

State of California  
AIR RESOURCES BOARD

**Final Statement of Reasons for Rulemaking,  
Including Summary of Comments and Agency Response**

PUBLIC HEARING TO CONSIDER THE ADOPTION OF AMENDMENTS TO THE CURRENT REGULATIONS FOR LARGE SPARK-IGNITION ENGINES WITH AN ENGINE DISPLACEMENT LESS THAN OR EQUAL TO ONE LITER

Public Hearing Date: November 21, 2008  
Agenda Item No.: 08-10-4

**I. GENERAL**

The Air Resources Board (Board or ARB) amended California's exhaust emission regulations for large spark-ignition (LSI) engines with an engine displacement less than or equal to one liter ( $\leq 1.0$  L) to include more stringent exhaust emission standards. The Board also adopted new regulations to control evaporative emissions from LSI equipment using these engines. LSI engines  $\leq 1.0$  L are typically used in different equipment types, such as portable generators, large turf care equipment, industrial equipment, scrubbers, sweepers, and various airport ground support equipment. The amendments include the following primary elements:

- Increased stringency of current exhaust emission standards

<b>Model Year</b>	<b>Engine Displacement</b>	<b>HC+NO<sub>x</sub><sup>1</sup> (g/kW-hr)<sup>2</sup></b>	<b>CO (g/kW-hr)</b>
<b>2011 and subsequent</b>	$\leq 825$ cc	8.0	549
<b>2011 - 2014</b>	$> 825$ cc - $\leq 1.0$ L	6.5	375
<b>2015 and subsequent</b>	$> 825$ cc - $\leq 1.0$ L	0.8	20.6

<sup>1</sup> HC+NO<sub>x</sub> means combined hydrocarbons and oxides of nitrogen

<sup>2</sup> g/kW-hr means grams per kilowatt-hour

- New evaporative emission standards and requirements
- Use of off-highway recreational vehicles (OHRV) test procedures for LSI engines  $\leq 1.0$  L used in OHRV-like applications

This rulemaking was initiated on October 3, 2008 with the release of a notice and staff report entitled "Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider Amendments to the Current Regulations for

Large Spark-Ignition Engines with an Engine Displacement Less Than or Equal to One Liter,” which is incorporated by reference herein (Staff Report or ISOR).

On November 21, 2008, the Board conducted a public hearing to consider staff’s proposed amendments to the existing off-road LSI engine regulations. After consideration of the written comments received during the 45-day public comment period prior to the hearing and the testimony received at the public hearing, the Board adopted Resolution 08-42 to amend the regulations that incorporate by reference the revised regulations and test procedures. The amendments to section 2433, chapter 9, article 4.5, title 13, California Code of Regulations (CCR), and related amendments to the incorporated, “California Exhaust and Evaporative Emission Standards and Test Procedures for New 2010 and Later Off-Road Large Spark-Ignition Engines,” were included as attachments to the Staff Report. A copy of Board Resolution 08-42 adopting the regulatory action described above, and the regulatory documents for this rulemaking, are available online at the following ARB website: <http://www.arb.ca.gov/regact/2008/lsi2008/lsi2008.htm>

This Final Statement of Reasons (FSOR) updates the Staff Report by identifying and providing the rationale for the modifications made to the originally proposed regulatory text. The FSOR also contains a summary of the comments received on the proposed regulatory amendments during the formal regulatory process and ARB’s responses to those comments.

**Fiscal Impacts.** In developing the regulatory proposal, staff evaluated the potential economic impacts on private persons and businesses. In general, any business involved in the manufacture of LSI engines  $\leq 1.0$  L and associated equipment will potentially be affected by the regulatory amendments. Also potentially affected are businesses that supply engines and parts to these manufacturers, and those businesses that buy and sell equipment in California. As described in the Staff Report, there are 13 manufacturers of LSI engines  $\leq 1.0$  L that market certified engines in California. None of these manufacturers is located in California, although some have small repair and distribution operations in the state.

