STATE OF CALIFORNIA
AIR RESOURCES BOARD

Proposed Amendments to the Small Off-Road Engine Regulations: Transition to Zero Emissions	**)**	**Supplemental 15-Day Notice Changes Availability Date: May 27, 2022 Comment Deadline: June 13, 2022**

ADDITIONAL COMMENTS OF THE TRUCK AND ENGINE MANUFACTURERS ASSOCIATION

June 13, 2022

Patricia Hanz
Truck & Engine Manufacturers Association
333 West Wacker Drive, Suite 810
Chicago, IL 60606

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Proposed Amendments to the Small Off-Road Engine Regulations: Transition to Zero Emissions	**)**	**Supplemental 15-Day Notice Changes Availability Date: May 27, 2022 Comment Deadline: June 13, 2022**

At its December 9, 2021 public hearing, the California Air Resources Board (CARB) approved for adoption certain amendments to the California Code of Regulations as recommended by the CARB staff, and further directed the staff to make additional regulatory changes with additional supporting documentation. Those additional changes and documentation were published on March 30, 2022. Subsequently, CARB published a Third Notice of Public Availability of Additional Documents and Information on May 27, 2022, which notice is the subject of these comments. These comments are in addition to the comments the Truck and Engine Manufacturers Association (EMA) previously submitted regarding the Amendments that the Board approved at the December 9, 2021 public hearing, and the comments that EMA submitted regarding the additional changes and documentation published on March 30, 2022.

CARB has added twenty-three (23) documents to the Rulemaking Record through the Third Notice at issue. However, CARB has not provided adequate actual notice with respect to those documents. More specifically, the Notice was published at the end of the business day on the Friday before the 3-day Memorial Holiday Weekend. In addition, the 23 documents were only made available for inspection at CARB's offices in Sacramento, unless a request for electronic access was submitted to CARB staff. EMA submitted such a request on the first business day after the holiday weekend (Tuesday, May 31st) and was later granted access to a password-controlled site on which the documents were posted. Nowhere in the password-controlled site is there any explanation of why the 23 documents are being added to the Record, or how they might support CARB's rulemaking. Rather, the 23 documents appear to be a hodge-podge of documents including Operator Manuals, Executive Orders, references to research publications, previously published government reports, and various marketing materials.

The foregoing raises a number of procedural issues. First, CARB's pre-Memorial Day filing and its failure to make the 23 documents readily accessible has resulted in a period of review that is, in fact, less than the requisite 15 days. That is a violation of the California Administrative Procedure Act (APA). Second the 23 documents are not germane to any specific 15-day changes - - indeed, CARB makes no claim that they are - - and so CARB's action in that regard, in effect, amounts to an improper attempt to supplement the Record in a broad-based manner after the close of that Record. That too amounts to a violation of the APA.

EMA and the Outdoor Power Equipment Institute (OPEI) engaged Air Improvement Resources (AIR) to conduct a review of the Documents and Information added to the rulemaking record which appear to relate to the California State University – Fullerton (CSU-F) Survey and CARB's 2020 SORE Air Emissions Inventory and Model. The Survey and Inventory and Model

are foundations of the Proposed Amendments to the SORE Regulations and Transition to Zero Emissions. As detailed in AIR's Analysis (attached to and incorporated into these comments in Attachment A), the Additional Documents and Information included in this Third Notice support the comments previously submitted by EMA and the OPEI. The CSU-F Survey is materially deficient and the CARB analysis of the survey data is contrary to accepted research and analysis methodology. As discussed in more detail in the AIR Analysis (Attachment A) the Additional Documents and Information added to the Record in this Third Notice in fact confirm that the CSU-F survey is flawed and that the methodology chosen by CARB – an arithmetic mean – is inappropriate given the distribution of the survey data. The result of the use of the flawed survey data and the inappropriate analysis methodology is that the SORE air emissions inventory is materially overstated. Thus, the CARB forecasted air emission reductions of the Proposed Amendments are also overstated and the costs are substantially understated.

