California Biopower Impacts Project

Biomass Working Group

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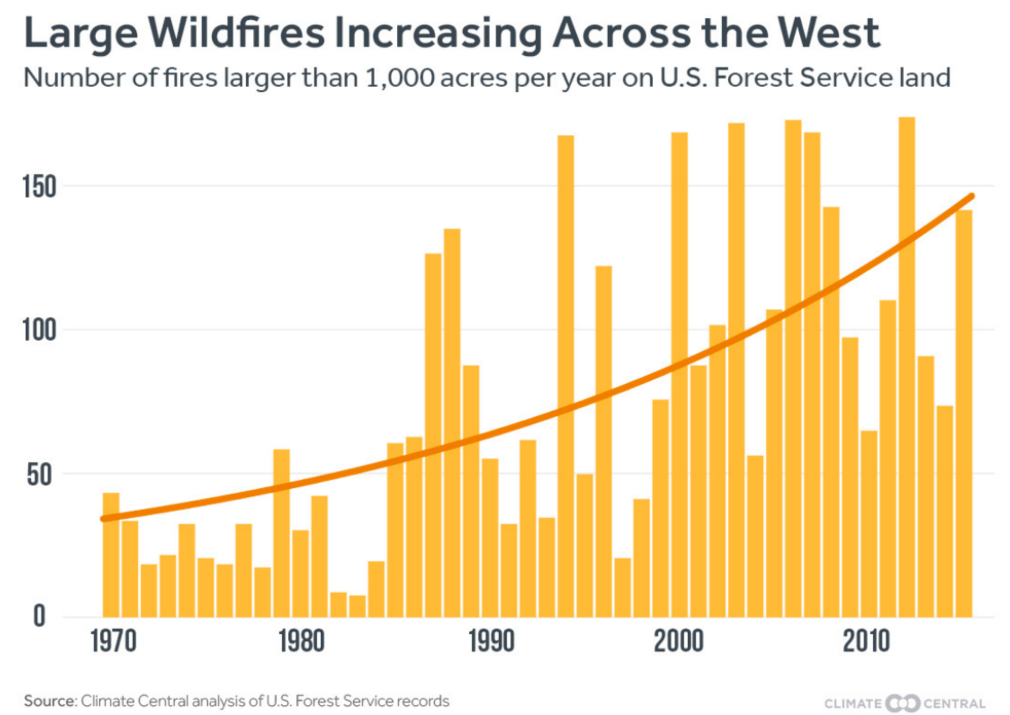
Project Manager: Jerome Carman

Background and Motivation

- Dual imperatives in CA – renewable energy and forest management
  - Biomass energy – from forest and agricultural residues – can support both sustainably, but only when managed carefully
- Significant spatial and supply-chain variability in the impacts of biomass energy
- Lack of transparency in Life-Cycle accounting
- The CBI Project aims to support policy makers and the private sector in shaping this industry.



