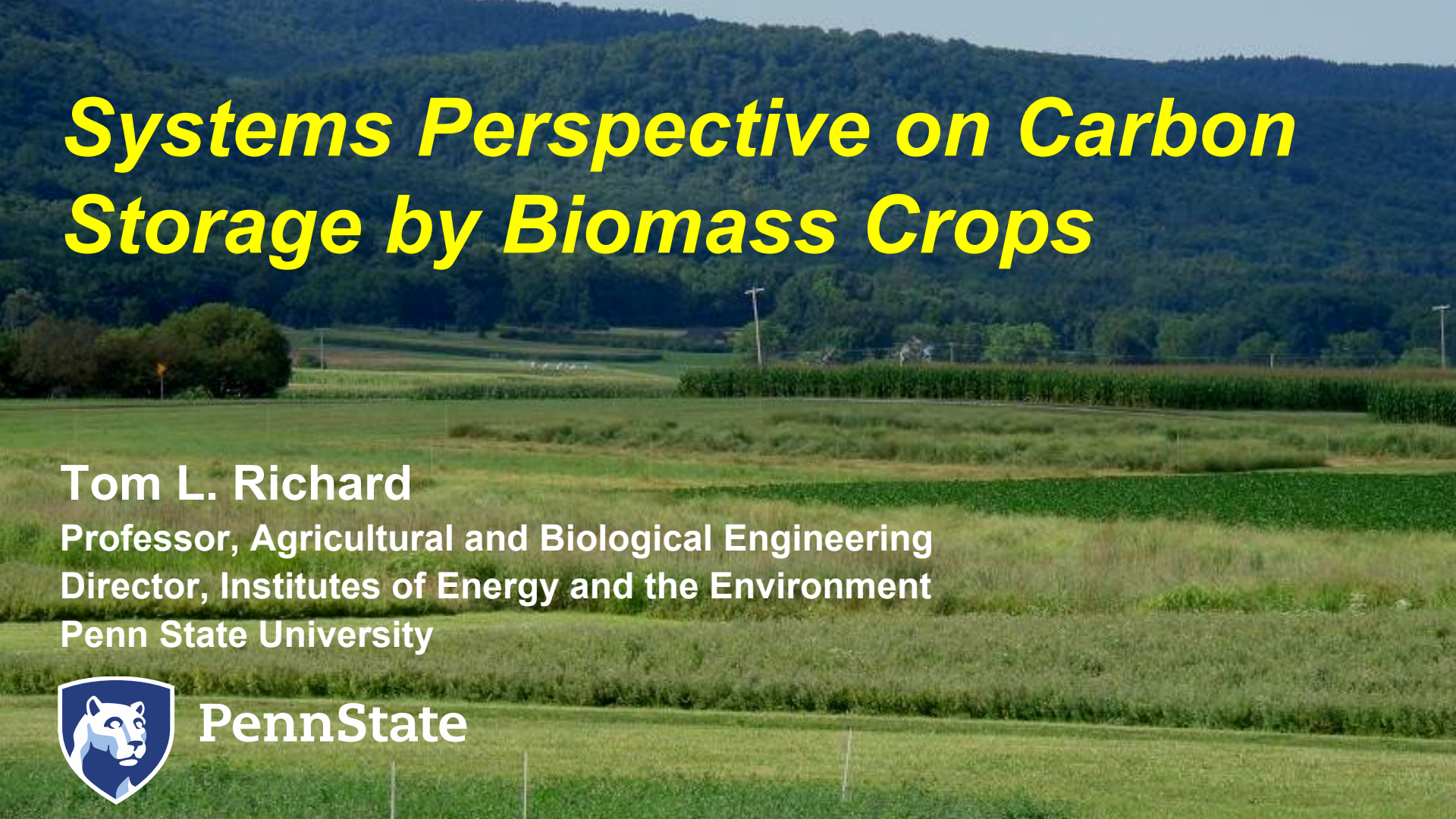
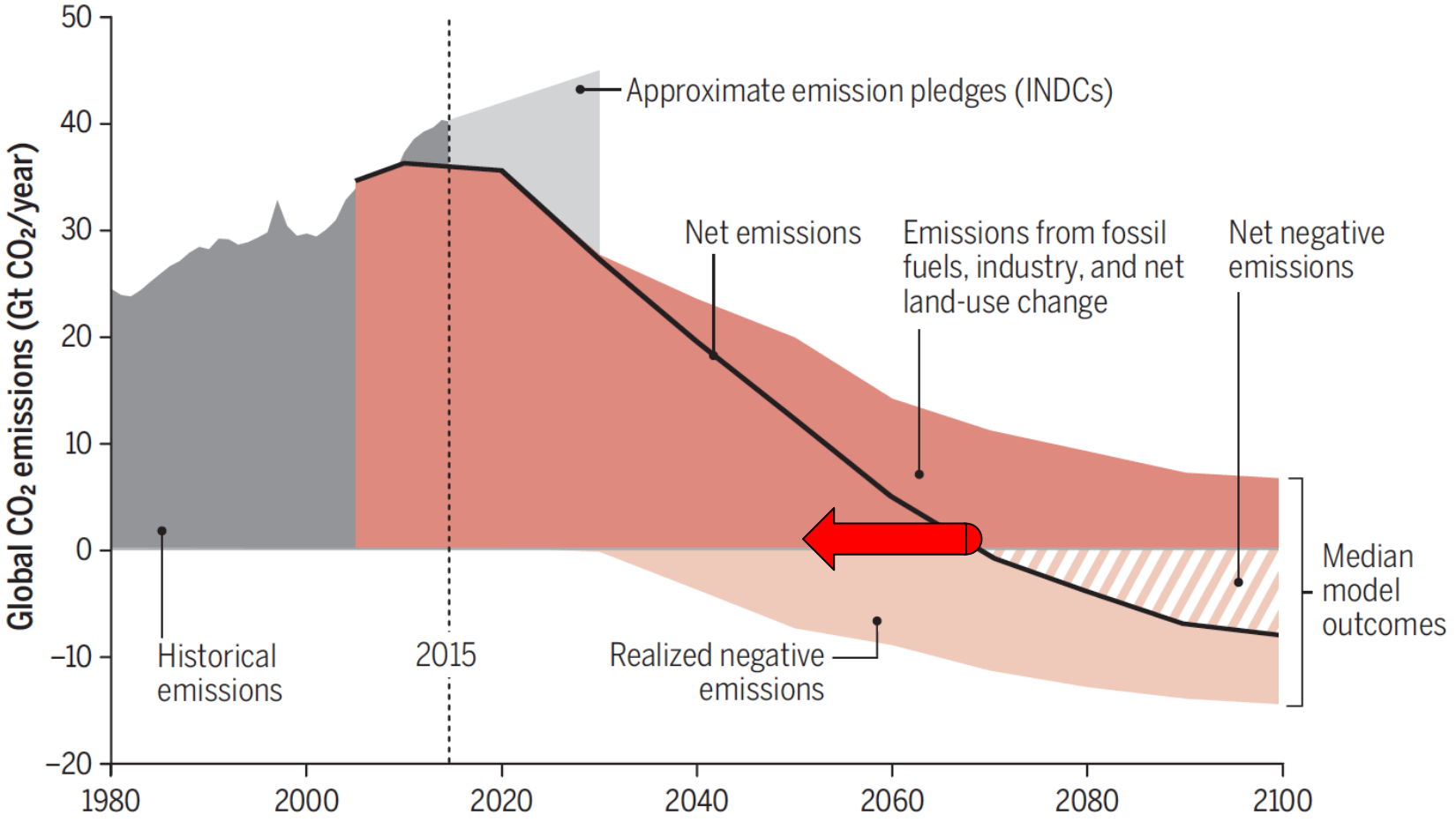
Systems Perspective on Carbon Storage by Biomass Crops



