Forest Sector Carbon Accounting

What Question are You Trying to Answer?

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Photo Credit: Shavonne Sargent

Outline

Biogenic Carbon Cycle 101:

- Stock vs. Flux
- Net vs. Gross
- Anthropogenic vs. Natural
- Examples:
  - Oregon headlines vs. FIA inventory
  - Portlandia Chickens
  - IPCC reporting

Carbon Accounting 101:

- Reporting vs. Comparing (aka what is the baseline?)
- Differences in Country vs. Product vs. Organizational Reporting (aka what is the timeframe?)

Matching the question to the right accounting framework, Examples:

- I want to calculate the carbon benefit of my offset project
- I want to know the carbon impact of the wood product I am buying
- I want to report my company's GHG emissions
- I want to know what will happen if we increase demand for wood
- I want to know what will happen if we stop/reduce harvesting

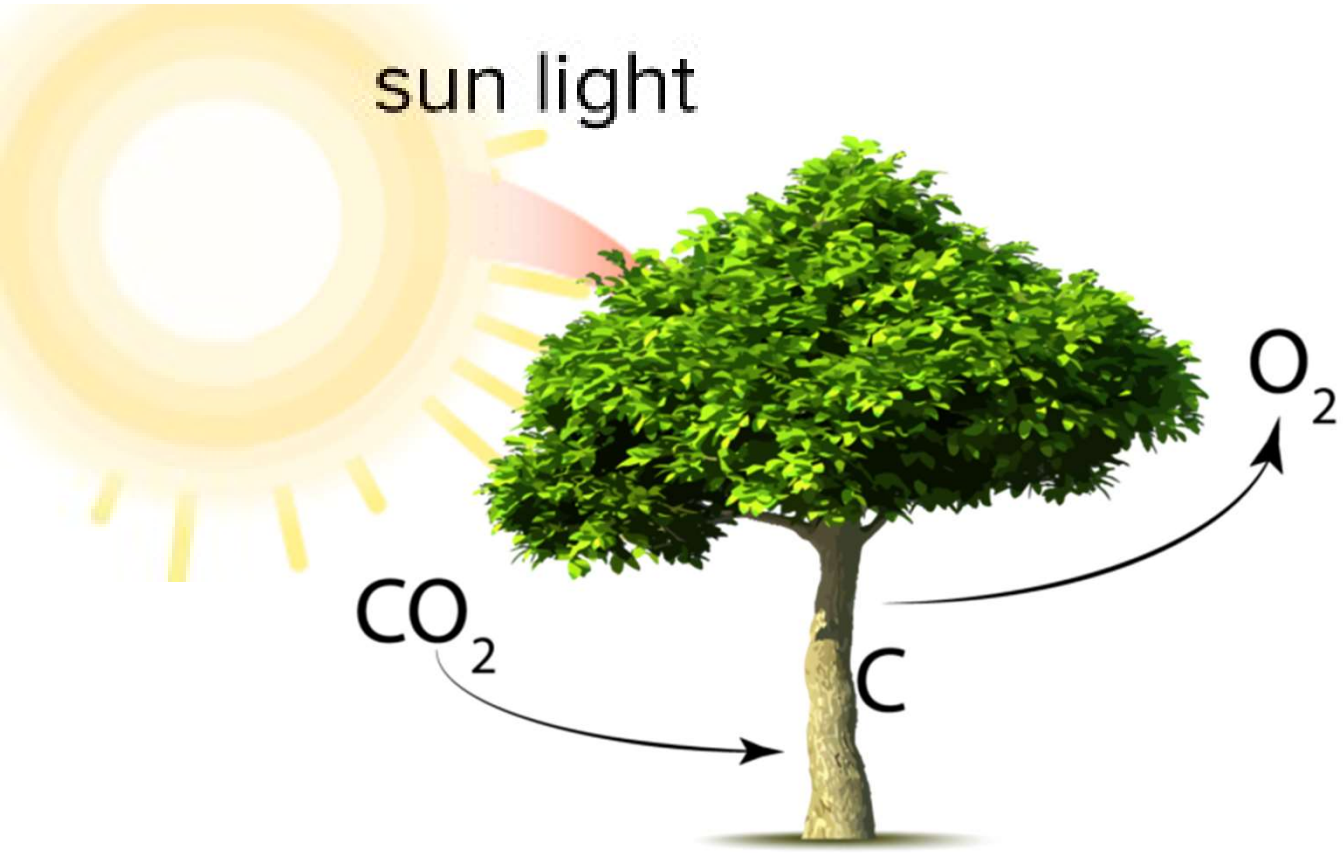
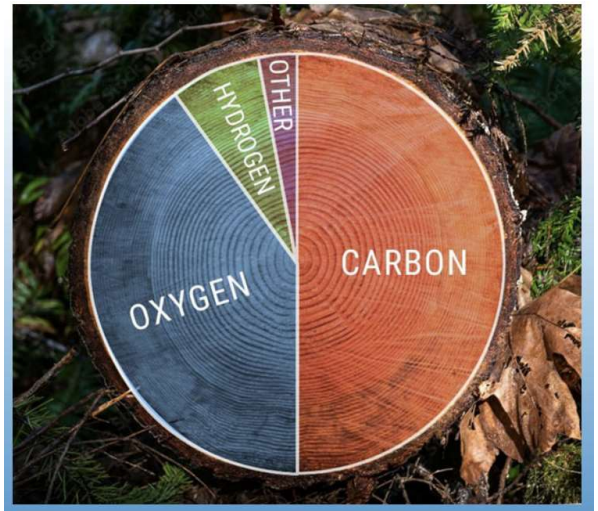


Photo source: [CO2 fertilizes forests around the globe • Forest Monitor (forest-monitor.com)]



The dry weight of tree wood is composed mostly of solid carbon which remains in this solid stored state until the wood decays or is destroyed by burning.

Photo Source: [Carbon Sequestration & Sustainable Forest Management — Janicki Logging Co.]

Photosynthesis $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

But Also:

Respiration $\mathbf{C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O}$

What does the atmosphere see?

