Forestry and Carbon Sequestration

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Oregon Global Warming Commission

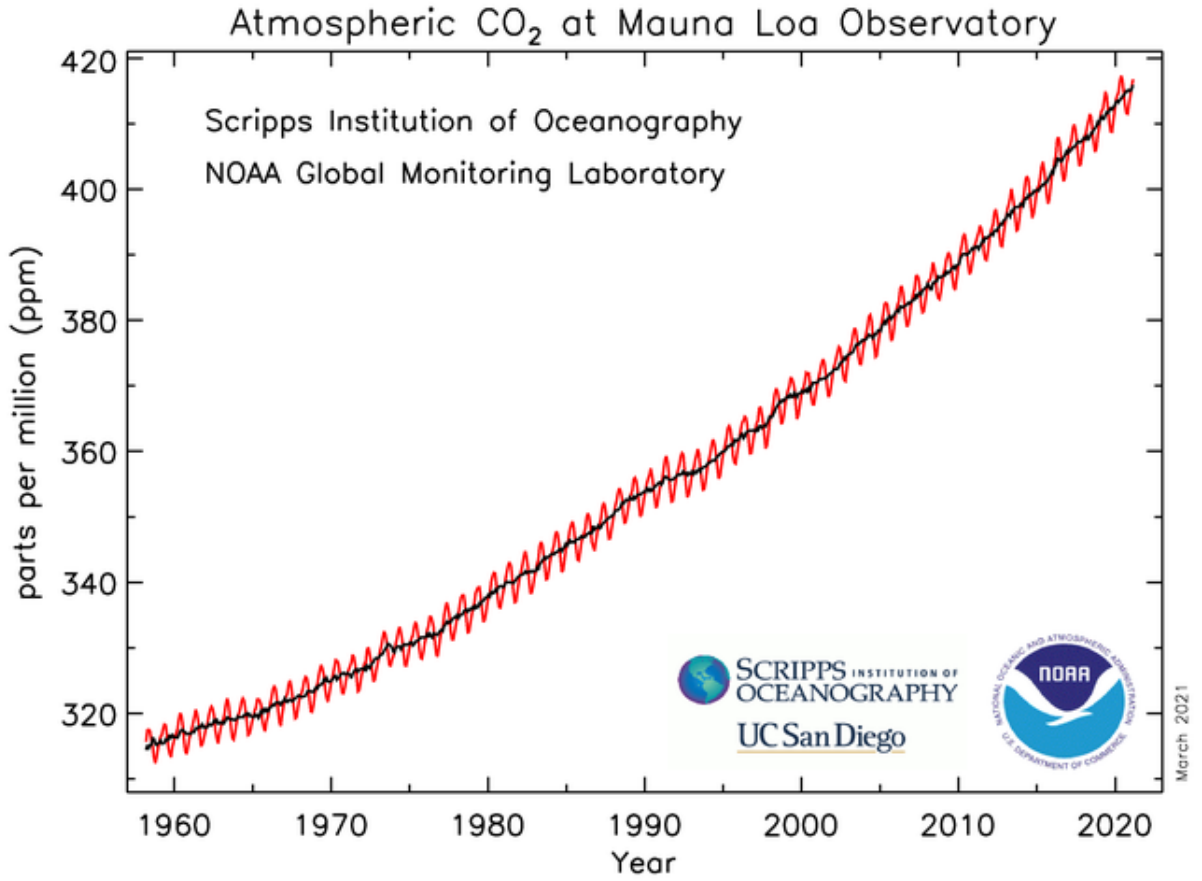
KeepOregonCool
Oregon Global Warming Commission

Forest Carbon Accounting Project Report 2018

- So, what am I going to cover today? Nothing particularly earth shattering!
- The Problem – Consumption
- Forests & Forestry – We aren’t that bad, but we can do better
- Leakage – A real problem
- Fire, PyC, and cycled carbon
- Wood structures and carbon storage
- Elliott, systems thinking, and the future

The problem!

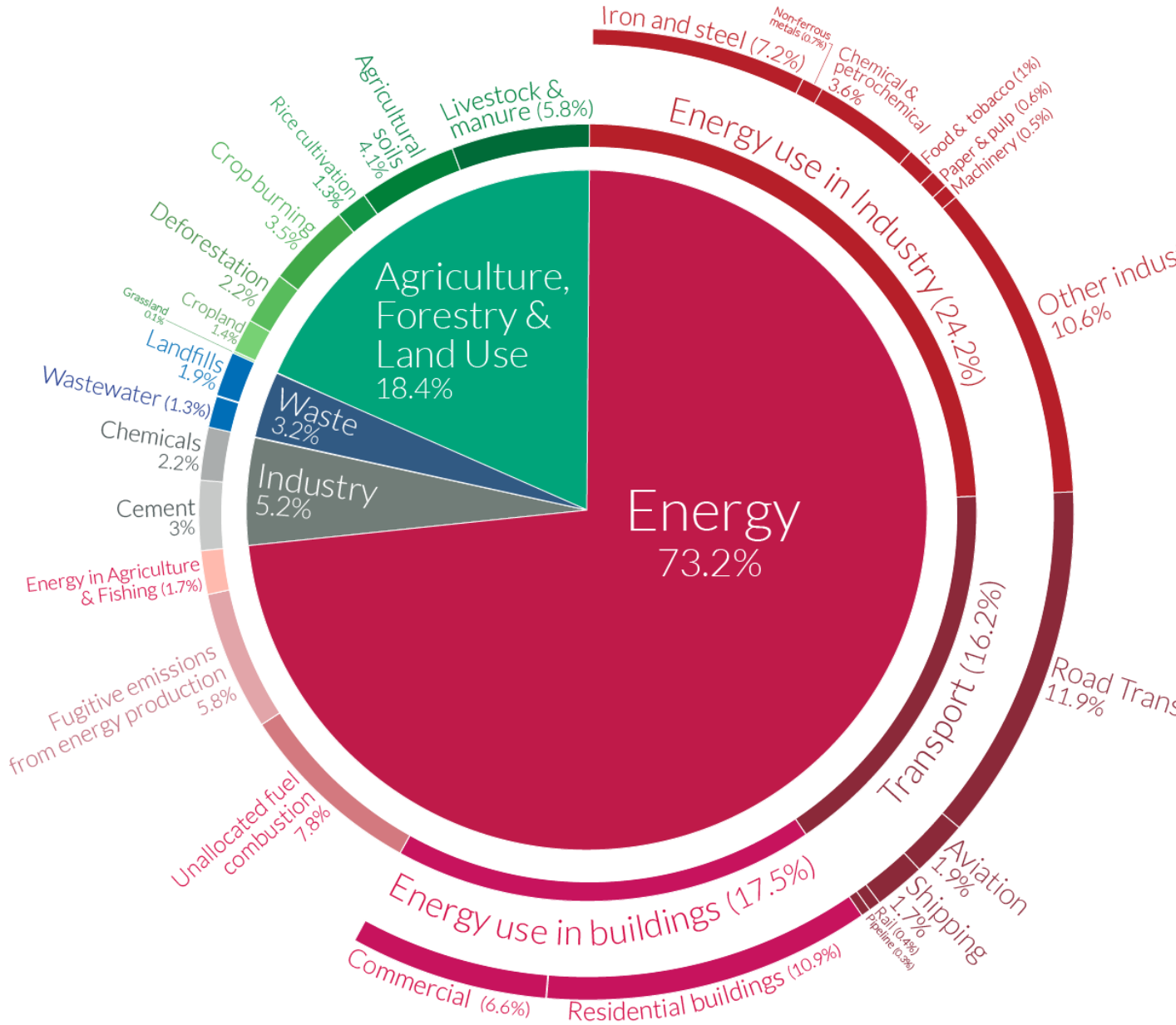
- GHG concentrations continue to rise now approaching 420 ppm
- Cause is fossil fuel consumption
- Secondary causes are land conversion, agriculture, and construction