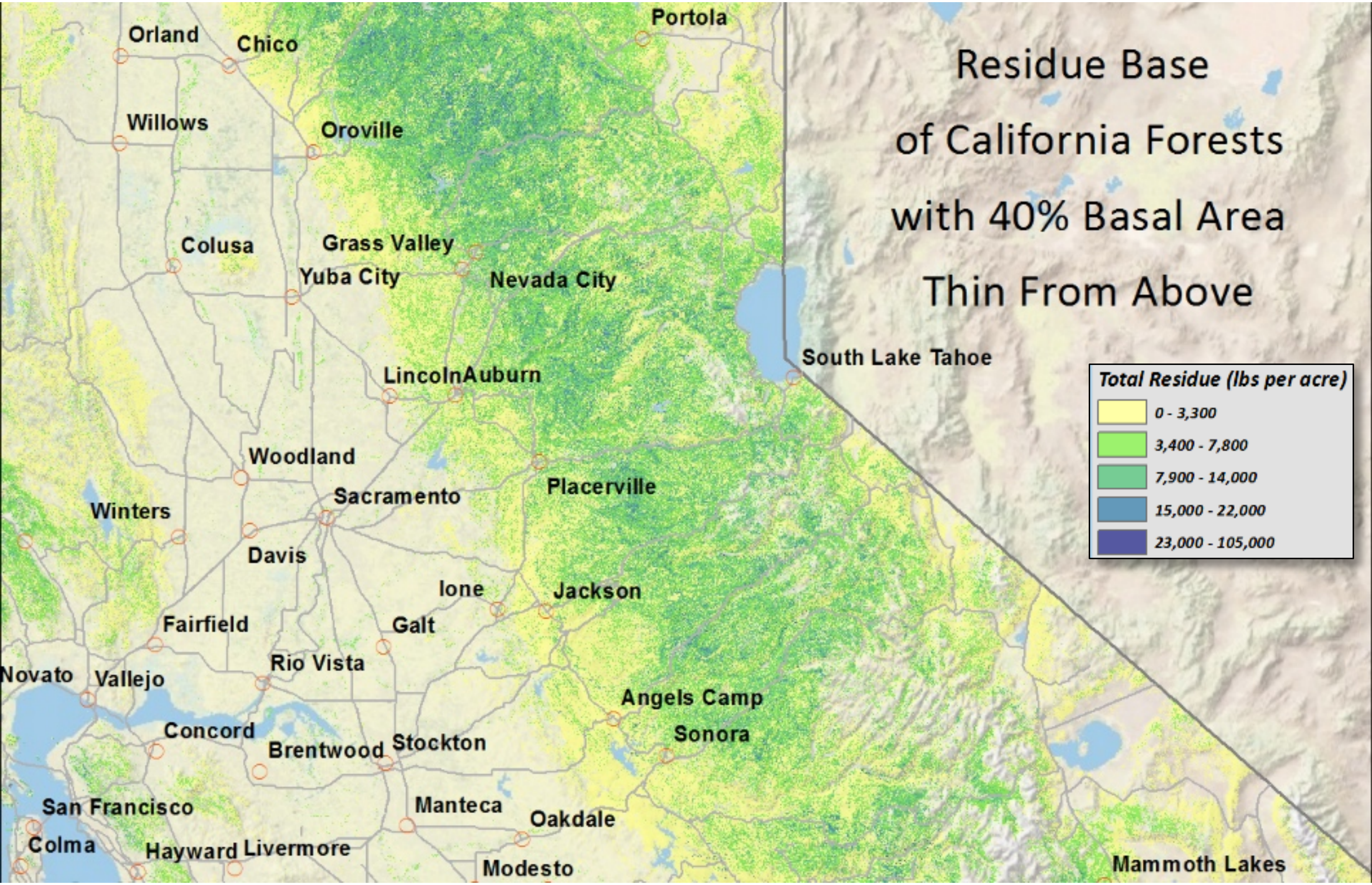
High-Level Project Goals

- Map technically recoverable forest and agricultural residue in California.
- Develop and implement the California Residual Biomass-to-electricity Carbon Accounting Tool.
- Characterize key positive and negative environmental impacts of residual biomass mobilization such as changes to soil nutrient balance and carbon stock, and air quality effects.
- Assess potential to offset residue mobilization costs through value added supply chains, post-harvest processing, payments for ecosystem services and similar schemes.
- Consolidate project results into actionable policy recommendations, and disseminate these recommendations to California stakeholder groups.

