

Pile Burning Estimates in the 2022 Emissions Modeling Platform



Source: https://forestry.nv.gov/uploads/hero-backgrounds/Spooner_Rx_Burn_-_202220220115_0021.JPG

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What is a Pile Burn?

Piles may sit until wood is dry and conditions are right for ignition

Thinned or downed woody biomass are placed into **piles**



Piles can be stacked by hand or machine in a variety of geometries and sizes

Piles in Rocky Mountain National Park

Why are pile burns important?

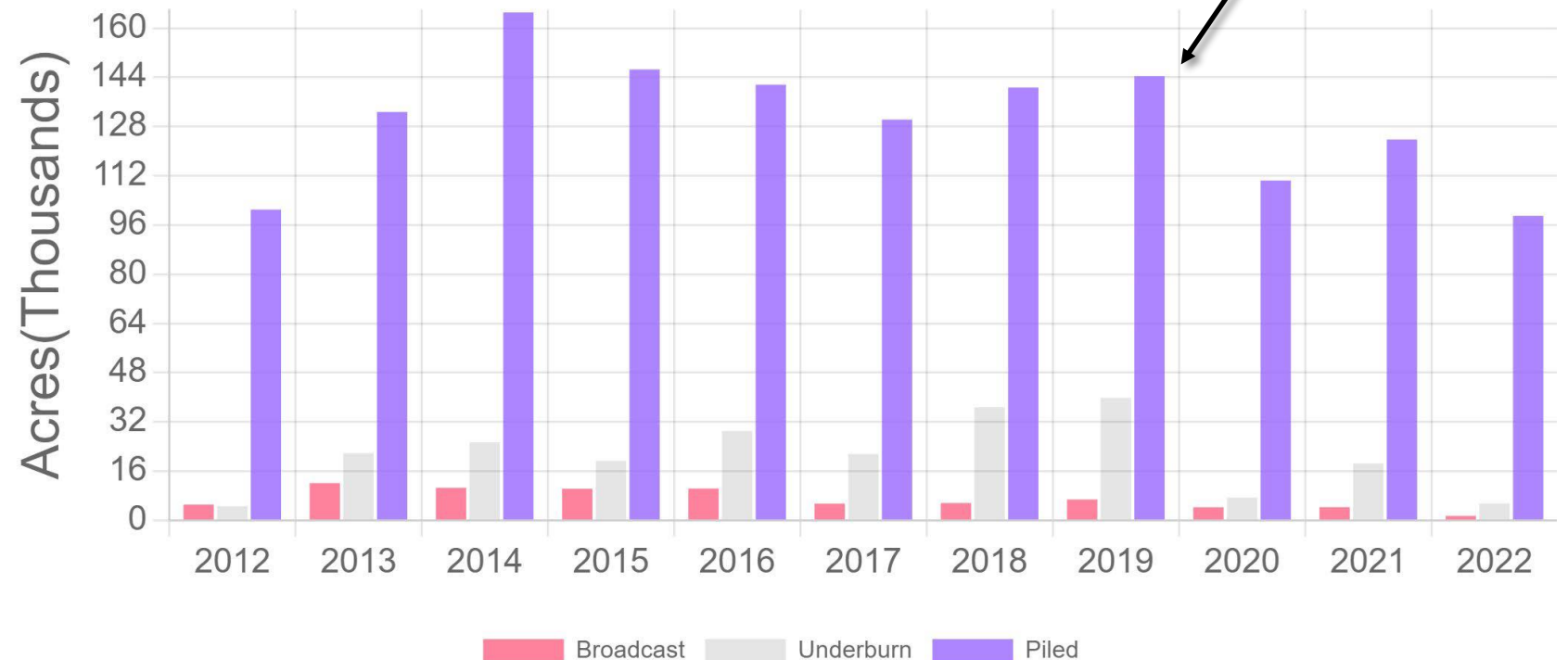
Pile burn (PB)
emissions estimates
not included in 2020
NEI methods

Rx Fire a large
contributor to PM in
CONUS

2020 NEI misclassified
pile burns as area
prescribed burns (e.g.
broadcast and
underburn)

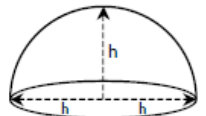
~75-90% of area treated with
fire in **Oregon** each year are
in the form of pile burns.

Piled vs Broadcast vs Underburn Acres Burned



Land Manager Tools for Pile Burn Emissions

The US Forest Service (USFS) and University of Washington (UW) maintains a pile burn calculator based on methods in CONSUME and Hardy 1996.

