Item available for public inspection in the Clerk's office during regular business hours (Monday – Friday, 9 AM – 5 PM)

April 15, 2025

Regular Meeting

Presentation - Item #7B. - TSS Consultants Update on Biomass Facility

Update for the Pre-Development Work for the Mammoth Bioenergy Facility.

Fred Tornatore
Chief Technical Officer
TSS Consultants
fatoxic@tssconsultants.com
916.601.0531

April 15, 2025

What is Trying to Be Solved?

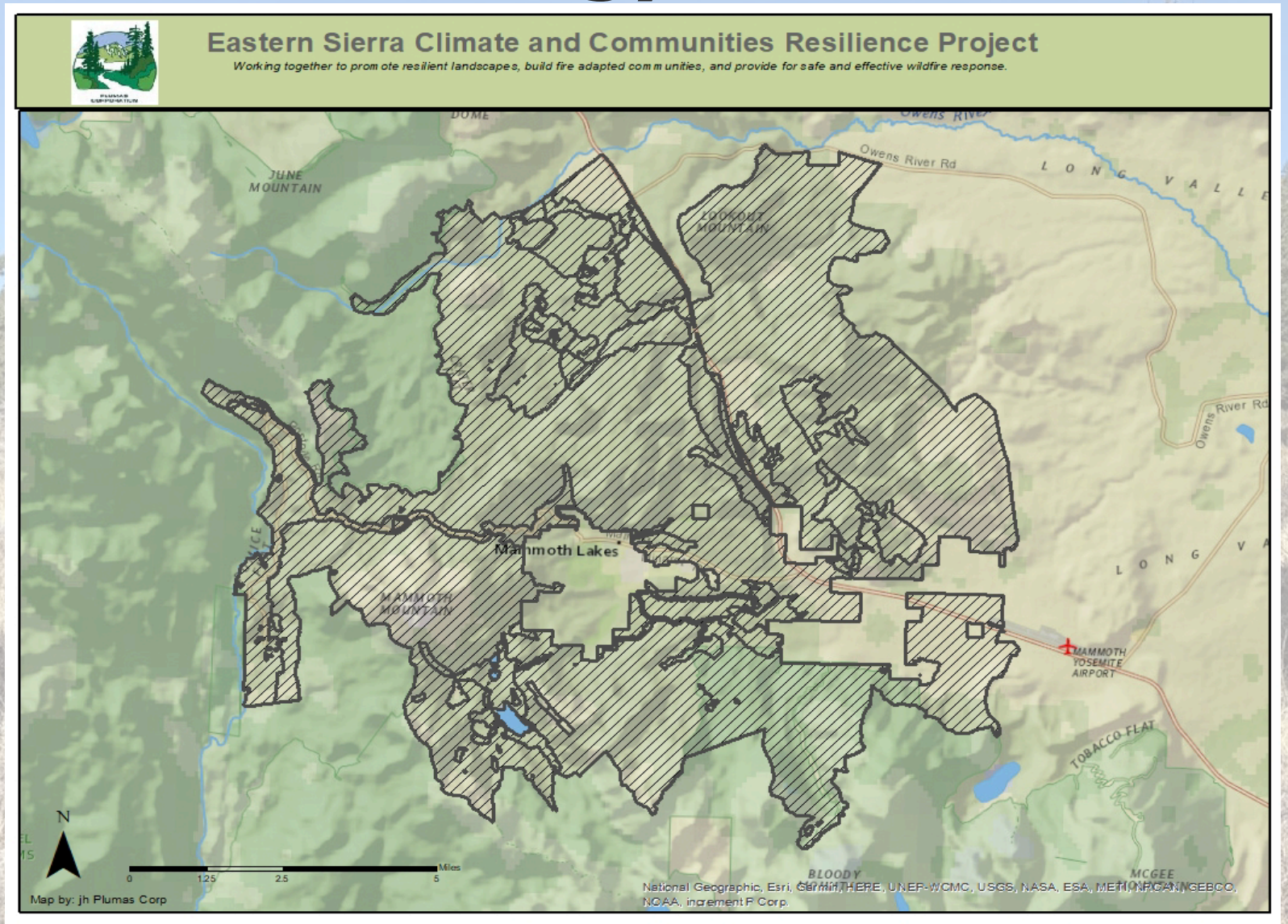
Catastrophic Wildfire

Forest Health

Reduction/Elimination of Open Burning Emissions

Long-Term Solutions w/Emphasis on Bioenergy

The Eastern Sierra Climate & Communities Resilience Project (ESCCRP) has begun implementing ecological forest restoration on over 55,000 acres and hopefully that's not all



Status as of 4/1/2025

- Site visit in October with Stakeholders and Board of Supervisors
- Meetings with various local agencies and interested parties, such as the Planning Department, Air District, Town of Mammoth Lakes representatives
- Continuing interconnection process with Southern California Edison for power grid connection via the Casa Diablo Electrical Substation
- Some delay in the last few months due in part to continued grant funding uncertainties, which now seem resolved
- Request by Mono County CAO for discussion of bioenergy facility and air quality

