AB 1504 Forest Ecosystem and Harvested Wood Product Carbon Inventory: 2017 Reporting Period

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California Forest Carbon Policy Background

2006 Global Warming Solutions Act (AB 32)

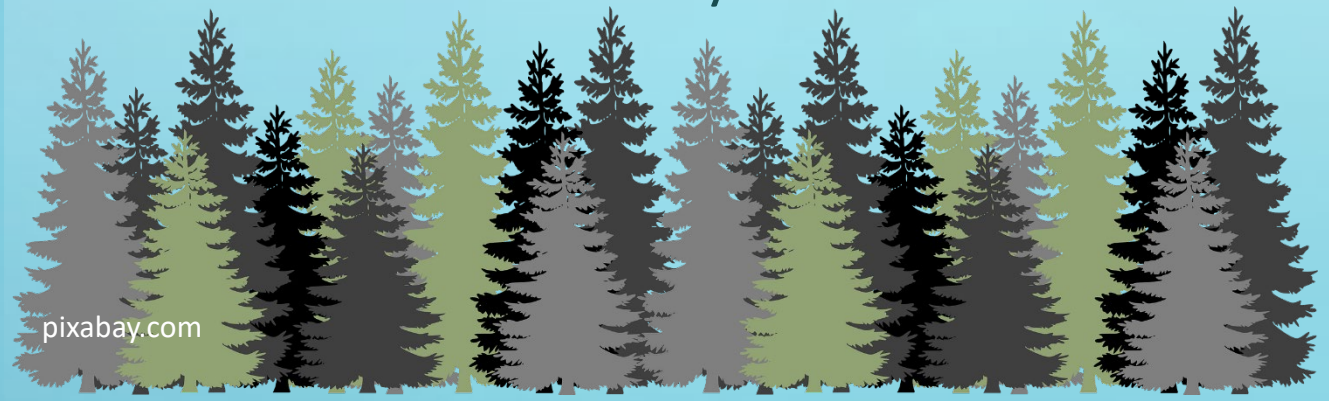
- 1990 levels by 2020
- Forest target = 5 MMT CO_2e/yr by 2020

2010 AB 1504

- 2020 target = BOF responsibility

2016 SB 32

- 40% below 1990 levels by 2030
- 80% below 1990 levels by 2050



2017 Scoping Plan Update - Natural & Working Lands

- Maintain C sink
- Minimize GHG/black C
- ↓ 15-20 MMT CO_2e by 2030

2018 FCP

- FCAT released Forest Carbon Plan

2018 Executive Orders

- B-52-18 Forest Management
- B-55-18 Carbon neutrality by 2045

AB 1504 Forest Ecosystem and Harvested Wood Product Carbon Inventory

- 2015 full report + erratum
- 2016 data update and summary
- HWP C workshop Spring 2018
- **2017 full report [this report]**

BOARD OF FORESTRY AND FIRE PROTECTION
STATE OF CALIFORNIA

CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION
CAL FIRE
SINCE 1885

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

BUREAU OF BUSINESS AND ECONOMIC RESEARCH
UNIVERSITY OF MONTANA

Reports available at:

http://bof.fire.ca.gov/board_committees/ab_1504_process/

What's new from the last reports?

- **Forest floor**: stock and flux estimates
- **Soil organic carbon**: revised stock and flux estimates
- **Dead trees**: carbon stock estimates for trees ≥ 5.0 inches instead of 1.0 inches
- **Forest ecosystem carbon stock and flux**:
  - County
  - National Forest
  - California Forest Practice District
- **Harvested wood products**: carbon stock and flux estimates

California Forest Carbon Flux 2017 Reporting Period

Forest land remaining forest land

Report table 7.1

	Net flux	
	Total	SE
CARBON POOL	million metric tons CO_2 equivalent	
Forest land remaining forest land (FF)		
Forest ecosystem		
Aboveground live[1]	19.1	2.2
Aboveground dead[2]	5.8	1.5
Belowground live[3]	3.8	0.4
Belowground dead[4]	1.0	0.2
NET FLUX	29.6	2.4
Forest Floor[5]	0.1	0.2
Soil Organic C	-0.6	0.4
FOREST ECOSYSTEM NET FLUX	29.1	2.7
Harvested Wood		
Products in use	-1.1	TBD
Products at SWDS	2.0	TBD
HWP NET FLUX	0.9	TBD
TOTAL NET FLUX	30.0	2.7[6]

[1] includes live trees, foliage, and understory veg

[2] includes standing and down dead wood

[3] includes live tree and understory veg roots

[4] includes dead tree roots

[5] Forest floor flux is a new addition from previous reports and is separated as a line item to highlight this addition. In future reports this will likely be lumped with aboveground dead.

[6] Excludes HWP C sampling error.

California Forest Carbon Flux 2017 Reporting Period
27.8 MMT CO2e/yr

Report Table 7.2

	Net flux	
	Total	SE
	million metric tons CO_2 equivalent	
Land-use category		
Forest land remaining forest land (FF)		
Forest ecosystem		
Changes in forest ecosystem carbon	29.1	2.7
Non-CO2 emissions from forest fires	-0.5	0.0
Harvested Wood Products		
Changes in HWP carbon	0.9	TBD
NET FLUX	29.5	2.7[1]
Forest land conversions (LF)		
Changes in forest carbon, forest to non-forest	-3.2	0.5
Changes in forest carbon, non-forest to forest	1.5	0.3
TOTAL NET FLUX (LF)	-1.7	0.5
TOTAL NET FLUX (FF & LF)	27.8	2.8[1]

[1]Excludes HWP C sampling error.