		Piled Fuels Biomass and Emissions Calculator	
		<i>Last updated: 3/26/2014</i>	
1. DATA ENTRY MODE: MANUAL (USE ONLINE FORM)		[Start over/change measurement system/use batch mode] [Help]	
2. MEASUREMENT SYSTEM: ENGLISH			
3. Add Pile Group of Pile Type: ☒ Hand ☐ Machine			
Describe this pile group:			
Pile group name:	PileGroup1		
Number of piles:	1		
Pile shape:	☒ Half sphere ☐ Paraboloid ☐ Half cylinder ☐ Half-frustum of cone ☐ Cone w/ rounded ends ☐ Half ellipsoid ☐ Irregular solid		
Pile dimensions (ft):	W1: W2: H1: H2: L1: L2: 		
Pile composition:	Conifer		
Consumption:	% of piled material (Note: Default for Consume = 90%, default for Washington DNR estimates = 85%)		
Add pile group Reset current values			

<https://depts.washington.edu/nwfire/piles/>

Estimating Pile Burn Emissions

$$\text{Pile Burning Emissions} = \text{Biomass Burned} * \text{Emission Factor}$$

- **Biomass burned (tons) =**

(All calculations are equivalent)

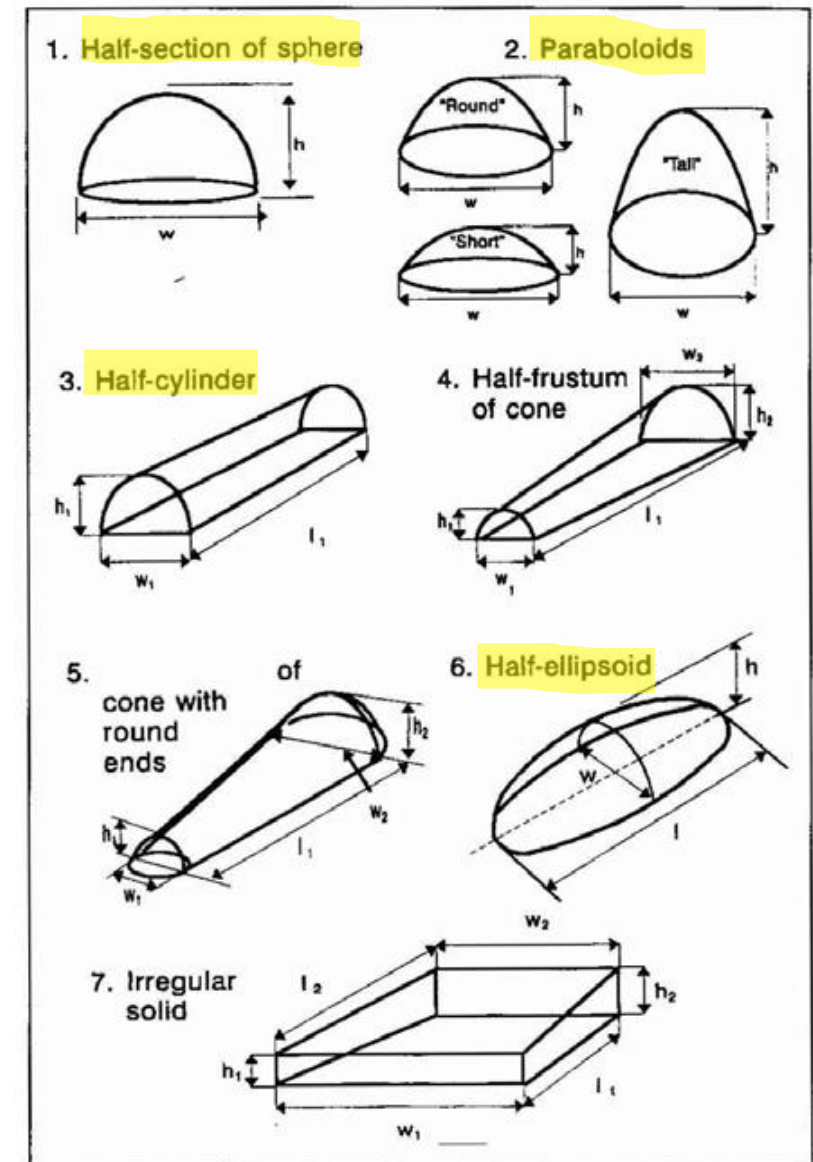
- *Mass consumed or*
- *Mass of piled material $\times$ consumption fraction (CF) or*
- *Pile volume $\times$ biomass density $\times$ packing ratio $\times$ CF or*
- *Area $\times$ fuel loading $\times$ CF*

