

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Preliminary Draft Staff Report

Proposed Rule 445 - Wood Burning Appliances

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TABLE OF CONTENTS

Executive Summary	1
Regulatory Background	1
Air Quality Background	3
Purpose and Applicability	6
Legal Authority	6
Affected Industry	6
Summary of Proposed Rule	7
Emissions Inventory	11
Emissions Reductions	15
Cost Effectiveness	17
California Environmental Quality Act	18
Socioeconomic Assessment	18
Draft Findings	18
References	19
List of Figures	
Figure 1 – PM2.5 Seasonal Variation, 2005	3
Figure 2 – Contribution to Atmospheric PM10 Mass in the South Coast Air Basin (November – December)	4
Figure 3 – Contribution to Atmospheric PM10 Mass in the South Coast Air Basin (May to November)	5
Figure 4 – Relative Emissions from Various Heating Sources	8
Figure 5 - EPA Phase II-Certification Label	9
List of Tables	
Table 1 – Annual Average Emissions from Residential Wood Combustion (ARB, 2002)	12
Table 2 – American Housing Survey Information	13
Table 3 – Interpolated American Housing Survey Information for Basin and the Coachella Valley	14
Table 4 – 2002 PM2.5 Emissions Inventory for the Basin and the Coachella Valley (OMNI Environmental)	14
Table 5 – Adjusted 2002 PM2.5 Emissions Inventory for the Basin and the Coachella Valley	15

APPENDICES

Appendix A: Proposed Rule 445 – Wood Burning Appliances

Appendix B: Draft Emissions Inventory for Wood Burning Appliances in the South Coast
Air Basin and the Coachella Valley Portion of the Salton Sea Air Basin
(OMNI Environmental Services, Inc., 2006)

Appendix C: Draft Emissions Reductions and Cost-Effectiveness Calculations

EXECUTIVE SUMMARY

Wood burning for aesthetic and heating use is limited in southern California, but due to the large number of sources, emissions do contribute to exceedances of State and federal air quality standards for PM10 and PM2.5, collectively referred to as particulate matter or PM. (Wood burning can also produce carbon monoxide and toxic air contaminants.) The 2003 Air Quality Management Plan (AQMP) included a control measure to reduce PM emissions from wood burning fireplaces and wood stoves.¹ The California Air Resources Board (ARB) has also developed a suggested control measure to reduce emissions from wood burning appliances and other sources.² Air districts and states have developed wood smoke control programs with varying degrees of stringency, based primarily on local conditions and concerns. Proposed Rule 445 has also been developed to assist in the attainment of State and federal PM standards for the South Coast jurisdiction.

Staff research indicates that properly installed and operated clean burning appliances significantly reduce emissions inside and outside of the home. The Proposed Rule and outreach program will phase-out less efficient wood-burning appliances and educate the public on how to burn wood in a clean manner.

Six months after adoption, Proposed Rule 445 would prohibit the installation of a new wood burning appliance unless it is one of the cleanest technologies available. Proposed Rule 445 prohibits the installation of more than one controlled wood burning appliance in new housing units constructed after January 1, 2008. Beginning in 2010, Proposed Rule 445 also prohibits new and existing commercial facilities from using uncontrolled burning devices. Proposed Rule 445 prohibits the burning of non-wood items such as trash, establishes moisture content standards for wood sold as seasoned, and includes a mandatory wood burning curtailment program during periods of poor air quality. Staff is also seeking public comment on a proposal that would require the change-out of older wood heaters during property transfers made after 2012 in areas with high fine particulate matter concentrations.

The 2003 and 2007 AQMPs estimated emissions from wood burning stoves and fireplaces at approximately six tons of PM2.5 per annual average day, and nearly 11 tons per winter day. A recent review of the emissions inventory estimates PM2.5 emissions to range from approximately ten to 20 tons per annual average day and up to 30 tons per day during periods with greater wood burning (generally, November through February). A discussion of key variables for the emissions inventory and potential uncertainties is presented later in this report. Emissions reductions for the Proposed Rule 445 requirements have been estimated at approximately 64 tons of PM2.5 per year by 2008, increasing to 249 ~~265~~ tons of PM2.5 per year by 2014.

REGULATORY BACKGROUND

The District monitors ambient air quality for criteria pollutants (ozone, carbon monoxide, particulate matter, lead and sulfate) at 32 locations within the South Coast Air Basin (Basin) and the Coachella Valley portion of the Salton Sea Air Basin (SSAB). Pollutant

¹ Control Measure #2003MSC-06, http://www.aqmd.gov/aqmp/docs/2003AQMP_AppIVa.pdf - page IV-60

² ARB, Proposed List of Measures to Reduce Particulate Matter – PM10 and PM2.5, (Implementation of Senate Bill 656, Sher), Approved November 18, 2005

concentrations exceed federal and/or State standard(s) for suspended particulate matter (AQMP, 2003). In accordance with a court order, EPA issued revised particulate matter standards on September 21, 2006³. The new standards, including the revocation of the PM10 annual average standard, took effect 60 days from federal register publishing. Under the newly issued PM standards, the prior 24-hour PM10 standard has been retained at 150 $\mu\text{g}/\text{m}^3$ as with the PM2.5 annual average standard at 15 $\mu\text{g}/\text{m}^3$. The prior 24-hour PM2.5 standard was, however, reduced from 65 to 35 $\mu\text{g}/\text{m}^3$. Although final designations have not been made by EPA, data suggests that the Basin will be classified as non-attainment under the newly issued PM2.5 standards and the Coachella Valley will be designated as unclassifiable. Both the Basin and the Coachella Valley are classified as non-attainment for the State PM10 standard (50 $\mu\text{g}/\text{m}^3$ on a 24-hour basis and 20 $\mu\text{g}/\text{m}^3$ for the annual average). The Basin is also classified as non-attainment for the State PM2.5 annual average standard (12 $\mu\text{g}/\text{m}^3$) while the Coachella Valley is designated as unclassified.

Prior to the 2003 AQMP, the District had not proposed a control measure to reduce emissions from wood burning appliances, which include fireplaces, fireplace inserts, and wood burning stoves. EPA has, however, previously adopted performance standards for new wood heaters (wood stoves and fireplace inserts) sold since 1992.⁴ Currently, there are no federal certification requirements for traditional fireplaces that have an air-to-fuel ratio in excess of 35:1, as a suitable test method has not been developed. An ASTM Fireplace Task Group has developed an emissions and measurement draft protocol which may be used by EPA and/or individual states to set emission thresholds for traditional fireplaces, however, these efforts are ongoing (Stegmeir, 2006).

