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$_2$e/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$_2$e 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]

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*

<table>
<thead>
<tr>
<th>CARBON POOL</th>
<th>Net flux</th>
<th>Total</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest land remaining forest land (FF)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest ecosystem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aboveground live&lt;sup&gt;1&lt;/sup&gt;</td>
<td>19.1</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Aboveground dead&lt;sup&gt;2&lt;/sup&gt;</td>
<td>5.8</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Belowground live&lt;sup&gt;3&lt;/sup&gt;</td>
<td>3.8</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Belowground dead&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.0</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td><strong>NET FLUX</strong></td>
<td>29.6</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>Forest Floor&lt;sup&gt;5&lt;/sup&gt;</td>
<td>0.1</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Soil Organic C</td>
<td>-0.6</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td><strong>FOREST ECOSYSTEM NET FLUX</strong></td>
<td><strong>29.1</strong></td>
<td><strong>2.7</strong></td>
<td></td>
</tr>
<tr>
<td>Harvested Wood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Products in use</td>
<td>-1.1</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>Products at SWDS</td>
<td>2.0</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td><strong>HWP NET FLUX</strong></td>
<td>0.9</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL NET FLUX</strong></td>
<td><strong>30.0</strong></td>
<td><strong>2.7</strong>&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>Land-use category</th>
<th>Net flux</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>million metric tons CO₂</td>
</tr>
<tr>
<td></td>
<td>equivalent</td>
</tr>
<tr>
<td><strong>Forest land remaining forest land (FF)</strong></td>
<td></td>
</tr>
<tr>
<td>Forest ecosystem</td>
<td></td>
</tr>
<tr>
<td>Changes in forest ecosystem carbon</td>
<td>29.1</td>
</tr>
<tr>
<td><strong>Non-CO2 emissions from forest fires</strong></td>
<td>-0.5</td>
</tr>
<tr>
<td><strong>Harvested Wood Products</strong></td>
<td></td>
</tr>
<tr>
<td>Changes in HWP carbon</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>NET FLUX</strong></td>
<td>29.5</td>
</tr>
<tr>
<td><strong>Forest land conversions (LF)</strong></td>
<td></td>
</tr>
<tr>
<td>Changes in forest carbon, forest to non-forest</td>
<td>-3.2</td>
</tr>
<tr>
<td>Changes in forest carbon, non-forest to forest</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>TOTAL NET FLUX (LF)</strong></td>
<td>-1.7</td>
</tr>
<tr>
<td><strong>TOTAL NET FLUX (FF &amp; LF)</strong></td>
<td>27.8</td>
</tr>
</tbody>
</table>

¹Excludes HWP C sampling error.
California average annual net forestland CO₂e flux by pool and owner
2001-2007 to 2011-2017

Million metric tons CO₂e/year

- National Forest
- Other Federal
- State and Local Govt.
- Private Corporate
- Private Noncorporate
- All Ownership

- Live trees
- Dead trees
- Roots
- Understory
- Forest Floor
- Down woody debris
- Soils

Average annual net flux (±95% confidence interval)
5 MMT CO₂e/yr AB1504 target
Figure 4.1

California average annual net forest CO₂e flux by owner
2001-2007 to 2011-2017 (MMT CO₂e/yr)

- National Forest: 10.3, 35%
- Other Federal: 10.3, 36%
- State and Local Govt.: 4.8, 16%
- Private Corporate: 2.2, 7%
- Private Noncorporate: 1.6, 6%
Figure 4.4b

California timberland (productive forest land) average annual net CO₂e flux per acre in the aboveground live tree pool from growth, mortality and harvest by ownership and land status, 2001-2007 to 2011-2017

- Gross tree growth
- Removals - harvest
- Mortality - cut and fire
- Mortality - fire killed
- Mortality - insects and disease
- Mortality - natural/other
- Net change
California average annual net CO$_2$e flux in the aboveground live tree pool from growth, harvest and mortality by ecological region 2001-2007 to 2011-2017
California Forest Carbon Stock, 2008-2017
3.3 Billion Metric Tons C

