How the Climate Crisis Can Help Finance Biochar Efforts, and What That Means to America, India and the Planet

A presentation to the webinar of Biochar Crusaders
on 11 January 2021 by

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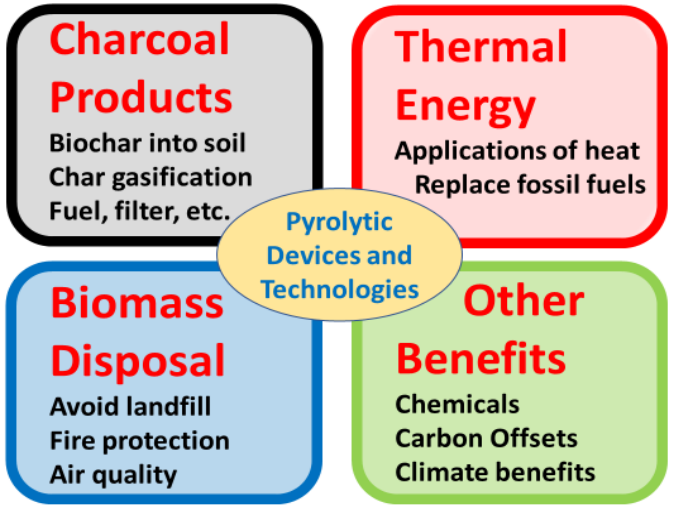


- It is assumed that this audience knows the basics about Biochar characteristics, production, uses and costs.

- Our focus is on how Biochar issues of carbon accounting can have impact on the global climate crisis, with benefits for those working with Biochar.

- The work done in the USA has relevance for India and other societies.

There is a Climate Crisis

- **Excessive carbon dioxide** (CO_2) and other greenhouse gases (GHG)
  - Need to **REDUCE emissions and REMOVE excess ppm** (parts per million).

- The climate crisis will **alter economic activity** around the world in at least two major ways:
- **Destructive disruption** of normal activities
  - floods, fires, storms, etc.

- **Constructive stimulation** of activities that could help end the crisis
  - shift to renewable energy **Energy from biomass means REDUCTION of emissions.**
  - repair the climate regarding CO2e issues **Biochar is REMOVAL of excess.**
  - adaptation to sustain life: Biochar improves soil that increases food supply.

Focus on Removal

- I am involved with CDR and NET and GGR. These are global issues !!
  - In most ways, **what applies to America also applies to India.**

- Presented a white paper in Dec 2020.
  - **"Climate Intervention with Biochar"** [52 pages.]
  - Available free at: **www.woodgas.energy/resources**

- Preparing for release this week another document at same website.
  - **"Understanding Removal of Carbon Dioxide (CDR)"**

    That document proposes a fundamental restructuring of CDR terminology.

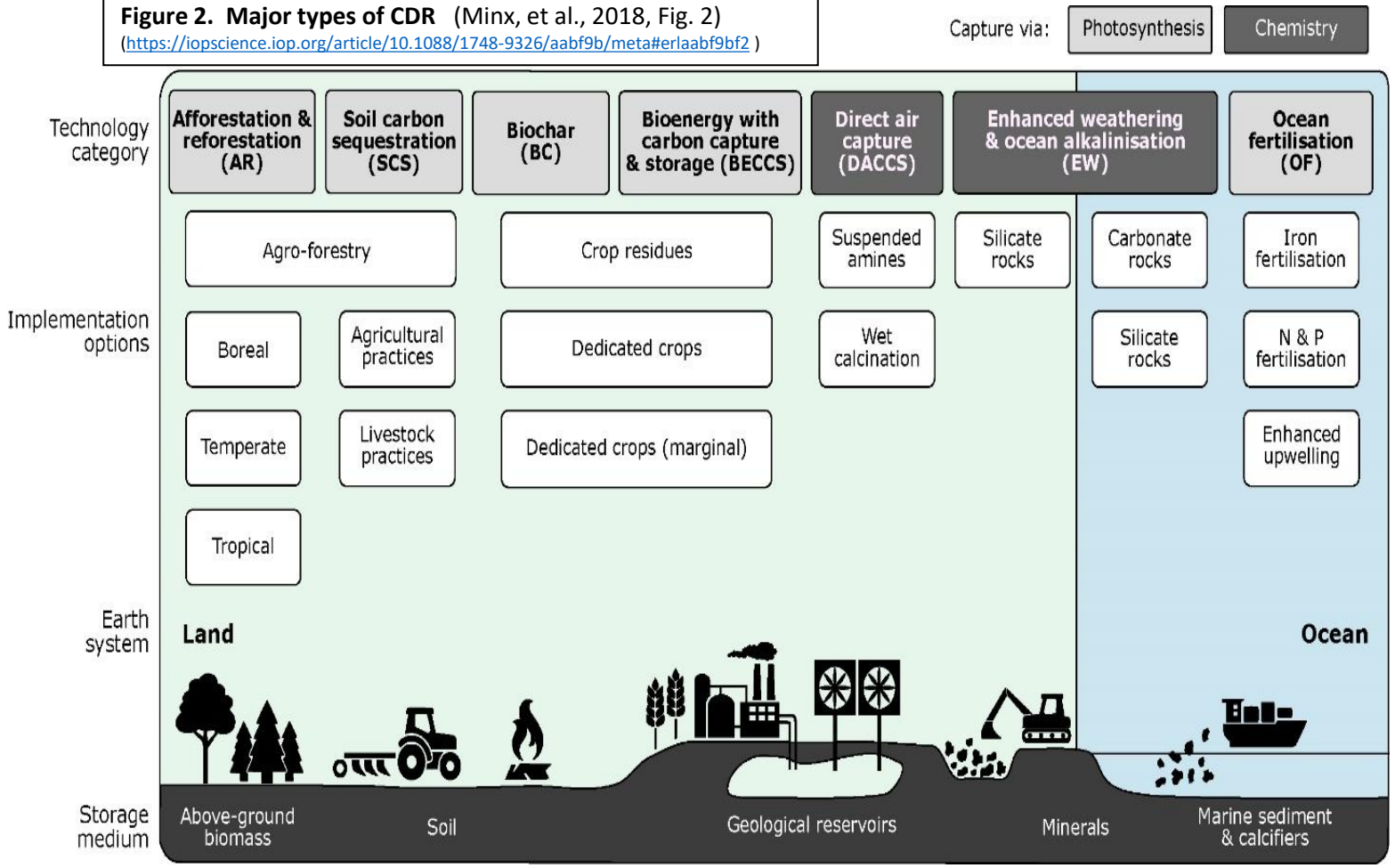
- We discuss the pre-2021 view of CDR and a new view presented in 2021.