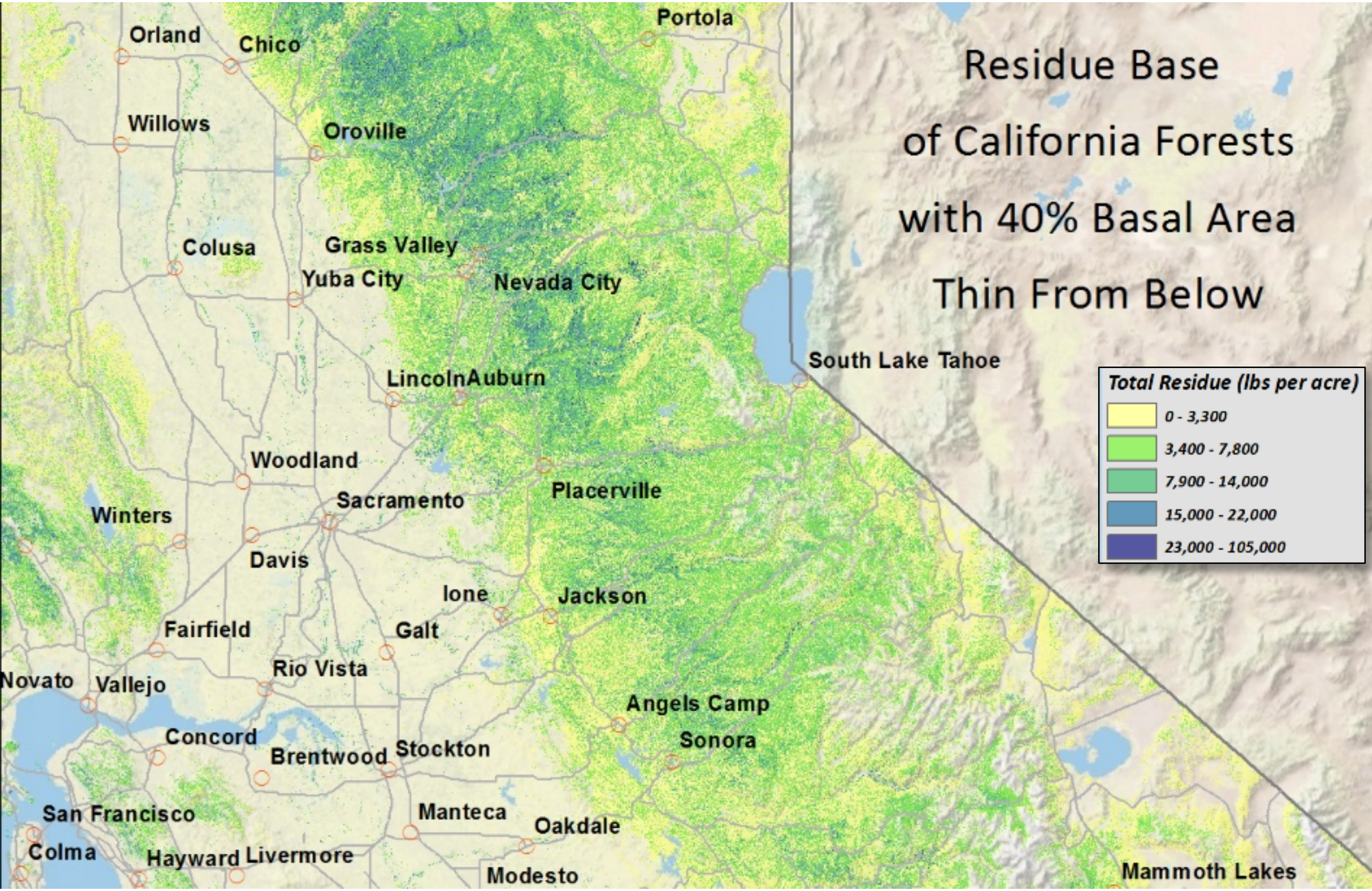
Biomass Residue Base

- Residue base is tops, branches, etc. generated through primary forest management activity
  - Thin from above (i.e. selecting for larger diameter trees) removing 20, 40, 60, 80, and 100% of total tree basal area.
  - Thin from below (i.e. selecting for smaller diameter trees) removing 