Section 7.1
Residential Wood Combustion
Plumas County Update

Revised July 2023

Emission Inventory Source Category
Miscellaneous Processes/Residential Fuel Combustion

Emission Inventory Codes (CES Codes) and Description
610-600-0230-0000 (82115) Residential Wood Combustion – Wood Stoves
610-602-0230-0000 (82123) Residential Wood Combustion – Fireplaces

I. Overview

This methodology is used to estimate criteria pollutant emissions from various types of residential wood combustion devices in Plumas County for the year 2020. This document contains emissions estimates for wood-burning fireplaces and wood stoves (which includes fireplace inserts and pellet stoves). This update reflects data specific for Plumas County and the Portola Nonattainment Area (NAA) provided by the Northern Sierra Air Quality Management District (District).

II. Background

The types of devices that burn wood in a typical residence are fireplaces, wood-burning stoves, fireplace inserts, and pellet stoves. The most common wood-burning device in a home is the fireplace. A fireplace is generally a masonry or prefabricated (metal) enclosure with the side facing the interior of the house left open and a chimney to exhaust the flue gas. The combustion air can be supplied from the outside air or from the inside air.

Wood stoves are enclosed stand-alone devices that vent exhaust gas through an existing chimney or flue. Wood stoves radiate heat from their exterior surfaces, and they are commonly used in residences as space heaters. They are used both as the primary source of residential heat and to supplement conventional heating systems. Wood stoves control burning or burn time by restricting the amount of air that can be used for combustion (U.S. EPA, 1996a). This methodology estimates emissions for four different types of wood stoves: (1) the conventional wood stove; (2) the non-catalytic wood stove; (3) the catalytic wood stove; and (4) the pellet stove.

Conventional wood stoves do not have any emission reduction technology or design features and, in most cases, were manufactured before July 1, 1986 (U.S. EPA, 1996a). Non-catalytic wood stoves do not contain catalysts, but they do have emission reducing technology or features. Older, non-catalytic wood stoves reduce emissions by directing unburned hydrocarbons and carbon monoxide (CO) into a secondary chamber, where mixing with fresh, preheated makeup air enhances further combustion (U.S. EPA, 1996a). Newer non-catalytic wood stoves have three internal characteristics that create a good environment for complete combustion: firebox insulation; a large baffle to produce a longer, hotter gas flow path; and pre-heated combustion air introduced through small holes above the fuel in the firebox. The baffle and some other internal parts of a non-catalytic stove need replacement periodically as they deteriorate with the high heat of efficient combustion (WHO, 2013).

Catalytic wood stoves are equipped with a ceramic or metal honeycomb device, called a combustor or converter that is coated with a noble metal such as platinum or palladium. The catalyst material reduces the ignition temperature of the unburned hydrocarbons and CO in the exhaust gases, which allows these pollutants to be burned at normal stove operating temperatures. As these pollutants burn, the temperature inside the catalyst increases to a point where the ignition of the gases is essentially self-sustaining (U.S. EPA, 1996a). All catalytic stoves have a lever-operated catalyst bypass damper which is opened for starting and reloading. The catalytic honeycomb degrades over time and must be replaced, but its durability is largely in the hands of the stove user. The catalyst can last more than six seasons if the stove is used properly, but if the stove is over-fired, garbage is burned and regular cleaning and maintenance are not done, the catalyst may break down in as little as two years (WHO, 2013).

Residential wood stoves are classified as conventional (also referred to as uncertified or Pre-Phase I) and certified. As of writing this document, there were several rounds of New Source Performance Standard for certifying wood burning devices (1988, 1990, 2015, and 2020). Some Pre-Phase I stoves may use older catalytic technology; however, for the purposes of this methodology, we make the conservative assumption that all Pre-Phase I stoves are conventional devices.

Fireplace inserts can be described as wood stoves that fit into the firebox of a fireplace. These devices are used to heat a house, or a portion of the house. Inserts are generally more effective at providing heat than a fireplace. They radiate the heat to the interior house space, or with the aid of a fan, circulate air around the insert and vent the heated air into the house. Since fireplace inserts share operating and combustion characteristics with wood stoves, the same emission factors are used for both fireplace inserts and wood stoves (HPBA, 2009a; U.S. EPA, 1996a; WHO, 2013).

Pellet stoves are fueled with pellets of sawdust, wood products, and other biomass materials pressed into manageable shapes and sizes. These stoves have active air flow systems and unique grate designs to accommodate pelleted fuel. Some pellet stove models are subject

to the 1988 New Source Performance Standards (NSPS), while others are exempt due to a high air-to-fuel ratio (i.e., greater than 35-to-1) (U.S. EPA, 1996a).

III. Emissions Estimation Method

For this revision based on 2020 occupied housing in Plumas County, the methodology for estimating emissions remained the same as the current statewide methodology, and the update reflects inclusion of data from the Greater Portola Wood Stove Change-Out Program (Program), specific to Plumas County and the Portola NAA. As part of the change-out program, the District offered incentives, up to the full cost of purchase and installation, to qualified residents of the Portola NAA using uncertified wood stoves or inserts as a primary source of heat. The Program collected data about the type and number of devices replaced in the NAA. These data are used to develop the residential wood burning emissions estimates for the Portola NAA. Emissions were estimated in three groups: a) Area outside the Portola NAA, b) emissions for devices updated in the Portola NAA, and c) the emissions of devices not updated within the Portola NAA.

A. Outside Portola Nonattainment Area

1. Wood-burning Fireplaces

a. Determine the number of wood-burning fireplaces that are actually used

Equation 1: $$FP_{all} = [H_{total}] * [P_{fp}] * [M_{fp}]$$

Where
FP_{all} = Number of fireplaces that are actually in use
H_{total} = Number of occupied housing units in the county outside the NAA
P_{fp} = Percent of homes with a fireplace
M_{fp} = Average number of fireplaces per home

Table below shows the values for the variables used in Equation 1.

H_{total} = Number of occupied housing units in Plumas County, not including the Nonattainment Area, 2020	5567[1]
P_{fp} = Percent of homes with a fireplace	64.2%[2]
M_{fp} = Average number of fireplaces per home	1.1[2]

[1] *2020 Census Data*
[2] *CARB Statewide Residential Fuel Combustion Methodology, Appendix A*

b. Determine the amount of wood burned in fireplaces

For fireplaces, we assume that three types of fuel are burned: (1) cord wood; (2) bundle wood; and (3) wax/sawdust manufactured logs (e.g., Duraflame, Pine Mountain, Hearthlog). Provided below are methods for estimating the consumption rates for the different fireplace fuels.

b.1 Fireplaces – Cord Wood & Bundle Wood

A standard cord of wood is defined as a stack of wood with a volume of 128 cubic feet (4 feet x 4 feet x 8 feet).

Bundle wood is typically purchased from a retail store, either packaged in a box or wrapped in plastic. Fireplaces burn cord wood and bundle wood for aesthetic purposes and for heating purposes. This methodology assumes wood consumption rates that include both cord wood and bundle wood. In addition, it is assumed that fireplaces burn more wood when they are used for heating purposes, as compared to aesthetic purposes (Houck, 2001a).

Provided below is a method to determine the percentage of fireplaces used for aesthetic and heating purposes, and the associated wood consumption rate for each of these uses. For fireplaces, the total amount of wood consumed is based on the number of individual fireplace units, rather than the number of homes that have fireplaces. This is done to maintain consistency with the units for the estimated consumption rate.