Figure 4.2

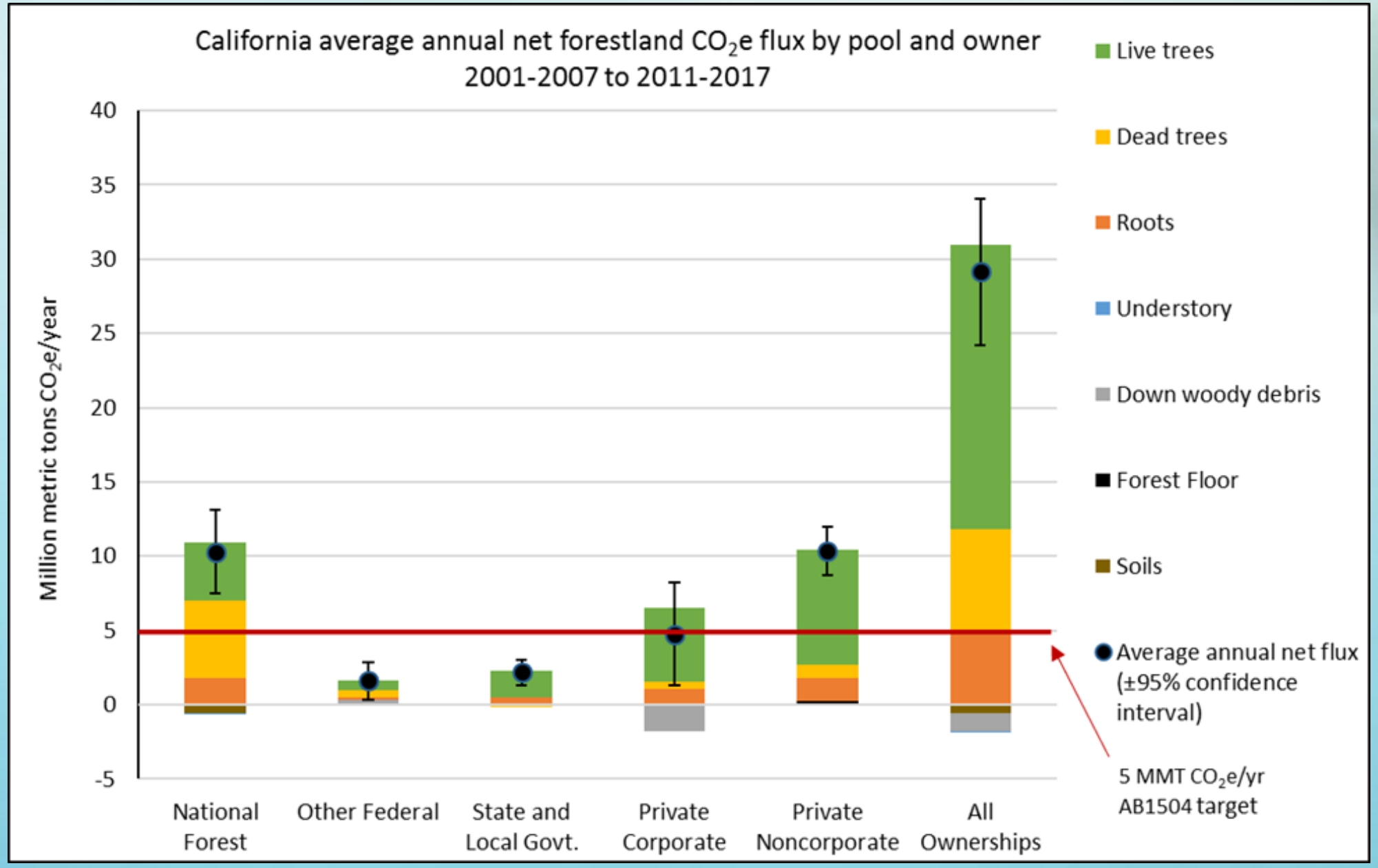

California average annual net forestland CO_2e flux by pool and owner
2001-2007 to 2011-2017
Million metric tons CO_2e/year
40
35
30
25
20
15
10
5
0
-5
National Forest
Other Federal
State and Local Govt.
Private Corporate
Private Noncorporate
All Ownerships
Live trees
Dead trees
Roots
Understory
Down woody debris
Forest Floor
Soils
Average annual net flux (±95% confidence interval)
5 MMT CO_2e/yr AB1504 target

Figure 4.1

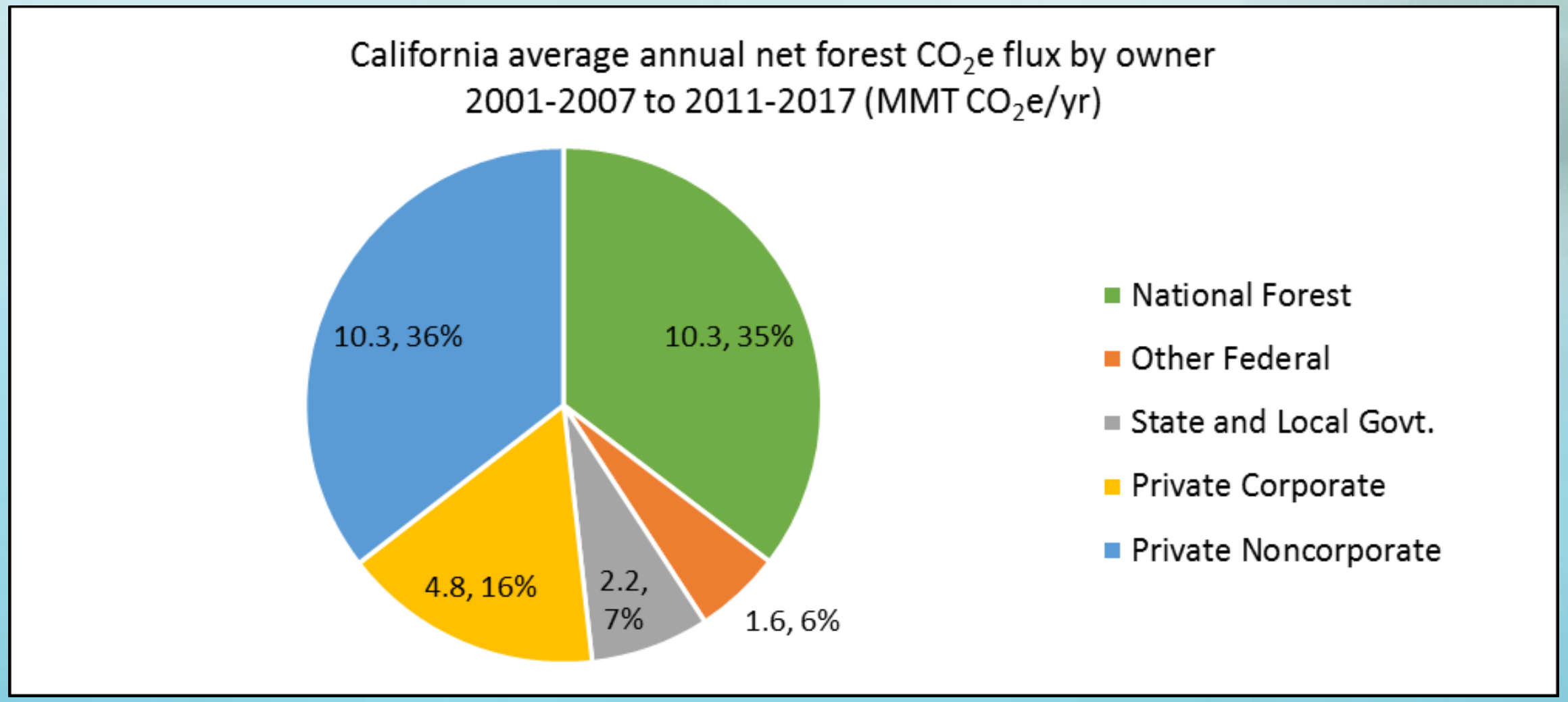

California average annual net forest CO_2e flux by owner
2001-2007 to 2011-2017 (MMT CO_2e/yr)
10.3, 35%
1.6, 6%
2.2, 7%
4.8, 16%
10.3, 36%
National Forest
Other Federal
State and Local Govt.
Private Corporate
Private Noncorporate