Figure 4.8

California average forest carbon stock by owner
2008-2017 (MMT C)

- National Forests: 1,686 MMT C (52%)
- Other Federal: 543 MMT C (17%)
- State and Local Govt: 297 MMT C (9%)
- Private Corporate: 129 MMT C (4%)
- Private Noncorporate: 601 MMT C (18%)
Figure 4.9

California statewide average forest carbon stock by pool and ownership
2008-2017

Million Metric Tons C

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
County data

Flux

Counties with net loss:
- San Bernardino (-0.3 ± 0.3 MMT CO₂e per year)
- Santa Barbara (-0.2 ± 0.2 MMT CO₂e per year)
- Tuolumne (-0.2 ± 1.0 MMT CO₂e per year).

Counties with highest sequestration:
- Mendocino (4.8 ± 1.6 MMT CO₂e per year)
- Humboldt (4.7 ± 2.5 MMT CO₂e 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$_2$e per year)
- Los Padres (-0.3 ± 0.4 MMT CO$_2$e per year)
- Angeles (-0.05 ± 0.2 MMT CO$_2$e per year)
- Lake Tahoe Basin (-0.07 ± 0.2 MMT CO$_2$e per year)

*Forest with highest sequestration:*

- Shasta-Trinity (2.7 ± 0.9 MMT CO$_2$e per year)

**Stock**

*National Forest with highest stock:*

- Shasta-Trinity 241.0 ± 26.2 MMT C
Table 4.2b – Flux by Forest Practice District

<table>
<thead>
<tr>
<th>Forest Practice District</th>
<th>Net flux Total</th>
<th>Net flux SE</th>
<th>Soil Organic C Total</th>
<th>Soil Organic C SE</th>
<th>non-CO₂ emissions from forest fires Total</th>
<th>non-CO₂ emissions from forest fires SE</th>
<th>net flux Total</th>
<th>net flux SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>11.4</td>
<td>1.6</td>
<td>-0.6</td>
<td>0.3</td>
<td>-0.3</td>
<td>0.0</td>
<td>10.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Southern</td>
<td>5.1</td>
<td>1.0</td>
<td>0.0</td>
<td>0.2</td>
<td>-0.2</td>
<td>0.0</td>
<td>5.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Coastal</td>
<td>13.1</td>
<td>1.6</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>13.1</td>
<td>1.6</td>
</tr>
<tr>
<td>All California</td>
<td>29.6</td>
<td>2.4</td>
<td>-0.6</td>
<td>0.4</td>
<td>-0.5</td>
<td>0.1</td>
<td>28.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Note: negative numbers are a net emission to the atmosphere

*million metric tons CO₂ equivalent*
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)

<table>
<thead>
<tr>
<th>Harvested Wood Product Carbon Pools</th>
<th>Products in-use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products at the landfill</td>
<td></td>
</tr>
<tr>
<td>Products burned with energy capture</td>
<td></td>
</tr>
<tr>
<td>Products burned without energy capture</td>
<td></td>
</tr>
<tr>
<td>TBD Actual avoided emissions</td>
<td></td>
</tr>
</tbody>
</table>
Annual Net Change in Carbon Stocks

- Net change starting in 1990
- Products in use
- Products in SWDS

Carbon Stocks Change (metric tons C/yr) \((10^6)\)