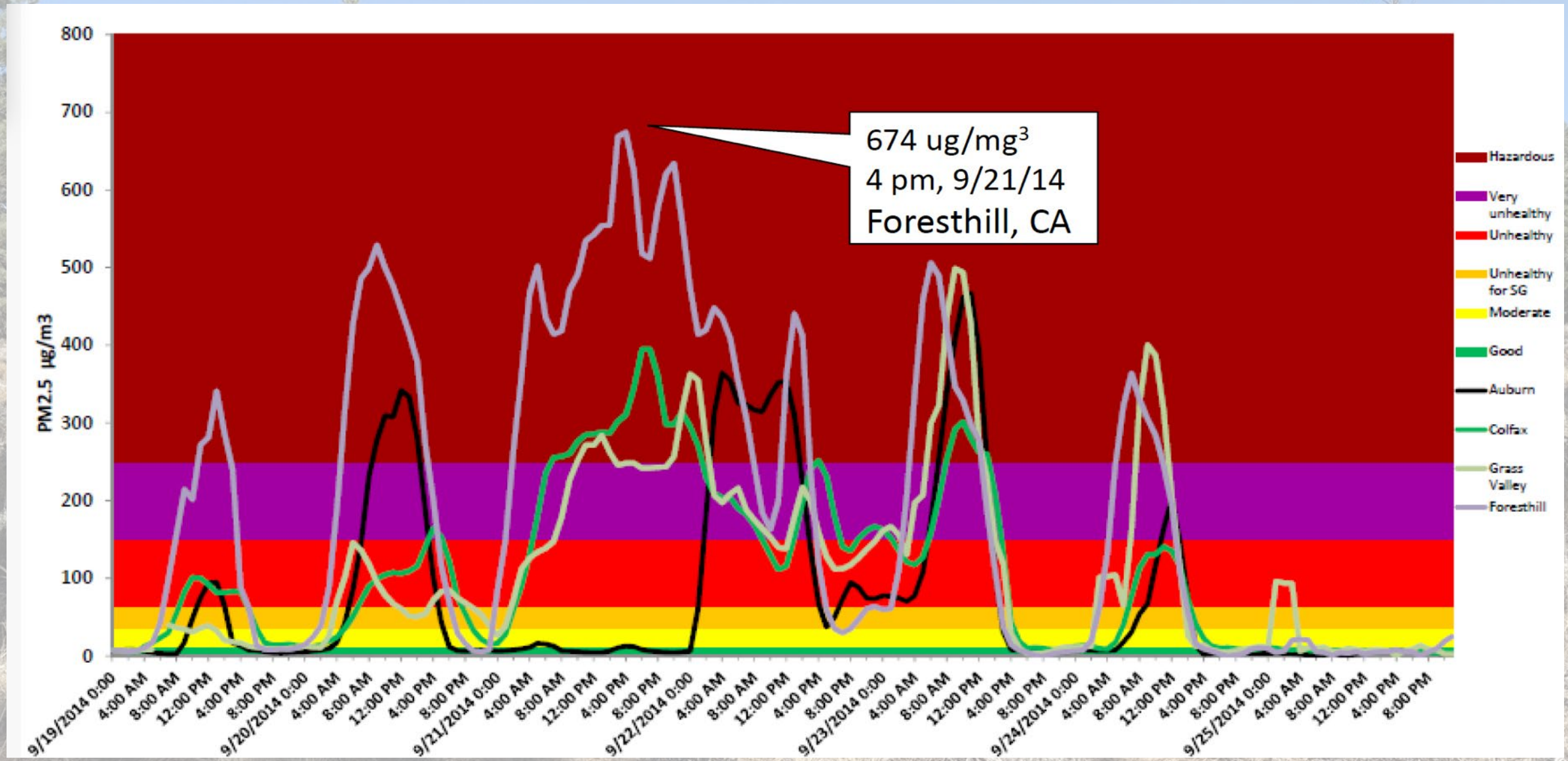
Wildfire and Open Burning Emissions

Implications of Wildfire and Open Burning Emissions on Health

- **Fine Particulate Matter ($PM_{2.5}$) Exposure** – Inhalation of fine particles can penetrate deep into the lungs, causing respiratory and cardiovascular issues.
- **Volatile Organic Compounds (VOCs)** – Emitted during combustion, VOCs can irritate the eyes, nose, and throat and contribute to long-term health effects, including cancer.
- **Polycyclic Aromatic Hydrocarbons (PAHs)** – These toxic compounds are formed during the burning of organic matter and are known carcinogens with potential for long-term health impacts.
- **Aggravation of Pre-existing Conditions** – Wildfire smoke can exacerbate asthma, chronic obstructive pulmonary disease (COPD), and other respiratory or cardiovascular conditions.

