2024 NORTH AMERICAN BIOCHAR CONFERENCE

— USBI —

CALIFORNIA, USA

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Forest Carbon Dynamics & The Role for Biochar

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Forests “piling up” with low-value wood stock

- From harvest, fuel treatments, rehabilitation, construction projects etc.
- ~375 million dry tons of forest slash produced each year in the US

Common Practice:

Pile Burning

Slash piles are burned for disposal

Negatives:

- **Release CO2 to the atmosphere**
- Air quality
- Fire risk
- Nutrient volatilization
- Legacy of burn scars
- Invasive species
- Loss of soil organic matter

Photo Credit: C. Rhoades, L. Asherin; USFS-RMRS

BIOCHAR PRODUCTION

Turning waste biomass into a climate smart product

Photo credit
Nathanael Johnson

Burning piles sends most of the biomass C into the atmosphere

Turning slash into biochar reduces C emissions by

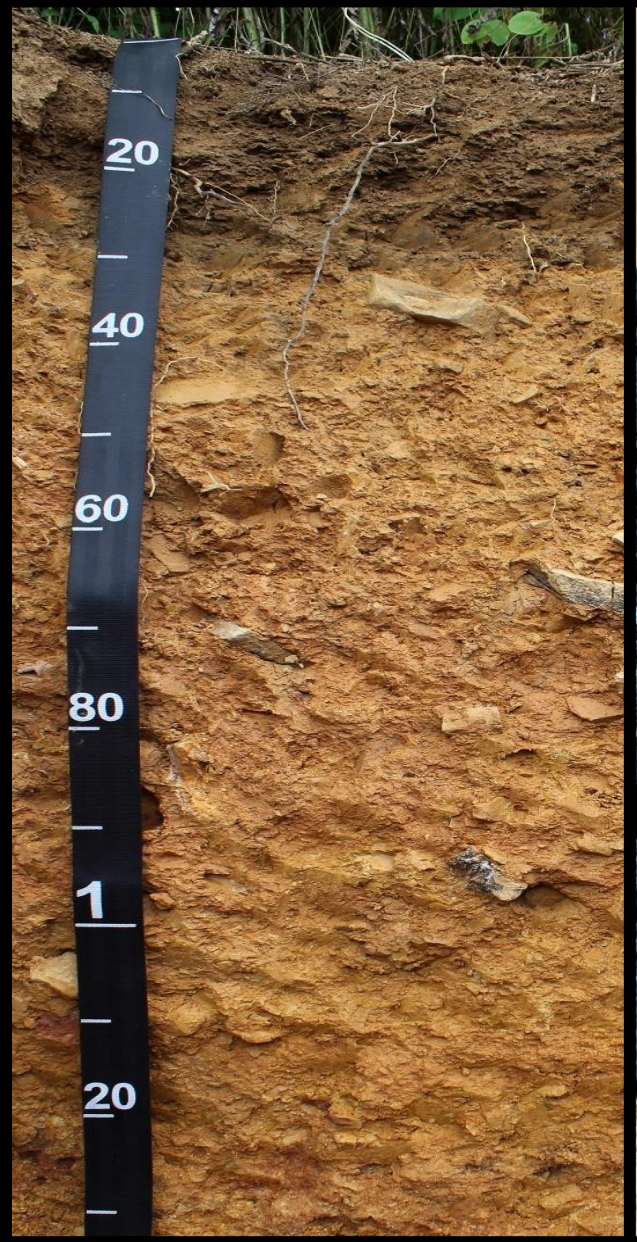
~20-40%

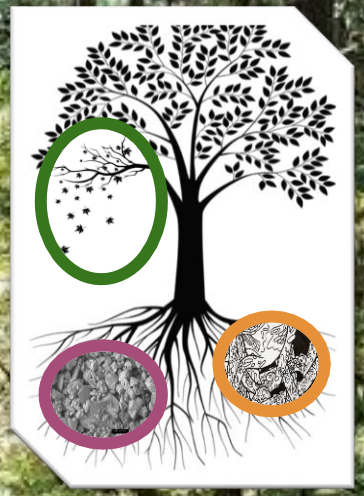
Kilns process 1-2 ton of forest slash per hour

Return 15-25% as biochar

Sequesters ~35% of the carbon in biochar

SOIL CARBON SEQUESTRATION → Where does biochar stand?

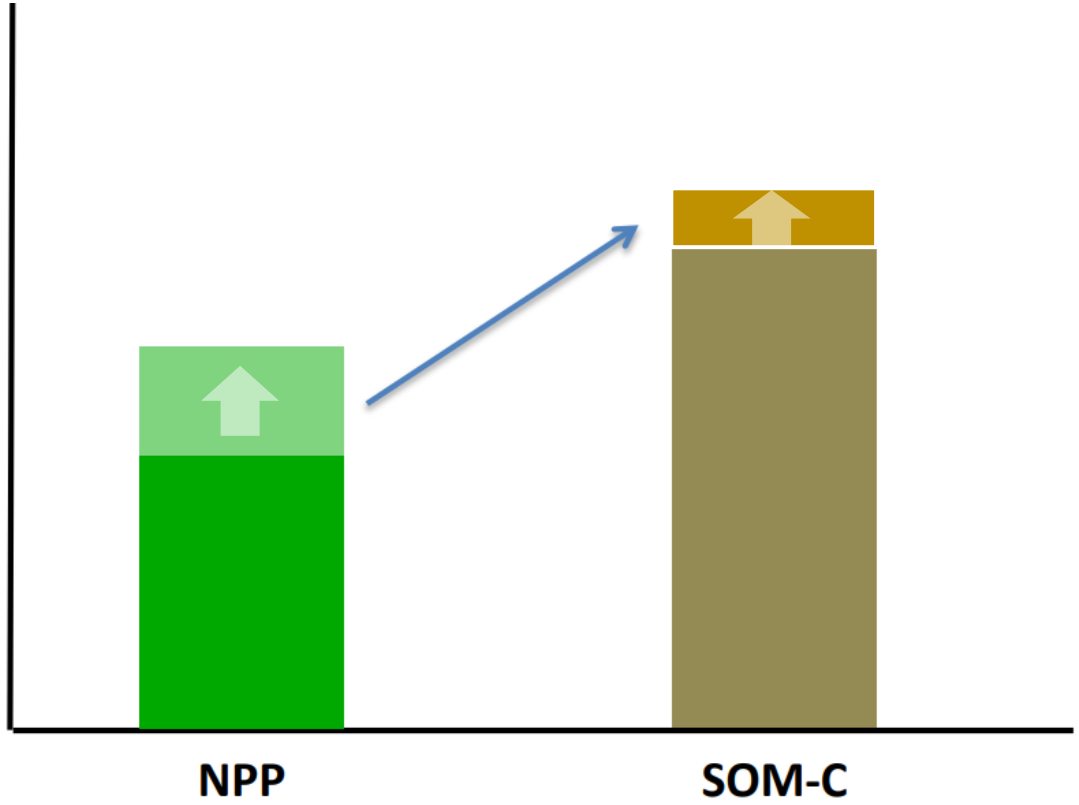




The DIRT Network

DIRT = Detrital Input and Removal Treatment

“Often expected” soil organic matter (~carbon) response to additional plant detrital inputs:

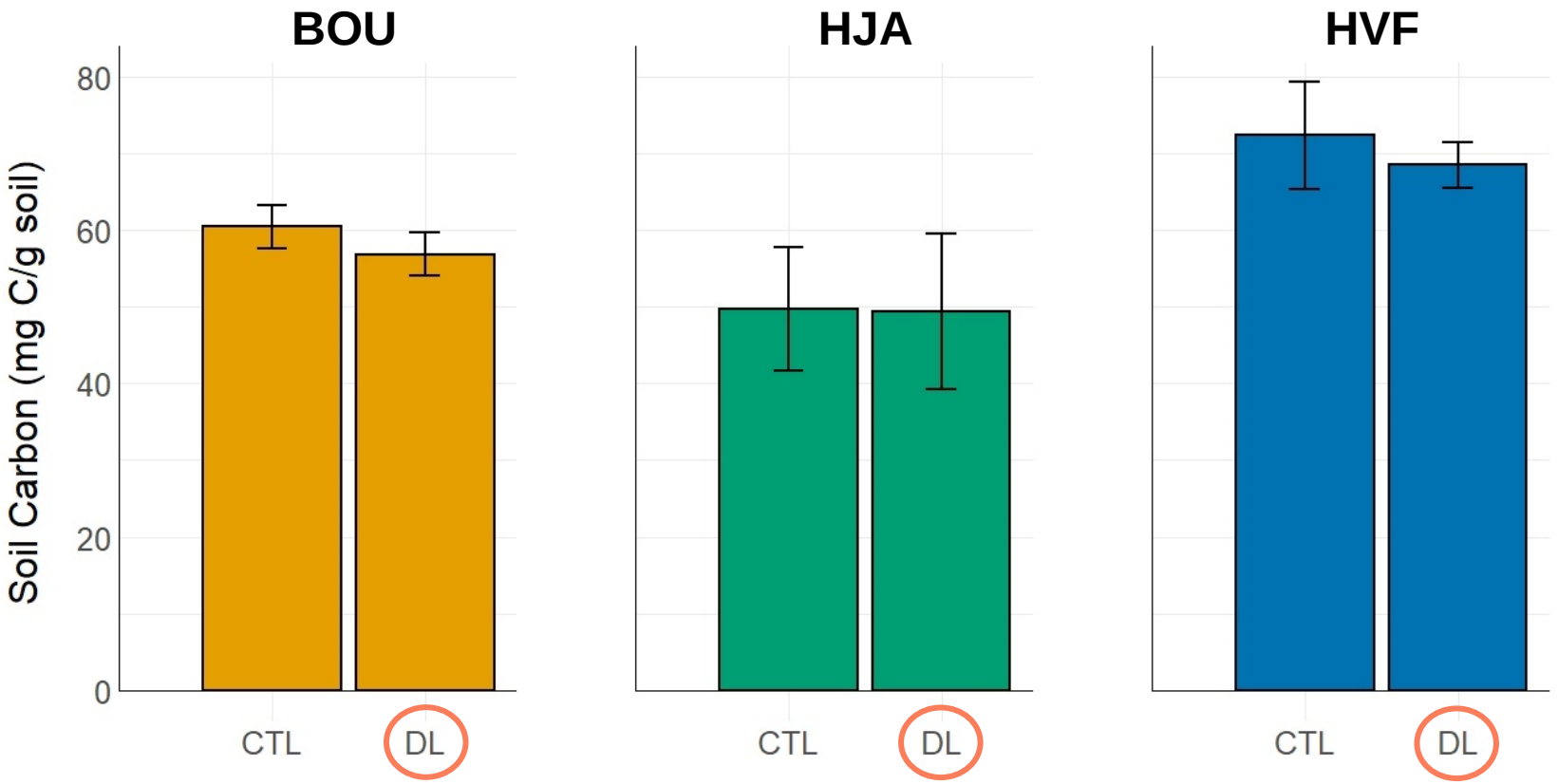


Increased soil C storage with increased NPP and plant inputs to soils

DIRT Network: Add OM ≠ More SOC

After **20 years** of **doubling litter inputs...**

0-10 cm

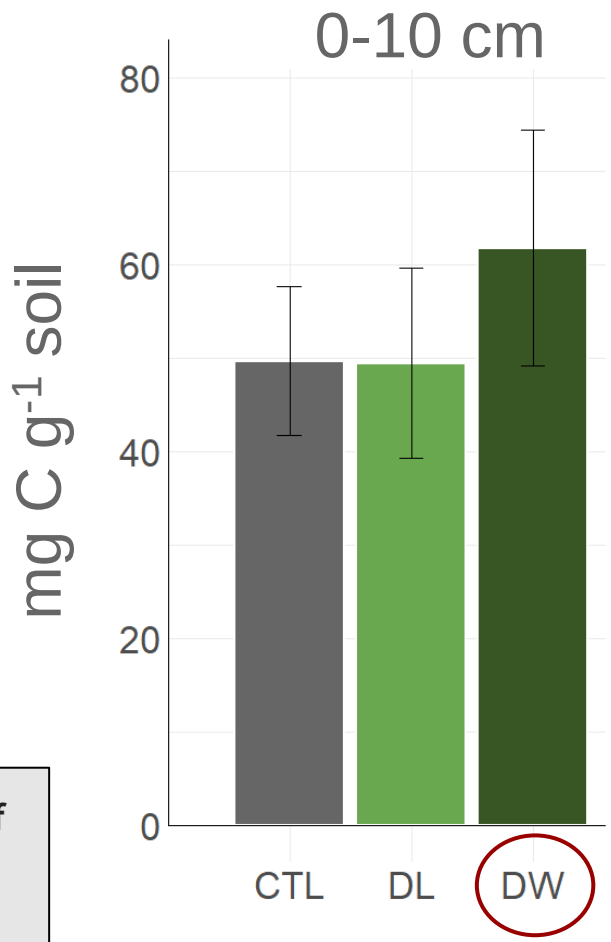


Differences in ΔSOC by detrital input quality

Wood chip additions increase soil carbon from 0-10+ cm.