Pre-2021 View of CDR

Box 4: Names in 2020 of the Seven (7) Prominent Negative Emission Technologies (NETs) for Carbon Dioxide Removal (CDR):

EW Enhanced Weathering
DACCS Direct Air Carbon Capture and Storage.
AR Afforestation and Reforestation
SCS Soil Carbon Sequestration
OF Ocean Fertilization
BECCS Bioenergy Carbon Capture and Storage
BC Biochar

Figure 2. Major types of CDR (Minx, et al., 2018, Fig. 2)
(https://iopscience.iop.org/article/10.1088/1748-9326/aabf9b/meta#erlaabf9bf2)



- List of **18 "inaccuracies"** in this system, including:
  - **Lacks clarity of what is CAPTURE and what is STORAGE.**
  - **BC and BECCS do NOT capture any CO_2 from the air.**
  - Crops do capture. • AR and SCS have short-term storage.

2021 View of CDR

Major categories of "ways" to have capture and storage of carbon dioxide (CDR)

PG to OMS

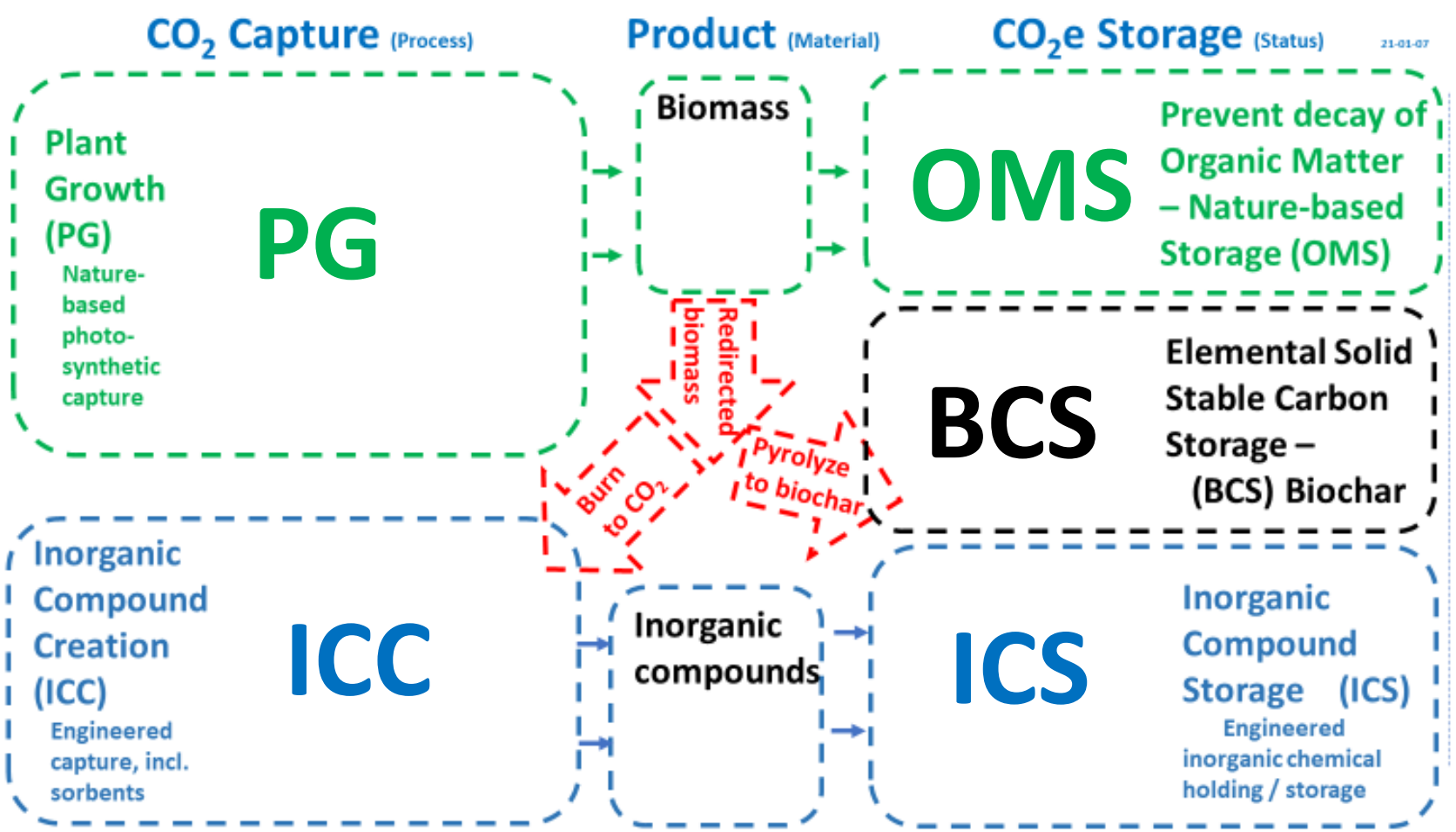
- FWG to TREES
- SOMG to SOMS
- PG to SOMS

