

Revisions to RULE 74.11 NATURAL GAS-FIRED WATER HEATERS

BACKGROUND

Rule 74.11 was adopted on April 9, 1985, and is based on Control Measure N-10, *Residential Water Heaters*, in the 1982 Ventura County Air Quality Management Plan (AQMP). The measure was expected to “limit the allowable nitrogen oxide emission level from new heating equipment by requiring combustion modifications.” The 40 nanogram per joule (ng/J) NO_x limit was predicted to yield a maximum control efficiency of 13.3 percent. Control Measure N-10 was based on a Reasonably Available Control Measure (RACM) proposed in the 1981 update to the Final 1979 AQMP. The RACM predicted a future (1987) NO_x reduction of 28 tons per year.

On December 10, 1999, South Coast Air Quality Management District (SCAQMD) adopted a revision to their residential water heater rule (1121). In this revision, new units were required to meet a NO_x emission limit of 20 ng/J by July 1, 2002. A 2004 amendment required a NO_x limit of 10 ng/J by January 1, 2006. A mitigation fee was available as an alternative to meeting the 2002 limit.

In developing this revision to Rule 74.11, staff felt that a key requirement was a commitment to the

process from the SCAQMD. Revised Rule 1121 creates a new market for low-NO_x residential water heating equipment in Southern California. Ventura County can expand on that market. In addition, SCAQMD noted in 1999 that revised Rule 1121 was a technology forcing rule; residential water heater burners were redesigned to meet the limits. Since the 10 ng/J NO_x limit took effect on January 1, 2006, it has become clear that complying water heaters are available in Southern California (see Appendix A).

Equipment Users

Water heaters in this size range are used primarily to heat water for residential homes. However, these units are also used in commercial operations where a limited amount of hot water is needed. According to data received from the Gas Company in December, 1996, there are 2428 commercial users of units up to 75,000 Btu/hr in the county.

To estimate the number of residential units in the county, staff assumed that the number is equal to the number of housing units that are owner occupied. Using the 2006 census, this number is estimated to be 182,962.

PROPOSED RULE

In order to create a market for ultra low-NO_x water heaters that is as broad as possible, the emission limits recommended for Rule 74.11 are the same as those in SCAQMD Rule 1121. However, since final compliance in the SCAQMD has occurred, an interim NO_x limit of 20 ng/J is not proposed.

Staff proposes to amend the applicability statement in the initial paragraph of the rule to include all water heaters rated at less than 75,000 Btu/hour, including mobile home water heaters. Mobile home water heaters are discussed further below. Note that the word "residential" has been removed, which adds commercial water heaters to the rule. In addition, both "Residential" and "Control of NO_x" have been removed from the title of the rule. The revised applicability statement will read as follows:

The provisions of this rule shall apply to any person selling, offering for sale, or installing natural gas-fired residential water heaters, including mobile home water heaters, rated at less than 75,000 Btu per hour in Ventura County.

In the amended rule, new Subsection A.2 will limit NO_x emissions from all water heaters (except mobile home) to 10 ng/J (or 15 ppmv). In addition, new Subsection A.3 will impose a 40 ng/J NO_x limit on mobile home water heaters, which will no longer be exempt. The new limits will go into effect on July 1, 2010, when the existing limits in renumbered Subsection A.1 will sunset. The July 1 date is intended to allow non-complying water heater inventory to be sold. Note that the new ultra low-NO_x water heaters are a direct replacement for existing units.

The proposed revisions to Section A, Requirements, are as follows:

- 1. After December 31, 1985 Until July 1, 2010, a person shall not sell, offer for sale, or install in Ventura County any natural gas-fired residential water heater that:**
 - ~~1. Emits emits nitrogen oxides in excess of 40 nanograms of NO_x (calculated as NO₂) per joule of heat output (93 lb per billion Btu), and~~
 - ~~2. Is not certified in accordance with Section B.~~
- 2. After July 1, 2010, except as specified in Subsection A.3, no person shall sell, offer for sale, or install within Ventura County any natural gas-fired water heater unless the water heater is certified pursuant to Section B to a NO_x emission level of less than or equal to:**
 - a) 10 nanograms of NO_x (calculated as NO₂) per joule of heat output (23 lb per billion Btu of heat output); or**
 - b) 15 ppmv at 3% O₂, dry (17.5 lb per billion Btu of heat input).**
- 3. After July 1, 2010, no person shall sell, offer for sale, or install within Ventura County any natural gas-fired mobile home water heater unless the water heater is certified pursuant to Section B to a NO_x emission level of less than or equal to:**
 - a) 40 nanograms of NO_x (calculated as NO₂) per joule of heat output (93 lb per billion Btu of heat output); or**
 - b) 55 ppmv at 3% O₂, dry (71 lb per billion Btu of heat input).**

Note that sentence 2 in Subsection A.1 is being deleted. This requirement no longer coincides with the certification requirements in Section B. Deleting the sentence will have little effect on compliance before Subsection A.1 sunsets on July 1, 2010.

Parts per million (PPM) measurements are by volume and made at three percent oxygen on a dry basis. There may appear to be a discrepancy between the ng/J NO_x limits in Section B and the concentration (ppm) limits. The concentration limits are based on an assumed thermal efficiency of 76 percent. This adjustment reflects both the efficiency benefit of a ng/J limit and the relative difficulty of determining ng/J, which requires both an emission and energy measurement. Although many units manufactured today have a thermal efficiency greater than 76 percent, no emission limit correction factor for higher efficiency units is suggested for the rule; a correction factor would complicate the rule unnecessarily.

