

Portola Wood Stove Change-Out 2019 Progress Report

WOOD STOVE CHANGE-OUTS COMPLETED
THROUGH 12/31/2019



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TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	1
I. Change-outs Completed Between 2016 and 2019.....	3
II. Calculations	4
III. Estimated Emission Reductions.....	6
IV. Documentation Collected to Confirm Project Compliance with Program Requirements.....	8
V. Changes to Relevant Forms	11

Appendix A: CARB Emission Benefit Calculator

Appendix B: Revised Forms

EXECUTIVE SUMMARY

The Northern Sierra Air Quality Management District (District) developed the Portola Fine Particulate Matter (PM_{2.5}) Attainment Plan (Plan) to demonstrate attainment of the annual PM_{2.5} standard by 2021. The core element of the attainment strategy is implementing the Greater Portola Wood Stove Change-out Program (Program) in Plumas County funded by the U.S. Environmental Protection Agency (U.S. EPA) 2015 Targeted Air Shed Grant Program. The goal of the Program is to replace 600 old, uncertified wood stoves with cleaner burning and more energy efficient home heating devices. The change-outs will take place between 2016 and 2020, with an estimated 100 to 150 change-outs per year. The District is offering incentives, up to the full cost of purchase and installation, to qualified residents of the Plumas County PM_{2.5} Nonattainment Area (Nonattainment Area) using uncertified wood stoves or inserts as a primary source of heat.

The District and California Air Resources Board (CARB) developed an enforceable measure to allow U.S. EPA to credit the incentive emission reductions towards the attainment demonstration. According to U.S. EPA guidelines, emission reductions achieved from the implementation of an incentive program can be credited towards an attainment demonstration if they meet the following integrity elements: enforceable, quantifiable, surplus, and permanent.¹ The reductions achieved due to change-outs completed between 2016 and 2019 meet all of these integrity elements.

As part of the enforceable measure, CARB must submit an annual report that includes the elements listed below. This progress report demonstrates that the Program met each of these requirements as outlined below:

- Identify each project implemented during the previous calendar year by Program tracking number, description of both baseline and new equipment, and quantified emission reductions (Appendix A);
- Provide an internet link to the EPA Burnwise Emission Calculator used to calculate emission reductions (Alternative Calculator was used as explained in Chapter II);
- Describe the actions taken and documentation collected by CARB to confirm each project's compliance with Program requirements (Chapter IV);
- Determine whether the quantified annual PM_{2.5} emission reductions are projected to achieve the full amount of enforceable commitment of 0.045 tons per day (tpd) by December 31, 2019 and 0.077 tpd by December 31, 2021 (Table 2 and Figure 3); and
- Describe any changes to relevant forms and related impacts on Program integrity (Chapter VI).

¹ See "Guidance on Incorporating Voluntary Mobile Source Emission Reduction Programs in State Implementation Plans (SIPs)," October 24, 1997, at page 6-7; "Improving Air Quality with Economic Incentive Programs," January 2001 at Section 4.1; "Incorporating Emerging and Voluntary Measures in a State Implementation Plan (SIP)," September 2004 at pages 3-4' and "Diesel Retrofits: Quantifying and Using Their Emission Benefits in SIPs and Conformity," February 2014 at pages 27-29.

In addition to the annual report, CARB committed to perform a retrospective assessment which would evaluate the overall performance of the Program and develop recommendations for future enhancements to Program implementation. This assessment, included in every third annual report, shall include the following:

- Comparison of projected rate of wood stove change-outs (units/year, as described in plan submission) with actual rate of change-outs;
- Comparison of projected numbers of change-outs by type (e.g., wood to pellet stove, or wood to gas stove, as described in plan submission) with actual change-outs by type;
- Description of the geographic distribution of change-outs;
- Adequacy of State resources to implement the Program over the expected life of the Program;
- Comparison of projected PM2.5 air quality improvements from implementation of Program (as described in plan submission) to monitored PM2.5 air quality data;
- Discussion of implementation difficulties and potential solutions – e.g., coordination with stove retailers, types of landlord/tenant complaints; and
- Discussion of reasons for changing Program forms, if any.