In 1989, the ARB adopted a suggested control measure (SCM) for emissions from wood burning appliances. A summary of the most promising potential control actions from ARB's SCM include:

Voluntary Curtailment Program: This program encourages the public to refrain from use of wood heaters and fireplaces when air quality is expected to be poor.

Public Awareness Programs: The goal is to inform the public about the proper operation and maintenance of wood heaters and health effects of wood smoke.

Replacement of Existing Wood Heaters: Upon the sale of real property that contains a wood heater, the heater must be clean burning as reflected by an EPA-certified, Oregon-certified, or pellet-fueled wood heater.

Moisture Content of Seasoned Wood: Dry wood burns more efficiently; therefore firewood that is offered for sale as "seasoned wood" must have a moisture content of 20 percent by weight or less.

Prohibited Fuel Types: Garbage, treated wood, plastic, rubber, waste petroleum products, paints and paint solvents, and coal having a sulfur content exceeding more than one percent by weight are prohibited from being burned in a wood-burning appliance.

³ PM10 refers to Particulate Matter with an aerodynamic diameter of 10 microns or less and PM2.5 refers to Particulate Matter with an aerodynamic diameter of 2.5 microns or less.

⁴ 4.1 grams PM per hour for catalytic heaters and 7.5 grams per hour for non-catalytic heaters

Many California air districts have developed programs/regulations to reduce emissions from wood burning appliances including the Bay Area Air Quality Management District, the San Joaquin Valley Unified Air Pollution Control District and the Sacramento Metropolitan Air Quality Management District.

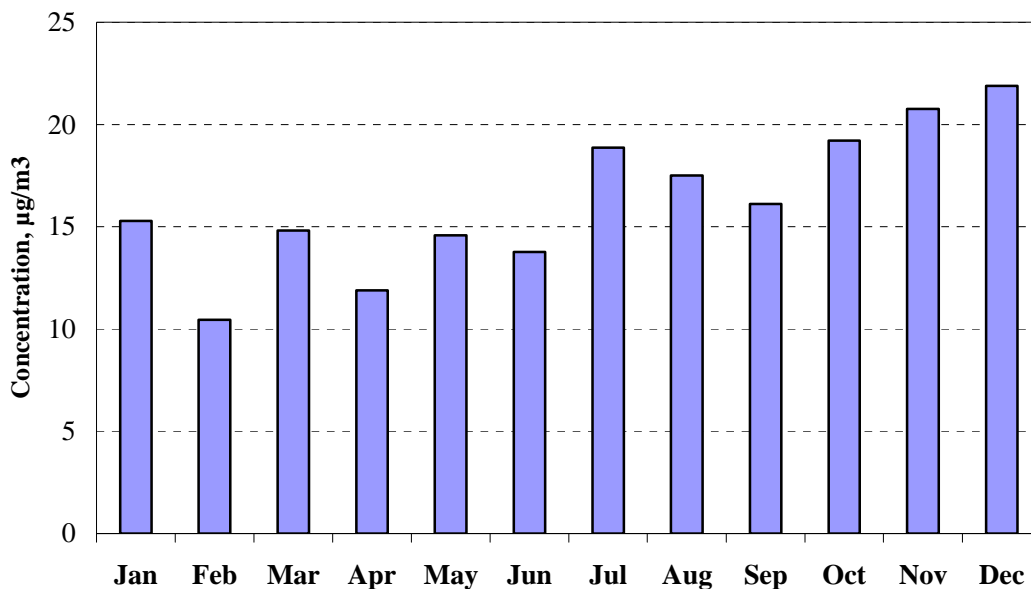
National Efforts to Reduce Wood Smoke Emissions

A variety of programs have been initiated to assist in the removal of older wood burning technologies and replacement with cleaner technologies. Specifically, EPA has initiated the Great American Woodstove Change-Out program to assist local agencies in developing and implementing programs intended to reduce emissions from wood stoves. Under the program agencies have provided incentives for the replacement of non-certified wood stoves with U.S. EPA Phase II-certified appliances. The Energy Policy Act, approved on August 8 of 2005, also establishes a rebate program for the purchase of renewable/biomass energy-fueled appliances with an efficiency of at least 75 percent (Title II, subtitle A, Section 106), however, funding and implementation mechanisms must be resolved.

AIR QUALITY BACKGROUND

As mentioned above, PM_{2.5} is monitored at various sites throughout the District. Unlike ozone that has a predictable summertime increase; ambient PM_{2.5} measurements tend to be higher in the third and fourth quarters of the year. Figure 1 shows the average PM_{2.5} concentration for each month in the Basin for the year 2005.

Figure 1
PM_{2.5} Seasonal Variation, 2005
Monthly Average Concentration in the Basin, $\mu\text{g}/\text{m}^3$

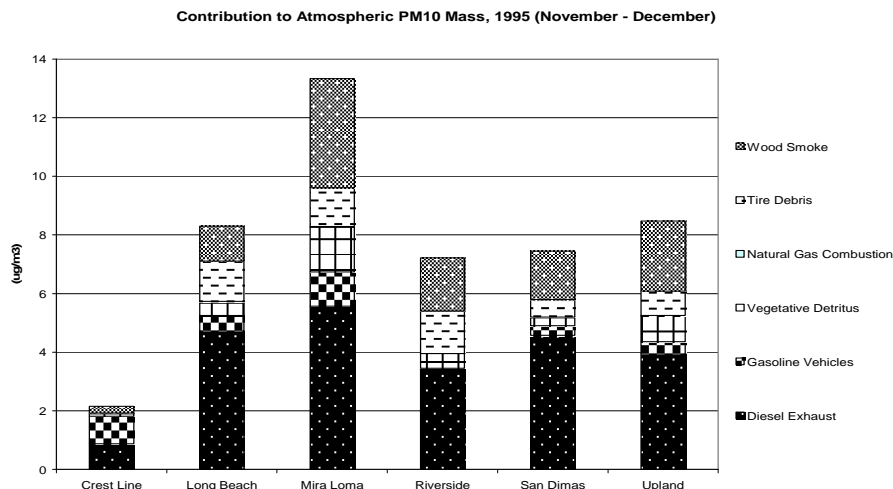


In addition to emissions inventory information, the magnitude of wood smoke's contribution to ambient PM levels can be estimated through receptor modeling. Receptor modeling is intended to account for specific chemical compounds collected on air sampling filters by

matching them against known sources of those chemical compounds. By comparing the collected particulate mass and composition to known source emissions profiles, it is possible to attribute the measured mass to its emissions sources. The term chemical mass balance is commonly used for such calculations. Using these methodologies, a study analyzing 1982 data estimated that wood smoke contributed 9.6, 5.7, 10.8, and 1.3 percent of PM_{2.5} mass on an average annual basis at Pasadena, Downtown Los Angeles, West Los Angeles, and Rubidoux, respectively (Schauer, 1996).