Figure 4.4a

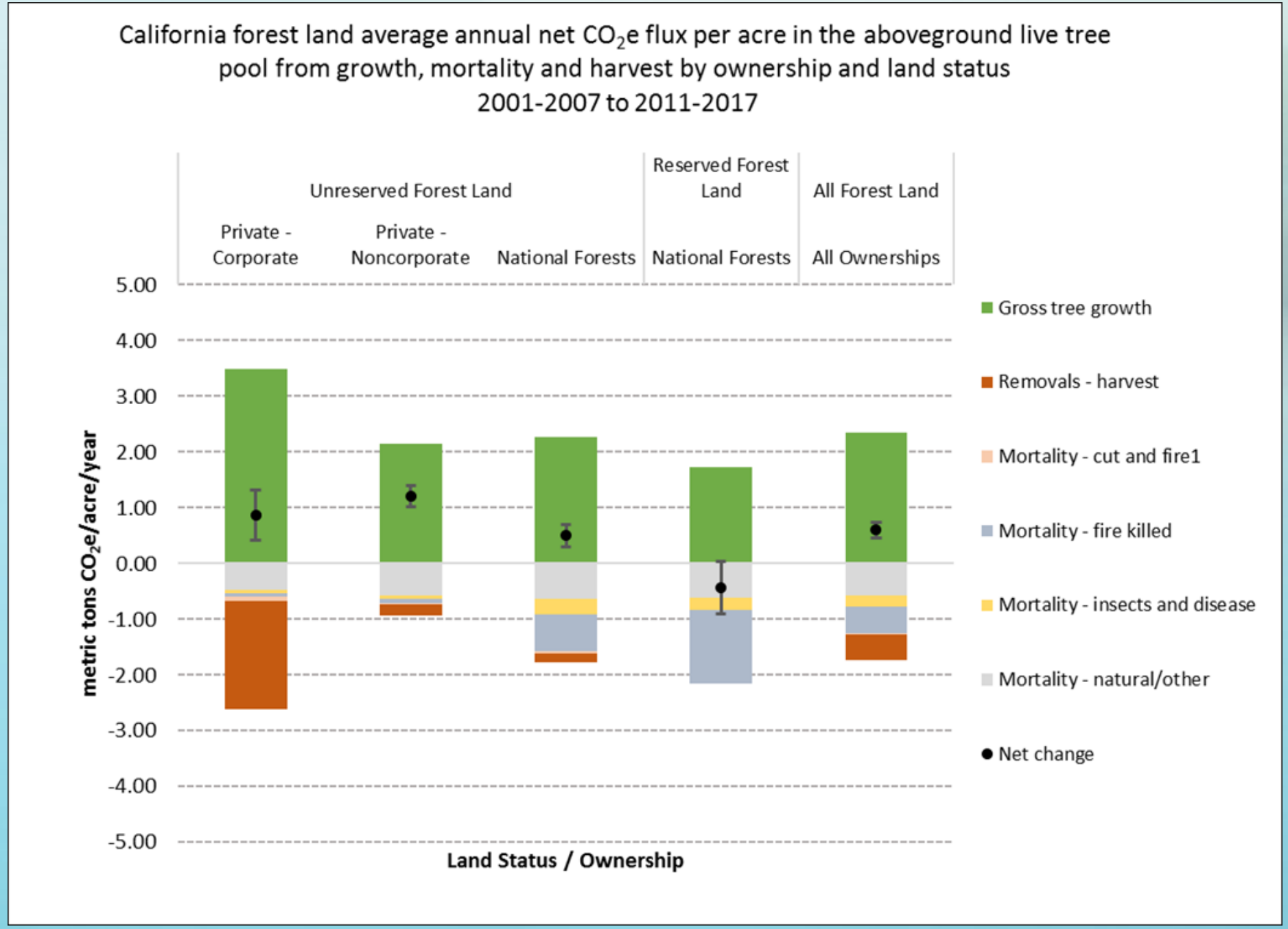

California forest land average annual net CO_2e flux per acre in the aboveground live tree pool from growth, mortality and harvest by ownership and land status
2001-2007 to 2011-2017
Unreserved Forest Land
Reserved Forest Land
All Forest Land
Private - Corporate
Private - Noncorporate
National Forests
National Forests
All Ownerships
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
metric tons CO_2e/acre/year
Land Status / Ownership
Gross tree growth
Removals - harvest
Mortality - cut and fire1
Mortality - fire killed
Mortality - insects and disease
Mortality - natural/other
Net change