PG to BCS

- FWG to BC-SOILS
- AAG to BC-CONS

ICC to ICS

- DAC to ICS
  - DAC to GEOS
  - DAC to CONS
- CCE to ICS
  - CCE to GEOS
  - CCE to CONS
- EW to ICS
  - EW to SOILS
  - EW to OCS



- **Two ways of Capture**
- **Three ways of Storage**

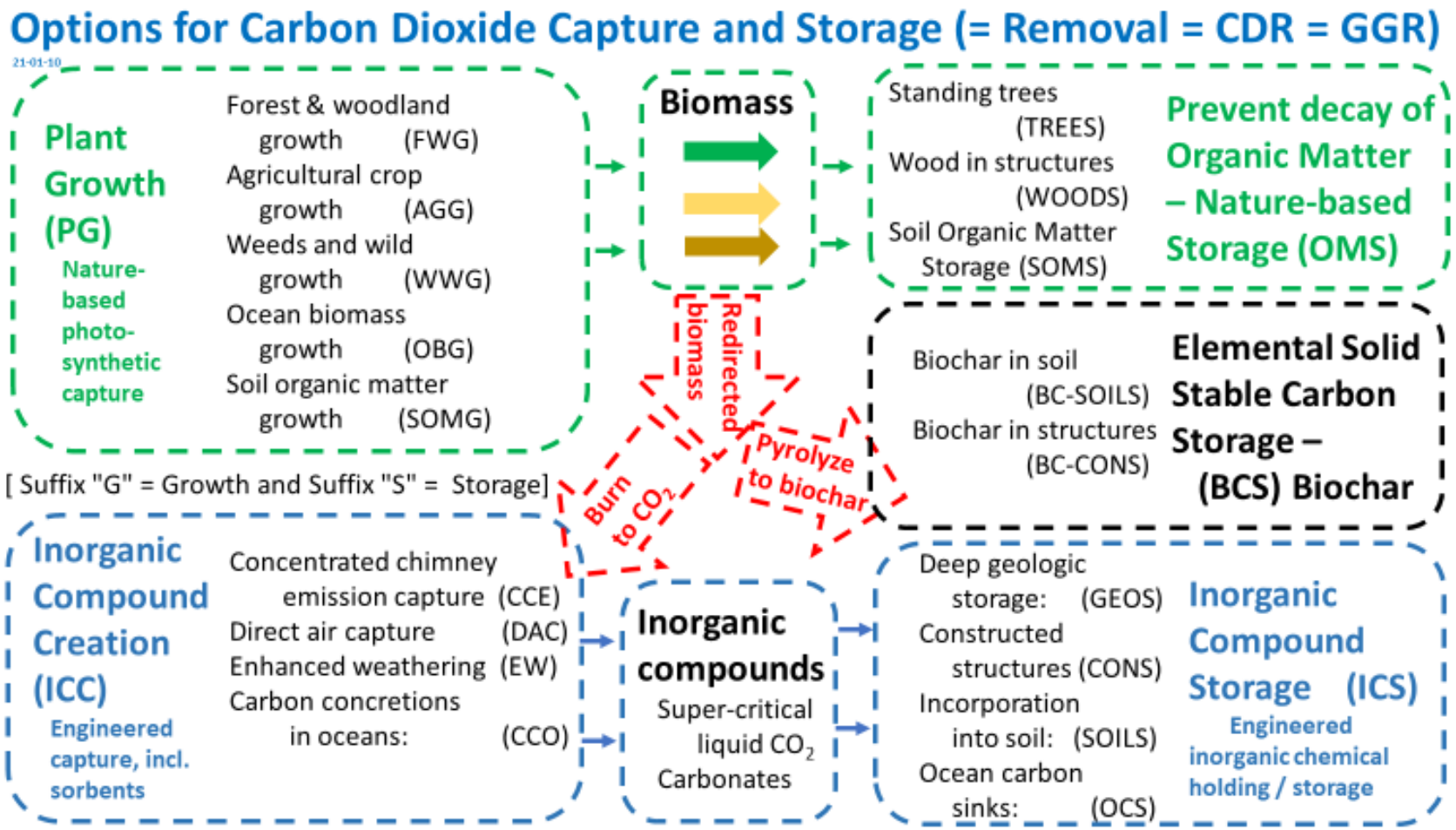
New View of CDR

Selected sub-categories of "ways" to have capture and storage of carbon dioxide (CDR)

PG to OMS
- **FWG to TREES**
- **SOMG to SOMS**
- **PG to SOMS**

PG to BCS
- **FWG to BC-SOILS**
- **AAG to BC-CONS**

ICC to ICS
- **DAC to ICS**
  - **DAC to GEOS**
  - **DAC to CONS**
- **CCE to ICS**
  - **CCE to GEOS**
  - **CCE to CONS**
- **EW to ICS**
  - **EW to SOILS**
  - **EW to OCS**



- There can be additional sub-categories and sub-sub-categories for further refinement.