- **Emission factors (g/kg)**

- Smoke Emissions Reference Application (SERA) pile burn factors
- By combustion phase where possible: flaming vs. smoldering vs. residual

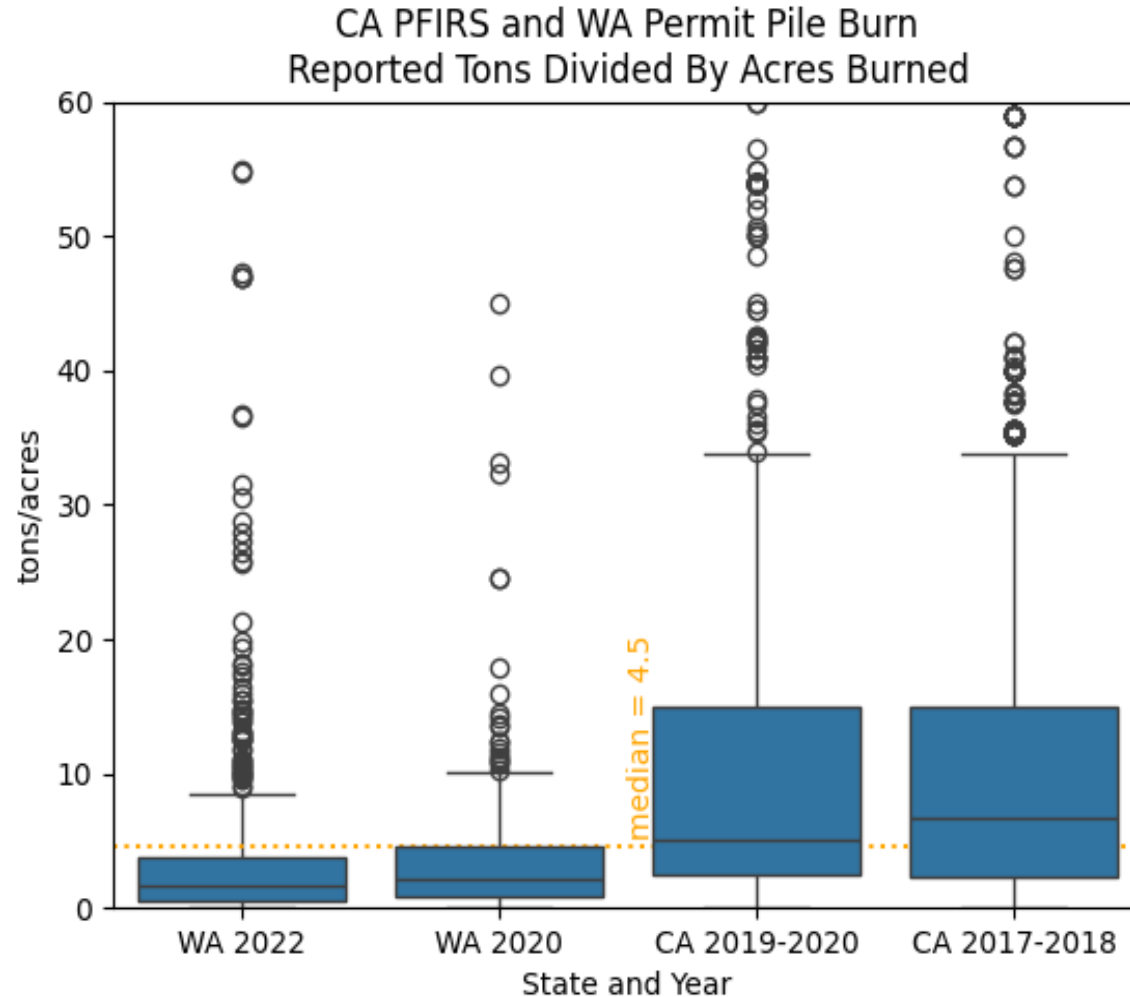
Estimating Biomass Burned From Activity

- Activity supplied as a **mass**
 - If it is burned or consumed – great! Nothing more to do.
 - If it is total mass in pile – apply the consumption fraction (75-95% Hardy 1996) (90-95% Wright 2019)
- Activity supplied as a **pile volume**
 - Determine packing ratio to calculate effective volume (0.1-0.3 Hardy 1996/CONSUME v3) for machine piles
 - Determine wood species to calculate mass using biomass density (Miles 2009) or regression formula (Wright 2010)
- Activity supplied as a **geometry**
 - Determine best volume formula to calculate pile volume
 - Follow the pile volume method above