The testing and calculation portion of the certification process in Section B is proposed for deletion. The compliance reporting requirements will be amended and retained. For a number of years, it has been District policy to accept SCAQMD certification results in lieu of the test requirements in Section B. Staff proposes to specify in the rule that water heaters certified for use in the South Coast Air Quality Management District will be considered certified for use in Ventura County, as noted below:

B. Certification

- 1. The requirements of Section D not withstanding, applicable equipment certified by the South Coast Air Quality Management District in accordance with the certification requirements in Section (d) of SCAQMD Rule 1121, adopted September 3, 2004, shall be considered certified for use in Ventura County.**

The proposed revisions to the certification reporting requirements in renumbered Subsection B.2 appear below:

23. Compliance Report

~~The manufacturer shall submit to the APCO a Compliance Report by December 1, 1985 which contains the following information for each water heater subject to the provisions of this rule:~~

Prior to the sale of any model of water heater in Ventura County, the manufacturer shall submit to the Air Pollution Control Officer a Compliance Report documenting its certification

pursuant to Section B of this rule. The Compliance Report shall contain the following information:

(a) Compliance Statement

A statement that the water heater model is in compliance with Section B of this rule. The statement shall be signed by the manufacturer and dated, and shall attest to the accuracy of all statements.

(b) General Information

- (1) Name and address of manufacturer,
- (2) Brand name of water heater,
- (3) Model number, as it appears on the water heater rating plate, and
- (4) Description of each model water heater being certified.
- (5) A copy of the letter from the South Coast Air Quality Management District certifying the water heater model.

(b) Test Report

- ~~(1) All data from compliance testing of water heater, and~~
- ~~(2) All calculations for determining compliance of the water heater~~
- (c) Compliance Statement

~~A signed and dated statement attesting to the accuracy of all statements and information in the Compliance Report.~~

~~A manufacturer shall submit a new Compliance Report for any water heater whose design is changed in any manner which may alter the emissions from the water~~

~~heater. New Compliance Reports, for either altered models or new models, shall be submitted to the APCO at least 30 days before the water heater is offered for sale in Ventura County.~~

Any model certified for sale in Ventura County must be marked as such. It is important for a purchaser to easily identify complying units. As stated in revised Section C, the certification status of a unit must appear on both the permanent nameplate and the packaging. The model number and date of manufacture must also appear. District staff will assume that a unit offered for sale without the necessary certification status declaration is non-complying.

C. Identification of Complying Water Heaters

~~The water heater manufacturer shall display the model number of the water heater subject to the provisions of this rule on the shipping carton and rating plate.~~

The manufacturer shall display the model number, the date of manufacture, and the certification status, as determined in Section B of this rule, of an applicable unit on both the permanent nameplate and the packaging.

As stated in Subsection D.1, the District may require emission testing on units stocked by local distributors, retailers, and installers. Tests are not limited to units without SCAQMD certification; a test may be requested on any unit. All testing shall be done at the manufacturer, distributor, retailer, or installer's expense. With a certification process in place, few specific source tests are expected.

A reference to the SCAQMD source test protocol is proposed for Subsection D.1. In addition, both NO_x and CO₂ are specified for the calculation of nano-grams per joule (ng/J). No change is proposed for Subsection D.2.

D. Enforcement

1. The APCO may require that the a NO_x and CO₂ emission test results be provided when deemed necessary to verify compliance. Testing shall be conducted according to the South Coast Air Quality Management District Protocol For Nitrogen Oxides Emissions Compliance Testing For Natural Gas-

**Fired Water Heaters And Small Boilers,
dated March 1995 (amended January
1998).**

The exemption in Subsection E.3 for mobile home water heaters is proposed for deletion. As noted above, mobile home water heaters will be required to meet a 40 ng/J NO_x limit and will no longer be exempt from the provisions of the rule.

E. Exemptions

The provisions of this rule shall not apply to:

- ~~3. Water heaters installed in mobile homes constructed in compliance with Title 24 CFR Part 3280—Manufactured Home Construction and Safety Standards.~~

Burners for mobile home (or manufactured home) water heaters are designed to be operated with different fuel types such as natural gas, propane, or butane. For this reason, mobile home water heater burners differ from general-use water heater burners and are not transferable. Rule 74.11 applies only to natural gas-fired equipment, so water heaters burning liquefied propane or butane gas remain exempt from the rule. Note, however, that mobile homes equipped with a natural gas-fired general-use water heater must install a complying unit.

Mobile home water heaters that comply with the 40 ng/J NO_x limit are commercially available. Several air districts (SCAQMD, Bay Area, San Joaquin and Yolo-Solano) have established a mobile home water heater NO_x limit of 40 ng/J. In addition, most mobile home water heaters certified in the SCAQMD have done so at less than 40 ng/J NO_x; only one base model mobile home water heater family was certified at 41 ng/J. Staff has found complying mobile home water heaters from the following manufacturers: Rheem, State, Lochinvar, A.O. Smith and American. More may be available from other manufacturers.

The new definitions in Section F come from a variety of sources. The definition of "rated heat input capacity" is similar to the definition District Rule 74.15.1; note that the derating provision in Rule 74.15.1 has been removed. The definition of "mobile home" is similar to one appearing in California Administrative Code title 2, § 1870, Definitions.

The "water heater" definition is drawn from Rule 74.11.1, *Large Water Heaters and Small Boilers*. The first sentence is the same as existing Rule 74.11. The remainder of the definition describes the process

in greater detail. Because the word "vessel" is included, the definition does not apply to "instantaneous" tankless water heaters. Also, SCAQMD notes that the capacity of instantaneous water heater burners is typically greater than 75,000 Btu/hr.¹ The definition of "Heat Output" will be renumbered as Subsection F.3 but is otherwise unchanged.