Net flux = emissions – sequestration = Stock Change

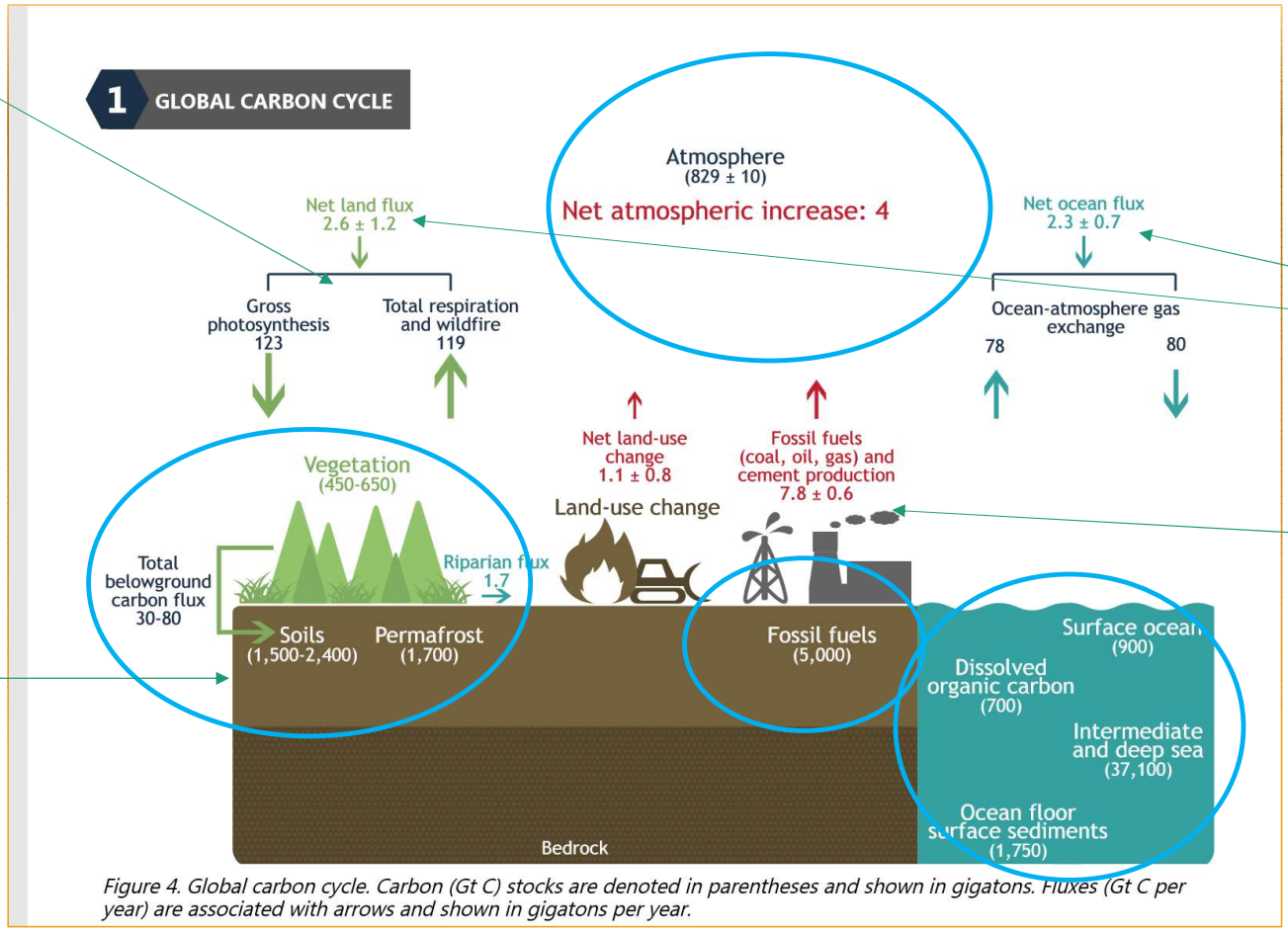


Figure 4. Global carbon cycle. Carbon (Gt C) stocks are denoted in parentheses and shown in gigatons. Fluxes (Gt C per year) are associated with arrows and shown in gigatons per year.

Currently, more CO_2 going into Ocean and Land than going into atmosphere = net sinks

Stocks/Pools= Vegetation/Land; Ocean; Atmosphere; Fossil Fuel

Fossil Fuel emissions is one way only = always net source

Source: Janowiak, M.; Swanston, C. (May, 2017). Carbon and Land Management Introduction. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center. www.fs.usda.gov/ccrc/topics/carbon-land-mgmt/introduction

Anthropogenic vs. Natural Impacts on Biogenic Carbon Cycle

Table 7.1 | Net anthropogenic emissions (annual averages for 2010–2019[a]) from Agriculture, Forestry and Other Land Use (AFOLU). For context, the net flux due to the natural response of land to climate and environmental change is also shown for CO_2 in column E. Positive values represent emissions, negative values represent removals.

Anthropogenic						Natural response	Natural and anthropogenic
Gas	Units	AFOLU Net anthropogenic emissions [h]	Non-AFOLU anthropogenic GHG emissions [d, f]	Total net anthropogenic emissions (AFOLU + non-AFOLU) by gas	AFOLU as a % of total net anthropogenic emissions by gas	Natural land sinks including natural response of land to anthropogenic environmental change and climate variability [e]	Net land-atmosphere CO_2 flux (i.e., anthropogenic AFOLU + natural fluxes across entire land surface
		A	B	C = A+B	D = (A/C) *100	E	F=A+E
CO_2	$GtCO_2$-eq yr^{-1}	5.9 ± 4.1 [b, f] (book-keeping models, managed soils and pasture). 0 to 0.8 (NGHGI/ FAOSTAT data)	36.2 ± 2.9	42.0 ± 29.0	14%	**–12.5 ± 3.2**	**–6.6 ± 4.6**
CH_4	$MtCH_4$ yr^{-1}	157.0 ± 47.1 [c]	207.5 ± 62.2	364.4 ± 109.3		– [i]	
	$GtCO_2$-eq yr^{-1}	4.2 ± 1.3 [g]	5.9 ± 1.8	10.2 ± 3.0	41%		
N_2O	MtN_2O yr^{-1}	6.6 ± 4.0 [c]	2.8 ± 1.7	9.4 ± 5.6			
	$GtCO_2$-eq yr^{-1}	1.8 ± 1.1 [g]	0.8 ± 0.5	2.6 ± 1.5	69%		
Total [j]	$GtCO_2$-eq yr^{-1}	11.9 ± 4.4 (CO_2 component based on book-keeping models, managed soils and pasture)	44 ± 3.4	55.9 ± 6.1	21%		

MENU | High Country News

HCN For the holidays, g
to *High Country N*

CLIMATE CHANGE

Timber is Oregon's biggest carbon polluter

A new study finds that forests are key to reducing the state's climate impacts.