Estimating Biomass Burned from Area

4.5 tons/acre median value derived from CA and WA permit data

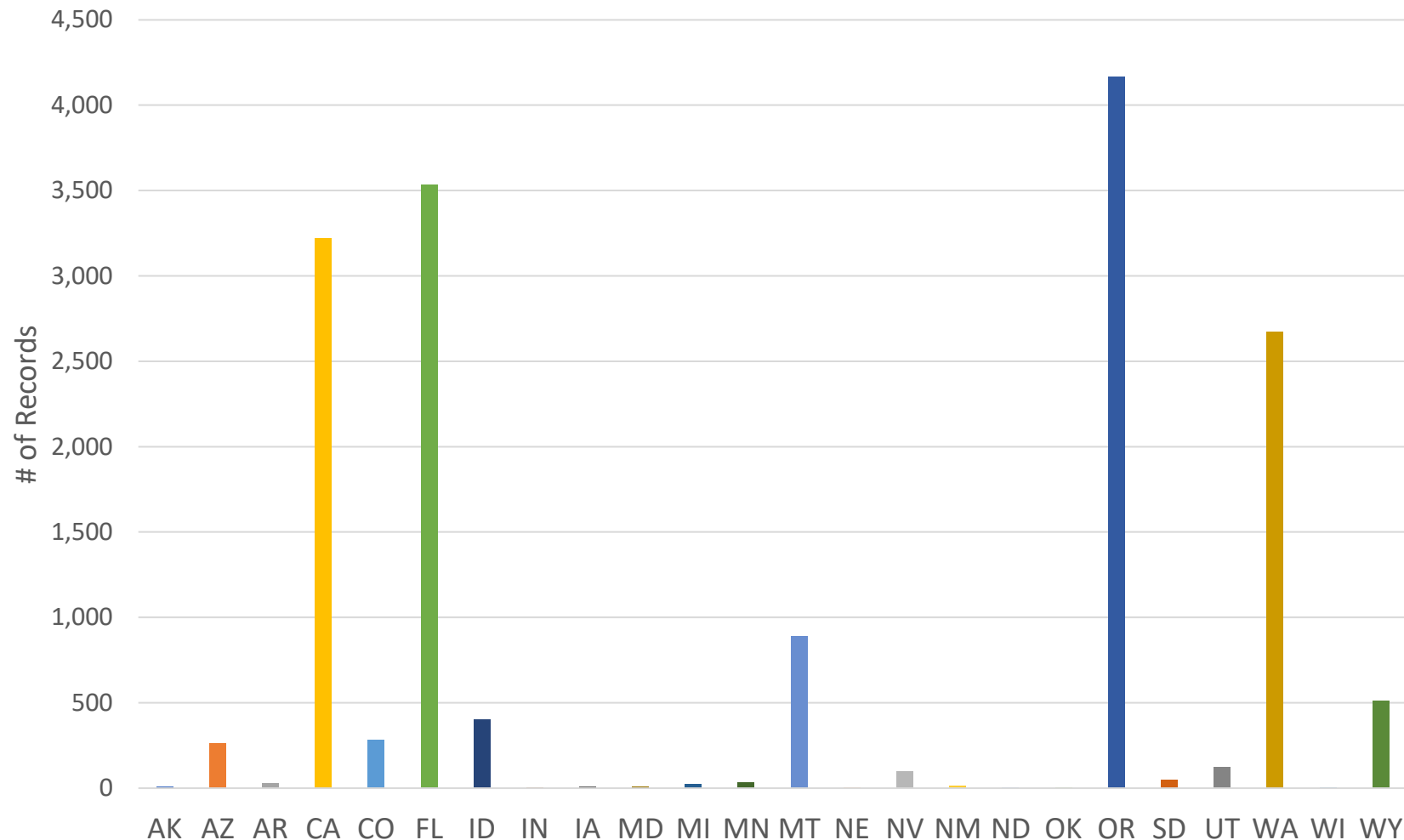


For states and agencies that only provide **area**:

$$\text{Biomass burned} = 4.5 \text{ tons/acre} \times \text{acres (treated)} \times CF$$