The following new definitions are proposed:

F. Definitions

For the purposes of this rule the following definitions shall apply:

1. **"Btu": British thermal unit or units.**
2. **"Heat input": The heat of combustion released by fuels burned in a unit based on the higher heating value of fuel, excluding the enthalpy of incoming combustion air.**
4. **"Mobile Home": A structure built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities. The structure typically includes plumbing, heating, air conditioning, and electric systems and may be transportable in one or more sections. Excluded are self-propelled vehicles and recreational vehicles.**
5. **"Rated Heat Input Capacity": The gross heat input capacity specified on the nameplate of either the unit or the burner.**
6. **"Recreational vehicle": A motor home, travel trailer, truck camper, or camping trailer, with or without motive power, designed for human habitation for recreational, emergency, or other occupancy, as defined pursuant to California Health and Safety Code § 18010.**
- ~~1. "Water heater" is defined as a device that heats water at a thermostatically-controlled temperature for delivery on demand.~~
7. **"Water heater": A device vessel that heats water at a thermostatically-controlled temperature for delivery on**

demand. Water is heated by the combustion of either liquid and/or gaseous fuel and withdrawn for use external to the vessel at pressures not exceeding 160 psig. The device includes

the apparatus by which heat is generated and all controls and equipment necessary to prevent water temperatures from exceeding 210°F (99°C).

EMISSIONS / COST-EFFECTIVENESS

Emission Reduction - General

To calculate low-NOx water heater emission reductions, it is important to estimate the number of water heaters in the program. According to the US Census Bureau², there were 270,654 dwelling units in Ventura County in 2006. The Census also provides a home ownership rate of 67.6 percent; based on this, the number of water heaters in private homes is estimated to be 182,962. If we assume that 10 percent of these are replaced every year, 18,296 water heaters will be replaced annually.

According to the Gas Company (SCG), there are about 2,428 commercial users of water heaters of up to 75,000 Btu/hr in the county (see Appendix C). As noted above, units this size are used in commercial operations where a limited amount of hot water is needed. Assuming a 10 percent replacement rate, 243 water heaters will be replaced annually. This leads to an estimated annual replacement total of 18,539 water heaters in Ventura County.

To estimate emissions, it is assumed that all existing units are meeting the requirements of the current version on Rule 74.11. This means that all existing units emit NOx at no more than 40 ng/J, which is equal to about 93 pounds of NOx per billion Btus of natural gas burned (93 lb/10⁹ Btu). The proposed NOx emission rate of 10 ng/J is equal to 23.25 lb/10⁹ Btu. (These estimates are based in a conversion factor of 1 lb/mmBtu = 430 ng/J).³ Unit efficiency is assumed to be 76 percent.

Fuel use per unit is estimated at 190 therms per year. In 1999, SCAQMD provided the following analysis:

The annual average natural gas usage in 1998 for residential water heaters for the Basin is approximately 190 therms per year based on estimates from Southern California Gas Co. and 215 therms per year based on California Energy Commission estimates. . . Based on information from SCG, the annual average gas usage in 1998 for commercial establishments with

residential-type gas-fired water heaters is approximately 260 therms per year.

According to data for Ventura County from SCG in 1996, the 2428 commercial users noted above used an average of 337 therms of natural gas per year.

In 2007, EPA stated the following:

"Using the DOE test procedure for calculations, a fifty-gallon gas storage water heater with an Energy Factor of 0.62 would consume 242 therms per year."

Most conventional water heaters meet a lower federal Energy Factor standard of 0.58, which leads to an annual consumption of 261 therms. However, for the purpose of calculating cost-effectiveness, 190 therms per year is assumed for both commercial and residential units to underestimate emission reductions and maximize the relationship between cost and emission reductions. (190 therms = 19 x 10⁶ Btu).

For a point-of-sale rule, NOx reductions occur gradually over a 10 year period. After year one, 90 percent of the water heaters in the county will be old units and 10 percent will be new, low-NOx units. The change in NOx emissions for each year of the 10 year implementation cycle appears in Table 2.

To calculate cost-effectiveness, the NOx reduction for a single year of replacement water heaters is calculated as follows (with 10⁶ Btu cancelled out):

Annual Existing Emission Rate (40 ng/J)
 $(19)(18,539)(93)(0.76)/(1000)(2000) = \mathbf{12.45 \text{ tons per year}}$ NOx emitted countywide

Annual New Unit Emission Rate (10 ng/J)
 $(19)(18,539)(23.25)(0.76)/(1000)(2000) = \mathbf{3.11 \text{ tons per year}}$ NOx emitted countywide

On this basis, the NOx emission reduction for one year of complying water heaters is expected to be about **9.34 tons per year**. Over a ten year period, 93.36 tons of NOx is expected to be reduced.

Table 2
General-Use Water Heater Emission Reduction
over a 10 year period

Year	Water Heater Status (Percent)		Water Heater Status (Quantity)		NOx Emissions (Tons/year)	
	Old	New	Old	New	Old	New
0	100	0	185,390	0	124.48	0.00
1	90	10	166,851	18,539	112.03	3.11
2	80	20	148,312	37,078	99.59	6.22
3	70	30	129,773	55,617	87.14	9.34
4	60	40	111,234	74,156	74.69	12.45
5	50	50	92,695	92,695	62.24	15.56
6	40	60	74,156	111,234	49.79	18.67
7	30	70	55,617	129,773	37.34	21.78
8	20	80	37,078	148,312	24.90	24.90
9	10	90	18,539	166,851	12.45	28.01
10	0	100	0	185,390	0.00	31.12
					NOx Reduced	93.36

Cost-Effectiveness - General

For water heaters meeting the 10 ng/J NOx limit, water heater manufacturing costs will increase an estimated \$15 to \$50⁴. Other assumptions are as follows:

1. 18,539 units are replaced per year. New units are not included.
2. After one initial expenditure, each low-NOx unit will reduce NOx for 10 years.

