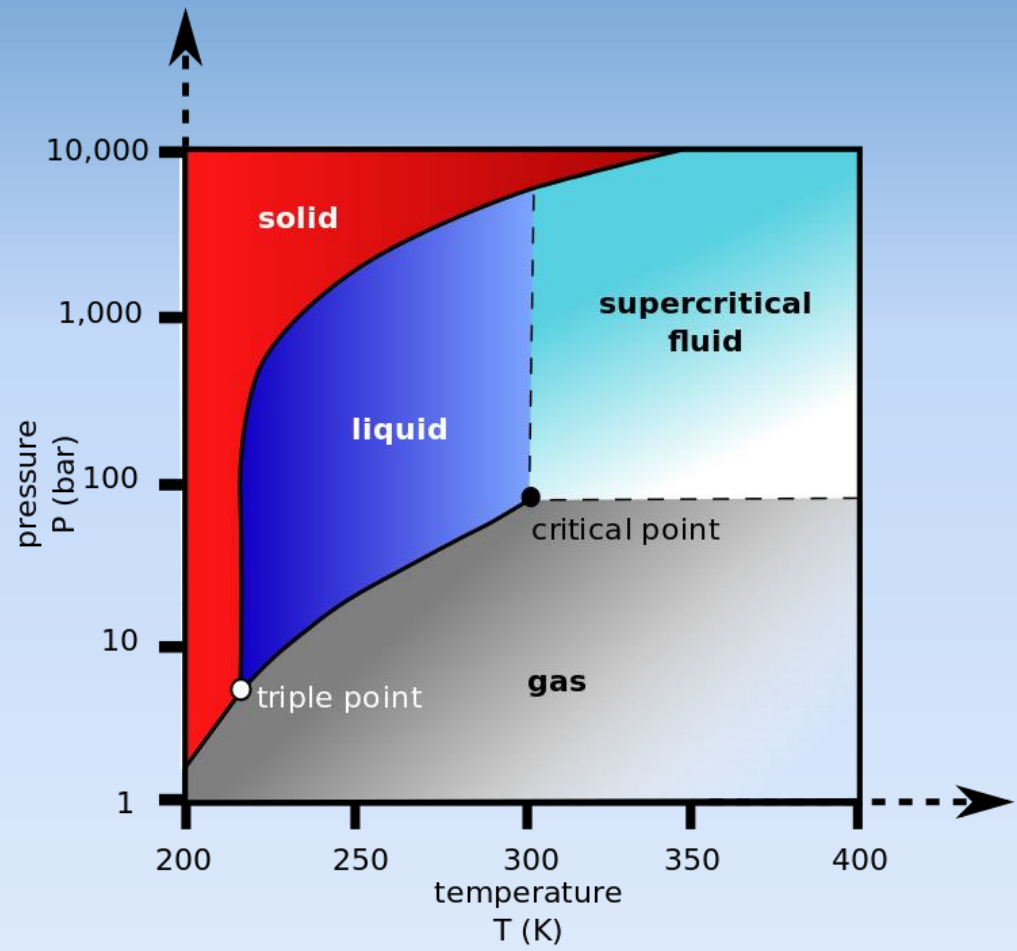
Royal Society

Additional

- SRM
  - Cloud Brightening to increase Earth's Albedo (reflectivity) also investigated
- CDR
  - Ocean fertilization with Iron to create algal blooms that sink to the sea floor:
    - https://en.wikipedia.org/wiki/Ocean_fertilization
  - Enhanced weathering: taking unstable mantle minerals, particularly Olivine to lock up Carbon https://en.wikipedia.org/wiki/Enhanced_weathering
  - Carbon Sequestration often ignores the potential of Biochar
  - Carbon Sequestration synonymous with Carbon Negativity

Supercritical CO_2

- See https://en.wikipedia.org/wiki/Supercritical_carbon_dioxide
- Miscible with salt water (saline aquifers)
- it can adopt properties midway between a gas and a liquid. More specifically, it behaves as a supercritical fluid above its critical temperature (304.25 K, 31.10 °C, 87.98 °F) and critical pressure (72.9 atm, 7.39 MPa, 1,071 psi), expanding to fill its container like a gas but with a density like that of a liquid.



