Attachment D:

Economic Analysis Methodology for Off-Highway Recreational Vehicles

May 2013

California Air Resources Board

Monitoring and Laboratory Division

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ARB	[California] Air Resources Board
ATV	All-Terrain Vehicle
DMV	[California] Department of Motor Vehicles
ISOR	Initial Statement of Reasons
MIC	Motorcycle Industry Council
MY	Model Year
OHRV	Off-Highway Recreational Vehicles
OMC	Off-Road Motorcycle
PY	Person Year
ROG	Reactive Organic Gases
TP	Test Procedure
TOG	Total Organic Gases
TPD	Tons per Day (emissions rate)
U.S.C.	United States Code
U.S. EPA	United States Environmental Protection Agency

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I. EXECUTIVE SUMMARY

Attachment D provides detailed information on the methodology used to estimate economic impacts for the proposed off-highway recreational vehicle (OHRV) evaporative emission control requirements. The OHRV population is divided into three main categories: all-terrain vehicles (ATV), off-road motorcycles (OMC), and specialty vehicles (e.g., side-by-side vehicles, and sand cars, etc.) which collectively represent more than 93 percent of the California OHRV population. When fully implemented, the proposed regulation is expected to provide substantial emission reductions in reactive organic gases (ROG). ROG is a precursor for ground level ozone throughout California.

Air Resources Board (ARB) staff collected data on compliance costs by distributing a survey to OHRV manufacturers. The information received from the surveys was then separated into low-cost and high-cost scenarios. The cost to comply with the OHRV regulation is $216 per OHRV in the low cost estimate and $465 per OHRV in the high cost estimate which represent 4 to 9 percent of the retail costs of the OHRV. Using the increased costs per vehicle for both low and high cost scenarios, the annualized costs were determined and the total estimated lifetime cost for the proposed OHRV regulation was calculated. The total lifetime cost of the proposed rule is about $90 million for the low estimate and $215 million for the high estimate.

The cost impact analysis is highly dependent on future OHRV sales. The steps required for OHRV manufacturers to comply with the proposed evaporative standards are expected to lead to price increases that will be borne by the purchaser. The influence of the poor economy and relatively long useful lives of OHRVs contribute to the slow turnover to controlled OHRVs in California. Staff collaborated with manufacturers and stakeholders to mitigate the cost impact of the proposed regulation by delaying the implementation until model year (MY) 2018 and by designing a flexible phase-in for OHRV compliance.

As the number of OHRVs sold in California per family per year decreases, the per-vehicle cost increases. For low sales volumes families, OHRV manufacturers may choose not to sell their low volume models in California. Staff assumes that companies with high volume sales of those types of OHRV will step in to meet consumer demand, thus causing a shift in the market share towards higher volume manufacturers.

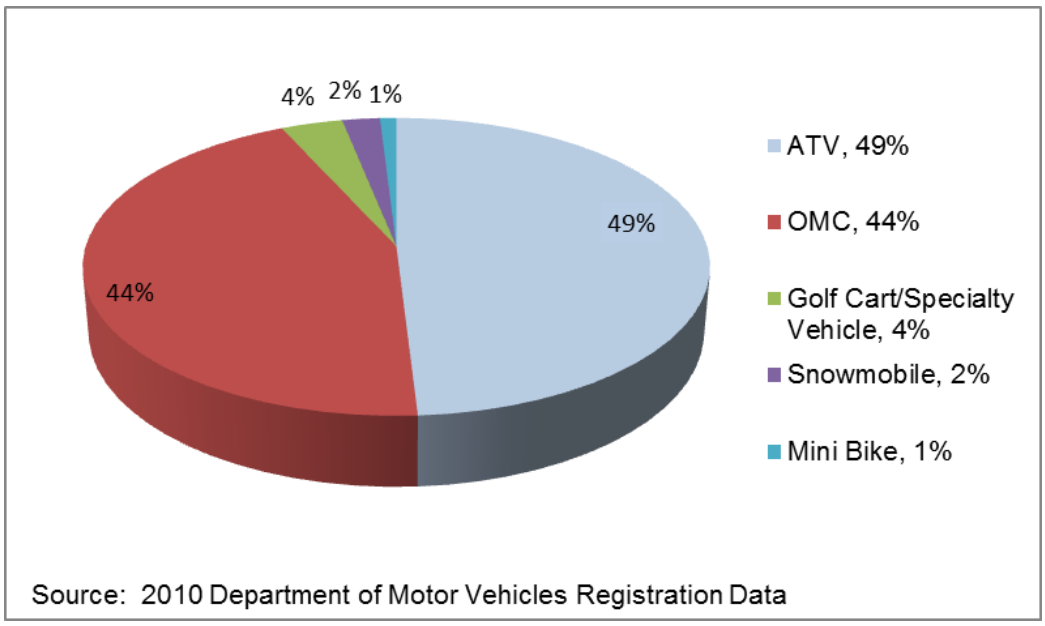
Overall, the proposed OHRV regulation is cost-effective, ranging from an estimated $4.09 to $9.76 dollars per pound of ROG reductions with an average of $6.93. The cost of the regulation does not include the cost savings associated with a likely shift to fuel injection as a result of this proposed regulation. The phase-in option allows manufacturers to delay the compliance of more costly evaporative families. This is allowed as long as 75 percent of their fleet is compliant during phase-in and fully compliant in 2022.

II. BACKGROUND

In March 2006, at a public workshop in El Monte, California, ARB introduced the concept of more comprehensive and stringent evaporative emissions standards for OHRVs. In 2007, ARB adopted OHRV evaporative permeation standards for fuel tanks and fuel hoses to harmonize with federal standards set by the United States Environmental Protection Agency (U.S. EPA).

The proposed regulation will further reduce ROG by controlling evaporative emissions generated during the three evaporative usage modes: running loss, hot soak, and diurnal. Staff used cost data provided by OHRV manufacturers and vehicle registration data from the California Department of Motor Vehicles (DMV, 2010) for the largest segments of OHRVs to determine the cost per vehicle, the total cost over the lifetime of the regulation, and the cost-effectiveness. As shown in Figure II-1, in 2010, more than 93 percent of OHRVs registered in California were ATVs and OMCs with less than 10 percent being specialty vehicles.

Figure II-1. Types of OHRVs Registered in California



III. COST IMPACTS METHODOLOGY

This section describes the data sources, methodology, and assumptions used in assessing the cost impacts of the proposed OHRV regulation.

A. METHODOLOGY

The methodology used to determine the economic impacts of the proposed OHRV regulation is based primarily on manufacturer supplied cost estimates. Based on what has been observed in implementation of other mobile source regulations, it is assumed

manufacturers will try to keep compliance costs low by using transferable technology from the on-road sector. Staff believe that much of the technology used in on-road applications can cost-effectively be scaled down for use on OHRVs. This technology includes any combination of the following technologies, but is not limited to the following:

- Low permeation fuel hose
- Low permeation fuel tank
- Carbon canister
- Pressure relief valves
- Tank placement/insulation
- Connectors
- Improved carburetors
- Fuel injection

The proposed standards are not prescriptive so it is anticipated that manufacturers will meet the standards with a combination of evaporative control technologies, including low permeation hoses, low permeation fuel tanks, carbon canister/pressure relief valves, and fuel injection.

In conducting this assessment, staff also considered testing and certification costs. The proposed OHRV regulation was designed to verify emissions control for running loss and hot soak events without requiring additional expensive performance tests. The test procedure developed for this regulation includes running loss and hot soak events as preparation cycles to reduce evaporative testing costs.

Using data received from OHRV manufacturers, total cost was calculated by combining component cost estimates for each vehicle with fixed cost estimates for each evaporative family. All cost data was adjusted for retail markup and weighted by family size. The incremental cost increases were then combined and added to the total estimated fixed costs to yield the total estimated cost increase per vehicle. Low and high cost estimates were then developed based on cost survey responses.

The total cost of the proposed regulation was determined by converting the estimated weighted annual cost per vehicle, as described above, into an amortized payment to represent the overall price increase for compliance for the life of the rule. The amortized payment was then multiplied by the annual sales. The life of the rule is defined as the mean life of an OHRV (21 years) in California. Annual sales are based on projections from ARB's OHRV emissions inventory model that was updated as part of this regulatory process. The annual sales have been adjusted to reflect the proposed phase-in schedule for model years 2018 to 2021. The resulting annual cost for regulatory compliance was also adjusted for each vehicle model year to reflect present value (2013$) by applying a discount rate of five percent. Summation of all the annual costs for compliance from MY2018 through MY2038 provided the total cost of the proposed OHRV evaporative emission regulation.

The cost-effectiveness of the regulation was estimated by taking the sum of the amortized costs in 2035 and dividing by the tons per day (TPD) of reactive organic gases (ROG) reduced by this proposed regulation in 2035 (the last year of the emissions model projection). The cost of the regulation takes into account cost savings to the end user from reduced fuel loss resulting from evaporative controls. The cost of the regulation does not include the likely cost savings from the expected shift to electronic fuel injection that the regulation will likely bring about. EFI will lead to a substantial increase in fuel economy.

The proposed regulation was designed to allow a manufacturer to reduce overall compliance costs by using credits. The proposed regulation allows OHRV manufacturers to produce a group of vehicles that exceed the proposed evaporative emission standards if they have sufficient credits from vehicles that are certified below the proposed emissions standard. However, no single evaporative family can exceed three times the emission limit. This analysis takes a conservative approach and does not include a credit analysis.