Cost-effectiveness for the various incremental emission limit scenarios appears in Table 3. These estimates are much less than the District guideline of \$18,000 per ton NOx reduced. The cost-effectiveness calculations in the SCAQMD Staff Report for Rule 1121 include a "retail markup" factor.⁴ At that time, one source estimated this number to be 2.44, which represents a 144% price increase from manufacturing to retail. However, the U.S. Department of Energy states in a December, 2000 study that an overall markup factor of 1.59 is appropriate for natural gas water heaters.⁵ If this factor is applied to the calculations in Table 3, the cost-effectiveness estimates for each category remain less than the District guideline (see Table 4).

Emission Reduction - Mobile Home

In 1982, SCAQMD Rule 1121 established an NOx emission limit of 50 ng/J for natural gas-fired mobile

home water heaters. It is likely that mobile home water heaters currently sold in Ventura County comply with this limit. Using the conversion factor noted above, 50 ng/J is equal to 116 lb/10⁹ Btu NOx.

The proposed revision to Rule 74.11 establishes a NOx emission limit of 40 ng/J (93 lb/10⁹ Btu) for water heaters that are specifically made for mobile homes equipped to burn natural gas in addition to propane or butane.

Based on information from the California Department of Housing and Community Development (DHCD)⁶, there are 10,789 mobile home lots in Ventura County. Assuming again that 10 percent are replaced every year, 1,079 low-emission units will be purchased each year for 10 years. Although mobile home water heaters typically store less water than general-use units, we will assume that annual fuel use remains the same.

As noted above, NOx emission reductions occur gradually over a 10 year period. This applies to mobile home water heaters as well. The change in NOx emissions for each year of the 10 year implementation cycle appears in Table 5.

To calculate cost-effectiveness, the NOx reduction for a single year of replacement water heaters is calculated as follows (with 10⁶ Btu cancelled out):

Table 3
Annualized Cost-Effectiveness of Proposed Revision

Old NOx Limit	New NOx Limit	Quantity	Incremental Cost (\$)	Cost (\$)	10 Yr Life NOx Reduced (tons)	Cost-effectiveness (\$/ton)
General-Use						
40 ng/J	10 ng/J	18,539	15	278,085	93.36	\$ 2,979
40 ng/J	10 ng/J	18,539	35	648,865	93.36	\$ 6,950
40 ng/J	10 ng/J	18,539	50	926,950	93.36	\$ 9,929
Mobile Home						
50 ng/J	40 ng/J	1,079	15	16,185	1.80	\$ 8,992

Table 4
Annualized Cost-Effectiveness of Proposed Revision w/ Markup Factor

Old NOx Limit	New NOx Limit	Quantity	Incremental Cost (\$)	Cost (\$)	Markup Factor	10 Yr Life NOx Reduced (tons)	Cost-effectiveness (\$/ton)
General-Use							
40 ng/J	10 ng/J	18,539	15	278,085	1.59	93.36	\$ 4,736
40 ng/J	10 ng/J	18,539	35	648,865	1.59	93.36	\$ 11,051
40 ng/J	10 ng/J	18,539	50	926,950	1.59	93.36	\$ 15,787
Mobile Home							
50 ng/J	40 ng/J	1,079	15	16,185	1.59	1.80	\$ 14,297

Table 5
Mobile Home Water Heater Emission Reduction over a 10 year period

Year	Water Heater Status (Percent)		Water Heater Status (Quantity)		NOx Emissions (Tons/year)	
	Old	New	Old	New	Old	New
0	100	0	10,789	0	9.04	0.00
1	90	10	9,710	1,079	8.13	0.72
2	80	20	8,631	2,158	7.23	1.45
3	70	30	7,552	3,237	6.33	2.17
4	60	40	6,473	4,316	5.42	2.90
5	50	50	5,395	5,395	4.52	3.62
6	40	60	4,316	6,473	3.61	4.35
7	30	70	3,237	7,552	2.71	5.07
8	20	80	2,158	8,631	1.81	5.80
9	10	90	1,079	9,710	0.90	6.52
10	0	100	0	10,789	0.00	7.24
NOx Reduced						1.80

Annual Existing Emission Rate (50 ng/J)
 $(19)(1,079)(116)(0.76)/(1000)(2000) = \mathbf{0.90 \text{ tons per year}}$ NOx emitted countywide

Annual New Unit Emission Rate (40 ng/J)
 $(19)(1,079)(93)(0.76)/(1000)(2000) = \mathbf{0.72 \text{ tons per year}}$ NOx emission countywide.

On this basis, the NOx emission reduction for one year of complying mobile home water heaters is expected to be about **0.18 tons per year**. Over a ten year period, 1.8 tons of NOx is expected to be reduced.

Cost-Effectiveness - Mobile Home

As noted above, most mobile home water heaters certified in the SCAQMD had NO_x emission of 40 ng/J or less. Therefore, it is possible that compliance with the proposed emission limit will require no additional cost. However, for illustrative purposes,

staff estimates that water heater manufacturing costs will increase \$15. Using the same assumptions noted above, cost-effectiveness estimates for mobile home water heaters appear in Table 3 and 4. These estimates are less than the District guideline of \$18,000 per ton NO_x reduced.