Figure 4.4b

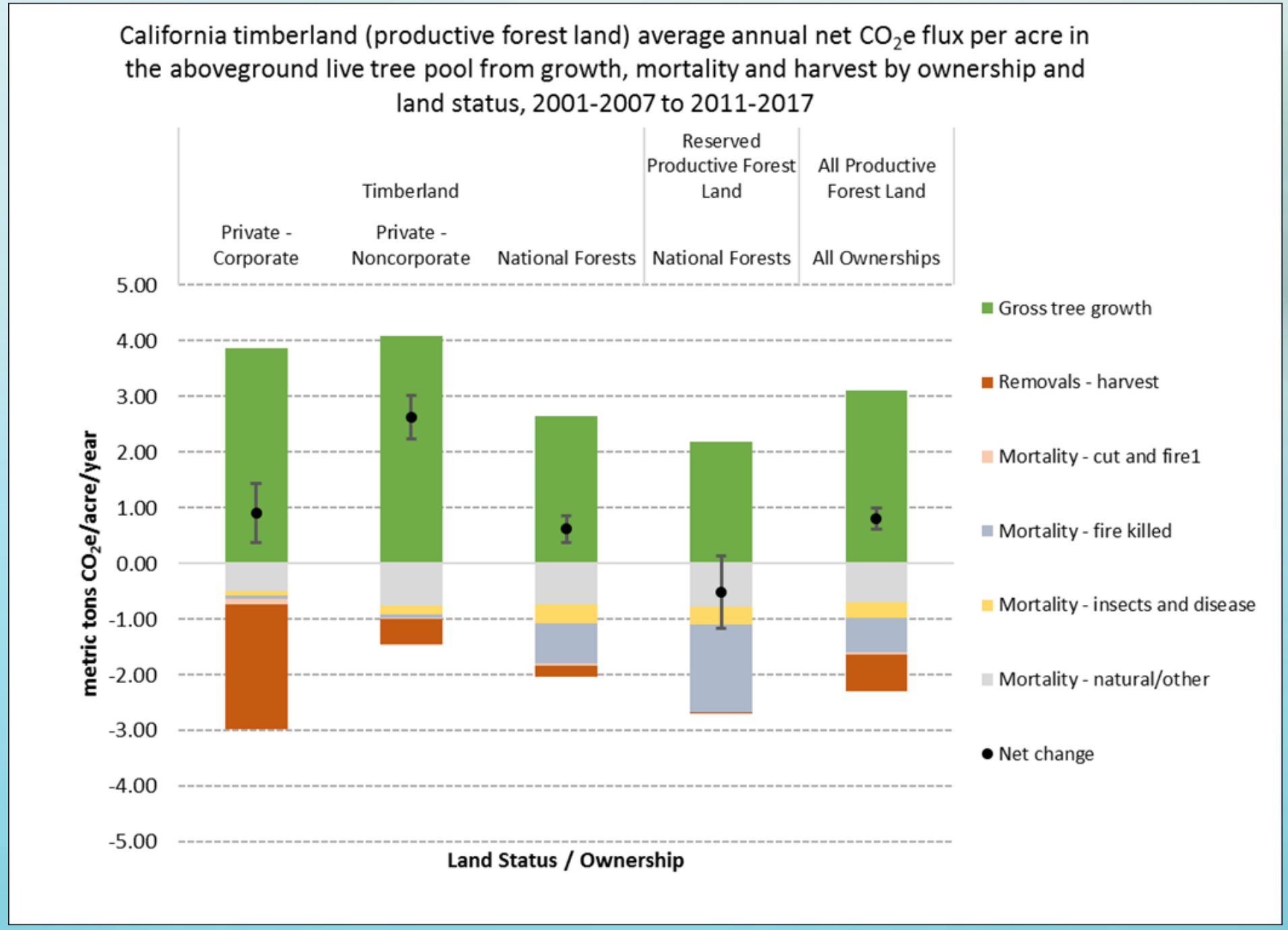
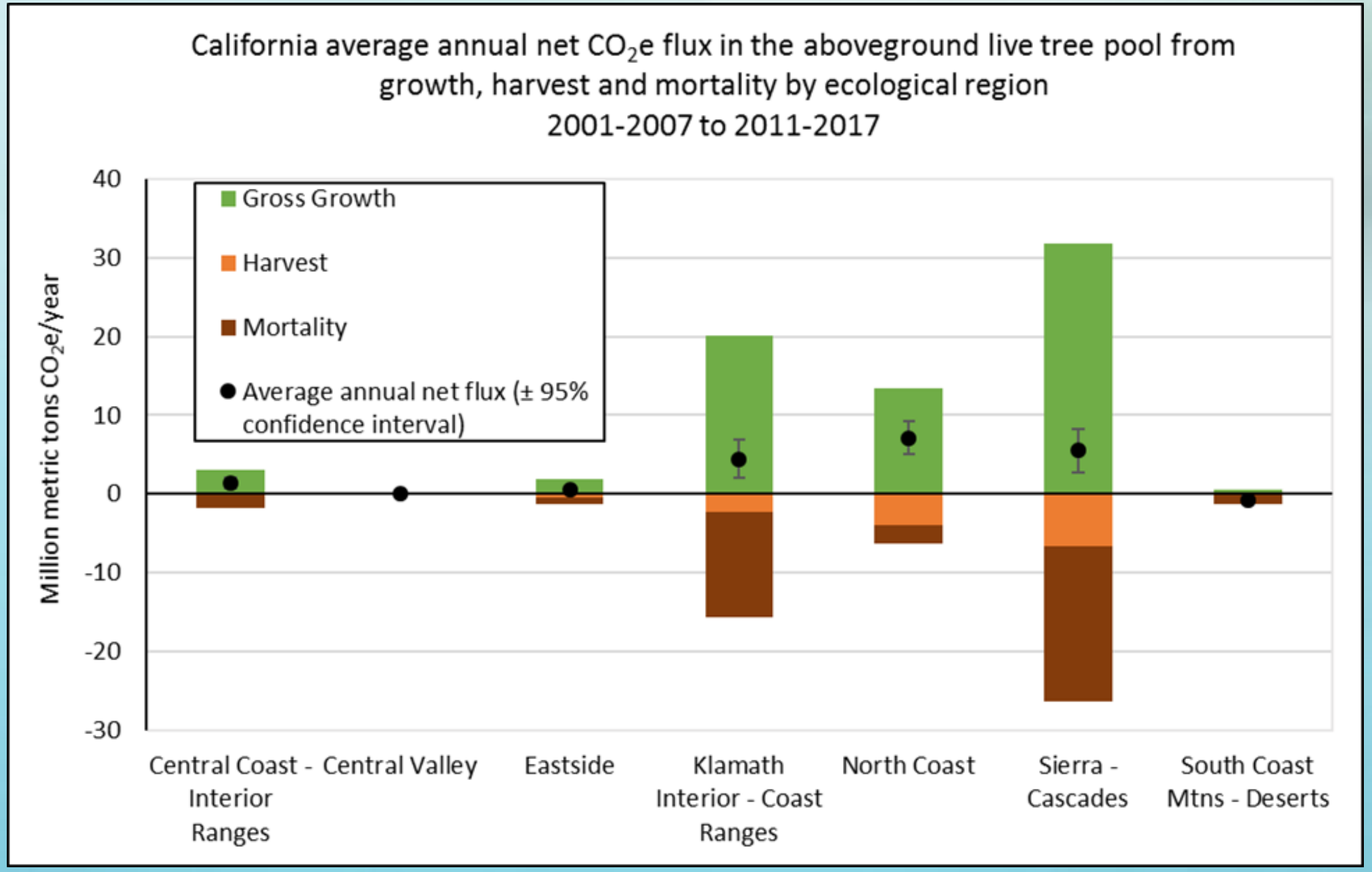

California timberland (productive forest land) average annual net CO_2e flux per acre in the aboveground live tree pool from growth, mortality and harvest by ownership and land status, 2001-2007 to 2011-2017
Timberland
Reserved Productive Forest Land
All Productive Forest Land
Private - Corporate
Private - Noncorporate
National Forests
National Forests
All Ownerships
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
metric tons CO_2e/acre/year
Land Status / Ownership
Gross tree growth
Removals - harvest
Mortality - cut and fire1
Mortality - fire killed
Mortality - insects and disease
Mortality - natural/other
Net change

Figure 4.6


California average annual net CO_2e flux in the aboveground live tree pool from growth, harvest and mortality by ecological region
2001-2007 to 2011-2017
Million metric tons CO_2e/year
40
30
20
10
0
-10
-20
-30
Gross Growth
Harvest
Mortality
Average annual net flux (± 95% confidence interval)
Central Coast - Interior Ranges
Central Valley
Eastside
Klamath Interior - Coast Ranges
North Coast
Sierra - Cascades
South Coast Mtns - Deserts