https://www.esrl.noaa.gov/gmd/ccgg/trends/

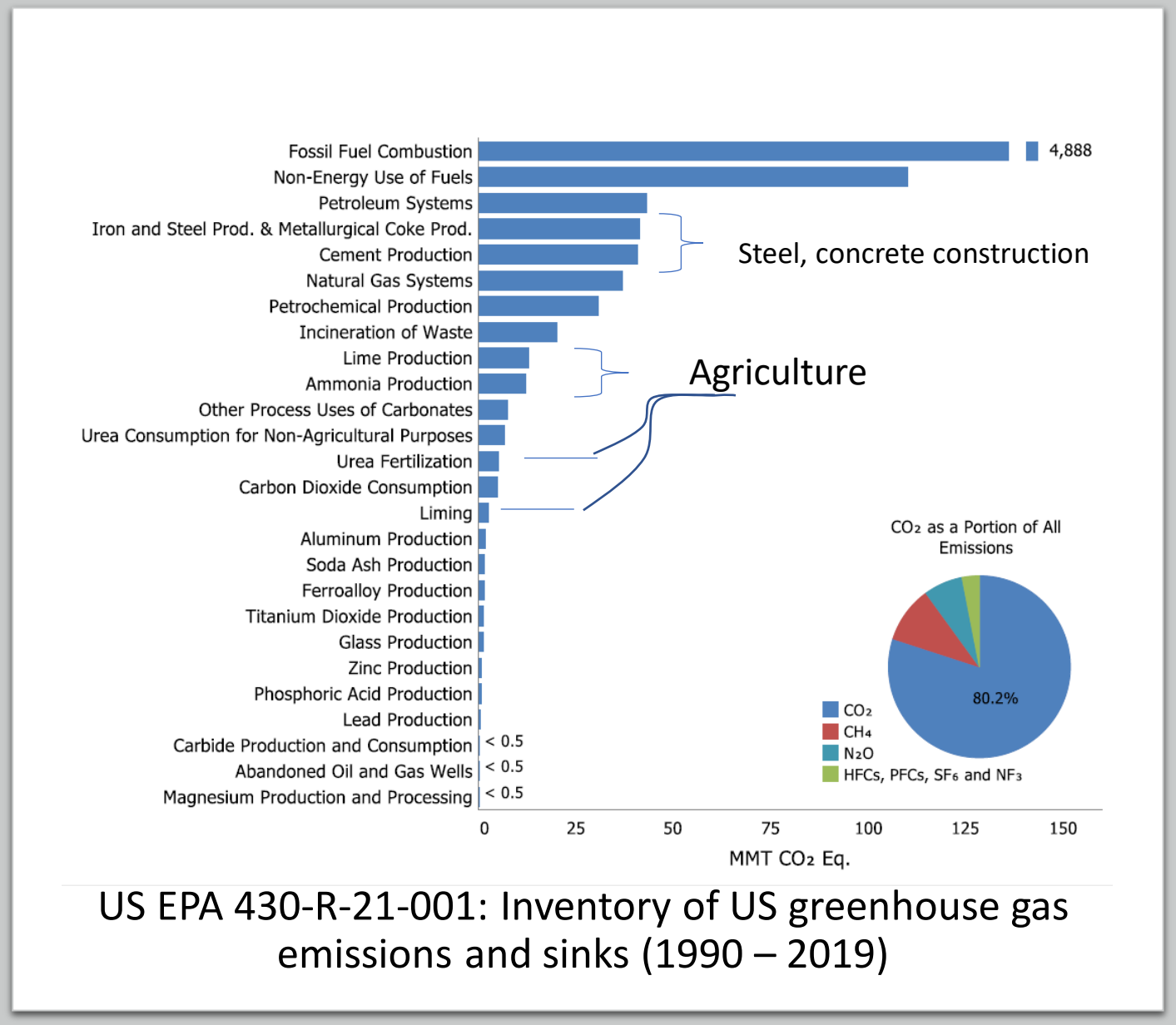
Global emissions

- Energy use in buildings, industry, transportation, agriculture = 73% of total
- (Tourism (mostly transportation) = 8%)
- Land conversion, deforestation = 2.2%
- Agricultural soils, crop residue burning, rice, Livestock = 16.2%
  - Food systems in total may account for closer to 33% of total global emissions (Crippa et al 2021)
- Concrete, iron and steel = 10%



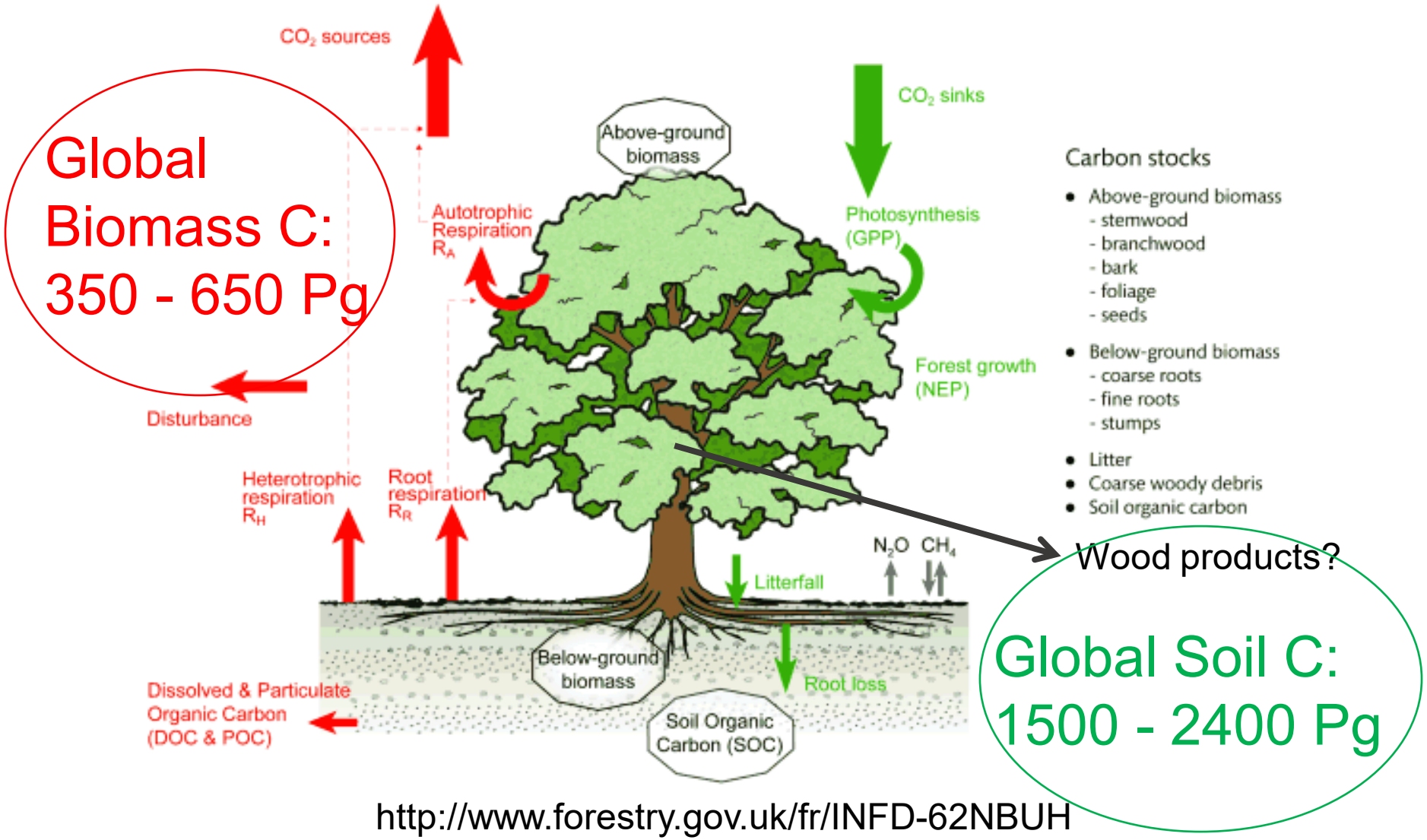
US CO_2 emissions

- United States: fossil fuel combustion accounted for 92.7 percent of CO_2 emissions in 2019.
- Energy use, transportation, agriculture
- Forestry? Wood construction?
- FF = permanently stored C, forests are cycled C… Keep our eye on the ball

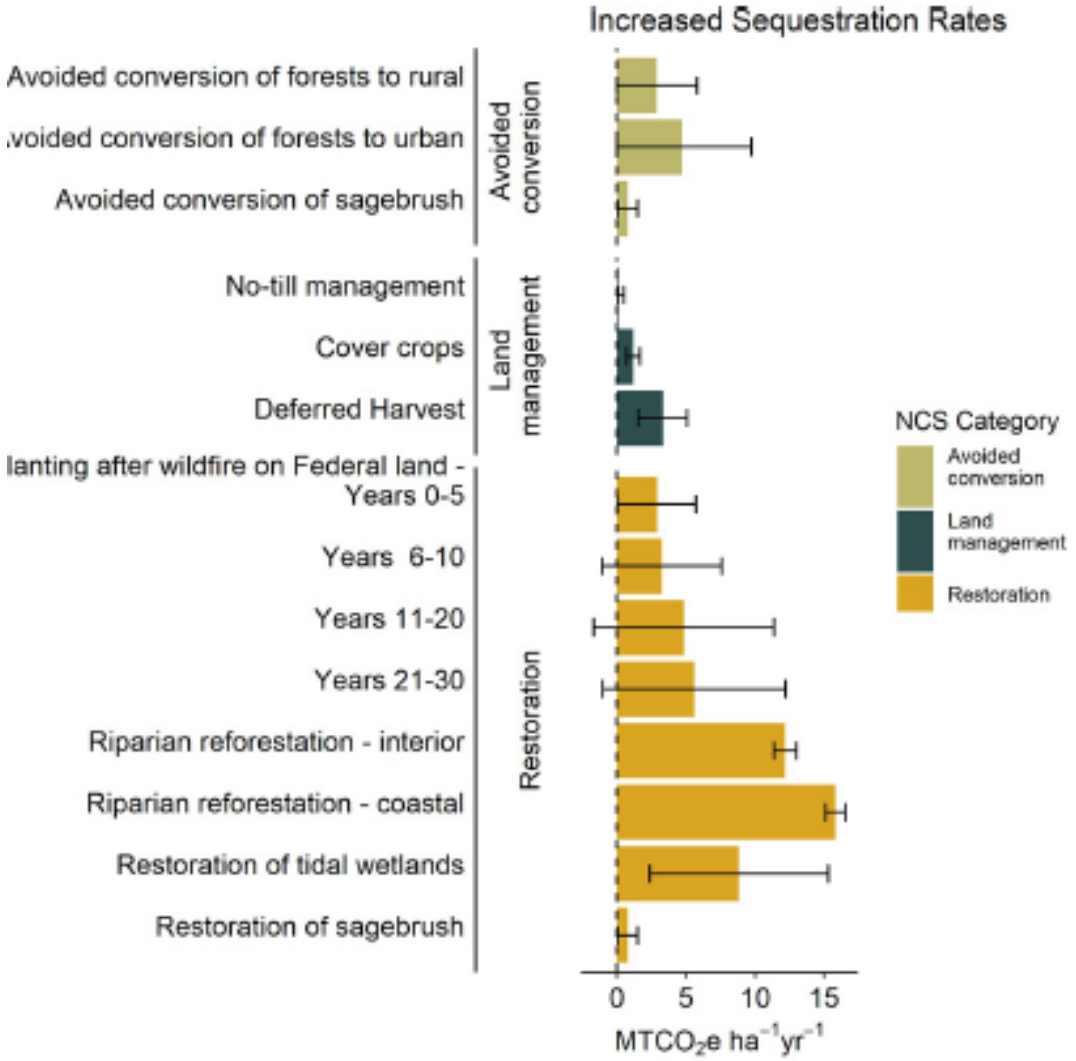


US EPA 430-R-21-001: Inventory of US greenhouse gas emissions and sinks (1990 – 2019)

What About Forests?