Equation 2: $$FP_{aes} = [FP_{all}] * \left[P_{fp,\text{cord}}\right] * [PF_{fp,aes}]$$

Equation 3: $$F_{aes} = [FP_{aes}] * \left[N_{\text{cord,aes}}\right] * [W_{cord}]$$

Where

FP_{aes} = Number of fireplaces being used primarily for aesthetic purposes
FP_{all} = Number of fireplaces that are actually in use
$P_{fp,cord}$ = Percent of fireplaces that burn cord wood
$P_{fp,aes}$ = Percent of fireplace use that is described as aesthetic
F_{aes} = Amount of cord wood burned in fireplaces for aesthetic purposes, tons wood/year
$N_{cord,aes}$ = Number of cords burned in fireplaces – aesthetics
W_{cord} = Weight of an average cord of wood

Equation 4: $$FP_{heat} = [FP_{all}] * \left[P_{fp,\text{cord}}\right] * [P_{fp,heat}]$$

Equation 5: $$F_{heat} = [FP_{heat}] * \left[N_{\text{cord,heat}}\right] * [W_{cord}]$$

Where

FP_{heat} = Number of fireplaces being used primarily for heating purposes
FP_{all} = Number of fireplaces that are actually in use
$P_{fp,heat}$ = Percent of fireplace use that is for heating purposes (non-aesthetic)
F_{heat} = Amount of cord wood burned in fireplaces for heating purposes, tons wood/year

$N_{cord,heat}$ = Number of cords burned in fireplaces – heating
W_{cord} = Weight of an average cord of wood

Table below shows values of variables for Equations 2-5.

$P_{fp,cord}$ = Percent of fireplaces that burn cord wood	88%[3]
$P_{fp,aes}$ = Percent of fireplace use that is described as aesthetic	59%[3]
$N_{cord,aes}$ = Number of cords burned in fireplaces – aesthetics	0.74[4] cord/fireplace/year
W_{cord} = Weight of an average cord of wood	1.54[4] tons/cord
$P_{fp,heat}$ = Percent of fireplace use that is for heating purposes (non-aesthetic)	41%[3]
$N_{cord,heat}$ = Number of cords burned in fireplaces – heating	4.3[4] cord/fireplace/year

b.2 Fireplaces - Manufactured Wax/Sawdust Logs

Manufactured Wax/Sawdust Logs (e.g., Duraflame, Pine Mountain, Hearthlog) are made from a mixture of sawdust, wax, and binders. Below is a method to determine the manufactured log consumption rate for fireplaces.

Equation 6: $$H_{fp,ml} = [H_{total}] * [P_{fp,u}] * [P_{fp,ml}]$$

Equation 7: $$F_{ml} = [H_{fp,ml}]/[H_{fp,ml,statewide\ total}] * [CA_{mfrd\ log\ sales}]$$

Where
$H_{fp,ml}$ = Number of homes with fireplaces that primarily burn manufactured logs
H_{total} = Number of occupied housing units in the county, not including the NAA
$P_{fp,u}$ = Percent of homes with a fireplace that was actually used during the burn season
$P_{fp,ml}$ = Percent of active fireplaces that primarily burn manufactured logs
F_{ml} = Amount of manufactured logs burned in fireplaces, tons/year
$H_{fp,ml}$ = Number of homes with fireplaces that primarily burn manufactured logs
$H_{fp,ml,statewide\ total}$ = Statewide total for all homes with fireplaces that primarily burn manufactured logs
$CA_{mfrd\ log\ sales}$ = Total sales of manufactured logs in California, tons/year

Table[5] below contains the variables used in Equations 6-7.

[3] *CARB Statewide Residential Fuel Combustion Methodology, Appendix A*
[4] *Wood Stove Change-Out Program Data collected for Portola NAA*
[5] *CARB Statewide Residential Fuel Combustion Methodology, Appendix A*

$H_{fp,ml}$ = Number of homes with fireplaces that primarily burn manufactured logs	12%
$H_{fp,ml,statewide\ total}$ = Statewide total for all homes with fireplaces that primarily burn manufactured logs	372,371
$CA_{mfrd\ log\ sales}$ = Total sales of manufactured logs in California, tons/year	60,825

2. Wood Stoves

a. Determine the number of homes with wood stoves that are actually used

Equation 8: $$H_{w,u} = [H_{total}] * [P_{w,u}]$$

Where
$H_{w,u}$ = Number of homes with wood stoves that are actually in use
H_{total} = Number of occupied housing units in the county
$P_{w,u}$ = Percent of homes with a wood stove that was actually used during the burn season

Table[5] below contains the values used in Equation 8.

H_{total} = Number of occupied housing units in Plumas County, not including the Nonattainment Area, 2020	5567
Pw,u = Percent of homes with a wood stove that was actually used during the burn season	28%

b. Determine the amount of wood burned in wood stoves

For wood stoves, we assume that only cord wood is burned, because survey data indicate that wood stove owners do not purchase bundles of wood (OMNI, 2003). In addition, wax/sawdust manufactured logs are not recommended for use in wood stoves (HPBA, 2009b). There are three types of wood stoves that are addressed in this methodology:

(1) Conventional Wood Stoves

(2) Certified Catalytic Wood Stoves

(3) Certified Non-Catalytic Wood Stoves

Provided below are methods for estimating the consumption rates for wood stoves.

b.1 Wood Stoves – Cord Wood

This methodology assumes that all wood stoves in use burn cord wood. In addition, it is assumed that wood stoves are used for heating purposes only. Provided below is a method to determine the cord wood consumption rate for wood stoves.

b.1.1 Total Cord Wood Consumption for All Wood Stoves

Equation 9: $$F_w = \left[H_{w,u}\right] * [N_{\text{cord}}] * [W_{cord}]$$

Where

F_w = Total amount of cord wood burned in wood stoves, tons wood/year
$H_{w,u}$ = Number of homes with wood stoves that are actually in use
N_{cord} = Number of cords burned in wood stoves, cords/home/year
W_{cord} = Weight of an average cord of wood

b.1.2 Cord Wood Consumption for Conventional Non-Catalytic Wood Stoves

Equation 10: $$F_{w,con} = [F_w] * \left[100\% - P_{\text{ph}}\right]$$

Where

$F_{w,ncat}$ = Amount of cord wood burned in conventional wood stoves, tons wood/year
F_w = Total amount of cord wood burned in wood stoves, tons wood/year
P_{ph} = Percent of wood stoves that are EPA certified

Note: It is assumed that all wood stoves purchased prior to 1 July 1990 are conventional non-catalytic units and all wood stoves purchased on or after 1 July 1990 are EPA-certified units (catalytic and non-catalytic). Therefore, the estimated percentage of conventional wood stoves is [100% - P_{ph}].

b.1.3 Cord Wood Consumption for Certified Catalytic Wood Stoves

Equation 11: $$F_{w,cat} = [F_w] * \left[P_{\text{ph}}\right] * [P_{\text{c}}]$$

Where

$F_{w,cat}$ = Amount of cord wood burned in certified catalytic wood stoves, tons wood/year
F_w = Total amount of cord wood burned in wood stoves, tons wood/year
P_{ph} = Percent of wood stoves that are EPA certified
P_c = Percent of wood stoves that are catalytic

Note: It is assumed that all wood stoves purchased prior to 1 July 1990 were conventional non-catalytic units. Therefore, the percentage of catalytic wood stoves was only applied to certified wood stoves purchased on or after 1 July 1990.

b.1.4 Cord Wood Consumption for Certified Non-Catalytic Wood Stoves

Equation 12: $$F_{w,ncat} = [F_w] * [P_{\text{ph}}] * [100\% - P_c]$$

Where

$F_{w,ncat}$ = Amount of cord wood burned in certified non-catalytic wood stoves, tons wood/year
F_w = Total amount of cord wood burned in wood stoves, tons wood/year
P_{ph} = Percent of wood stoves that are EPA certified
P_c = Percent of wood stoves that are catalytic

Table below contains the values for Equation 9-12.