Biochar

- Definition: https://en.wikipedia.org/wiki/Biochar
- Biochar tab: http://denverclimatestudygroup.com/?page_id=28

Carbon Dioxide Removal (CDR)

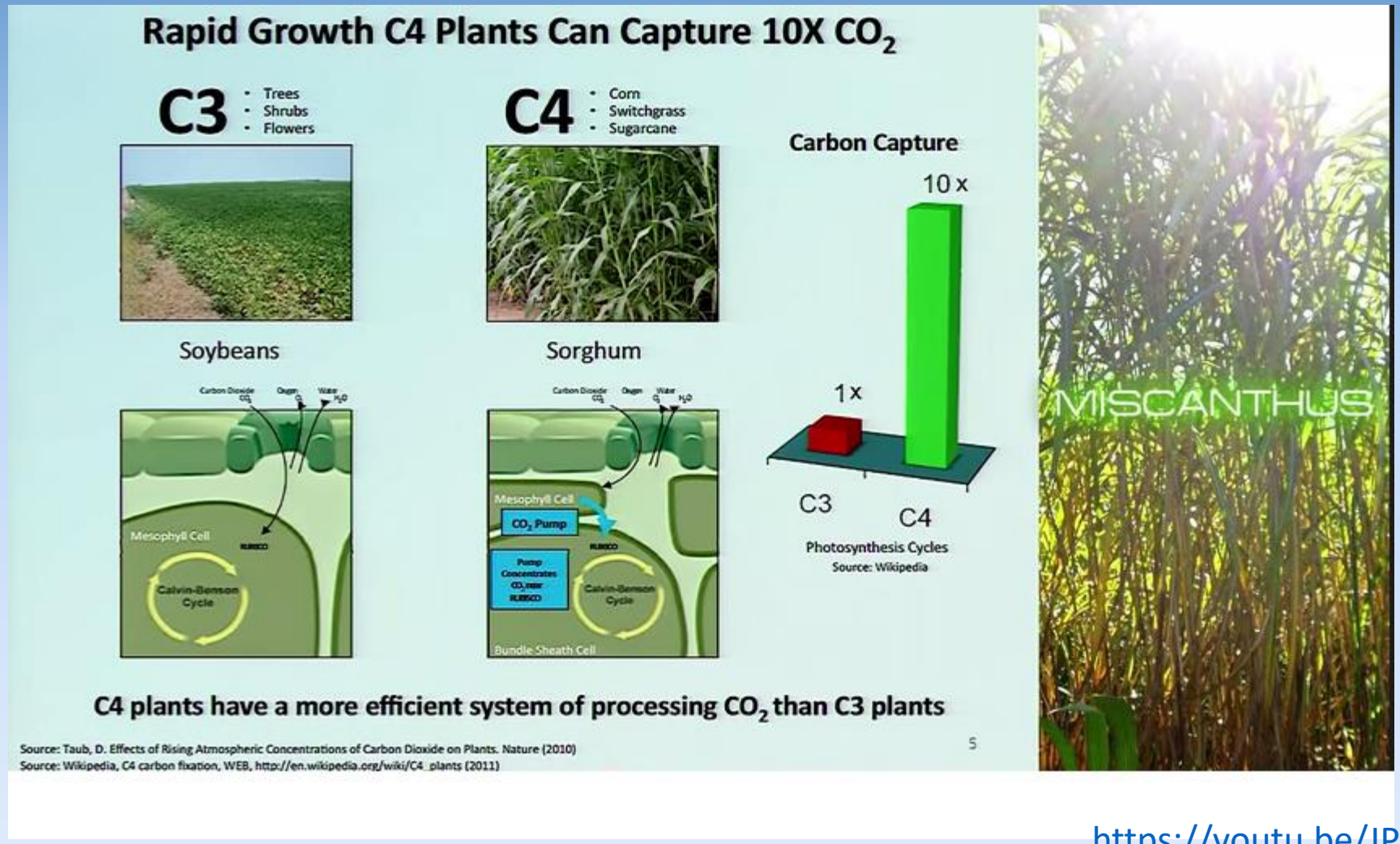
- https://en.wikipedia.org/wiki/Biochar:

"**Biochar** is charcoal used as a soil amendment. Like most charcoal, biochar is made from biomass via pyrolysis. Biochar is under investigation as an approach to carbon sequestration to produce negative carbon dioxide emissions.[1] Biochar thus has the potential to help mitigate climate change via carbon sequestration.[2][3] Independently, biochar can increase soil fertility ofacidic soils (low pH soils), increase agricultural productivity, and provide protection against some foliar and soil-borne diseases.[4] Furthermore, biochar reduces pressure on forests.[5] Biochar is a stable solid, rich in carbon, and can endure in soil for thousands of years.[1]"

Cool Planet - @ 9:00 minutes

- https://youtu.be/JPJsYZLU_sM?t=535

Following slides from Cool Planet Video

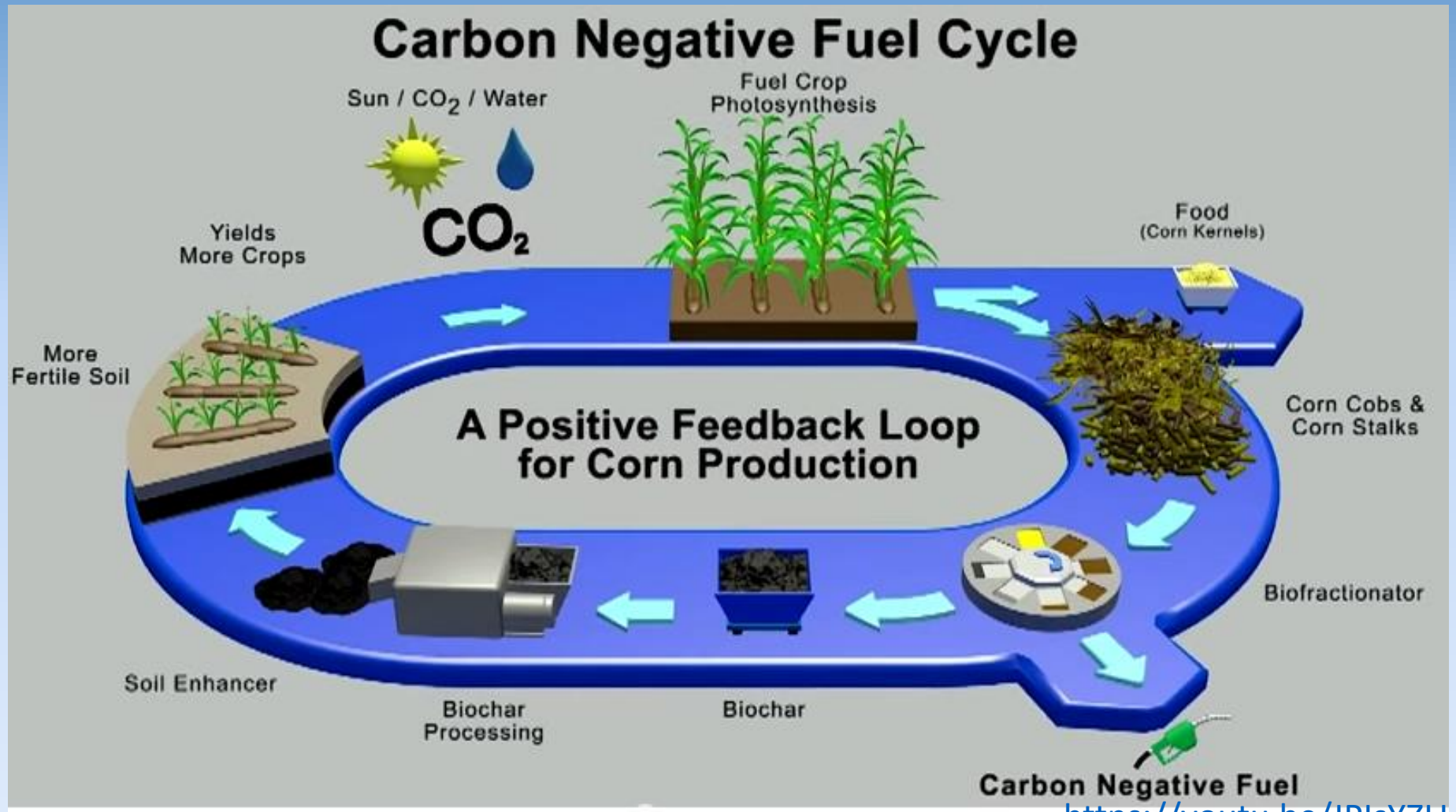


https://youtu.be/JPJsYZLU_sM?t=535

Types of Photosynthesis

- **About C3, C4 and Cam Photosynthesis and Plants:**
- **Photosynthetic efficiency: http://en.wikipedia.org/wiki/Photosynthetic_efficiency**
- **C3 carbon fixation: http://en.wikipedia.org/wiki/C3_carbon_fixation**
- **C4 carbon fixation:http://en.m.wikipedia.org/wiki/C4_carbon_fixation**
- **Summary table comparison: http://www.cropsreview.com/types-of-photosynthesis.html**
- **C3 C4 CAM Photosynthesis video: https://www.youtube.com/watch?v=Yg_pdXzWXVA**

Carbon negative fuel cycle: Biochar and Biofuels



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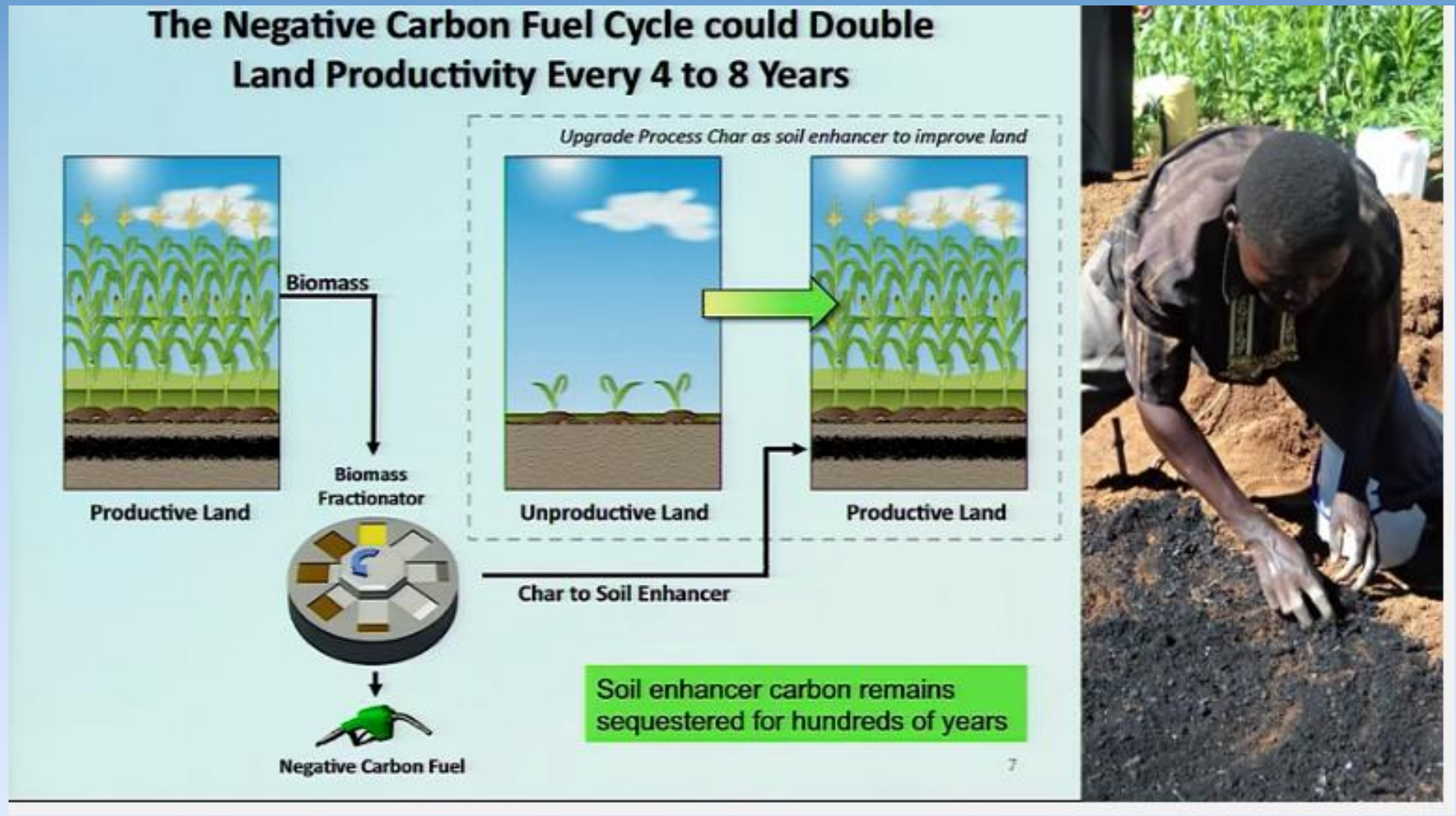
Soil Enhancement