Conclusion

The Rulemaking at issue remains defective in multiple respects, including, due to the lack of necessary lead time and the reliance on materially flawed survey data which overstates the air emissions inventory and forecasted emission reductions and understates the cost of the Proposed Amendments. Accordingly, EMA again requests that serious consideration be given to the alternate proposal described in our previous comments. EMA believes that the alternative proposal will provide real-world emission reductions in a cost-effective and technologically achievable manner.

Respectfully Submitted,

TRUCK AND ENGINE MANUFACTURERS ASSOCIATION

Attachment A

Additional 15-day Comments Based on New Resources Submitted by CARB
Air Improvement Resource, Inc.
June 13, 2022

ARB submitted a number of new statistical references to support their SORE survey and subsequent emission inventory analysis.[1] ARB's emission analysis and modeling is described in their September 2020 emission inventory report.[2] Section 4.2 of the report describes ARB's methods for estimating annual activity from different equipment types from its SORE equipment survey. The report also describes "outlier" data that were examined by CARB and eliminated prior to estimating annual equipment usage. Basically, ARB estimated annual activity by using an arithmetic average of the data that remained after the ARB-identified outliers were removed. [3]

Metric for Estimating Central Tendency (annual hours of use per year) From the Data

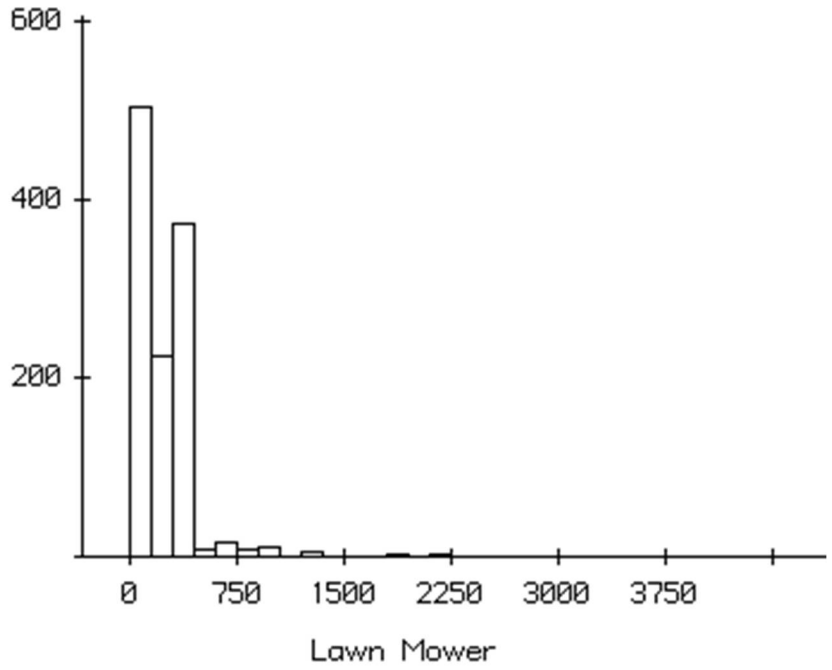
AIR has commented that ARB should have used a geometric mean to estimate annual activity instead of an arithmetic average, even after removing outliers. Arithmetic averages are generally used for data that is normally distributed – i.e., the familiar bell-shaped curve. The annual activity data, however, are not normally distributed, even after removing a few outliers. The data are highly skewed toward higher uses, and there is no data below 0 hours, for obvious reasons. Nowhere in ARB's analysis can we find a discussion of how the ARB annual use data from the survey are distributed (after removal of outliers), and what rationale ARB relied upon in choosing and arithmetic average instead of some other metric for estimating central tendency.

Reference 9 (Costa) from ARB's new sources discusses circumstances under which the geometric mean can be used in certain datasets. The following statements from the report are relevant.

a. "Page 1, "A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average were calculated"
b. Page 2, "Geometric mean is often used to evaluate data covering several orders of magnitude, and sometimes for evaluating ratios, or percentages, or other data sets bounded by zero."

The plot below shows the distribution of data on annual use for landscape lawnmowers. The vertical axis is frequency, the horizontal axis is hours per year of use. No outliers have been removed from these data.