HJ Andrews EF

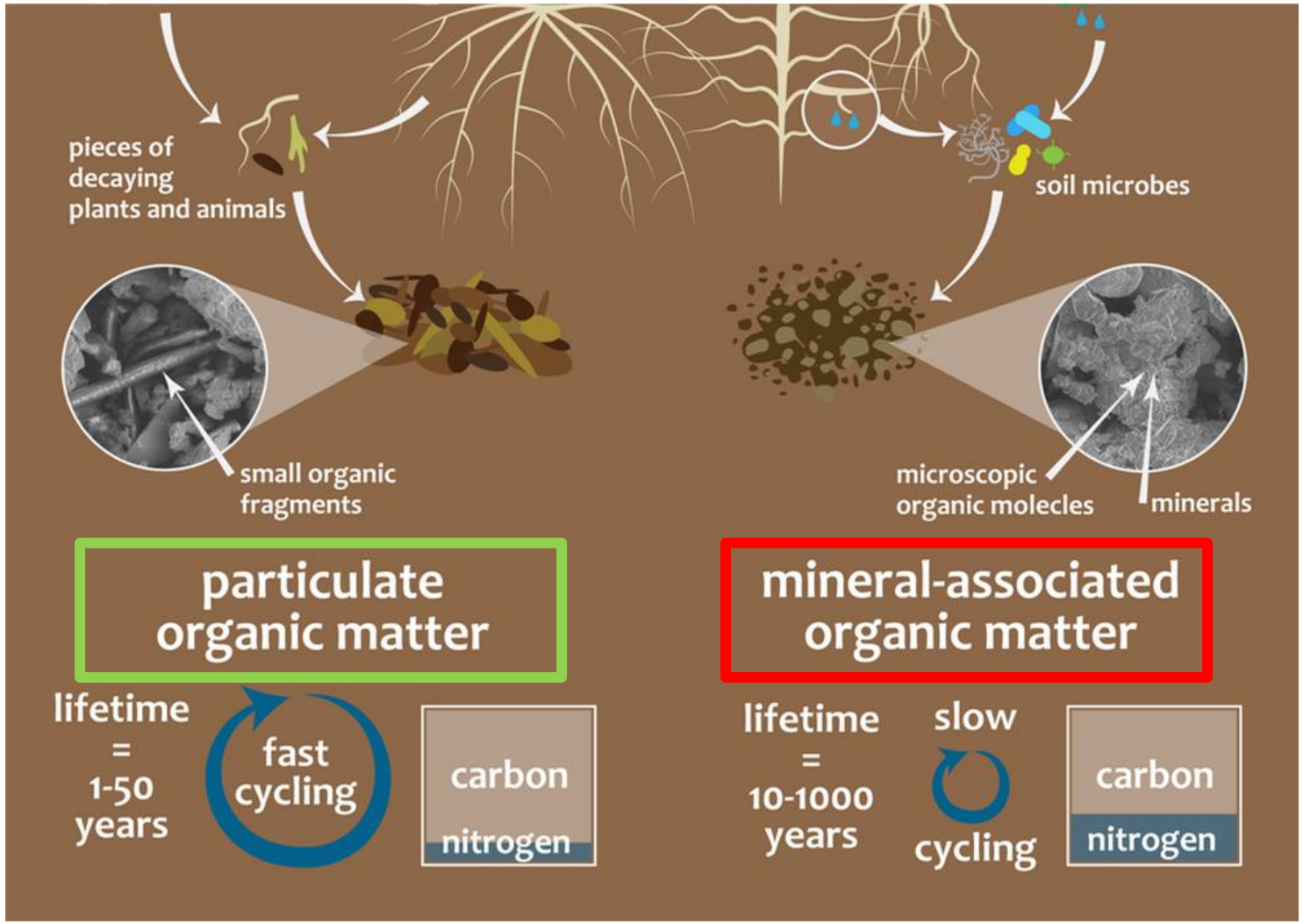
Bulk Soil C



Competing Processes Drive the Resistance of Soil Carbon to Alterations in Organic Inputs.
Pierson et al. Frontiers in Environmental Science. 2021 Apr

SOC Pools

POM



MAOM

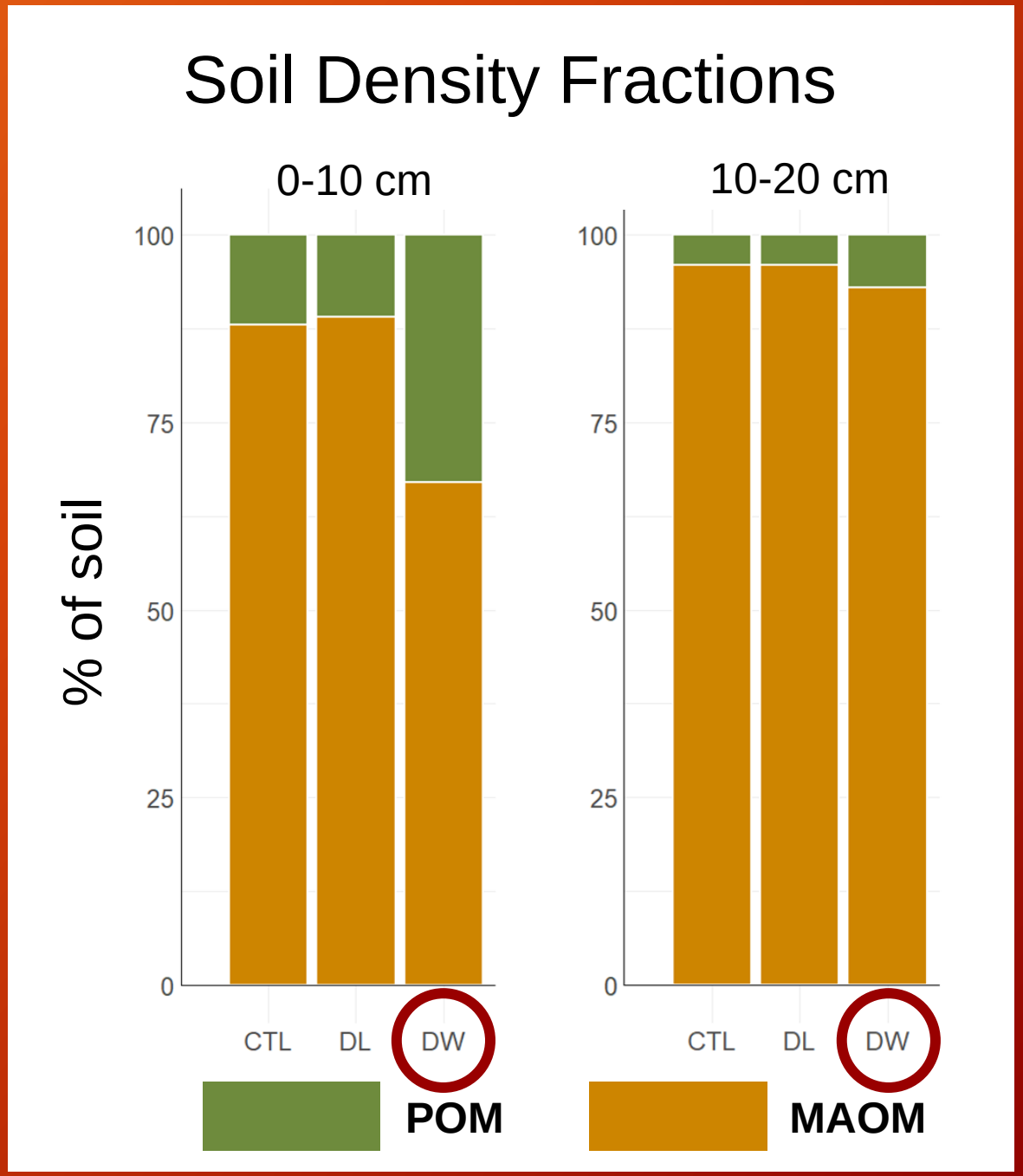
Short-term
(~Plant origin)

Long-term
(~Microbial origin)

Where did the wood go?

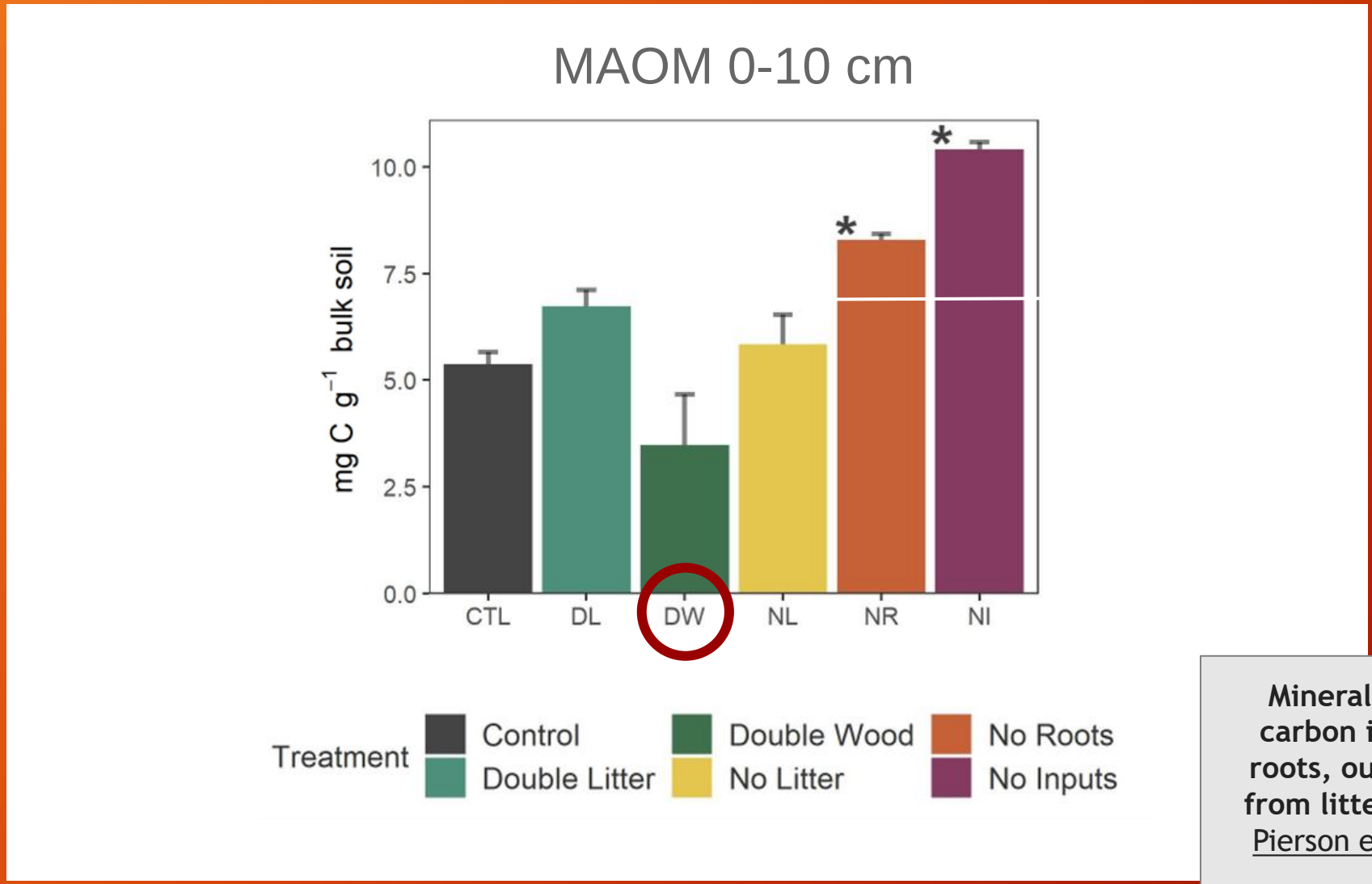
- Double wood addition led to soil C gains in particulate OM