http://www.forestry.gov.uk/fr/INFD-62NBUH



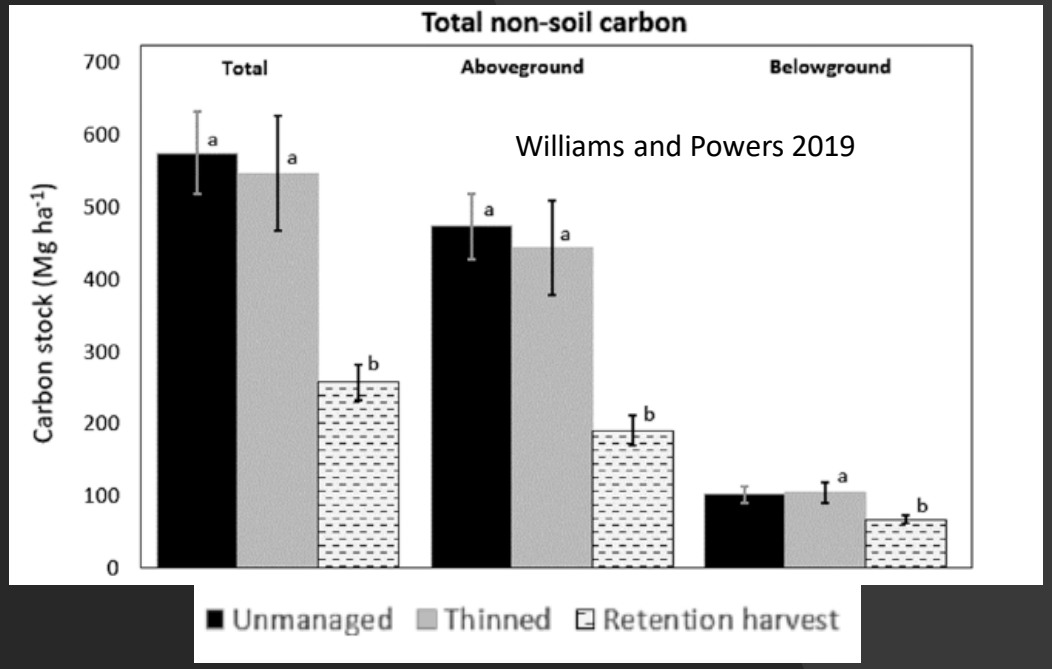
Graves et al. 2020

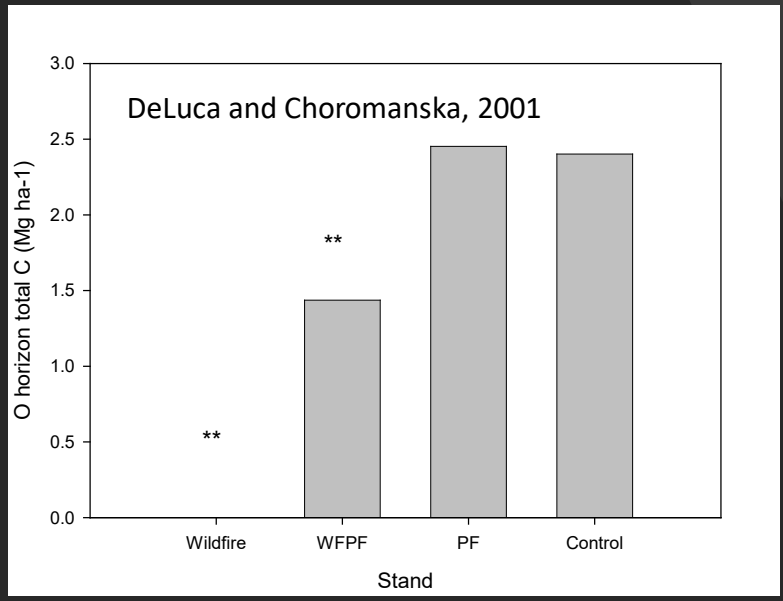
Forestry and carbon:

- Oregon and US forests are a net sink for CO_2
- Increasing rotation lengths can increase sequestration
  - 35 → 70 yr rot increases C storage (Franklin et al. 2019)
  - 45 → 80 yr w/50% harvest on private = 17% increase in state level C storage (Law et al. 2018)
- Alternative or ecological management
  - VRH increases ecosystem C storage (Franklin et al 2019)
  - FSC green tree reten & RMZ buffers increase C storage (Diaz et al. 2018)
  - Deferred harvest & preservation = increased storage & reduced emissions (Graves et al 2020)
- Land preservation in PNW greatly increases C storage
  - ~1,485 Tg C by 2099 (Buotte et al. 2020)

More notes on forest carbon storage

- Young forests add C quickly per unit area, but older forests store more C (Gray et al 2016)
- Light thinning can maintain C storage & yield wood products (Williams and Powers, 2019)
- Eastside restoration harvests and Rx fire can increase C storage if exposed to wildfire (Foster et al. 2020; Stephens et al 2020; Choromanska and DeLuca, 2001)
- ~40% biomass remains as harvest residues, 27% of timber = wood products, 18% mill residues and boiler fuel, 15% wood chips (Franklin et al. 2018)





Assumptions and important notes

1. More soil considerations
2. Assumptions: Reduce wood product generation in OR …
   a. Leakage will occur, may increase C losses
3. Reductions in cycled emissions are temporary
   a. Fire and windthrow = realities of all forests
4. Storing cycled C in ecosystems = a stop gap measure
5. PNW forestry = native species
   a. most large international, high productivity timber baskets are exotics

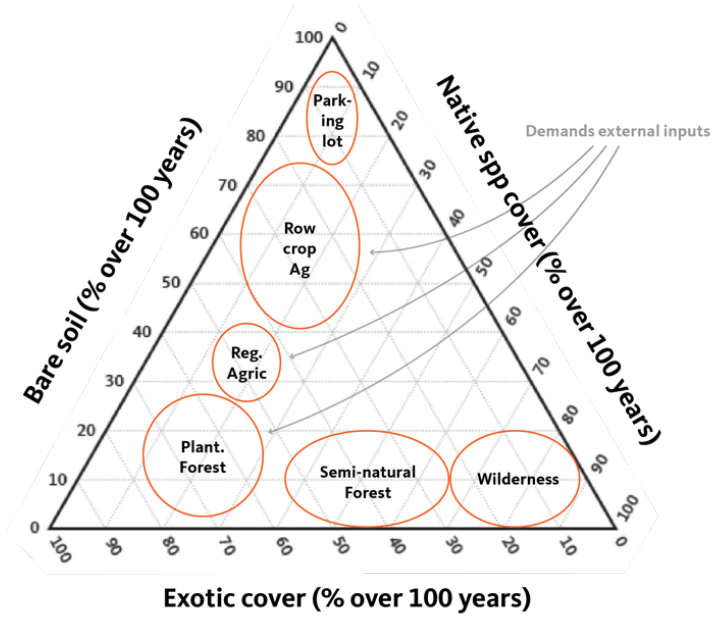
The soil guy says:

Bare soil is bad!

- Erosion and C mineralization (CO_2 gen)

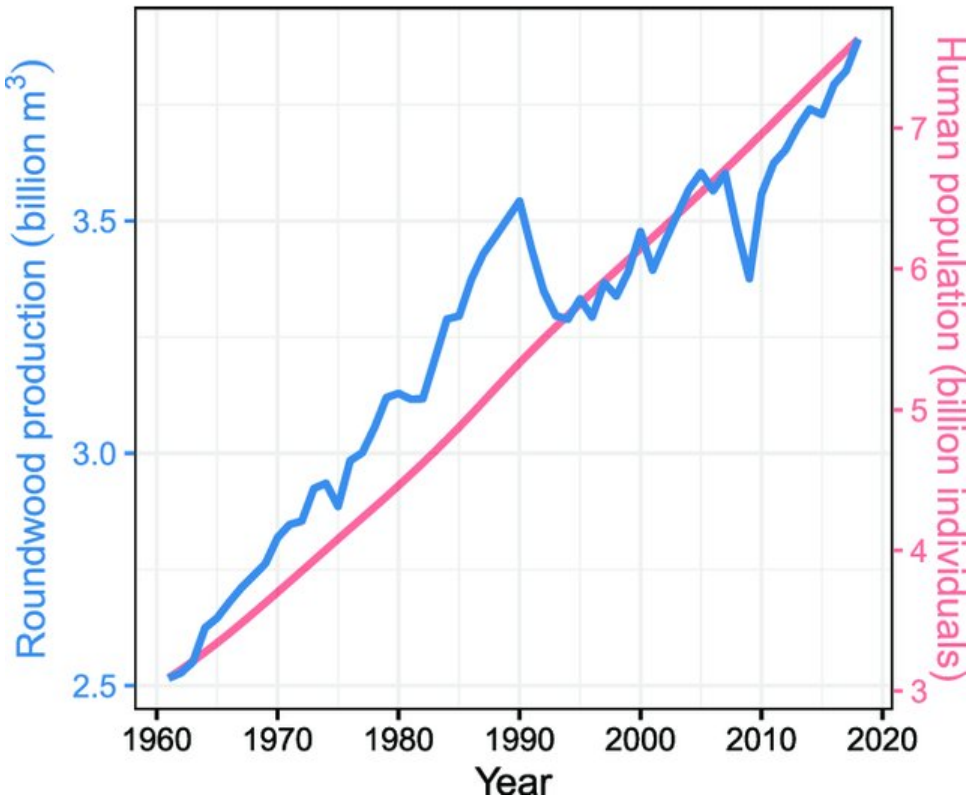
- Time as bare soil 100 yrs:
  - *Row crop = 70%/yr*
  - *No-till row crop = ~30%/yr*
  - *Plantation forests = ~12%/yr*
  - *Seminatural forests = 1%/yr*
  - *Wildland forests and grasslands*