SOCIOECONOMIC IMPACT

Assembly Bill 2061 (Polanco) [H&S § 40728.5], which went into effect on January 1, 1992, requires that the APCD Board consider the socioeconomic impact of any new rule or amendment to an existing rule if air quality or emission limits are affected. Proposed Rule 74.11 imposes emission limits and may affect air quality in Ventura County, so the requirements of the bill must be evaluated. The Board must evaluate the following socioeconomic information on revised Rule 74.11:

- (1) *The type of industries or business, including small business, affected by the rule or regulation.*

Rule 74.11 will primarily affect residential homeowners and small or medium-sized businesses in Ventura County. It is not possible to predict any other type of new source to which Rule 74.11 will apply.

- (2) *The impact of the rule or regulation on employment and the economy of the region affected by the adoption of the rule or regulation.*

The proposed revision to Rule 74.11 are expected to have no impact on employment in and the economy of Ventura County. The proposed rule is a point-of-sale rule, where new, low-NO_x units replace obsolete standard units gradually over time. The cost-effectiveness of the proposed rule is favorable. While new lower-NO_x units will be more expensive than existing units, this additional expense is expected to be less than significant.

- (3) *The range of probable costs, including costs to industry or business, including small business, of the rule or regulation.*

Complying equipment may cost between \$15 and \$50 per unit more than existing equipment. For the proposed general NO_x emission limit,

the cost-effectiveness of gas-fired lower-NO_x water heaters varies from \$2,979 to \$15,787 per ton of NO_x reduced. For mobile home water heaters, the cost-effectiveness varies from \$8,992 to \$14,297 per ton of NO_x reduced. This is consistent with the District's cost-effectiveness guideline of \$18,000 per ton of NO_x reduced. See Tables 3 and 4 above.

- (4) *The availability and cost-effectiveness of alternatives to the rule or regulation being proposed or amended.*

No alternatives to the proposed revisions are available. Complying equipment for the proposed 10 ng/J NO_x limit has been available in the SCAQMD since January 1, 2006. Mobile home equipment complying with the proposed 40 ng/J NO_x limit has been available in the SCAQMD since the mid-1980's.

- (5) *The emission reduction potential of the rule or regulation.*

After full implementation in 2020, the estimated total NO_x reduction for the general water heater portion of proposed Rule 74.11 is 93.36 tons per year (Table 2). For mobile home water heaters, total NO_x reduction is estimated to be 1.8 tons per year (Table 5).

- (6) *The necessity of adopting, amending, or repealing the rule or regulation in order to attain state and federal ambient air standards pursuant to Chapter 10 (commencing with Section 40910).*

By reducing NO_x emissions, adoption of proposed Rule 74.11 will assist in the District's progress towards attainment and maintenance of the federal and California ozone ambient air quality standards.

ENVIRONMENTAL IMPACTS OF METHODS OF COMPLIANCE

California Public Resources Code Section 21159 requires the District to perform an analysis of the reasonably foreseeable environmental impacts of the methods of compliance. The analysis shall take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and specific sites. The analysis must include the following information on the proposed rule:

- (1) *An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.*

The proposed rule is a point-of-sale rule, where new, low-NOx units replace obsolete standard units over time. Since units become obsolete at different rates and low-NOx units are expected to become obsolete at the same rate as standard units, no additional waste is expected to appear in landfills. In addition, old water heaters and small boilers are frequently recycled. The new low-NOx units are expected to cause no adverse environmental impacts. Since many forced-draft low-NOx designs have a greater thermal efficiency than atmospheric designs, a decrease in fuel consumption is expected for many new units.

- (2) *An analysis of the reasonably foreseeable mitigation measures.*

Since no adverse environmental impacts are expected, no mitigation measures are proposed.

- (3) *An analysis of the reasonably foreseeable alternative means of compliance with the rule or regulation.*

No alternatives are proposed. As shown in Appendix A, there are a number of manufacturers supplying equipment that complies with the proposed rule. Other manufacturers are expected to develop complying equipment as well, increasing competition and decreasing costs. Although both electric and heat pump water heaters have been ruled out as cost-effective alternatives, heat recovery water heaters reduce annual costs. However, heat recovery water heaters are applicable only in specific applications. Solar water heating is another viable alternative in southern California.

The above analysis under Public Resource Code Section 21159 further demonstrates that there is no reasonable possibility that the adoption of proposed Rule 74.11 will have a significant effect on the environment due to unusual circumstances.

CEQA Requirements

Staff concludes that the adoption of proposed Rule 74.11 is within the scope of the categorical exemptions from the California Environmental Quality Act (CEQA) under state CEQA guideline Sections 15307, Protection of Natural Resources, and 15308, Protection of Environment, and that no exception to these categorical exemptions apply.

ANALYSIS OF EXISTING REGULATIONS

California Health & Safety Code Section 40727.2(a) requires districts to provide a written analysis of existing regulations prior to adopting, amending or repealing a regulation. Section 40727.2(a) states:

In complying with Section 40727, the district shall prepare a written analysis as required by this section. In the analysis, the district shall identify all existing federal air pollution control requirements, including, but not limited to, emission control standards constituting best available control technology for new or modified equipment, that apply to the same equipment or source type as the rule or regulation proposed for adoption or

modification by the district. The analysis shall also identify any of that district's existing or proposed rules and regulations that apply to the same equipment or source type, and all air pollution control requirements and guidelines that apply to the same equipment or source type and of which the district has been informed pursuant to subdivision (b).

Proposed Rule 74.11 applies to water heaters rated under 75,000 Btu/hr input capacity. No known state or federal air pollution control regulations apply to this equipment. Units in this size range do not require District Permits to Operate.

INCREMENTAL COST-EFFECTIVENESS

Health and Safety Code Section 40920.6 requires the performance of an incremental cost-effectiveness analysis for a regulation that identifies more than one control option to meet the same emission reduction objectives. Incremental cost-effectiveness is defined as the difference in costs divided by the difference in emission reductions between one level of control and the next more stringent level of control.