Ncord = Number of cords burned in wood stoves, cords/home/year	4.3[6] cords/home/year
P_{ph} = Percent of wood stoves that are EPA certified	46%[7]
P_c = Percent of wood stoves that are catalytic	24%[7]
W_{cord} = Weight of an average cord of wood	1.54[6] tons/cord

3. Fireplace Inserts

a. Determine the number of homes with fireplace inserts that are actually used

Equation 13: $$H_{fi,u} = [H_{total}] * [P_{fi,u}]$$

Where
$H_{fi,u}$ = Number of homes with fireplace inserts that are actually in use
H_{total} = Number of occupied housing units in the county, not including the NAA
$P_{fi,u}$ = Percent of homes with a fireplace insert that was actually used during the burn season

[6] *Wood Stove Change-Out Program Data collected for Portola NAA*
[7] *CARB Statewide Residential Fuel Combustion Methodology, Appendix A*

b. Determine the amount of wood burned in fireplace inserts.

For fireplace inserts, we assume that three types of fuel are primarily burned: (1) cord wood; (2) bundle wood; and (3) compressed sawdust logs which are 100% sawdust and wood shavings with no wax or binders (e.g., Pres-to Logs, Eco-Logs, etc.).

Similar to wood stoves, there are three types of fireplace inserts that are addressed in this methodology:

(1) Conventional Fireplace Inserts

(2) Certified Catalytic Fireplace Inserts

(3) Certified Non-Catalytic Fireplace Inserts

Emissions for fireplace inserts are reported under EIC 610-600-0230-0000, the general wood stove category. Provided below are methods for estimating the consumption rates for fireplace inserts.

b.1 Fireplace Inserts - Cord Wood

This methodology assumes that fireplace inserts burn cord wood for heating purposes only. Provided below is a method to determine the cord wood consumption rate for fireplace inserts.

b.1.1 Total Cord Wood Consumption for All Fireplace Inserts

Equation 14: $$F_{fi,cord} = \left[H_{fi,u}\right] * \left[N_{\text{cord,i}}\right] * \left[W_{\text{cord}}\right]$$

Where

$F_{fi,cord}$ = Total amount of cord wood burned in fireplace inserts, tons wood/year
$H_{fi,u}$ = Number of homes with fireplace inserts that are actually in use
$N_{cord,i}$ = Number of cords burned in fireplace inserts, cords/home/year
W_{cord} = Weight of an average cord of wood

b.1.2 Cord Wood Consumption for Conventional Non-Catalytic Fireplace Inserts

Equation 15: $$F_{fi,con} = \left[F_{fi,cord}\right] * \left[100\% - P_{\text{ph}}\right]$$

Where

$F_{fi,con}$ = Amount of cord wood burned in conventional fireplace inserts, tons wood/year
$F_{fi,cord}$ = Total amount of cord wood burned in fireplace inserts, tons wood/year
P_{ph} = Percent of fireplace inserts that are EPA certified

Note: It is assumed that all fireplace inserts purchased prior to 1 July 1990 are conventional non-catalytic units and all fireplace inserts purchased on or after 1 July

1990 are EPA-certified units (catalytic and non-catalytic). Therefore, the estimated percentage of conventional fireplace inserts is [100% - P_{ph}].

b.1.3 Cord Wood Consumption for Certified Catalytic Fireplace Inserts

Equation 16: $$F_{fi,cat} = [F_{fi,cord}] * [P_{ph}] * [P_c]$$

Where

$F_{fi,cat}$ = Amount of cord wood burned in certified catalytic fireplace inserts, tons wood/year
$F_{fi,cord}$ = Total amount of cord wood burned in fireplace inserts, tons wood/year
P_{ph} = Percent of fireplace inserts that are EPA certified
P_c = Percent of fireplace inserts that are catalytic

Note: It is assumed that all fireplace inserts purchased prior to 1 July 1990 were conventional non-catalytic units. Therefore, the percentage of catalytic fireplace inserts was only applied to certified fireplace inserts purchased on or after 1 July 1990.

b.1.4 Cord Wood Consumption for Certified Non-Catalytic Fireplace Inserts

Equation 17: $$F_{fi,ncat} = [F_{fi,cord}] * [P_{ph}] * [100\% - P_c]$$

Where

$F_{fi,ncat}$ = Amount of cord wood burned in certified non-catalytic fireplace inserts, tons wood/year

$F_{fi,cord}$ = Total amount of cord wood burned in fireplace inserts, tons wood/year
P_{ph} = Percent of fireplace inserts that are certified (i.e., purchased after 1 July 1990)
P_c = Percent of fireplace inserts that are catalytic

Table below contains the variables used in Equations 13-17.

$P_{fi,u}$ = Percent of homes with a fireplace insert that was actually used during the burn season	6.3%[8]
N_{cord} = Number of cords burned in fireplace inserts, cords/home/year	4.3[9]

[8] *CARB Statewide Residential Fuel Combustion Methodology, Appendix A*
[9] *Wood Stove Change-Out Program Data collected for Portola NAA*

P_{ph} = Percent of fireplace inserts that are EPA certified	46%[8]
P_c = Percent of fireplace inserts that are catalytic	31%[8]
W_{cord} = Weight of an average cord of wood	1.54[9] tons/cord

b.2 Fireplace Inserts - Bundle Wood

Bundle wood is typically purchased from a retail store, either packaged in a box or wrapped in plastic. Depending on the type of survey data available, bundle wood may be included with cord wood, or it may be broken out separately. This methodology assumes that 9.4% of fireplaces burn bundle wood in addition to cord wood, based on average survey results (OMNI, 2003). However, this percentage may change if more detailed usage data are available. Average survey results may also be used to estimate the average consumption rate for bundles of wood (OMNI, 2003). Provided below is a method to determine the bundle wood consumption rate for fireplace inserts.

b.2.1 Total Bundle Wood Consumption for All Fireplace Inserts

Equation 18: $$F_{fi,bundle} = [H_{fi,u}] * [P_{\text{fi,bundle}}] * [N_{\text{bundle}}] * [W_{\text{bundle}}]$$

Where

$F_{fi,bundle}$ = Amount of bundle wood burned in fireplace inserts, tons wood/year
$H_{fi,u}$ = Number of homes with fireplace inserts that are actually in use
$P_{fi,bundle}$ = Percent of fireplace inserts that burn bundle wood
N_{bundle} = Number of bundles burned in fireplaces, bundles/home/year
W_{bundle} = Weight of an average bundle of wood

b.2.2 Bundle Wood Consumption for Conventional Non-Catalytic Fireplace Inserts

Equation 19: $$F_{fi,con,b} = [F_{fi,bundle}] * [100\% - P_{\text{ph}}]$$

Where

$F_{fi,con,b}$ = Amount of bundle wood burned in conventional fireplace inserts, tons wood/year
$F_{fi,bundle}$ = Total amount of bundle wood burned in fireplace inserts, tons wood/year
P_{ph} = Percent of fireplace inserts that are EPA certified

Note: It is assumed that all fireplace inserts purchased prior to 1 July 1990 are conventional non-catalytic units and all fireplace inserts purchased on or after 1 July

1990 are EPA-certified units (catalytic and non-catalytic). Therefore, the estimated percentage of conventional fireplace inserts is [100% - P_{ph}].