  0.5-2%/yr avg



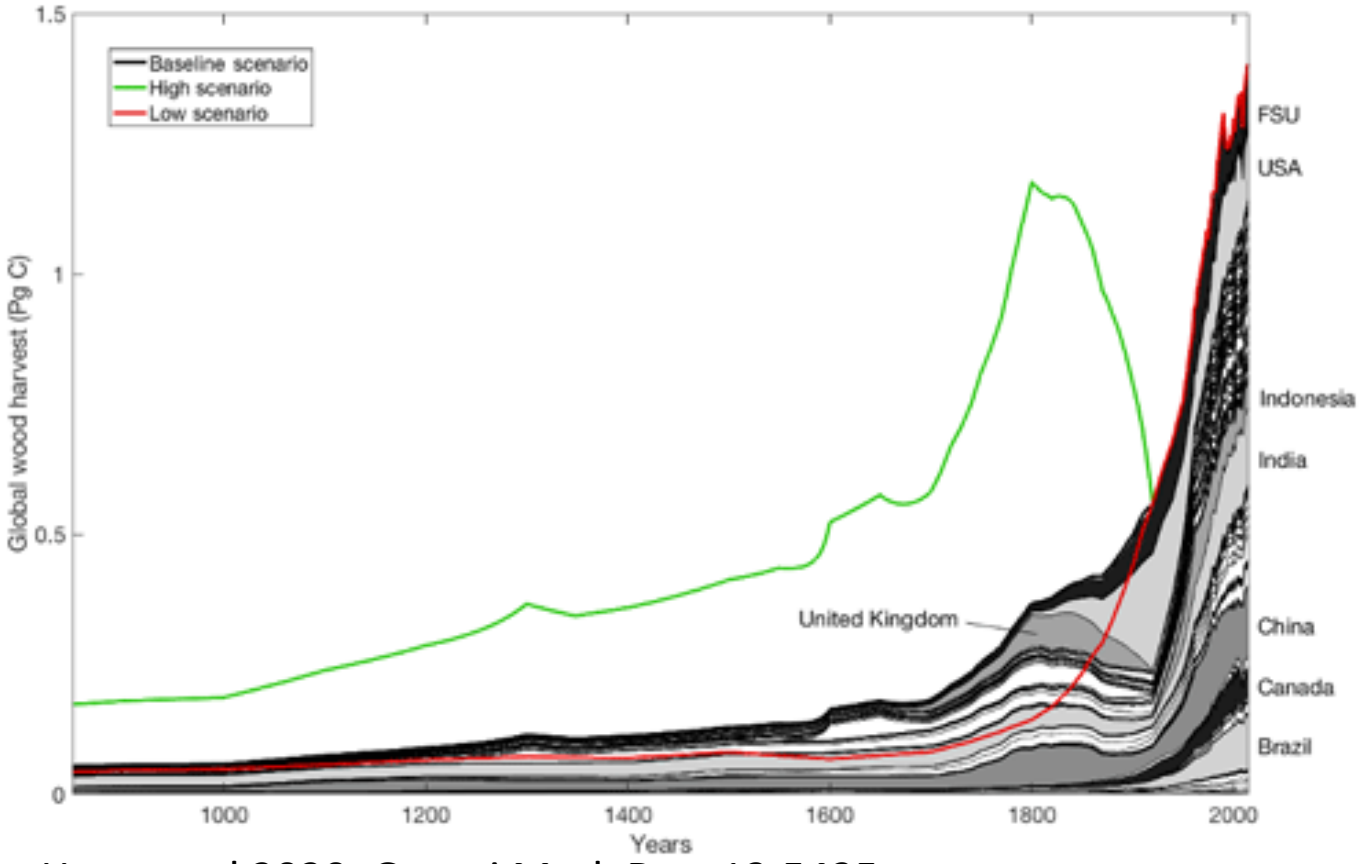
Leakage? Consider global wood demand and international forest harvest. CO_2 knows no borders

Global roundwood production



Betts et al 2021

Forest harvest

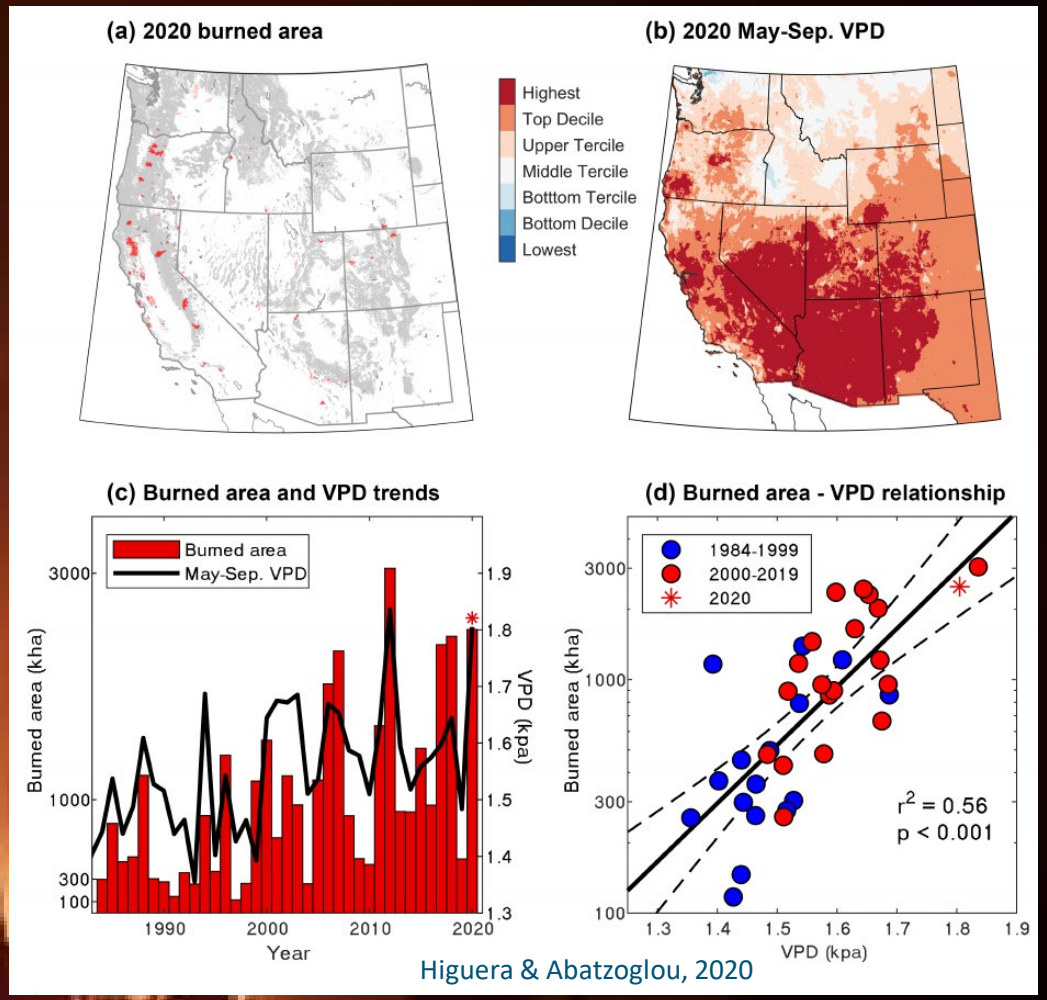


Hurtt et al 2020. Geosci Mod. Dev. 13:5425

Fire and Climate Change

What about emissions?

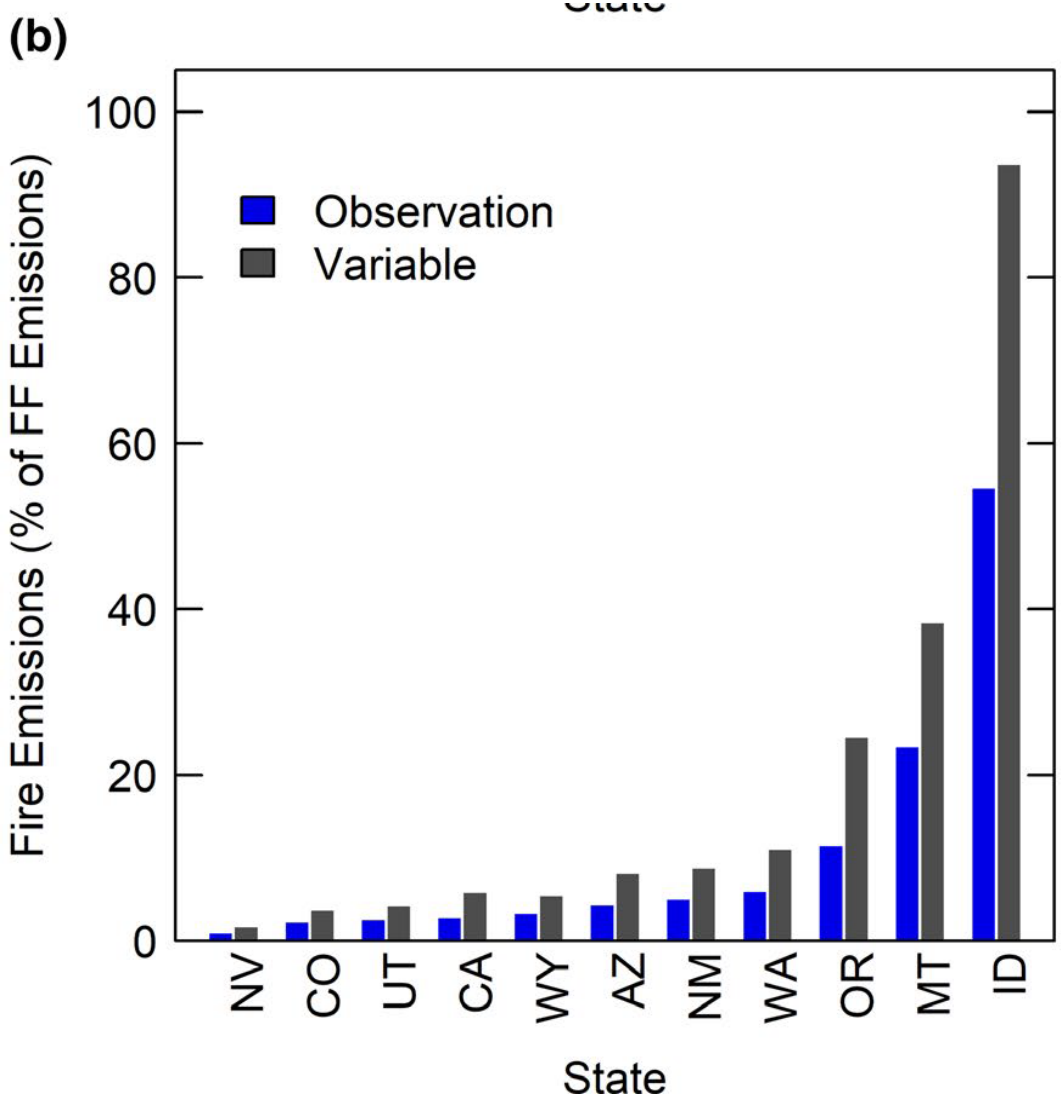
- **4 million acres** in CA and OR alone in 2020
- Right. Fire and climate western US. (a) Burned area through September 2020; (b) Avg 2020 May-September vapor pressure deficit (VPD); (c) West-wide annual burned area; (d) Relationship between VPD and log of burned area (Higuera and Abatzoglou, 2020 GCB https://doi.org/10.1111/gcb.15388
- ~20% of biomass consumed
- 5% of mature tree biomass. Dead trees slowly decompose (Stenzle et al 2019)
- Salvage? 25% WP storage, rapid regeneration (Dunn et al. 2021)