1. ARB Cost Survey Development – Stakeholder Participation

In January 2013, ARB requested cost information from manufacturers for complying with the proposed regulation. A cost survey form was also posted on ARB's OHRV webpage. In addition, ARB sent out an announcement of the posting on the off-road recreational vehicle List Serve, to over 2600 subscribers. Staff also directly emailed the request to several OHRV manufacturers and members of the Motorcycle Industry Council (MIC).

a. <u>Cost Survey Forms</u>

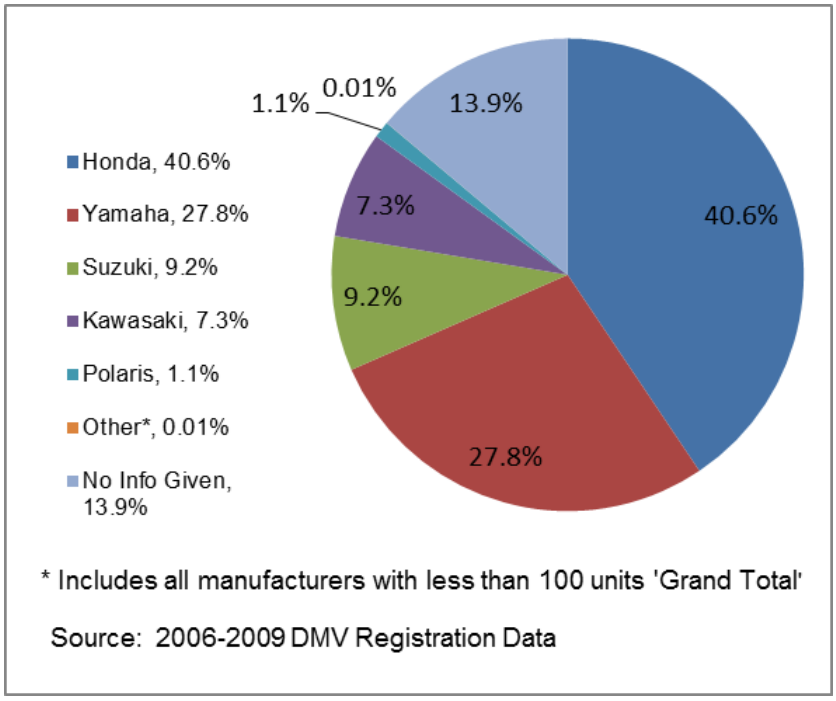
The cost survey forms developed by ARB staff (Figure VII-1 through Figure VII-6 presented in the Appendix) were given to OHRV manufacturers to provide estimated costs for complying with the proposed evaporative emissions performance standards. The survey form allowed manufacturers to show their emissions control incremental and fixed costs based on OHRV type for forecasted MY2018 sales. Manufacturers were asked to provide incremental cost information for low permeation fuel hoses and fuel tanks, carbon canisters, pressure relief valves, fuel management systems and components, fuel injection, roll-over valves and other components they might be considering using in their evaporative control systems. Manufacturers were also asked to provide fixed costs related to OHRV re-design; performance testing, and certification. Manufacturers were also encouraged to provide any descriptive information about other control components or re-design concepts that might have an impact on cost.

b. Cost Survey Results

ARB sent the cost surveys to OHRV manufacturers through the MIC who collectively represent the manufacturers of 86 percent of California's OHRV sales according to 2006-2009 DMV OHRV registration data (Figure III-1). Staff received responses from four OHRV manufacturers representing approximately 50 percent of the total California market share. The respondents represented large and small manufacturers. All the data used to estimate the cost of this regulation were confidential costs self-reported by industry. Some of the cost information received was submitted anonymously and did not contain projected sales figures. Data that did not contain projected sales figures were omitted and were not used in the cost evaluation. The omitted information contained data for eight anonymously-reported evaporative families.

To preserve manufacturer anonymity, the remaining incremental cost data is aggregated and listed by evaporative family with no designation of vehicle category. The cost analysis focused primarily on ATV and OMC categories, which account for more than 90 percent overall OHRV sales in California.

Figure III-1. California OHRV Market Share by Manufacturer



For some evaporative families where OHRV manufacturers were unsure about estimating incremental cost data, a cost range for control options was provided. For example, manufacturers estimated that the incremental cost for adding fuel injection to comply with ARB's proposed regulation as a range. Another variable used to bracket the low and high cost estimates was the time between vehicle evaporative family redesigns. In the case where redesign time was not provided,

staff assumed a range of as few as 5 years and up to 10 years between evaporative family redesign. Using cost data as received, and including cost data that was provided in a range format, low and high cost estimate scenarios were created. The low estimate scenario assumes a 10-year evaporative family life (unless otherwise noted by the manufacturer) and the lower fuel management incremental cost increase of $0 (Table III-1). The high cost scenario assumes a 5-year evaporative family life (unless otherwise noted by the manufacturer) and the higher fuel management incremental cost increase (Table III-2). The fuel cost savings (fuel offsets) from the proposed evaporative controls are calculated in Section IV.i.2 for the number of compliant vehicles in each fleet year and subtracted from the annual costs per year.

Table III-1. Tabulated Cost Increase Data for Low Estimate Scenario OHRV Emission Control, 2013$

			Incremental Costs ($ per vehicle)						Fixed Costs ($ per evap family)			
Family Size	Evap Family Life (years)	Displace-ment Range (cc)	Hose	Tank	CC or PRV	Fuel Manage-ment	Other	Retail (Y/N)	Re-design (cost per evap family)	Retail (Y/N)	Testing & Certification (cost per evap family)	Retail (Y/N)
C*	10	450	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	650	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	400	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	500	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	800	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	250	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	800	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	1000	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	350	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	450-500	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	550	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	590	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	1000	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	600 +	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	3	850	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	812	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	1000	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	10	50-249	C*	C*	C*	C*	C*	Y	C*	y	C*	N
C*	10	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	10	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	10	50-249	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	10	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	10	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	10	600-1000	C*	C*	C*	C*	C*	Y	C*	Y	C*	N

Notes: C* = Confidential Data used

* The low cost estimate assumes a 10-year evaportive family life and low fuel management costs while the high cost estimate assumes a 5-year evaporative family life and fuel management costs.

CC or PRV = Carbon Canister or Pressure Relief Valve

ROG = Reactive Organic Gas

Applied 20% retail increase to incremental costs where needed.

Table III-2. Tabulated Cost Increase Data for High Estimate Scenario OHRV Emission Control, 2013$

			Incremental Costs ($ per vehicle)						Fixed Costs ($ per evap family)			
Family Size	Evap Family Life (years)	Displace-ment Range (cc)	Hose	Tank	CC or PRV	Fuel Manage-ment	Other	Retail (Y/N)	Re-design (cost per evap family)	Retail (Y/N)	Testing & Certification (cost per evap family)	Retail (Y/N)
C*	5	450	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	650	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	400	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	500	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	800	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	250	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	800	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	1000	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	350	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	450-500	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	550	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	590	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	1000	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	600 +	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	3	850	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	812	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	3	1000	C*	C*	C*	C*	C*	N	C*	N	C*	N
C*	5	50-249	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	5	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	5	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	5	50-249	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	5	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	5	250-600	C*	C*	C*	C*	C*	Y	C*	Y	C*	N
C*	5	600-1000	C*	C*	C*	C*	C*	Y	C*	Y	C*	N

Notes: C* = Confidential Data used

* The low cost estimate assumes a 10-year evaportive family life and low fuel management costs while the high cost estimate assumes a 5-year evaporative family life and fuel management costs.

CC or PRV = Carbon Canister or Pressure Relief Valve

ROG = Reactive Organic Gas

Applied 20% retail increase to incremental costs where needed.

The lifespan of an evaporative family is crucial to the cost analysis because it is used as the fixed cost amortization period. The inverse relationship between lifespan and annual cost has a significant impact on the overall cost-effectiveness of this regulation. The low and high cost estimate approach

was chosen to preserve the integrity of the costs provided by respondents who could not project or provide an exact cost estimate.

Staff assumed OHRV manufacturers are at liberty to select any combination of evaporative emission control strategies and low-emission components for specific evaporative families; therefore, the range of incremental costs varies widely depending upon the mix of strategies and components used by the manufacturers.

A 20 percent increase (1.20 indirect cost multiplier) was applied to all cost data (unless it was already included by the manufacturer) to account for retail profit at the manufacturing and dealer/distributor level.

2. Assumptions

Wherever possible, staff relied on actual data provided by manufacturers, only in the cases where data was not available staff made assumptions, which included: time between vehicle platform redesigns, cost of fuel management systems, conversions from manufacturer's cost to manufacturer's suggested retail price, and life expectancy of an average OHRV.

a. Evaporative Family Lifespan and Fuel Management System Costs

When defining the low and high cost scenarios, both were evaluated based on evaporative family life span and fuel management system cost. The lifespan of an evaporative family affects the cost per year (Table III-3). As an evaporative family life span decreases the annualized fixed costs increase.

The costs associated with fuel management systems varied due to the wide range of redevelopment costs associated with altering existing fuel management systems or transitioning from carburetion to electronic fuel injection.

Table III-3. Cost Analysis Parameters for Low and High Estimate Scenarios

Cost Analysis	Evaporative Family Life*	Fuel Management Assumption
Low Estimate	10 years	Low Cost
High Estimate	5 years	High Cost

*Time between vehicle platform redesigns

b. Indirect Cost Multiplier

Using the guidelines provided in the Automobile Industry Retail Equivalent and Indirect Cost Multipliers Report (U S. EPA, 2009), staff assumed that modifying existing on-road evaporative components for use in OHRVs would require a medium level of technological complexity as a result of modular and architectural changes. Staff applied a retail markup of 20 percent or cost multiplier of 1.20

(USEPA, 2009). The markup converts manufacturers' costs to retail price increase. The indirect cost multiplier was applied to all cost data (unless it was already included by the manufacturer) received through ARB's cost survey.

c. Average Life Expectancy

Based on OHRV survival curves developed by ARB staff and presented in Attachment C: Emissions Estimation Methodology for Recreational Vehicles, of the Initial Statement of Reasons (ISOR), staff assumed in this economic analysis that the mean life for OHRVs used in California is 21 years. This value (in years) is an average calculated from the estimated life spans of OMCs (20) and ATVs (22), which make up approximately equal parts of the OHRV fleet in California. Also referred to as the useful life, the mean life defines the length of time an average vehicle is in operation. In order to determine the lifetime compliance costs associated with the proposed regulation, all cost calculations and projections are carried out through MY2018 to MY2038.

d. OHRV Population

Staff consulted several data sources in order to estimate the OHRV population at different points in time. Historical population data was provided by the DMV, while forecasted sales were extracted from the ARB's RV2013 emissions inventory model beginning with calendar year 2018 (see Attachment C). ARB's emissions inventory model was the basis for determining the cost-effectiveness of the regulation throughout the useful life of an OHRV. However, costs on a per unit basis at the point of production and first retail sale were based on sales estimates provided by survey respondents.

e. OHRV Warranty

This regulatory proposal includes a 30 month warranty for all evaporative emission-related repairs that cost less than $200, which is similar to the existing 30 month warranty for fuel lines, tanks, and exhaust-related parts. In addition, this regulation extends the warranty to 60 months for all evaporative emissions-related repairs that cost more than $200, adjusted for inflation. The costs associated with complying with the 30 month warranty are expected to be negligible because all the evaporative components are already covered by the current evaporative regulations, with the exception of the carbon canister. The warranty costs associated with carbon canisters is expected to be small based on the low failure rate for on-road vehicle carbon canisters. The small increase in warranty costs to manufacturers associated with the 60 month warranty is assumed to be included in the industry-provided cost estimates.