b.2.3 Bundle Wood Consumption for certified Catalytic Fireplace Inserts

Equation 20: $$F_{fi,cat,b} = [F_{fi,bundle}] * [P_{ph}] * [P_c]$$

Where

$F_{fi,cat,b}$ = Amount of bundle wood burned in EPA certified catalytic fireplace inserts, tons wood/year
$F_{fi,bundle}$ = Total amount of bundle wood burned in fireplace inserts, tons wood/year
P_{ph} = Percent of fireplace inserts that are EPA certified
P_c = Percent of fireplace inserts that are catalytic

Note: It is assumed that all fireplace inserts purchased prior to 1 July 1990 were conventional non-catalytic units. Therefore, the percentage of catalytic fireplace inserts was only applied to certified fireplace inserts purchased on or after 1 July 1990.

b.2.4 Bundle Wood Consumption for Certified Non-Catalytic Fireplace Inserts

Equation 21: $$F_{fi,ncat,b} = [F_{fi,bundle}] * [P_{ph}] * [100\% - P_c]$$

Where

$F_{fi,ncat,b}$ = Amount of bundle wood burned in EPA certified non-catalytic fireplace inserts, tons wood/year
$F_{fi,bundle}$ = Total amount of bundle wood burned in fireplace inserts, tons wood/year
P_{ph} = Percent of fireplace inserts that are EPA certified
P_c = Percent of fireplace inserts that are catalytic

Table[10] below contains values for the variables used in Equation 18-21.

$P_{fi,bundle}$ = Percent of fireplace inserts that burn bundle wood	9.4%
N_{bundle} = Number of bundles burned in fireplaces	2.2 bundles/home/year
W_{bundle} = Weight of an average bundle of wood	0.024 ton/bundle
P_{ph} = Percent of fireplace inserts that are EPA certified	46%
P_c = Percent of fireplace inserts that are catalytic	31%

[10] *CARB Statewide Residential Fuel Combustion Methodology, Appendix A*

Emissions for each device type is calculated using the following equation:

Equation 22: $$E_{device} = (EF_{device} \times F_{device})/2000$$

Where

E_{device} = Emissions of device, tons/year
EF_{device} = Emission Factor for device, lbs/tons of wood burned
F_{device} = Amount of wood burned, tons of wood burned/year

The emission factors in lbs/tons of wood burned (NEI 2020, USEPA Wagon Wheel) for each pollutant, device, and, fuel type are shown in the table below.

Device Description	**Fuel Type**	**CO**	**NO_X**	**$PM_{2.5}$**	**SO_2**	**ROG/VOC**	**NH_3**
Fireplace	Cord Wood, Bundles	149	2.6	22.7	0.4	18.9	1.8
Fireplace	Manufactured Log	137	6.5	46.4	4.2	33.8	0.004
Woodstove - Conventional	Cord Wood	230.8	2.8	29.5	0.4	53	1.7
Woodstove – Certified Non-Catalytic	Cord Wood	140.8	2.28	14.1	0.4	12	0.9
Woodstove – Certified Catalytic	Cord Wood	104.4	2	19.6	0.4	15	0.9
Fireplace Inserts - Conventional	Cord Wood, Bundles	230.8	2.8	29.5	0.4	53	1.7
Fireplace Inserts - Certified Non-Catalytic	Cord Wood, Bundles	140.8	2.28	14.1	0.4	12	0.9
Fireplace Inserts - Certified Catalytic	Cord Wood, Bundles	104.4	2	19.6	0.4	15	0.9

Below is a description of the pollutants used in the table above and later in this report.

Pollutant	Description
CO	Carbon Monoxide
NO_X	Oxides of Nitrogen
$PM_{2.5}$	Particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
PM_{10}	Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
PM	Total Particulate Matter
SO_x	Oxides of Sulfur
SO_2	Sulfur Dioxide
TOG	Total Organic Gases
ROG	Reactive Organic Gases
VOC	Volatile Organic Carbon
NH_3	Ammonia

B. Portola Nonattainment Area

Emissions for the Portola NAA are calculated based on information specific to the area. Devices that burn wood in the Portola NAA consist of fireplaces, woodstoves, and pellet stoves. Estimates of the amount of wood burned for each device category is provided below. Emissions for the NAA are calculated in two steps: 1) emission calculations for devices that were upgraded during the change-out program and 2) emission calculations for those devices that were not replaced.

1. Emissions for Upgraded Devices in Portola NAA

The District worked on replacing uncertified wood stoves with cleaner burning and more efficient home heating devices in the Portola NAA. Table below provides a summary of the new upgraded and installed devices through 2019. These devices replaced 340 uncertified wood stoves and 24 fireplaces that makes the total installations as of 12/31/2019 to be 364.

Table below show the breakdown of the newly installed devices as part of the change-out program.

Device Type	Number of Devices
Non-Catalytic Stoves	229
Catalytic Stoves	68
Catalytic/Non-Catalytic Stoves (Hybrid)	6
Pellet Stoves	43
Propane/Kerosene Stoves	18

The following formula was used to estimate emissions for the new devices.

Equation 23: $$E_d = (EF_{new} \times WU \times WD \times [EFC_{old}/EFC_{new}])/2000$$

Where

E_d = Emission of new device
EF_{new} = Emission factor for new device
WU = Wood usage
WD = Wood density
EFC_{old} = Old uncertified stove efficiency
EFC_{new} = New certified stove efficiency

Table[11] below contains the variables used in Equation 23.

WU = Wood usage	4.3 cords/household/year
WD = Wood Density	1.54 tons/cord
EFC_{old} = Old uncertified stove efficiency	54%
EFC_{new} = New certified stove efficiency	68%

Emissions factors in lbs/tons of wood burned (NEI 2020 USEPA Wagon Wheel and change-out Program data) for every pollutant and device type are shown in Table below. Please

[11] *Wood Stove Change-Out Program Data collected for Portola NAA*

note that the $PM_{2.5}$ emission factors are based on change-out program data provided in Appendix A below.

Device Type	CO	NO_x	$PM_{2.5}$	SO_x	ROG/VOC	NH_3
Catalytic Wood Stove	92.3	2	See Appendix A	0.4	15	0.67
Non-Catalytic Wood Stove	122.6	1.69	See Appendix A	0.4	12	0.67
Hybrid Wood Stove	122.6	1.69	See Appendix A	0.4	12	0.67
Pellet Stove	15.9	3.8	See Appendix A	0.32	0.04	0.3

2. Emissions for Devices Not Replaced in Portola

Emissions from this category includes those devices in the Portola NAA that were not upgraded through the change-out program. These devices include: (1) Wood Stoves, (2) Fireplaces, and (3) Pellet Stoves. Prior to the device change-out program the District gathered information about the types of devices used in the NAA. See below tables for the *change-out Program data* from the District.

Table below shows the household data from the change-out program.

Occupied homes in Portola NAA, 2020	2765
Percent of households using wood as heating fuel	57
Households using wood as heating fuel in Portola NAA	1576

Table[12] below shows the breakdown by device type before the change-out program.