Inventory Year

- 1950
- 1960
- 1970
- 1980
- 1990
- 2000
- 2010
- 2020
Table 6.4

<table>
<thead>
<tr>
<th>Disposition category</th>
<th>2018(^a)</th>
<th>2017</th>
<th>2010</th>
<th>2000</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Markup storage (MT C per year)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Products in use:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End-use products</td>
<td>77,037,876</td>
<td>77,083,980</td>
<td>78,472,415</td>
<td>80,491,658</td>
<td>74,177,617</td>
</tr>
<tr>
<td>Recovered products</td>
<td>522,050</td>
<td>537,417</td>
<td>773,434</td>
<td>1,126,961</td>
<td>731,715</td>
</tr>
<tr>
<td><strong>Products in SWDS:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon in landfills</td>
<td>53,260,383</td>
<td>52,483,316</td>
<td>47,057,770</td>
<td>37,645,813</td>
<td>22,689,570</td>
</tr>
<tr>
<td>Carbon in dumps</td>
<td>4,374,716</td>
<td>4,549,505</td>
<td>6,057,167</td>
<td>9,405,139</td>
<td>14,636,588</td>
</tr>
<tr>
<td><strong>Cumulative emissions (MT CO(_2)e per year)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emitted from fuelwood</td>
<td>371,506,279</td>
<td>365,444,137</td>
<td>326,637,490</td>
<td>284,511,853</td>
<td>237,574,946</td>
</tr>
<tr>
<td>Emitted from burning discarded products</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Emitted from landfills</td>
<td>40,535,827</td>
<td>39,554,598</td>
<td>32,328,953</td>
<td>20,792,426</td>
<td>10,055,952</td>
</tr>
<tr>
<td>Emitted from dumps</td>
<td>132,612,323</td>
<td>131,857,057</td>
<td>125,518,693</td>
<td>111,893,385</td>
<td>89,042,729</td>
</tr>
<tr>
<td>Emitted from recovered products</td>
<td>48,865,689</td>
<td>48,280,885</td>
<td>43,447,680</td>
<td>32,303,902</td>
<td>20,289,150</td>
</tr>
<tr>
<td>Emitted from burning</td>
<td>104,500,017</td>
<td>103,698,991</td>
<td>98,010,015</td>
<td>88,052,525</td>
<td>72,418,393</td>
</tr>
<tr>
<td>Emitted from compost</td>
<td>10,802,842</td>
<td>10,345,808</td>
<td>7,111,207</td>
<td>1,954,267</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^a\) 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.
HWP C stock by owner, 2017 reporting period

<table>
<thead>
<tr>
<th>Owner group</th>
<th>Products in use</th>
<th>SWDS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>53,685,169</td>
<td>35,797,892</td>
<td>89,483,061</td>
</tr>
<tr>
<td>USFS</td>
<td>23,227,944</td>
<td>18,215,259</td>
<td>41,443,203</td>
</tr>
<tr>
<td>BLM</td>
<td>272,395</td>
<td>222,983</td>
<td>495,377</td>
</tr>
<tr>
<td>State and other public</td>
<td>571,573</td>
<td>404,440</td>
<td>976,013</td>
</tr>
<tr>
<td>Tribal</td>
<td>567,785</td>
<td>408,742</td>
<td>976,527</td>
</tr>
<tr>
<td>All owners</td>
<td>78,324,866</td>
<td>55,049,316</td>
<td>133,374,181</td>
</tr>
</tbody>
</table>
### HWP C flux by owner, 2017 Reporting period

<table>
<thead>
<tr>
<th>Owner group</th>
<th>Products in use</th>
<th>SWDS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MT CO(_2)e</td>
<td></td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>-208,341</td>
<td>1,539,685</td>
<td>1,331,344</td>
</tr>
<tr>
<td><strong>USFS</strong></td>
<td>-861,386</td>
<td>476,383</td>
<td>-385,003</td>
</tr>
<tr>
<td><strong>BLM</strong></td>
<td>-11,935</td>
<td>4,109</td>
<td>-7,825</td>
</tr>
<tr>
<td><strong>State and other public</strong></td>
<td>-12,181</td>
<td>15,108</td>
<td>2,926</td>
</tr>
<tr>
<td><strong>Tribal</strong></td>
<td>-8,769</td>
<td>13,360</td>
<td>4,591</td>
</tr>
<tr>
<td><strong>All owners</strong></td>
<td>-1,102,613</td>
<td>2,048,645</td>
<td>946,033</td>
</tr>
</tbody>
</table>
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, CALFIRE, 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?

Welcome to a warmer future
+9.0 °C, Ambient CO₂