2022 Pile Burn Activity

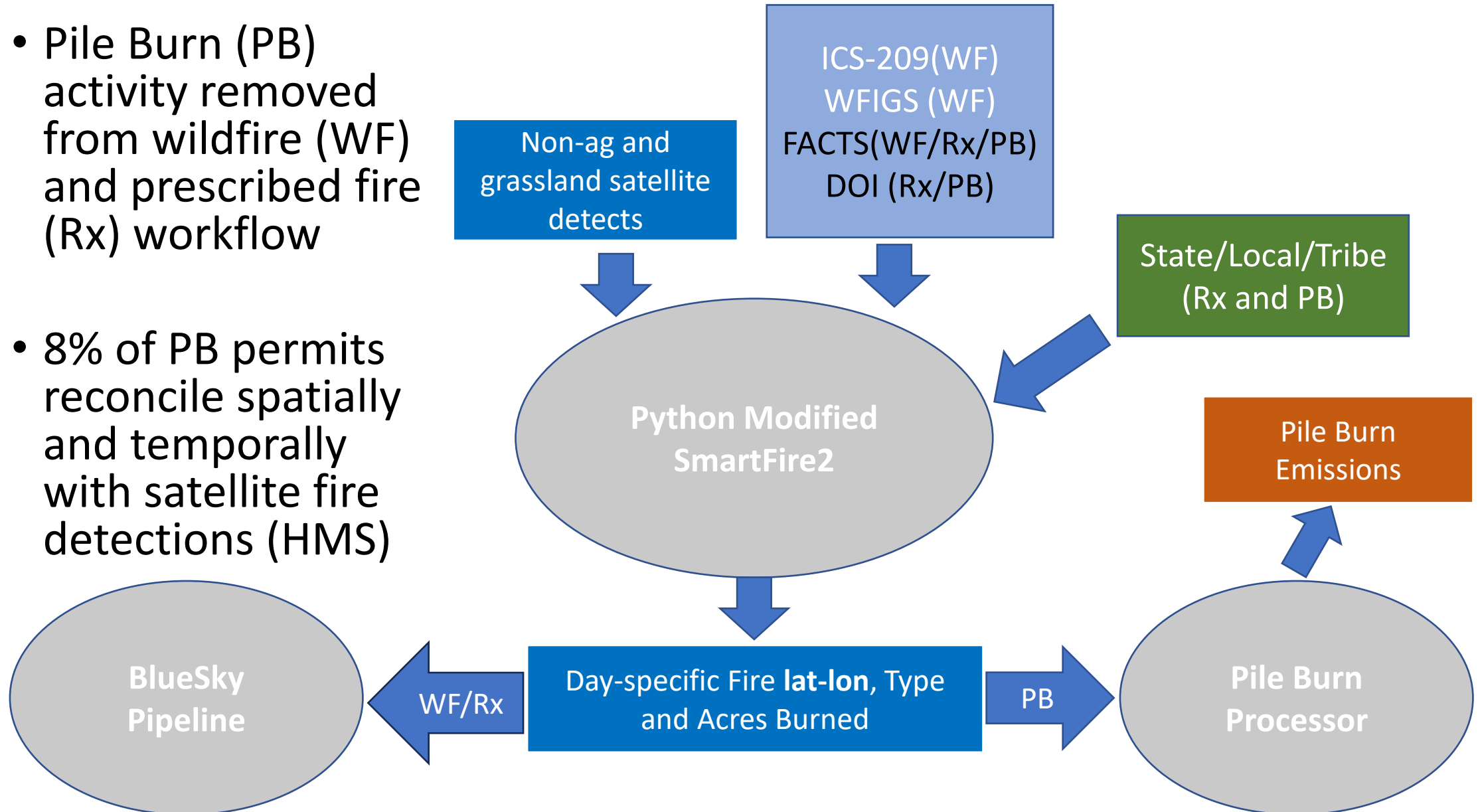
2022 Pile Burn Records by State



- EPA received pile burn activity from
 - 13 States
 - 2 Federal Agencies
 - 1 Tribe
- Permit and other activity critical to emissions estimates
- Each record may represent multiple piles