The first retrospective assessment was included in the 2018 Annual Report.

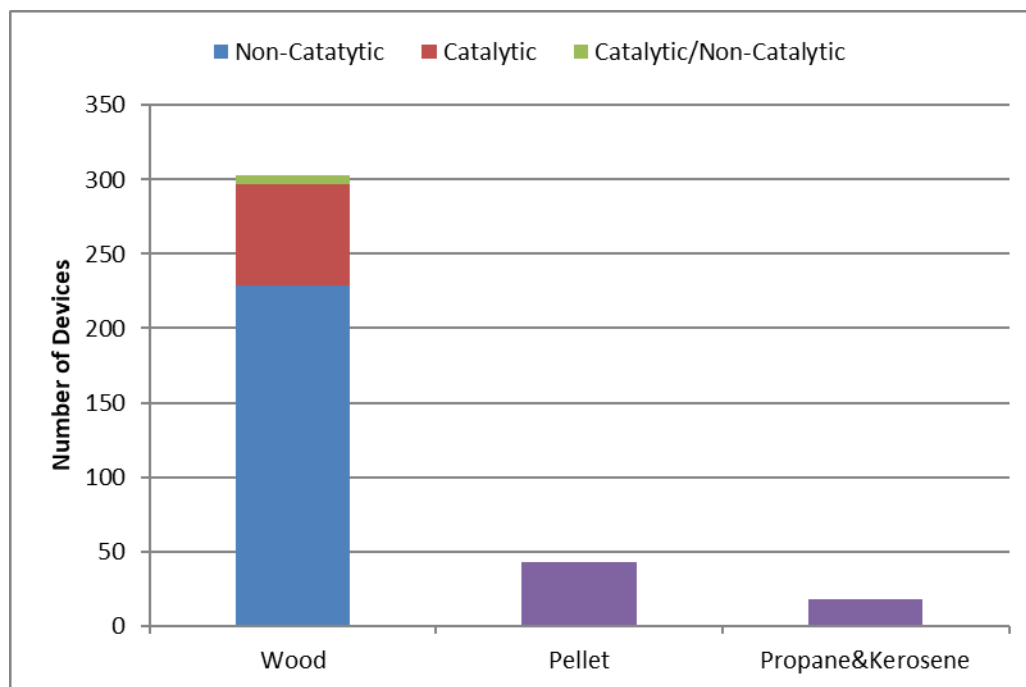
I. CHANGE-OUTS COMPLETED BETWEEN 2016 AND 2019

As part of the enforceable measure, the District committed to changing-out 500 stoves between 2016 and 2018. With 364 change-outs completed by December 31, 2019, the District was one 136 change-outs or 27 percent short of the original estimate. Eighty-four percent of the baseline devices (old devices) were uncertified wood stoves with a default PM2.5 emission rate of 30.60 pounds of PM2.5 per ton of wood burned (pounds per ton) and an efficiency of 54 percent.² The remaining 16 percent were comprised of fireplaces (6 percent) and old certified devices no longer working properly (10 percent). Most of the households replaced their old devices with U.S. EPA certified wood stoves. Forty three households chose pellet stoves and 18 household chose a propane or a kerosene stove as the replacement option (see Appendix A). Figure 1 illustrates the devices replaced through December 31, 2019 grouped by the device type.

There are two main categories of wood stoves depending on the construction, combustion, and emission characteristics of the device: non-catalytic and catalytic. Non-catalytic stoves have built-in features allowing re-circulating and re-burning of the smoke to keep the devices running cleanly and efficiently. Catalytic stoves are equipped with a ceramic or metal honeycomb device called a combustor. The catalyst material reduces the ignition temperature of the unburned volatile organic compounds (VOC) and carbon monoxide (CO) in the smoke, thus making the smoke ignite at lower temperatures. As these gases burn, the temperature inside the catalyst increases to a point at which the ignition of the gases is self-sustaining. There are also hybrid models on the market, which combine catalytic and non-catalytic technology.