  POM = fast cycling, not stabilized



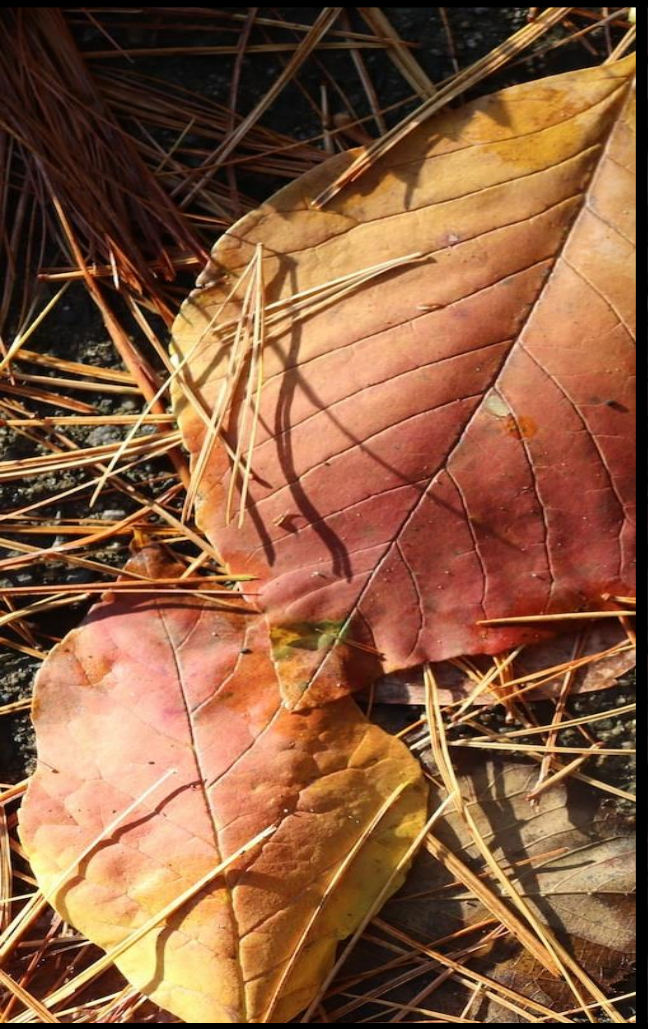
Utilizing Soil Density Fractionation to Separate Distinct Soil Carbon Pools. Journal of Visualized Experiments: Jove. 2022 Dec 16(190).

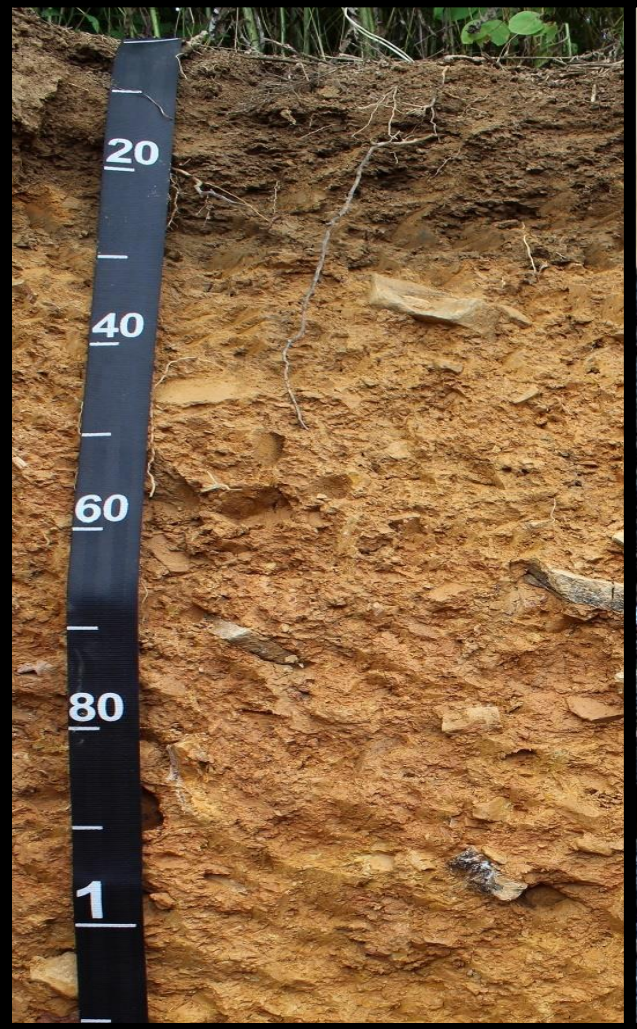
Wood addition caused losses of MAOM C stocks @ HJ Andrews LTER



Mineral stabilization of soil carbon is suppressed by live roots, outweighing influences from litter quality or quantity.
Pierson et al. Biogeochemistry 2021 Jul