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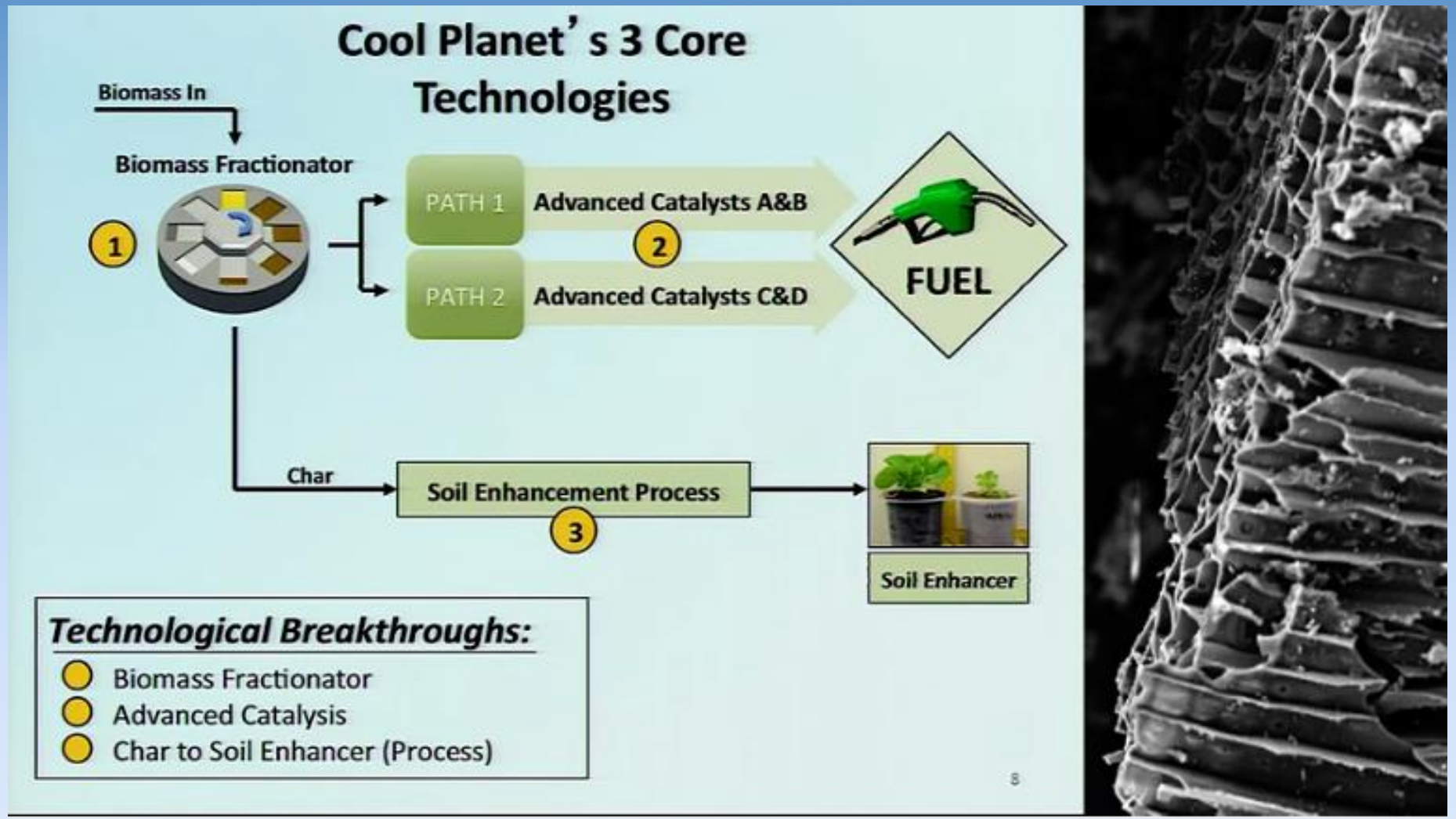
Core Technologies:



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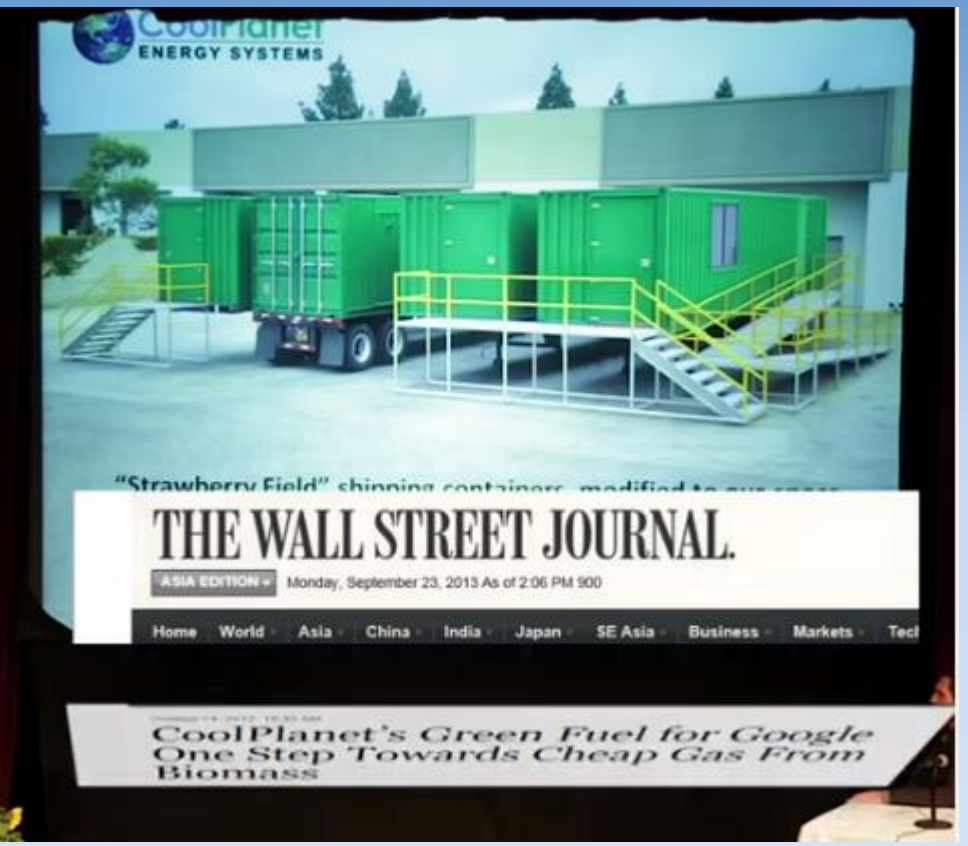