IV. COST IMPACT ANALYSIS

For each evaporative family, the adjusted total incremental cost was obtained by summing all costs for evaporative components and applying the indirect cost multiplier as appropriate. Likewise, an adjusted total fixed cost per year was determined by summing all annualized fixed costs and applying the indirect cost multiplier where applicable. Weighted fixed costs per vehicle were independently calculated by dividing the respective total adjusted costs by the evaporative family size, or manufacturer projected sales in MY 2018 as reported by each manufacturer. Because manufacturers are expected to amortize fixed costs, the Adjusted Total Fixed Cost per Year values were calculated based on the evaporative family lifetime and five percent interest.

Table IV-1. Cost Analysis Data for Low Estimate Scenario
OHRV Emission Control, 2013$

Adjusted Total Incremental Cost ($retail per vehicle)	Weighted Incremental Cost ($retail)	Adjusted Total Fixed Cost per Year($retail per family)	Weighted Fixed Costs per Year ($retail)	Weighted Fixed Cost ($ per vehicle)	Cost Effectiveness ($ per pound ROG)	Total Cost per Vehicle per Family
$237.60	$ 0.06	$ 223,318	$ 59.43	$ 5.40	289.32	20,539.21
$294.00	$ 0.19	$ 61,015	$ 39.85	$ 1.48	35.97	2,553.80
$267.60	$ 0.21	$ 68,288	$ 54.52	$ 1.65	32.92	2,336.93
$294.00	$ 0.23	$ 68,288	$ 54.52	$ 1.65	33.29	2,363.33
$102.00	$ 0.11	$ 38,000	$ 41.37	$ 0.92	13.33	946.45
$192.00	$ 0.41	$ 18,649	$ 39.70	$ 0.45	5.69	403.92
$294.00	$ 0.95	$ 189,513	$ 609.75	$ 4.58	24.21	1,718.91
$294.00	$ 1.00	$ 197,999	$ 670.58	$ 4.79	24.06	1,708.28
$192.00	$ 0.78	$ 7,770	$ 31.58	$ 0.19	3.36	238.25
$192.00	$ 1.30	$ 7,770	$ 52.44	$ 0.19	3.10	219.85
$38.40	$ 0.37	$ 70,259	$ 679.87	$ 1.70	3.02	214.05
$38.40	$ 0.37	$ 70,259	$ 679.87	$ 1.70	3.02	214.05
$102.00	$ 1.28	$ 140,561	$ 1,768.19	$ 3.40	5.24	372.31
$303.30	$ 5.14	$ 13,332	$ 225.77	$ 0.32	4.54	322.35
$38.40	$ 0.74	$ 70,259	$ 1,359.74	$ 1.70	1.78	126.22
$36.00	$ 0.87	$ 94,495	$ 2,285.96	$ 2.29	1.84	130.49
$38.40	$ 0.93	$ 70,259	$ 1,699.66	$ 1.70	1.53	108.66
$316.90	$ 8.13	$ 14,419	$ 369.74	$ 0.35	4.66	330.50
$333.60	$ 14.20	$ 16,531	$ 703.84	$ 0.40	4.83	342.99
$333.60	$ 14.20	$ 16,531	$ 703.84	$ 0.40	4.83	342.99
$489.90	$ 32.95	$ 19,609	$ 1,318.73	$ 0.47	7.00	496.95
$183.60	$ 32.38	$ 33,218	$ 5,858.09	$ 0.80	2.65	188.16
$183.60	$ 32.38	$ 33,218	$ 5,858.09	$ 0.80	2.65	188.16
$86.60	$ 28.53	$ 52,318	$ 17,238.11	$ 1.27	1.27	90.44

	Incremental	Fixed
Average Life of Vehicle (years)	21	21
Total Size of All Families	41,337	41,337
Average Cost per Family		$ 42,403
Weighted Cost for OHRVs	$ 177.72	$ 38.61

Retail Markup (%)	20%
Interest Rate (APR)	5.00%

Table IV-2. Cost Analysis Data for High Estimate Scenario
OHRV Emission Control, 2013$

Adjusted Total Incremental Cost ($retail per vehicle)	Weighted Incremental Cost ($retail)	Adjusted Total Fixed Cost per Year($retail per family)	Weighted Fixed Costs per Year ($retail)	Weighted Fixed Cost ($ per vehicle)	Cost Effectiveness ($ per pound ROG)	Total Cost per Vehicle per Family
$237.60	$ 0.06	$ 398,293	$ 105.99	$ 9.64	513.38	36,446.05
$294.00	$ 0.19	$ 108,821	$ 71.08	$ 2.63	60.91	4,324.41
$267.60	$ 0.21	$ 121,793	$ 97.23	$ 2.95	55.76	3,958.31
$294.00	$ 0.23	$ 121,793	$ 97.23	$ 2.95	56.13	3,984.71
$102.00	$ 0.11	$ 67,774	$ 73.78	$ 1.64	22.65	1,608.09
$192.00	$ 0.41	$ 33,260	$ 70.81	$ 0.80	8.03	569.96
$294.00	$ 0.95	$ 338,001	$ 1,087.50	$ 8.18	39.94	2,835.36
$294.00	$ 1.00	$ 353,136	$ 1,196.00	$ 8.54	39.67	2,816.40
$192.00	$ 0.78	$ 13,858	$ 56.32	$ 0.34	3.87	274.49
$192.00	$ 1.30	$ 13,858	$ 93.54	$ 0.34	3.40	241.67
$38.40	$ 0.37	$ 70,259	$ 679.87	$ 1.70	3.02	214.05
$38.40	$ 0.37	$ 70,259	$ 679.87	$ 1.70	3.02	214.05
$102.00	$ 1.28	$ 250,694	$ 3,153.61	$ 6.06	8.23	584.10
$626.30	$ 10.61	$ 23,779	$ 402.67	$ 0.58	9.30	660.27
$38.40	$ 0.74	$ 70,259	$ 1,359.74	$ 1.70	1.78	126.22
$36.00	$ 0.87	$ 94,495	$ 2,285.96	$ 2.29	1.84	130.49
$38.40	$ 0.93	$ 70,259	$ 1,699.66	$ 1.70	1.53	108.66
$316.90	$ 8.13	$ 25,716	$ 659.44	$ 0.62	4.81	341.16
$333.60	$ 14.20	$ 29,483	$ 1,255.31	$ 0.71	4.94	350.35
$333.60	$ 14.20	$ 29,483	$ 1,255.31	$ 0.71	4.94	350.35
$489.90	$ 32.95	$ 34,973	$ 2,352.00	$ 0.85	7.08	502.48
$506.60	$ 89.34	$ 59,244	$ 10,448.06	$ 1.43	7.25	514.73
$506.60	$ 89.34	$ 59,244	$ 10,448.06	$ 1.43	7.25	514.73
$409.60	$ 134.96	$ 93,311	$ 30,744.62	$ 2.26	5.87	416.45

	Incremental	Fixed
Average Life of Vehicle (years)	21	21
Total Size of All Families	41,337	41,337
Average Cost per Family		$ 70,374
Weighted Cost for OHRVs	403.54	61.74

Retail Markup (%)	20%
Interest Rate (APR)	5.00%

A. COST ESTIMATE EQUATIONS

The following cost estimate equations are used to develop values in each of the cells in the columns of Tables IV-1 and IV-2.

1. Adjusted Total Incremental Cost

$$ATIC = [(\sum ICI) \times ICM]$$

Where,
ATIC = Adjusted Total Incremental Costs
ICI = Incremental Cost Increases/Technology Type
ICM = Indirect Cost Multiplier (20 percent)

2. Weighted Incremental Cost

$$WIC = ATIC \times \frac{FS}{SFS}$$

Where,
WIC = Weighted Incremental Cost
ATIC = Adjusted Total Incremental Costs
FS = Family Size
SFS = Sum of All Family Sizes in Survey

3. Adjusted Total Fixed Cost per Year (Costs Reported at MSRP)

$$ATFCY = PMT(IR, EFL,$$
$$SUM(\ IF\big(Retail(y/n) = \text{y}, RD, RD * (1 + RM)\big),$$
$$IF(Retail(y/n) = \text{"y"}, TCC, TCC * (1 + RM)))) * -1$$

Where,
ATFCY = Adjusted Total Fixed Cost per Year
RD = Redesign Cost
TCC = Testing and Certification Costs
IR = Interest Rate (5 percent)
FS = Family Size
RM = Retail Markup
EFL = Evaporative Family Lifespan
PMT and SUM are Functions from Microsoft Excel

4. Weighted Fixed Costs per Year

$$WFCY = (ATFCY \times FS) \div SFS$$

Where,
WFCY = Weighted Fixed Costs per Year
ATFCY = Adjusted Total Fixed Cost per Year
FS = Family Size
SFS = Sum of all Family Sizes in Survey

5. Weighted Fixed Cost per OHRV

$$WFC_{OHRV} = \text{W}FCY \div FS$$

Where,
WFC_{OHRV} = Weighted Fixed Cost per OHRV
WFCY = Weighted Fixed Cost per Year
FS = Family Size

6. Cost-Effectiveness per OHRV per Pound ROG

$$CE = \left(ATIC + \frac{ATFCY}{FS}\right) \div PR$$

Where,
CE = Cost-Effectiveness per OHRV per Pound
ATIC = Adjusted Total Incremental Costs
ATFCY = Adjusted Total Fixed Cost per Year
FS = Family Size
PR = Pounds Reduced per Controlled Vehicle

7. Total Costs per Vehicle per Family

$$TCV = ATIC + \frac{ATFCY}{FS}$$

Where,
TCV = Total Costs per Vehicle per Family
ATIC = Adjusted Total Incremental Costs
ATFCY = Adjusted Total Fixed Cost per Year
FS = Family Size

B. COST PER VEHICLE

The total weighted cost per vehicle is the sum of the weighted average incremental costs and fixed costs.