[1] References 4, 9, 10, 14, 17, 19, 23
[2] *2020 Emissions Model for Small Off-Road Engines – SORE2020*, ARB, September 2020.
[3] AIR also identified outliers and these were identified in previous EMA and OPEI comments.



Some landscape lawnmowers are used for less than 0.5 hours per year, others as much as 2250 hours per year. These data cover several orders of magnitude as discussed in Costa and therefore the use of a geometric mean is appropriate.

Overall, this report lends support to the use of a geometric mean to estimate annual activity as recommended by AIR. At a minimum, ARB should have examined the distribution of responses for each equipment type (and category) after removal of outliers and determined the best method of estimating annual use after examining these distributions.

Survey Methods

Reference 10 (E.H. Pechan) from the new ARB sources discusses how to develop local or regional inputs lawn and garden activity (hours per year) for the EPA NONROAD model. There are extensive discussions on sample sizes and survey methods. Chapter 3 discusses survey methods. Pages 3-10 and 3-11 discuss forming the correct survey questions to get the appropriate answers. On page 3-11, one of the suggested survey questions is "How long does it take to mow your lawn?" The report qualifies this question, however, by indicating

> "The……question as posed could lead to overestimating lawn mowing activity if survey respondents consider the actual time that they spend taking care of the lawn, including, e.g.,raking clippings or using an edge trimmer. Instead, the more accurate and direct question "How long does your lawnmower run when you mow the lawn?" should be asked.

This is a critical point that ARB and its contractor overlooked when conducting the SORE survey. The surveyors never asked the respondents for engine-on or equipment run times. Some respondents probably understood what the surveyors meant, but many did not. ARB should clearly address whether they think their survey appropriately considered this point.

Box-Cox Transformations of Activity Data

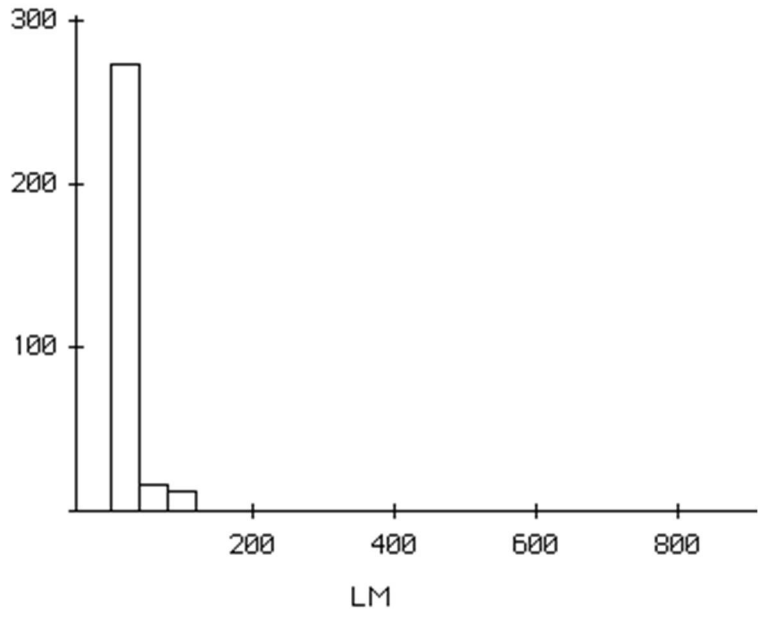
The Box-Cox transformation is also often used for data that is highly skewed. The data are first transformed using this methodology, and then an arithmetic average is computed and converted back to real space. [4]

We used the Box-Cox transformation method on residential and commercial lawnmowers as an example.

Residential Lawnmowers

The Box Cox Transformation methodology was applied to the Residential Lawn Mower data. This statistical procedure usually changes a highly skewed dataset into a more normal distribution. The graph below shows the histogram of the original data. As can be seen, the data are highly skewed to the right.