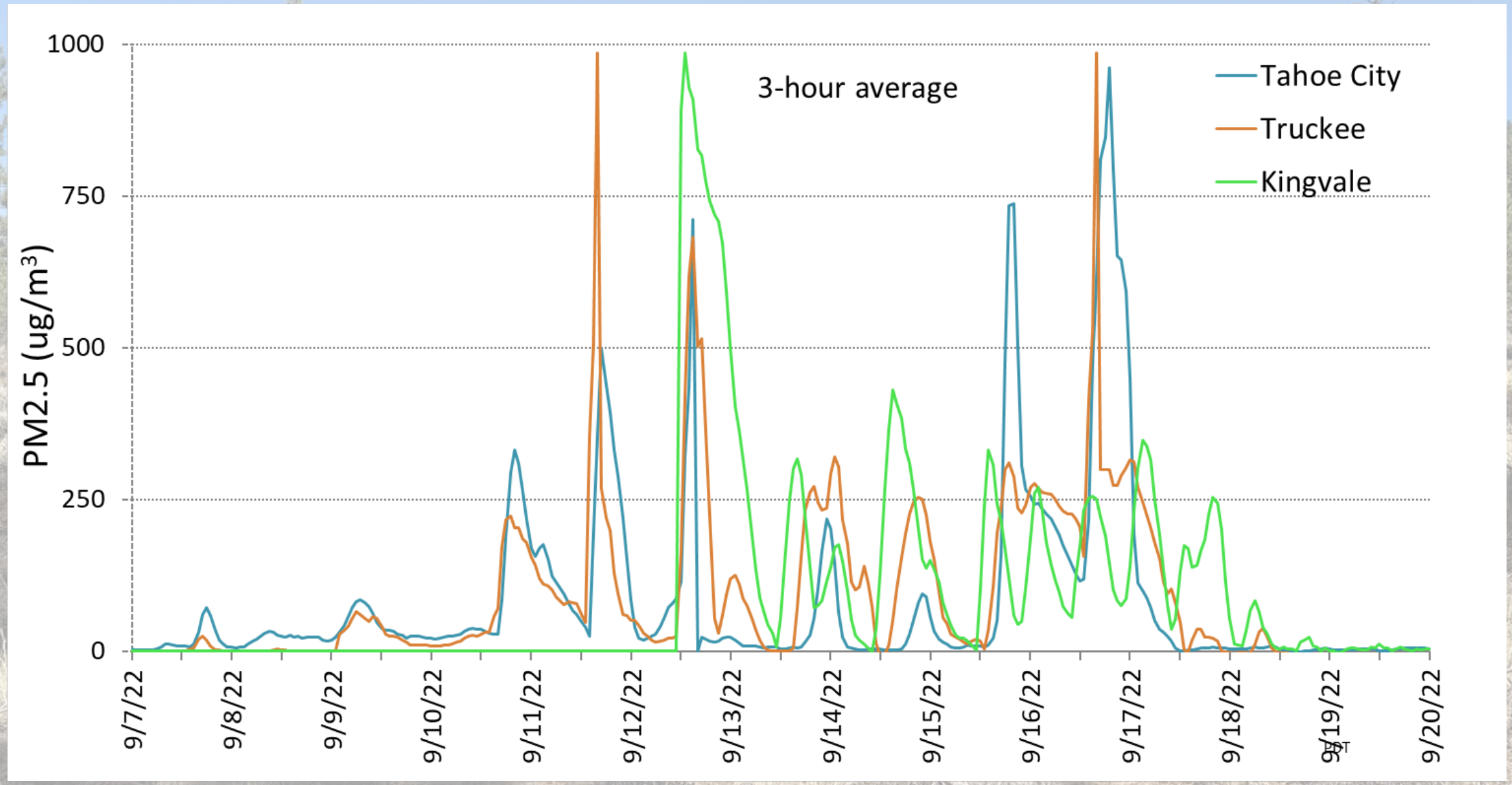
Air Quality Impact

King Fire, Placer County (2014)



Mosquito Wildfire Placer County (2022)