Options for Carbon Dioxide Capture and Storage (= Removal = CDR = GGR)

21-01-10

Plant Growth (PG)

Nature-based photo-synthetic capture

- Forest & woodland growth (FWG)
- Agricultural crop growth (AGG)
- Weeds and wild growth (WWG)
- Ocean biomass growth (OBG)
- Soil organic matter growth (SOMG)

[Suffix "G" = Growth and Suffix "S" = Storage]

Biomass

- Standing trees (TREES)
- Wood in structures (WOODS)
- Soil Organic Matter Storage (SOMS)

Prevent decay of Organic Matter – Nature-based Storage (OMS)

Redirected biomass

Burn to CO_2

Pyrolyze to biochar

Elemental Solid Stable Carbon Storage – (BCS) Biochar

- Biochar in soil (BC-SOILS)
- Biochar in structures (BC-CONS)

Inorganic Compound Creation (ICC)

Engineered capture, incl. sorbents

- Concentrated chimney emission capture (CCE)
- Direct air capture (DAC)
- Enhanced weathering (EW)
- Carbon concretions in oceans: (CCO)

Inorganic compounds

- Super-critical liquid CO_2
- Carbonates

Inorganic Compound Storage (ICS)

Engineered inorganic chemical holding / storage

- Deep geologic storage: (GEOS)
- Constructed structures (CONS)
- Incorporation into soil: (SOILS)
- Ocean carbon sinks: (OCS)

Major ways of CDR, their Sub-categories and Suggested Common Names.

PG to OMS

Plant Growth to Organic Matter Storage

FWG to TREES ***TREES*** **(Formerly AR)**

Forest and Woodland Growth to Tree Storage

SOMG to SOMS ***SOMS*** **(Formerly SCS)**

Soil Organic Matter Growth to Soil Organic Matter Storage

PG to SOMS

Plant Growth to Soil Organic Matter Storage

PG to BCS ***BC***

Plant Growth to Biochar Storage

FWG to BC-SOILS

Forest and Woodland Growth to Biochqr in Soil Storage

AGG to BC-CONS

Agriculture Crop Growth to Biochar in Construction Storage

ICC to ICS

Inorganic Compound Creation to Inorganic Compound Storage

DAC to ICS ***DAC***

Direct Air Capture to Inorganic Compound Storage

DAC to GEOS

Direct Air Capture to Deep Geologic Storage

DAC to CONS

Direct Air Capture to Construction Storage

CCE to ICS ***CCE*** **(Formerly BECCS – which actually is PG to CO_2 to CCE to ICS)**