Carl Segerstrom | NEWS | May 16, 2018 | *From the print edition* |

Table 1.

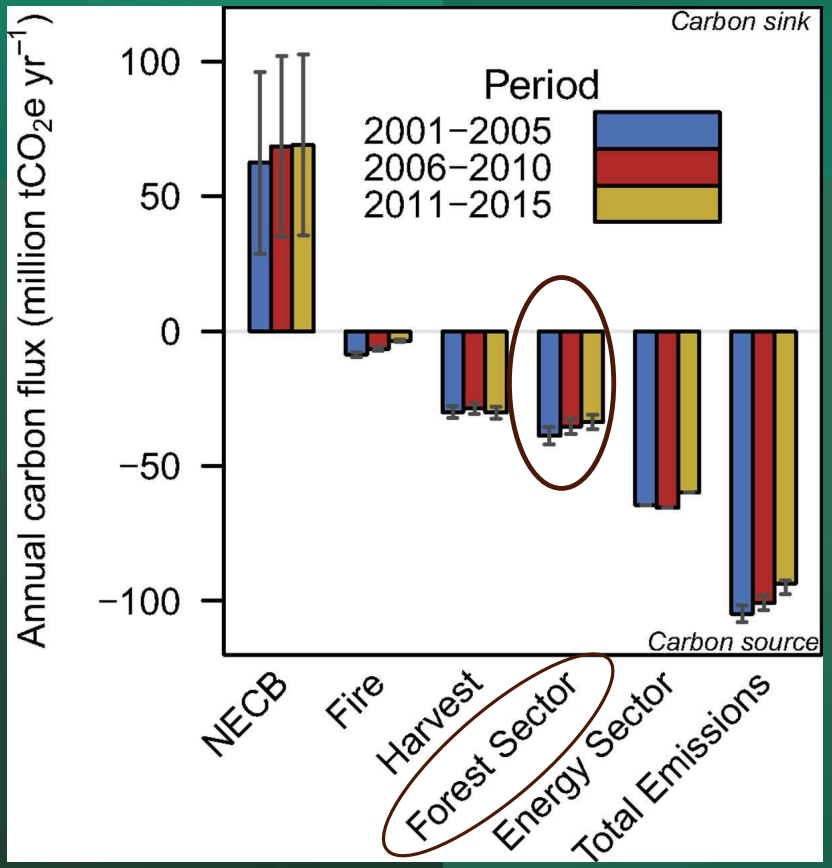
Forest carbon budget components used to compute NECB

OPEN IN VIEWER

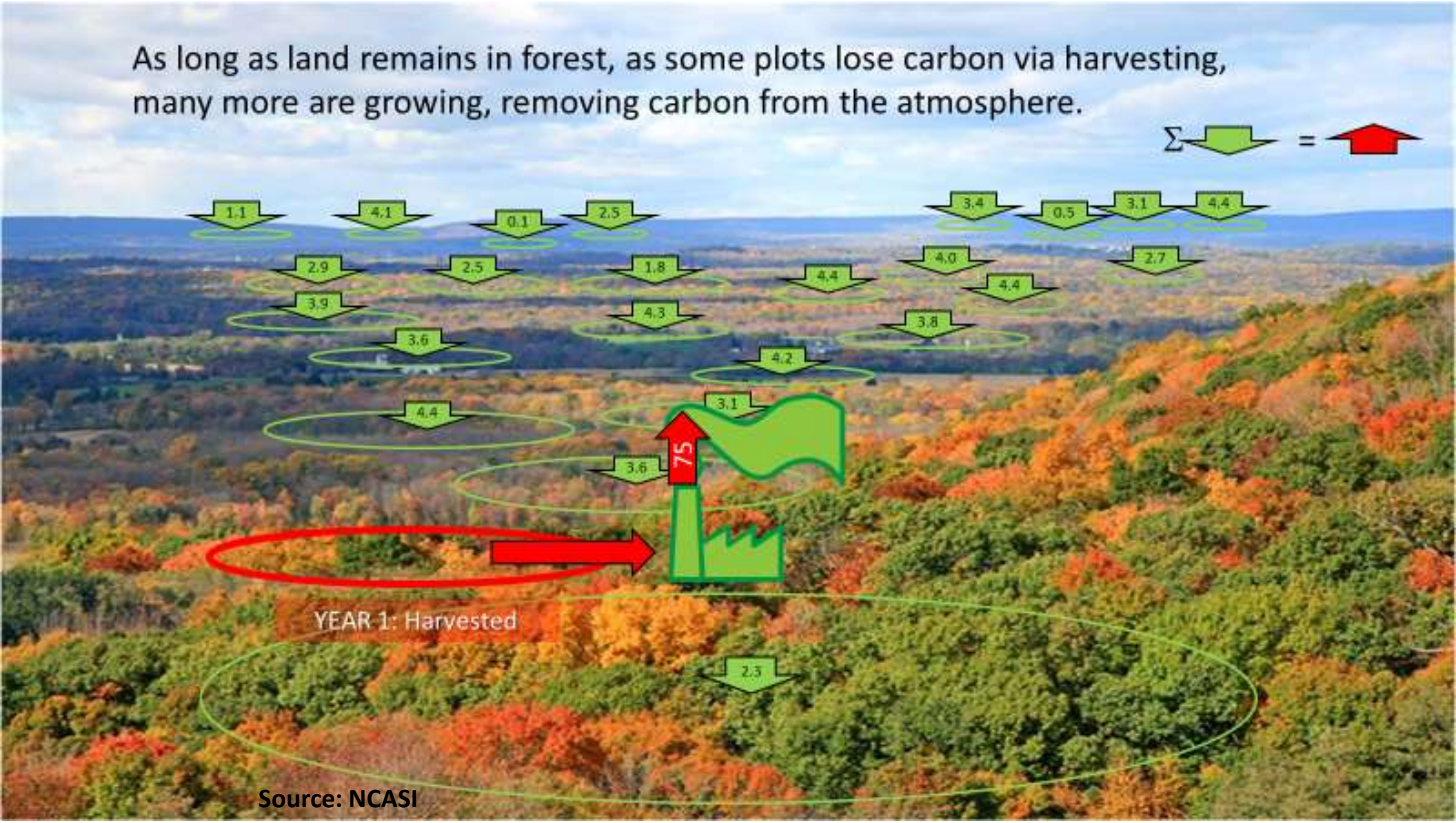
Flux, Tg C·y^{-1}	2001–2005		2006–2010		2011–2015		2001–2015
NPP	73.64	7.59	73.57	7.58	73.57	7.58	73.60
Rh	45.67	5.11	45.38	5.07	45.19	5.05	45.41
NEP	27.97	9.15	28.19	9.12	28.39	9.11	28.18
Harvest removals	8.58	0.60	7.77	0.54	8.61	0.6	8.32
Fire emissions	2.37	0.27	1.79	0.2	0.97	0.11	1.71
NECB	17.02	9.17	18.63	9.14	18.81	9.13	18.15