TWC = TWIC + TWFC

TWIC = $\sum(WIC)$

TWFC = $\sum(WFC_{OHRV})$

Where,
TWC = Total Weighted Cost
TWIC = Total Weighted Incremental Cost
TWFC = Total Weighted Fixed Cost
WFC_{OHRV} = Weighted Fixed Cost per OHRV
WIC = Weighted Incremental Cost

Figure IV-1. Summary of OHRV Cost per Vehicle per Evaporative Family

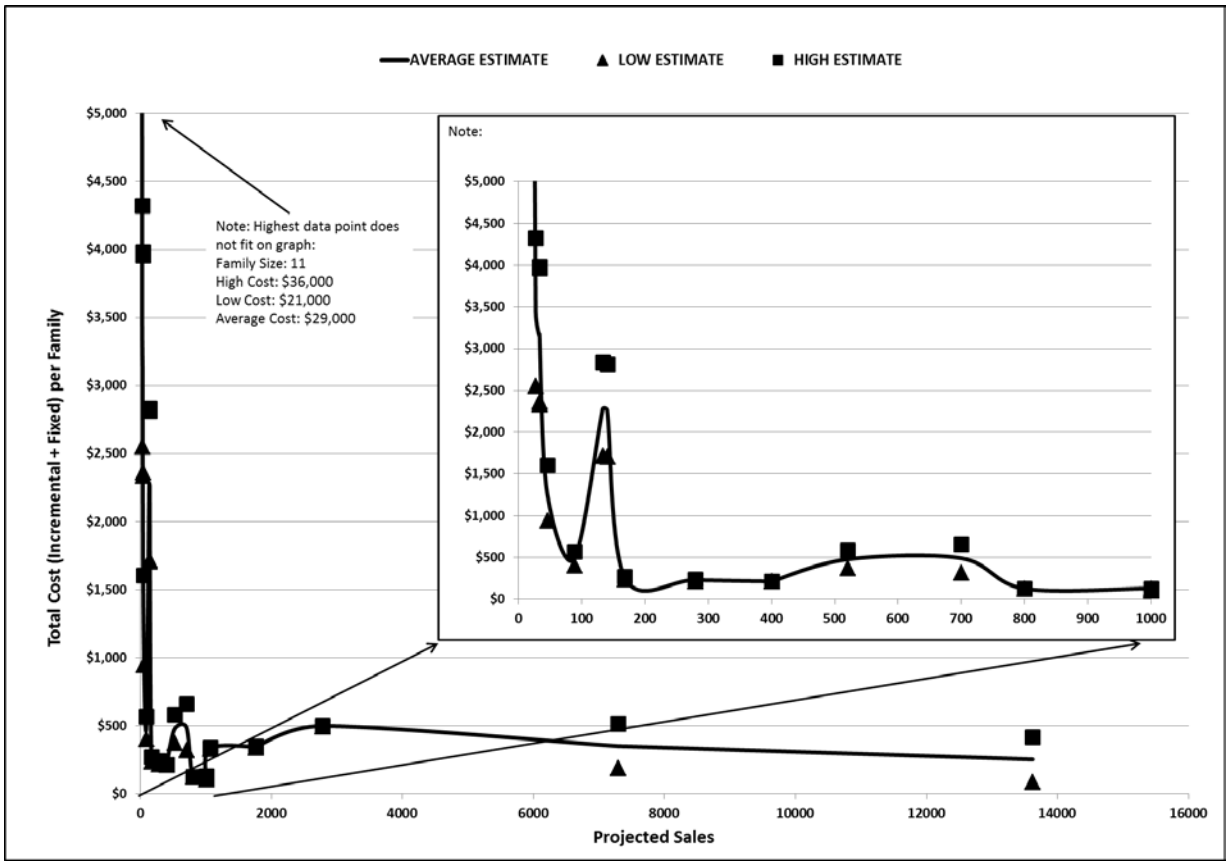


Figure IV-1 shows a summary of OHRV cost per vehicle per evaporative family based on the results of ARB's cost survey. The graph shows that the evaporative family cost decreases as projected sales increase.

C. TOTAL COST OF REGULATION

All the cost information used to develop the costs of this regulation were self-reported values supplied by manufacturers that will be subject to this regulatory proposal. Survey results were used regardless of cost and were omitted only if data was incomplete.

For the low and high cost estimates the annualized costs and the total lifetime cost for the proposed OHRV regulation was calculated. Cumulative annualized costs were estimated by multiplying the incremental cost increases by the projected annual OHRV sales from the emissions inventory model RV2013 to reflect the costs of all compliance vehicles operating within a calendar year. After converting the cumulative annualized costs to present value (2013$), the total lifetime cost of the proposed rule is about $90 million for the low estimate and $215 million for the high estimate. Based on the high estimate scenario values listed under Present Value of Cumulative Annualized Costs in Table IV-4, the economic impacts of the proposed regulation are expected to exceed the $10 million threshold for a major regulation.

OHRV sales in California are projected to increase over the next 20 years after the significant decline in sales associated with the 2007 economic downturn. Industry sales data from 2012 confirm that sales of off-road motorcycles and ATVs remain low due to the continued poor economy (MIC, 2013). As detailed in Attachment C: Emissions Estimation Methodology for Recreational Vehicles, ARB staff project that future OHRV sales in California will rebound based on the strong correlation between historical OHRV sales data and historical new housing starts. The expected annualized weighted fixed costs of the proposed regulations are expected to be between $2.7 million and $4.4 million as indicated in Table IV-3 and Table IV-4.

Table IV-3. Total Lifetime Cost and Cost-Effectiveness for Low Estimate Scenario for the Proposed OHRV Regulations, MY 2018 to MY2038 (2013$)

Weighted Incremental Cost Increase:	$ 177.72	Discount Rate:	5%
Weighted Fixed Incremental Cost Increase:	$ 38.61	Median Life of Vehicle (years):	21

Calendar Year	Annual OHRV Units Sold	Total Weighted Incremental Costs	Fuel Savings	Annualized Weighted Fixed Costs	Annualized Cost for New Sales	Cumulative Annualized Costs	Present Value of Cumulative Annualized Costs
2013	0	$0		$0	$0	$0	$0
2014	0	$0		$0	$0	$0	$0
2015	0	$0		$0	$0	$0	$0
2016	0	$0		$0	$0	$0	$0
2017	0	$0		$0	$0	$0	$0
2018	34071	$6,055,000	$114,000	$1,315,000	$461,000.00	$461,000	$361,000
2019	51720	$9,192,000	$167,000	$1,997,000	$706,000.00	$1,167,000	$871,000
2020	52341	$9,302,000	$163,000	$2,021,000	$720,000.00	$1,887,000	$1,341,000
2021	70625	$12,551,000	$212,000	$2,727,000	$980,000.00	$2,867,000	$1,940,000
2022	71473	$12,702,000	$209,000	$2,727,000	$994,000.00	$3,861,000	$2,489,000
2023	72330	$12,854,000	$207,000	$2,727,000	$1,008,000.00	$4,869,000	$2,989,000
2024	73198	$13,009,000	$206,000	$2,727,000	$1,021,000.00	$5,890,000	$3,444,000
2025	74077	$13,165,000	$205,000	$2,727,000	$1,035,000.00	$6,925,000	$3,856,000
2026	74965	$13,323,000	$205,000	$2,727,000	$1,047,000.00	$7,972,000	$4,228,000
2027	75865	$13,483,000	$205,000	$2,727,000	$1,059,000.00	$9,031,000	$4,561,000
2028	76775	$13,644,000	$206,000	$2,727,000	$1,071,000.00	$10,102,000	$4,859,000
2029	77697	$13,808,000	$206,000	$2,727,000	$1,084,000.00	$11,186,000	$5,124,000
2030	78629	$13,974,000	$207,000	$2,727,000	$1,096,000.00	$12,282,000	$5,359,000
2031	79573	$14,142,000	$208,000	$2,727,000	$1,108,000.00	$13,390,000	$5,564,000
2032	80528	$14,311,000	$209,000	$2,727,000	$1,120,000.00	$14,510,000	$5,742,000
2033	81494	$14,483,000	$210,000	$2,727,000	$1,132,000.00	$15,642,000	$5,895,000
2034	82472	$14,657,000	$212,000	$2,727,000	$1,144,000.00	$16,786,000	$6,025,000
2035	83461	$14,833,000	$213,000	$2,727,000	$1,157,000.00	$17,943,000	$6,134,000
2036	84239	$14,971,000	$214,000	$2,727,000	$1,166,000.00	$19,109,000	$6,221,000
2037	85161	$15,135,000	$215,000	$2,727,000	$1,178,000.00	$20,287,000	$6,290,000
2038	86082	$15,298,000	$216,000	$2,727,000	$1,190,000.00	$21,477,000	$6,342,000
						Total Lifetime Cost of OHRV Regulation (High Estimate) *:	$89,635,000
						Cost-Effectiveness of Regulation (for Form399):	4.09
						Cost-Effectiveness of a typical OHRV($/pound ROG) **:	3.05

Notes: * The Present Value of Cumulative Annualized Costs (Low Estimate) are not expected to exceed $10 million.

** Cost-Effectiveness was calculated using emissions model RV2013 population projections and estimated pounds per reactive organic gas (ROG) reductions from controlled vehicles.

Annual OHRV Units Sold values from CY2036 to CY2038 were calculated from a linear regression over the previous 18 years.