More recently, the organic compound levoglucosan has been identified as a tracer for wood smoke (Schauer and Cass, 2000). Figures 2 and 3 present the estimated contribution of wood smoke to ambient PM₁₀ levels using the chemical mass balance model (Phase II of the Children’s Health Study, ARB, 2001). Figure 2 presents 1995 data for November and December while Figure 3 presents data during the May through November time period. It should be noted that the information presented in Figures 2 and 3 do not include emissions from paved road dust (largest source category) or secondary PM₁₀ emissions (e.g., ammonium nitrate and sulfate).

Figure 2



As illustrated in the Figure 2 (winter months), the estimated contribution of wood smoke to ambient PM₁₀ levels ranges from a low of less than one microgram per cubic meter ($\mu\text{g}/\text{m}^3$) in the mountain community of Crestline to nearly four $\mu\text{g}/\text{m}^3$ in the community of Mira Loma. This can be compared with diesel exhaust emissions that range from less than one $\mu\text{g}/\text{m}^3$ in Crestline to approximately six $\mu\text{g}/\text{m}^3$ in Mira Loma. As would be expected, the data in Figure 3 (Spring-Summer months) shows a smaller contribution of wood smoke to ambient PM₁₀ mass (generally less than $0.4 \mu\text{g}/\text{m}^3$). A comparison of Figure 2 and 3 also shows that diesel exhaust emission estimates are generally consistent throughout both evaluation periods.

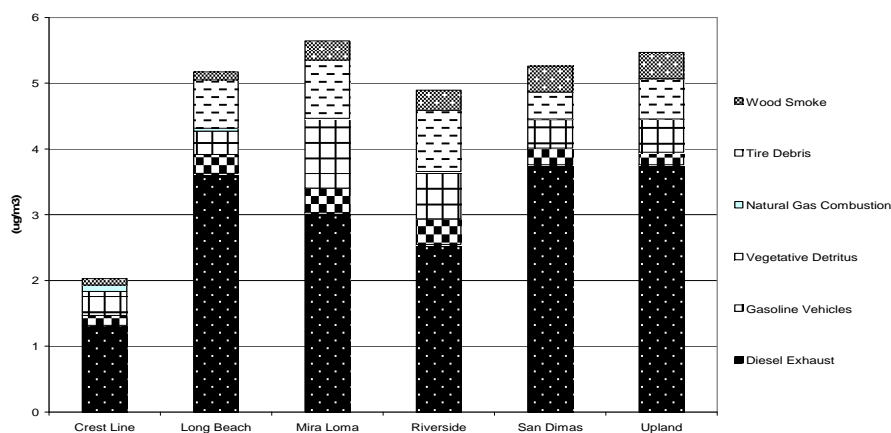
Public Complaints

Another measure of the severity of wood smoke contribution to ambient air quality is public complaints from a source. District staff evaluates and responds to public complaints via a toll-free telephone number 24 hours each day. Based on a review of the AQMD’s records, public complaints are received concerning smoke but it is difficult to determine the specific number attributable to residential wood burning as most complaints only identify smoke from

an unknown source. However, residential complaints have been received regarding the burning of trash in fireplaces and wood stoves. A review of 2003 to 2006 data indicates 32 complaints where the complainant or AQMD staff identified the source as wood burning at a residence (Caso, 2006). In addition to the formally filed complaints, AQMD staff received numerous complaints and observations from the public about wood smoke during public forums such as AQMP workshops and AQMD Town Hall meetings.

Figure 3

Contribution to Atmospheric PM10 Mass, 1995 (May - November)



Health Effects from Fine Particulate Matter⁵

A consistent correlation between elevated ambient fine particulate matter (PM10 and PM2.5) levels and an increase in mortality rates, respiratory infections, number and severity of asthma attacks and the number of hospital admissions has been observed in different parts of the United States and various areas around the world. In recent years, studies have reported an association between long-term exposure to air pollution dominated by fine particles (PM2.5) and increased mortality, reduction in life-span, and an increased mortality from lung cancer.

Daily fluctuations in fine particulate matter concentration levels have also been related to hospital admissions for acute respiratory conditions, to school and kindergarten absences, to a decrease in respiratory function in normal children and to increased medication use in children and adults with asthma. Recent studies show lung function growth in children is reduced with long-term exposure to particulate matter.

The elderly, people with pre-existing respiratory and/or cardiovascular disease and children appear to be more susceptible to the effects of PM10 and PM2.5.

Health Effects from Wood Smoke

Wood smoke is generally in the fine fraction of PM with most particles having an aerodynamic diameter of 2.5 microns or less. Wood smoke is comprised of nitrates, microscopic pieces of fly ash, dust, smoke, and soot as well as polycyclic organic hydrocarbons. Wood smoke is usually released near ground level in populated areas and is especially apt to be breathed by many residents. The health effects of household and

⁵ Chapter 2, Air Quality and Health Effects, 2007 Draft Air Quality Management Plan, South Coast Air Quality Management District.

neighborhood wood smoke have been studied extensively. The greatest health effect from wood smoke originates from fine particles that can cause health problems ranging from minor irritations such as burning eyes and runny noses to chronic illnesses such as bronchitis. Fine particles also can aggravate chronic heart and lung diseases and are linked to premature deaths in people with these conditions. Persons that may be more susceptible to health effects from wood smoke include those with existing heart or lung disease (congestive heart failure, angina, chronic obstructive pulmonary disease, emphysema or asthma), the elderly, and the young.⁶ A literature search of available studies (Boman, et al, 2003) also recently concluded that there is no reason to assume that the effects of particulate matter in areas polluted with wood smoke are weaker than elsewhere [e.g., areas with similar ambient PM concentrations not affected by wood smoke]. Conclusions in a more recent health effects study included a statement that there is no persuasive evidence that wood smoke particles are significantly less dangerous for respiratory disease than other major categories of combustion-derived particles in the same size range (Naeher, et al, 2007). The same study did acknowledge, however, that there is too little evidence available to make a judgment concerning the relative toxicity of wood smoke particles with respect to cardiovascular or cancer outcomes.