[12] *Wood Stove Change-Out Program Data collected for Portola NAA*

Device Type	Percent	Number of Devices (Multiply by 1.1 to account for multiple devices in household)
Woodstoves/Fireplace Inserts	88%	1526
Noncertified/Unknown	*53%*	809
EPA Certified	*47%*	717
Fireplaces used for heating	9%	156
Pellet Stoves	3%	47

Since emissions for 2020 will include both new devices installed as well as the devices that were not upgraded, the 364 upgraded devices will be subtracted out from the information above leaving the new device count for 2020 as follows[12]:

Device Type	Devices Replaced during Program	Devices Not Replaced
Woodstoves/Fireplace Inserts		1186
Noncertified/Unknown	340	469
EPA Certified		717
Fireplaces used for heating	24	132
Pellet Stoves		47

Provided below are the methods used for estimating the wood consumption rates and emissions for each device type.

a. Woodstoves/Fireplace Inserts

Woodstoves and fireplace inserts are broken down into three categories (1) conventional/noncertified, (2) certified catalytic, and (3) certified non-catalytic. The method for determining wood usage for each category is shown below.

a.1 Conventional/Noncertified Woodstoves

Equation 24: $$WU_{w,conv} = \left[N_{w,conv}\right] * [N_{\text{cord}}] * [W_{cord}]$$

Where

$WU_{w,conv}$ = Wood usage for conventional/noncertified woodstove, tons/year
$N_{w,conv}$ = Number of conventional/noncertified woodstoves
N_{cord} = Number of cords burned
W_{cord} = Weight of average cord

a.2 Certified Catalytic Woodstoves

Equation 25: $$WU_{w,cat} = [N_{w,cat}] * [N_{\text{cord}}] * [W_{cord}] * [P_{w,cat}]$$

Where

$WU_{w,cat}$ = Wood usage for certified catalytic woodstove, tons/year
$N_{w,cat}$ = Number certified catalytic woodstoves
N_{cord} = Number of cords burned
W_{cord} = Weight of average cord
$P_{w,cat}$ = Percent of certified catalytic woodstoves for region

a.3 Certified Non-Catalytic Woodstoves

Equation 26: $$WU_{w,nc} = [N_{w,nc}] * [N_{\text{cord}}] * [W_{cord}] * [P_{w,nc}]$$

Where

$WU_{w,nc}$ = Wood usage for certified non-catalytic woodstove, tons/year
$N_{w,nc}$ = Number certified non-catalytic woodstoves
N_{cord} = Number of cords burned
W_{cord} = Weight of average cord
$P_{w,nc}$ = Percent of certified non-catalytic woodstoves for region

b. Fireplaces

Equation 27: $$WU_f = [N_f] * [N_{\text{cord}}] * [W_{cord}]$$

Where

WU_f = Wood usage for fireplaces, tons/year
N_f = Number of fireplaces
N_{cord} = Number of cords burned
W_{cord} = Weight of average cord

c. Pellet Stoves

Equation 28: $$WU_{pellet} = [N_{pellet}] * [W_{pellets}]$$

Where

WU_{pellet} = Wood usage for pellet stoves, tons/year
N_{pellet} = Number of pellet stoves
$W_{pellets}$ = Amount of pellets burned per year per household

Table[13] below contains the variables used in Equations 24-28.

N_{cord} = Number of cords burned	4.3 cords/home/year
W_{cord} = Weight of average cord	1.54 tons/cord
$P_{w,nc}$ = Percent of certified non-catalytic woodstoves for region	76%
$P_{w,cat}$ = Percent of certified catalytic woodstoves for region	24%
$W_{pellets}$ = Amount of pellets burned per year per household	3 tons/home/yr

Emissions factors in lbs/tons of wood burned (NEI 2020 USEPA Wagon Wheel) for each pollutant and device type are shown in Table below.

Device type	**CO**	**NO_x**	**$PM_{2.5}$**	**SO_x**	**ROG/VOC**	**NH_3**
Conventional/Uncertified Woodstoves	230.80	2.80	29.50	0.40	53.00	1.70
Certified Catalytic Wood Stove	92.30	2.00	19.60	0.40	15.00	0.67
Certified Non-Catalytic Wood Stove	122.60	1.69	14.10	0.40	12.00	0.67
Fireplaces	149.00	2.6	22.7	0.40	18.9	1.8
Pellet Stove	15.90	3.8	2.9	0.32	0.04	0.30

[13] *Wood Stove Change-Out Program Data collected for Portola NAA*

IV. Emissions Estimates

Below is a summary of the emissions estimates following the methods outlined in the previous.

A. Emissions estimates for Outside Portola NAA

2020 Emissions estimates for outside the Portola Nonattainment Area in tons per year.

Device Description	**Fuel Type**	**Fuel Burned, tons/year**	**CO**	**NO_X**	**$PM_{2.5}$**	**SO_2**	**ROG/VOC**	**NH_3**
Fireplace	Cord Wood, Bundles	11719	873	15	133	2	111	11
Fireplace	Manufactured Log	70.1	5	0	2	0	1	0
Woodstove, Conventional	Cord Wood	5574	643	8	82	1	148	5
Woodstove, Certified Non-Catalytic	Cord Wood	3609	254	4	25	1	22	2
Woodstove, Certified Catalytic	Cord Wood	1140	59	1	11	0	9	1
Fireplace Inserts, Conventional	Cord Wood, Bundles	1255	145	2	19	0	33	1
Fireplace Inserts, Certified Non-Catalytic	Cord Wood, Bundles	738	52	1	5	0	4	0
Fireplace Inserts, Certified Catalytic	Cord Wood, Bundles	331	17	0	3	0	2	0

B. Emissions estimates for Portola NAA

2020 Emissions estimates for new installed devices in Portola NAA in tons per year.

Device Description	Fuel Type	Fuel Burned, tons/year	CO	NO_X	$PM_{2.5}$	SO_2	ROG/VOC	NH_3
Woodstove, Certified Catalytic	Cord Wood	450	16.50	0.36	0.56	0.07	2.68	0.12
Woodstove, Certified Non-Catalytic	Cord Wood	1516	73.82	1.02	4.01	0.24	7.23	0.40
Woodstove, Certified Hybrid	Cord Wood	40	1.93	0.03	0.02	0.006	0.19	0.01
Pellet Stove	Pellets	129	0.81	0.19	0.20	0.02	0.002	0.02

2020 Emissions estimates for devices that weren't replaced in the Portola NAA in tons per year.

Device Description	Fuel Type	Fuel Burned, tons/year	CO	NO_X	$PM_{2.5}$	SO_2	ROG/VOC	NH_3
Fireplace	Cord Wood, Bundles	874.3	65	1	10	0	8	1
Woodstove - Conventional	Cord Wood	3103	358	4	46	1	82	3
Woodstove - Certified Non-Catalytic	Cord Wood	3609	221	3	25	1	22	1
Woodstove - Certified Catalytic	Cord Wood	1140	53	1	11	0	9	0
Pellet Stove	Pellets	142	1	0	0	0	0	0

C. Emissions estimates by EIC for Plumas County

2020 Emissions summary by EIC for Plumas County in tons per year.

Source	EIC	CO	NO_X	$PM_{2.5}$	SO_2	ROG/VOC	NH_3
Woodstoves	610-600-0230-0000	1897	26	233	4	341	13
Fireplaces	610-602-0230-0000	943	17	145	3	120	11

Emissions for PM, PM_{10}, and TOG are speciated from $PM_{2.5}$ and ROG/VOC according to *CARB's Speciation Profile 424*.