Higuera & Abatzoglou, 2020

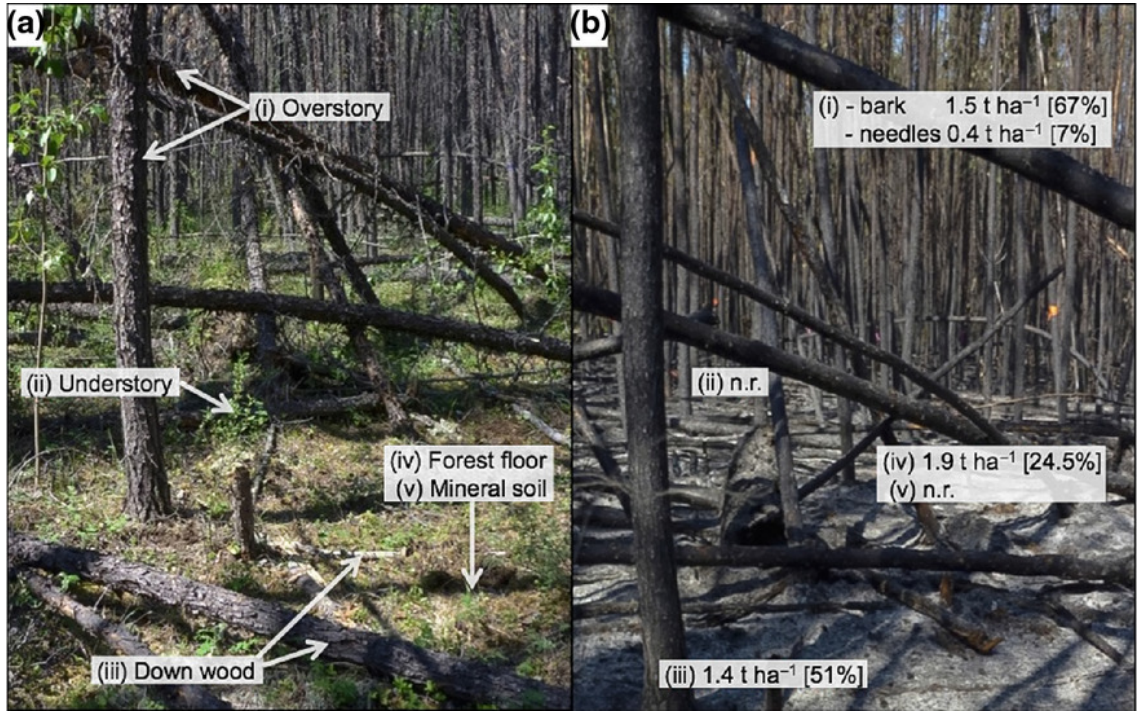
Fire and carbon storage?

- Fire emissions far less than OR (Stenzel et al. 2019)
- Dry forest treatments (mech/burn) can increase C stability (Foster et al. 2020; Stephens et al 2020)
- Wet forests? Its complicated!
- Pyrogenic C (PyC)
  - Boreal fire PyC (Santin et al 2015)
    - ~4.8 Mg PyC ha^{-1}
    - 115-383 Tg PyC yr^{-1}
  - Temperate fire PyC (DeLuca et al 2020)
    - Rx fire 1.6 Mg PyC ha^{-1}
    - wildfires 2.3 Mg C ha^{-1}

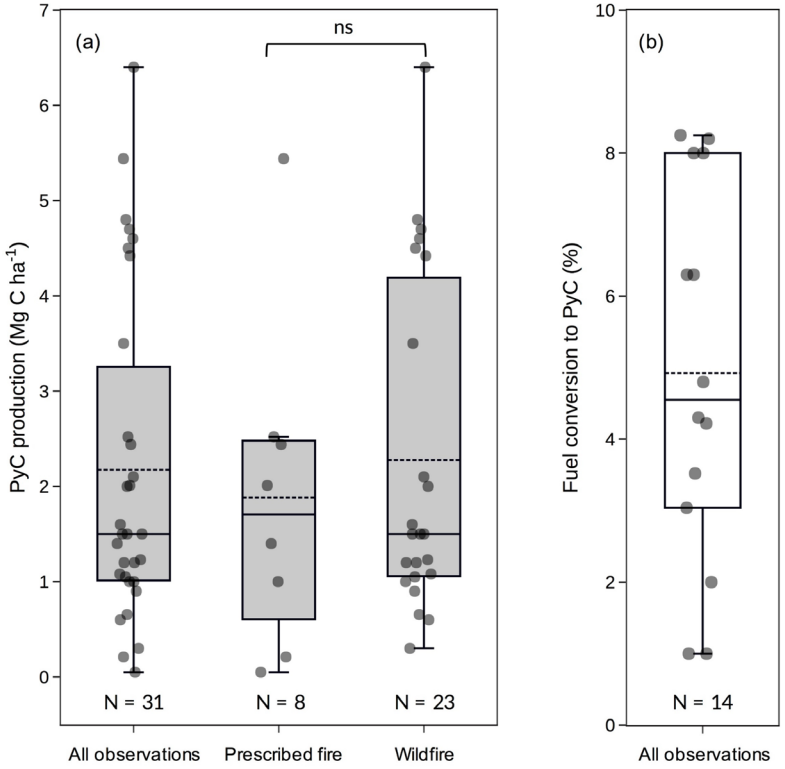


Figures for prior text

PyC Boreal (Santin et al 2016)

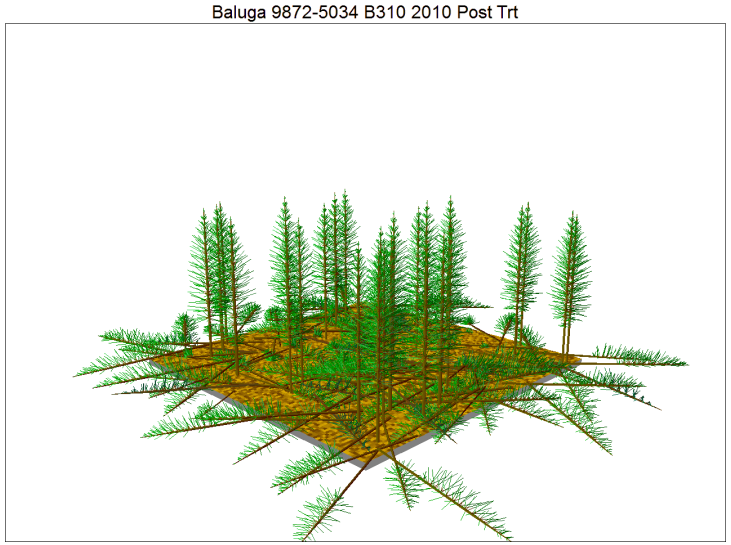


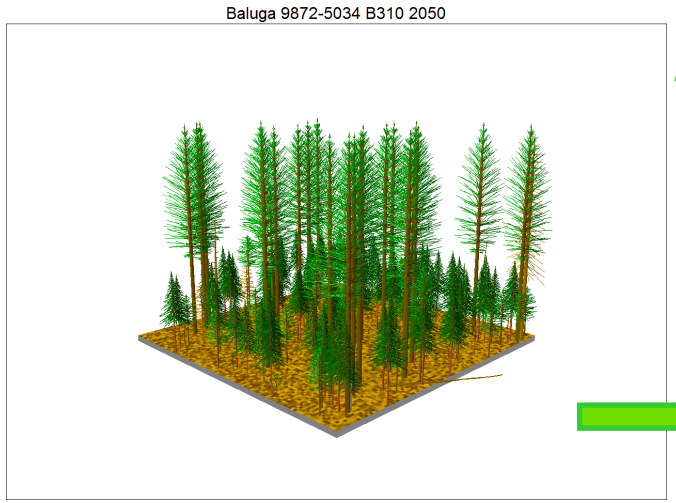
PyC with Rx Fire (DeLuca et al 2020)

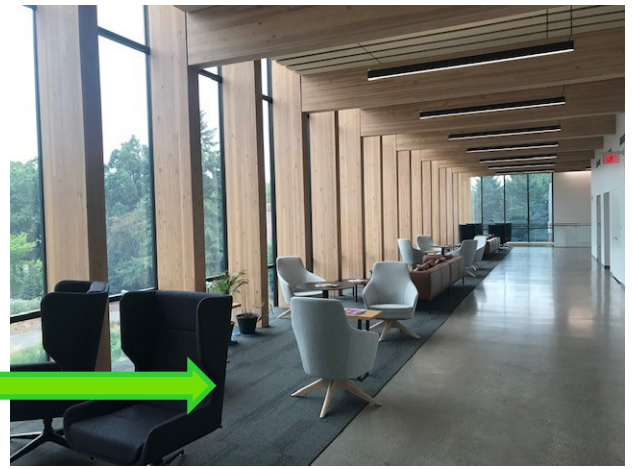


Improved Forest Management and C storage

- Longer rotations
- Less intensive harvesting
- More carbon storage
- Utilization in durable products