COLLAPSE

Average annual values for each period, including uncertainty (95% confidence interval) in Tg C y^{-1} (multiply by 3.667 to get million tCO_2e).



Source of graph and Table 1 from: Law et al (2018)

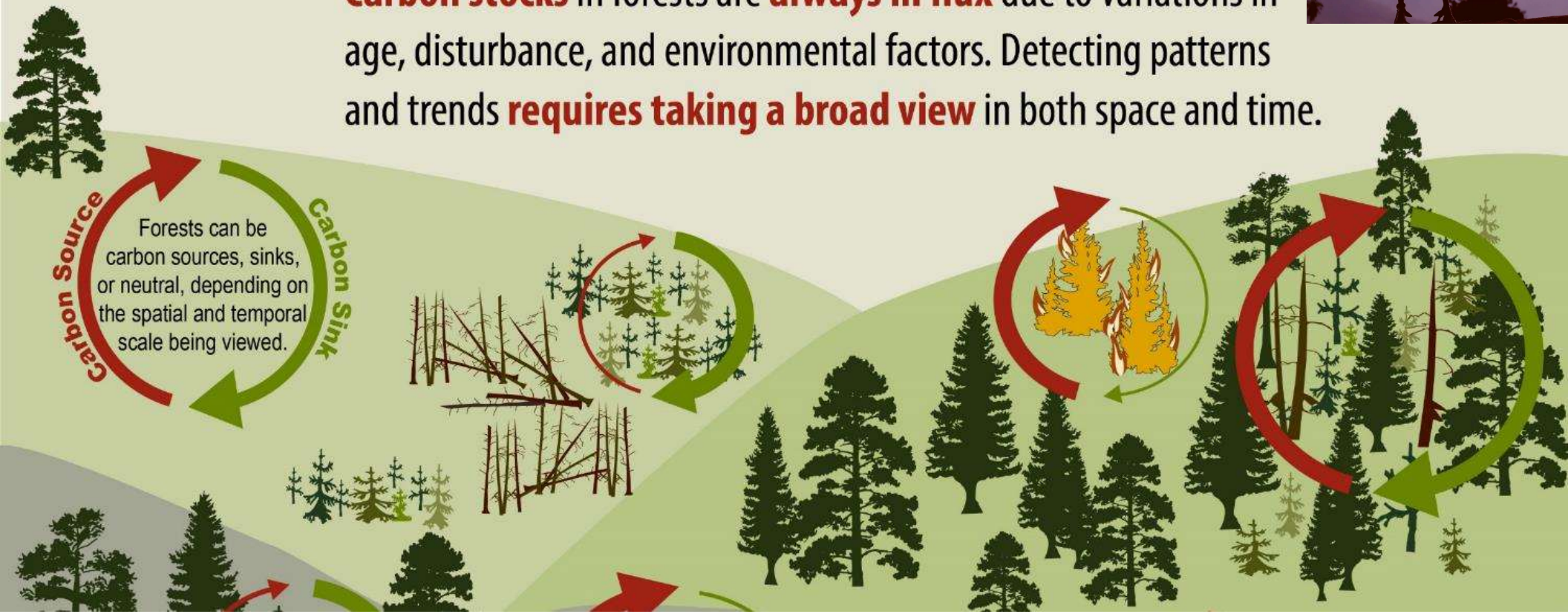

As long as land remains in forest, as some plots lose carbon via harvesting, many more are growing, removing carbon from the atmosphere.
Σ
=
1.1
4.1
0.1
2.5
3.4
0.5
3.1
4.4
2.9
2.5
1.8
4.4
4.0
2.7
4.4
3.9
4.3
3.8
3.6
4.2
4.4
3.1
75
3.6
YEAR 1: Harvested
2.3
Source: NCASI