V. Acronyms and Glossary

CO	Carbon Monoxide
EF	Emission Factor
EIC	Emission Inventory Code. A 14-digit code that CARB uses to define emission categories in all sectors (stationary, area-wide, mobile, and, natural sources)
NH_3	Ammonia
NO_X	Oxides of Nitrogen
NSPS	New Source Performance Standard
$PM_{2.5}$	Particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.
PM_{10}	Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.
ROG	Reactive Organic Gases
SO_x	Oxides of Sulfur
SO_2	Sulfur Dioxide
TOG	Total Organic Gases
Ton	2000 pounds (lb)
VOC	Volatile Organic Compounds

VI. References

1. Houck, 2001a. Houck, James E. (OMNI Consulting Services), Joseph Mangino (U.S. EPA), Garry Brooks (Eastern Research Group), and Roy H. Huntley (U.S. EPA); "Recommended Procedure for Compiling Emission Inventory National, Regional and County Level Activity Data for the Residential Wood Combustion Source Category"; In proceedings from U.S. Environmental Protection Agency Emission Inventory Conference, Denver, CO; 2001; *http://www.omni-test.com/publications/Compiling Emission.pdf*
2. HPBA, 2009a. Hearth, Patio, & Barbecue Association; "Fireplace Inserts Fact Sheet"; *http://www.hpba.org/fileadmin/factsheets/product/FS_FireplaceInsert.pdf*
3. OMNI, 2003. Broderick, David R. and James E. Houck (OMNI Consulting Services, Inc.); "Results of Wood Burning Survey - Sacramento, San Joaquin, and San Francisco Areas, University of California Berkeley/California Air Resources Board - GIS Study"; Jan. 15, 2003; *http://www.omni-test.com/publications/final.pdf*
4. OMNI, 2006. Houck, James E. and Brian N. Eagle (OMNI Environmental Services Inc.); "Residential Wood Combustion Emission Inventory, South Coast Air Basin and Coachella Portion of Salton Sea Air Basin, 2002 Base Year"; October 24 2006; *http://www.omni-test.com/publications/SCAQMD-RWC4.pdf*
5. U.S. EPA, 1996a. United States Environmental Protection Agency; AP-42, Compilation of Air Pollutant Emission Factors, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 1.0, 1.10 Residential Wood Stoves; October 1996; *http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s10.pdf*
6. WHO, 2013. Wood Heat Organization; "Wood Heating Systems"; *http://www.woodheat.org/wood-appliances.html* (as of January 2013)

VII. Appendix A

Information regarding the new wood burning devices installed in the Portola NAA and their respective *PM2.5 emission factors*. The emission factors were calculated as follows:

1. The certification test emission rate was scaled upward by 50 percent to reflect the real-world in-home performance[14];
2. The scaled emission rate was divided by the average burn rate of 1.5 kilograms per hour (kg/hr) to calculate grams of PM2.5 emissions per kilogram of wood (g/kg)[15]; and
3. The result was multiplied by 2 to convert g/kg to lb/ton.

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2016-001	wood	5/23/2016	NC	5.8
2016-003	wood	8/9/2016	NC	3.8
2016-006	wood	5/11/2016	NC	7
2016-007	wood	8/5/2016	NC	6.6
2016-008	wood	6/24/2016	NC	1.16
2016-009	wood	5/10/2016	NC	6.4
2016-011	wood	5/27/2016	NC	7.6
2016-012	wood	5/19/2016	NC	6.18
2016-015	wood	5/11/2016	NC	6.4
2016-016	wood	8/4/2016	NC	6
2016-017	wood	7/14/2016	NC	7
2016-019	wood	6/13/2016	NC	4.6
2016-020	wood	6/23/2016	NC	8.8
2016-021	wood	5/25/2016	NC	7.6
2016-022	wood	8/18/2016	NC	7.2
2016-023	wood	6/28/2016	NC	5.54
2016-024	wood	5/19/2016	NC	4.8
2016-025	wood	7/14/2016	NC	7
2016-026	wood	9/1/2016	NC	0.16
2016-028	wood	5/16/2016	NC	7
2016-029	wood	6/21/2016	NC	8.8
2016-030	wood	10/19/2016	NC	7.8

[14] *https://www3.epa.gov/ttnchie1/conference/ei17/session4/houck.pdf*

[15] Based on information received from Gary Blais of U.S. EPA Burnwise Program on August 2, 2016, titled "Conversion Factor TB." The spreadsheet was prepared by Tom Butcher, Research Engineer, Brookhaven National Laboratory.

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2016-032	wood	7/25/2016	NC	8.8
2016-033	wood	8/2/2016	NC	6.4
2016-035	wood	7/8/2016	NC	5.8
2016-036	wood	6/22/2016	NC	7.6
2016-037	wood	10/11/2016	NC	8.4
2016-038	wood	6/23/2016	NC	6.4
2016-039	wood	7/26/2016	NC	7
2016-040	wood	7/19/2016	NC	7.2
2016-041	wood	7/8/2016	NC	8.2
2016-042	wood	6/14/2016	NC	5.4
2016-044	wood	7/14/2016	NC	7.6
2016-045	wood	7/12/2016	NC	8.8
2016-046	wood	7/28/2016	NC	4.2
2016-047	wood	7/22/2016	NC	6.4
2016-048	wood	12/5/2016	NC	7.2
2016-049	wood	8/3/2016	NC	7
2016-050	wood	7/11/2017	NC	4.2
2016-051	wood	7/26/2016	NC	6.4
2016-054	wood	8/17/2016	NC	4.6
2016-055	wood	9/14/2016	NC	7.2
2016-056	wood	8/26/2016	NC	6.2
2016-057	wood	12/16/2016	NC	7
2016-058	wood	7/29/2016	NC	6
2016-059	wood	8/19/2016	NC	4.6
2016-061	wood	8/12/2016	NC	7.8
2016-062	wood	8/9/2016	NC	7.6
2016-064	wood	8/2/2016	NC	6
2016-065	wood	8/17/2016	NC	7.2
2016-066	wood	12/20/2016	NC	7.8
2016-068	wood	9/15/2016	NC	4.6
2016-069	wood	9/14/2016	NC	7.4
2016-070	wood	11/18/2016	NC	6.4
2016-072	wood	9/9/2016	NC	7.8
2016-073	wood	4/19/2018	NC	6.58
2016-074	wood	8/9/2016	NC	4.2
2016-075	wood	11/3/2016	NC	8.94
2016-076	wood	9/7/2016	NC	7.6

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2016-078	wood	10/13/2016	NC	7
2016-079	wood	8/18/2016	NC	7.6
2016-080	wood	6/27/2017	NC	3.8
2016-082	wood	9/9/2016	NC	7
2016-083	wood	10/11/2016	NC	7
2016-084	wood	9/13/2016	NC	7.4
2016-085	wood	10/19/2016	NC	7
2016-089	wood	9/8/2016	NC	6
2016-091	wood	10/6/2016	NC	6
2016-093	wood	12/1/2016	NC	7
2016-096	wood	10/18/2016	NC	8.8
2016-098	wood	11/18/2016	NC	6.4
2016-099	wood	5/17/2017	NC	8.4
2016-101	wood	10/10/2016	NC	8.8
2016-103	wood	10/12/2016	NC	8.8
2016-104	wood	11/22/2016	NC	6.4
2016-106	wood	10/21/2016	NC	7
2016-107	wood	2/24/2017	NC	3.8
2016-108	wood	8/18/2017	NC	7
2016-109	wood	12/7/2016	NC	6.2
2016-111	wood	11/3/2016	NC	8.4
2016-112	wood	11/21/2016	NC	7.8
2016-113	wood	11/17/2016	NC	6
2016-115	wood	10/17/2016	NC	8.8
2016-118	wood	10/31/2016	NC	7.78
2016-120	wood	12/20/2016	NC	8.8
2016-121	wood	11/8/2016	NC	8.8
2016-122	wood	11/16/2016	NC	8.8
2016-123	wood	12/16/2016	NC	7
2016-126	wood	1/27/2017	NC	7
2016-127	wood	9/6/2018	NC	6.6
2016-128	wood	12/19/2016	NC	8.94
2016-129	wood	6/14/2017	NC	7.6
2016-131	wood	11/7/2017	NC	7
2016-132	wood	12/12/2016	NC	8.8
2016-133	wood	12/7/2016	NC	7
2016-134	wood	12/7/2016	NC	8