Rule 74.11 regulates the supply of applicable units in Ventura County; in doing so, it requires water heater

users only to purchase a complying unit. Residential water heaters have been subject to NOx emission control since 1985. The proposed revisions reduce the NOx emission limit for these units.

For this rule, complying equipment is currently available in the SCAQMD. Implementation of the proposed limits in Ventura County depends in the availability of complying equipment. Therefore, no alternate control option is available and an incremental cost-effectiveness analysis is not necessary.

MEETINGS AND COMMENTS

Public Workshop

Staff held a public workshop on the proposed revisions to Rule 74.11 on September 15, 2009. There were no attendees.

Advisory Committee

On November 3, 2009, the Advisory Committee recommended unanimously that the Air Pollution Control Board adopt the proposed revisions to Rule 74.11, with the following revisions:

1. Remove the word "residential" from the new requirements of the rule. The committee felt that the rule should apply to water heaters used in both residential and commercial applications.
2. Delete sentence 2 from the existing NOx requirements in renumbered Subsection A.1. This sentence is not consistent with the new certification requirements in Section B. Staff believes that deleting this sentence will have little effect on compliance because all water heaters currently available are SCAQMD

certified. In addition, Subsection A.1 sunsets on July 1, 2010.

3. Change the definition of "Mobile Home" in Section F as follows:
4. **"Mobile Home": A structure built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities. The structure typically includes plumbing, heating, air conditioning, and electric systems and may be transportable in one or more sections. Excluded are self-propelled vehicles and recreational vehicles.**

Staff has incorporated these changes into the proposed rule.

Comments

The California Air Resources Board provided 'no comment' letters on 9/3/09 and 10/15/09. The USEPA provided a 'no comment' letter on 8/18/09. No other written comments have been received.

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2. U.S. Census Bureau, June 23, 2008 <http://quickfacts.census.gov/qfd/index.html>
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6. CA DHCD website, Ventura County search on <http://www.hcd.ca.gov/ParksListing/faces/parkslist/mp.jsp>, March 3, 2009

Appendix A
SCAQMD Rule 1121 Certification LIST
Water Heaters at 10 Nanograms per Joule NOx
(July 10, 2009)

Rheem Manufacturing Company

Phase I Units - Conventional Water Heaters ≤ 50 gallons
BASE MODEL Rheem 22V40SFN, 36,000 Btu/hr

Rheem.....22V40SFN, 22X40SFN
Rheem PRO22V40S PROFN
Ruud P-240SFN, M2-40SFN
Ruud PRO..... P2-40S PROFN
Richmond 6G40S-36FN, 9G40S-36FN
GE..... GG38S06AXK00, PG38S09ASK00
Hot Point..... HG38S01AXK00

SCAQMD Rule 1121 Certification, (October 11, 2007 Test Report), November 20, 2007

Phase I Units - Conventional Water Heaters ≤ 50 gallons
BASE MODEL Rheem 22VR40FN, 38,000 Btu/hr

Rheem.....22VR40FN, 22XR40FN
Rheem PRO RHG PRO40FN
Ruud P2R-40FN, M2R-40FN
Ruud PRO..... RUG PRO40FN
Richmond 6G40V-38FN, 12G40V-38FN
GE..... GG40T06TXK00, SG40T12TXK00

BASE MODEL Rheem 22VR50FN, 36,000 Btu/hr

Rheem.....22VR50FN, 22XR50FN
Rheem PRO RHG PRO50FN
Ruud P2R-50FN, M2R-50FN
Ruud PRO..... RUG PRO50FN
Richmond 6G50-36FN, 12G50-36FN
GE..... GG50T06TXK00, SG50T12TXK00

SCAQMD Rule 1121 Certification, December 7, 2007

Phase II Units - >50 gallon (60 Gallon), Conventional, NG
BASE MODEL Rheem 42V60FN, 45,000 Btu/hr

Rheem.....42V60FN
Rheem PRO RHG PRO60FN
Ruud PH2-60FN
Ruud PRO..... RUG PRO60FN
GE..... SG60T12YXS10

SCAQMD Rule 1121 Certification, (December 12, 2008 Request w/Source Test), February 13, 2009

Phase III Units - Direct Vent, Power Vent, or Power Direct Vent

BASE MODEL Rheem 22V50FN, 40,000 Btu/hr

Rheem.....22X50FN, 22V50FN
Rheem PRORHG PRO50FN
Ruud P2-50FN, M2-50FN
Ruud PRO.....RUG PRO50FN
Richmond 6G50-40FN, 12G50-40FN, 9G50-40FN
GE.....GG48T06AXK00, SG48T12AXK00, PG48T09AXK00

BASE MODEL Rheem 22V40FN, 38,000 Btu/hr

Rheem.....22X40FN, 22V40FN
Rheem PRORHG PRO40FN
Ruud P2-40FN, M2-40FN
Ruud PRO.....RUG PRO40FN
Richmond 6G40-40FN, 12G40-40FN, 9G40-40FN
GE.....HG38T01AXK00, GG38T06AXK00, SG38T12AXK00, PG38T09AXK00

BASE MODEL Rheem 22V30FN, 30,000 Btu/hr

Rheem.....22X30FN, 22V30FN
Rheem PRORHG PRO30FN
Ruud P2-30FN, M2-30FN
Ruud PRO.....RUG PRO30FN
Richmond 6G30-30FN
GE.....GG28T06AXK00, PG28T09AXK00

SCAQMD Rule 1121 Certification, (June 12, 2007 Request w/Source Test), September 18, 2007