Biochar is distinct with >turnover time

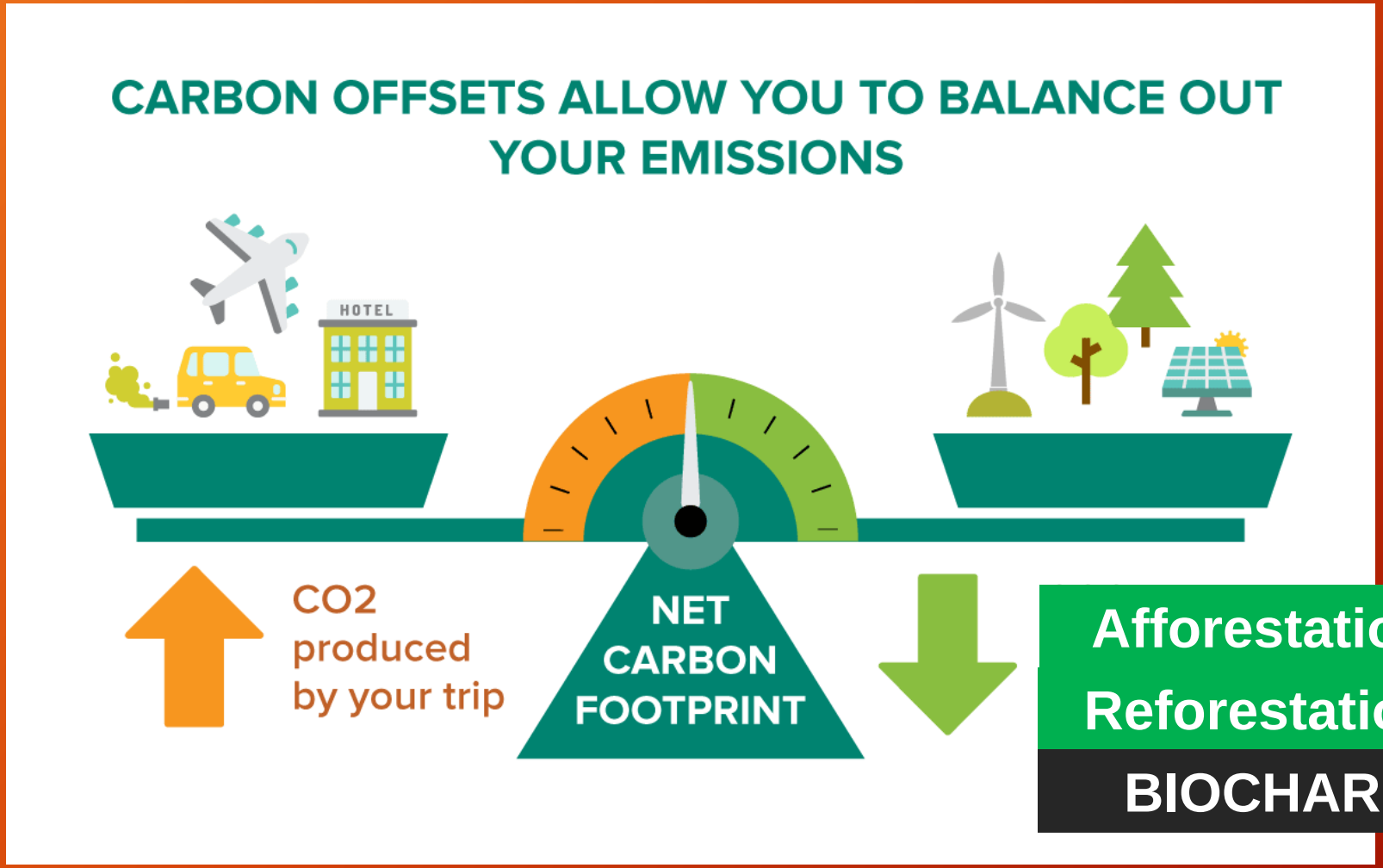




~ 1 year | 10-100 yr | 75-200 yr | >300 yr

^{14}C mean residence time

The Search for Forest Carbon Offsets



Sustainable biochar to mitigate global climate change

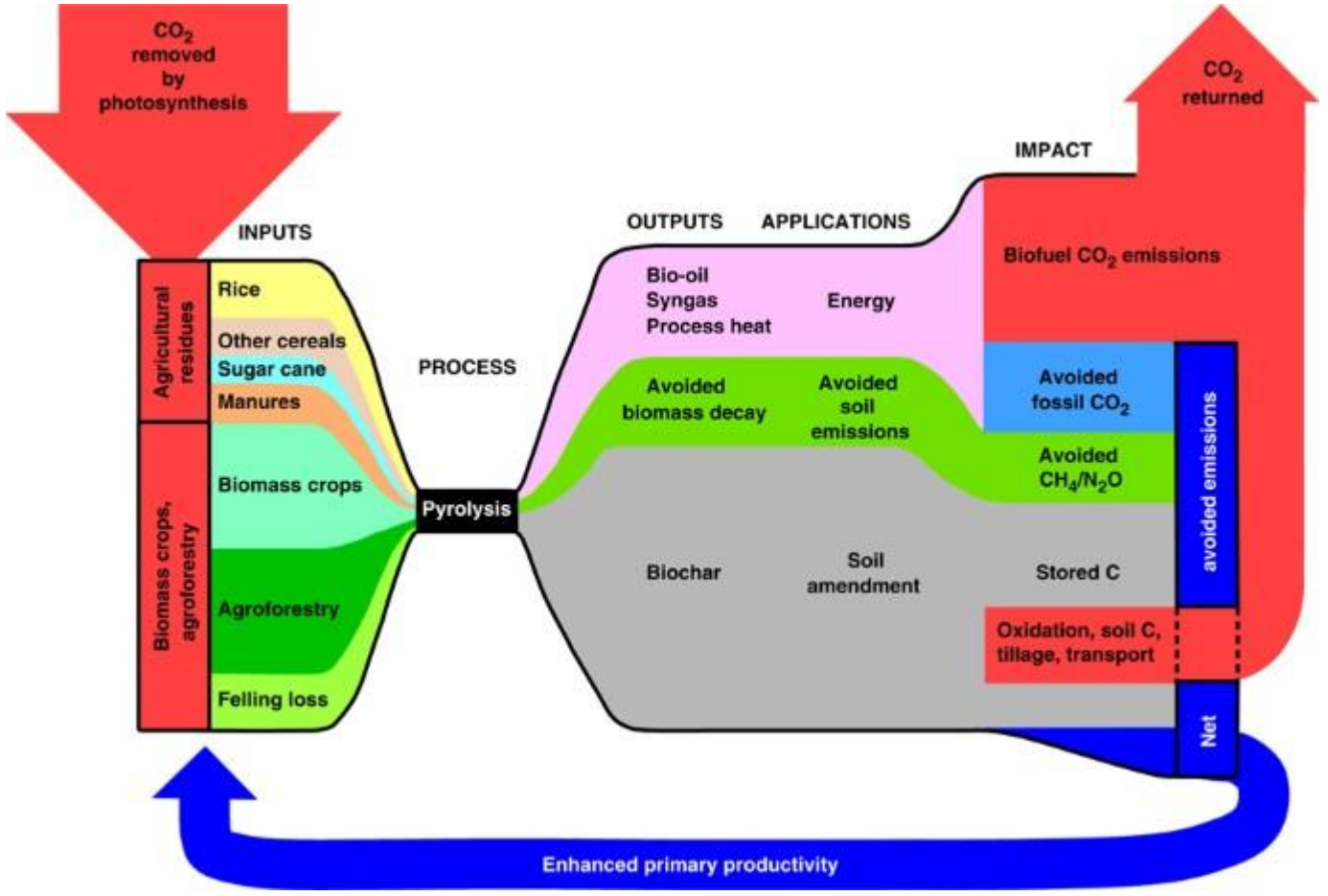
Woolf et al. 2010. Nature communications

Potential C for Sequestration

"~12% of anthropogenic C can be reduced with a biochar-based economy"

"Biochar can be produced sustainably or unsustainably."

…Scaling up biochar production remains a challenge



Woolf et al. 2010. Nature communications 1, 56

Example: Slash piles in Northern CO

140,000 piles in northern CO

CO_2 from 1 pile = 150 gallons of combusted gasoline

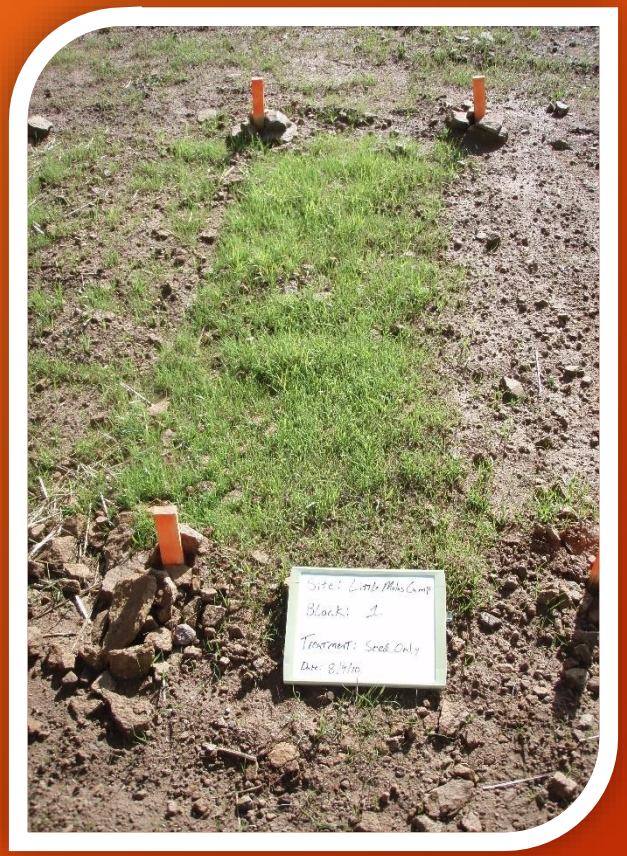
Let's imagine we make biochar out ½ of the piles instead of burning them…

~~~ Offsets the annual CO_2 emissions for ~7,000 vehicles

Pile burn scars in northern Colorado. Rhoades et al. 2015
~~~