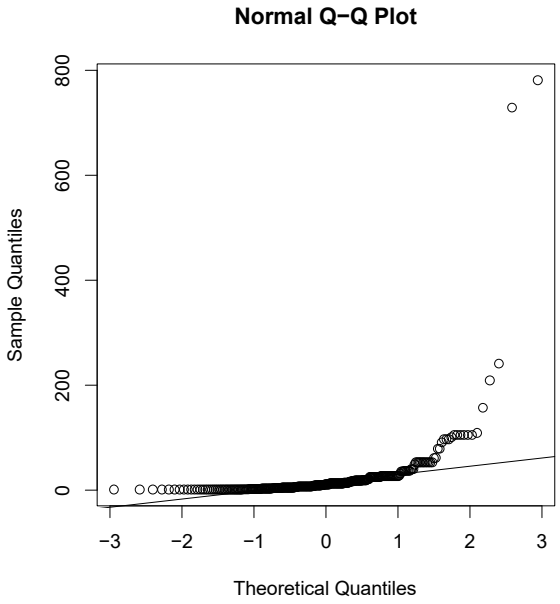
Original Residential Lawn Mower Activity Histogram



[4] https://onlinestatbook.com/2/transformations/box-cox.html

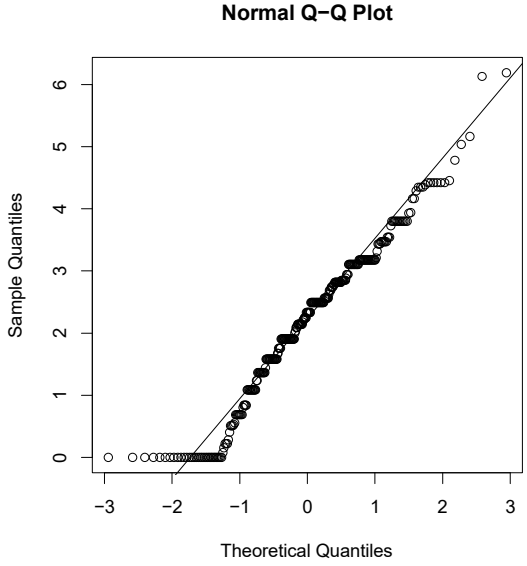
Since the Box Cox Transformation requires positive data, all activity values were increased by 1. The Q-Q below shows that the data are still highly skewed. (A normal distribution will have the symbols lie along the line.)

Residential Lawn Mower Activity



The next step was to perform the Box Cox Transformation on the data. This resulted in a more normally distributed Q-Q plot, but the 32 zero activity entries are an issue.

Box Cox Transformed Lawn Mower Annual Activity



Finally, the mean and median of this transformed data were computed and then reverted back to real-space, with 1 subtracted.

The results of this analysis are summarized below:

Household Gasoline Lawn Mower Annual Hours						
Dataset/ Method	**Count**	**Minimum**	**Maximum**	**Average**	**Median**	**Geometric Mean**
Original	308	0	780	23.4	10.0	**8.5**
Box Cox	308	-	-	**8.3**	10.0	-

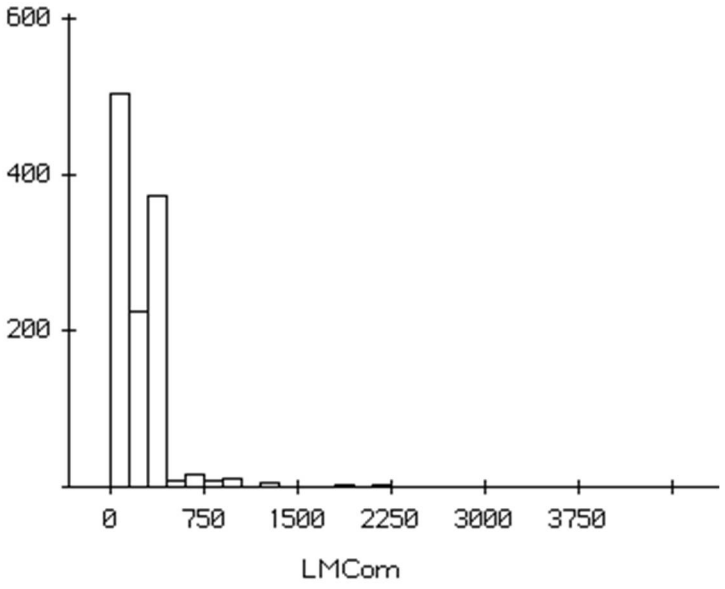
As can be seen, the Geometric Mean and the Box Cox Average values are very close and are much lower than the arithmetic average.