20, 40, 60, 80, and 100% of total tree basal area.
  - Proportional Thin (i.e. selecting equally across tree size) removing 20, 40, 60, 80, and 100% of total tree basal area.
  - Salvage logging: removal of all standing dead trees

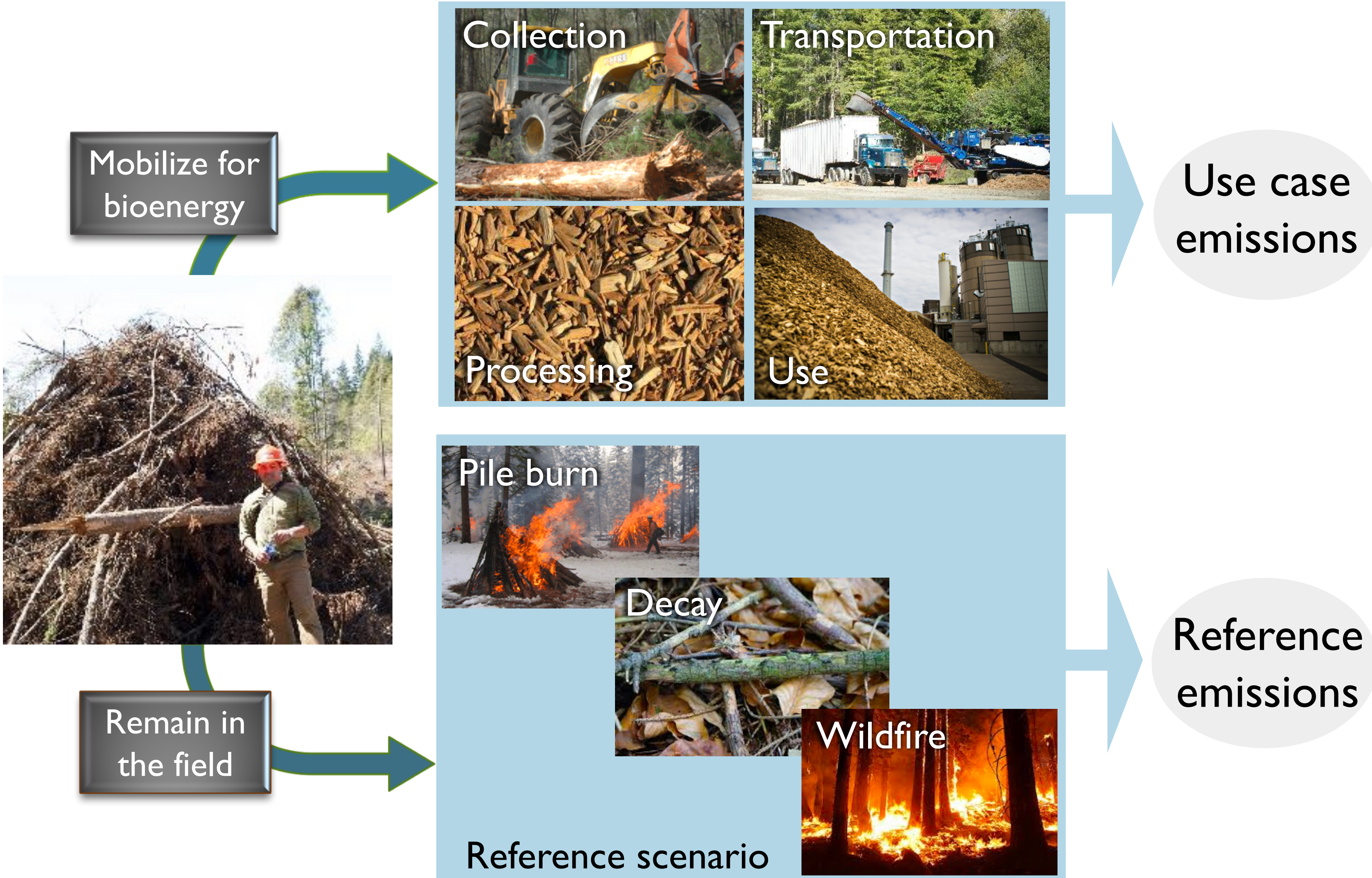
Residue Base of California Forests with 40% Basal Area Thin From Above