Biochar has many useful applications

Forest Soils



Mine Lands

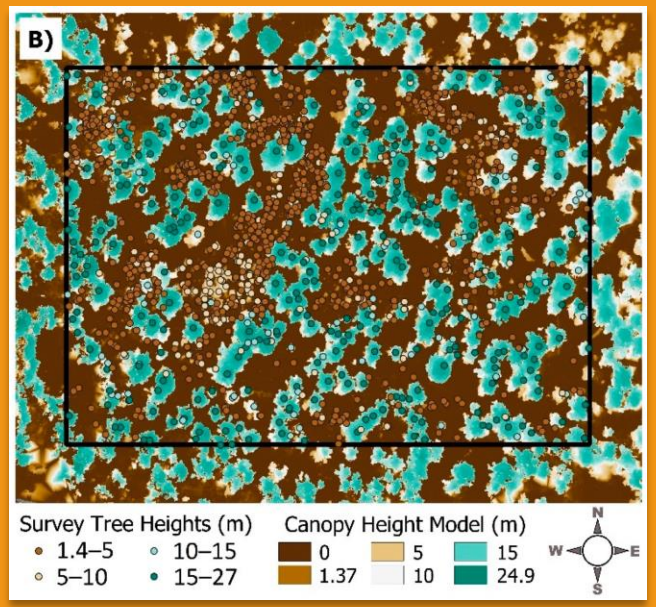
Agriculture

"Forest To Farm"

High resolution mapping of forest stands & soil

Moving to management scales:

- Where can we make biochar?
- Where should we add biochar?

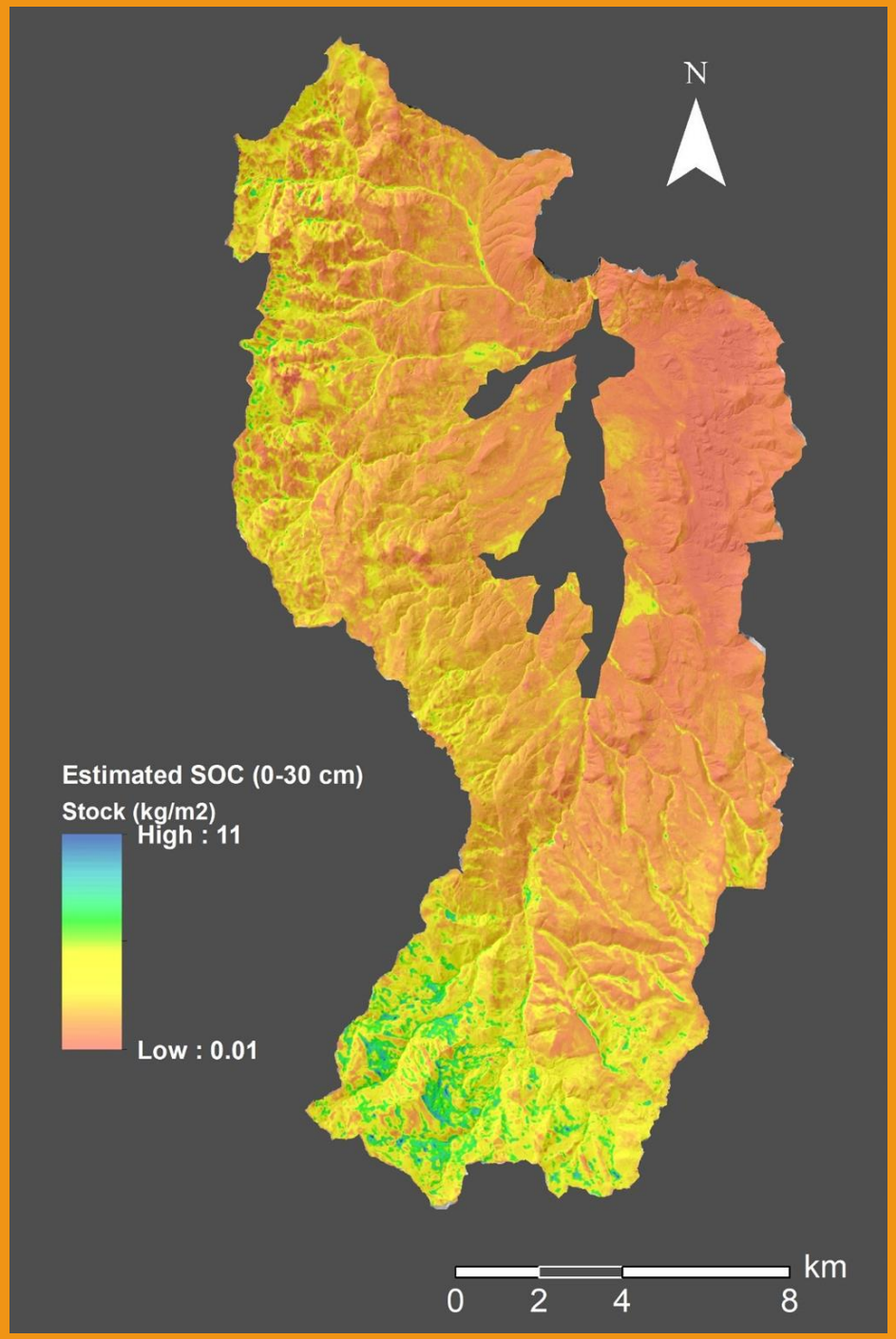


← Stand mapping

Wade Tinkham, USFS-RMRS

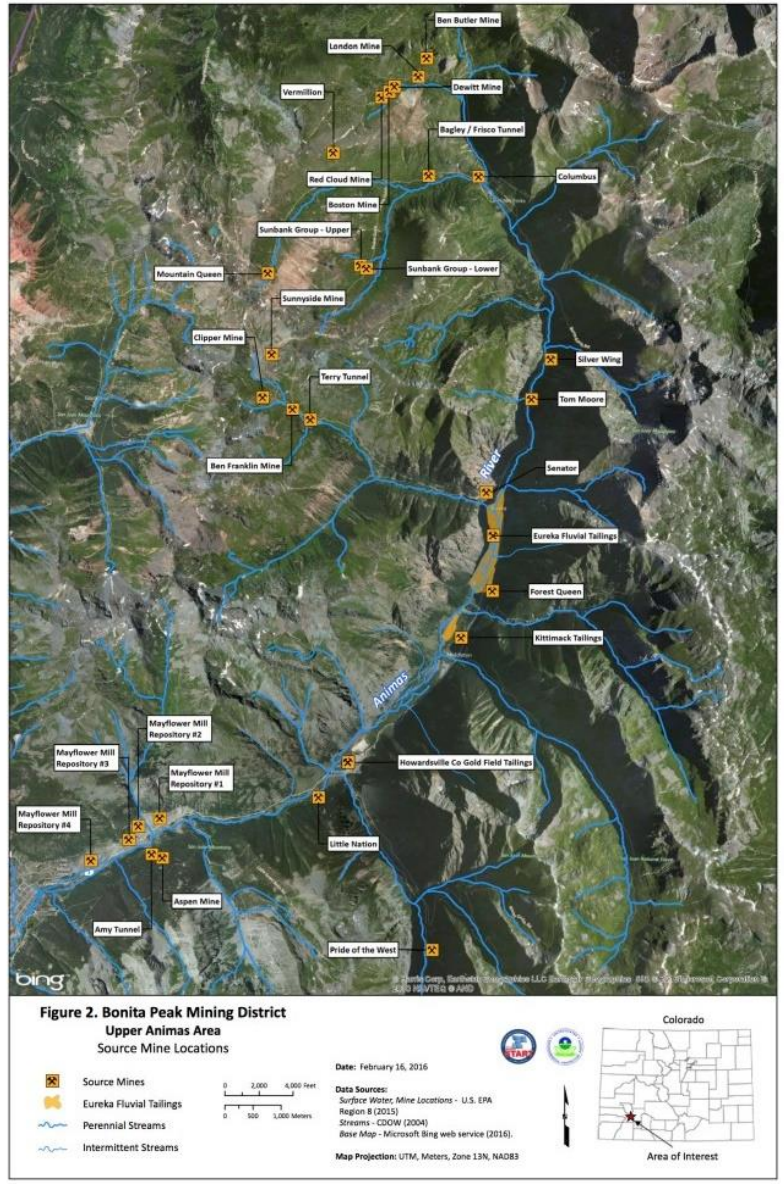
Soil carbon mapping →

Derek Pierson, USFS-RMRS



Abandoned Mine Lands (AMLs)