Table IV-4. Total Lifetime Cost and Cost-Effectiveness for High Estimate Scenario for the Proposed OHRV Regulations, MY 2018 to MY 2038 (2013$)

Incremental Weighted Cost Increase:	$ 403.54	Discount Rate:	5%
Weighted Fixed Incremental Cost Increase:	$ 61.74	Median Life of Vehicle (years):	21

Calendar Year	Annual OHRV Units Sold	Total Weighted Incremental Costs	Fuel Savings	Annualized Weighted Fixed Costs	Annualized Cost for New Sales	Cumulative Annualized Costs	Present Value of Cumulative Annualized Costs
2013	0	$0		$0	$0	$0	$0
2014	0	$0		$0	$0	$0	$0
2015	0	$0		$0	$0	$0	$0
2016	0	$0		$0	$0	$0	$0
2017	0	$0		$0	$0	$0	$0
2018	34071	$13,749,000	$114,000	$2,104,000	$1,122,000	$1,122,000	$879,000
2019	51720	$20,871,000	$167,000	$3,193,000	$1,710,000	$2,832,000	$2,113,000
2020	52341	$21,122,000	$163,000	$3,232,000	$1,737,000	$4,569,000	$3,247,000
2021	70625	$28,500,000	$212,000	$4,360,000	$2,351,000	$6,920,000	$4,684,000
2022	71473	$28,842,000	$209,000	$4,360,000	$2,381,000	$9,301,000	$5,996,000
2023	72330	$29,188,000	$207,000	$4,360,000	$2,410,000	$11,711,000	$7,190,000
2024	73198	$29,538,000	$206,000	$4,360,000	$2,438,000	$14,149,000	$8,273,000
2025	74077	$29,893,000	$205,000	$4,360,000	$2,467,000	$16,616,000	$9,252,000
2026	74965	$30,251,000	$205,000	$4,360,000	$2,495,000	$19,111,000	$10,135,000
2027	75865	$30,614,000	$205,000	$4,360,000	$2,523,000	$21,634,000	$10,927,000
2028	76775	$30,982,000	$206,000	$4,360,000	$2,551,000	$24,185,000	$11,633,000
2029	77697	$31,354,000	$206,000	$4,360,000	$2,580,000	$26,765,000	$12,261,000
2030	78629	$31,730,000	$207,000	$4,360,000	$2,608,000	$29,373,000	$12,815,000
2031	79573	$32,111,000	$208,000	$4,360,000	$2,637,000	$32,010,000	$13,301,000
2032	80528	$32,496,000	$209,000	$4,360,000	$2,666,000	$34,676,000	$13,722,000
2033	81494	$32,886,000	$210,000	$4,360,000	$2,695,000	$37,371,000	$14,085,000
2034	82472	$33,280,000	$212,000	$4,360,000	$2,724,000	$40,095,000	$14,392,000
2035	83461	$33,680,000	$213,000	$4,360,000	$2,754,000	$42,849,000	$14,648,000
2036	84239	$33,993,000	$214,000	$4,360,000	$2,777,000	$45,626,000	$14,855,000
2037	85161	$34,365,000	$215,000	$4,360,000	$2,805,000	$48,431,000	$15,017,000
2038	86082	$34,738,000	$216,000	$4,360,000	$2,833,000	$51,264,000	$15,138,000
						Total Lifetime Cost of OHRV Regulation (High Estimate) *:	$214,563,000
						Cost-Effectiveness of Regulation (for Form399):	9.76
						Cost-Effectiveness of a typical OHRV($/pound ROG) **:	6.55

Notes: * The Present Value of Cumulative Annualized Costs (High Estimate) are expected to exceed $10 million.
** Cost-Effectiveness was calculated using emissions model RV2013 population projections and estimated pounds per reactive organic gas (ROG) reductions from controlled vehicles.
Annual OHRV Units Sold values from CY2036 to CY2038 were calculated from a linear regression over the previous 18 years.

D. TOTAL COST ESTIMATE EQUATIONS

The following cost estimate equations are used to develop values in each of the cells in the columns of Tables IV-3 and IV-4.

1. Total Weighted Incremental Cost

$$TWIC = AOUS \times WIC$$

Where,
TWIC = Total Weighted Incremental Costs
AOUS = Annual OHRV Units Sold
WIC = Weighted Incremental Cost

2. Fuel Savings

$$FS = Average\ (AOUS \times FCSY)$$

Where,
FS = Fuel Savings
AOUS = Annual OHRV Units Sold
FCSY = Fuel Cost Savings per Year (see Section i.2.A)
WFICI = Weight Fixed Incremental Cost Increase
Average function is taken over all years from implementation year to current year

3. Annualized Weighted Fixed Cost

$$AWFC = (AOUS \times WFICI)$$

Where,
AWFC = Annualized Weighted Fixed Cost
AOUS = Annual OHRV Units Sold
WFICI = Weight Fixed Incremental Cost Increase

4. Annualized Costs for New Sales

$$ACNS = \mathrm{PMT}(\mathrm{IR}, \mathrm{MLV}, (\mathrm{TWIC} + \mathrm{AWFC})) - \mathrm{FS}$$

Where,
ACNS = Annualized Costs for New Sales
AWFC = Annualized Weighted Fixed Cost
TWIC = Total Weighted Incremental Costs
IR = Interest Rate (5 percent)

MLV = Median Life of Vehicle
FS = Fuel Savings
PMT Function from Microsoft Excel

5. Cumulative Annualized Costs

$$CAC = (\sum ACNS_{Previous\ Years}) + ACNS_{Current\ Year}$$

Where,
CAC = Cumulative Annualized Costs
ACNS = Annualized Costs for New Sales

6. Present Value of Cumulative Annualized Costs

$$PVCAC = CAC \times \left((1 + IR)^{-YRS}\right)$$

Where,
PVCAC = Present Value of Cumulative Annualized Costs
CAC = Cumulative Annualized Costs
IR = Interest Rate (5 percent)
YRS = Difference in Years from Future and Present Years

7. Cost-Effectiveness of Regulation

$$CE = CAC \div PR$$

Where,
CE = Cost-Effectiveness (per Pound ROG for CY2035)
CAC = Cumulative Annualized Costs (For Controlled Vehicles operating in CY2035)
PR = Pounds Reduced in CY2035

E. COST-EFFECTIVENESS

Cost-effectiveness for the regulation was determined by adding all of the annualized retail costs for controlled vehicles and dividing by the ROG emissions benefit for 2035. The pounds of ROG emissions reduced was estimated for 2035 because the OHVR emission inventory goes out to calendar year 2035 and represents a fleet turnover of about 71.2 percent. Overall, the proposed OHRV regulation is cost-effective with low, high, and average estimates as shown earlier in Table IV-3 and Table IV-4, respectively.

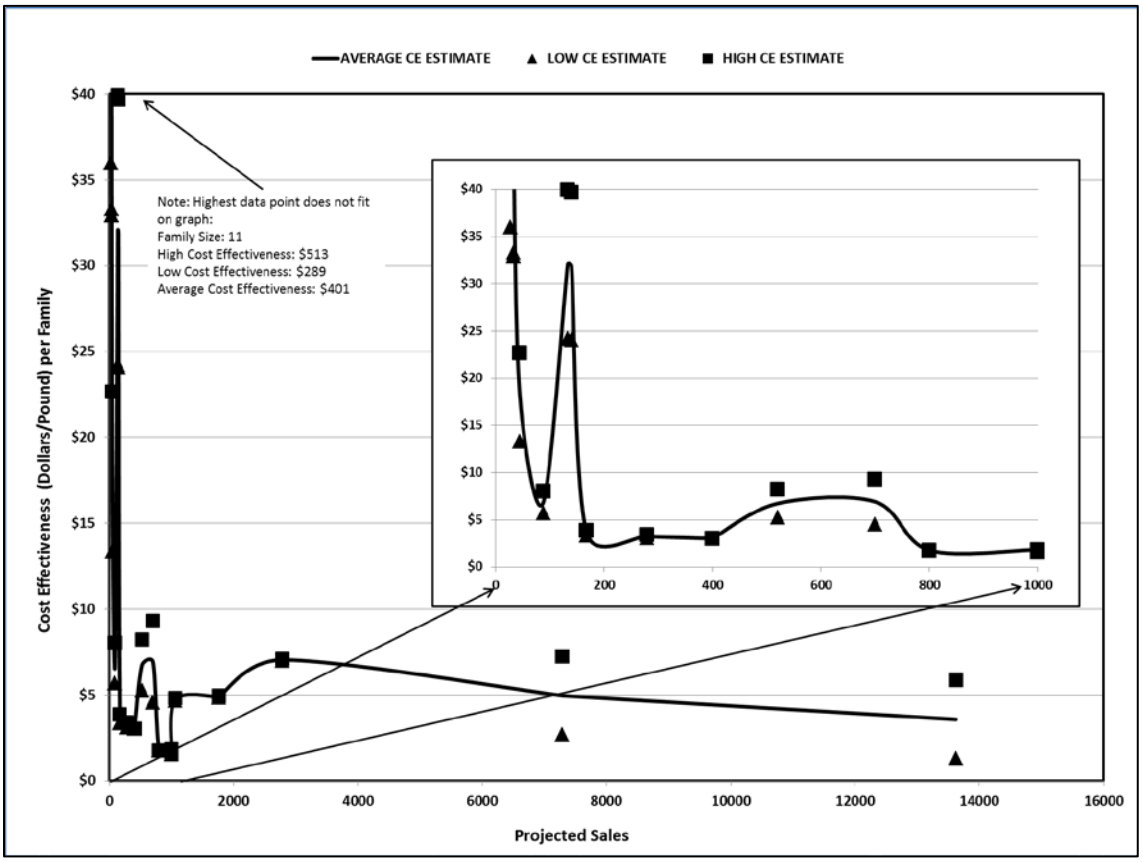
Table IV-5. Summary of Cost-Effectiveness Values for OHRV Regulation

	Weighted Average Overall Cost-Effectiveness* ($/lb.)
Low Estimate	4.09
High Estimate	9.76
Average	6.93

* Adjusted for retail by 20 percent, 2013$

Similar to the per evaporative vehicle family cost data, the cost-effectiveness values for each evaporative family varies widely based on estimated cost for compliance and projected sales. As the evaporative family volume decreases, the cost for compliance increases. For manufacturers whose model production is less than 50 units per year, staff proposes allowing a small volume alternative. For manufacturers who produce more than 50 but less than 150 units, the cost for compliance may result in a manufacturer choosing not to sell that model in California.