Concentrated Chimney Emission Capture to Inorganic Compound Storage

CCE to GEOS

CCE to CONS

EW to ICS ***EW***

Enhanced Weathering to Inorganic Compound Storage

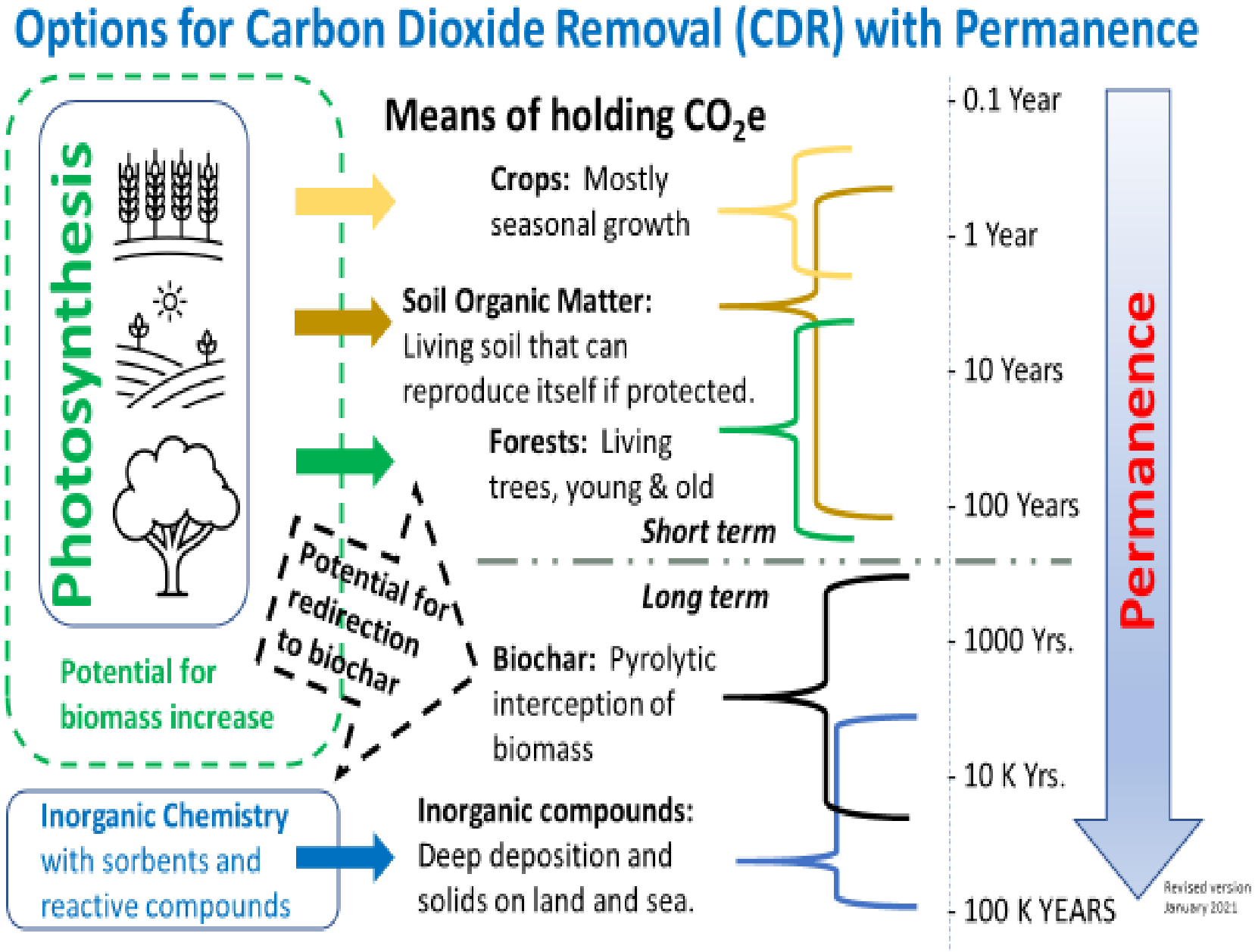
EW to SOILS

EW to OCS ***OCS*** (F**ormerly OF and OA –alkalinization)**

Enhanced weathering to Ocean Carbon Sinks

The Issue of Permanence

- REMOVAL that is not permanent for **at least multiple centuries** is not sufficient storage for the needed climate impact.
- If in doubt, name it **CDRS** (add "S" to emphasize storage) or "True CDR".



Position of Biochar among the CDR options

- **Biochar (and BECCS) do not capture any CO2 from the atmosphere.**
  - Plants do that capture and provide biomass that can be burned by BECCS (carbon neutral) or pyrolyzed into biochar (carbon negative).

- Biochar (and BECCS) are the only CDR methods associated with **significant release energy.**
  - The energy comes from biomass. Most others consume energy. Even OMS such as by TREES and crops cannot provide energy release except by a loss of storage of CO_2.
  - BECCS can provide energy from nature-based plant growth (PG) but its link to CO2 capture is from engineer inorganic compound creation (ICC) using capture of concentrated chimney emission that requires an input of energy.

- **Biochar is the only way for the carbon of plant growth (PG) to directly become stable storage for long-term sequestration.**

- Pyrolysis transforms the carbon in biomass into charcoal (biochar) that is **typically 80% pure stable carbon.**

- **Biochar is the most physically visible and tangible of any long-term storage of CDR.**
  - All organic matter storage (OMS) is short-term, and all inorganic compound storage (ICS) is more difficult to collect, handle and measure.

- **Therefore, *biochar is the most verifiable way to claim carbon units* for true removal.**

Value of Biochar

- Biochar as CO_2equivalent. Molecular weights 44/12 = 3.666 To be conservative, we commonly use 3.0 or 2.5 as the conversion factor.
- **Approximately 330 kg of biochar equals about 1t CO_2**
- There is concern about the lack of permanence of current REMOVAL of CO_2 by other CDR methods. **No true CDRS units are available for even $100 per 1t CO_2e, which would be approximately 330 kg of biochar.**
- *"Ultimately, we didn't believe the carbon removal credits [on the voluntary markets] that we could find and afford [for $100 per 1t CO_2e] on the market today represent the high-quality carbon removal we see as imperative for meeting climate goals."* November 2020 article by Carbon180.org https://carbon180.medium.com/in-search-of-carbon-removal-offsets-42abf71b3ccc
- Question to audience: **Can you show that you are taking 330 kg of decent biochar and putting it into permanent storage?** If yes, then that is worth about US$100, and you still get to sell the biochar for that storage.

Carbon Market General Info. for Offsets, Not CDR

Many, many variations.

Still trying to sort out some of the procedures.