Ambient PM2.5 During Fire



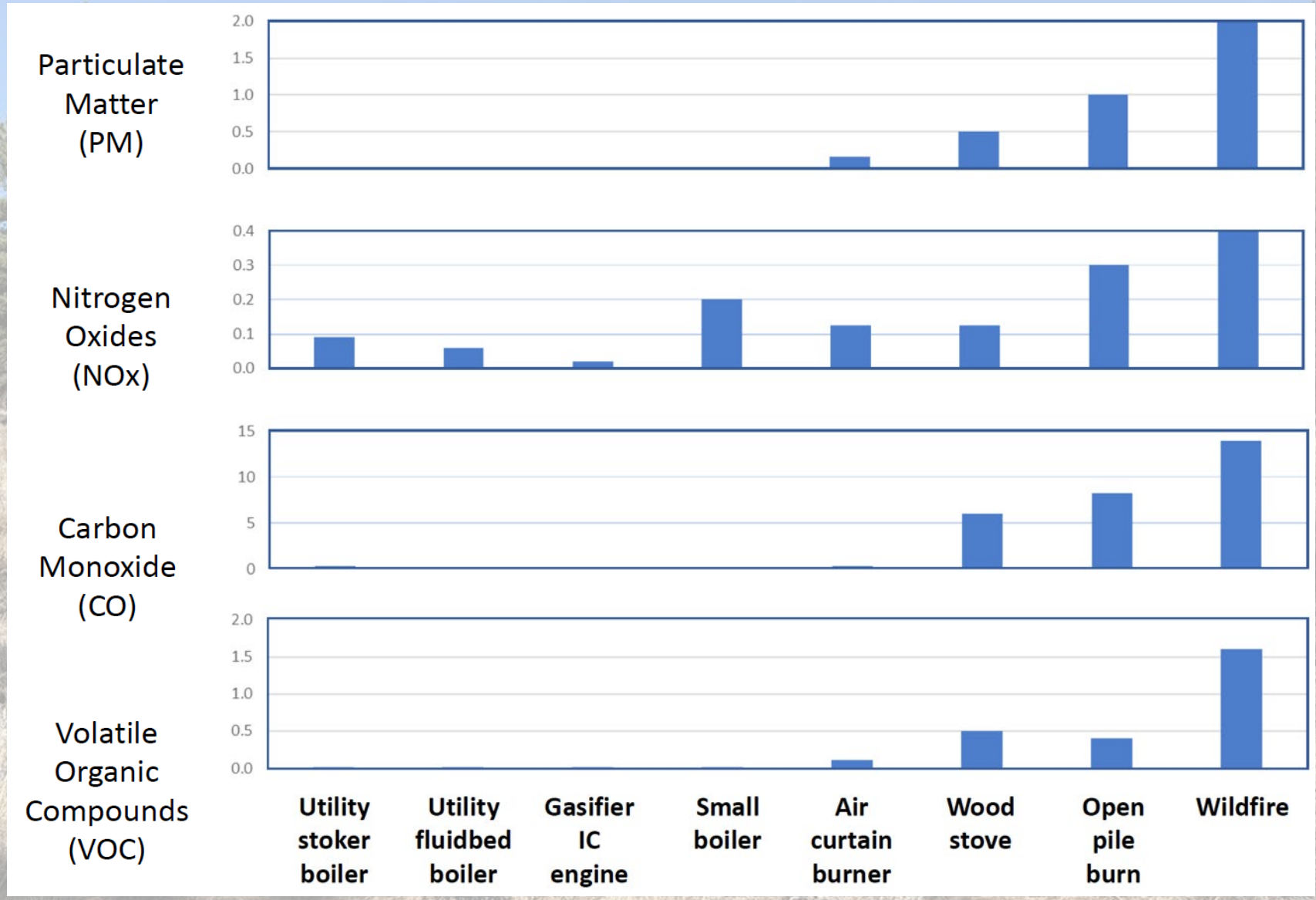
Criteria Air Pollutant Comparison

	VOC	NOx	PM10	PM2.5
	tons (x1,000)			
Mosquito Wildfire (approx. 14 days)	**44.0**	**2.2**	**29.6**	**26.6**
Placer County (all 2023)				
Total	**5.8**	**4.0**	**6.4**	**2.3**
Stationary				
Stationary	1.4	0.4	0.7	0.4
Area-wide	2.2	0.2	5.3	1.8
Mobile				
On-road	0.8	1.4	0.3	0.1
Off-road	1.3	1.9	0.1	0.1