PURPOSE AND APPLICABILITY

The purpose of this rule is to reduce the amount of particulate matter entrained in the ambient air from wood burning appliances. Proposed Rule 445 applies to the sale, installation and use of wood burning appliances. The Proposed Rule would affect large and small businesses and the general public. Examples of large businesses include the building industry and manufacturers of wood burning appliances. Smaller businesses affected would be retailers, chimney sweeps, and wood suppliers. The general public that burns wood would also be affected by the Proposed Rule.

LEGAL AUTHORITY

The AQMD obtains authority to adopt, amend, or repeal rules and regulations from Health and Safety Code Sections 39002, 40000, and 40001.

AFFECTED INDUSTRY

Traditional wood burning fireplaces, and stoves to a lesser degree, are nearly ubiquitous in existing single family houses and condominiums, and are also widely available in new home construction. The following background information was obtained from ARB⁷ and EPA⁸ documents.

The types of devices that burn wood in a typical residence are: 1) fireplaces, 2) fireplace inserts, and 3) wood burning stoves (includes subcategories). The most common wood

⁶ US EPA Fact Sheet, Health Effects of Wood Smoke, <http://www.epa.gov/woodstoves/healtheffects.html>

⁷ ARB (California Air Resources Board), Area Source Methodology, Section 7.1, Residential Wood Combustion, July 1997

⁸ EPA, AP-42, Section 1.9, Residential Fireplaces, October 1996

burning device in a home is the traditional, uncontrolled fireplace. A fireplace is generally masonry or, more recently, a prefabricated (metal), enclosure with the combustion area facing the interior of the house and a chimney to exhaust the flue gas. Combustion air can be supplied from outside air or from inside air. A fireplace is an inefficient method of heating a house and in some cases can have a negative heating efficiency, if the inside air is used as combustion air. Specifically, when inside air is used for combustion air the colder outside air will be drawn into the house to balance the inside air loss due to combustion. Constant owner attention is required to assure safety and efficiency.

Fireplace inserts are devices that fit into a fireplace. Fireplace inserts that burn wood, pellets, or gaseous fuels are commercially available and can provide similar efficiencies as wood burning stoves. EPA Phase II-certified wood and pellet burning inserts are also available. These devices can be used to heat a house, or a portion of the house, by radiating heat into the interior house space or, with the aide of a fan, circulating air around the insert and venting heated air into the house. The result is better fireplace performance and a safer system.

Wood stoves are stand alone devices that vent flue gas through an existing chimney or flue. They are enclosed wood heaters that control burning or burn time by restricting the amount of air that can be used for combustion. Wood stoves are used both as the primary source of residential heat and to supplement conventional heating systems. Based on known variations in construction, combustion, and emission characteristics, there are five different wood stove subcategories: (1) the conventional [non-EPA Phase II-certified] wood stove; (2) the non-catalytic EPA Phase II-certified wood stove; (3) the catalytic EPA Phase II-certified wood stove; (4) the pellet stove; and (5) the masonry heater. The newer, certified models, as well as the pellet and masonry units have significantly improved safety and efficiency characteristics. Electric fireplaces (primarily decorative but some have heating elements) have also been developed by industry but the extent of the devices in the southern California market is unknown.

Figure 4 presents a relative comparison of fine particulate emissions from various heating sources.⁹

SUMMARY OF PROPOSED RULE

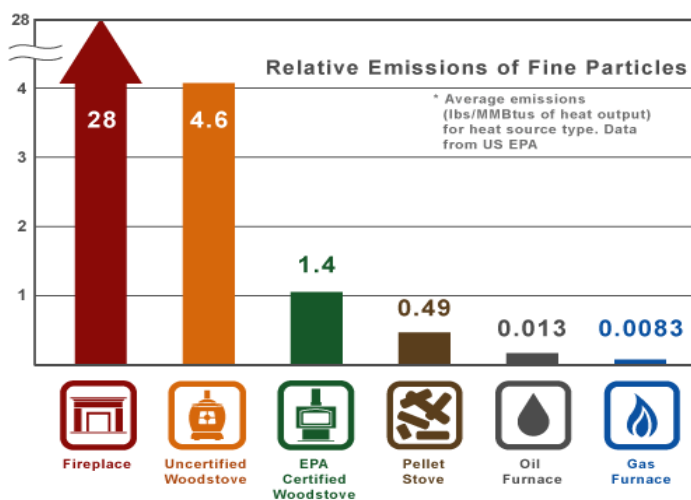
A copy of Proposed Rule 445 is included in Appendix A and is summarized below.

Subdivisions (a) – Purpose; (b) – Applicability; (c) Definitions

These sections describe the purpose of the rule, what parties are subject to rule, and key definitions used throughout the rule.

⁹ <http://www.epa.gov/airprog/oar/woodstoves/refp.html>

Figure 4
Relative Emissions from Various Heating Sources



Subdivision (d) - Requirements

Six months after adoption, paragraph (d)(1) of Proposed Rule 445 would prohibit the installation of a wood burning appliance into any new or existing household unless it is a EPA Phase II-certified wood burning heater (i.e., wood stove and fireplace insert), or is a pellet-fueled wood stove, or a masonry heater. Paragraph (d)(1) does not prohibit the installation of other wood burning appliances (i.e., traditional fireplaces) provided that such devices achieve the same performance standards as EPA Phase II-certified wood heaters and is approved by the Executive Officer. Generally, these performance standards are 4.1 grams PM per hour for catalytic heaters and 7.5 grams per hour for non-catalytic heaters. This provision will allow new wood-burning appliance technology to be evaluated for equivalency as it is developed. New Phase II wood heaters have a certification placard on the back (Figure 5) of the device and the EPA maintains a list of certified wood heaters on a web site.¹⁰ Paragraph (d)(1) does not prohibit the installation of new pellet stoves and masonry heaters as these appliances are designed to burn very efficiently and do not require EPA certification.¹¹

Paragraph (d)(2) of Proposed Rule 445 prohibits the sale of a housing unit constructed after January 1, 2008 with more than one wood burning appliance that meets the criteria of paragraph (d)(1).

Paragraph (d)(3) of Proposed Rule 445 prohibits the sale, transfer, and installation of any used wood burning device that does not meet the performance standards of paragraph (d)(1) unless the unit is rendered permanently inoperative. Examples of wood burning devices that would not be prohibited for sale would include antique or decorative wood stoves that can no longer be used for heating.