**American Water Heater Company
Conventional Water Heaters ≤ 50 gallons**

American Standard Models UG(1,3,5,6,8,9,10,12)(1,2)40T403N, 40,000 Btu/hr

U.S. CraftmasterUG(1,2)(A,E,F,H,J)4040T3N
Reliance 6 40 UBRT, 6 40 UOCT, 9 40 UKRT, (6,9) 40 U(B,K)CT
A.O. Smith.....GCHN-40, GNR-40
StateGS6 40 UBRT (G), GS6 40 UOCT (G)
Sears 153.330642, 153.330942, 153.331242, 153.330660, 153.330960, 153.331280

BASE MODEL American Water Heater UG(1,3,5,6,8,9,10,12)30T303N, 30,000 Btu/hr

U.S. CraftmasterUG(1,2)(A,E,F,H,J)3030T3N
Reliance 6 30 UORT
A.O. Smith.....GCHN-30
StateGS6 30 UORT (G)

BASE MODEL American Water Heater UG(1,3,5,6,8,9,10,12)(1,2)50T403N, 40,000 Btu/hr

U.S. CraftmasterUG(1,2)(A,E,F,H,J)5040T3N
Reliance 6 50 UBRT, 6 50 UOCT, 9 50 UKRT, (6,9) 50 U(B,K)CT
A.O. Smith.....GCHN-50, GNR-50
StateGS6 50 UBRT (G), GS6 50 UOCT (G)
Sears 153.330652, 153.330952, 153.331252, 153.330970, 153.331290

Notes:

- All models may have any combination of suffix letters: V, O, X, M, H, or C
- Conventional Water Heaters

SCAQMD Rule 1121 Certification

(August 10, 2006), (September 21, 2007), (November 14, 2008), January 20, 2009

AMERICAN STANDARD WATER HEATERS

Conventional Water Heaters (Phase I) ≤ 50 gallons

AMERICAN STANDARD MODELS	Capacity Gallons	Input (Btu/Hr)
G-30L	30.....	35,000
G-40L	40.....	37,000
G-50L	50.....	40,000
G-30T	30.....	35,000
G-40T	40.....	40,000
G-50T	50.....	40,000
G-50T	50.....	48,000

SCAQMD Rule 1121 Certification, November 30, 2007

BRADFORD WHITE

Conventional Water Heaters (Phase I)

BRADFORD WHITE BASE MODEL	LOCHINVAR DERIVATIVE	Input (Btu/Hr)
U1-30S6FRN	USN030G	30,000
U1-30T6FRN	UTN030G	32,000
U4-30T6FRN	UTN030G-EF	32,000
U1-40T6FRN	UTN040G	40,000
U1-403T6FRN	UTN041G	40,000
U4-40T6FRN	UTN040G-EF	40,000
U1-403S6FRN	USN041G	40,000
U1-XR-403S6FRN	--	40,000
U4-403S6FRN	USN040G-EF	40,000
U1-5036FRN	UTN050G	40,000
U4-5036FRN	UTN050G-EF	40,000
U1-50L6FRN	USN050G	40,000
U1-404T6FRN.....	UTN050G-4	50,000
U1-504S6FRN.....	--	50,000

SCAQMD Rule 1121 Certification, (November 20, 2007), June 25, 2008

Appendix B

CONTROL TECHNOLOGY DISCUSSION

The proposed revision to Rule 74.11 focuses on the pollutants generated during fuel combustion. Note, however, that non-fuel burning equipment is also available. This includes electric water heaters, heat recovery water heaters, heat pump water heaters and solar water heaters. Heat recovery units use waste heat and emit no air pollution. The only emissions associated with electric water heaters and heat pumps are those generated at the utility power plant. Solar water heaters emit no air pollution.

All of the above alternative technologies except solar were evaluated as replacements for large gas-fired water heaters and small boilers during the development of Rule 74.11.1. At that time, each alternative was found to exceed cost-effectiveness guidelines. Staff believes that this situation extends to small general-use water heaters. Due to government incentives, solar water heating may be a viable alternative. However, no alternative technology is evaluated in this report.

NOx Formation

NOx is formed in two ways during the combustion process. Thermal NOx is formed by the reaction of nitrogen and oxygen in high temperature combustion air. Prompt NOx is dependent on the availability of hydrocarbon radicals; temperature is not a factor. Hydrocarbon radicals combine with nitrogen to form HCN, which subsequently yields NO and prompt NOx.

Thermal NOx can be reduced by lowering the peak flame temperature in the burner. This is done primarily by eliminating "hot spots" in the combustion gases. Hot spots are locations where very rapid mixing of fuel and air occur. Slowing the mixing of fuel and air results in a lower uniform flame temperature and a reduction in thermal NOx. (APTI, 1980). Burner designs that reduce the development of "hot spots" include radiant burners, multiple-port burners, low swirl stabilized burners, and lean flame stabilization ring inserts.

Prompt NOx is reduced by oxidizing available free hydrocarbon radicals. To do this, oxygen is blended into the combustion zone at the molecular level. The available oxygen will burn the hydrocarbon radicals, reducing their availability to form prompt NOx. Premixed burners are used to reduce prompt NOx in practice.⁷

Gas-fired Equipment

Although tankless instant-heating units are available, general-use water heaters are generally "tank-type" units. Water is circulated through an upright tank shaped like a cylindrical ring, with hot combustion gases flowing vertically upward through the ring.⁸

Two types of burners are used in general-use water heaters under 75,000 Btu/hr in size; "atmospheric" or "forced-draft." Atmospheric burners use the motion created by the combustion of fuel and air to transfer heat to confined water; this is called natural draft⁹. Forced-draft burners use a fan or blower to move either air alone or an air and fuel mixture through the combustion chamber; this enables better control of the amount of air in the system¹⁰.