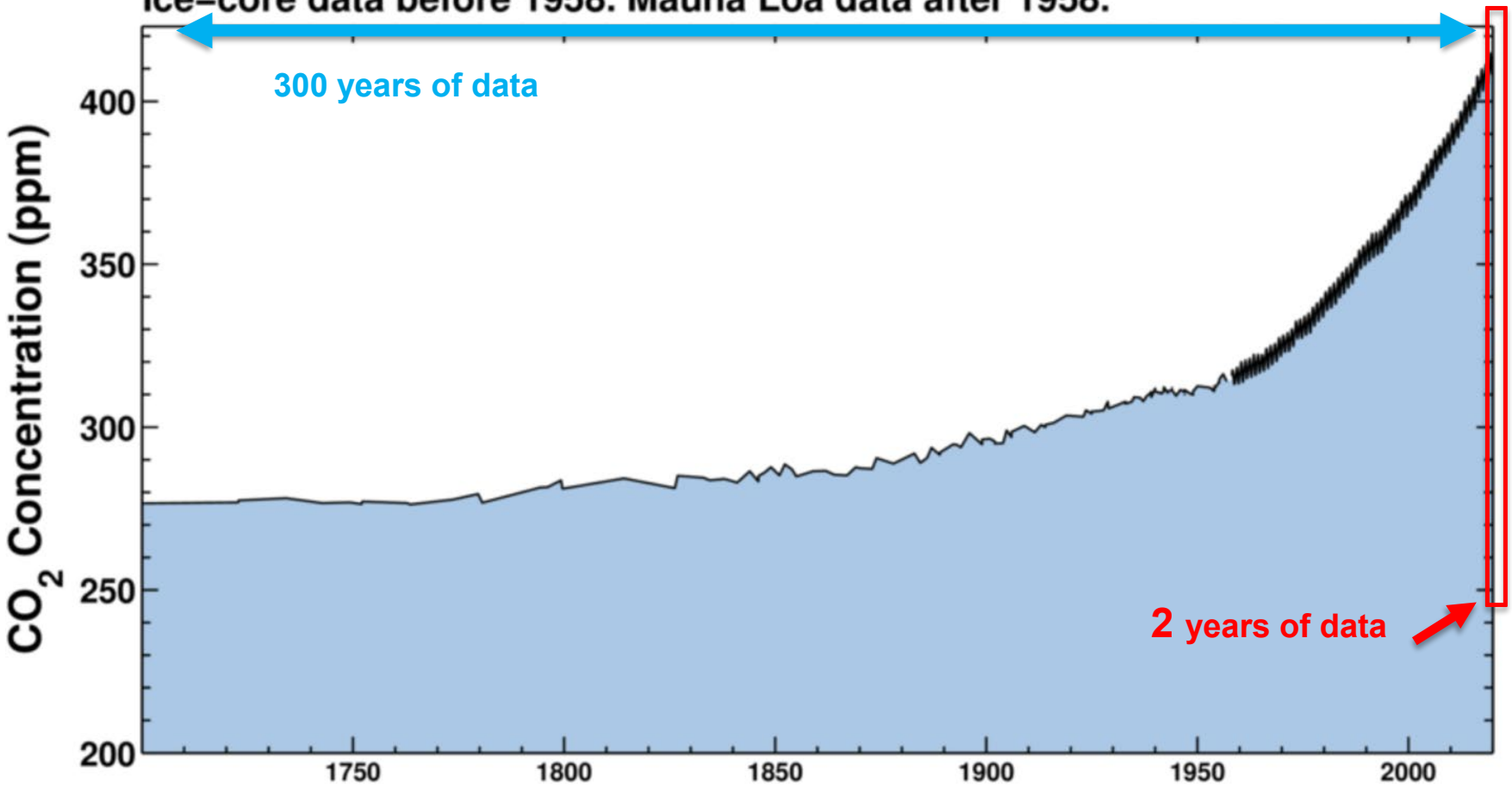
Tom L. Richard
Professor, Agricultural and Biological Engineering
Director, Institutes of Energy and the Environment
Penn State University