Figure IV-2. Cost-Effectiveness per Evaporative Family



Cost-effectiveness steeply declines and stabilizes as family size increases. The average cost-effectiveness of the regulation is $6.93 per pound of total organic gases (TOG). The proposed OHRV regulation is cost-effective. The cost-effectiveness of the proposed

regulation includes cost reductions due to fuel savings. The phase-in option allows manufacturers to delay the compliance of more costly evaporative families so long as 75 percent of phase in OHRVs are compliant during the phase-in period.

F. COST IMPACTS

The results of the cost impact analysis are highly dependent on assumptions of future OHRV sales. Beginning with model year 2018, the evaporative emission requirements for OHRV manufacturers are expected to lead to price increases that will be borne by the purchaser. When the economy is prosperous, OHRV consumers who perceive these vehicles as luxury items are more likely to purchase new vehicles (IBIS, 2010a; IBIS, 2010b). Recent housing and unemployment trends are indicative of a rebounding economy. As described in Attachment C: Emissions Estimation Methodology for Recreational Vehicles, new projected OMC sales were based on strong correlation to new housing starts. Staff collaborated with manufacturers and stakeholders to mitigate the cost impact by delaying the implementation to model year 2018, which gives manufacturers several years of lead-time and provides time for new sales of OHRV to recover. In addition, staff is proposing a flexible phase-in period. The incentive for the phase-in structure is to comply as early as possible with low-cost evaporative families.

1. Small Volume Manufacturers

To mitigate the high-per-vehicle cost of low sales volume manufacturers, a small-volume option has been included in the proposed OHRV regulation for manufacturers of 50 or fewer new OHRVs per model year. The small volume option will allow small volume and ultra-custom OHRVs to be available in California without subjecting them to compliance testing and design. The small volume options will save small businesses the fixed costs associated with compliance. The small business population in California is dominated by sand cars so the costs in this section are calculated for them. Their costs are assumed to be restricted to annual reporting and incremental component costs of $282 per vehicle adjusted for 2013 dollars. Staff developed the small business incremental cost estimates through survey data submitted by fuel hose, fuel tank vent valve, and carbon canister manufacturers (Figures VII-7 through VII-9 presented in the Appendix). Cost estimates were based on an average OHRV, and the results are listed below in Table IV-6.

Table IV-6. Small Volume Manufacturer Component Costs

Emission Control Components	Component Code	Current U.S.EPA Specifcation Costs (2010$)	Proposed ARB Specification Costs (2010$)	Cost Difference (2010$)	Average Cost Difference (2010$)
Hose (5/16" Inside Diameter)	H-I	$0.43	$0.45	$0.02	$0.34
	H-II	$0.72	$0.72	$0.00	
	H-III	$1.97	$2.96	$0.99	
Carbon Canister (For 5.0 Gallon Fuel Tank)	CC-I	NA	$6.46	$0.00	$6.21
	CC-II	NA	$6.00	$6.00	
	CC-II	NA	$8.00	$8.00	
	CC-III	NA	$4.50	$4.50	
	CC-III	NA	$5.00	$5.00	
	CC-IV	NA	$10.00	$10.00	
	CC-IV	NA	$10.00	$10.00	

Note: NA = Not Applicable

For sand cars, staff found it necessary to adjust the OHRV hose, and carbon canister estimates commensurate with the specifications expected for sand cars. For fuel hoses, staff assumed that sand car manufacturers would use an inside diameter found in automotive applications, such as 5/16”. As such staff assumed the average price increase for the incremental hose cost ($0.34 per linear feet) and a total of 5.0 feet installed per sand car. Since manufacturers estimated incremental carbon canister costs assuming a nominal fuel tank volume of 5.0 gallons, staff estimated the incremental cost using an average fuel tank volume of 30 gallons and an average price increase of $6.21. The cost differential of the fuel tanks themselves were estimated based on a comparison of plastic versus metallic aftermarket fuel cells. Unlike typical OHRV manufactures, sand car manufactures will not be subjected to the cost increases associated with electronic fuel injection, because they already purchase fuel injected, ARB exhaust compliant, engine systems during the fabrication of their vehicles.

Table IV-7. Small Business Incremental Component Cost per Vehicle

Incremental Component Cost Per Vehicle – Small Business	
Component	**Incremental Cost***
2010$ Low Permeation Hose ($0.34 × 5.0 feet)	$2
2010$ Carbon Canister ($6.21 × 6)	$37
2010$ Low permeation fuel tank ($Aluminum - $Resin)	$225
2010$ Total Incremental Component Cost per Vehicle:	$264
2013$ Total Component Cost per Vehicle ($264*1.07):	**$282**

*Totals may not sum exactly due to rounding

2. Brand Unavailability/Market Shift

Some manufacturers do not produce vehicles in all OHRV categories. The brand choices for consumers of low volume OHRV models may be impacted due to the proposed regulations. Because of the high per unit costs of compliance, manufacturers of low volume models may decide not to sell that model in California. It is likely that other brands would step up to meet consumer demand, resulting in a shift in market share.

3. Reporting Costs

It is anticipated that OHRV manufacturers will incur costs associated with annual reporting. Staff determined a high and low estimate for annual reporting costs of OHRVs. The succeeding table depicts the estimated cost per business for the anticipated range of evaporative families.

Table IV-8. Summary of Estimated Reporting Costs

Number of Evaporative Families per Manufacturer	Staff Hours to Apply per Evaporative Family	Estimated Pay Rate ($ per hour)	Total Estimated Reporting Cost
2 - 8	10	$30	$600 – $2,400

G. IMPACT TO INDIVIDUAL CONSUMER

1. Direct Impact

The increased cost for evaporative control, testing, and certification costs per vehicle are expected to be from $216 to $465 which represent 4 to 9 percent of the retail cost of an OHRV (assuming an average cost of $5,000). It is anticipated that the increased cost will be reduced due to cost savings from fuel injection fuel efficiency

and evaporative emission reductions over the lifetime of the OHRV (see Section IV.i Cost Savings).

2. Indirect Impact

Any OHRV manufacturer that sells an evaporative family with fewer than 150 units in California may experience high per-vehicle costs which could result in model unavailability. This may affect consumers who are expecting to purchase a particular model produced by a manufacturer who can longer support the costs. Staff expects that a manufacturer with higher sales volumes for that segment of OHRV will be available to provide a similar model to purchase.

H. IMPACT TO DEALERS

Most OHRV manufacturers sell their products through distributors and dealers, some of which are owned by manufacturers and some are independent. A potential indirect impact could be that dealers, distributors, or importers downsize their staff due to a decrease in OHRV sales associated with the increase in costs to control evaporative emissions from OHRVs. A retail price increase would be less noticeable for OHRV manufacturers that can more readily absorb fixed cost increases, such as manufacturers with high sales volumes or higher priced vehicles.

I. COST SAVINGS

1. Fuel Efficiency Savings

The stringency of the proposed diurnal standard is expected to speed-up the transition from carburetors to fuel injection. Standard carburetors produce evaporative emissions and do not optimize air/fuel ratios for all load/speed conditions, thereby reducing overall fuel efficiency of the engine. Electronic fuel injection (EFI) can reduce or eliminate these issues. Fuel injection uses an engine control unit, sensors, and electronic fuel injectors to optimize the air/fuel ratio and reduces evaporative emissions because the fuel management system is sealed and does not vent.

For engines subjected to transient loading, such as those used in OHRVs, switching from carbureted engines to EFI controlled engines can result in an increase in fuel efficiency. The cost savings get transferred on to the end user in the form of lower operating costs. However, fuel efficiency for an EFI controlled OHRV is very dependent on the fuel injection calibration. In some cases the potential for increased fuel economy may not be realized. In addition, the regulation does not specifically require EFI because the proposed diurnal standard is performance–based. Manufacturers may choose any technology to comply with the diurnal standard. This leads to an uncertainty in projecting future EFI OHRV sales. Based on the uncertainties, the cost savings from improved fuel injection engine efficiency were not included.

2. Evaporative Control Savings

The reduction of evaporative emissions from OHRVs from the proposed regulation will result in a decrease in fuel usage because less fuel will be lost due to evaporation. This reduction can be estimated as a fuel cost savings based on emission reductions. The cost savings is calculated from the sum of the emission reductions for each year and the corresponding value of retail gasoline for that year. The retail gas prices are obtained from a California Energy Commission report that determined the forecasted retail gas prices from 2011 to 2030 (CEC, 2011). All the prices were then converted from 2010 dollars to 2013 dollars with a factor of 7 percent using an inflation calculator provided by U.S. Department of Labor (USDL, 2013). Also, the prices were extrapolated from 2031 to 2038 using 0.7 percent increase.

a. Fuel Cost Savings per Year

$$FCSY = \left[IF\ X\ (RCG)\ \mathrm{X}\ \left((\mathrm{ER})\right)\right] \div GD$$

Where,
FCSY = Fuel Cost Savings per Year
IF = Inflation Factor
RCG = Retail Cost of Gasoline
ER = Emissions Reduction
GD = Gasoline Density (6.073 lbs./US Gallons)

b. Fuel Offsets (Lifetime of Vehicle)

$$FO = \sum FCYS$$

Where,
FO = Fuel Offsets
FCSY = Fuel Cost Savings per Year

The estimated fuel cost savings over the lifetime of the vehicle is $52.71. This value reduced the incremental cost increase from the proposed evaporative controls.

J. ALTERNATIVES

1. No Action

Although maintaining the status quo has no cost, it offers no benefit. The “no action” alternative translates into deference to U.S. EPA tank and hose permeation standards, which provide an insufficient level of ROG reductions.