- Sparse vegetation
- Poor soil structure
- Acidic soils
- Heavy metal contamination

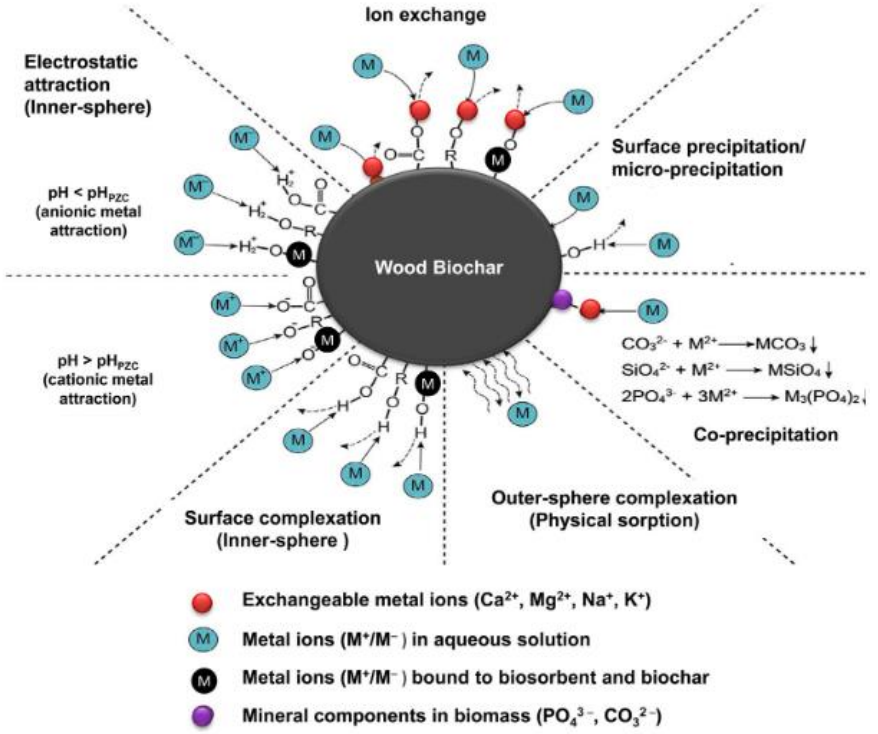


Biochar Properties

1) Biochar is porous… extremely high surface area, >4000 ha per cubic meter
2) Forged in fire → Non-specific binding capacity
3) Adsorption mechanisms:
   - Surface sorption
   - Electrostatic interaction
   - Cation/ion exchange capacity
   - Precipitation
   - Complexation

Microscopic structure of biochar made from poplar wood chips

Biochar-Fungi Interactions in Soils
Katja Wiedner & Bruno Glaser
Biochar and Soil Biota (2013)



Schematic diagram of various sorption mechanisms of heavy metals by biochar in water
(Shaheen et al 2019)