PennState

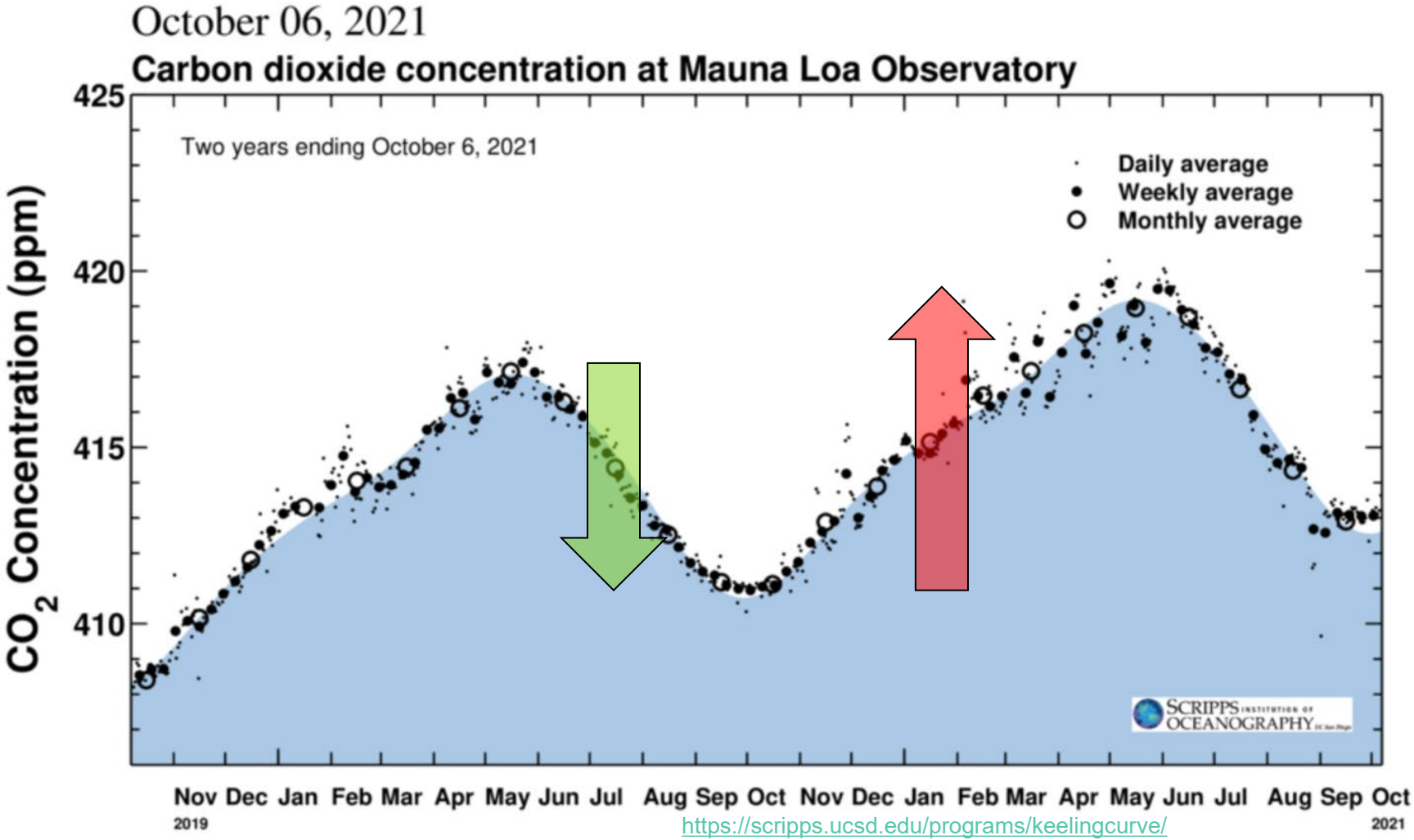


Anderson and Peters. 2016

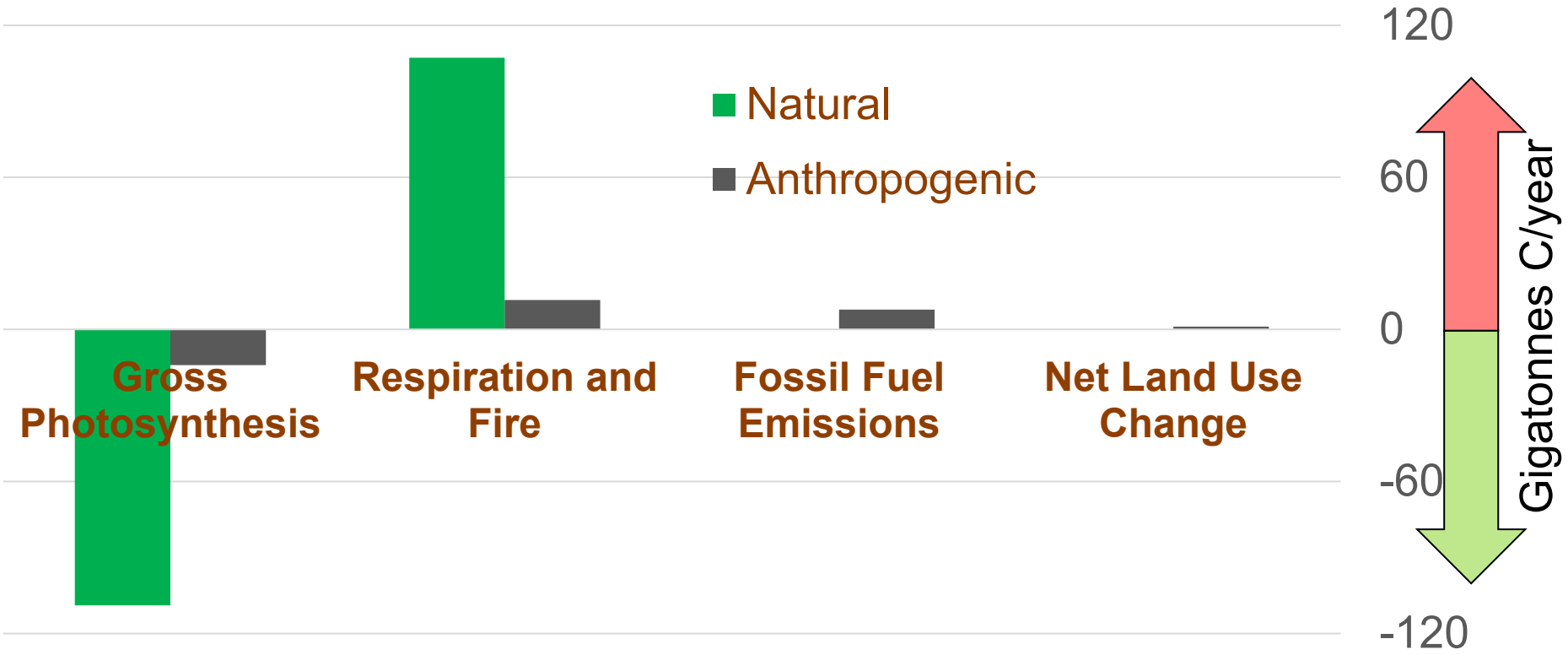
August 30, 2020



https://scripps.ucsd.edu/programs/keelingcurve/


October 06, 2021
Carbon dioxide concentration at Mauna Loa Observatory
Two years ending October 6, 2021
Daily average
Weekly average
Monthly average
CO2 Concentration (ppm)
425
420
415
410
Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct
2019
2021
SCRIPPS INSTITUTION OF OCEANOGRAPHY
https://scripps.ucsd.edu/programs/keelingcurve/

Annual Terrestrial and Fossil Carbon Flux



Data from IPCC, 2013

Leveraging Natural Solutions

Opportunities

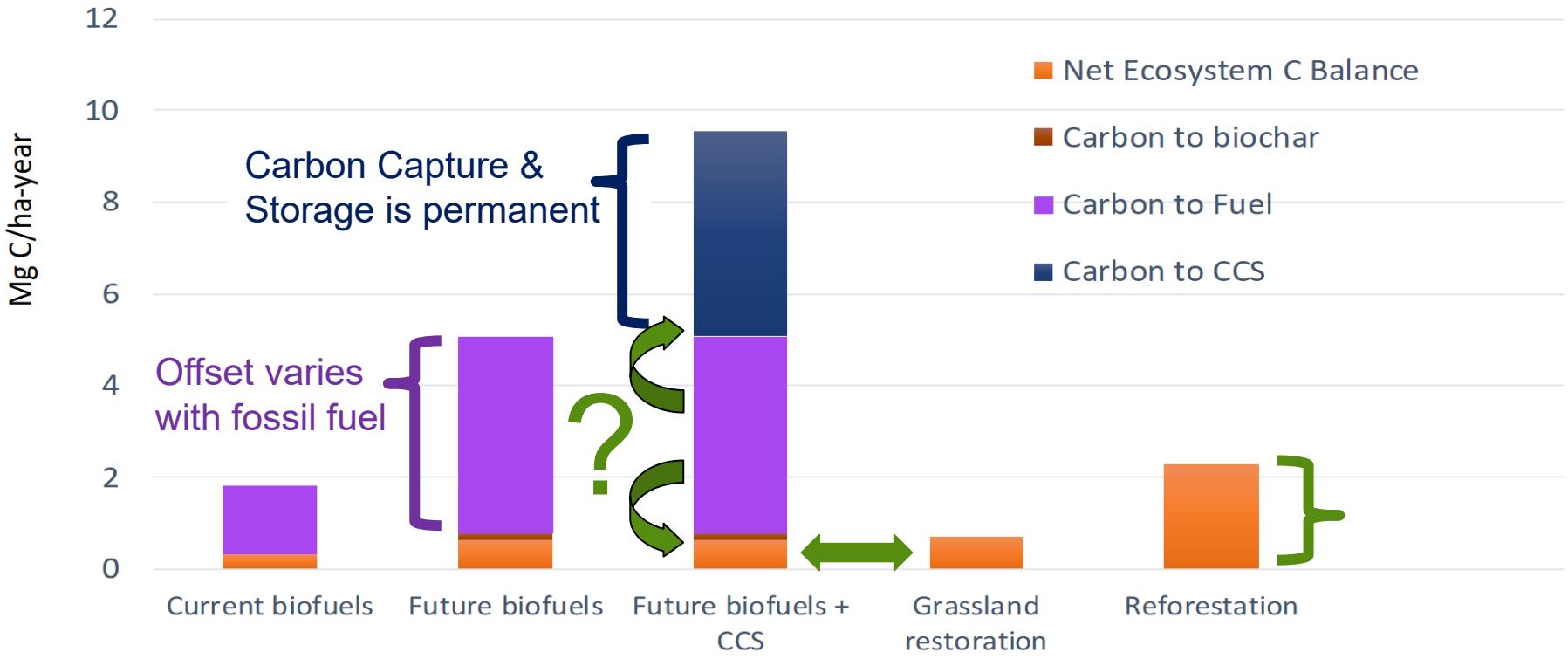
- Low Cost
- Large Volumes
- Synergies:
  - Biodiversity
  - Water Quality
  - Soil Health
- Rural Economic Development