² AP-42 Tables 1.10-1 and 1.10-5: <https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s10.pdf>

Figure 1. Number of Replacement Devices Installed by Type through 12/31/2019



II. CALCULATIONS

Initial estimates of emission reductions achieved by replacing uncertified wood stoves with cleaner burning and more energy efficient home heating devices were based on the U.S. EPA Burnwise Emission Calculator (EPA Calculator).³ The EPA Calculator is designed to calculate the average emission reductions for the entire Program using the default emission factors. In order to come up with device specific emission estimates, CARB staff developed a supplemental calculator, referred to in this Progress Report as the CARB Calculator.

The CARB Calculator was used to estimate PM_{2.5} emission reductions achieved by replacing 364 wood stoves between 2016 and 2019 with cleaner-burning and more energy efficient alternatives. The individual calculations for each device, along with the device tracking number and new equipment type, are presented in Appendix A. Listed below are the step-by-step instructions and formulas.

The first step in calculating emission reductions required converting certification test emission rates in grams per hour (g/hr) to emission factors in pounds per ton (lb/ton), as described below:

1. The certification test emission rate was scaled upward by 50 percent to reflect the real-world in-home performance;⁴

³ Available at <https://www.epa.gov/burnwise/burn-wise-additional-resources>

⁴ <https://www3.epa.gov/ttnchie1/conference/ei17/session4/houck.pdf>

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);⁵ and
3. The result was multiplied by 2 to convert g/kg to lb/ton.

The average certification test emission rate for the 303 devices between 2016 and 2019 was 2.9 g/hr. Table 1 provides additional information about the emission limits of the wood burning devices installed in between 2016 and 2018.

Table 1. Breakdown of Wood Burning Devices Installed between 2016 and 2018 by Emission Rate

Certification Test Emission Rate	Number of Devices
Not exceeding 3.0 g/hr	119
Between 3.0 g/hr and 4.0 g/hr	143
Greater than 4.0 g/hr	41
Total	303

The following equation was used to calculate emission factor in pounds per ton:

$$\text{Equation 1: } EF = (ER \times 1.5) / BR \times 2$$

Where:

- EF* Emission factor in pounds per ton
- ER* Emission rate in grams per hour
- BR* Average burn rate in kilograms per hour of operation
- 1.5 Factor used to scale certification test emission rate to reflect potential increase in emissions during in-home operation
- 2 Factor used to convert grams per kilogram to pounds per ton

The average emission factor of 6.05 lb/ton calculated using Equation 1 is close to the emission factor of 8.76 lb/ton estimated in the Regulatory Impact Analysis for Residential Wood Heaters NSPS Review Table 4.3 (NSPS Review).⁶ Considering that the average replacement device had about 1/3 lower certification test emission rate than the 4.5 g/hr assumed in NSPS Review, the calculated emission factors seem appropriate.

⁵ 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.

⁶ https://www3.epa.gov/ttnecas1/docs/ria/wood-heaters_ria_final-nsps-revision_2015-02.pdf

The following formulas were used to calculate PM2.5 emissions of the old device, the new device, and the difference between them.

$$\text{Equation 2: } E_{old} = (EF_{old} \times WU \times WD)/2000$$

$$\text{Equation 3: } E_{new} = (EF_{new} \times WU \times WD \times (EFC_{old}/EFC_{new}))/2000$$

$$\text{Equation 4: } E_{benefit} = E_{old} - E_{new}$$

Where:

E_{old}	Emissions of old device (ton/year)
E_{new}	Emissions of new device (ton/year)
EF_{old}	Emission factor for the old device (lb/ton)
EF_{new}	Emission factor for the replacement device (lb/ton)
WU	Wood usage (cords/year)
WD	Wood density (ton/cord)
EFC_{old}	Device efficiency for the old device (%)
EFC_{new}	Device efficiency for the new device (%)
$E_{benefit}$	Emission reductions from change-out (ton/year)

Since emission factors for pellet stoves are considered to be more representative of actual in-home usage,⁷ a default emission factor of 3.06 lb/ton, consistent with NSPS Review, was used for all pellet stoves.⁸ Portola households that use a pellet stove as a main source of heat use two to three tons of pellet fuel per year.⁹ In order to ensure a conservative estimate, three tons were assumed in estimating emission reductions. Consistent with the California's Short-Lived Climate Pollutant Reduction Strategy¹⁰ propane and kerosene fueled heating devices were assumed to have negligible PM2.5 emissions.