Atmospheric units are simpler and less expensive than forced-draft units. However, recovery efficiencies for atmospheric units are much lower. (Recovery efficiency is the ratio of heat contained in the natural gas to the amount of heat absorbed by the circulating water, including losses). The recovery efficiency of most current new general-use atmospheric units is 76 percent, consistent with California Energy Commission requirements. Forced-draft units can be 83 to 94 percent efficient. Despite the potential fuel savings, virtually all small general-use water heaters are atmospheric.

Flame Vapor Ignition Issue

Most gas-fired water heaters draw combustion air through vents at the bottom of the device, near the burners. If gasoline, paint, solvents or other flammable liquids are being stored or were spilled near these vents, flammable vapors may be drawn into the water heater burner and ignite. There are four theoretical approaches that can be used to prevent flammable vapor ignition:

- 1) Install a flame arrestor
- 2) Install a flammable sensor device
- 3) Use a 100% premixed burner and a sealed combustion chamber
- 4) Draw combustion air from the outside and use a sealed combustion chamber.¹¹

To address the issue, the American National Standard Institute (ANSI) adopted a standard for water heaters that incorporates a new testing protocol to address the

flammable vapor ignition issues (Z21.10.1).¹² Although the standard is voluntary, it has become industry practice. These water heater burner designs are currently on the market.

Low-NOx Burners

Low-NOx burners are used to meet the proposed 10 nanogram/joule (ng/J) emission limits. In 1991, Alzeta developed an atmospheric low-NOx burner that can achieve the proposed 10 ng/J emission limit. It was a ported ceramic fiber radiant burner developed under a contract sponsored by the SCAQMD, the Southern California Gas Company, and A.O. Smith. The burner was a flat plate matrix of ceramic fibers consolidated with inorganic binders. Laboratory tests indicate an emission rate of about 6 ng/J at 80% recovery efficiency (air free, dry) over 1600 hrs of operation. In addition, the combustion chamber is sealed, increasing its resistance to flammable vapors.¹³

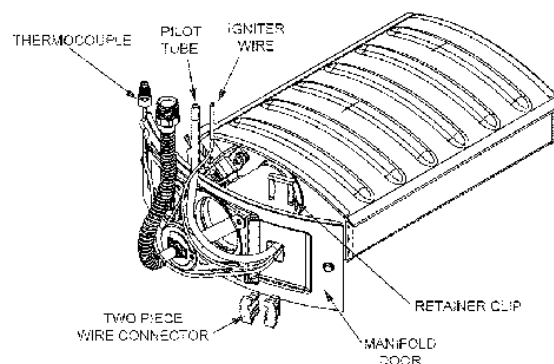
During the 1990's, many other companies developed ultra low-NOx burner designs. **Acotech** manufactured a metal fibre burner for residential heating appliances.¹⁴ **Polidoro** manufactured a stainless steel "hyper-stoichiometric" burner that limits excess air by premixing air and fuel outside the burner.¹⁵ **Schott Gas Systems** manufactured a low-NO_x atmospheric ceramic and metal fiber burner.¹⁶ **GRI and Arthur D. Little** patented a partially premixed stamped steel low-NOx burner design.¹⁷ **Altex Technologies Corporation** designed a low-cost partially premixed stamped steel low-NOx burner for storage tank-type water heaters.¹⁸ None of these atmospheric burners, developed in the 1990's, met the 10 ng/J limit.

Forced-draft low-NOx burners limit NOx emissions by reducing the amount of excess air in the burner.

Because a fan or blower controls the air available and provides better mixing of the air and fuel, combustion is more complete and flame temperatures are lower. In addition, thermal efficiency increases when excess air is reduced. **Schott Gas Systems** "Ceramat" forced-draft burner and **Alzeta's** "Duratherm" burner were able to meet the 10 ng/J limit.^{19,20}

Despite the low emission rate and high efficiency of forced-draft burner, all residential water heaters certified for general use in 2009 use atmospheric burners (see Appendix A). Rheem describes their stainless steel burner as an "ultra low NOx radiant burner design."²¹ Bradford-White describes their burner as an "ultra low NOx burner with primary and secondary air distribution" to ensure "proper air to gas ratio for reduction of NOx generated by the combustion process."²² The American Water Heater Co. is also using a radiant burner design, as shown in Figure 1.

Figure 1
American Water Heater Co. Burner²³



REFERENCES FOR APPENDIX B

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Appendix C
Commercial Water Heater Use Information from
Southern California Gas Company
12/30/96

Boiler And Water Heater Rating	Number of Boilers and Water Heaters	Percentage of Total	Total Throughput	Average Unit Throughput
Btu/hr			MBtu/year	MBtu/year
Less Than 75,000	2,428	54.2	81,783,533	33,583
75,000 to 100,000	821	18.3	113,166,530	137,840
100,001 to 200,000	242	5.4	33,875,061	139,980
200,001 to 300,000	181	4.0	55,349,838	305,800
300,001 to 400,000	178	4.0	81,487,899	457,797
400,001 to 500,000	87	1.9	40,213,782	462,227
500,001 to 600,000	48	1.1	37,214,913	775,311
600,001 to 700,000	71	1.8	50,752,016	714,817
700,001 to 800,000	74	1.7	54,410,344	735,275
800,001 to 900,000	42	0.9	27,964,740	665,827
900,001 to 1 MM	75	1.7	115,709,009	1,542,787
Greater Than 1 MM	236	5.3	1,201,324,169	5,090,357
TOTAL	4,483	100.0	1,893,251,734	-----

Source: Correspondence from Reese Martin, Southern California Gas Company, December 30, 1996