Challenges

- Additionality
- Leakage
- Reversals
- Permanence
- Uncertainty & Verification
- Social Justice
  - Land tenure
  - Food security
  - Energy security

Adapted from Oldfield et al. 2021
https://www.edf.org/soilcarbon

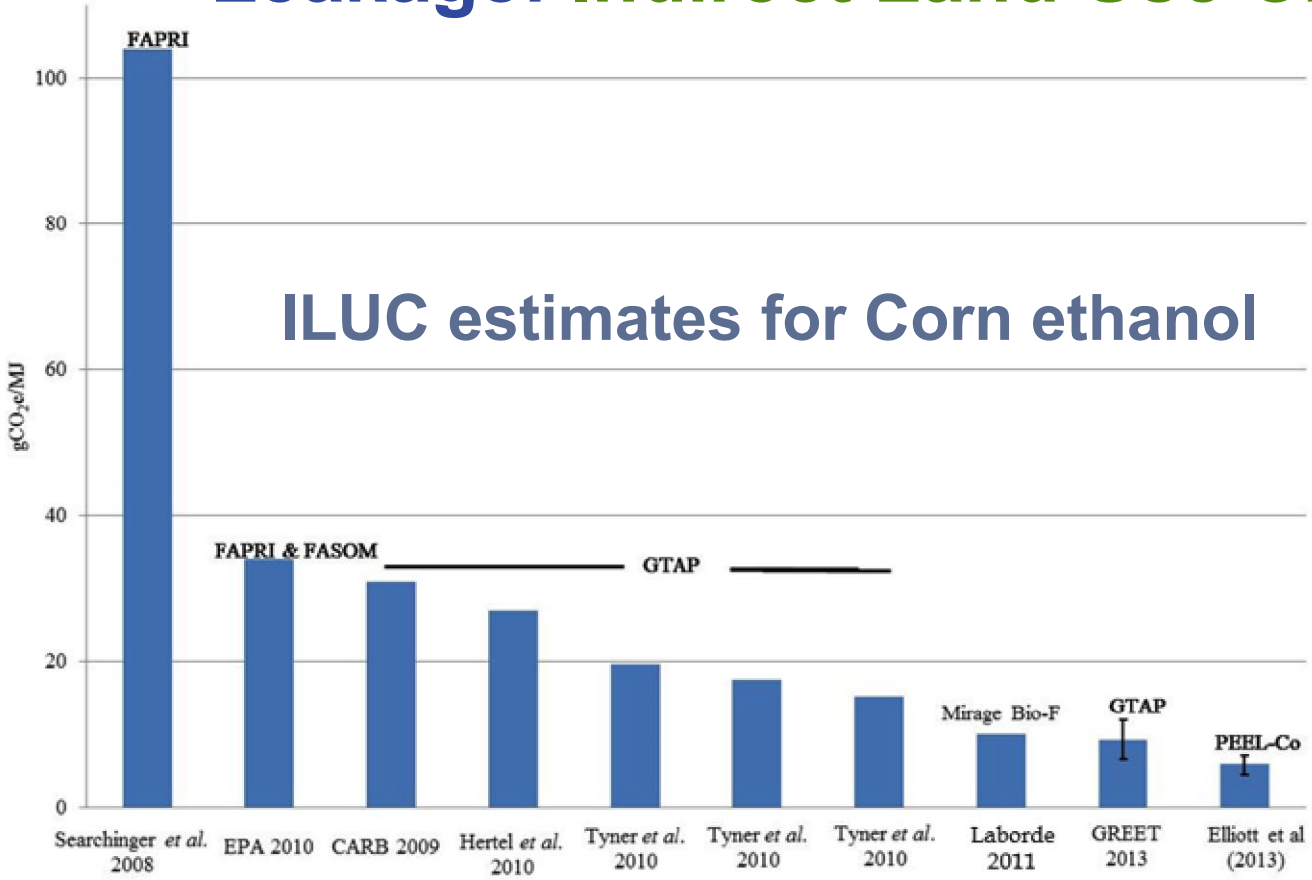
Additionality: vs Business as Usual



Biomass Crop: Switchgrass, future yield assumes 2% annual increase, compounded
Process: Cellulosic ethanol, future includes hybrid CBP and thermochemical