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2016-135	wood	7/14/2017	NC	7.6
2016-136	wood	12/15/2016	NC	6.4
2016-137	wood	12/20/2016	NC	4.6
2016-138	wood	1/27/2017	NC	7.2
2016-139	wood	1/24/2017	NC	6.4
2016-140	wood	12/16/2019	NC	7.8
2016-145	wood	3/16/2017	NC	7
2016-146	wood	6/20/2017	NC	7
2016-147	wood	3/30/2017	NC	7
2016-148	wood	12/28/2016	NC	5.6
2016-149	wood	1/31/2017	NC	7
2016-150	wood	8/3/2017	NC	7
2016-151	wood	7/6/2017	NC	7.18
2017-001	wood	5/21/2017	NC	6.4
2017-002	wood	8/9/2018	NC	6.8
2017-003	wood	3/9/2017	NC	7.8
2017-155	wood	5/26/2017	NC	8.8
2017-156	wood	5/10/2017	NC	6.4
2017-157	wood	3/27/2017	NC	6.4
2017-159	wood	3/31/2017	NC	6.4
2017-161	wood	4/12/2017	NC	3.8
2017-163	wood	9/5/2017	NC	8.4
2017-164	wood	5/25/2017	NC	6
2017-165	wood	5/20/2017	NC	6.4
2017-166	wood	6/30/2017	NC	1.6
2017-168	wood	5/19/2017	NC	4.6
2017-169	wood	6/28/2017	NC	6.18
2017-170	wood	9/12/2018	NC	6.58
2017-171	wood	6/7/2017	NC	7.6
2017-172	wood	6/13/2017	NC	7.6
2017-173	wood	7/14/2017	NC	7.18
2017-174	wood	8/22/2017	NC	6
2017-177	wood	7/17/2017	NC	6.8
2017-179	wood	9/4/2018	NC	7.6
2017-182	wood	8/7/2017	NC	5.8
2017-183	wood	8/24/2017	NC	8.58
2017-184	wood	10/12/2017	NC	8.8

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2017-187	wood	7/25/2017	NC	7.78
2017-188	wood	8/23/2017	NC	3.8
2017-190	wood	9/6/2017	NC	7.78
2017-191	wood	8/17/2017	NC	6.2
2017-192	wood	8/16/2017	NC	7.98
2017-193	wood	11/30/2017	NC	7.78
2017-194	wood	7/27/2017	NC	8.8
2017-195	wood	11/30/2017	NC	7
2017-197	wood	12/5/2017	NC	7.78
2017-198	wood	1/24/2019	NC	8.8
2017-199	wood	12/5/2017	NC	7.18
2017-200	wood	11/20/2017	NC	7.72
2017-203	wood	11/15/2017	NC	4.2
2017-205	wood	9/7/2017	NC	5
2017-207	wood	8/30/2017	NC	7
2017-208	wood	12/21/2017	NC	6.78
2017-210	wood	2/7/2018	NC	8.8
2017-211	wood	11/21/2017	NC	7.78
2017-212	wood	11/20/2017	NC	7.78
2017-213	wood	12/1/2017	NC	7.6
2017-216	wood	12/26/2017	NC	8.4
2017-217	wood	12/6/2017	NC	6.58
2017-221	wood	11/9/2017	NC	8.8
2017-223	wood	1/26/2018	NC	7
2017-225	wood	8/2/2018	NC	8.4
2017-228	wood	2/6/2018	NC	6.6
2017-229	wood	1/31/2018	NC	6.78
2017-231	wood	2/21/2018	NC	7.38
2017-232	wood	1/10/2018	NC	3.8
2017-234	wood	12/8/2017	NC	8.8
2017-236	wood	3/6/2018	NC	3.8
2018-239	wood	9/21/2018	NC	3.08
2018-241	wood	4/26/2018	NC	7.78
2018-242	wood	10/4/2018	NC	3.8
2018-244	wood	2/6/2018	NC	7.78
2018-245	wood	2/7/2018	NC	7.78
2018-246	wood	9/20/2018	NC	3.08

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2018-250	wood	5/13/2018	NC	7
2018-251	wood	6/6/2018	NC	7
2018-254	wood	4/4/2018	NC	8.58
2018-256	wood	4/30/2018	NC	7.8
2018-260	wood	5/9/2018	NC	6.58
2018-261	wood	6/26/2018	NC	6.58
2018-263	wood	5/24/2018	NC	8.4
2018-265	wood	3/28/2018	NC	1.16
2018-266	wood	3/14/2018	NC	5.68
2018-267	wood	5/1/2018	NC	7.8
2018-270	wood	3/19/2018	NC	7.8
2018-271	wood	6/4/2018	NC	7.78
2018-272	wood	8/31/2018	NC	7
2018-273	wood	5/18/2018	NC	6.58
2018-276	wood	9/12/2018	NC	2.2
2018-278	wood	5/8/2018	NC	8.58
2018-280	wood	10/10/2018	NC	7
2018-282	wood	8/3/2018	NC	5.38
2018-287	wood	3/29/2019	NC	6.4
2018-289	wood	9/5/2018	NC	7.18
2018-290	wood	9/21/2018	NC	6.58
2018-292	wood	10/25/2018	NC	3.8
2018-293	wood	12/7/2018	NC	6.58
2018-297	wood	10/3/2018	NC	3.8
2018-298	wood	11/1/2018	NC	7
2018-299	wood	11/1/2018	NC	6.4
2018-301	wood	10/2/2018	NC	7.8
2018-310	wood	11/13/2019	NC	6.4
2018-312	wood	3/21/2019	NC	7.18
2018-314	wood	10/12/2018	NC	4.6
2018-315	wood	11/26/2018	NC	3.8
2018-320	wood	12/6/2018	NC	3.08
2018-323	wood	12/5/2019	NC	6
2018-324	wood	1/8/2019	NC	3.8
2018-327	wood	3/13/2019	NC	7
2018-328	wood	3/5/2019	NC	3.98
2019-331	wood	5/7/2019	NC	8.58

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2019-332	wood	10/3/2019	NC	8.58
2019-333	wood	9/10/2019	NC	6.58
2019-335	wood	4/11/2019	NC	7.8
2019-340	wood	6/6/2019	NC	8.58
2019-342	wood	6/20/2019	NC	6.6
2019-345	wood	5/30/2019	NC	3.8
2019-348	wood	10/14/2019	NC	3.8
2019-349	wood	7/26/2019	NC	8.58
2019-359	wood	10/30/2019	NC	2.98
2019-360	wood	5/13/2019	NC	7.4
2019-361	wood	6/4/2019	NC	6
2019-362	wood	11/20/2019	NC	6.58
2019-366	wood	10/2/2019	NC	8.58
2019-367	wood	7/11/2019	NC	8.58
2019-369	wood	8/29/2019	NC	6.78
2019-371	wood	5/22/2019	NC	7.4
2019-375	wood	6/13/2019	NC	5.2
2019-376	wood	10/9/2019	NC	1.6
2019-378	wood	6/18/2019	NC	8.4
2019-385	wood	8/13/2019	NC	8.58
2019-386	wood	10/1/2019	NC	6.6
2019-397	wood	8/9/2019	NC	7.18
2016-010	wood	11/1/2017	CAT	3.52
2016-018	wood	7/21/2016	CAT	3.6
2016-043	wood	8/16/2016	CAT	2.96
2016-067	wood	8/18/2016	CAT	0.9
2016-071	wood	8/17/2016	CAT	0.9
2016-087	wood	10/5/2016	CAT	4.84
2016-090	wood	10/19/2016	CAT	4.84
2016-095	wood	9/22/2016	CAT	3.52
2016-102	wood	9/21/2016	CAT	2.96
2016-105	wood	11/16/2016	CAT	2.6
2016-130	wood	1/17/2017	CAT	3.52
2017-176	wood	6/21/2017	CAT	4.8
2017-178	wood	9/20/2017	CAT	1.94
2017-201	wood	8/17/2017	CAT	7.6
2017-209	wood	10/4/2017	CAT	4.84