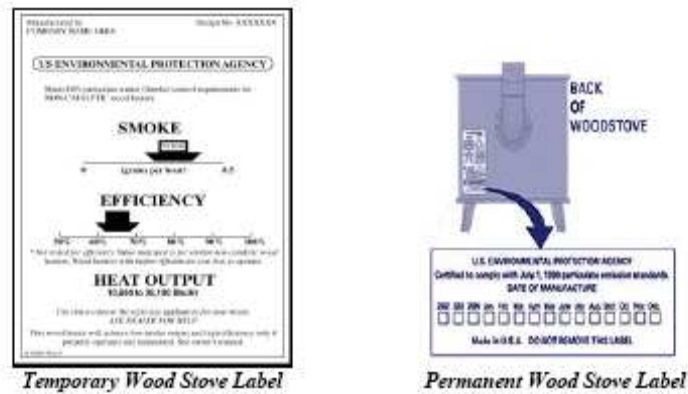
Proposed Rule 445 paragraph (d)(4) requires that all wood burning appliances must be installed and operated in accordance with the manufacturer's specifications. Proper

¹⁰ <http://www.epa.gov/Compliance/resources/publications/monitoring/caa/woodstoves/certifiedwood.pdf>

¹¹ <http://www.epa.gov/woodstoves/basic.html>

installation and operation of wood burning appliances is necessary to ensure that heating outputs are maximized while emissions are minimized.

Figure 5
EPA Phase II-Certification Label



Paragraph (d)(5) of Proposed Rule 445 prohibits the sale, or offer for sale, of firewood that is advertised as seasoned wood unless the moisture content is 20 percent or less. ASTM Test Method D 4442-92 is the identified method to measure moisture content and the regulation specifies that the Executive Officer may identify a delegate or other authority to conduct moisture content evaluations. Moisture content is an important parameter for efficient wood burning. Firewood with too high a moisture content will not burn efficiently and will smolder, resulting in increased emissions. Seasoned wood (aged for at least six months) will burn hotter, cut fuel consumption and reduce smoke inside and outside the home.

Paragraph (d)(6) of Proposed Rule 445 prohibits the burning of garbage, treated wood, particle board, plastic products, rubber products, waste petroleum, paints, solvents, coatings, any other product not intended by a manufacturer for use as fuel in any wood burning appliance.

Paragraph (d)(7) prohibits the operation of a wood burning appliance at commercial facilities (e.g., restaurants, hotels) unless the equipment is either EPA Phase II-certified, a pellet-fueled wood burning heater, a masonry heater, or a fireplace that is determined to meet EPA Phase II standards. These provisions are proposed to become effective January 1, 2010 to allow commercial facilities the time necessary to replace traditional, uncontrolled wood burning appliances. It is anticipated that, similar to new residential developments, the majority of commercial facilities that have fireplaces have dedicated natural gas systems, however, efforts will be made through the public outreach process to determine the number of traditional wood burning appliances at existing commercial operations.

Paragraph (d)(8) of Proposed Rule 445 prohibits the burning of wood in any indoor or outdoor wood burning appliance or portable outdoor wood burning appliance when, based on meteorological or air quality conditions, a no burn day is forecast under District Rule 444 (Open Burning). Rule 444 presently provides information to open burning sources, such as agricultural activities and prescribed burners (federal and state land managers) when meteorological/air quality conditions are not conducive to open burning. The meteorological

criterion that needs to be satisfied to permit open burning in the South Coast Air Basin includes:

- the expected height of the inversion base, if any, near 6:00 a.m. at Los Angeles International Airport is 1,500 feet above mean sea level or higher;
- the expected maximum mixing height during the day is above 3,500 feet above the surface;
- the expected mean surface wind between 6:00 a.m. and noon is greater than five miles per hour;

Under District Rule 444, a no burn day is declared when none of the meteorological criteria for the South Coast Air Basin are met or a California 1-hour Ozone Health Advisory Episode (0.15 ppm) is predicted. Separate criteria are included in Rule 444 for the Riverside County portion of the Salton Sea Air Basin (Burn Area 55), and a portion of eastern Riverside County that resides in the Mojave Desert Air Basin (Burn Area 53).

Anyone wishing to access information for permissible, marginal, and no burn day forecasts under Rule 444 can access the information via the District's web site¹² or through a toll free number (800) CUT-SMOG [288-7664]. Efforts to expand this notification process through a list-serve e-mail, the media (e.g., Public Service Announcements) or to tailor forecasts specific to residential wood burning will be considered in the future. On average, there are three forecast no burn days annually during the November through February time period.

As mentioned, staff is also seeking public comment on a proposal that would require the change-out of older wood heaters during property transfers in areas with high fine particulate matter concentrations. Specifically, paragraph (d)(9) of Proposed Rule 445 states that no person shall sell or transfer any real property in areas with annual average PM_{2.5} concentrations above 20 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) that contains a wood burning heater unless each wood burning heater is determined to be EPA Phase II-certified, pellet-fueled, or rendered inoperable. These provisions are proposed to become effective January 1, 2012 and the proposed rule states that the Executive Officer will define the areas that are above 20 $\mu\text{g}/\text{m}^3$ no later than January 1, 2011. Areas in which public input is sought on this proposal include the appropriate mechanism(s) to document compliance with change-out provisions, the responsible agencies, timing of notifications, and enforceability.

Other air district wood smoke control programs include requirements to change-out older, uncertified wood heaters during property transfers. For example, San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) regulation 4901 states that, "No person shall sell or transfer any real property which contains a wood burning heater without first assuring that each wood burning heater included in the real property is EPA Phase II Certified, a pellet fueled wood burning heater, rendered permanently inoperable, or removed." Similar provisions are contained in regulations governing activities in Washoe County (Reno, Nevada) and the Town of Mammoth Lakes.

Subdivision (e) – Public Awareness Program

Paragraph (e)(1) of Proposed Rule 445 includes requirements for wood burning appliance retailers to provide outreach material that includes information on proper installation, operation, and maintenance of a wood burning appliance in accordance with manufacturer specifications as well as information on proper fuel selection and use to buyers at the point of

¹² <http://www.aqmd.gov/telemweb/Forecast.aspx>

sale. Paragraph (e)(2) also requires wood burning appliance retailers to provide information as provided by the District at the point of sale on health effects of wood smoke and the wood burning restrictions contained in paragraph (d)(8) of Proposed Rule 445. Paragraph (e)(3) of Proposed Rule 445 requires commercial firewood facilities to provide information as prepared by the District on health effects of wood smoke and the wood burning restrictions to customers at the point of sale. District staff will work with affected industries to tailor the District-supplied outreach information to be industry specific. For example, outreach information required to be distributed by commercial firewood facilities may be condensed so that it can be included in bundles of wood sold at grocery stores and other retail outlets.