Landscape Lawnmowers

The Box Cox Transformation methodology was applied to the Landscape Lawn Mower data. This statistical procedure usually changes a highly skewed dataset into a more normal distribution.

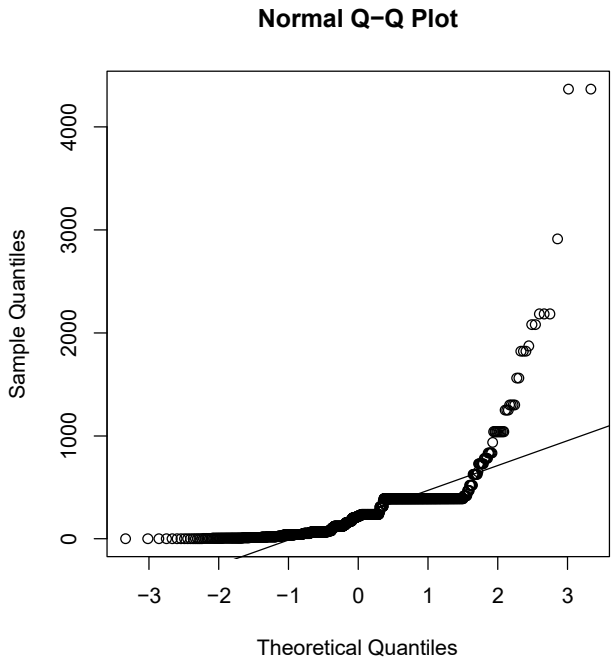
The graph below shows the histogram of the original data. As can be seen, the data are highly skewed to the right, and may be bimodal via the two peaks.

Original Landscape Lawn Mower Activity Histogram



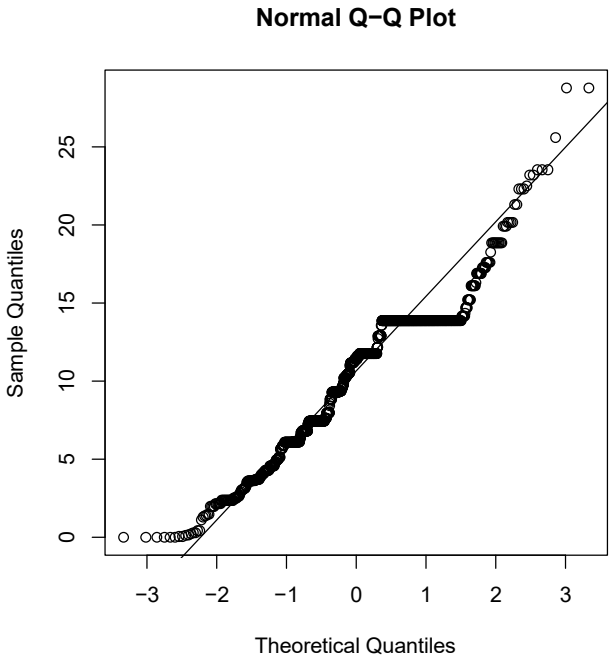
Since the Box Cox Transformation requires positive data, all activity values were increased by 1. The Q-Q below shows that the data are still highly skewed. (A normal distribution will have the symbols lie along the line.)