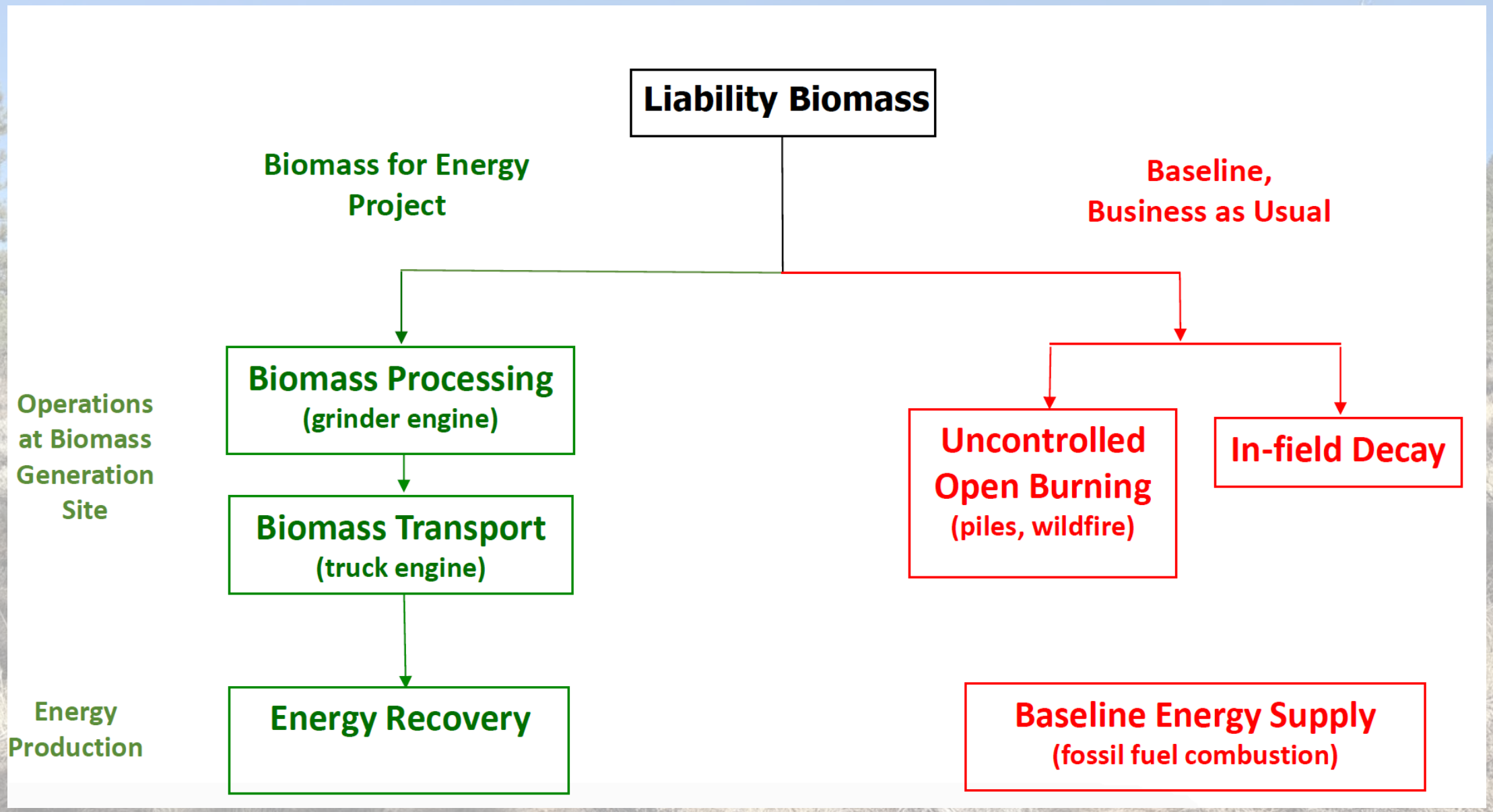
Greenhouse Gases Comparison

	CO_2e tons (x1,000,000)
Mosquito Wildfire	
Wildfire (approx. 14 days)	3.7
Post wildfire (many years)	2.1
Total	**5.8**
Placer County, 2020	**4.2**