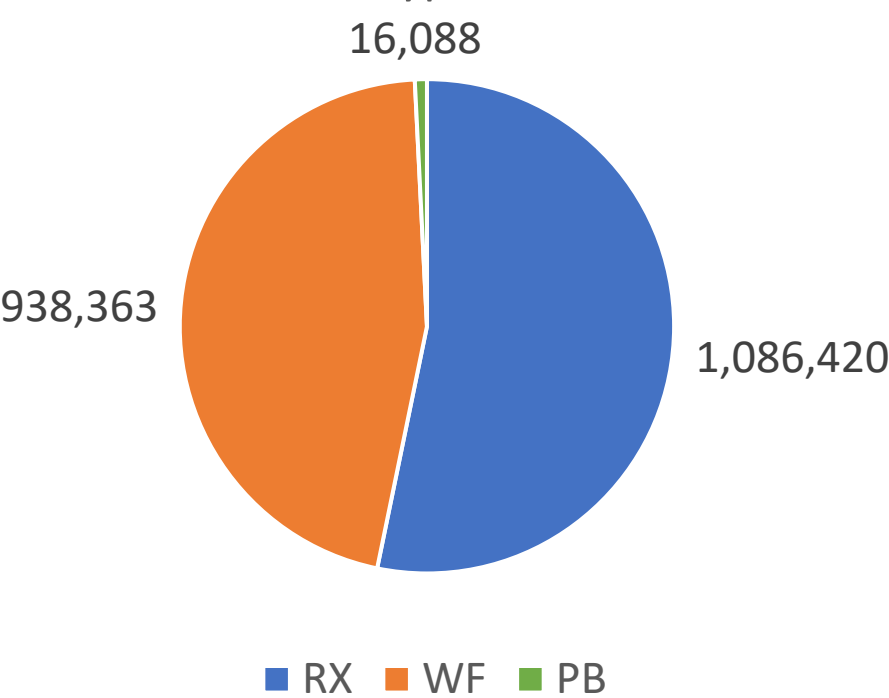
2022 Pile Burn Workflow

- Pile Burn (PB) activity removed from wildfire (WF) and prescribed fire (Rx) workflow
- 8% of PB permits reconcile spatially and temporally with satellite fire detections (HMS)