Subdivision (f) – Exemptions

For clarity, subparagraph (f)(1)(A) specifies that gaseous fuel residential hearth appliances are exempt from the provisions of Proposed Rule 445. Gaseous fuel residential hearth appliances can burn either natural gas or propane. They emit very little pollution, require little maintenance, and can be installed almost anywhere in the home.¹³ Residential gaseous fuel hearth appliances are subject to the applicable American National Standards Institute (ANSI) standards.

Subparagraph (f)(1)(B) exempts cook stoves from Proposed Rule 443. Generally, cook stoves are defined under Title 40 of the Code of Federal Regulations (CFR) Section 60.531 as a wood-fired appliance that is primarily designed for cooking and has the following characteristics: 1) an oven with an oven rack with a volume of one cubic foot or greater, 2) a device for measuring oven temperature, 3) a flame path that is routed around the oven, 4) a shaker grate, 5) an ash pan, 6) an ash clean-out door beneath the oven, and 7) the absence of a fan or heat channels to dissipate heat from the appliance.

Paragraph (f)(2) exempts wood burning appliances operated 3,000 or more feet above mean sea level from the burn prohibitions contained in paragraph (d)(8). A review of available 2000 Census data indicates there are approximately 8,700 housing units in the Big Bear area and the Wrightwood area has approximately 1,500 households.¹⁴

EMISSIONS INVENTORY

Emissions from residential wood burning devices are caused primarily by incomplete combustion and include PM, CO, NOx, SOx, and VOC, although particulate emissions have been the focus of other air district control programs. Studies have shown that these emissions are generally in the accumulation (≤ 2.5 microns) size range (Jacob, et.al., 2000). Additionally, incomplete combustion of wood produces polycyclic organic matter, a group of compounds classified as hazardous air pollutants under Title III of the federal Clean Air Act.

Existing Emissions Inventory

Table 1 presents year 2002 annual average emissions from wood stoves and fireplaces in the District (ARB, CEIDARS, 2006). All emissions are reported in terms of tons per annual

¹³ <http://www.epa.gov/woodstoves/basic.html>

¹⁴ <http://quickfacts.census.gov/hunits/states/06pl.html> (Big Bear City)

http://en.wikipedia.org/wiki/Wrightwood,_California (Wrightwood)

average day. ARB data also estimates the 2002 PM2.5 wood stove and fireplace emissions inventory at 10.6 tons PM2.5 per winter day.¹⁵

**Table 1
2002 Annual Average Emissions from Residential Wood Combustion (tons/day)**

CES/EIC Codes	Equipment Description	VOC	CO	PM	PM10	PM2.5
610-600-0230-0000	Wood Combustion - Wood Stoves	1.05	14.34	2.40	2.25	2.17
610-602-0230-0000	Wood Combustion - Fireplaces	1.6	29.78	4.08	3.81	3.67
	TOTAL	2.65	44.12	6.48	6.06	5.84

The ARB emissions inventory was developed based on estimated number of wood-burning units and amount of wood burned per household by county multiplied by EPA’s AP-42 emission factors. AQMD staff, in cooperation with ARB and other stakeholders, has been reevaluating the emissions inventory in conjunction with current rule development efforts.

Updated Emissions Inventory

Air pollution emissions from wood burning, in simple terms, are determined by the number of sources, multiplied by amount of fuel per source, multiplied by an emission factor. Emissions from wood burning appliances are highly variable, depending on the amount and type of wood burned and the types of appliances being used for burning wood. Installation and wood burning practices also influence emissions. In order to estimate emissions from this source category, many assumptions are required to be made with the realization that any variations in one or more of these variables will substantially change the calculations. With the support of the Hearth, Patio, and Barbeque Association (HBPA), a revised wood burning appliance emission inventory (referred to as the OMNI report) was developed for both the Basin and the Coachella Valley portion of the Salton Sea Air Basin (OMNI Environmental, 2006).

Assumptions used to update the inventory were based, to the extent feasible, on local data and are included in Appendix B. For example, the American Housing Survey (AHS), conducted by the U.S. Census Department, compiles data on the number and type of wood burning appliances for Los Angeles, Santa Ana, and Riverside/San Bernardino areas based on statistical sampling within each area. The information in Table 2 presents a summary of 2002 AHS data, or interpolated data, for the Basin that includes the estimated number of households with useable fireplaces, households (separated by appliance type) using wood for primary heat, and households (separated by appliance type) using wood burning as a supplemental heating source. As illustrated in Table 2, there are many households with useable fireplaces but a very small portion (less than one percent) are used as a primary heat source. Households with a usable fireplace not used as main or other heating equipment are considered to use the fireplace for aesthetic purposes. AHS data is not additive as

¹⁵ www.arb.ca.gov/app/emsinv/ccos/fcemssumcat_cc212.php

respondents could indicate that a stove or a fireplace is considered “main heating equipment” and “other heating equipment”.

**Table 2
American Housing Survey Information**

Metropolitan Area	Useable Fireplace	Main Heating Equipment			Other Heating Equipment ¹		
		Stove	Fireplace with Insert	Fireplace (no insert)	Stove	Fireplace with Insert	Fireplace (no insert)
Los Angeles-Long Beach	1,121,450	925	5,850	2,275	17,525	71,750	174,225
Anaheim-Santa Ana	531,600	<50	<50	800	2,400	32,100	54,100
Riverside-San Bernardino	573,800	6,500	1,800	3,700	18,200	65,300	84,400
Total	2,226,850	7,475	7,700	6,775	38,125	169,150	312,725

¹ Supplemental heating source

With information from the AHS report as a first start, the OMNI report used assumptions based on regional and national surveys to estimate the number of wood burning appliances within various wood burning appliance categories (Table 3).