USDA United States Department of Agriculture

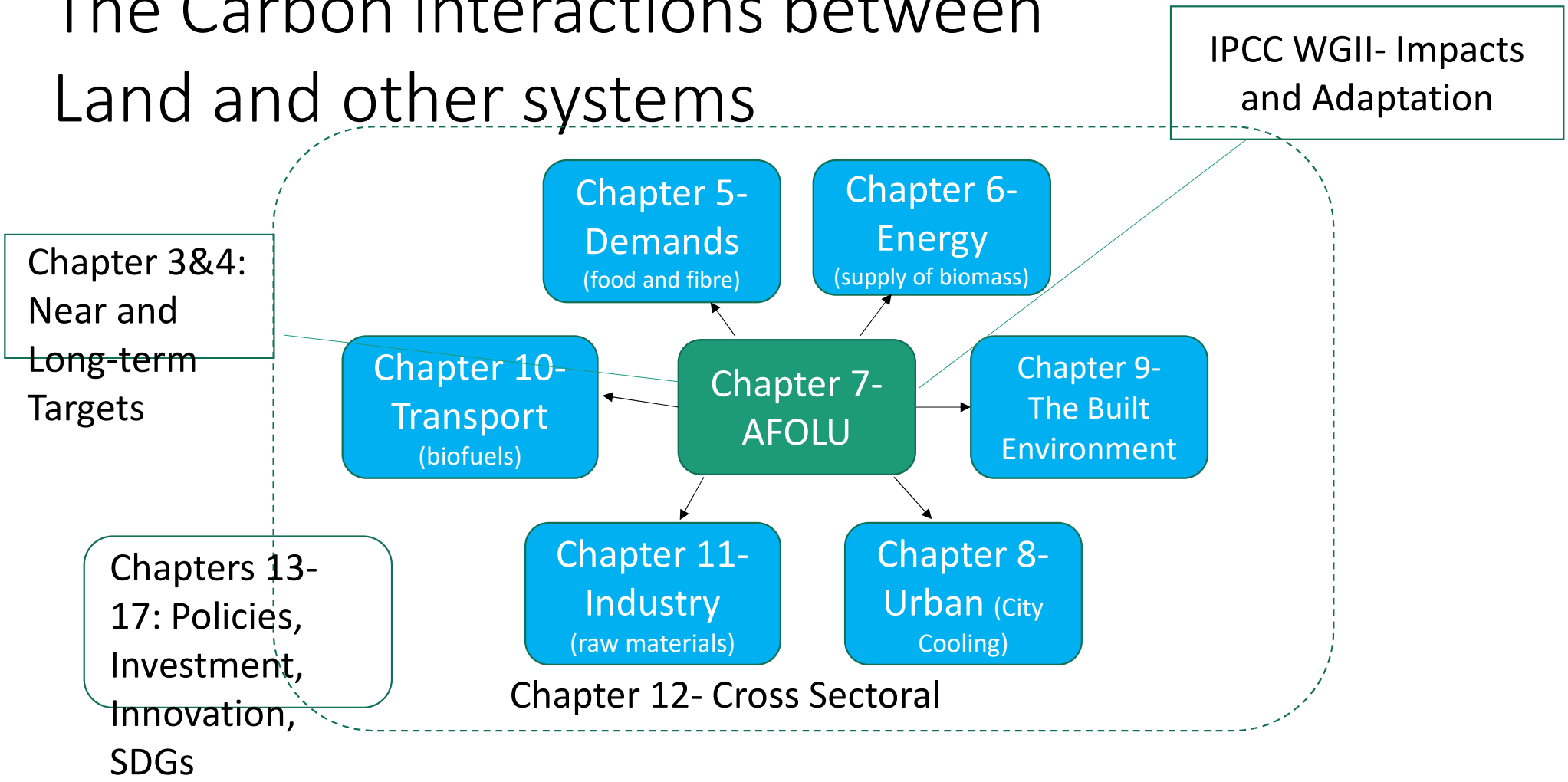
A spatial and temporal view

Carbon in Time and Space

Carbon stocks in forests are **always in flux** due to variations in age, disturbance, and environmental factors. Detecting patterns and trends **requires taking a broad view** in both space and time.