III. ESTIMATED EMISSION REDUCTIONS

The District made an enforceable commitment to achieve PM2.5 emission reductions of 0.045 tpd by December 31, 2019 and 0.077 tpd by December 31, 2021 by replacing uncertified wood stoves with cleaner burning and more efficient home heating devices in the Nonattainment Area. The emission reductions can only be used for State Implementation Plan (SIP) purposes if they are fully realized throughout the calendar year. Therefore, the reductions associated with devices replaced through the end of 2016, 2017, 2018, and 2019 are respectively compared to 2017, 2018, 2019, and 2020 emission estimates. The level of emission reductions achieved through December 31, 2018 was adequate for meeting 2019 milestone.

⁷ <https://www3.epa.gov/ttnchie1/ap42/ch01/related/woodstove.pdf>

⁸ https://www3.epa.gov/ttnecas1/docs/ria/wood-heaters_ria_final-nsps-revision_2015-02.pdf.

⁹ Quincy Hot Spot personal communication

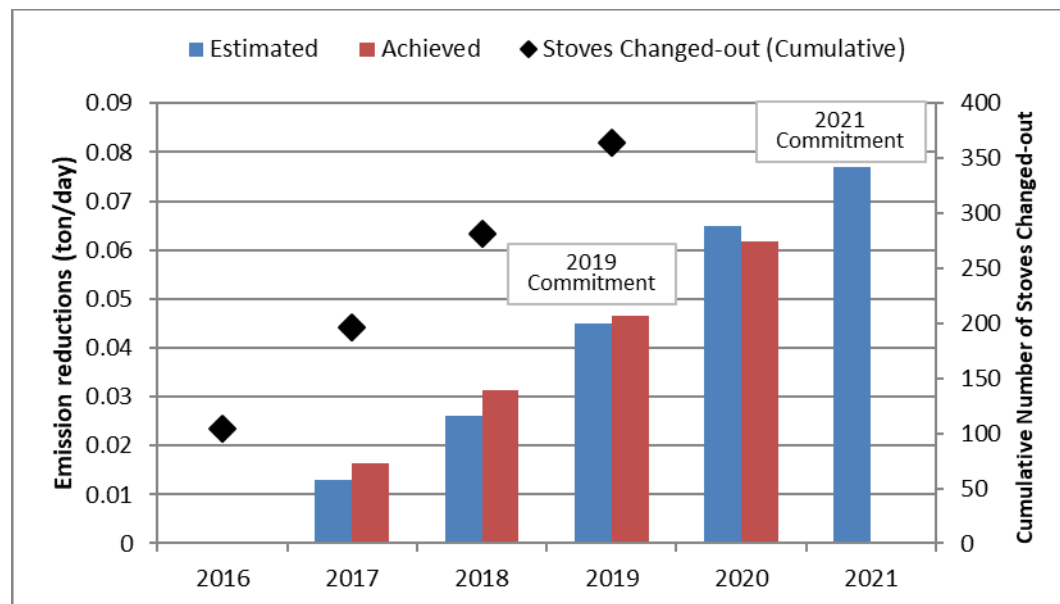
¹⁰ https://www.arb.ca.gov/cc/shortlived/meetings/03142017/final_slcp_report.pdf

Emission reductions achieved by the end of 2019 should be compared to 2020 emission reduction goals. Although only 364 of the 500 devices estimated to be replaced by the end of 2019 were installed, the emission reductions are only five percent behind the 2020 emission reductions goal. This is because the installed devices have significantly lower PM2.5 emission rates compared to the initial estimate. In order to have a conservative estimate, the assumption was that each qualified uncertified device will be replaced with a Phase II wood stove with an average certification test emission rate of 7.5 g/hr. The 303 wood burning replacement devices installed between 2016 and 2019 had an average certification test emission rate of 2.9 g/hr. The remaining 61 devices were even cleaner and included 43 pellet stoves with average emission rates of 1.4 g/hr and 18 propane/kerosene stoves. The change-out statistics through December 31, 2019, including the number of specific devices and associated emission reductions are summarized in Table 2. Figure 2 compares the reductions achieved to the initial estimates and 2019 and 2021 enforceable commitment.