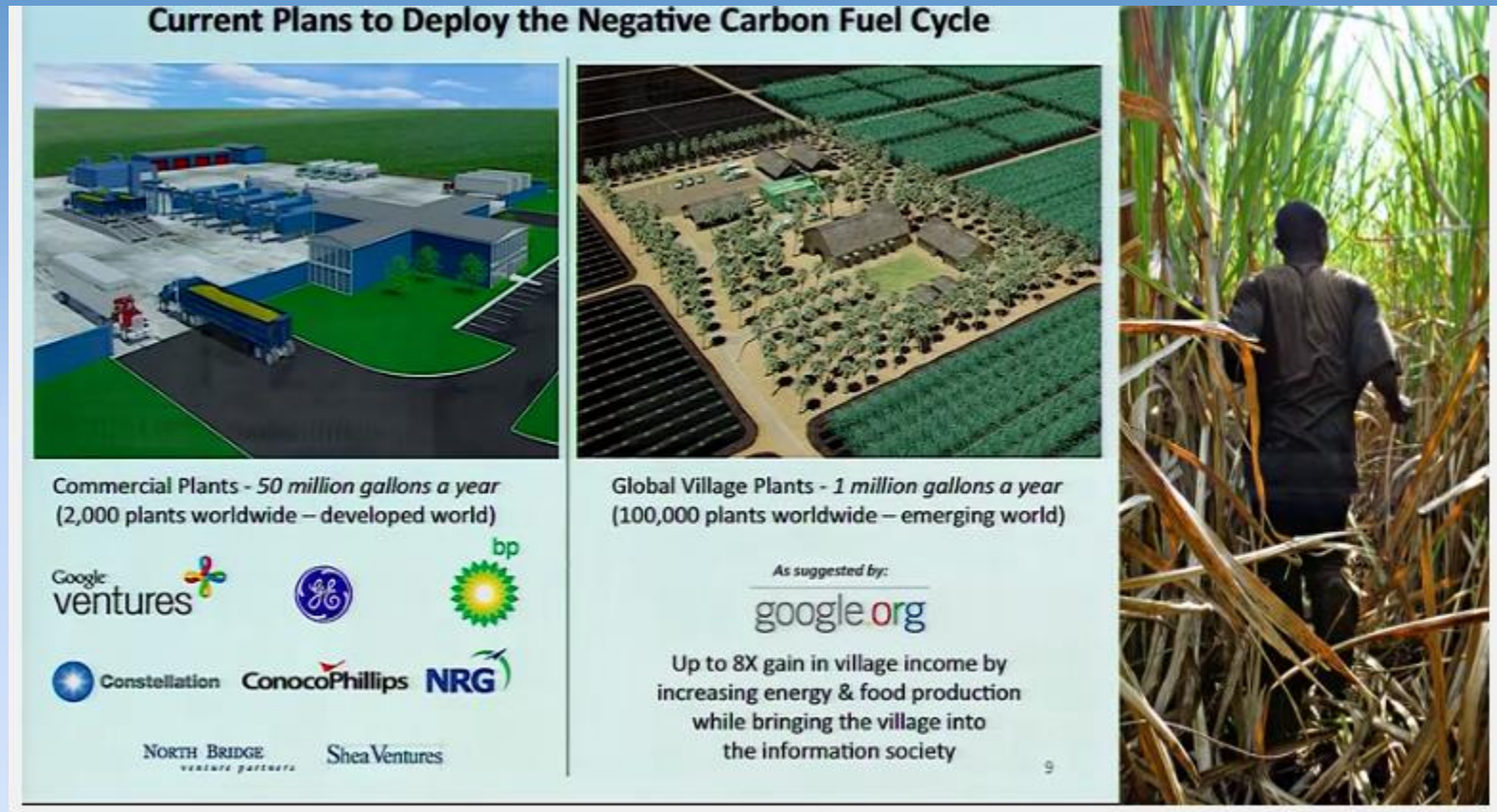
Sponsorships