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2017-214	wood	11/14/2017	CAT	0.09
2017-215	wood	10/6/2017	CAT	1.58
2017-220	wood	10/31/2017	CAT	0.7
2017-230	wood	3/13/2018	CAT	4.84
2018-243	wood	7/19/2018	CAT	15
2018-255	wood	4/23/2018	CAT	0.18
2018-258	wood	4/25/2018	CAT	4.84
2018-262	wood	9/25/2018	CAT	4
2018-264	wood	3/29/2018	CAT	4.84
2018-268	wood	8/16/2018	CAT	3.52
2018-274	wood	8/8/2018	CAT	2.6
2018-277	wood	9/19/2018	CAT	2.6
2018-279	wood	6/18/2018	CAT	2.6
2018-284	wood	7/24/2018	CAT	2.6
2018-294	wood	7/16/2018	CAT	2.6
2018-300	wood	10/11/2018	CAT	4.8
2018-302	wood	9/18/2018	CAT	4.4
2018-304	wood	10/15/2018	CAT	4.8
2018-305	wood	10/22/2018	CAT	4.84
2018-308	wood	11/30/2018	CAT	1.8
2018-309	wood	11/5/2018	CAT	4.8
2018-313	wood	12/4/2018	CAT	4.84
2018-316	wood	12/4/2018	CAT	2.6
2018-318	wood	11/14/2018	CAT	2.6
2018-325	wood	2/19/2019	CAT	1.6
2018-326	wood	1/25/2019	CAT	3.58
2019-329	wood	2/12/2019	CAT	5.18
2019-338	wood	10/14/2019	CAT	1.8
2019-339	wood	8/7/2019	CAT	2.6
2019-344	wood	5/14/2019	CAT	3.52
2019-346	wood	7/9/2019	CAT	1.4
2019-350	wood	5/29/2019	CAT	4.84
2019-351	wood	6/11/2019	CAT	2.74
2019-352	wood	5/30/2019	CAT	3.52
2019-353	wood	5/21/2019	CAT	3.52
2019-358	wood	6/3/2019	CAT	3.52
2019-364	wood	5/29/2019	CAT	3.52

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2019-368	wood	5/30/2019	CAT	1.46
2019-372	wood	10/10/2019	CAT	0.88
2019-373	wood	5/31/2019	CAT	1.46
2019-377	wood	11/21/2019	CAT	1.44
2019-382	wood	6/5/2019	CAT	3.52
2019-389	wood	7/21/2019	CAT	3.52
2019-390	wood	7/21/2019	CAT	3.52
2019-392	wood	8/2/2019	CAT	0.88
2019-395	wood	8/22/2019	CAT	2.6
2019-398	wood	10/3/2019	CAT	2.52
2019-402	wood	9/30/2019	CAT	2.52
2019-408	wood	12/18/2019	CAT	1.44
2019-410	wood	12/3/2019	CAT	1.44
2019-413	wood	12/19/2019	CAT	0.88
2019-416	wood	12/6/2019	CAT	1.46
2019-424	wood	12/30/2019	CAT	1.6
2016-002	wood	5/18/2016	Hybrid	1.6
2016-004	wood	5/19/2016	Hybrid	1.6
2016-005	wood	5/17/2016	Hybrid	0.9
2016-014	wood	5/25/2016	Hybrid	0.9
2019-330	wood	2/21/2019	Hybrid	1.6
2019-357	wood	5/28/2019	Hybrid	1.18
2016-013	pellet	5/25/2016	pellet	3.06
2016-031	pellet	8/2/2016	pellet	3.06
2016-052	pellet	5/17/2017	pellet	3.06
2016-063	pellet	8/1/2017	pellet	3.06
2016-088	pellet	11/15/2016	pellet	3.06
2016-094	pellet	11/4/2016	pellet	3.06
2016-100	pellet	11/1/2016	pellet	3.06
2016-117	pellet	11/17/2016	pellet	3.06
2016-124	pellet	12/13/2016	pellet	3.06
2016-141	pellet	3/14/2017	pellet	3.06
2016-144	pellet	3/10/2017	pellet	3.06
2017-160	pellet	4/13/2017	pellet	3.06
2017-162	pellet	10/10/2017	pellet	3.06
2017-167	pellet	5/12/2017	pellet	3.06
2017-175	pellet	8/8/2017	pellet	3.06

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2017-196	pellet	9/8/2017	pellet	3.06
2017-204	pellet	10/13/2017	pellet	3.06
2017-218	pellet	1/31/2018	pellet	3.06
2017-222	pellet	12/5/2017	pellet	3.06
2017-233	pellet	12/11/2017	pellet	3.06
2017-235	pellet	1/9/2018	pellet	3.06
2017-237	pellet	2/27/2018	pellet	3.06
2018-238	pellet	4/19/2018	pellet	3.06
2018-275	pellet	8/14/2018	pellet	3.06
2018-281	pellet	5/30/2018	pellet	3.06
2018-285	pellet	9/27/2018	pellet	3.06
2018-286	pellet	7/17/2018	pellet	3.06
2018-291	pellet	8/31/2018	pellet	3.06
2018-296	pellet	10/24/2018	pellet	3.06
2018-303	pellet	11/21/2018	pellet	3.06
2018-317	pellet	5/10/2019	pellet	3.06
2019-336	pellet	12/3/2019	pellet	3.06
2019-337	pellet	5/30/2019	pellet	3.06
2019-365	pellet	9/12/2019	pellet	3.06
2019-370	pellet	8/12/2019	pellet	3.06
2019-379	pellet	8/20/2019	pellet	3.06
2019-381	pellet	8/22/2019	pellet	3.06
2019-383	pellet	7/10/2019	pellet	3.06
2019-388	pellet	9/17/2019	pellet	3.06
2019-391	pellet	9/18/2019	pellet	3.06
2019-393	pellet	9/25/2019	pellet	3.06
2019-399	pellet	10/8/2019	pellet	3.06
2019-407	pellet	10/11/2019	pellet	3.06
2016-053	propane	9/1/2016	propane	0
2016-092	propane	10/13/2016	propane	0
2017-185	propane	8/8/2017	propane	0
2017-186	propane	10/4/2017	propane	0
2017-202	propane	10/19/2017	propane	0
2017-224	propane	2/23/2018	propane	0
2018-248	propane	5/30/2018	propane	0
2018-253	propane	7/13/2018	propane	0
2018-269	propane	11/7/2018	propane	0

Program Tracking # (YYYY-XXX)	New Fuel	Install Date	Replacement Device Type	Emission Factor, lb $PM_{2.5}$/ton wood
2018-295	propane	9/24/2019	propane	0
2018-311	propane	1/17/2019	propane	0
2019-341	propane	10/8/2019	propane	0
2019-394	propane	10/17/2019	propane	0
2019-401	propane	8/27/2019	propane	0
2016-125	kerosene	1/6/2017	kerosene	0
2018-259	kerosene	3/27/2018	kerosene	0
2019-403	kerosene	10/9/2019	kerosene	0
2019-414	kerosene	12/10/2019	kerosene	0