**Table 3
Estimates of Appliances by Appliance Type**

Appliance Type	South Coast Air Basin		Coachella Valley	
	Number Owned	Number Used	Number Owned	Number Used
Conventional pre-EPA certification wood heaters	161,260	148,008	7,425	6,702
EPA-certified non-catalytic wood heaters	34,341	33,107	1,590	1,499
EPA certified catalytic wood heaters	14,134	13,632	649	615
Pellet Heaters	9,490	9,278	497	479
Fireplaces without inserts	1,673,684	1,221,721	45,530	33,237
Total	1,892,909	1,426,746	55,691	42,532

Wood burned by appliance type was then estimated and the mass of wood was multiplied by the appropriate emission factor to estimate annual average emissions. Table 4 presents the annual average daily emissions estimate for wood burning appliances included in the OMNI report.

Table 4
2002 PM2.5 Emissions Inventory for Basin and Coachella Valley

PM2.5 (tons/day)

Appliance Type	Basin	Coachella Valley
Conventional pre-EPA certification wood heaters	9.07	0.43
EPA certified non-catalytic wood heaters	0.65	0.03
EPA certified catalytic wood heaters	0.32	0.02
Pellet heaters	0.03	<0.01
Fireplaces without inserts (wax/fiber logs included)	9.85	0.19
Total	19.92	0.68

With the high number of households with usable fireplaces in southern California, a key component used to estimate emissions is the average wood consumption per unit. The California Air Resources Board (ARB) includes a default statewide wood burning estimate of 0.28 cords per household and an estimate that a cord of wood weighs approximately two tons (ARB, 1997). For reference, a cord of wood is measured by volume as four feet wide by four in height, by eight feet in length. A review of wood seller survey information indicates that the average weight of a cord of wood in southern California is approximately 3,081 pounds or 1,400 kilograms (Sierra Research, 1989). Emission inventory guidance encourages the use of local survey data when available.

Using the average weight of a cord of wood in southern California and data from available survey information, the OMNI report estimated that wood burning heaters used for heat burned an average of 0.95 to 1 cord (approximately 3,000 pounds) per year. For fireplaces without inserts two independent methods were developed by OMNI to estimate the amount of wood burned for heating and wood burned for aesthetic use. One method estimated the number and duration of fires and the other included a weighted average to estimate cords burned per year for relative heating and aesthetic use. The first method (based on number and duration of fires) estimated typical annual wood usage per household for relative heating and aesthetics at 0.22 cord or approximately 678 pounds. The second method (weighted average) was based on estimates of the average cords burned in fireplaces without inserts for heating (0.656 cords or approximately 2,000 pounds) and average cords burned for aesthetics (0.069 cords or approximately 213 pounds).¹⁶ This resulted in an estimate that the average cords burned per household per year, weighted for relative heating and aesthetic use, was 0.17 cords (523 pounds).

In order to provide a range of emissions estimates, variations to the wood burned per household assumptions were applied to the base information included in the OMNI report. Specifically, the amount of wood burned in wood burning heaters used for primary heating was reduced from approximately 3,000 to 2,000 pounds based on data from the referenced

¹⁶ Houck J.E., et al, A Recommended Procedure for Compiling Emission Inventory for National, Regional, and County Activity Data for the Residential Wood Combustion Source Category, proceedings U.S. Environmental Protection Agency Emission Inventory Conference, Denver, CO, 2001

report.¹⁰ Similarly, the amount of wood burned for relative heating and aesthetics was reduced from 0.22 cords or approximately 678 pounds to 0.069 cords or approximately 213 pounds from the referenced report.¹⁰ Applying these average wood burning estimates to the number of wood burning appliances developed in the OMNI report results in the adjusted emission inventory presented in Table 5. It should be noted that the adjusted emission inventory presented in Table 5 does not alter the emission estimates for pellet stoves or wax/fiber logs where it is believed that better data was available.

Reducing the estimate of the average amount of wood burned per household for primary heating, relative heating, and aesthetic use, especially for the southern California area, appears appropriate and is consistent with available survey information indicating that households tend to overestimate when asked about the amount of wood burned each year (Sierra Research, 1989).

Based on this information, the annual average daily emissions from wood burning appliances is estimated to range from approximately ten to 20 tons per annual average day for the Basin and 0.41 to 0.68 ton per annual average day for the Coachella Valley portion of the Salton Sea Air Basin. It is acknowledged that the total annual wood burning emissions will increase during periods of cooler weather (generally November through February). For example, applying the total annual average wood burning emissions estimate of ten tons per day to the winter months identified above would result in an estimate of approximately 30 tons of PM2.5 per winter day.

Table 5
Adjusted 2002 PM2.5 Emissions Inventory for Basin and Coachella Valley
to Account for Lower Wood Burning Estimates

Appliance Type	PM2.5 (tons/day)	
	Basin	Coachella Valley
Conventional pre-EPA certification wood heaters	6.26	0.30
EPA certified non-catalytic wood heaters	0.45	0.02
EPA certified catalytic wood heaters	0.22	0.01
Pellet heaters	0.03	<0.01
Fireplaces without inserts (wax/fiber logs included)	3.13	0.08
Total	10.1	0.41

EMISSIONS REDUCTIONS

The paragraph (d)(1) prohibition of the installation of traditional, uncontrolled fireplaces in new developments, remodels, or permanent outdoor installations is a large source of emissions reductions from Proposed Rule 445. Emission reductions can be estimated as the differential in emissions from an uncontrolled fireplace to a combination of permissible appliances under the Proposed Rule 445 provisions. It is anticipated that, due to buyer

preference for convenience, the majority of fireplaces installed in new home construction are dedicated natural gas units; however, traditional, uncontrolled fireplaces are still permitted to be installed in new homes, remodels, and outdoor applications.

To estimate Proposed Rule 445 emissions reductions potential, U.S. Census housing census data was used to determine the annual average number of housing units constructed in the District (Appendix C). The number of housing units with fireplaces was then determined based on an ARB assumption that 40 percent of households have fireplaces. (This ARB assumption was corroborated by comparing 2002 AHS data for District households with usable fireplaces with the total number of District households based on 2002 US Census data). An assumption that 75 percent of new households constructed have dedicated natural gas fireplaces was then used to estimate the number of traditional, uncontrolled fireplaces that would have been installed in new homes in absence of Proposed Rule 445. It was then presumed that instead of installing traditional, uncontrolled fireplaces in new home construction, a mix of US EPA Phase II-certified units, dedicated natural gas units, and electric units would be installed to comply with the regulation. The resulting emissions reductions from Proposed Rule 445 paragraph (d)(1) provisions are estimated at approximately 18.5 tons of PM_{2.5} per year beginning in 2008. It should be noted that Proposed Rule 445 will also result in cumulative air quality benefits as annual emissions reductions will be recurring. Therefore, Proposed Rule 445 paragraph (d)(1) emissions reductions can be estimated at approximately 130 tons of PM_{2.5} per year by 2014.