Residue Base of California Forests with 40% Basal Area Thin From Below



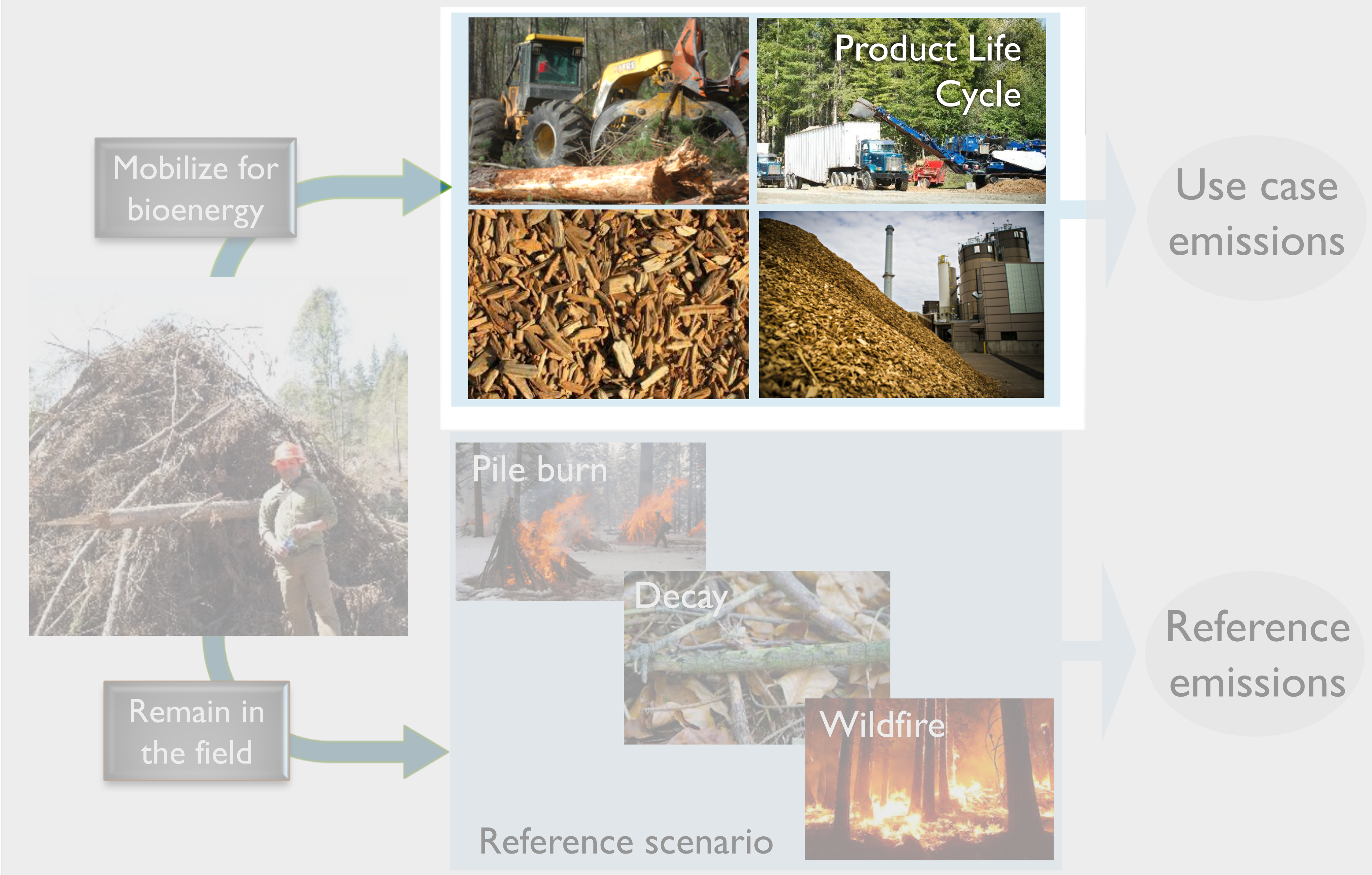
LCA Conceptual Structure



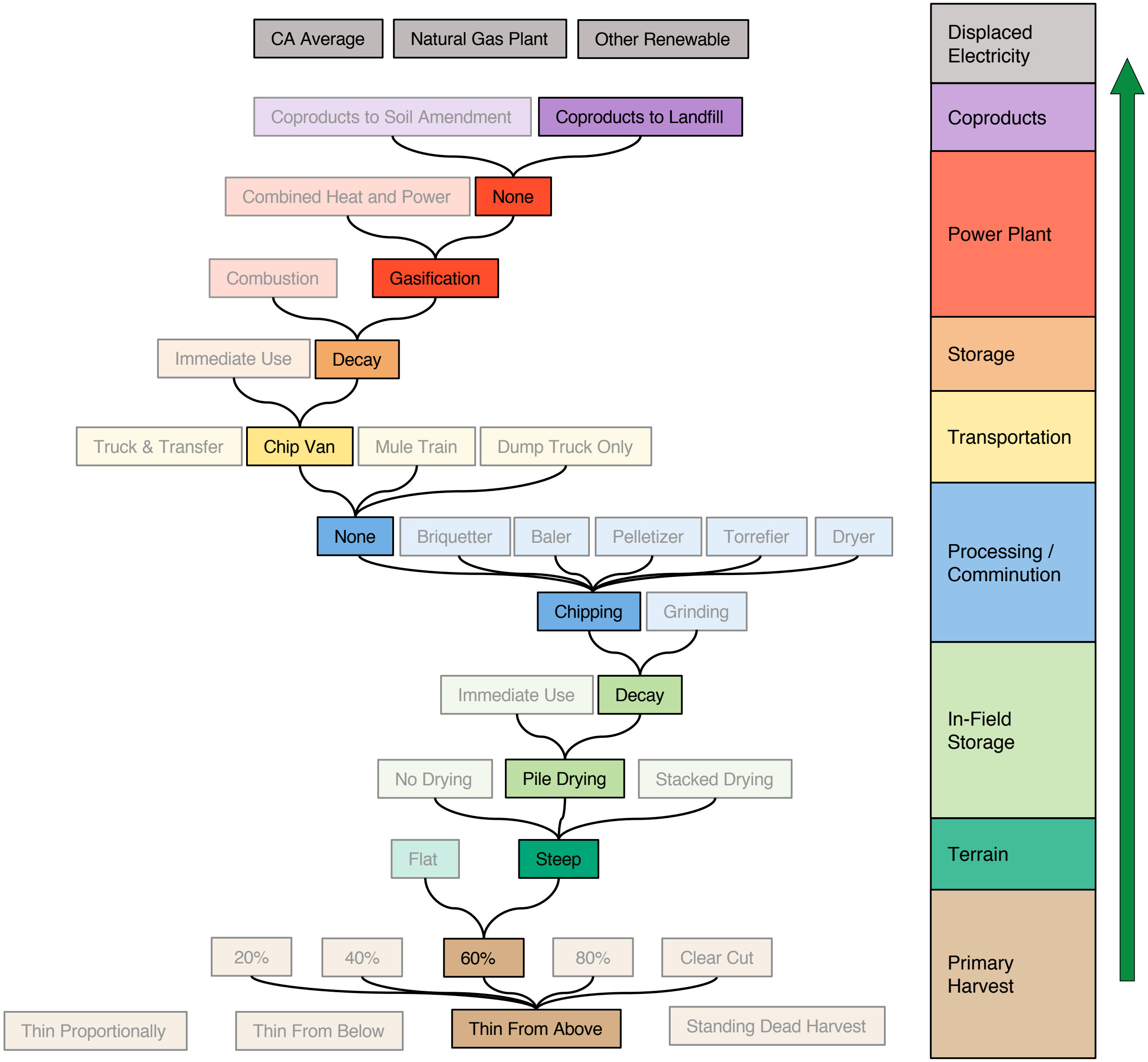
Key issues of scope

- We assume that the feedstocks are "true wastes" – they would not have otherwise been used
- As such, we don't allocate upstream emissions or sequestration to bioenergy supply chains
- Forestry and agricultural activity happens in both bioelectricity and reference cases, so land use emissions are not considered
- We don't consider the growth phase – only the reference fate for same material