The new emission standards are not expected to impose a significant cost burden to either engine or equipment manufacturers. Manufacturers have indicated that they would use liquid-cooled engines with closed-loop electronic fuel injection systems and three-way catalysts to meet the standards. Based on results from staff’s analysis of an industry survey, this added technology will result in an average per engine increase of approximately \$1,940. This represents a 14-percent cost increase over the current average equipment cost of \$14,000, which staff anticipates manufacturers will pass directly on to consumers. Although such a price increase for equipment with LSI engines  $\leq 1.0$  L may cause a consumer to delay a purchase in the short-term, it is not expected to significantly impact the long-term demand because this equipment eventually wears out and is replaced. Therefore, the lifetime cost impact on equipment operators, as a result of the amendments, is expected to be negligible.

The amendments to the LSI engine regulations will have some impact, although not significant, on small businesses that buy and sell portable generators, large turf care

equipment, and industrial equipment. For small retailers, during the initial years of implementation, the increased cost of the equipment may lead to a slight drop in demand that could result in lower profits. These retailers would also need to carry over unsold stock to the next year, possibly realizing less profit on the future sale of these units.

Finally, the Board has determined that this regulatory action will not create costs or savings, as defined in Government Code section 11346.5(a)(5) and 11346.5(a)(6), to any state agency or in federal funding to the state, costs or mandate to any local agency or school district, whether or not reimbursable by the state pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code, or other non-discretionary costs or savings to local agencies.

**Consideration of Alternatives.** The amendments and new regulatory language proposed in this rulemaking were the result of extensive discussions and meetings involving staff and the affected LSI engine manufacturers, equipment manufacturers, and other stakeholders. Staff considered all of the alternatives proposed by industry and was able to incorporate a majority of industry's proposed amendments into the regulation presented to the Board. The Board evaluated and rejected four potential alternatives as described in both the Staff Report (see section 5) and in the responses below.

Additional proposed alternatives were submitted by commenters during the rulemaking process and considered by the Board. For the reasons set forth in the Staff Report, in staff's comments and responses at the hearing, and in this FSOR, the Board has further determined that no alternative considered by the agency would be more effective in carrying out the purpose for which the regulatory action was proposed or would be as effective and less burdensome to affected private persons than the action taken by the Board.

## **II. MODIFICATIONS TO THE ORIGINAL PROPOSAL**

At the hearing the staff presented, and the Board adopted, the amended regulations as proposed in the Staff Report released on October 3, 2008. No substantive modifications to the proposed amendments were directed by the Board. Pursuant to Government Code section 11346.8(c) and section 40, title 1 of the CCR and to Board Resolution 08-42 directing appropriate revisions, staff has made the following nonsubstantial change.

Final Regulation Order, CCR, title 13, section 2433 (b) (5): corrected the exhaust emission standards reference from "Section 2411 (b)(1)(A)" to "Section 2433 (b)(1)(A)."

## **III. SUMMARY OF COMMENTS AND AGENCY RESPONSE**

At the November 21, 2008 hearing, oral testimony was received from the Engine Manufacturers Association (EMA), Outdoor Power Equipment Institute (OPEI), the

Manufacturers of Emission Controls Association (MECA), Polaris Industries Inc., and the South Coast Air Quality Management District (SCAQMD). Additional written comments were received by the hearing date. Below is a listing of persons and organizations that submitted comments.

Comments Received during the 45-day Public Comment Period and Board Hearing

Organization and Person Providing Comments	Written testimony	Oral testimony
James McNew, OPEI	11/18/2008	11/21/2008
Rasto Brezny, MECA	11/21/2008	11/21/2008
Roger Gault, EMA	11/21/2008	11/21/2008
Henry Hogo, SCAQMD	11/14/2008	11/21/2008
Lawrence E. Keller, Polaris Industries Inc.	11/21/2008	11/21/2008
Paul C. Vitrano, Recreational Off-Highway Vehicle Association (ROHVA)	11/20/2008	-

Set forth below is a summary of each objection or recommendation received for the proposed regulatory actions, and an explanation of how the proposed action was either changed to accommodate an objection or recommendation, or the reason for not making a change. The comments have been grouped by topic whenever possible. Comments not involving objections or recommendations specifically directed toward the rulemaking, or to the procedures followed by ARB in this rulemaking, are not summarized. Comments in support of the regulations are not summarized either.