Table 2. Summary of Change-outs Completed between 2016 and 2019

Total Installations as of 12/31/19	364
Summary by Replacement Device Type	
Non-catalytic Stoves	229
Catalytic Stoves	68
Catalytic/Non-catalytic Stoves (Hybrid)	6
Pellet Stoves	43
Propane/Kerosene Stove	18
Summary of Emission Reductions	
Total PM2.5 Emissions Saved (tons per year)	22.552
Total PM2.5 Emissions Saved (tons per day)	0.062
2020 Emission Reductions Goal (tons per day)	0.065
Difference	-0.003

Figure 2. Comparison of PM2.5 Emission Reductions Achieved to the 2019 and 2021 Enforceable Commitment



The District is implementing changes to the Program in order to address slower than expected rate of change-outs. In 2019, the District hired additional staff to help with public outreach. The District estimates that up to 40 percent of homes in the City of Portola are rentals with the owners residing out of the area. Therefore, the District will work with the City of Portola in order to obtain owners' addresses and mail Program information to property owners rather than tenants. The District will also start to drive through the community at dawn and dusk in order to identify homes with excessive smoke from chimneys.

IV. DOCUMENTATION COLLECTED TO CONFIRM PROJECT COMPLIANCE WITH PROGRAM REQUIREMENTS

On a monthly basis CARB receives reports from the District listing each installation and the associated expenditures by tracking number. Every quarter the District submits progress reports to CARB summarizing change-outs accomplished during the quarter.

Per the Program design, wood stove installers are not reimbursed prior to completing the installation and submitting the following documentation to the District:

- Completed Application
- Owner/Tenant Agreement, if applicable
- Cost estimate approved by the District
- Exceeds \$3500/\$4500 form, if applicable
- Photo of the non-certified device installed in the residence before removal
- Photo of the new U.S. EPA certified device installed in the residence
- Program Tracking Form
- Acknowledgement of Training Form

- Verification of surrendering the device to the City of Portola Public Works Yard
- Photo of non-certified device destroyed
- Copy of Permit
- Final Invoice

The wood stove installer delivers the old, uncertified stove to the City of Portola Public Works Yard with the Program Tracking Number written on the stove. City staff destroy the stove, generally by cutting a hole in at least one panel with a plasma torch, and take a picture of the destroyed stove showing the Program Tracking Number. The inoperable stove is recycled. City staff sign the Program Tracking Form, taking responsibility of the old stove from the wood stove installer, and sign the Verification of Destruction Form when the old stove has been destroyed.

After the installation is complete and residents have been using the new stove for at least one winter, the District will follow up with a survey to verify that the installation has been satisfactorily completed and that the resident is following the installer's recommendations on proper burning techniques and wood storage. The follow-up is conducted by an in-home visit, phone call, and/or mail survey.

Figure 3 shows an example of the picture of the original stove and the replacement stove maintained as part of the documentation. Figure 4 shows a picture of stove being destroyed by the City of Portola staff and a picture of stoves stored at the City of Portola yard awaiting transport to the recycling facility. Figure 5 shows pictures of two stoves, with tracking numbers printed on the top of each stove, deemed permanently inoperable.

Figure 3. Example of Before (left) and After (right) Pictures Collected as Part of the Documentation for Change-out 2016-011



Figure 4. Picture of Stove Being Destroyed (left) and Stored for Recycling (right)



Figure 5. Pictures of Stoves Deemed Permanently Inoperable by the City of Portola Staff



V. CHANGES TO RELEVANT FORMS

The forms updated in 2019 are summarized in Table 5 and included in Appendix B.

Table 5. Program Forms Revised in 2019

Form	Reason
NSAQMD Zone 2 Application	Revise income limits with 2019 numbers
Chimney Sweep Agreement 2019	New Program element
NSAQMD Chimney Sweep Voucher	New Program element