2. Removal of the "Tip Test"

The proposed regulation includes a requirement that OHRVs are equipped with emission controls to prevent fuel leakage in case of tip over. The effectiveness of these controls is determined with a tip test. Removal of the tip test from the proposed test procedure, *Test Procedure for Determining Evaporative Emissions from Off-Highway Recreational Vehicles* (TP-933) could prove counterproductive for the OHRV industry. Tip testing is essential to the prevention of carbon canister liquid contamination; and therefore, operation. If ARB's Enforcement Division conducted an in-use evaluation of OHRVs, and observed consistent carbon canister liquid contamination due to a manufacturer's failure to protect the carbon canister, the OHRV manufacturer would be compelled to absorb all costs associated with component redesign, product recalls, and enforcement penalties.

3. Separate Standards for Each Mode of Use

Requiring standards for each mode of evaporative emissions from OHRVs (running loss, hot soak, and diurnal) would increase a manufacturer's investment in evaporative testing enclosure or Sealed Housing for Evaporative Determination, SHED, time, and therefore overall fixed costs. The proposed regulation and test procedure emphasize diurnal testing and relegates hot soak and running loss to the preconditioning period.

V. SUMMARY

Based on industry costs, the proposed regulation is expected to be cost-effective over the entire fleet of OHRV. The proposed OHRV regulation has a low estimate value of $4.09 and a high estimate value $9.76 per pound of ROG reductions in 2035 with an average of $6.93 per pound. The proposed regulation maximizes cost-effectiveness by allowing flexibility for demonstrating compliance with the standards and by giving manufacturers flexibility in certification, which accommodates the diversity of vehicle types and testing capabilities. Manufacturers have full control in selecting emission control components and in determining the necessary design changes needed to produce a compliant OHRV. Staff collaborated with manufacturers and stakeholders to mitigate the cost impact by delaying the implementation model year to 2018 and permitting a flexible phase-in for OHRV compliance. These concessions provide additional time for new sales to recover and system redesign.

VI. REFERENCES

CEC, 2011. Transportation Energy Forecasts and Analyses for the 2011 Integrated Energy Policy Report. California Energy Commission (CEC) Draft Staff Report CEC-600-2011-007-SD. August, 2011.

DMV, 2010. Department of Motor Vehicle Registration Data for 2001 to 2010.

IBIS, 2010a. IBIS World Industry Report 33699a - Motorcycle, Bike, & Parts Manufacturing in the US, August 2010, Copyrighted.

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MIC, 2013. Drastic Decline in California Off-Highway Motorcycle/ATV Sales, Motorcycle Industry Council (MIC) correspondence presented to ARB Staff at an OHRV Workshop, March 6, 2013.

USDL, 2013. United States Department of Labor (USDL) Bureau of Labor Statistics Data, Table & Calculators by Subject. http://www.bls.gov/data/inflation_calculator.htm accessed May 8, 2013 .

U.S. EPA, 2009. Automobile Industry Retail Equivalent and Indirect Cost Multipliers Report, United States Environmental Protection Agency (U.S. EPA), EPA-420-R-09-003, February 2009, http://www.epa.gov/otaq/ld-hwy/420r09003.pdf accessed 5/2/2013).

VII. APPENDIX

Figure VII-1. ARB Cost Survey (Page 1)

State of California
Air Resources Board
MLD/ECCB-057 (01/2013 Updated)

Incremental Manufacturer Costs for Compliance with ARB's Proposed OHRV Evaporative Regulation and Test Procedures

January 2013

Assistance requested:
Air Resources Board (ARB) staff is proposing amendments to the evaporative emission standards for Off-Highway Recreational Vehicles (OHRV). A copy of the draft regulation and test procedure is posted on the ARB website: http://www.arb.ca.gov/msprog/offroad/orrec/orrec.htm

OHRV Manufacturers are encouraged to complete the following table, as applicable, to estimate the incremental manufacturer cost associated with the draft proposed regulation and test procedure. Incremental manufacturer cost is the increase in cost, to the manufacturer (not retail price equivalent), of components associated with this proposed regulation (new component cost minus current component cost).

For questions, please contact Pippin Mader at (916) 322-8930 or by email pmader@arb.ca.gov.

Please provide responses by March 1, 2013.
Mail: ARB, MLD
Attn: Pippin Mader
P.O. Box 2815
Sacramento, CA 95812

Fax: (916) 322-2444

Date:	**Treat source of information as confidential:** ☐ **Yes** ☐ **No**
Manufacturer Name:	Contact Name:
Telephone:	Email:
Contact Address:	
What is the average time, in model years, between evaporative family re-design?	
What percentage of your OHRVs are manufactured in California?	
Are cost estimates based on building "California only" or "50 state" OHRVs?	
Estimated retooling cost, if any, associated with the assembly process of OHRVs with low emissions technology:	

Figure VII-2. ARB Cost Survey (Page 2)

State of California
Air Resources Board
MLD/ECCB-057 (01/2013 Updated)

Incremental Manufacturer Costs for Compliance with ARB's Proposed OHRV Evaporative Regulation and Test Procedures

	OHRV Evaporative Family # (e.g. 1, 2, 3, …)	Evaporative Family Displacement Range (cc)	Incremental Costs for Compliance with ARB's Proposed OHRV Evaporative Regulation and Test Procedures							
			Low Perm Fuel Hose ($Incr Cost per vehicle)	Low Perm Fuel Tank ($Incr Cost per vehicle)	Carbon Canister / Pressure Relief Valve ($Incr Cost per vehicle)	Fuel Management ($Incr Cost per vehicle)	Other Control Components* ($Incr Cost per vehicle)	Re-Design resulting from this regulation** ($Cost per evaporative family)	Testing and Certification ($Cost per evaporative family)	Evaporative Family Size (Projected vehicle sales in California per evaporative family)
ATV Evaporative Families**	ATV Evap Evaporative Family #1									
	ATV Evap Evaporative Family #2									
	ATV Evap Evaporative Family #3									
Motorcycle Evaporative Families**	MC Evap Evaporative Family #1									
	MC Evap Evaporative Family #2									
	MC Evap Evaporative Family #3									
Side-by-Side vehicle Evaporative Families**	Side-by-Side vehicle Evaporative Family #1									
	Side-by-Side vehicle Evaporative Family #2									
Misc Evap Families**	Other* (i.e. sand cars, etc.)									

* Please provide additional information as needed regarding "Other OHRV Categories", "Re-Design", or "Other Control Components".
** Add additional families as needed

Figure VII-3. ARB Cost Survey 2 (Page 1)

State of California
Air Resources Board
MLD/ECCB-057 (04/2013 Updated)

Treat source of information as confidential:
☐ Yes ☐ No

Updated Manufacturer Costs for Compliance with ARB's Proposed OHRV Evaporative Regulation and Test Procedures

April 2013

Assistance requested:
Air Resources Board (ARB) staff has recently made amendments to the proposed evaporative emission standards for Off-Highway Recreational Vehicles (OHRV) in an attempt to reduce the testing cost for manufacturers. Simplified versions of the regulation and test procedure are attached. They summarize the current draft regulation and test procedure posted on the ARB website: http://www.arb.ca.gov/msprog/offroad/orrec/orrec.htm. The summary documents are not intended to replace any regulatory items, but merely serve as an aid when completing this form.

OHRV Manufacturers are encouraged to complete the following table, as applicable, to estimate the incremental and capital manufacturer costs in 2013 U.S. dollars ($) associated with the revised proposed draft regulation and test procedure. In order to integrate stakeholder cost estimates into the rulemaking support documents ARB staff must receive cost estimates no later than April 29, 2013.

Please return by April 29, 2013	
Mail: Pippin Mader, ARB/MLD P.O. Box 2815 Sacramento, CA 95812	
Fax: (916) 322-2444 Attn: P. Mader	**Email:** pmader@arb.ca.gov

Manufacturer Information:

Manufacturer Name: _____

Contact Name: _____ Telephone: _____ Email: _____

Vehicle Production:

What is the average time, in model years, between evaporative family re-design? _____

What percentage of your current California OHRV fleet already meets the proposed standards? _____

Do you currently manufacture zero emission OHRVs?: ☐yes ☐ no What percent of California fleet? % _____

Do you sell less than 50 OHRV units in California per model year? _____

For questions, please contact Pippin Mader at (916) 322-8930 or by email pmader@arb.ca.gov.

Figure VII-4. ARB Cost Survey 2 (Page 2)

State of California
Air Resources Board
MLD/ECCB-057 (04/2013 Updated)

The cost estimates in 2013$ provided below are based on building OHRVs designed to comply with ARB's proposed evaporative standards.
These vehicles will be distributed to the following market: ☐California only ☐50 state

Instructions: Estimate the cost increase per model year to design current CA compliant vehicles to meet the proposed OHRV evaporative standards. Rows can be added, as needed, to accommodate additional evaporative families.

	Evaporative Family Displacement Range (cc)	$ Incremental Costs per *Vehicle* (cost of equipment needed to meet the proposed standards)					$ Capital Costs per *Evaporative Family Life*		MY2018 Projected Vehicle Sales in California per *Evaporative Family*
		Reduced Permeation Fuel Hose[1]	Reduced Permeation Fuel Tank[1]	Carbon Canister / Pressure Relief Valve	Fuel Management	Other Control Components[2]	Vehicle Re-Design[2]	Testing and Certification	
Example	ATV: 51cc – 249cc	$2.5	$5.00	$20.00	$150.00	$2.50	$100,000.00	$50,000.00	5000
ATV Evaporative Families									
Motorcycle Evaporative Families									
Misc. Evap families									

[1] A cost should only be estimated for the fuel hose/tank if a lower permeation is needed to meet the standard beyond current federal evaporative requirements.
[2] Please provide an estimate and description of any additional costs incurred by designing vehicles to comply with the proposed evaporative standards.

For questions, please contact Pippin Mader at (916) 322-8930 or by email pmader@arb.ca.gov.

Figure VII-5. ARB Cost Survey 2 (Page 3)

State of California
Air Resources Board
Attachment 1 of 2 to MLD/ECCB-057 (04/2013 Updated)

Short Summary of the OHRV Evaporative Emission Regulation*

Applicability- [§2418(a)]
Applies to Off-highway recreational vehicles (OHRV) including gasoline fueled off-road motorcycles, all-terrain vehicles, off-road sport vehicles, off-road utility vehicles, and sand cars. Zero emission OHRV may be certified to receive credits, but are not required to perform testing.