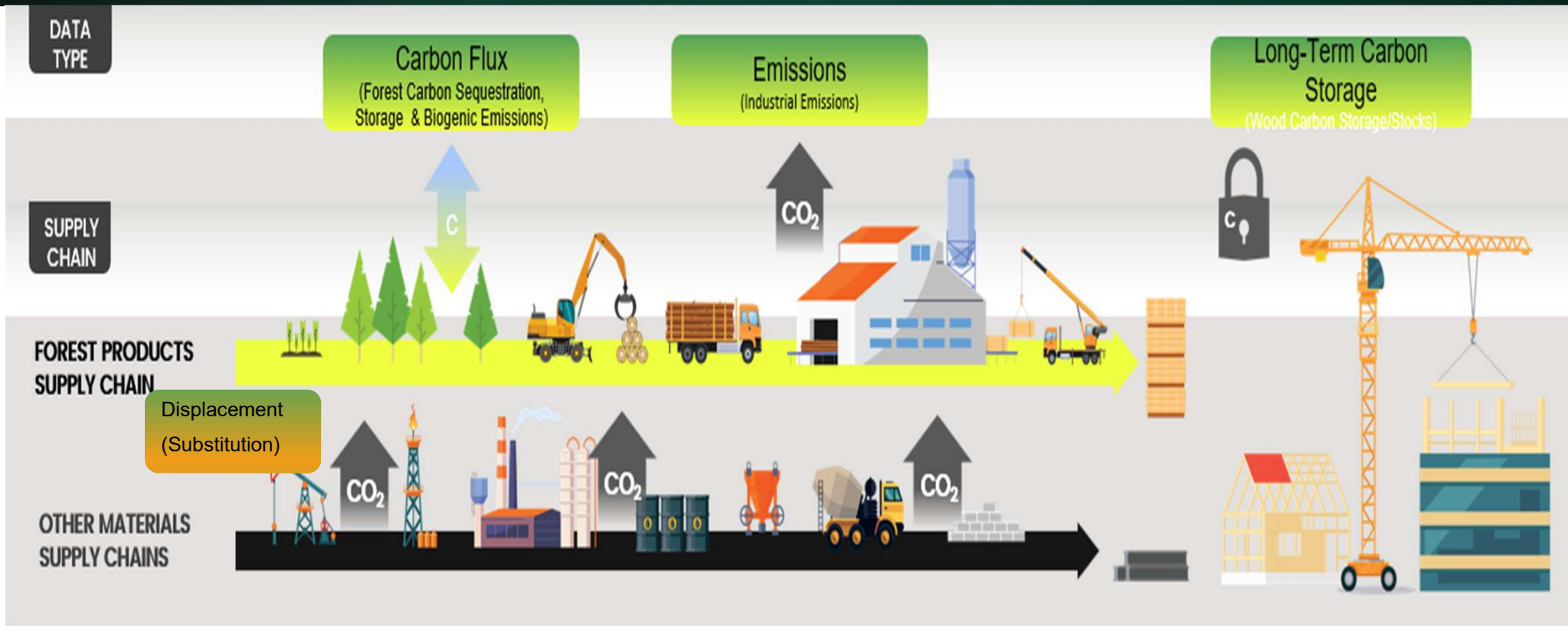


The Carbon interactions between Land and other systems



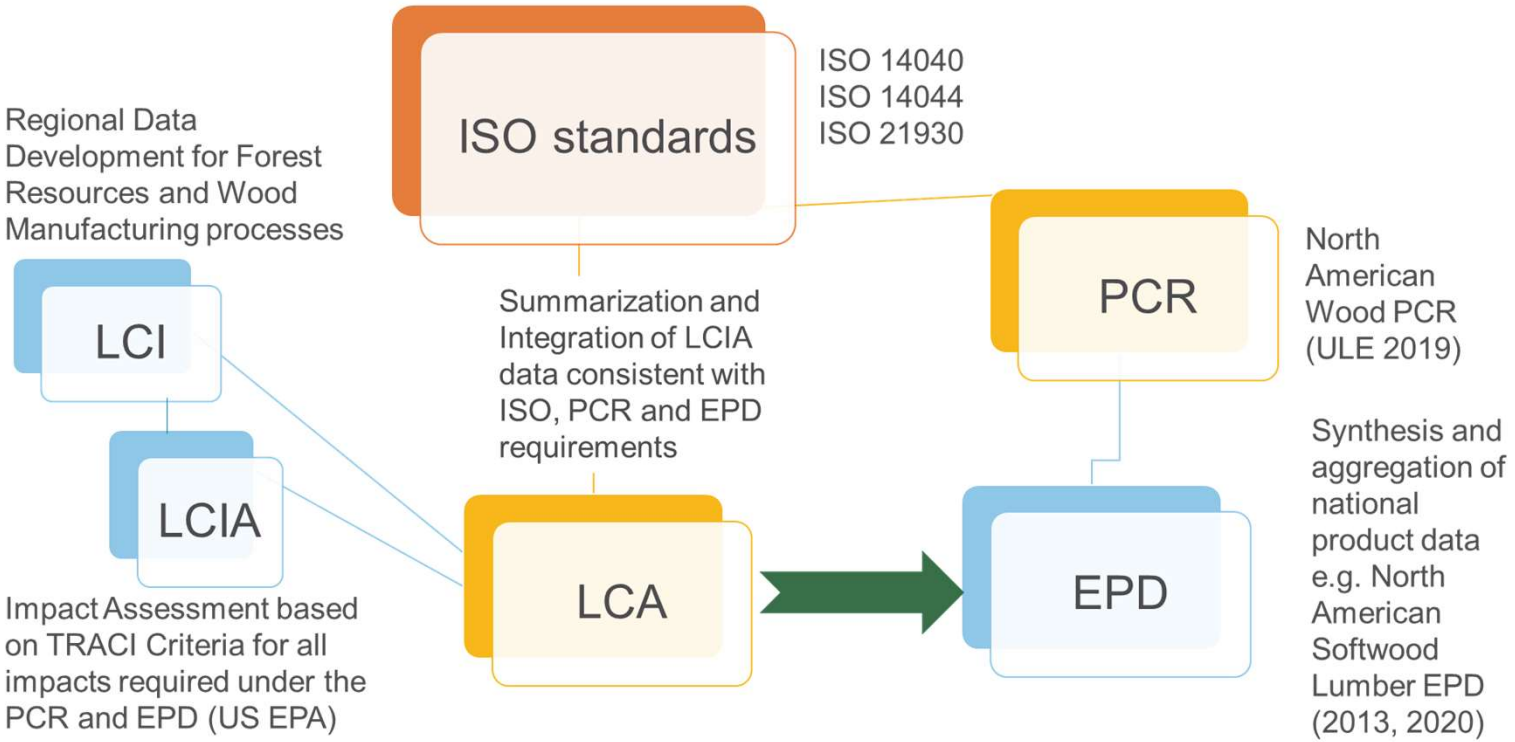
From: Adapted from Figure 7.1, IPCC AR6 Working Group III Final Draft, Chapter 7. April 2022, IPCC_AR6_WGIII_FinalDraft_FullReport.pdf

Carbon emissions and sequestration in the forest supply chain



Source: NAFO, 2023

Standards Governing Wood Product EPDs



Slide taken from James Salazar presentation "How LCA Handles Wood" for CLF's Wood Carbon Seminars, Spring 2020

http://carbonleadershipforum.org/wood-carbon-seminars/

Carbon Accounting 101

Are you reporting or comparing?