Landscape Lawn Mower Annual Activity

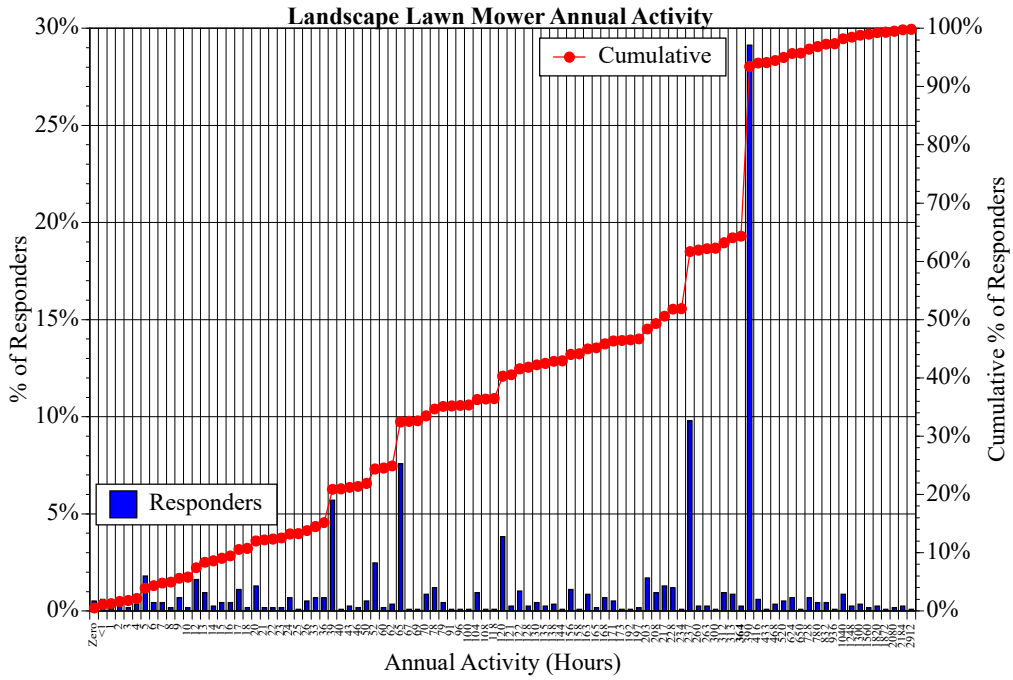


The next step was to perform the Box Cox Transformation on the data. This resulted in a more normally distributed Q-Q plot.

Box Cox Transformed Lawn Mower Annual Activity



However, an abnormality is present in the Q-Q plot. The horizontally flat area indicates that something is very odd about the data. As a result, the following plot was created.



This plot shows that 342 responses (~29% of the total) were at the 390 hour/year mark. Such a concentration can adversely affect obtaining any meaningful statistics.

Nevertheless, the mean and median of the Box Cox transformed data were computed and then reverted back to real-space, with 1 subtracted.

The results of this analysis are summarized below:

Landscape Gasoline Lawn Mower Annual Hours						
Dataset/ Method	**Count**	**Minimum**	**Maximum**	**Average**	**Median**	**Geometric Mean**
Original	1174	0	4368	253.8	216.7	162.3
Box Cox	1174	-	-	**121.4**	216.7	-

Finally, the table below shows that the landscape lawn mower activities are being dominated by only a few responders.:

ID	Count	Hours
199-G2	50	390.0
258-G1	50	390.0
315-G1	50	236.6
397-G1	50	390.0
16-G1	35	390.0
480-G1	32	236.6
345-G1	30	65.0
208-G2	20	390.0
269-G1	20	202.5
1-G5	15	216.7
21-G1	15	5.4
97-G2	15	39.0
527-G1	12	121.7
182-G1	10	65.0
190-G1	10	69.8
2-G1	10	162.5
319-G1	10	227.5
324-G1	10	313.3
4-G2	10	390.0
462-G1	10	12.8
484-G1	10	390.0
499-G1	10	390.0
18-G1	8	390.0

194-G1	8	39.4
276-G1	8	168.1
13-G2	7	119.6
218-G1	7	390.0
90-G1	7	12.2
147-G2	6	236.6
151-G1	6	236.6
152-G1	6	32.9
190-G2	6	170.9
211-G1	6	17.3
222-G1	6	19.9
302-G1	6	65.0
313-G1	6	39.0
41-G1	6	390.0
426-G1	6	390.0
501-G1	6	390.0

Summary

Due to the survey methods used, and the general nature of activity data obtained through telephone surveys instead of through using actual data loggers on equipment, the annual activity data collected by ARB and its contractor are highly skewed. As a result, arithmetic averages should not be used on the raw data, but alternative methods such as geometric averages, or transformation of the data by the Box-Cox method, should have been used by ARB to estimate annual activity for SORE equipment.