**EMISSION STANDARDS**

1. **Comment:** EMA recommends that ARB treat LSI engines  $\leq 1.0$  L in the same fashion as the United States Environmental Protection Agency (U.S. EPA). Specifically, the engine manufacturer should be provided the flexibility to determine based on the intended market for the engine, if the engine will be certified to comply with the small spark-ignition regulatory requirements or the LSI  $> 1.0$  L regulatory requirements. (EMA)

**Comment:** EMA's proposal would preserve the ability to produce very clean, substantially improved LSI engines with a minimal impact on the projected air quality benefit of the program. (OPEI)

**Comment:** The proposed schedule does not allow adequate lead time to achieve the substantial exhaust and evaporative emission reductions required, compared to the current standards. (Polaris, ROHVA)

**Agency Response:** In developing the proposal, staff evaluated technology to control both exhaust and evaporative emissions. As presented in the Staff Report, the results from staff's analysis of the industry survey, as well as data supplied by manufacturers of the applicable emission control technology, clearly support staff's finding that the proposed emission standards are technologically feasible. Specifically, to meet the proposed 2011 model year (MY) exhaust emission standards, these engines will require only minor engine modifications and air/fuel ratio changes. Compliance with the adopted 2015 MY exhaust emission standards will likely be based on water-cooled engines with closed-loop electronic fuel injection systems, and three-way catalysts. Although these technologies are not presently common in this segment of the market, they are nevertheless all well-established, proven emission control technologies. Three currently certified engine families within this category meet the proposed exhaust emission standards. Furthermore, the adopted 2015 MY implementation timeframe would allow six years of lead time for manufacturers, with engines that do not yet meet the newly adopted standards, to develop and integrate the requisite technology into their engine designs and products.

Staff also evaluated cost-effectiveness based on estimates of lifetime emission reductions for typical off-road LSI equipment. Cost estimates for the technology to control exhaust and evaporative emissions were based on estimates provided by the manufacturers of this technology and included an allowance for manufacturer and dealer markups. These cost estimates were also presented in the Staff Report (see section 4.2). Staff's conclusion was that its proposal was cost-effective.

2. **Comment:** If ARB continues with the current segregation of the LSI > 1.0 L and LSI ≤ 1.0 L, EMA recommends that the 2015 exhaust emission standard level requirement be replaced with a 5.0 g/kW-hr standard for HC+NO<sub>x</sub> applicable in 2014 model year. (EMA)

**Agency Response:** The difference between the EMA proposal and the staff's proposal is that EMA's proposed 5.0 g/kW-hr HC+NO<sub>x</sub> emission standard is over six times the 0.8 g/kW-hr HC+NO<sub>x</sub> emission standard proposed by staff. As explained in the Agency Response to Comment No. 1, control to the 0.8 g/kW-hr HC+NO<sub>x</sub> emission standard is both technologically feasible and cost-effective. Furthermore, setting the emission standard above the proposed level may impact the Board's ability to fulfill the overall emission reductions required under the State Implementation Plan.

3. **Comment:** ARB staff is proposing, however, less stringent standards for LSI engines with engine displacements less than or equal to 825 cubic centimeter (≤ 825 cc) because of the small number of sales and poor cost-effectiveness. SCAQMD staff is concerned that migration from the more stringently

regulated LSI engines with engine displacements larger than 825 cc but less than or equal to one liter ( $> 825 \text{ cc} - \leq 1.0 \text{ L}$ ) would occur. In addition, because of the large difference in emission standards, a small number of large engines migrating to the smaller engine category would erase the emission reductions gained by the proposed regulation. Moreover, the very generous time frame of seven years should provide adequate time for manufacturers to cost-effectively meet the exhaust emission standard of 0.8 g/kW-hr for HC+NO<sub>x</sub>. Therefore, SCAQMD staff urges ARB to set the same HC+NO<sub>x</sub> emission level for all LSI engines  $\leq 1.0 \text{ L}$  at 6.5 g/kW-hr in 2011 and 0.8 g/kW-hr in 2015. (SCAQMD)