Field et al. 2020

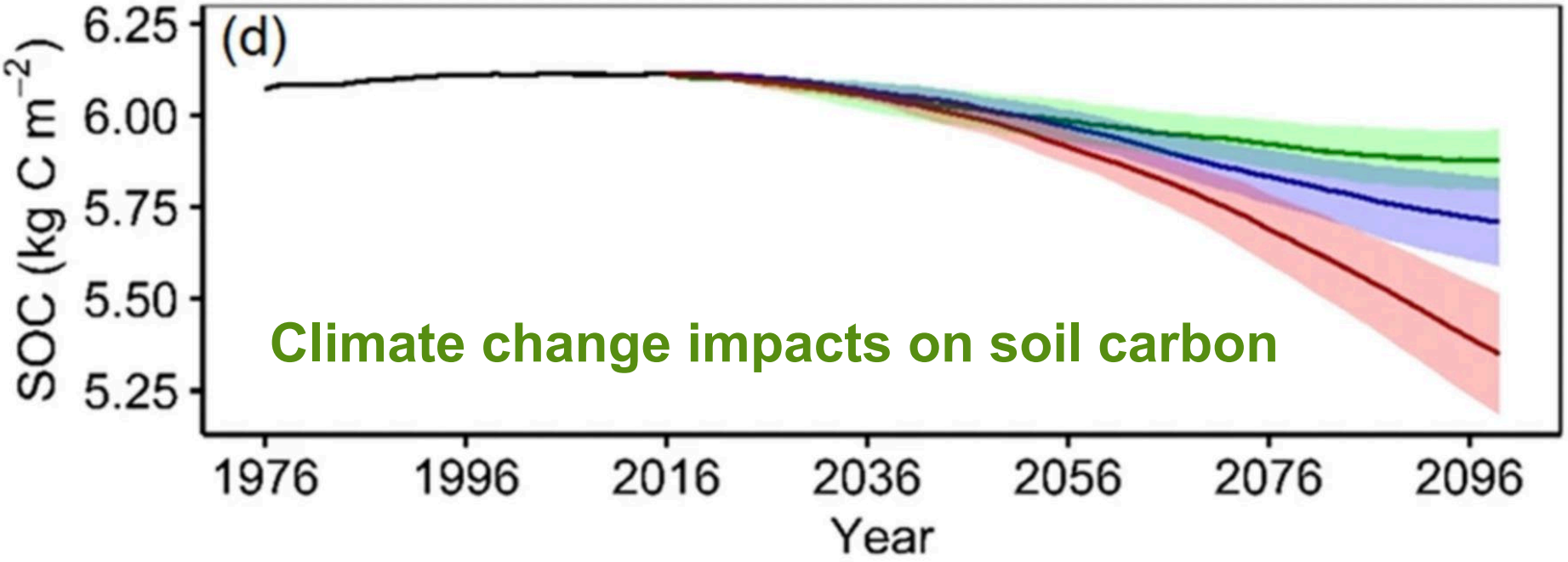
Leakage: Indirect Land Use Change



de Carvalho Macedo et al. 2015. p 597.
http://bioenfapesp.org/scopebioenergy/index.php/project-overview/

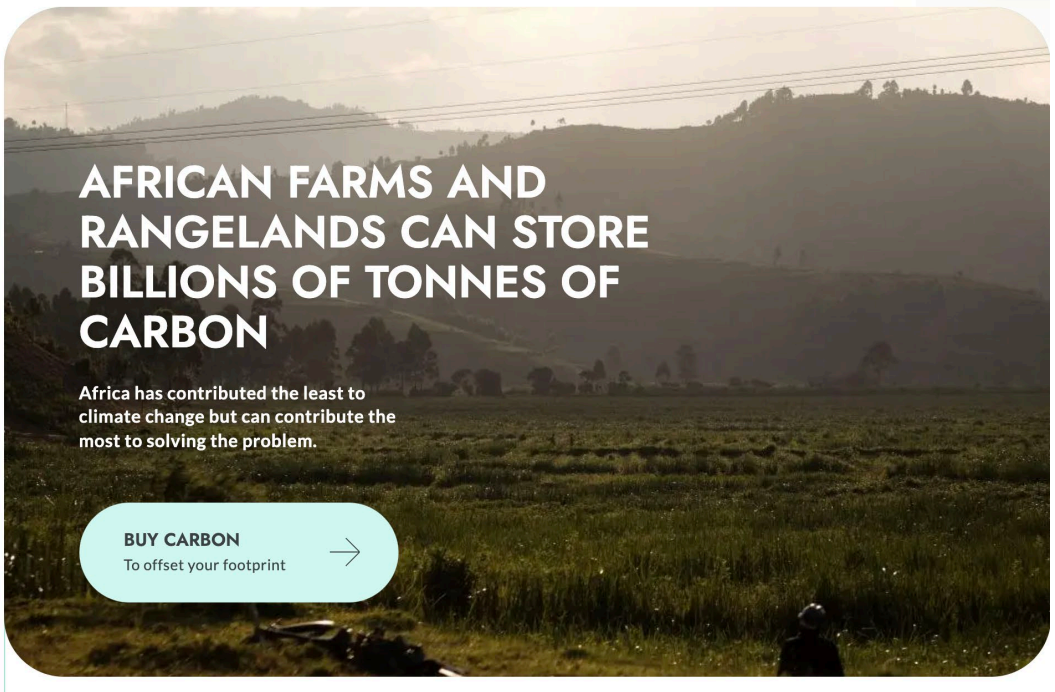
Reversals: Direct Land Use Change

Permanence: Future Generations?