Box ES.1 / Carbon pricing in numbers

61 carbon pricing initiatives implemented/scheduled

31 ETS and 30 carbon taxes

46 national, 32 subnational jurisdictions

Covering **12 $GtCO_2e$** (22% of global GHG emissions)

US$45 billion raised in carbon pricing revenues in 2019

More than **14,500** registered crediting projects to date, generating almost 4 billion tCO_2e of cumulative carbon credits

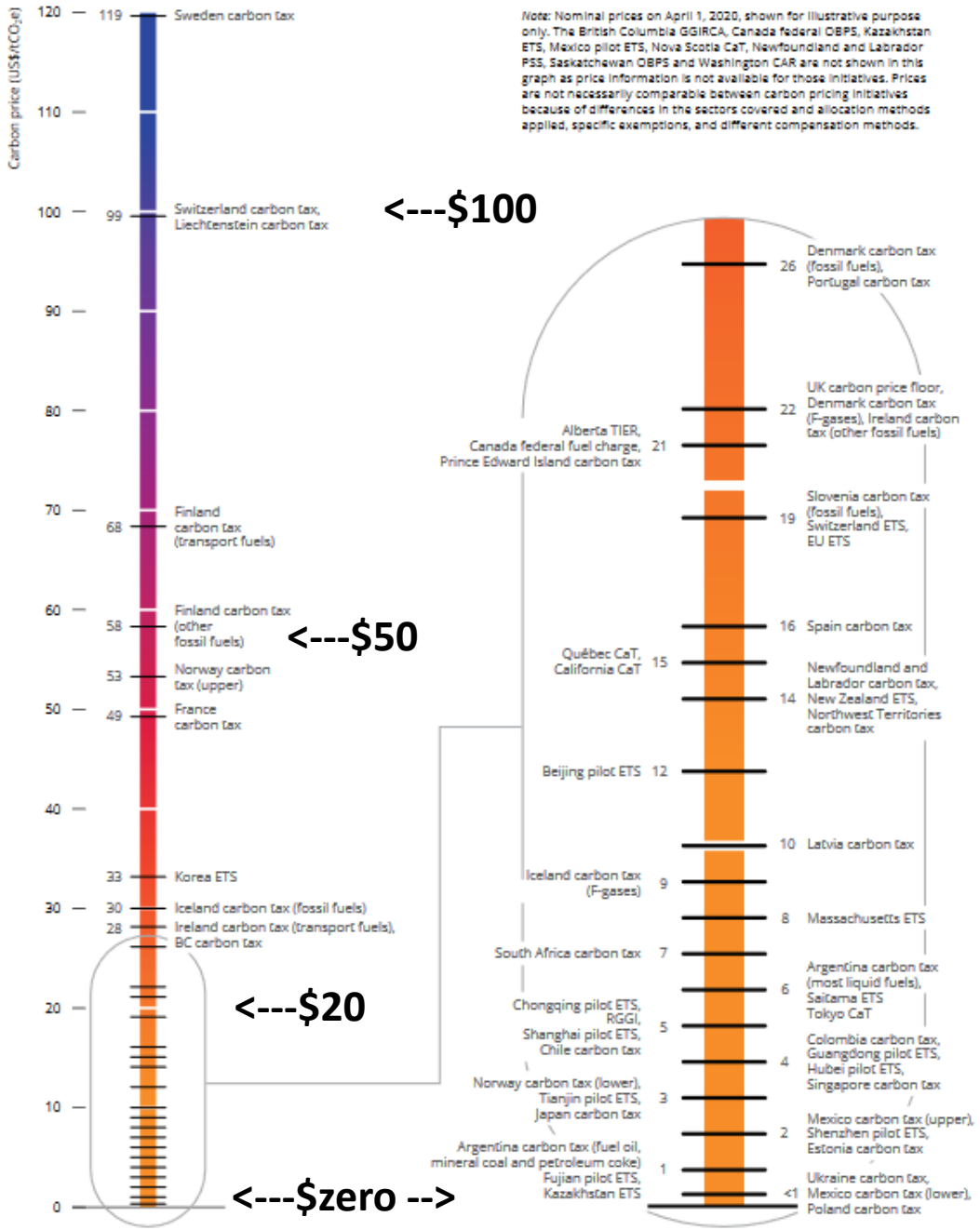
Forestry sector credits make up **42%** of all credits issued in last five years

Regular emission *reductions* have low values.

US$ 45 Billion since 2019

42% TREES

Figure 2.3 / Prices in implemented carbon pricing initiatives



Source: https://carbonpricingdashboard.worldbank.org/

Potential for gigatonnes of REMOVAL of CO_2 emissions based on available biomass supply: (See Box 2 of white paper)

- *"Every year, plants convert 4,500 EJ (exajoules) of solar energy and 120 Gt (gigatons) of carbon [= 439 Gt CO_2] from the atmosphere into* ***[~240 Gt of new] biomass – eight times as much as the global energy need."*** (World Bioenergy Association (2016)).
- About half of that plant growth is in oceans, and [as an assumption] about half to three-quarters of the land-based growth is inaccessible in current conditions of terrain and location, [being 10% to 20% of total],
- which would mean having **30 to 60 Gt of biomass accessible** for many uses, including pyrolysis into biochar if society decides that climate change can be combated with BC&E and decides to manage the biomass.
- At 17% char yield by weight, that could be **5 to 10 Gt/yr of biochar**, which multiplied by 2.5 could be **12 to 25 Gt/yr of stored CO_2e.**

Potential for gigatonnes of REDUCTION of CO2 emissions because of energy from pyrolysis.

- That same [WBA, 2016] document identified the **annual global supply to be 56 EJ of biomass energy** [about 2.9 Gt of biomass] in 2012,

- with an expected **near tripling to 150 EJ by 2035** [~8.5 Gt of biomass].

- This indicates there can be **decades of increasing CDR** by actively employing the energy aspect of pyrolytic biochar and energy (BC&E) drawdown before we reach the planetary limit of annual biomass supply.