**Comment:** Gasoline engines that are below 825 cc cannot provide the needed power for commercial turf care and utility vehicles that are currently powered by LSI  $> 825 \text{ cc}$  gasoline engines. (OPEI)

**Agency Response:** Staff proposed the less-stringent emission standard for the 825 cc displacement cut point for a couple of reasons. First, because LSI engines  $\leq 825 \text{ cc}$  tend to be used in equipment that is relatively much less expensive than LSI engines  $> 825 \text{ cc} - \leq 1.0 \text{ L}$ , the profit potential for manufacturers is not as attractive. Accordingly, staff believes that the probability for migration from the more stringently regulated LSI engines  $> 825 \text{ cc} - \leq 1.0 \text{ L}$  category is small. Secondly, LSI engines  $\leq 825 \text{ cc}$  represent approximately only 10 percent of the engines in the LSI  $\leq 1.0 \text{ L}$  category, and they are already used mostly in turf care equipment. Since their performance and operation characteristics are comparable to small off-road engines, staff believed that the proposal that these engines meet exhaust emission standards equivalent to the tier 3 emission standards for small off-road engines was reasonable.

## PERFORMANCE

- Comment:** Even after installing three-way catalysts with a heated oxygen sensor and multiport fuel injection on current “optimized” engines, OPEI members are certifying 953 cc displacement engines used on lawn tractors at 6.6 g/kW-hr HC+NO<sub>x</sub>. 2015 exhaust emission standards for LSI Engines  $> 825 \text{ cc}$  should be amended. Only automotive-based gasoline engines could practically meet ARB’s 0.8 g/kW-hr standard. Several OPEI members have tried to use water-cooled, automotive-based engines in turf care equipment. In these member’s development programs, automotive-style engines completely failed to meet the extreme operational challenges and constraints for lawn and garden products. (OPEI)

**Agency Response:** The comment is not consistent with recent turf care industry sales literature in which “automotive-based” water-cooling and electronic fuel-injected engine technologies are touted as providing added value to the customer, and which are all present in the market today. Indeed, OPEI itself identifies a water-cooled engine with fuel injection and a three-way catalyst as being currently used on lawn tractors. So obviously this technology can be used for turf care equipment applications. Furthermore,

although OPEI notes that this engine does not meet the proposed 0.8 g/kW-hr HC+NO<sub>x</sub> standard, it does have zero-hour emission levels that are only slightly above that level. Since the OPEI-identified engine has significantly less catalytic material and a higher emissions deterioration rate than the engines that can meet the proposed emission standard, a higher catalyst loading would reduce both the zero-hour emission level and the emissions deterioration rate. Therefore, with a higher catalyst loading, the OPEI-identified engine would be expected to satisfy the 0.8 g/kW-hr HC+NO<sub>x</sub> emission standard.

In addition, staff surveyed the industry in February 2008 to ascertain whether there were any applications for which it would be essential to retain the lowest common denominator engine (i.e, air-cooled and carbureted, with no catalyst). The responses from industry indicated that there could be some of these applications, in the lower engine displacements. Accordingly, staff then modified its proposal to allow less stringent standards for LSI engines ≤ 825 cc. Ultimately, however, the concerns boil down to cost.

5. **Comment:** Unlike forklifts and certain other industrial applications, LSI engines > 825 cc - ≤ 1.0 L used in tractors, generators, utility vehicles, and turf care equipment typically depend on air-cooled engines to maintain their power and weight ratio, packaging, and performance requirements. Liquid-cooled automotive-style engines can not meet the performance demands and operational challenges. (OPEI)

**Agency Response:** In general, staff agrees with OPEI regarding the need for some equipment chassis redesign for some models to accommodate cleaner engines. The cost estimates provided by OPEI are generally consistent with staff's cost estimates in the Staff Report. However, not all equipment platforms need to be redesigned. There are already many products in the market with liquid-cooled engines, including some that share platforms with air-cooled engines. According to ARB's 2008 MY certification records, 15 out of a total of 24 LSI engine families > 825 cc – ≤ 1.0 L are water-cooled. Furthermore, only one engine manufacturer does not offer at least one water-cooled engine family in either the small off-road engine or LSI engine categories.