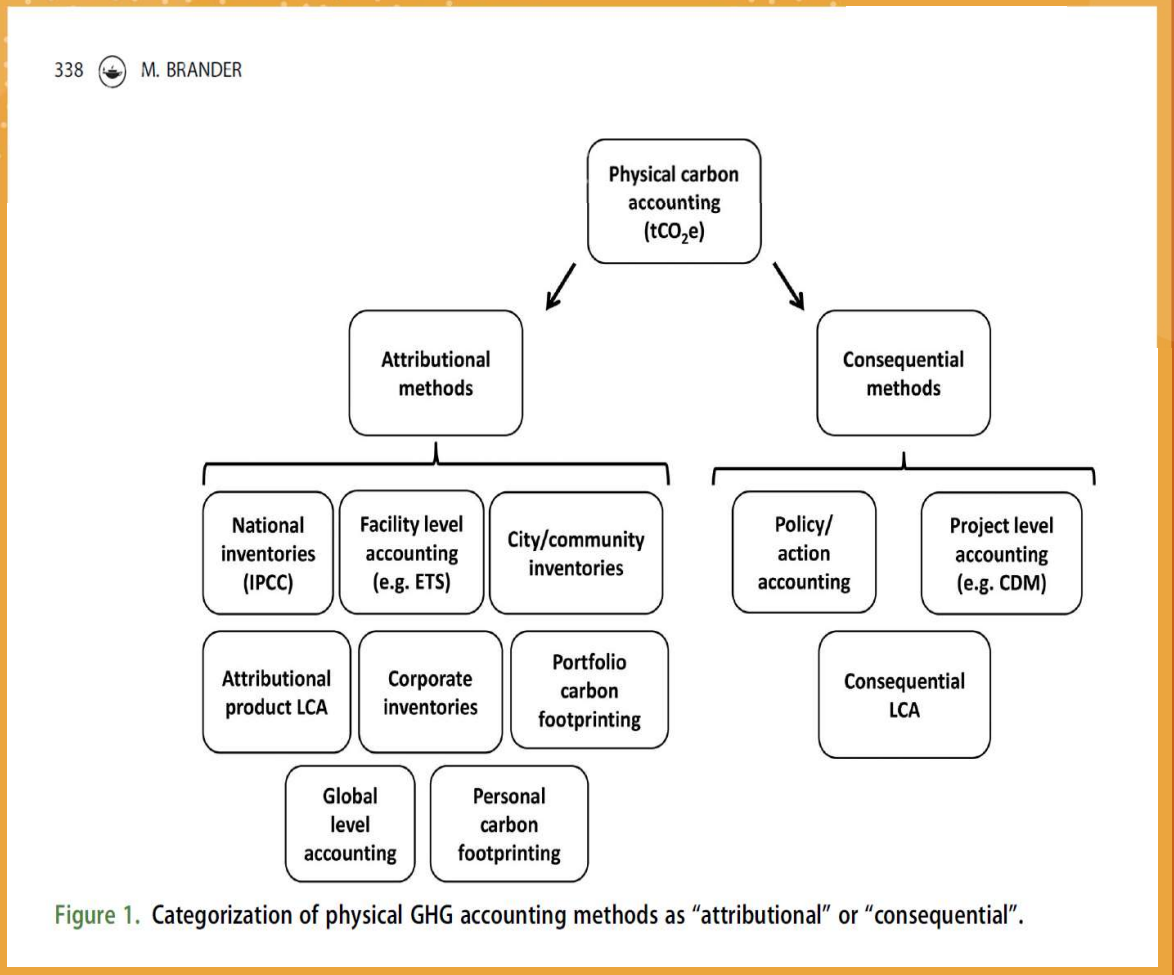


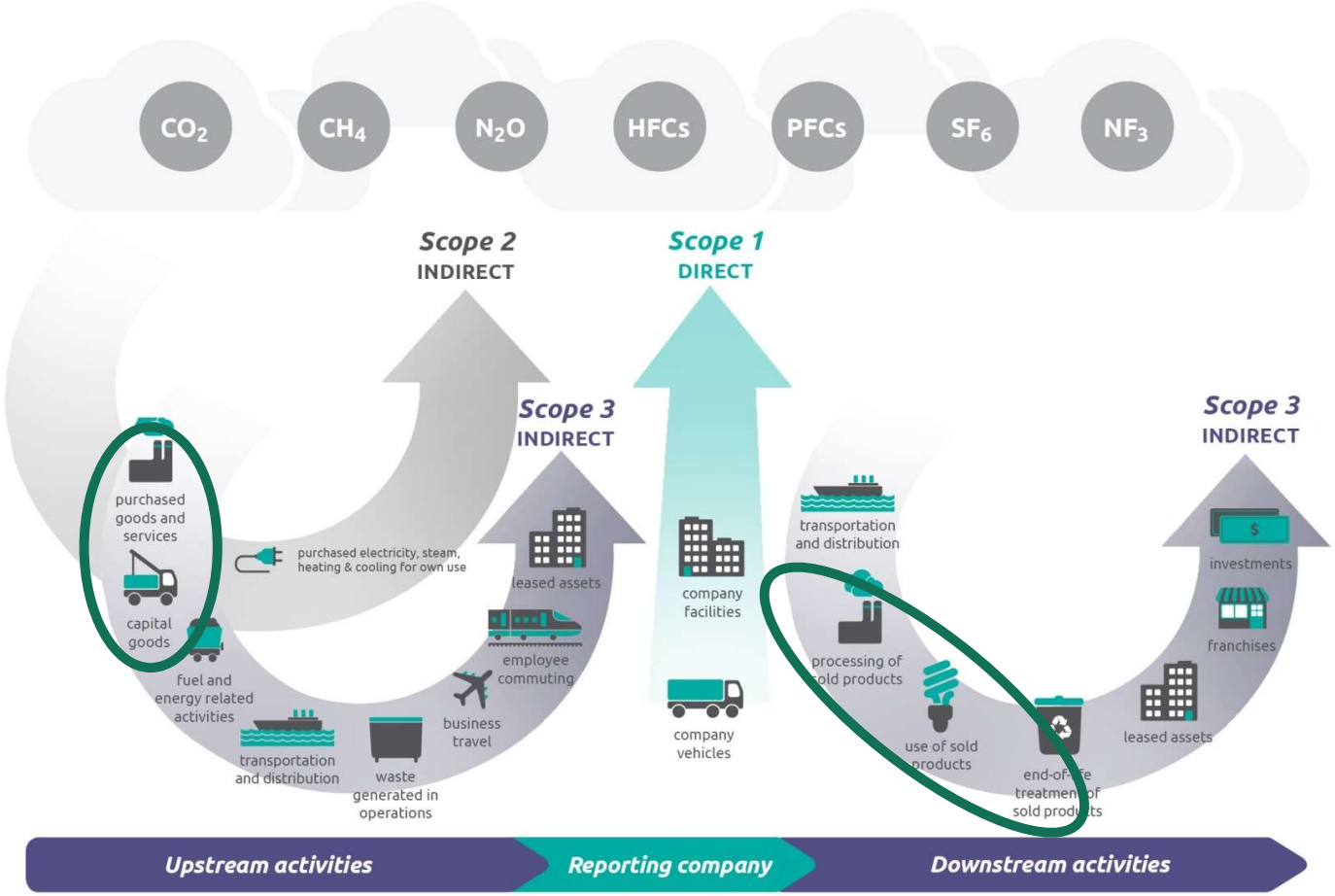
Figure 1. Categorization of physical GHG accounting methods as "attributional" or "consequential".

Source: Brander, M 2022, 'The most important GHG accounting concept you may not have heard of: The attributional-consequential distinction', *Carbon Management*, vol. 13, no. 1, pp. 337-339 . https://doi.org/10.1080/17583004.2022.2088402

Timeframes vary with Different Reporting Frameworks

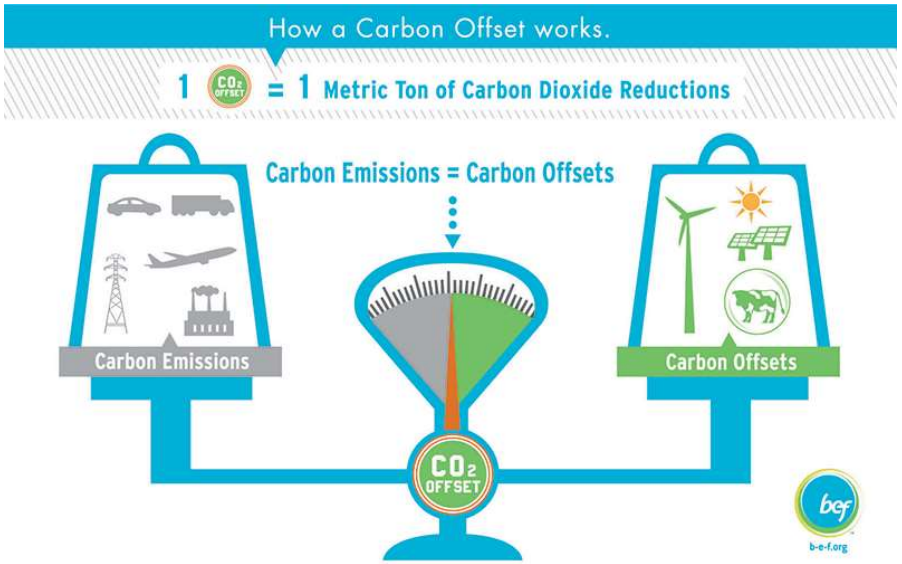
Level of Analysis	Example	Timeframe
Country	National GHG Inventories (IPCC reporting to UNFCCC)	Annual
Product LCA	Environmental Product Declaration (EPD)	Life cycle
Organizational	GHG Protocol	Scope 1 = annual; Scope 3 emissions and removals can include upstream and downstream over life of product (life cycle/time element).