- **This requires the USE of HEAT from pyrolysis to replace (offset) some current use of fossil fuel.**

How to reach those numbers. See white paper for a starting statement

Reduce surplus biomass and obtain biochar

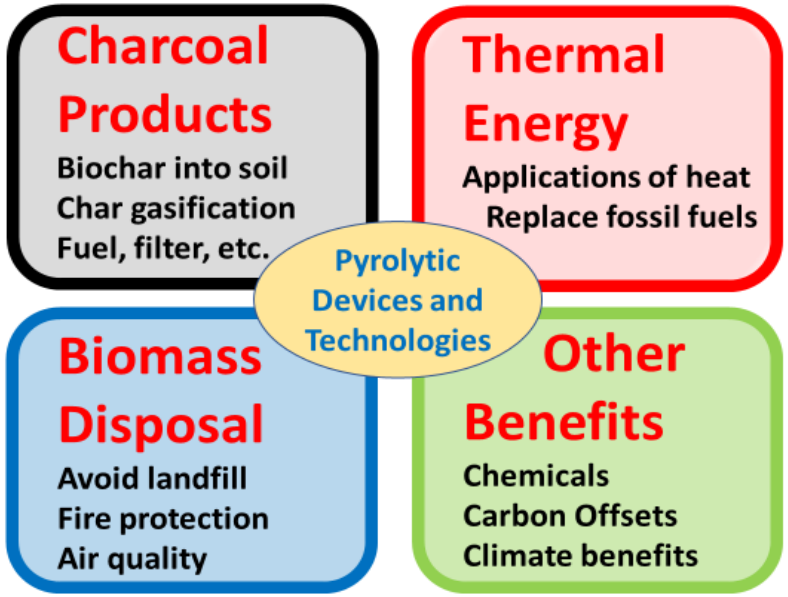
- Crop residues
- Forest safety
- Urban tree waste

Most is disposed without benefits of biochar production.

- **Power is primary**, BC is secondary
- Electric power
- Home heating
- Process heat

Most biomass energy is produced without benefits of biochar production.

- **Special cases**
- Cookstoves that happen to produce charcoal. (Leading example !!)
- If the <u>only</u> purpose is to make charcoal, then throwing away money. (You?)



Few char producers are getting carbon funding. Very little sequestration of CO2e as biochar.

Potential for gigatonnes of CO_2e REMOVAL

Projections for CDR via BC&E (Version 2020-11-30) **Units = Gt of CO_2 removal (CDR) per year**

Application	**2030**	**2050**	**2100**	**Cumulative during 70 years**
Cookstoves (TLUD)	0.1 – 0.2	0.5 – 1.0	1.0 – 1.5	60 – 80
Crop residue	0.2 – 0.5	1.0 – 2.0	1.0 – 2.0	60 - 100
Subtotal ALIA	*0.3 – 0.7*	*1.5 – 3.0*	*2.0 – 3.5*	*120 - 180*
Forest safety	0.1 – 0.2	0.5 – 1.0	1.0 – 1.0	40 – 80
Urban tree waste	0.1 – 0.1	0.2 – 0.8	0.5 – 1.0	30 – 50
Subtotal	0.2 – 0.3	0.7 – 1.8	1.5 – 2.0	70 -130
Elect. power gen.	0.1 – 0.1	0.2 – 0.3	0.5 – 1.0	30 - 40
Home heating	0.1 – 0.1	0.2 – 0.4	1.0 – 1.5	50 - 70
Process heat	0.1 – 0.2	0.2 – o.4	0.6 – 1.2	50 - 70
Subtotal	0.3 – 0.4	0.6 – 1.1	2.1 – 3.7	130 - 180
TOTAL	**0.8 – 1.4**	**2.8 – 5.9**	**5.6 – 9.2**	**320 - 490**

Notes:

1. All numbers are "best estimates" and are subject to increases or decreases of 50%.
2. Abbreviations: ALIA = Areas of Labor-Intensive Agriculture
3. In 2020, all the BC&E amounts were virtually zero.
4. No double counting. Example: do not count as crop residues or urban tree waste what is collected and counted for cookstove fuel or other heating.

Different carbon activities in different places.

- On a global scale, **societies exist with different financial levels** that are affluent and impoverished and “middle” or "mixed."
- These differences can impact the types of CDRS actions that are realistic.

- The USA is fully affluent. Can pay to develop DAC and EW and CCE and should develop BC.

- India has some of all three levels of affluence. BC is the natural choice for carbon dioxide removal efforts.

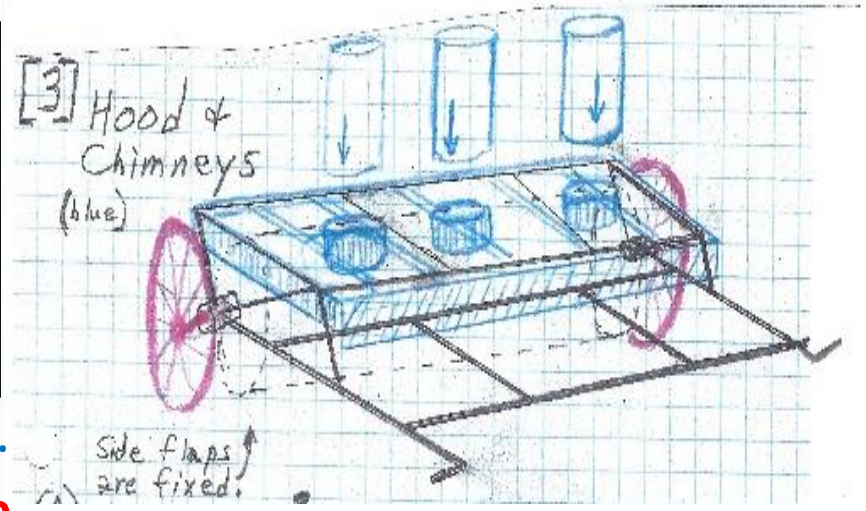
Biochar-producing TLUD cookstoves make money