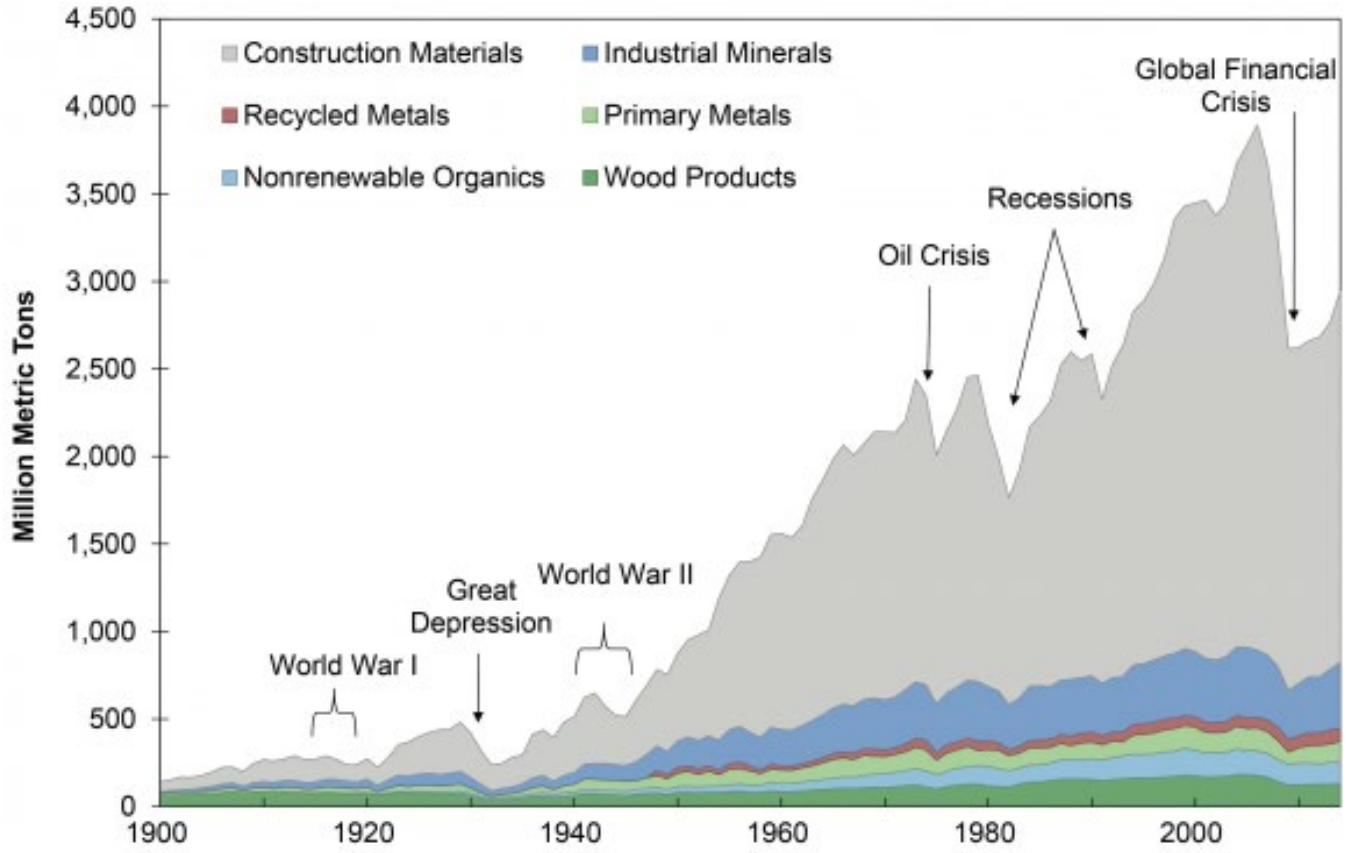






TDI: http://tallwoodinstitute.org/

Mid, high rise construction & waste

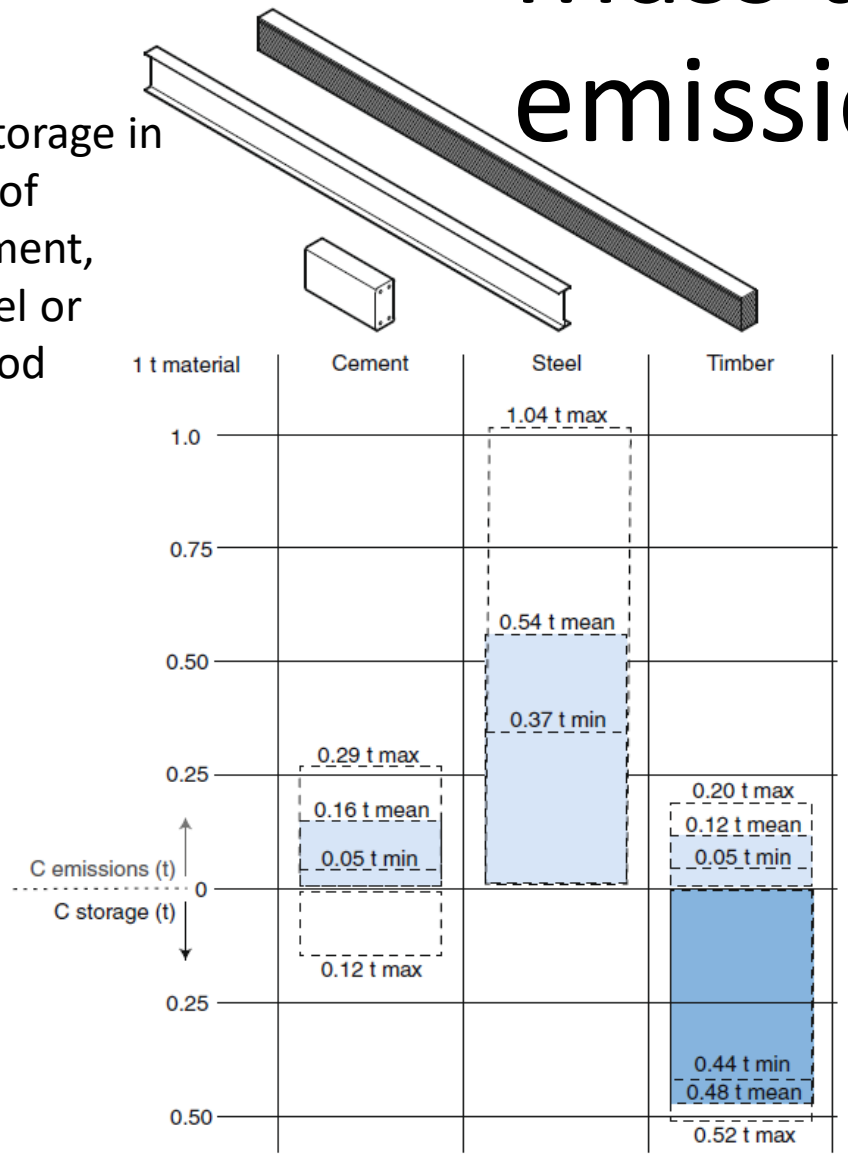


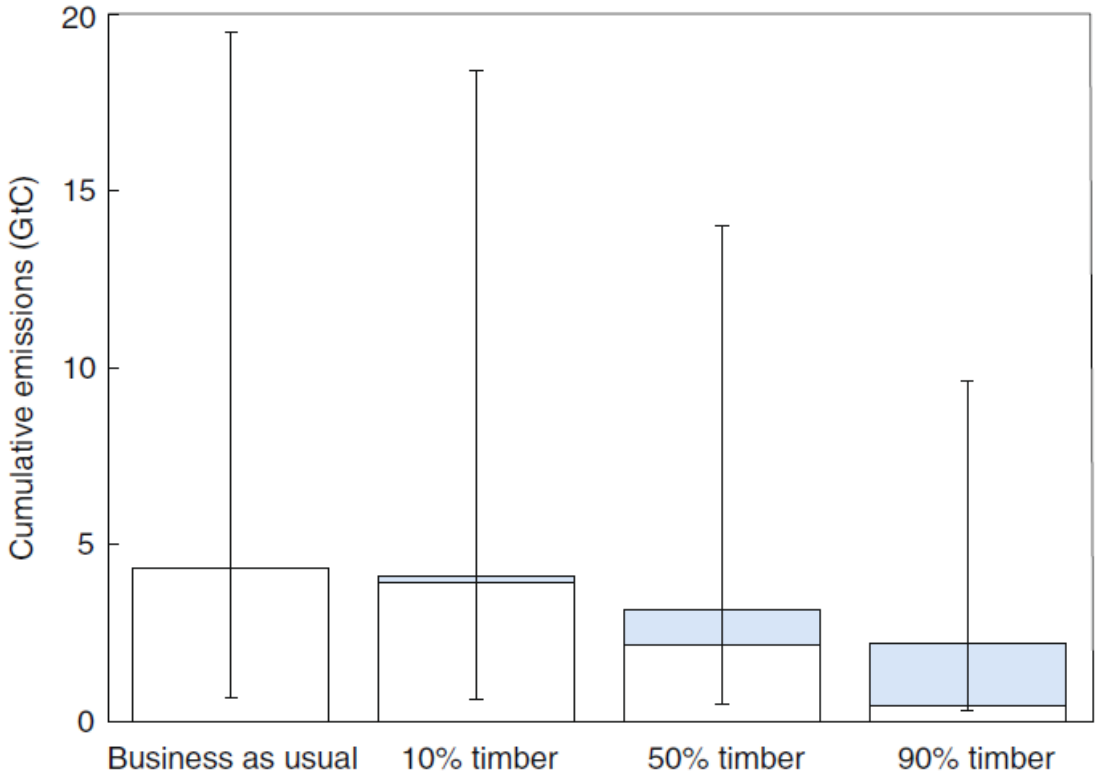
- Steel & concrete 6% - 8% of global anthropgenic carbon emissions
- US non-food, non-fuel consumption