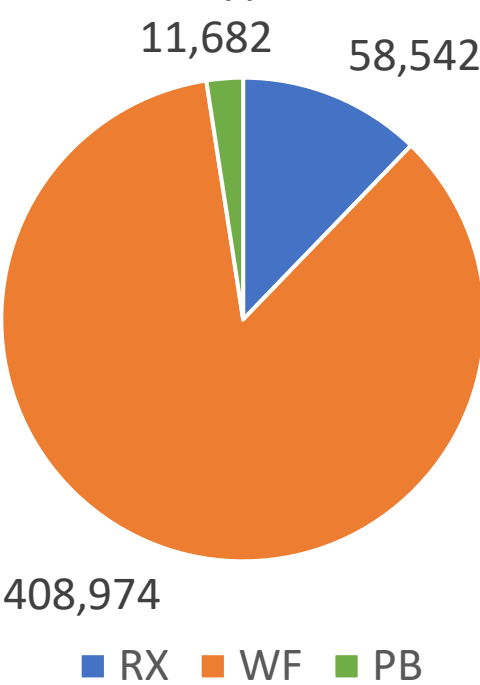


2022 National PM2.5 for All Wildland Fires

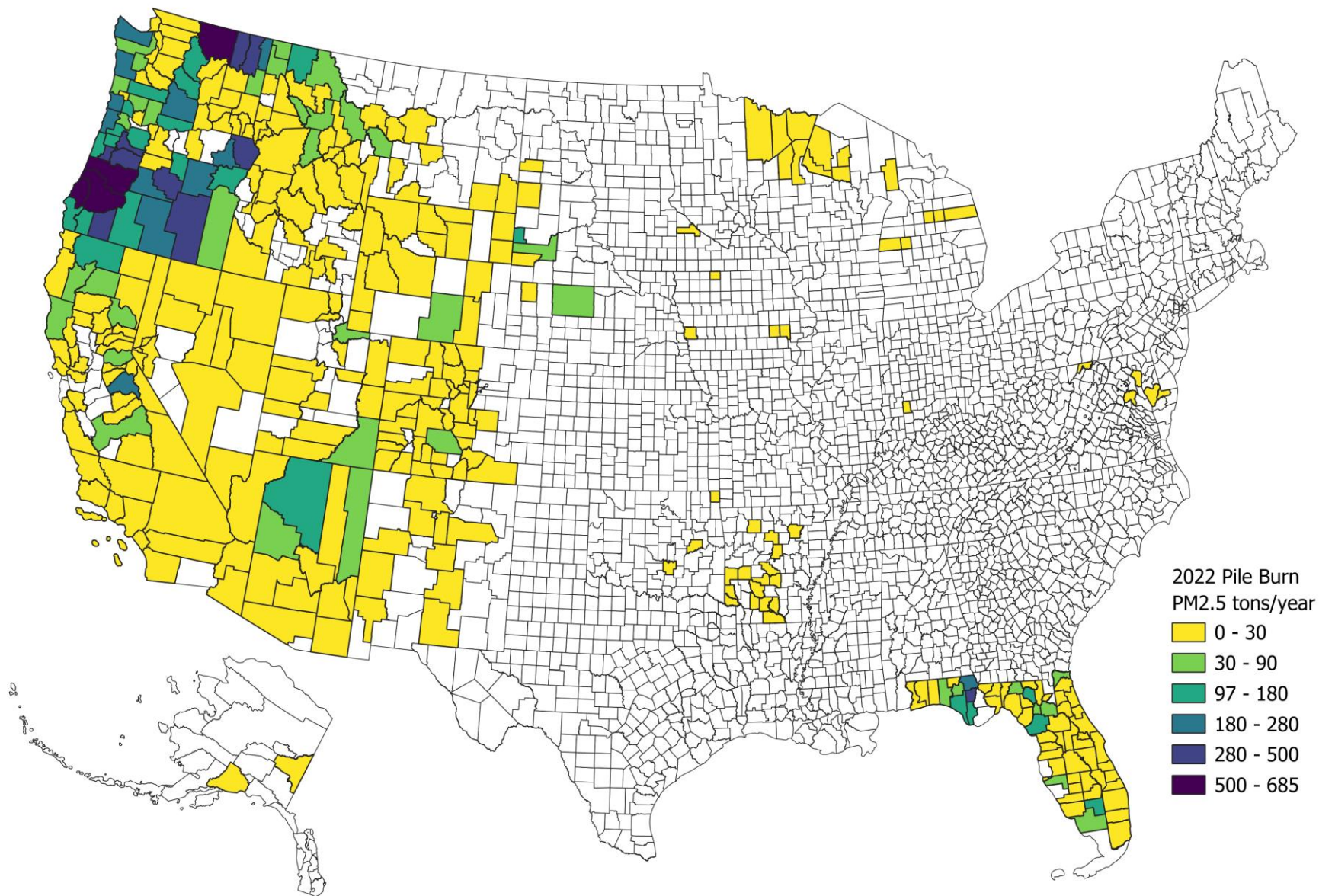
2022 National Wildland Burning PM2.5 (tons) by
Type