Although some manufacturers have expressed concern that water-cooled engines might not be readily accepted in to the market, in actuality the advantages offered by these engines may encourage market acceptance. Specifically, these engines are capable of running cooler than air-cooled engines, and they use less fuel, thereby reducing production of carbon dioxide, a greenhouse gas.

## **INVENTORY/EFFECT ON MARKET**

6. **Comment:** While ARB staff has made a number of emission inventory adjustments over the course of the proposal's development, the inventory assessment recently provided by staff, as an update to the inventory in the

amendment hearing notice, remains controversial due to population projections. The projected population is based on a significant growth rate in annual sales in 2002 through 2011, resulting in a 50 percent increase between 2008 and 2011. EMA member company projections compiled prior to the recent collapse of the housing market were for limited growth of less than one percent per year or four percent for the period. EMA believes that the population in 2020 and 2030 will be less than the staff's projections, significantly reducing the projected emissions benefits assumed by the staff's proposal. (EMA)

**Comment:** ARB's growth projections for turf care equipment overestimate the future market for these products. In fact, this market segment has been fairly flat and in the current market is trending downwards. ARB should correct its exaggerated cost-effectiveness calculations to account for turf equipment's low volume sales and its flat growth projections as well as the likely switch to > 825 cc diesel engines. (OPEI)

**Agency Response:** The emission inventory projections are consistent with both the sales and actual production data. These projections were revised after publication of the Staff Report in response to industry comments. Staff revised the growth rate to reflect actual data submitted by engine manufacturers during the certification process and production line testing. The new growth rate used in the emission inventory projections is actually more conservative than both the sales projections and actual production numbers.

7. **Comment:** The major engine changes will require significant design changes to the equipment that these engines power. EMA anticipates that, based on the small market potential for these products, engine and equipment manufacturers will not invest the design and manufacturing resources to produce products that comply with the 2015 standard level. Consumers that utilize the equipment currently powered by these engines will be forced to either prolong the use of their existing equipment and/or replace the equipment with diesel powered alternatives. While diesel powered alternatives currently exist in many cases, such products typically cost more than today's spark ignition products. Increased manufacturing costs combined with capital amortization for creating a spark ignition engine powered product compliant with the proposed 2015 standard is expected to result in equipment costs equal to or greater than diesel powered alternatives. (EMA)

**Comment:** If ARB proceeds along the lines proposed, new gas-powered turf care equipment will not be offered in California and/or most turf care equipment users will switch to diesel powered product options. In turn, this will 1) cause harm to California businesses and landscape operators; and 2) disrupt the marketplace – with no commensurate benefits. (OPEI)

**Comment:** When volume projected growth is corrected, the EMA proposal provides almost an equivalent air quality benefit to the proposed amendments not taking into account the expected shift from spark ignition to diesel product. (OPEI)

**Agency Response:** Staff believes that a switch to diesel engines is extremely unlikely, mainly because the cost of LSI engine-powered equipment will always be less than diesel-powered equipment. For the case when a diesel version is not already available, equipment manufacturers would still face redesign issues in order to integrate a water-cooled diesel engine in to their equipment. For the case when a diesel product is currently available, then the Tier 4 diesel emission standards, which will go into effect for the equivalent horsepower range in 2013, will require particulate matter (PM) filters. Adding a PM filter will create its own set of redesign and economic concerns. Current cost estimates for diesel versions of off-road equipment in this category are approximately \$3,000 more than for the equivalent gasoline-fueled counterparts. Compliance with the Tier 4 diesel standards is likely to add another \$1,000. So even with the incremental costs of complying with staff's proposal, LSI equipment will be less expensive than diesel equipment.

8. **Comment:** Thousands of California landscape contractors depend on commercial turf care equipment to perform their essential operations. ARB staff has apparently not evaluated whether these California landscape business will be adversely impacted. The Board should direct ARB staff to submit to the Board an analysis of: 1) the impacts on California landscape businesses due to the lack of product availability; and 2) the costs (per unit of the redesigned turf care sold in California). (OPEI)

**Agency Response:** Staff does not believe additional analyses are necessary or appropriate. The cost impacts are included in the Staff Report (see section 4.2). Additionally, as noted specifically in the Agency Response to Comment No. 7, and in other responses regarding equipment availability, nothing in the OPEI comment would materially change staff's conclusions.