What is Scope 1, Scope 2, Scope3 Reporting?



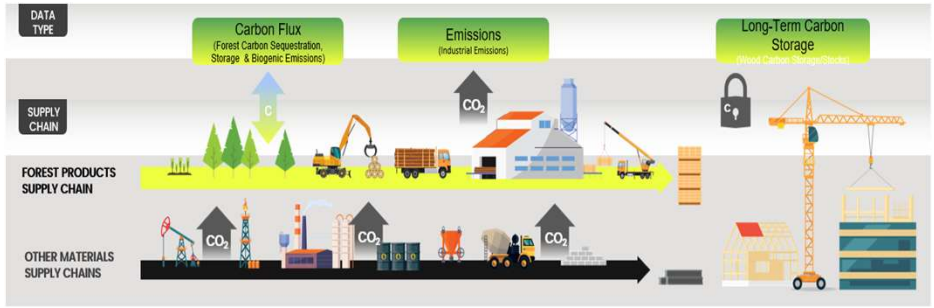
I want to calculate the carbon in my forest offset project.

Methodology Consideration	Forest Offset
Accounting	Compare against counterfactual/intervention accounting
Timeframe	Long (long enough to adhere to permanence principal)
Other	Offset intended to balance against an emission. Need to have additionality and consider leakage



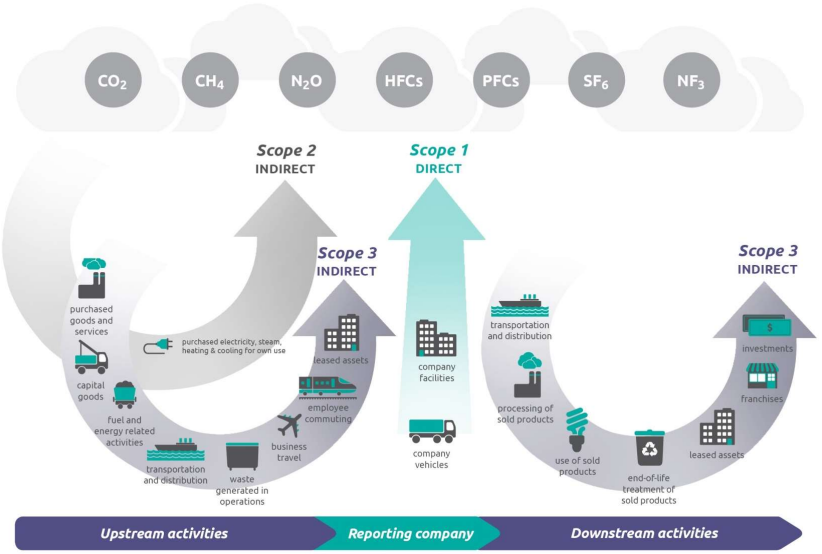
I want to know the carbon impact of the wood I am buying

Methodology Consideration	Purchased Wood
Accounting	Attributional/Inventory
Timeframe	Long (e.g. cradle to grave, cradle to gate, or over specified time horizon)
Other	Forest hard to include, but if include must consider risk of reversal over specified time horizon.



I want to report my company's GHG emissions and removals

Methodology Consideration	Corporate Inventory
Accounting	Attributional/Inventory
Timeframe	Scope 1= Annual; Scope 3 = mix of annual and life cycle
Note	Target setting could include consequential

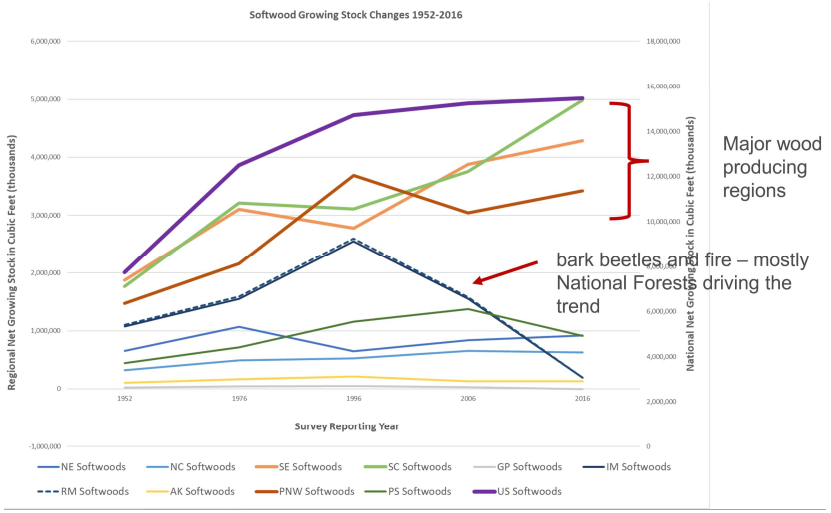


I want to compare a wood building vs. a concrete building

Methodology Consideration	Wood building vs. Concrete Building
Accounting	Either attributional or consequential
Timeframe	Long (e.g. cradle to grave, cradle to gate, or over specified time horizon)
notes	Choice of accounting depends on whether you are making comparison as consumer choice or in a policy

I want to know what will happen if we increase or decrease demand for wood

Methodology Consideration	Scenario- Increase Demand for Wood
Accounting	Consequential
Timeframe	Specified time horizon (but longer gives fuller picture)
Notes	Should include global economic-forest modelling to understand impact of demand on forest investing/growth. Should also include displacement/substitution of the product mixes. Can also look at past empirical data.



Source: Oneil 2022. From RPA data

Questions?