2022 West Coast Wildland Burning PM2.5 (tons) by
Type

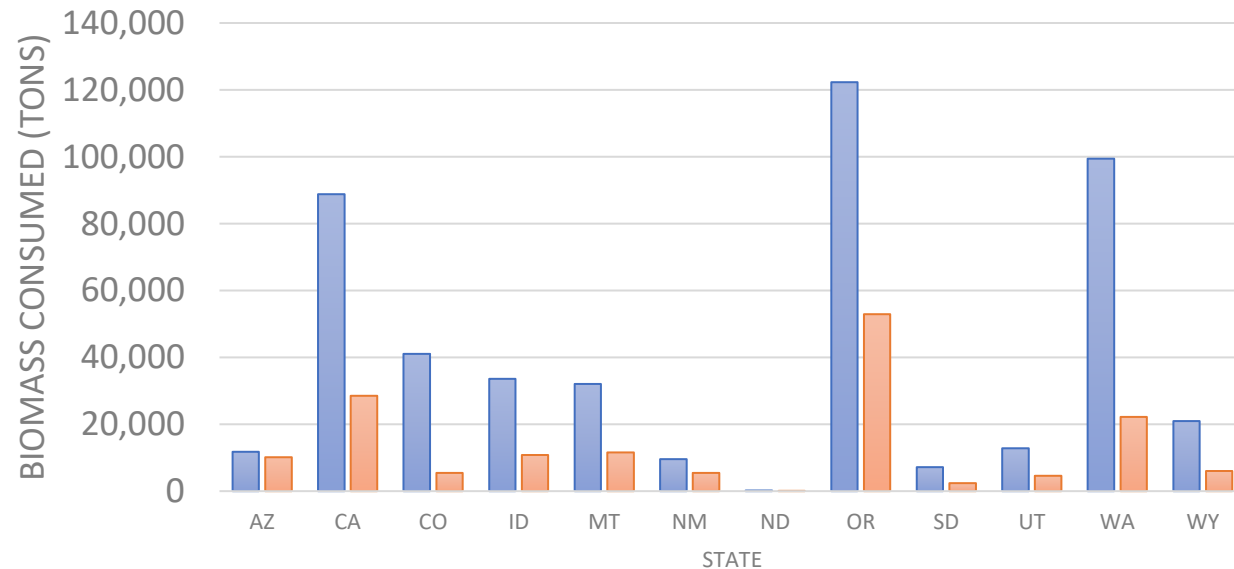


2022 Pile Burn PM2.5 By County



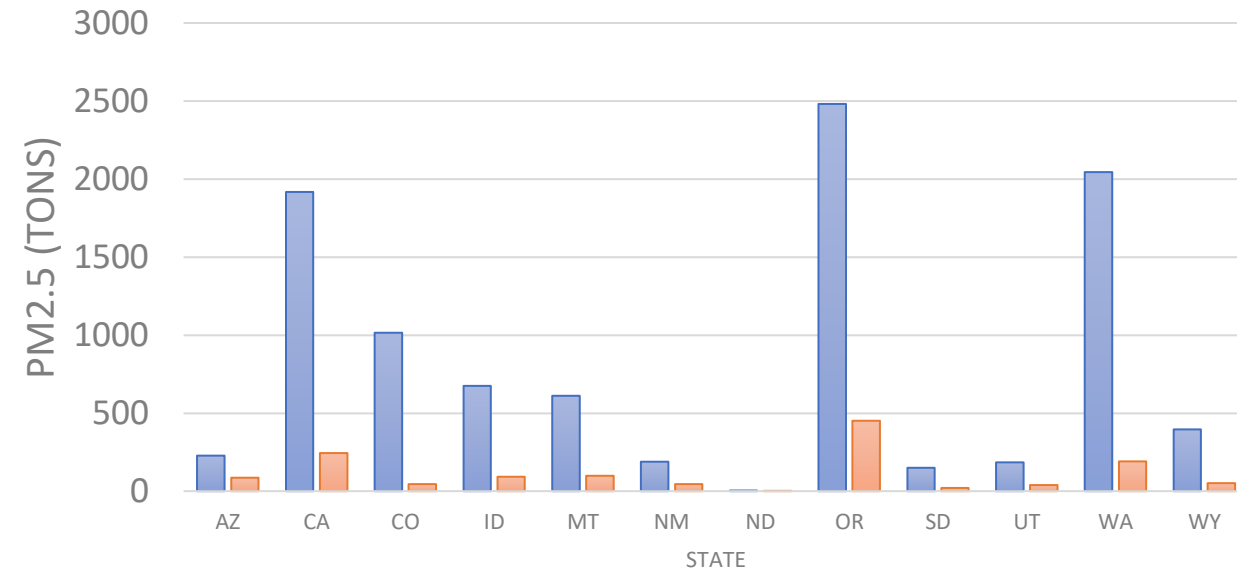
Impact on PM2.5: PB vs Broadcast Rx

2022 FACTS Prescribed Fire Consumption



■ Consumption as a Broadcast Rx (tons) ■ Consumption as a Pile Burn (tons)

2022 FACTS Prescribed Fire PM2.5



■ PM2.5 as a Broadcast Rx (tons) ■ PM2.5 as a Pile Burn (tons)

2022 USFS FACTS Pile Burn Activity Associated with HMS Detects

Broadcast Rx Processed through BlueSky as Rx Area Burns

PB Processed as piles using the draft pile burn method

Area treated is equivalent between methods

86% Reduction in PM2.5

Conclusions

- PM emitted per acre burned is ~85% lower when modeled as a pile burn instead of a broadcast burn for detected fires
 - Suggests historical overestimates of emissions from Rx fires in 2020NEI if treated area is equivalent
 - Permit data is largely in excess of what was previously detected by satellites, resulting in PM increases for some areas
- It all starts with activity: state/local/tribal permit data is crucial
- Pile burn practices vary resulting in large tons/acre differences

Modeling and Future Work for 2023 NEI

- **Temporal factors** by combustion phase if possible, currently using broadcast burn profiles
 - Pile burns may occur over snow and can have long smoldering tails
- **Plume rise** method – heat output from a single representative pile
 - Estimates using SMOKE/CMAQ Briggs approach show most in lowest layers
- **HAPs** and pile-specific speciation profiles
- Pile Burns included in 2023 NEI request for data

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