LCA Conceptual Structure



LCA Framework



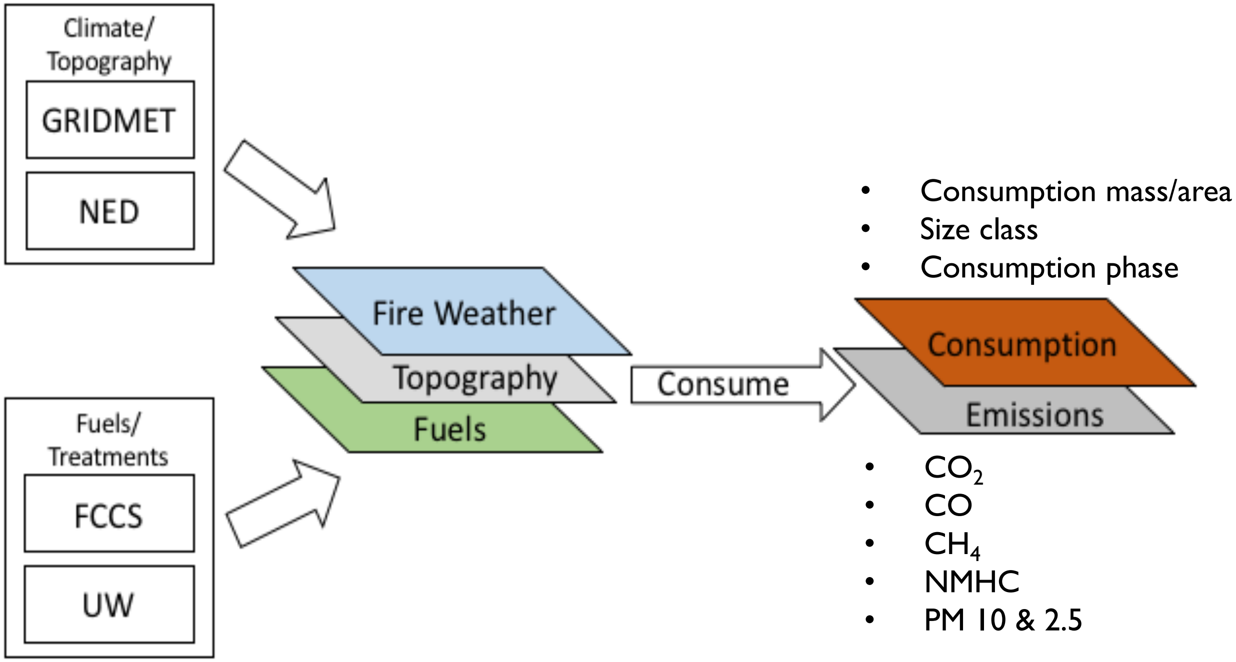
LCA Conceptual Structure

Emissions from decomposition

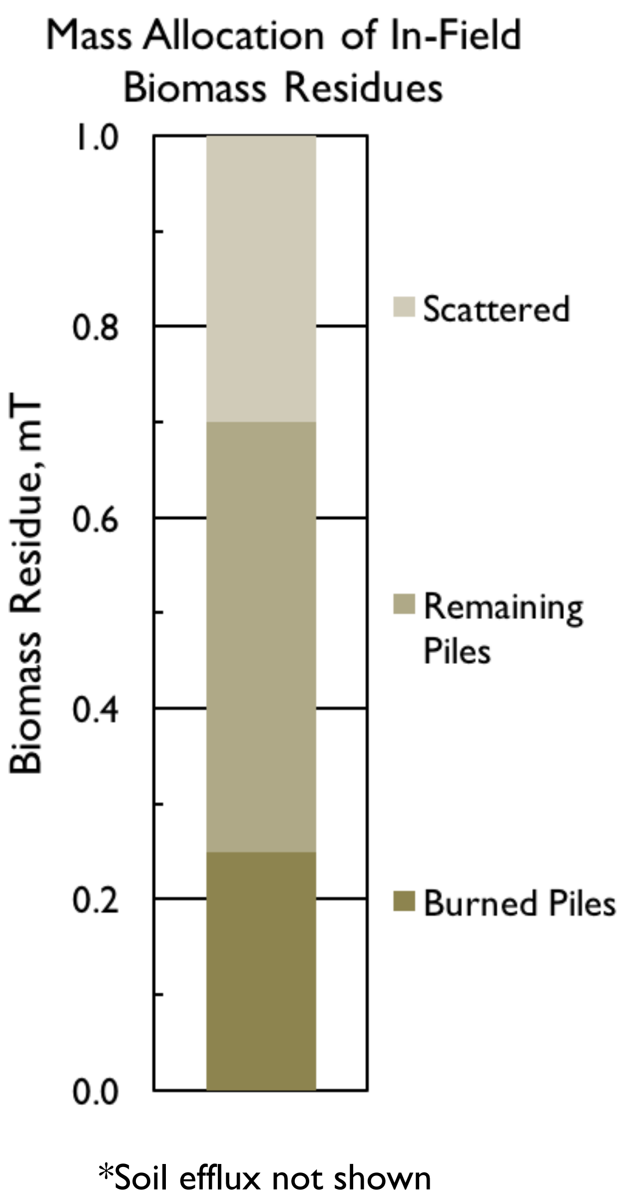
- Reference fate of material is decay over time.
- Exponential decay – rate varying based on:
  - Composition: Material type and species
  - Disposition: Piled vs scattered material
  - Climate: Temperature and residue moisture level