Phase-in Period [§2418(b)(2)]
Phased-in over a four year period beginning in model year 2018 using the following calculation: [(MY2018+MY2019+MY2020+MY2021)/4 X100]≥75%

Evaporative Emission Performance Standards [§2418(b)(1)(A)]
OHRV must meet a 1.0 g TOG diurnal standard (per test sequence) and have no visible liquid leakage during a fuel system leakage tip test. The diurnal standard can be demonstrated by performing one of the two following tests:

1. 72 hour diurnal
2. 24 hour diurnal plus calculated vented emissions (option includes a pressure relief valve exemption)

All-Terrain Vehicle Filler Neck Compatibility Standard [§2418(b)(1)(B)]
All-terrain vehicles with fuel tanks that are re-designed beginning in model year 2018, with a nominal capacity of greater than 3.5 gallons must meet filler pipe sealing surface requirements of Figure 1 of the International Standards Organization 13331:1995(E).

Small-Volume Manufacturer Evaporative Emission Design Standard [§2418(c)]
OHRV manufacturers that produce less than 50 vehicles per year for three consecutive calendar years may certify using design-based standards. OHRV must have fuel injection and an actively purged carbon canister with a 1.0 g/l working capacity, perform a tip-test, and meet permeation standards for the fuel tank (1.5 g/m^2/day @ 28°C (82°F)) and fuel hose (5.0 g/m^2/day @ 35°C (95°F)).

Advanced Fuel System Credits [§2418(f)]
An OHRV manufacturer may use credits generated from certification values that are below the applicable performance standard, or from zero emission OHRV to offset higher emitting evaporative families. Zero emission vehicles are awarded credits in the amount of 75% of the diurnal standard. All credits must be used in the same model year, may not be sold or traded, and cannot be used for evaporative families that emit over 300% of the performance standard.

Warranty Period [§ 2419.2]
The warranty period covers a period of use over 30 months, or 2500 miles, or 250 hours, whichever comes first, except for evaporative components over $200 including labor, which are covered for 60 months, or 5000 miles, or 500 hours.

Tampering [§ 2419.5(f)]
All evaporative emission control systems must be installed in such a way that they are resistant to tampering or removal. All off-road motorcycles with carbon canisters installed outside of the cross sectional profile, or clearly visible on all other OHRVs, must be mounted so that non-conventional tools are required to remove the canister and the vapor line connection to the canister.

* Not intended to replace the proposed OHRV regulatory documents posted: http://www.arb.ca.gov/msprog/offroad/orrec/orrec.htm.

Figure VII-6. ARB Cost Survey 2 (Page 4)

State of California
Air Resources Board
Attachment 2 of 2 to MLD/ECCB-057 (04/2013 Updated)

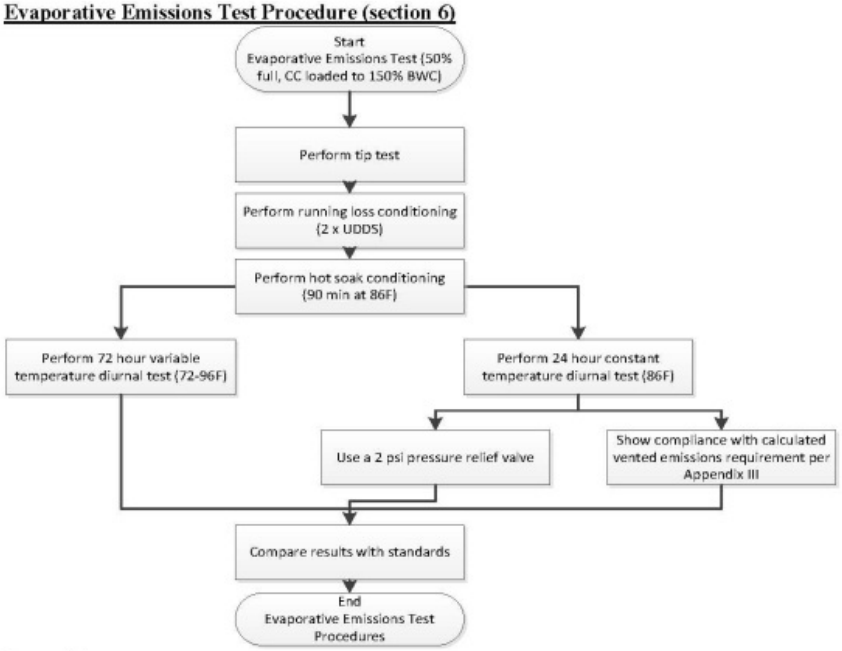
Short Summary of TP-933 - Test Procedure for Determining Evaporative Emissions from Off-Highway Recreational Vehicles*

Overview
TP-933 is a test procedure that is used to measure diurnal evaporative emissions from Off-highway recreational vehicles (OHRV).

Durability Testing (section 4)
Vehicle must show the evaporative emissions components are durable enough to control emissions for their full useful life. This includes remaining mechanically intact in environments with dust, vibration, heat, UV, and ozone. This also includes protecting the carbon canister from contamination by liquid fuel

Evaporative Emissions System Preconditioning (section 5)
All fuel system components that permeate must be soaked for the equivalent of 3,360 hours at a temperature between 68ºF and 86ºF. The carbon canister has to be conditioned and loaded to 1.5 times the nominal butane working capacity before the test.

Evaporative Emissions Test Procedure (section 6)



Appendix
Appendix A – Calculations: Evaporative Emissions
Appendix B - Calculation Method for demonstrating the adequacies of the Vented Evaporative Emissions system
Appendix C – Motorcycle Variable Speed Cooling Blower

* Not intended to replace the proposed OHRV regulatory documents posted:
http://www.arb.ca.gov/msprog/offroad/orrec/orrec.htm.

Figure VII-7. ARB Cost Survey 2010 (Page 1)

Air Resources Board

Mary D. Nichols, Chairman
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Linda S. Adams
Secretary for
Environmental Protection

Arnold Schwarzenegger
Governor

August 3, 2010

Dear Sir/Madam:

The purpose of this letter is to request participation in the enclosed evaporative emission control components surveys.

The Air Resources Board (ARB) is proposing amendments to the evaporative emission standards for Off-Highway Recreational Vehicles and On-Road Motorcycles. ARB staff requests an estimate of the increased costs of control components that manufacturers may use to meet the ARB standards and specifications as listed in the cost survey form. This information will be used for cost and impact analysis for the proposed regulation.

We realize that any information you provide may be proprietary. We will keep the source of the information confidential if you check the confidentiality box located in the upper right corner of the survey form. Any confidential or proprietary information submitted will be handled in accordance with California Code of Regulations, title 17, section 91000, which specifies the requirements for handling confidential information submitted to public agencies.

Please assist us with our cost survey by completing the enclosed forms and returning them **by September 15, 2010.** We appreciate your participation.

If you have any questions regarding this request, please contact Pippin Mader (916) 322-8930 or via email at pmader@arb.ca.gov, or contact Michele Dunlop at (916) 323-8971 or via email at mdunlop@arb.ca.gov.

Sincerely,

Pippin Mader P.E.
Evaporative Control, Engineering, and Regulatory Development Section
Monitoring and Laboratory Division

Enclosures (2)

Figure VII-8. ARB Cost Survey 2010 (Page 2)

State of California
Air Resources Board
MLD/ECCB-057 (08/10 New)

Treat source of information as confidential
☐ Yes ☐ No

Component Cost Survey for Evaporative Emission Controls on Off-Highway Recreational Vehicles

Assistance requested: The Air Resources Board (ARB) is proposing amendments to the evaporative emission standards for Off-Highway Recreational Vehicles (OHRV), and ARB staff anticipates that manufacturers will equip their vehicles with evaporative control components that meet the specifications as listed below in the survey table. Where applicable, please provide the costs of the control components that meet the specifications as listed.

Manufacturer Name:	Contact Address:	Date:
Contact Name:	Contact Telephone: Contact E-mail:	Manufacturing Locations:

Component Type	Off-Highway Recreational Vehicle Evaporative Emission Components			OHRV Manufacturer's Cost*	
	Current Specification	**Requested Specification**	**Size**	**Current Specification**	**Requested Specification**
Fuel Hose (Permeation)	15 grams / m^2 / day at 23 °C	5 grams / m^2 / day at 40 °C	3/16" internal diameter	$ / foot	$ / foot
			1/4" internal diameter	$ / foot	$ / foot
			5/16" internal diameter	$ / foot	$ / foot
Fuel Tank (Permeation)	1.5 grams / m^2 / day at 28 °C	1.5 grams / m^2 / day at 40 °C	2.5 gallons	$	$
			4.0 gallons	$	$
			5.0 gallons	$	$
Carbon Canister	None	~9.5 gram BWC	2.5 gallons (9.46 liters)	$	$
		~15 gram BWC	4.0 gallons (15.14 liters)	$	$
		~19 gram BWC	5.0 gallons (18.93 liters)	$	$
Pressure Relief Valve	None	2.00 psi	All tank sizes	$	$
	None	2.25 psi	All tank sizes	$	$
Fuel Management	Carburetor	Fuel Injection	None	$	$

Note: * **OHRV Manufacturer's Cost** is the price component manufacturers will charge when they sell to OHRV manufacturers.

OVER

Figure VII-9. ARB Cost Survey 2010 (Page 3)

State of California
Air Resources Board
MLD/ECCB-057 (08/10 New)

Please feel free to attach additional pages to this document in order to accurately describe the increased costs for the proposed regulation.

We appreciate your participation. If you have any questions regarding this request, please contact Pippin Mader (916) 322-8930 or via email at pmader@arb.ca.gov, or contact Michele Dunlop at (916) 323-8971 or via email at mdunlop@arb.ca.gov.

Please return this survey by September 15, 2010

Mail to: Pippin Mader, ARB/MLD
P.O. Box 2815
Sacramento, CA 95812

Fax to: (916) 322-2444
ATTN: Pippin Mader ARB/MLD

Email to: pmader@arb.ca.gov