California Forest Carbon Stock, 2008-2017
3.3 Billion Metric Tons C

Figure 4.8

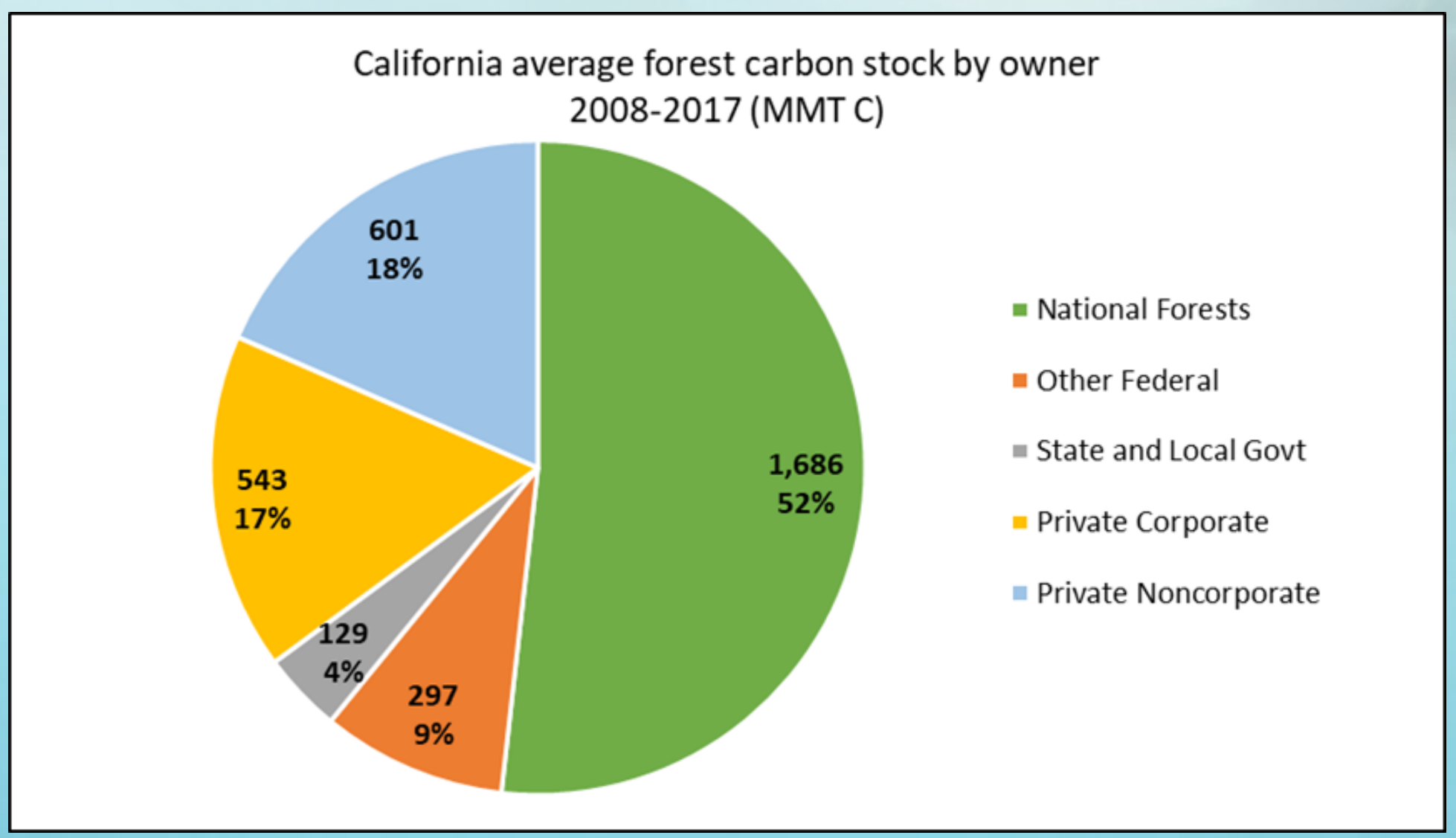


Figure 4.9

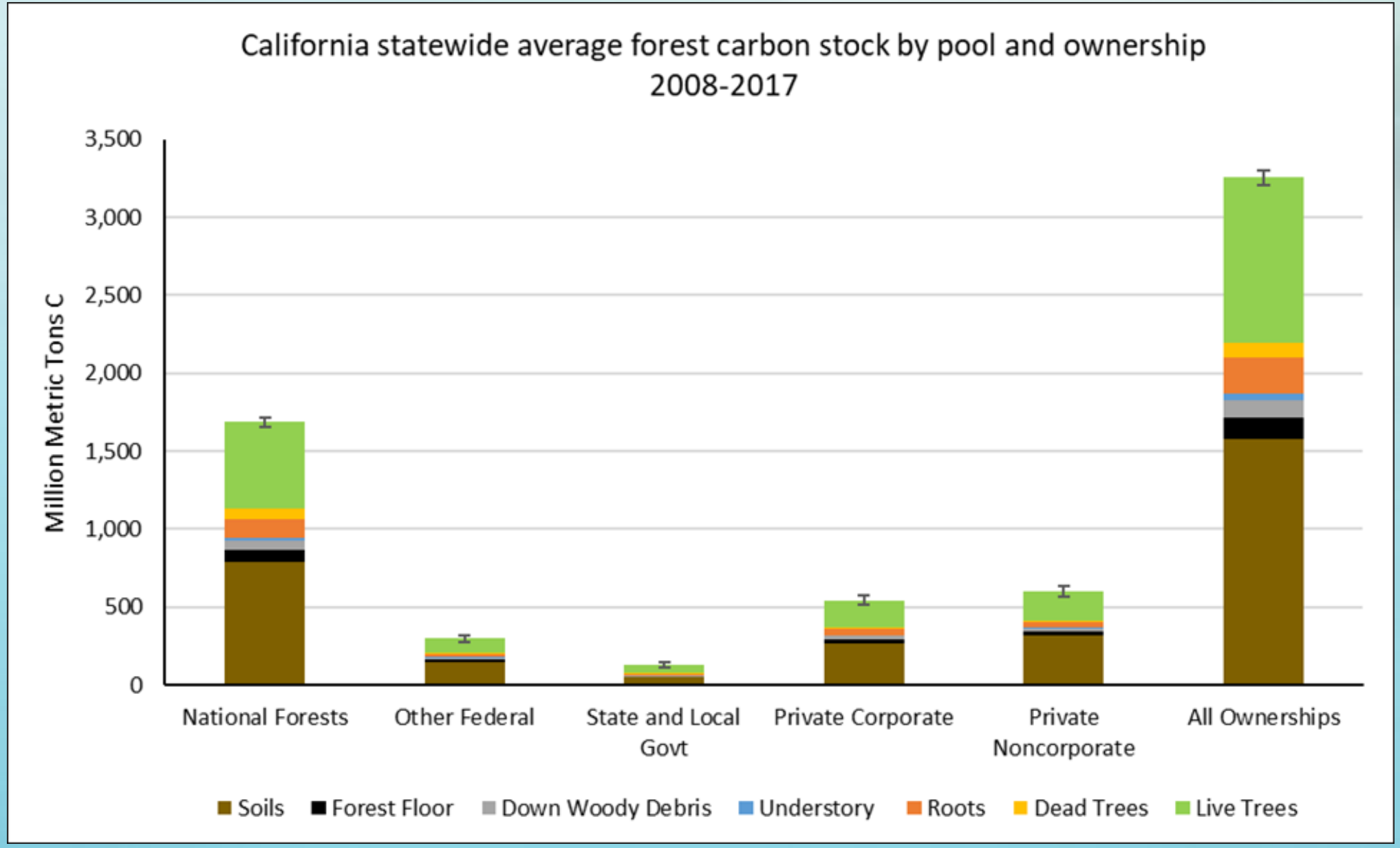
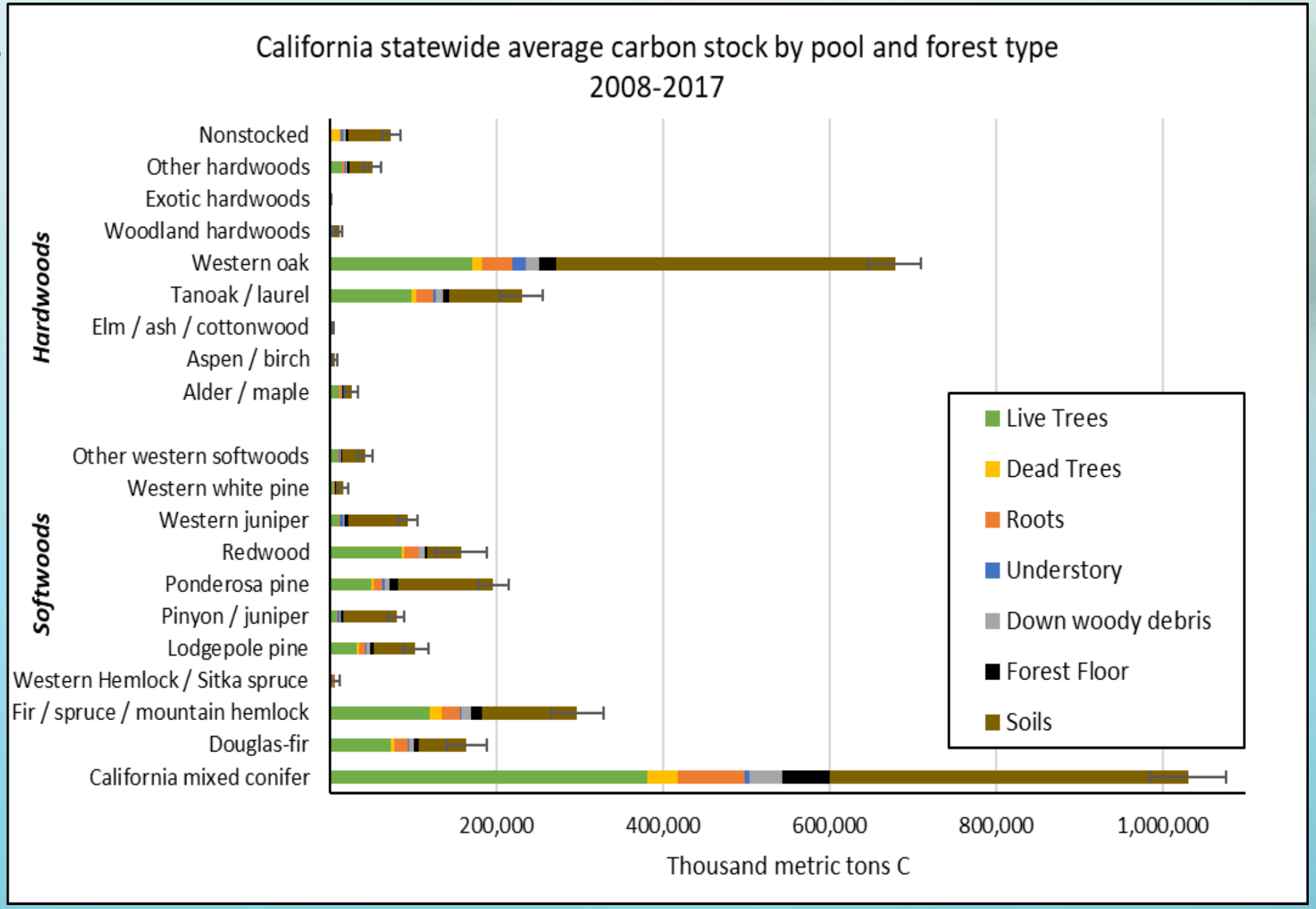