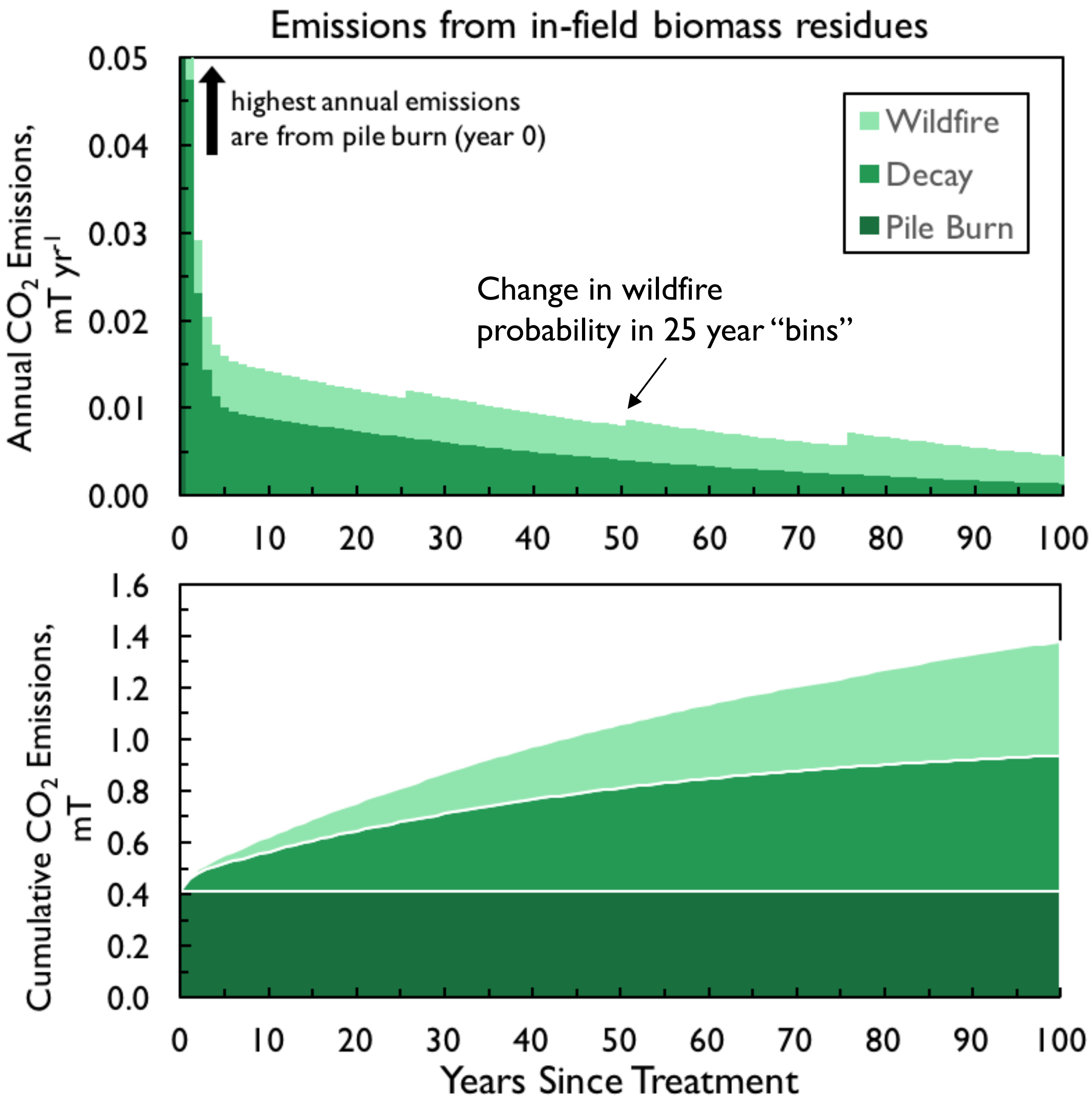
Fire Emissions

- Modeled with *Consume* software from USFS



- Emissions with and without biomass residue present.
- Assigned as avoided emissions to biomass mobilization based on fire return interval.
  - Some fraction pile-burned in year 1
  - Assumed to rise over time - subject to sensitivity analysis


Mass Allocation of In-Field Biomass Residues
Biomass Residue, mT
1.0
0.8
0.6
0.4
0.2
0.0
Scattered
Remaining Piles
Burned Piles
*Soil efflux not shown