BARRIERS

Roadblocks for biochar production and use

Photo credit: Oakland Zoo

Beyond biochar basics:
Scaling up and moving the needle

Durango, CO
September
2022

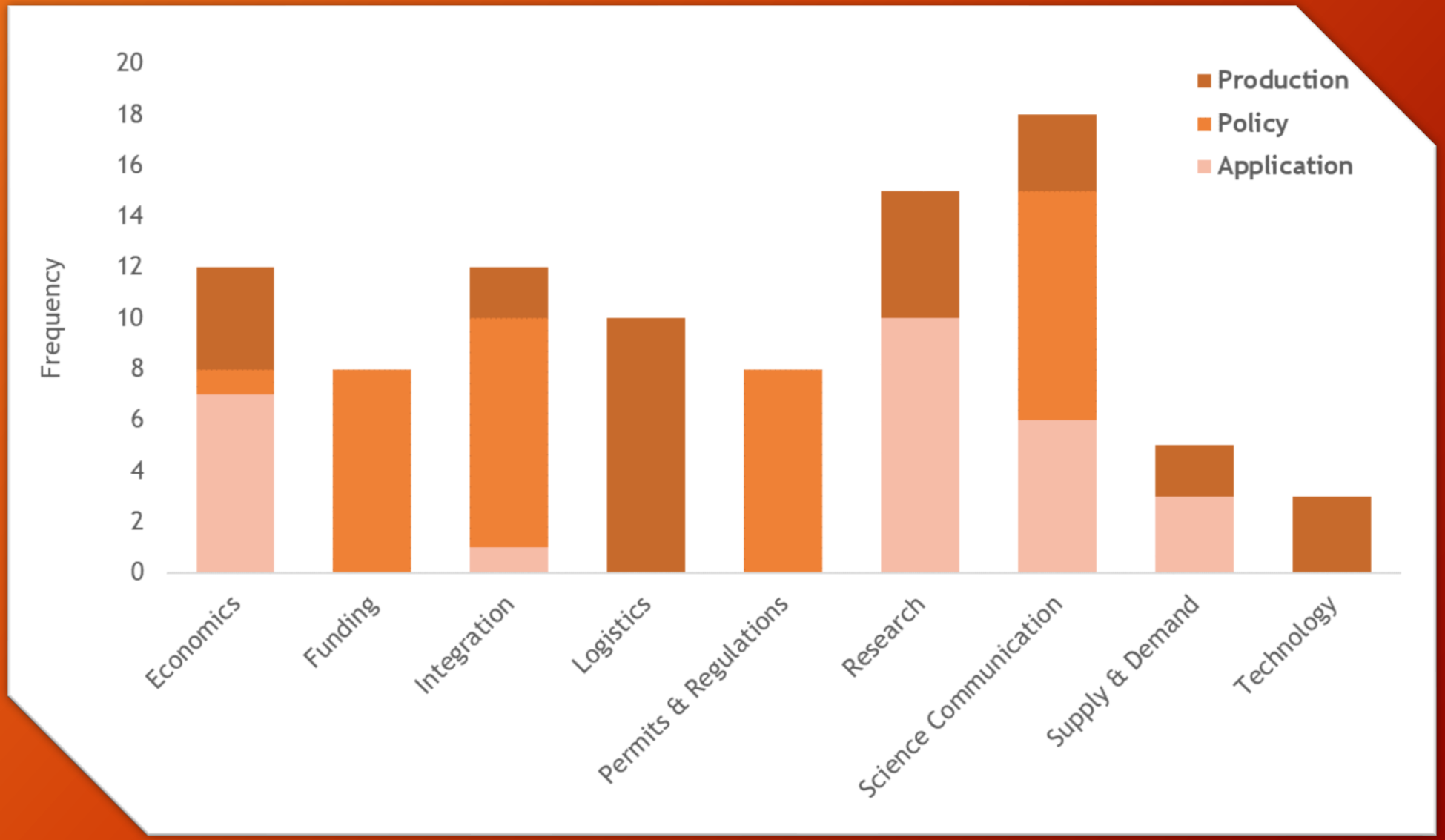
Dillon, MT
October
2022

Discussions with public & private stakeholders

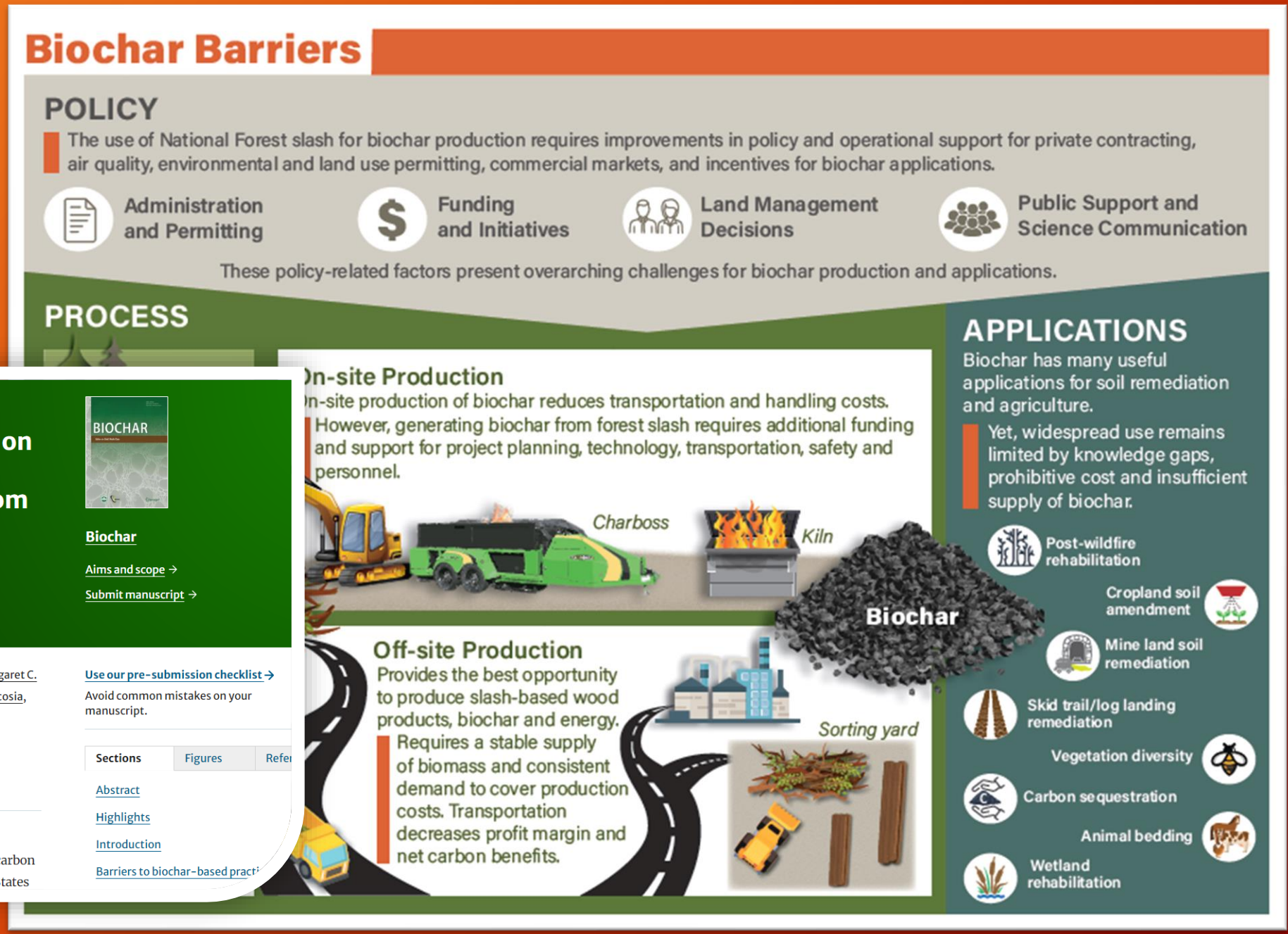
1. Share barriers for biochar production from wood slash.
2. Identify biochar production and application opportunities.
3. Determine specific, actionable pathways to reduce barriers and “move the needle.”

Land managers face many, diverse barriers

Categorizing the barriers shared during the workshop series…



Synthesis Paper

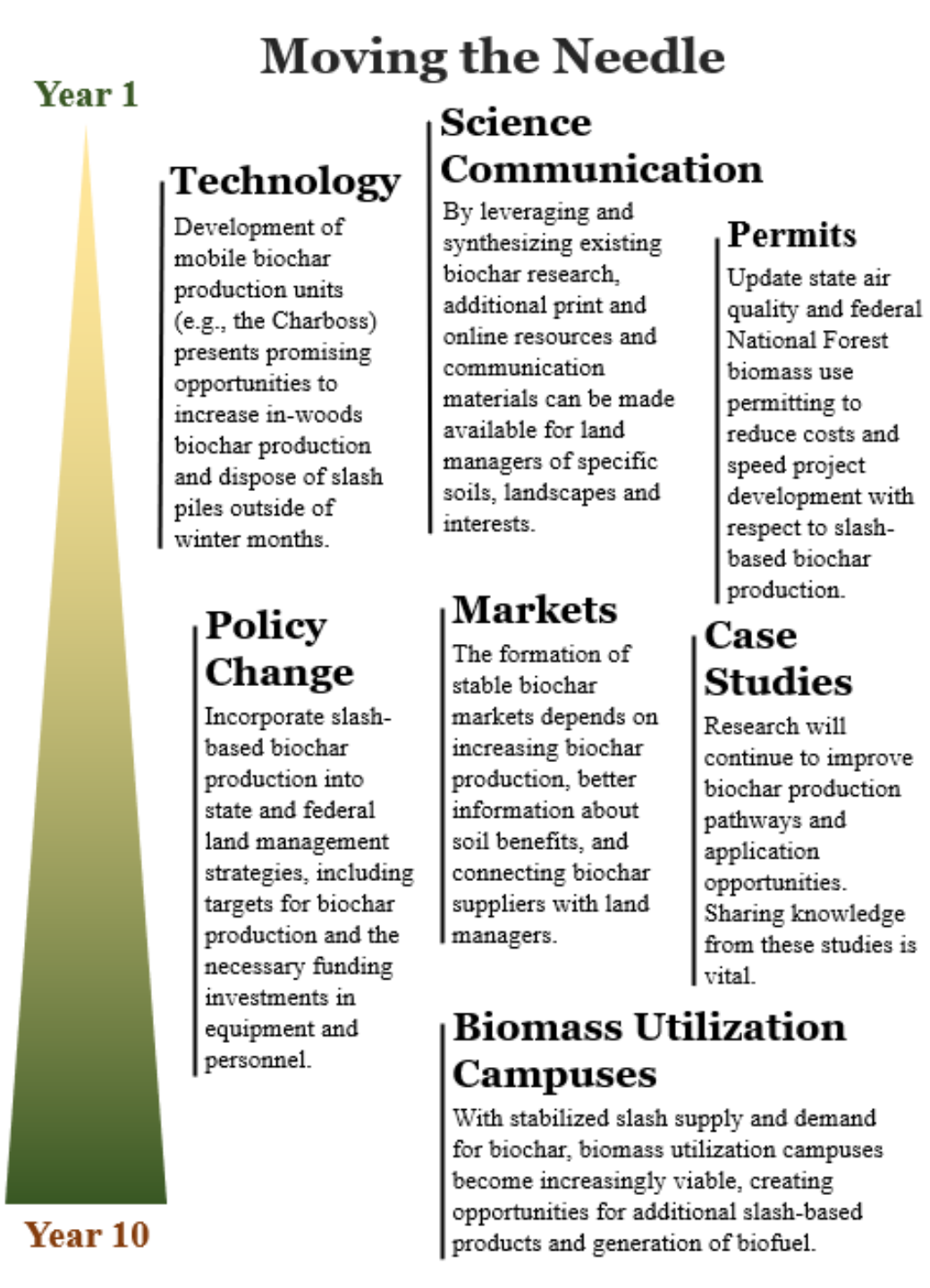


Pathways Forward

“No Targets, No Progress”

- Scott Snelson, USFS

- Creating goals and initiatives
- Improving technology and training
- Simplified, lower cost permitting
- Adjustments to biomass utilization contracting
- Building towards stable markets, infrastructure
- More science communication
- More research and case study examples



Thank You

Questions welcome after the last presentation, also anytime via email

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