California statewide average forest carbon stock by pool and ownership
2008-2017
Million Metric Tons C
3,500
3,000
2,500
2,000
1,500
1,000
500
0
National Forests
Other Federal
State and Local Govt
Private Corporate
Private Noncorporate
All Ownerships
Soils
Forest Floor
Down Woody Debris
Understory
Roots
Dead Trees
Live Trees

Figure 4.12


California statewide average carbon stock by pool and forest type
2008-2017
Hardwoods
Softwoods
Nonstocked
Other hardwoods
Exotic hardwoods
Woodland hardwoods
Western oak
Tanoak / laurel
Elm / ash / cottonwood
Aspen / birch
Alder / maple
Other western softwoods
Western white pine
Western juniper
Redwood
Ponderosa pine
Pinyon / juniper
Lodgepole pine
Western Hemlock / Sitka spruce
Fir / spruce / mountain hemlock
Douglas-fir
California mixed conifer
Live Trees
Dead Trees
Roots
Understory
Down woody debris
Forest Floor
Soils
200,000
400,000
600,000
800,000
1,000,000
Thousand metric tons C

County data

Flux

Counties with net loss:

- San Bernardino (-0.3 ± 0.3 MMT CO_2e per year)
- Santa Barbara (-0.2 ± 0.2 MMT CO_2e per year)
- Tuolumne (-0.2 ± 1.0 MMT CO_2e per year).

Counties with highest sequestration:

- Mendocino (4.8 ± 1.6 MMT CO_2e per year)
- Humboldt (4.7 ± 2.5 MMT CO_2e per year)

Stock

Counties with highest stock:

- Siskiyou county 349.5 ± 30.0 MMT C
- Humboldt county 248.7 ± 31.5 MMT C
- Trinity county 233.7 ± 26.7 MMT C

National Forest

Flux

Forests with net loss:

- San Bernardino (-0.3 ± 0.3 MMT CO_2e per year)
- Los Padres (-0.3 ± 0.4 MMT CO_2e per year)
- Angeles (-0.05 ± 0.2 MMT CO_2e per year)
- Lake Tahoe Basin (-0.07 ± 0.2 MMT CO_2e per year)

Forest with highest sequestration:

- Shasta-Trinity (2.7 ± 0.9 MMT CO_2e per year)

Stock

National Forest with highest stock:

- Shasta-Trinity 241.0 ± 26.2 MMT C

Table 4.2b – Flux by Forest Practice District

	Net flux		Soil Organic C		non-CO_2 emissions from forest fires		net flux	
	Total	SE	Total	SE	Total	SE	Total	SE
	million metric tons CO2 equivalent							
Forest Practice District								
Northern	11.4	1.6	-0.6	0.3	-0.3	0.0	10.5	1.7
Southern	5.1	1.0	0.0	0.2	-0.2	0.0	5.0	1.0
Coastal	13.1	1.6	0.0	0.2	0.0	0.0	13.1	1.6
All California	29.6	2.4	-0.6	0.4	-0.5	0.1	28.6	2.5

Note: negative numbers are a net emission to the atmosphere

Take aways

- Currently, net sink
- Current stocks may not = resilience
- Current flux may not be sustainable without forest management!
  - Aging of forests on federal lands
  - Current level of disturbance
  - Unknown impacts from climate change

AB 1504 Inventory – Harvested Wood Product Carbon Stocks

- Production approach
- Timber harvest data
- Primary product ratios
- End-uses/associated half-lives
- If possible, actual/potential avoided fossil fuel/other GHG emissions (informational only)
  - by-product utilization (slash, bark, sub-merch)
  - substitution for more energy-intensive materials (cement, steel)

Harvested Wood Product Carbon Pools
Products in-use
Products at the landfill
Products burned with energy capture
Products burned without energy capture
TBD Actual avoided emissions