Emissions from in-field biomass residues
Annual CO2 Emissions, mT yr-1
0.05
0.04
0.03
0.02
0.01
0.00
highest annual emissions are from pile burn (year 0)
Wildfire
Decay
Pile Burn
Change in wildfire probability in 25 year "bins"
0 10 20 30 40 50 60 70 80 90 100
Cumulative CO2 Emissions, mT
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0 10 20 30 40 50 60 70 80 90 100
Years Since Treatment

Welcome to CARBCAT ×
127.0.0.1:4886

Welcome to the CA Residual Biomass Carbon Accounting Tool

Instructions

Select your input for CARBCAT below:

Residue Sector

- (•) Forestry
- ( ) Agriculture

Treatment Type

Thin from below: 40% basal area

Post Harvest Processing

Briquette

Biomass Plant

Eel River Power

Percent of Biomass Piled

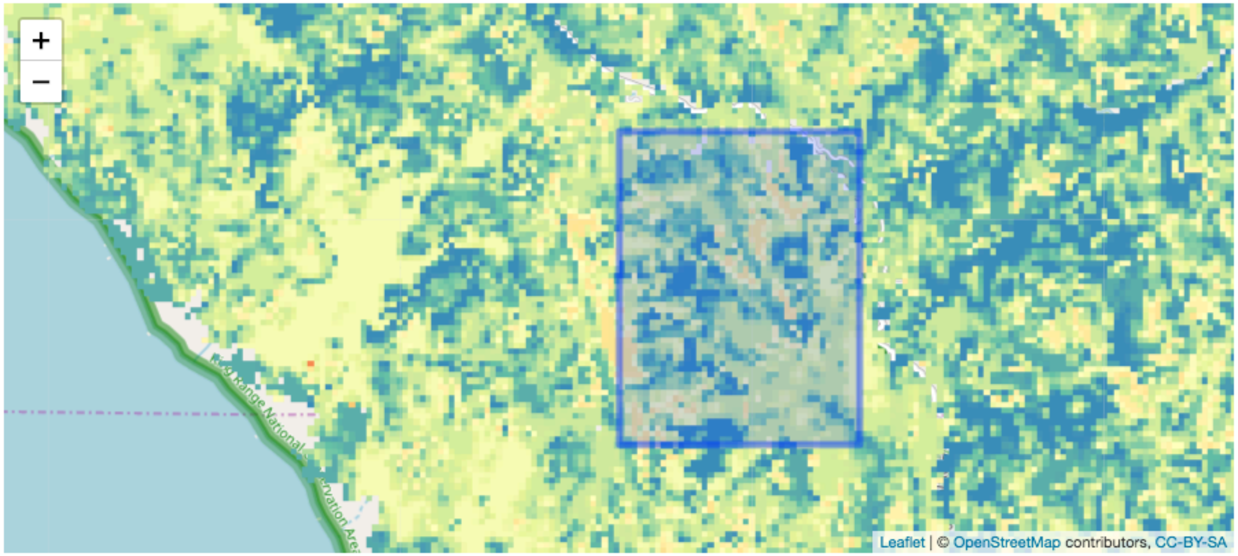
0 — 50 — 100

Percent of Biomass Burned

0 — 10 — 100

Emissions to Track

- [x] CO2
- [ ] CH4
- [ ] N2O



Greenhouse Gases (metric T/BDT)				
	CO_2	CH_4	N_2O	SLCPs
Project	1.83	0.02	0	0.04
Reference	1.71	0.06	0.01	0.07
Net	**0.12**	**-0.04**	**.0.01**	**-0.03**

Criteria Pollutants (kg/BDT)						
	PM2.5	PM10	O_3	CO	NO_x	SO_x
Project	0.1	0.15	0.5	.95	0.5	0.8
Reference	2.3	0.95	0.02	.1	0.5	0.9
Net	**-2.2**	**-0.8**	**0.48**	**.85**	**0**	**-0.1**

Note: these are NOT actual results, they are presented here for illustrative purposes only

	Climate Metrics (units as specified)			
	T CO_2e	AGWP ($W\ m^{-2}\ yr$)	iAGTP (K yr)	iGTP CO_2e (MT)
Project	100	98	100	98
Reference	98	100	98	100
Net	-2	2	-2	2

Model Capabilities/Sensitivities

- Location of source and destination in transport network
- "Counterfactual" fate of biomass
  - Burn probability, decomposition rate, etc.
- Wildfire frequency projection
- Supply chain characteristics such as harvest equipment, fuel use, landscape specifics, post-harvest treatment, and conversion technologies
- End-use technology pathway
- Analytical time horizon

Follow-on work

- Empirical studies of targeted emissions sources
- Integration with CALAND – natural and working lands C accounting model
- Accounting for pile burn emissions
- Air emissions health burden modeling

Thank you!

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