9. **Comment:** At a minimum, ARB should also create an equipment-based small volume exemption to avoid the total elimination of certain products in the California market. (OPEI)

**Agency Response:** Staff does not believe that an equipment-based small volume exemption is needed. As noted, OPEI did not identify anything unique to the small volume products that would warrant exempting them, beyond the fact that they are small volume. The newly created category for LSI engines  $\leq 825$  cc should take care of those applications that truly cannot absorb the cost of the additional emissions controls.

10. **Comment:** ROHVA supports functional harmonization between U.S. EPA and ARB vehicle classification systems. ROHVA is concerned by the fact that

some OHRVs covered under U.S. EPA's recreational vehicle emission regulations could be subject to ARB's LSI engine regulations. (ROHVA)

**Comment:** The most appropriate approach is that LSI engines  $\leq 1.0$  L used in OHRV-like applications would be immediately subject to the OHRV exhaust and evaporative emission limits. (Polaris)

**Agency Response:** The issue raised by Polaris and ROHVA is outside the scope of the amendments proposed in the rulemaking. Pursuant to Government Code section 11346.9(a)(3), ARB will not respond to these comments and testimony as they are not relevant to the proposed amendments.

## **COST/PACKAGING**

11. **Comment:** Many turf product platforms are niche products and constitute less than 10 units per year sold in California. For these niche products, the equipment manufacturer would incur (in equipment redesign costs) roughly \$20,000 on a per equipment basis (\$1 million costs/50 products sold over 5 years). Obviously, per-unit redesign costs for these niche California products (even without the additional engine costs) could dramatically exceed the total retail costs of these units. (OPEI)

**Agency Response:** Staff's analysis of the cost-estimate relied on the figures provided by OPEI that were evaluated with actual sales volumes identified by the manufacturers, and which were larger than the hypothetical sales figures stated in OPEI's comments. Staff acknowledges that niche products are likely to be dropped if it is not cost-effective for companies to re-engineer them to the more stringent standards or to use LSI engines  $\leq 825$  cc. However, it should be remembered that when evaluating any sales volumes that are exceptionally small, such as less than 10 units a year, the slightest change could significantly affect a product's profitability. Lastly, OPEI did not identify anything unique to the small volume products that would warrant exempting them from the more stringent emission standards, beyond the fact that they are small volume in sales.

12. **Comment:** Air cooled engines cannot practically or cost-effectively be modified to include water jackets to the block and cylinder head, water pumps, hoses, radiators and other components. Much larger and heavier water-cooled engines would not fit into most existing equipment designs, requiring equipment-design changes to maintain low turf load and equipment balance. OPEI members estimate that the additional costs of liquid-cooled engines with the necessary fuel injection, exhaust and cooling systems would be between \$1,150 and \$2,500. Assuming a 5-year production period and a one million dollar in equipment re-design and re-tooling and testing for these products, the equipment retooling costs would be around \$2,000 per common equipment platform. (OPEI)

**Agency Response:** The cost and cost-effectiveness analyses are included in the Staff Report (see section 4.2), as well as in the Agency Response to Comment Nos. 4 and 11. For the reasons stated, staff believes its cost and cost-effectiveness estimates more accurately reflect reality. Nevertheless, staff evaluated OPEI's estimated average redesign cost of \$2,000 based on a total redesign cost of one million dollars for 500 products. If OPEI's \$2,000 figure is substituted for the \$700 redesign cost used in the cost-effectiveness calculations in the Staff Report, the cost would range from \$0.02 - \$10.69 per pound of ROG+NO<sub>x</sub> reduced. The higher cost-effectiveness value of \$10.69 per pound still compares favorably with other emission control regulations adopted recently by ARB, which have ranged from less than \$1 to \$11 per pound of ROG+NO<sub>x</sub> reduced.