Matos 2017

Mass timber construction and global emissions

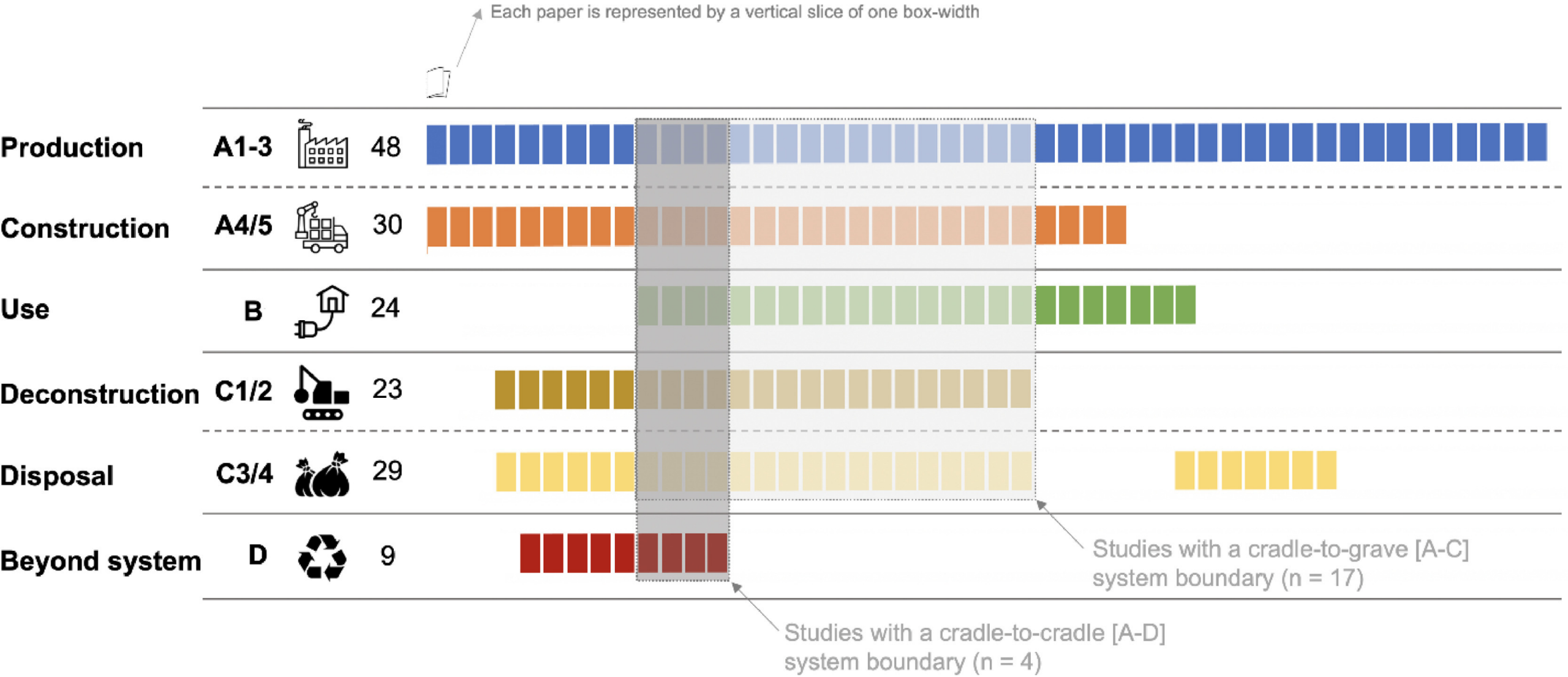
C storage in 1 t of cement, steel or wood