Air Pollution from Biomass Burning



Emissions Accounting for Bioenergy System

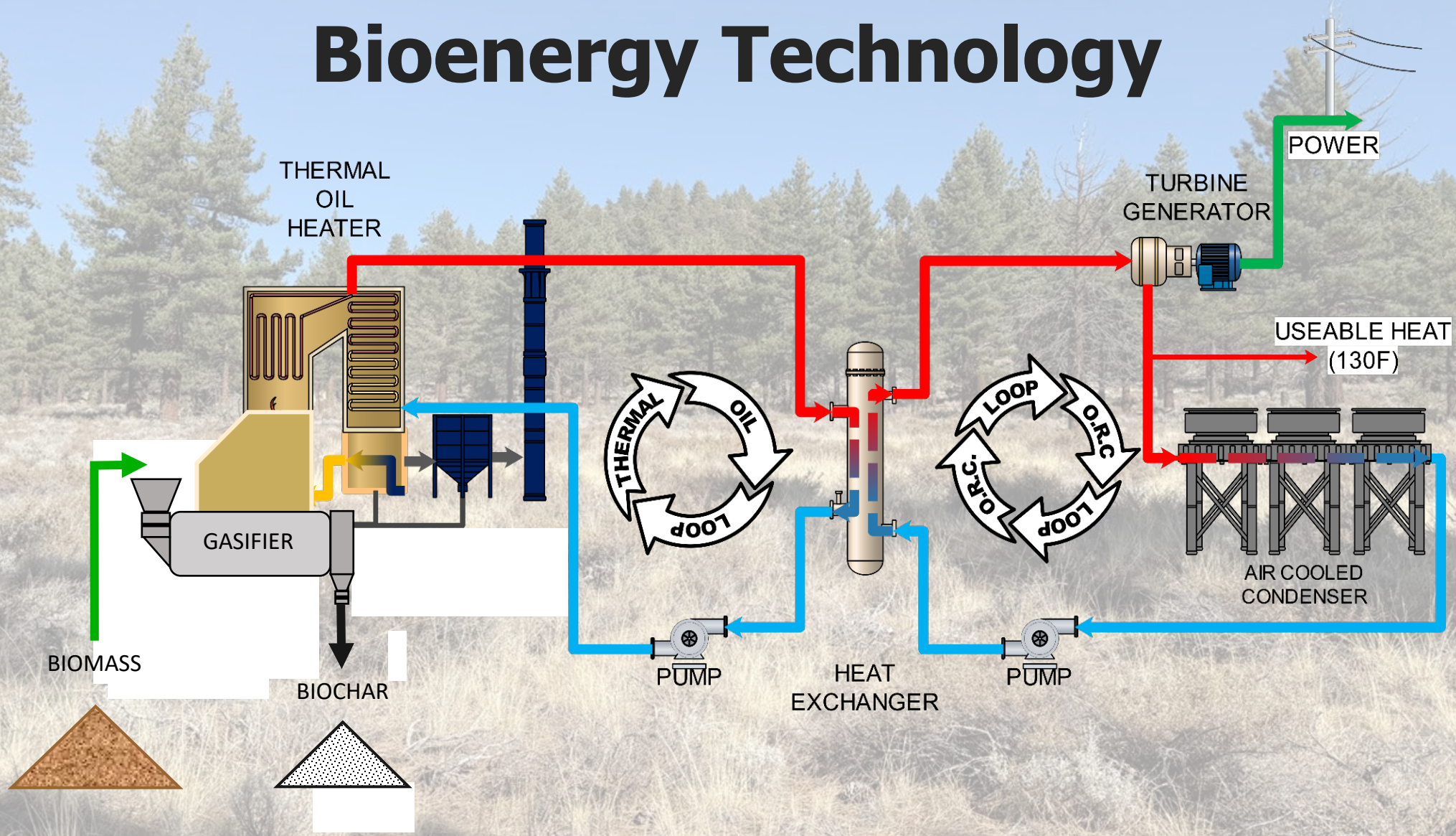


Open Pile Burning Alternative in the Mammoth Region

Pollutant	Annual emissions treating 7,000 acres (tons/yr.)	Annual emissions treating 12,000 acres (tons/yr.)	Non-biogenic (tons/yr.)	Total Project emissions (tons)	No Action Alternative wildfire burn emissions (tons)
CO	13,576	23,273	0.390	104,352	252,422
NO_x	117	200	0.298	924	2,381
VOCs	3,249	5,569	nil	25,244	74,609
SO_x	152	260	0.001	1,180	2,858
PM_{10}	2,477	4,247	0.002	19,279	59,483
$PM_{2.5}$	2,020	3,463	0.001	15,588	38,105
CO2e	194,370	333,205	107.1	1,520,586	3,807,177

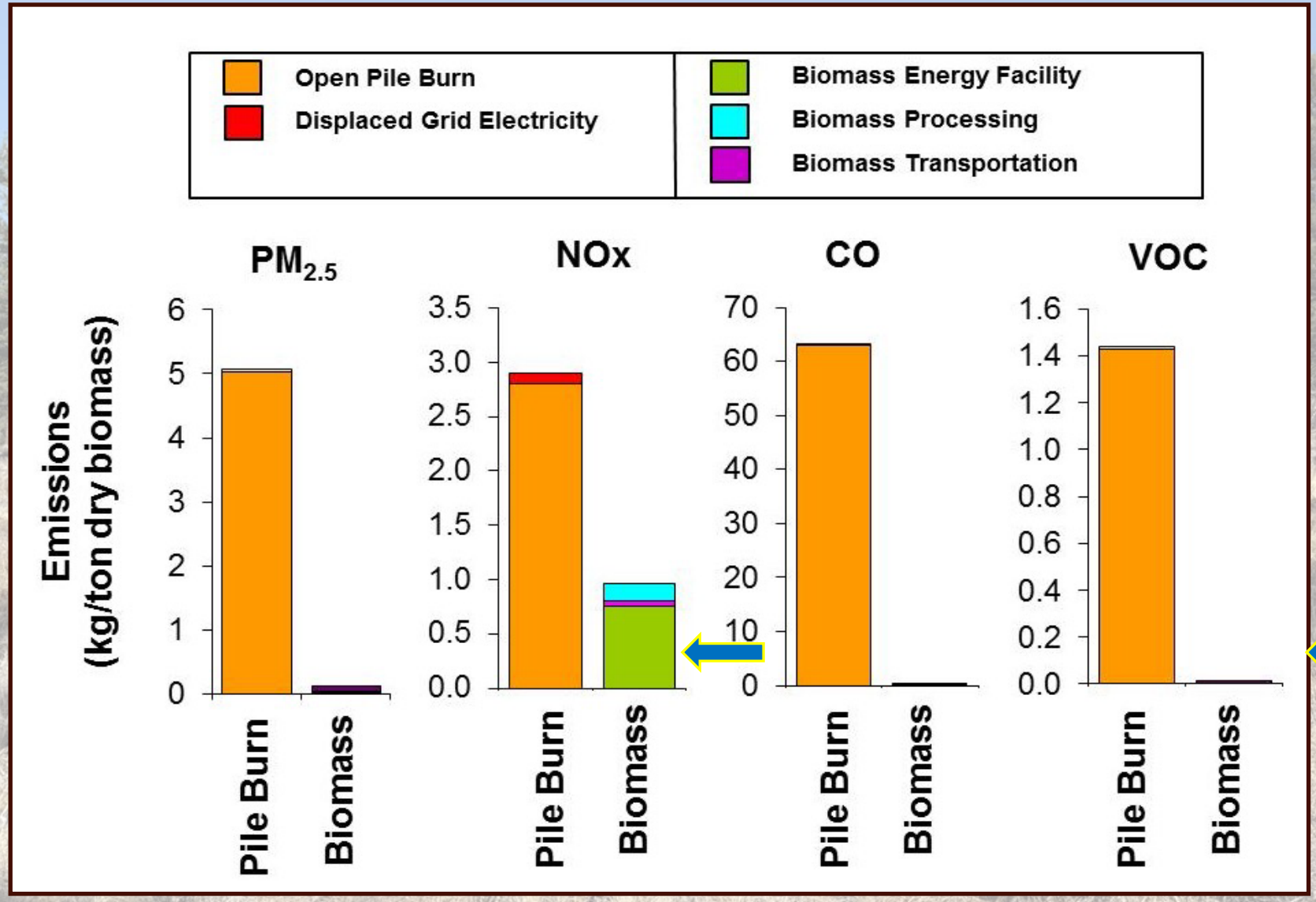
Table from the Air Quality Specialist Report for the ESCCRP Project EA Prepared for the Inyo National Forest, Mammoth District by Don Schweizer, USFS Air Resources Specialist.