Fig 6.2

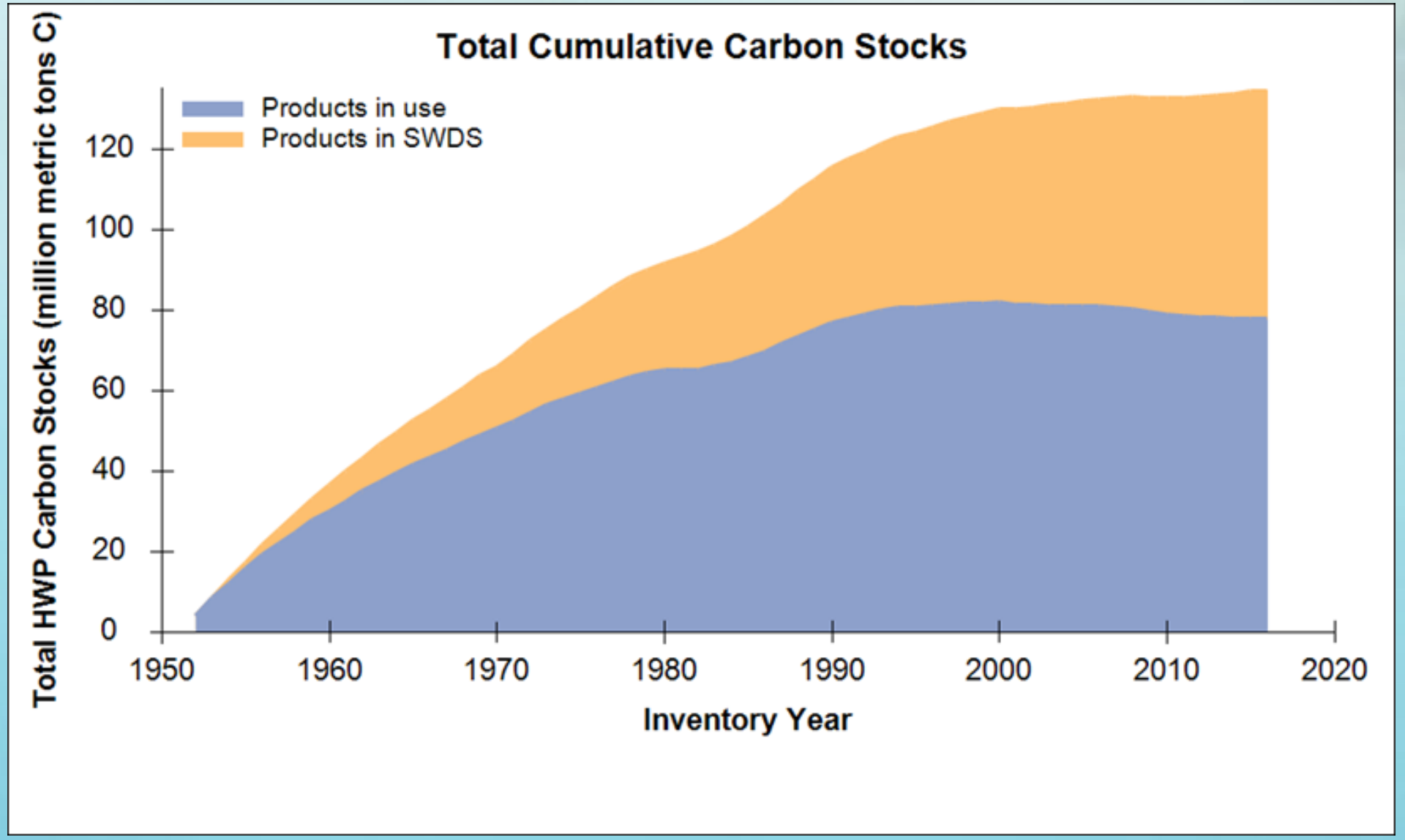

Total Cumulative Carbon Stocks
Products in use
Products in SWDS
Total HWP Carbon Stocks (million metric tons C)
0
20
40
60
80
100
120
1950
1960
1970
1980
1990
2000
2010
2020
Inventory Year

Fig 6.3

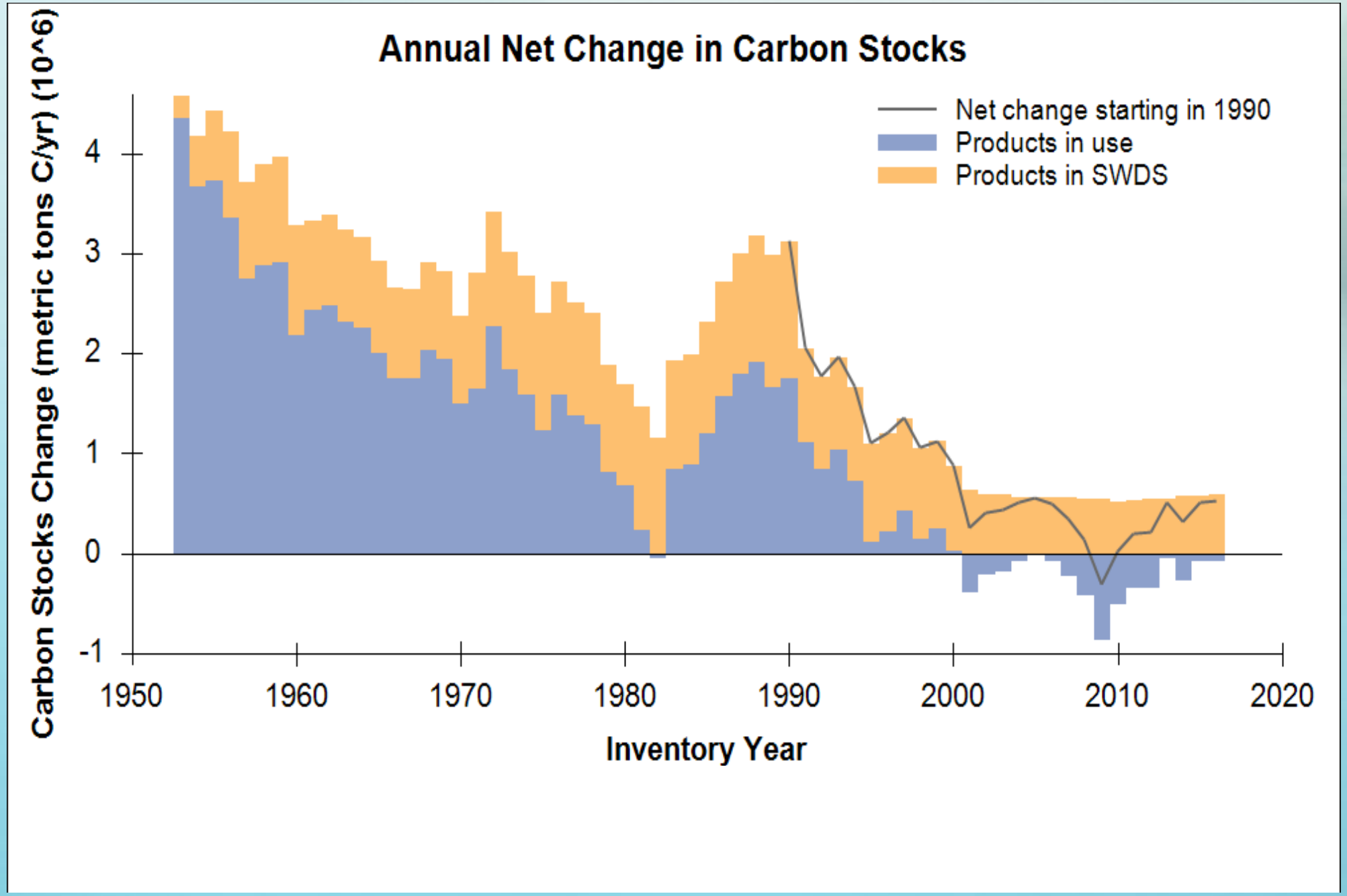
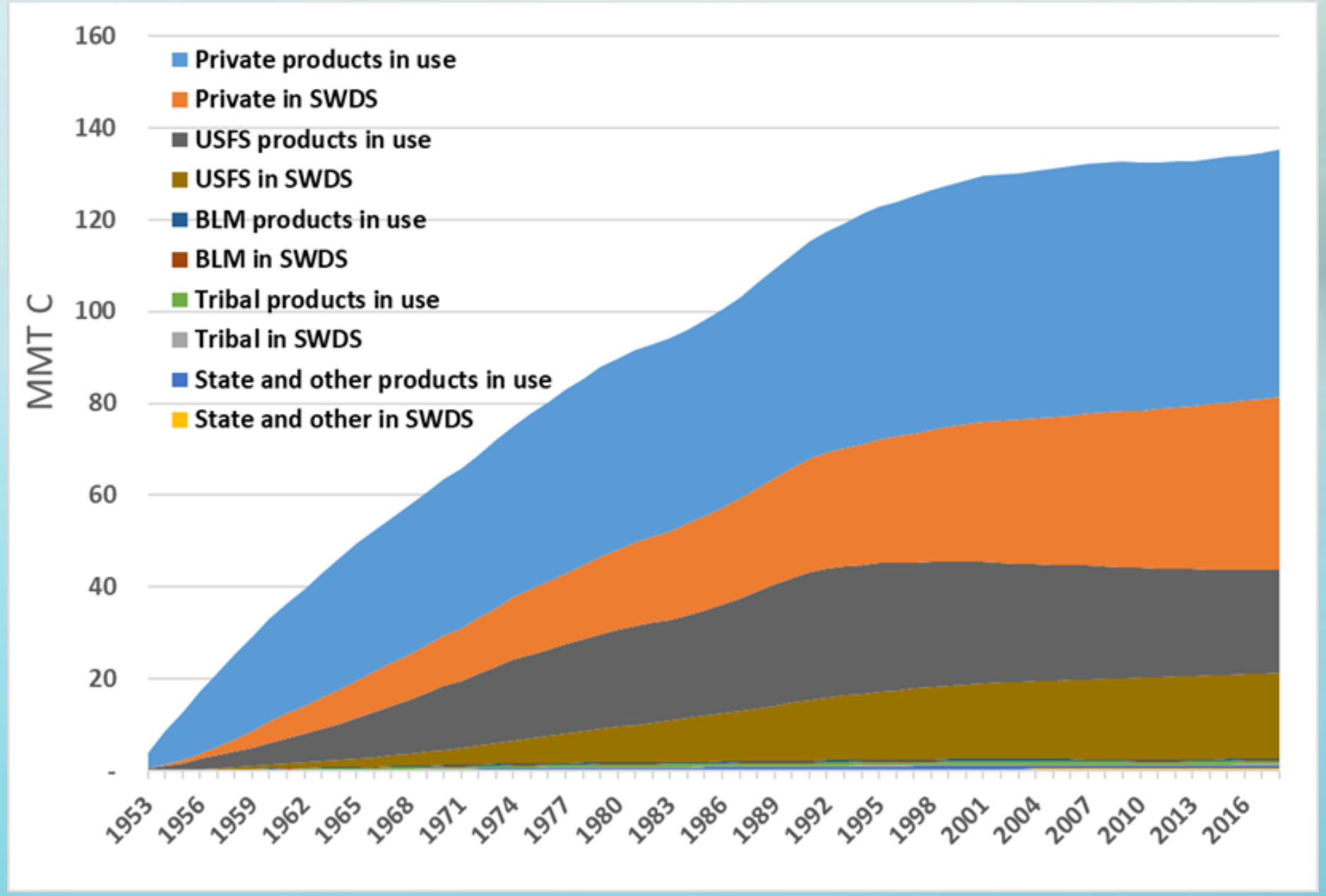