Churkina et al 2020. Nature sustainability

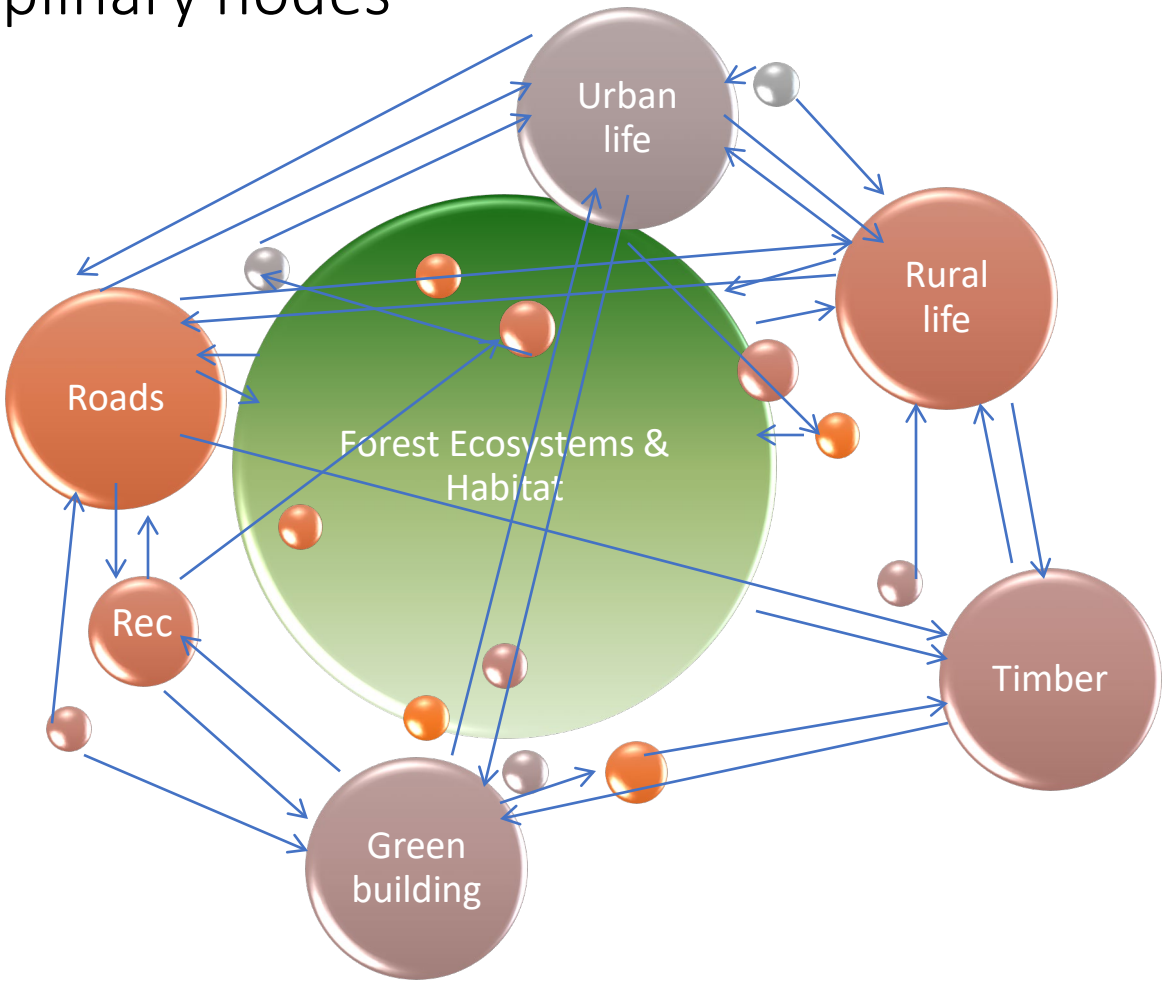
LCAs often incomplete



Arehart et al. 2021 Sustainable Production and Consumption 27:1047

Requires systems analysis – Cradle to cradle

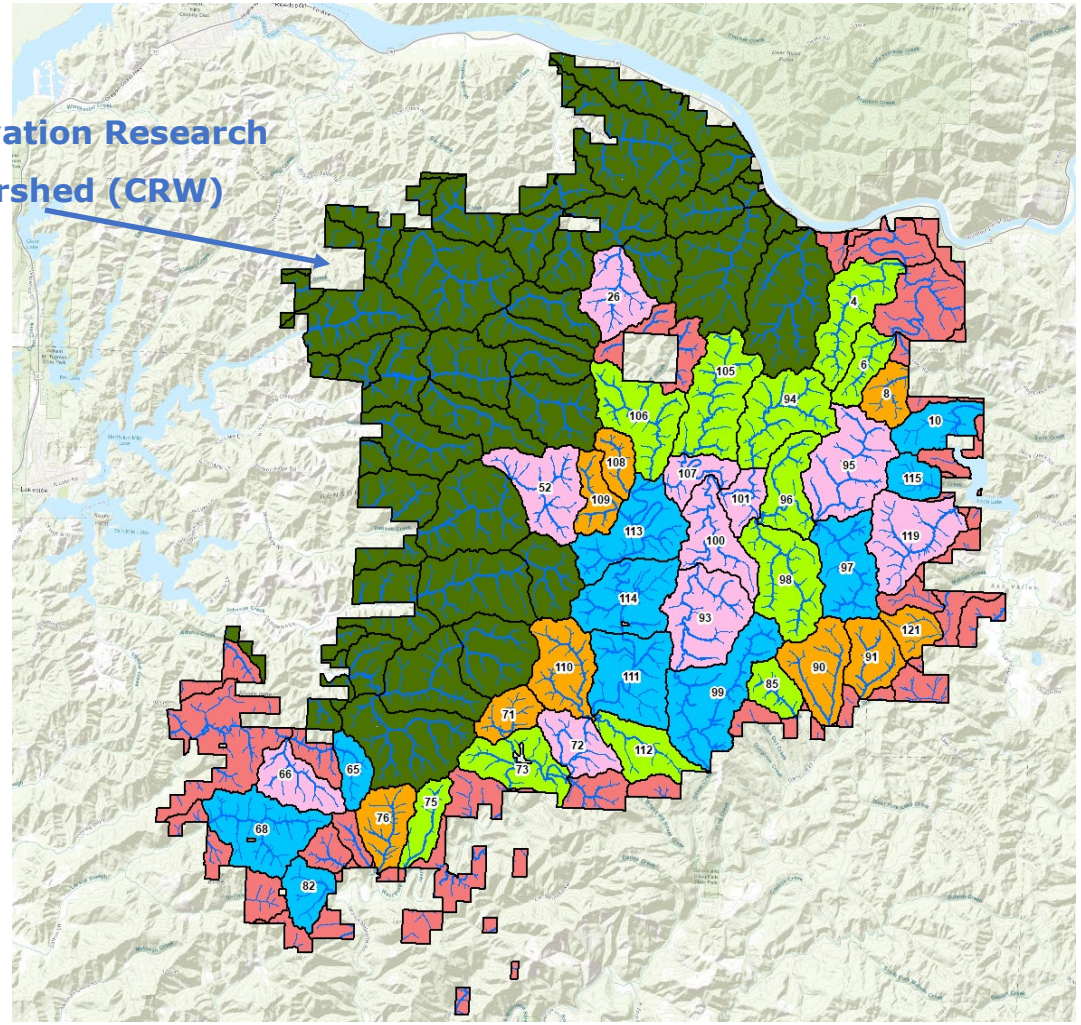
Integration of disciplinary nodes



Necessary for assessing C dynamics

The Elliott Res Forest?

- **The Northwestern ~34,000 acres put into reserve (shown in green).**
- **Southwestern 48,000 acres in research and reserve**
- **64,000 acres of reserve**
- **Research on tradeoffs in conservation**
- **Research on C emissions and storage**
- **BH 30 by 30**



August 25 Watershed Assignments

Needs?

Continued efforts on ecosystem modelling to address forest function

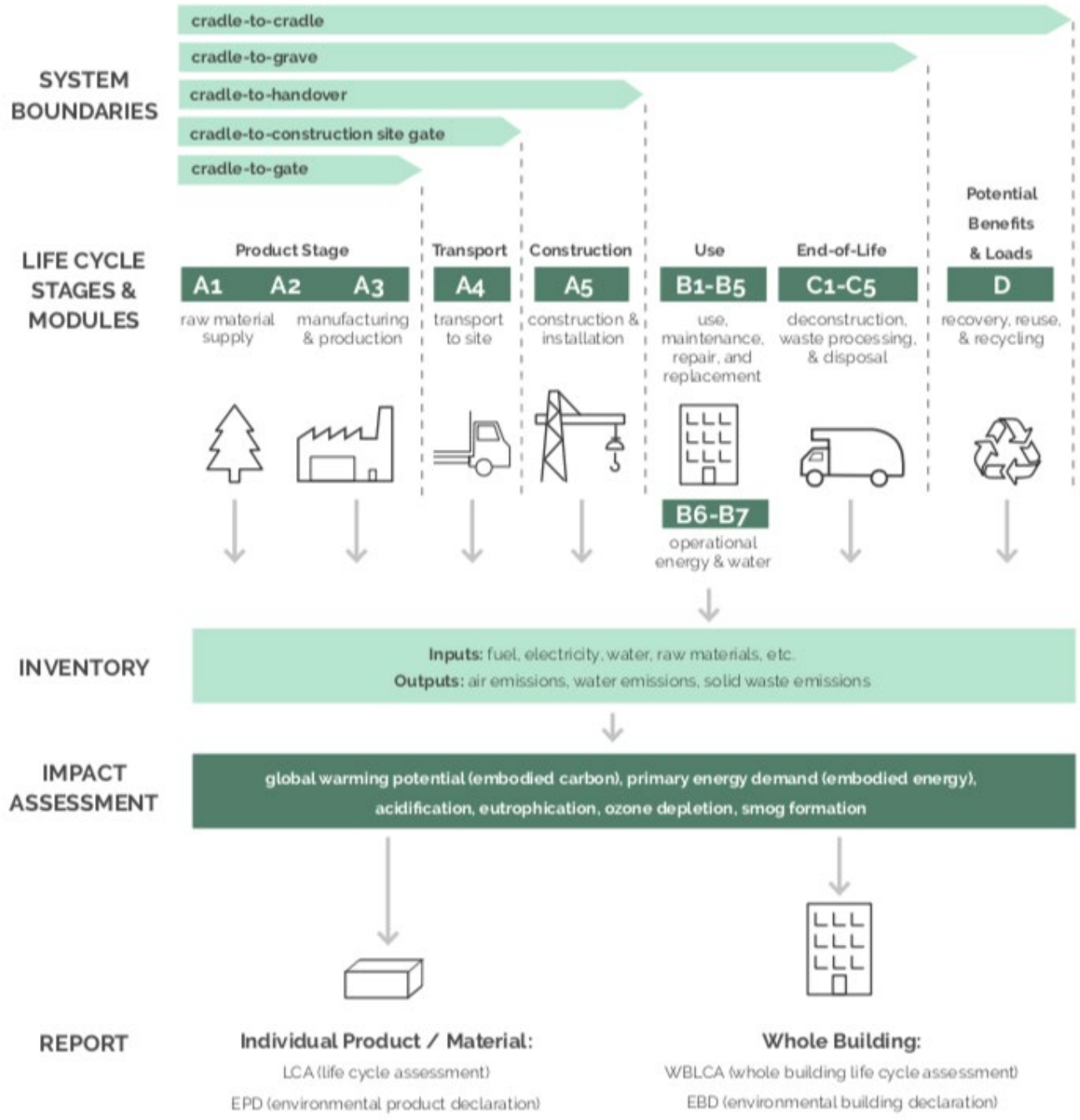
Systems dynamics – going beyond LCA or ensuring C-C LCA

Economics of a carbon economy

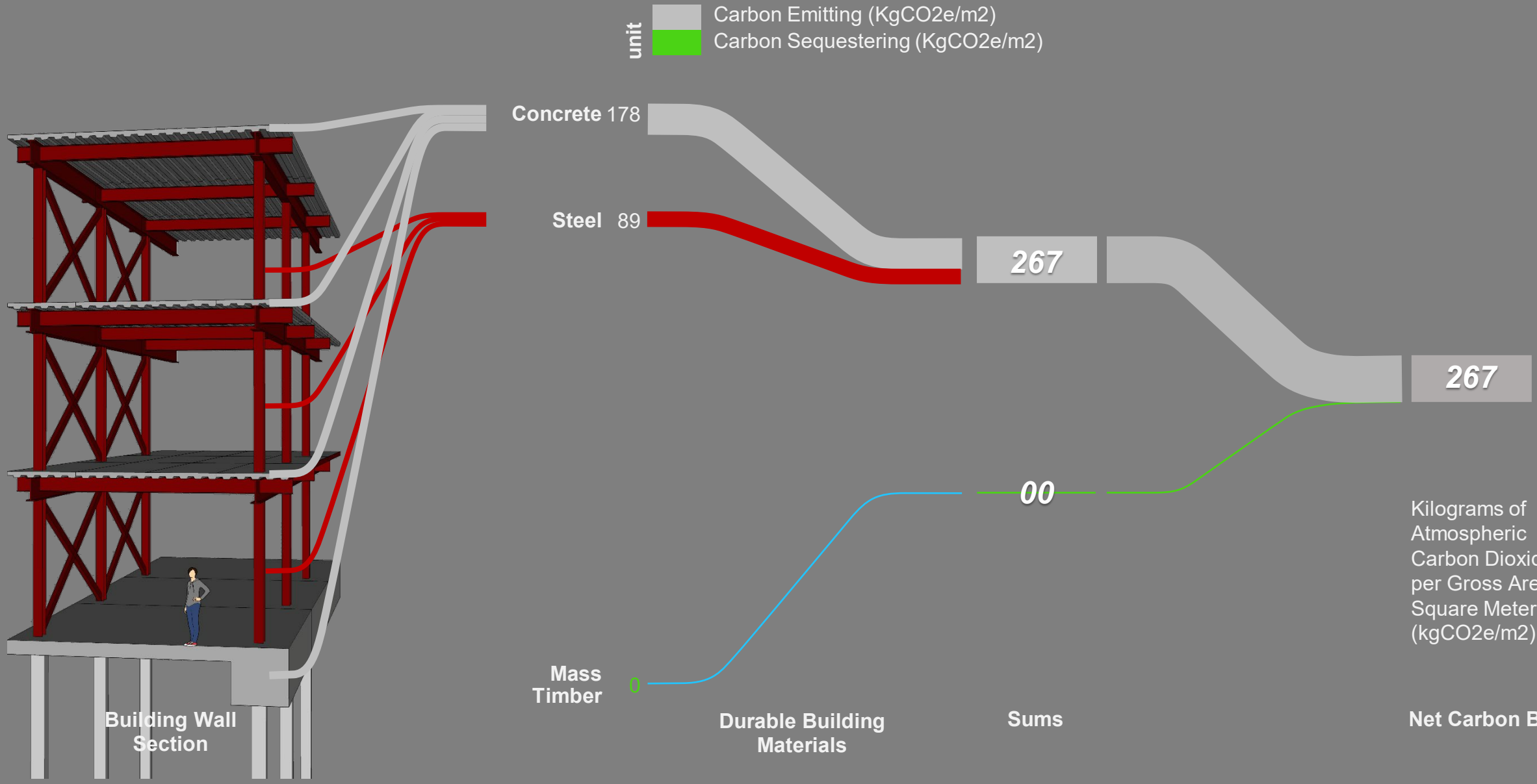

Thank You!
Any Questions?
Oregon State University

Wood building LCA

Tallwood Design Institute



BASE BUILDING CARBON BALANCE (SCHEDULE A1-A5+D)



MASS TIMBER CARBON BALANCE (SCHEDULE A1-A5 + D)