State of the Art Bioenergy Technology



Open Pile Burn v. Bioenergy Controlled Environment

Biomass to Electricity reduces criteria air pollutants from both open burning and wildfire emissions



Graphic courtesy of Placer County Air Pollution Control District

Netting Analysis for a 3 MW Bioenergy Power Plant

Pollutant	Amount of fuel per year in BDT	Percentage forest sourced fuel	Percentage of fuel diverted from pile and burn	Amount of fuel diverted from pile and burn	Emission factor for pile and burn in lb/BDT*	TPY for pile and burn	Estimated controlled emission in TPY+	Amount of net emissions produced in TPY
NOx	30,000	95%	95%	27,075	7	94.8	25.0	-69.8
PM10	30,000	95%	95%	27,075	15	203.1	8.3	-194.7
VOC	30,000	95%	95%	27,075	24	324.9	8.3	-316.6

* Emission factor from "The Value of the Benefits of U.S. Biomass Power" National Renewable Energy Lab, November 1999, and "Emission Reductions form Woody Biomass Waste for Energy as an Alternative to Open Burning", Journal of the Air and Waste Management Association, Volume 61, January 2011

Air District Oversight

- Permit to Operate issued and enforced by Air District
- Emission limits
- Recordkeeping and reporting
- Monitoring
- Biomass fuel feedstock limitations
- Stack emissions source testing by independent contractor
- Unannounced inspections
- Health risk assessment
- Comply with state and federal requirements

Peer Reviewed Technical Journal Publications

Research Article

Forest biomass diversion in the Sierra Nevada: Energy, economics and emissions

by Bruce Springsteen, Thomas Christofk, Robert A. York, Tad Mason, Stephen Baker, Emily Lincoln, Bruce Hartsough *and* Takuyuki Yoshioka

As an alternative to open pile burning, use of forest wastes from fuel hazard reduction projects at Blodgett Forest Research Station for electricity production was shown to produce energy and emission benefits: energy (diesel fuel) expended for processing and transport was 2.5% of the biomass fuel (energy equivalent); based on measurements from a large pile burn, air emissions reductions were 98%–99% for $PM_{2.5}$, CO (carbon monoxide), NMOC (nonmethane organic compounds), CH_4 (methane) and BC (black carbon), and 20% for NOx and CO_2-equivalent greenhouse gases. Due to transport challenges and delays, delivered cost was $70 per bone dry ton (BDT) — comprised of collection and processing ($34/BDT) and transport ($36/BDT) for 79 miles one way — which exceeded the biomass plant gate price of $45/BDT. Under typical conditions, the break-even haul distance would be approximately 30 miles one way, with a collection and processing cost of $30/BDT and a transport cost of $16/BDT. Revenue generated from monetization of the reductions in air emissions has the potential to make forest fuel reduction projects more economically viable.

Large regions of Sierra Nevada mixed conifer forests are in need of hazardous fuels reduction treatments to reduce the risk of high severity wildfire and return forests to fire-resilient conditions. Whether as a complement or replacement to prescribed burning, it is highly desirable to increase the pace and scale of these treatments (North 2012; North et al. 2012). Significant quantities of woody biomass wastes are the unavoidable byproduct of these treatments.

Open pile burning in the forest is most commonly used to dispose of woody biomass waste, as fire hazard reduction objectives prevent leaving the material in-field to decompose, and because in many cases it is the most economically viable option. While woody biomass wastes represent a significant renewable energy resource, the cost to process and transport the material for use as fuel to produce electricity (or use for other value-added bioproducts such as biochar, biofuels, polymer precursors or thermal energy) often well-exceeds the combined value at the biomass electricity generation plant, the avoided cost to pile burn, and the potential value of nutrients returned to the soil (which is low due to the localized and limited pile burn location). A significant drawback of open pile burning is that it generates emissions of criteria air pollutants (particulate matter, carbon monoxide, volatile organic compounds and nitrogen oxides), greenhouse gases (GHGs) and air toxics such as polycyclic aromatic hydrocarbons and aldehydes.