Additional emissions reductions are associated with Proposed Rule 445 paragraph (d)(8), wood burning prohibitions. Specifically, based on the adjusted PM_{2.5} emissions inventory of approximately ten tons per annual average day (30 tons per winter day) and an average of three no burns days forecasted during the November through February time period and a conservative fifty percent compliance rate, the emissions reductions from wood burning prohibitions are estimated at 45 tons of PM_{2.5} per year. Public education and outreach is also anticipated to increase and ensure emission reductions primarily on the no burn day restrictions; however, a conservative fifty percent compliance rate has been used for the early years of program implementation.

Emissions reductions would also be associated with the Proposed Rule 445 paragraph (d)(7) requirement that prohibits the use of uncontrolled wood burning appliances at existing commercial facilities after 2010, but these reductions are estimated to be relatively small due to the small number of these sources. To calculate emissions reductions, it has been estimated that there are 250 traditional, uncontrolled fireplaces operating at commercial facilities (hotels, restaurants, etc.) based on a limited internet search. For these sources, it is estimated that traditional, uncontrolled fireplaces would be replaced with a higher percentage of EPA Phase II-certified units due to the desire to continue wood burning for aesthetic purposes. The remaining traditional, uncontrolled fireplaces would be replaced with dedicated natural gas units. The resulting PM_{2.5} emissions reductions are estimated to range from approximately 1.2 to 2.5 tons per year, depending on wood usage. By 2014, emissions reductions are estimated to cumulatively increase to approximately 14.5 tons per year. An additional 0.4 tons per year of PM_{2.5} reductions are anticipated from the wood burning prohibitions contained in paragraph (d)(8).

Additional emission reductions would be associated with the paragraph (d)(9) requirements to replace, remove, or render inoperable all non-EPA Phase II-certified wood heaters upon the sale of real property in areas impacted by PM_{2.5} levels above 20 µg/m³. In order to estimate emissions reductions, assumptions were made regarding the number of wood burning heaters that may be affected, the frequency of property transfers, and compliance

options by those properties affected. To represent a conservative estimate, it was presumed that the property transfer requirements would apply to all wood heaters in Riverside and San Bernardino Counties. Frequency of property transfers was based on a Chicago Title Company database that identified an average turnover of property ownership to be 10.5 years. Property owner compliance options were presumed as follows: 70 percent replacement with EPA Phase II-certified wood heaters, 20 percent replacement with dedicated natural gas units and ten percent removal/rendered permanently inoperable. Based on these assumptions, the emissions reductions associated with Proposed Rule 445 paragraph (d)(9) requirements are estimated at 30 tons per year by 2013 and these emissions reductions will cumulatively increase to 60 tons per year by 2014.

Appendix C includes the worksheets for the emission reduction estimates. Efforts will continue to be made through the public process to further refine the estimated number of traditional, uncontrolled fireplaces currently being installed in new housing developments and operated at existing commercial facilities as well as the number of non-EPA Phase II-certified wood heaters that would be subject to change-out requirements beginning in 2012.

COST-EFFECTIVENESS

Cost-effectiveness is calculated by dividing the estimated compliance costs of a proposed regulation by the estimated emission reductions. Proposed Rule 445 compliance costs were based on assumptions regarding incremental increase in costs for new residential construction provided by product vendors and replacement costs for commercial facilities. Maintenance costs were presumed to be zero as the traditional, uncontrolled fireplaces that would have been installed in absence of the regulation would be subject to equivalent maintenance costs as the appliances installed to comply with Proposed Rule 445. These costs were divided by the estimated emission reductions for 20 years (estimated equipment lifetime) in order to obtain a cost-effectiveness estimate using the Discounted Cash Flow (DCF) methodology. The DCF methodology is based on the following formula:

$$\frac{K + \text{OEM (PVF)}}{\text{Emission Reductions} \times 20 \text{ years}}^{17}$$

Where:

K – capital costs

O&M – recurring (maintenance) costs

PVF – present value factor (12.5)

Based on the information presented in Appendix C, a preliminary cost-effectiveness evaluation of the Proposed Rule (d)(1) and (d)(8) requirements are estimated at approximately \$2,800 per ton of PM_{2.5} reduced. The cost-effectiveness of the Proposed Rule (d)(7) and (d)(8) requirements are estimated to range from approximately \$14,000 to \$27,000 per ton of PM_{2.5} reduced, depending on assumptions regarding wood burning per unit. The cost-effectiveness of the paragraph (d)(9) change-out requirements are estimated at approximately \$14,000 per ton of PM_{2.5} reduced. It should be noted that the information included in Appendix C is a preliminary evaluation of cost-effectiveness that does not

¹⁷ Estimated equipment lifetime

include cost savings from reduced wood usage in EPA Phase II-certified wood heaters when compared to traditional, uncontrolled fireplaces.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

Pursuant to the California Environmental Quality Act (CEQA) and AQMD Rule 110, staff is reviewing Proposed Rule 445 and will prepare the appropriate CEQA documentation for public review. Comments received will be considered when determining the appropriate CEQA document for the proposed project.

SOCIOECONOMIC ASSESSMENT

Staff will prepare a Socioeconomic Assessment of Proposed Rule 445 that will be included in the Set Hearing package.

DRAFT FINDINGS

Health and Safety Code Section 40727 requires the AQMD to adopt written findings of necessity, authority, clarity, consistency, non-duplication and reference.

Necessity

A need exists to adopt Rule 445 to implement 2003 AQMP control measure MSC-06 and draft 2007 AQMP control measure BCM-03.

Authority

The AQMD Governing Board obtains its authority to adopt, amend, or repeal rules and regulations from California Health & Safety Code Sections 40000, 40001, 40702, and 40725 through 40728, inclusive.

Clarity

The proposed amended rule has been written or displayed so that its meaning can be easily understood by persons directly affected by it.

Consistency

The proposed amended rule is in harmony with and not in conflict with or contrary to, existing statutes, court decisions or state or federal regulations.

Non-Duplication

The proposed amended rule does not impose the same requirements as any state or federal regulations. The amendment is necessary and proper to execute the powers and duties granted to, and imposed upon, AQMD.

Reference

By adopting the Proposed Rule, the AQMD Governing Board will be implementing, interpreting, and making specific the provisions of the California Health & Safety Code Section 40001 (rules to achieve ambient air quality standards).

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