Zhao et al. 2021
https://doi.org/10.1186/s13021-021-00187-2

Uncertainty and Verification: Carbon For Good

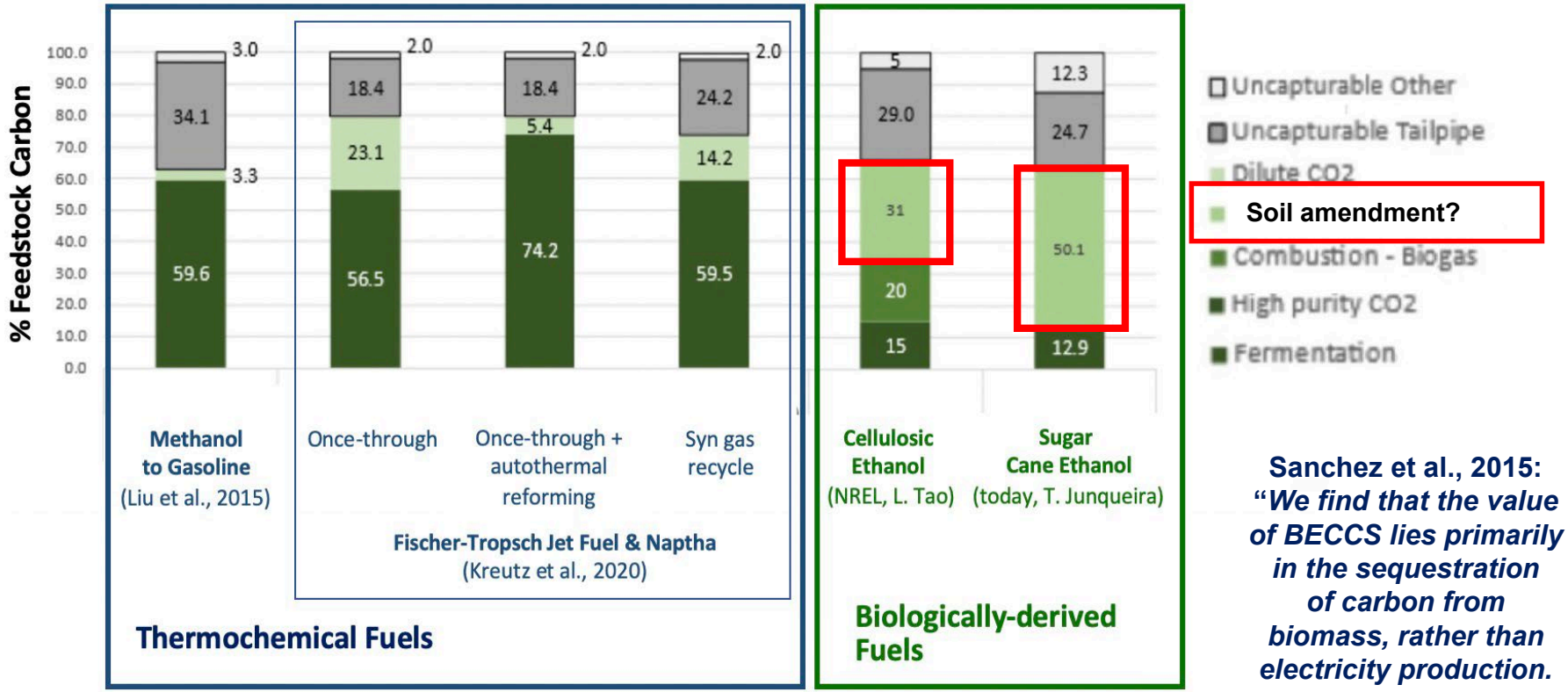


- Community Engagement
- On-site Educators
- Localized Carbon models
- Satellite & Cellphone Verification
- Blockchain Accounting

777,290 TREES HAVE BEEN PLANTED FOR OFFSETTING

https://carbon4good.net/

Biofuels as a Vehicle for Carbon Storage

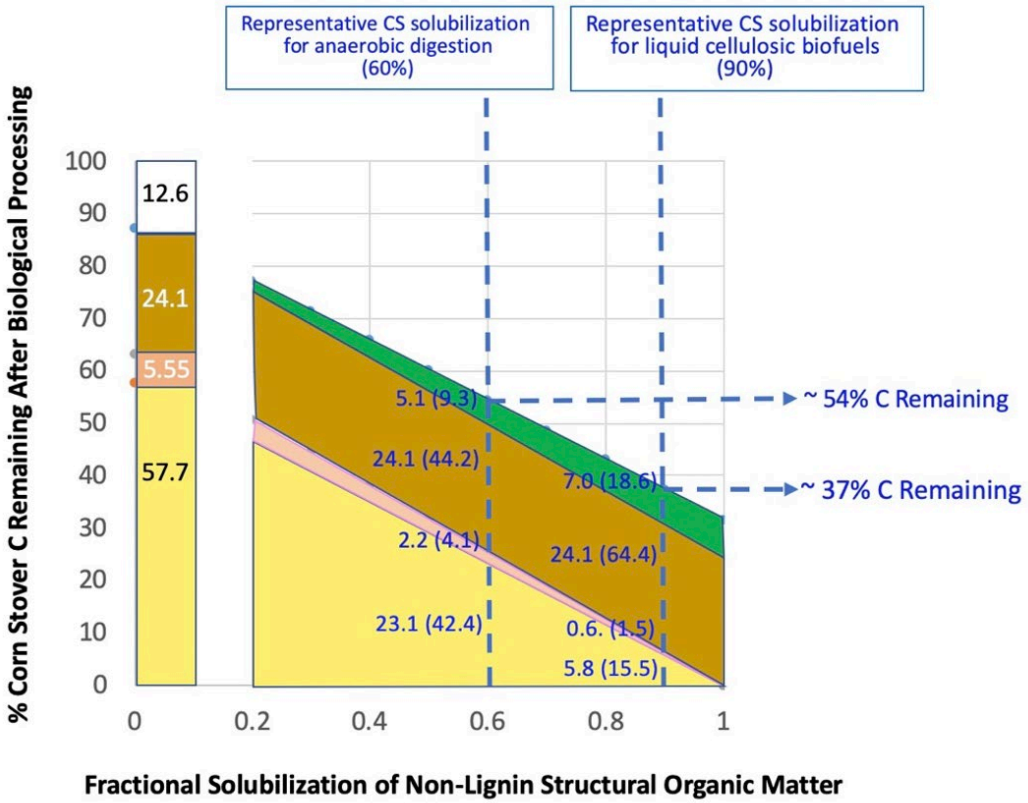


Sanchez et al., 2015:
"We find that the value of BECCS lies primarily in the sequestration of carbon from biomass, rather than electricity production.