- **Proven** with about 100,000 Champion ND-TLUD stoves in West Bengal area.
- **India could benefit** from over 10 million TLUD stoves that could earn perhaps $100 each per year only for CO_2e sequestration plus other benefits.

250 million of the world's poorest families could sequester 0.25 Gt CO_2/yr as a "by-product" of cooking daily meals while using less of the same biomass fuel [and therefore could ALSO earn credit for carbon emission reductions] that they currently use in traditional biomass stoves. This can be reached before 2030.

RoCC Rotatable Covered Cavity kilns

RoCC n' Roll Field Pyrolyzer. The cylinder is shown only with dashed lines. The fuel feeding shelf will be on the handles. Suggested width 6 ft to 2 meters.



Patent coverage; seeking Indian investors.

Figure 13. 4-ft diameter RoCC kiln, rear view, preparing to unload biochar. 28 February 2020

RoCC n' Roll Barrel Kiln 12-2020

Financing <u>your</u> CDR sequestration efforts

- Three main avenues:

- Use an **established system** with certification. None exist.

- Use an **innovative system**. Some exist; work with them.
  - One is Puro.earth , in Europe.
  - Another one is with CharTrac from Bitmaxim Laboratories (Rigorous documentation is required. This includes Paul Anderson's involvement. See next slide.)

- **Do it on your own.** "Beauty is in the eye of the beholder" and "the value of CDR units is in the perception of the buyer/sponsor." (See final slides)

A case study with biochar for CDR sequestration.

- The **Jalinga Tea Estate in Assam, India.** Starting 1Q 2021 with Bitmaxim Laboratories
- **EVERY action is timestamped and digitally signed, securely transmitted, and encoded to at least one blockchain transaction.**
- The central data engine, **CharTrac™**, is an advanced, multi-featured web application that **enables secure data acquisition from IoT devices and/or authorized persons** operating in the value chain who are equipped with Woodgas Impact mobile apps (primarily, CharTrac).
- With authentication and certification from the **proposed Woodgas Institute,** this data is key to **generating a credible registry of marketable CDR units tied specifically to biochar sequestration efforts.**
- Details about CharTrac and the Woodgas Impact initiative will be found at their respective websites, chartrac.com and woodgas.com or from Paul Anderson at email: psanders@ilstu.edu

How to prepare to sell *uncertified* carbon units

ALL of the following steps must be accomplished and documented. How it is recorded is of highest importance. **Credibility is paramount.**

- **Create** biochar of reasonably consistent quality.
- **Accumulate** biochar in a way that can be **measured** by weight and volume.
- Retain samples. **[If you can get this far, you have something tangible.]**
- **Render "unburnable"** the biochar such as by mixing with compost or manure or mixing with soil. Be sure to document this event very well !!
- Document the **final placement** of the char where it cannot be retrieved.
- Prepare your documentation, with calculations of claimed sequestration.
- **Find a buyer who believes you** and who will pay an acceptable price. This is on a voluntary basis, and good if you have this last step accomplished first.
- **FAR BETTER if your char is sold with verification and certification.**

Final Comments

- All countries of the world are **involved with the climate crisis**, the Paris Agreement of 2015, the coming COP meeting in 2021 to set carbon accounting rules, and the commitments both for Net Zero new emissions by 2050 and for the start of carbon dioxide removal (CDR).
- America with the incoming Biden administration will get back on track for climate and other environmental issues. But **do not wait for the USA.**
- **India** is an international powerhouse and **can set its own priorities** and its own rules, including what it can certify, especially in these very early years of carbon dioxide capture and storage (CDRS).
- We, the participants in **"Biochar Crusaders," should chart our course of actions** for the role of biochar in the struggle against climate chaos. We have a message to deliver; we should enlist advocates; **we should act;** we should **set examples to show what can be possible.**

To paraphrase John F. Kennedy,

Ask not what biochar can do for you.
Ask what you can do for biochar.
(And for the climate.)

Enlistment of Biochar Crusaders

- Do you have a **current situation of biochar sequestration** measured in **tonnes of reasonable biochar** that could be documented as an example worthy of claiming "Carbon Dioxide Removal Credits" ("CDR Credits") to offer for sale?
- If seriously "yes," please **send a reasonably detailed description** of that situation to:

  Paul S. Anderson at email: psanders@ilstu.edu

- Note: Expect that your involvement **will cost you both time and money and might have zero financial return.** But you might make history and/or be ahead of the game for further efforts.
- Anyone with **financial resources to give, lend or invest for biochar CDR actions** in India or elsewhere is also encouraged to contact Dr. Anderson to discuss options.