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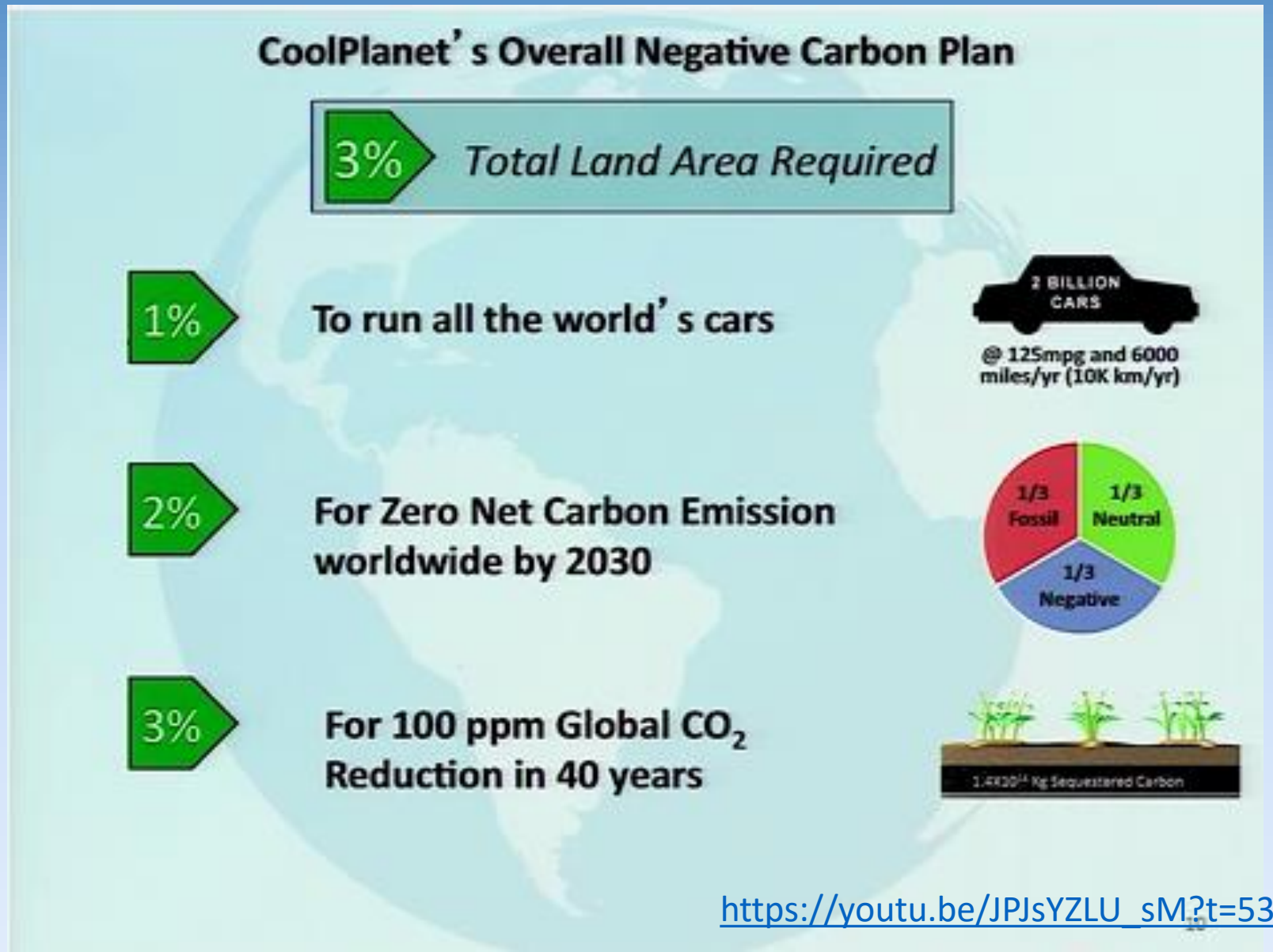
CARBON NEGATIVE BENEFITS:

- Sequester CO2
- create Biofuels



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Bio-energy with carbon capture and storage (BECCS)

Bio-energy with carbon capture and storage

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