Lynd et al. in prep

https://www.nature.com/articles/nclimate2488

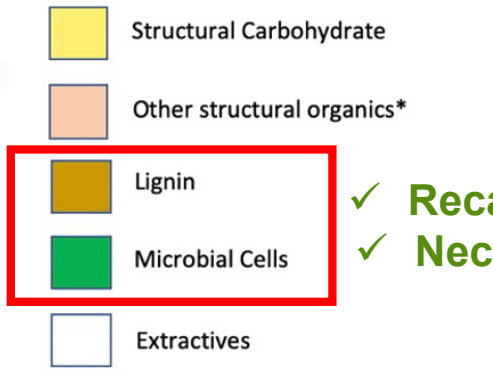
Fermentation Wastes? Or Treasure?



Lynd et al. in prep

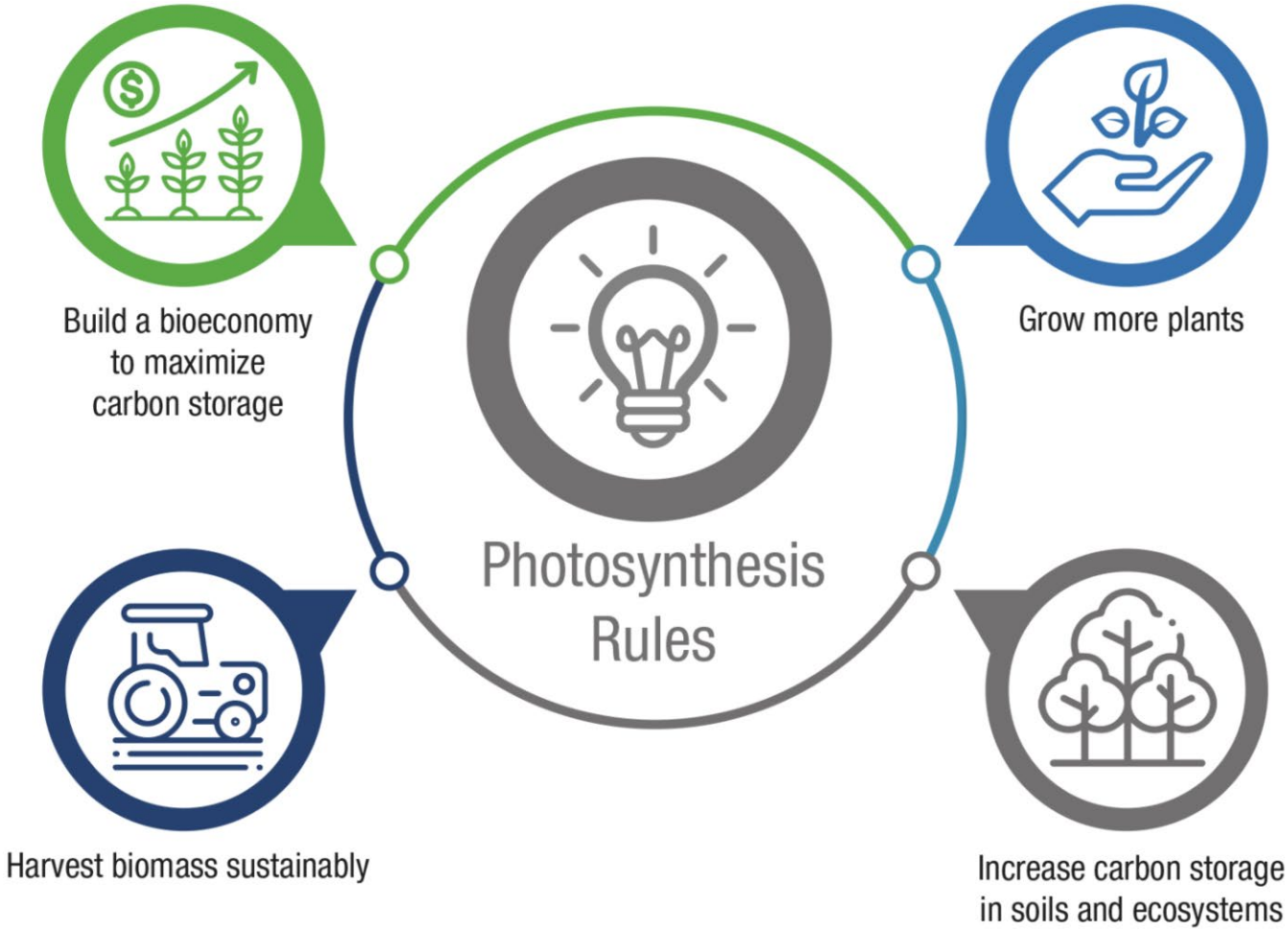
- Additionality
- Leakage
- Reversals
- Permanence
- Uncertainty & Verification

?



✓ Recalcitrant
✓ Necromass

* Protein and hemicellulose-bound acetyl



https://sdg-action.org/harnessing-the-power-of-photosynthesis-for-negative-emissions/

Penn State University

Professor Erica Smithwick
Professor Armen Kemanian
Professor Jay Regan
Dr. Michael Shreve (PostDoc)
Dr. Katie Hirl (soon Benedictine College)
Dr. Senorpe Asem-Hiablie (now Shell)
Dr. Stephanie Herbstritt (now Cornell)
Dr. Anahita Bharadwaj (now Meati Foods)
Dr. Veronika Vazhnik (now Jacobs)
Ms. Haley Stauffer (now InduFor)
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Dartmouth College

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Mark Laser

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