The Placer County Air Pollution Control District sponsored — in cooperation with the UC Berkeley Center for Forestry, United States Forest Service (USFS) Rocky Mountain Research Station Missoula Fire Lab, and UC Davis Biological and Agricultural Engineering — a case study to quantify the energy, air quality and GHG benefits, as well as the economics, of utilizing woody biomass

Online: http://californiaagriculture.ucanr.edu/landingpage.cfm?article=ca.v069n03p142&fulltext=yes
doi: 10.3733/ca.v069n03p142

Contractor CTL Forest Management Inc. loads a chip van with woody biomass waste from the Yeti Fuels Reduction Project in the Lake Tahoe Basin Management Unit, Kings Beach, CA. A case study at Blodgett Forest Research Station quantified the air quality and energy benefits of converting biomass waste to electricity as an alternative to open pile burning in the forest.

https://research.fs.usda.gov/treesearch/52990

TECHNICAL PAPER

ISSN:1047-3289 *J. Air & Waste Manage. Assoc.* 61:63–68
DOI:10.3155/1047-3289.61.1.63

Emission Reductions from Woody Biomass Waste for Energy as an Alternative to Open Burning

Bruce Springsteen, Tom Christofk, and Steve Eubanks
Placer County Air Pollution Control District, Auburn, CA

Tad Mason and Chris Clavin
TSS Consultants, Rancho Cordova, CA

Brett Storey
Placer County Planning Department, Auburn, CA

ABSTRACT
Woody biomass waste is generated throughout California from forest management, hazardous fuel reduction, and agricultural operations. Open pile burning in the vicinity of generation is frequently the only economic disposal option. A framework is developed to quantify air emissions reductions for projects that alternatively utilize biomass waste as fuel for energy production. A demonstration project was conducted involving the grinding and 97-km one-way transport of 6096 bone-dry metric tons (BDT) of mixed conifer forest slash in the Sierra Nevada foothills for use as fuel in a biomass power cogeneration facility. Compared with the traditional open pile burning method of disposal for the forest harvest slash, utilization of the slash for fuel reduced particulate matter (PM) emissions by 98% (6 kg PM/BDT biomass), nitrogen oxides (NO_x) by 54% (1.6 kg NO_x/BDT), nonmethane volatile organics (NMOCs) by 99% (4.7 kg NMOCs/BDT), carbon monoxide (CO) by 97% (58 kg CO/BDT), and carbon dioxide equivalents (CO_2e) by 17% (0.38 t CO_2e/BDT). Emission contributions from biomass processing and transport operations are negligible. CO_2e benefits are dependent on the emission characteristics of the displaced marginal electricity supply. Monetization of emissions reductions will assist with fuel sourcing activities and the conduct of biomass energy projects.

INTRODUCTION
Woody biomass waste material is generated as a byproduct throughout Placer County portions of the Sacramento Valley, foothills, and Sierra Nevada mountains from forest management projects, defensible space clearing, tree trimming, construction/demolition activities, and agricultural operations.

Forest management projects that produce woody biomass byproducts (tree stems, tops, limbs and branches, and brush) include fuel hazard reduction, forest health and productivity improvement, and traditional commercial harvest. These projects take place on private land and lands managed by various public agencies including the U.S. Forest Service (USFS), Bureau of Land Management, and state/federal parks. Forest fuel hazard reduction activities involving selective, targeted thinning treatments are implemented to lessen wildfire severity and improve forest-fire resiliency through reducing hazardous fuel accumulations resulting from a century of successful wildfire suppression efforts. Commercial timber harvests include thinning to improve health and productivity, and intensive management to optimize the yield of merchantable material for lumber production.

Defensible space clearings and fuel breaks in an expanding wildland urban interface area, including residential and commercial structures, produce woody biomass that typically includes deciduous and coniferous trees and brush.

Agricultural operations such as fruit and nut orchards and grape vineyards are a source of biomass wastes from annual pruning and periodic removal and replacement with more productive varieties or growing stock.

Open burning (in piles or broadcast burning) near the site of generation is the usual method of disposal for a significant quantity of the excess woody waste biomass throughout much of the western United States. A forest slash pile burn in the Lake Tahoe Basin is shown in Figure 1. The cost to collect, process, and transport biomass waste is often higher than its value for fuel or wood products because of the distance of the forest treatment activity location from the end user (e.g., mill, biomass energy facility), lack of infrastructure, and/or economics of biomass energy compared with fossil fuel generation. This limits the feasibility of using biomass waste for energy production although such use has significant environmental benefits.

IMPLICATIONS
Economic considerations frequently dictate the disposal of woody biomass wastes by open burning. The alternative use for energy provides significant reduction in criteria air pollutant and greenhouse emissions. Valuing these reductions will improve the economic viability and increase the use of biomass for energy as well as assist with forest and agricultural management objectives.

https://pubmed.ncbi.nlm.nih.gov/21305889/