Annual Net Change in Carbon Stocks
Net change starting in 1990
Products in use
Products in SWDS
Carbon Stocks Change (metric tons C/yr) (10^6)
4
3
2
1
0
-1
1950
1960
1970
1980
1990
2000
2010
2020
Inventory Year

Table 6.4

Disposition category	2018[a]	2017	2010	2000	1990
			Cumulative storage (MT C per year)		
Products in use:					
End-use products	77,037,876	77,083,980	78,472,415	80,491,658	74,177,617
Recovered products	522,050	537,417	773,434	1,126,961	731,715
Products in SWDS:					
Carbon in landfills	53,260,383	52,483,316	47,057,770	37,645,813	22,689,570
Carbon in dumps	4,374,716	4,549,505	6,057,167	9,405,139	14,636,588
			Cumulative emissions (MT CO_2e per year)		
Emissions w/ energy capture:					
Emitted from fuelwood	371,506,279	365,444,137	326,637,490	284,511,853	237,574,946
Emitted from burning discarded products	0	0	0	0	0
Emissions w/o energy capture:					
Emitted from landfills	40,535,827	39,554,598	32,328,953	20,792,426	10,055,952
Emitted from dumps	132,612,323	131,857,057	125,518,693	111,893,385	89,042,729
Emitted from recovered products	48,865,689	48,280,885	43,447,680	32,303,902	20,289,150
Emitted from burning	104,500,017	103,698,991	98,010,015	88,052,525	72,418,393
Emitted from compost	10,802,842	10,345,808	7,111,207	1,954,267	0

[a] Although no harvest records are entered for 2018, the annual net flux from the prior year harvest is estimated for 2018. Note that HWP storage and emissions as a result of the 2017 harvest are reported by the model in 2018.

Fig 6.4


MMT C
160
140
120
100
80
60
40
20
-
Private products in use
Private in SWDS
USFS products in use
USFS in SWDS
BLM products in use
BLM in SWDS
Tribal products in use
Tribal in SWDS
State and other products in use
State and other in SWDS
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016

HWP C stock by owner, 2017 reporting period

Owner group	Products in use	SWDS	Total
		MT C	
Private	53,685,169	35,797,892	89,483,061
USFS	23,227,944	18,215,259	41,443,203
BLM	272,395	222,983	495,377
State and other public	571,573	404,440	976,013
Tribal	567,785	408,742	976,527
All owners	78,324,866	55,049,316	133,374,181

HWP C flux by owner, 2017 Reporting period

Owner group	Products in use	SWDS	Total
	MT CO_2e		
Private	-208,341	1,539,685	1,331,344
USFS	-861,386	476,383	-385,003
BLM	-11,935	4,109	-7,825
State and other public	-12,181	15,108	2,926
Tribal	-8,769	13,360	4,591
All owners	-1,102,613	2,048,645	946,033

Next steps

- Late 2019/early 2020
  - ❖2018 data update
- Late 2020 - Repeat!
  - ❖2019 data update? Full report?
- Late 2021 - Repeat!
  - ❖2020 Full measurement cycle complete, FULL REPORT
- 2021 – start new measurement cycle!
  - ❖Switch to 5-year cycle?
  - ❖Double the number of plots?

  ^need funding ($3-6M/yr) and support

Room for improvement – ongoing studies

2018 Logging utilization study – BOF, CALFIRE, USFS TPO

- Logging residuals
- Potential effects of increased utilization
- Actual utilization of by-products

2018 Biomass study – USFS PNW

- Further refines biomass equations relied upon for carbon estimates

2018 Mill energy-use study – BOF, CAL FIRE, USFS TPO, Univ. MT

- CA Timber Industry carbon footprint

Room for improvement – future work

- Management/policy scenarios
  - ❖ Affect on imports/leakage?
  - ❖ Wood energy and material substitution benefits?
  - ❖ Canadian Carbon Budget Model?

- 1504 and NWL
  - ❖ Collaborate with CARB to evaluate differences in the inventories and identify areas for 1504 data to support NWL inventory

- CA / OR / WA / British Columbia forest carbon
  - ❖ Fall 2019 forest C workshop?

Questions?