APPENDIX F – USEFUL LIFE STUDY

2016 EFMP Retirement-Only Useful Life Study

In 2013, California Air Resources Board (CARB) and Bureau of Automotive Repair (BAR) staff jointly conducted a study to assess whether the Enhanced Fleet Modernization Program (EFMP) Retirement-Only program was successfully retiring vehicles with sufficient remaining useful life and thus achieving its emission reduction goals. The study found that many vehicles were likely near or already at the end of their useful life. In June of 2014, CARB amended the EFMP regulation in an attempt to improve the quality of retired vehicles. To see if these regulatory changes had the intended effect, this study replicated the study conducted in 2013 and compared results. Overall, the 2016 study found modest but ultimately insufficient improvement in the quality of vehicles retired since the regulatory changes. The study's methods, findings, conclusions and recommended next steps are detailed below. The next section provides some background and briefly summarizes the original 2013 study.

Background

The goal of EFMP Retirement-Only is to accelerate the turnover of the light-duty vehicle fleet in California by incentivizing drivers to retire their older, high-emitting vehicles several years earlier than they normally would. The emissions benefits of the retirement program strongly depend on accepting vehicles that are not only high-emitters, but also still capable of being driven for several additional years. While emission inventory models showed that the vehicles retired by EFMP have on average three years of remaining useful life, anecdotal evidence collected by CARB and BAR staff during the program's first several years of operation suggested many of the actual vehicles were close to end-of-life.

To investigate the end-of-life concern, CARB and BAR staff jointly assessed one hundred and sixty-four EFMP vehicles from two dismantler locations in Southern California in January of 2013. The quality of each vehicle was assessed qualitatively and quantitatively. The qualitative assessment consisted of a checklist (see Figure F-4 at the end of this appendix) completed by CARB Air Resources Field Representatives (CARB field reps), while an Accelerated Simulation Mode (ASM) dynamometer test (i.e. roadside Smog Check) was performed on each vehicle for the quantitative assessment. Sixty percent of the vehicles tested failed the Smog Check, with 21 percent failing as gross polluters. The average failure and gross polluter rates for similarly aged vehicles across the statewide fleet during this time period was 25 and 6 percent, respectively. Seventeen vehicles were incapable of completing the ASM test for various mechanical reasons.

Overall, the 2013 study concluded that the majority of vehicles retired through EFMP were high-emitters but had little to no remaining useful life. At the time, the acceptance inspection required the participant to drive vehicle to the dismantler on its own power, demonstrate starting of the engine and 30 feet of forward motion. The study recommended EFMP adopt a higher standard via a more sophisticated inspection

process to ensure the program wasn't accepting vehicles that would have been retired anyway.

CARB subsequently made several changes to the program's guiding regulation that were finalized in April 2015, some of which followed from the 2013 study's conclusions. Among other changes, vehicles are now required to successfully complete (pass or fail) an ASM dynamometer test to be eligible for the program. Also, eligible vehicles no longer have to be registered for two years prior to entry, as long as they can demonstrate to have been primarily used in California for two years prior to retirement.

2016 Testing Conducted at the Dismantlers

Across two successive Fridays in January 2016, BAR and CARB staff assessed 181 vehicles at two dismantler locations in South California (Monrovia and San Bernardino). All the vehicles we assessed qualitatively using the original checklist from the 2013 study, and the emissions of 175 vehicles were measured by the standard ASM dynamometer test. Six vehicles were prevented from being tested on the ASM dynamometer due to traction control features.

Qualitative Results

At the time the assessments were conducted at each site, the vehicles had been retired and sitting for a period of one to eight days. The majority of vehicles required no significant effort to start and prepare for testing, although a number of vehicles exhibited minor mechanical malfunctions, such as leaking fluids, broken emission hoses, and insufficient battery capacities. However, 3 percent of vehicles (six vehicles in total) had more serious mechanical failures, such as severe coolant leaks from cylinder head gaskets and heater cores that lead to rapid engine overheating, severe cylinder misfiring, and malfunctioning transmissions that prevented vehicles from completing the ASM test. See Table F-1 below for a summary of the most common mechanical issues.

Table F- 1: Common Observed Vehicle Malfunctions

Vehicle System with Observed Malfunction	2016
Engine (misfire/noise/oil leaks/smoking)	25 (14%)
Emission Control System (broken/disconnected vacuum lines)	22 (12%)
Cooling System (leaks/overheating)	14 (8%)
Suspension/Steering (loose/binding/noise)	5 (3%)
Transmission	4 (2%)
Brake System	3 (2%)

*Some vehicles may have demonstrated more than one mechanical malfunction

CARB field reps gave each of the vehicles an overall quality rating of either poor, fair, or good. Figure F-1 below summarizes the results. The majority of vehicles (50 percent) were deemed to be in fair condition; while an equal fraction (25 percent) of the remaining vehicles were rated either poor or good. These results are similar to

those from the 2013 study, which rated the exact same percentage of vehicles as either fair or good (75 percent). However, a higher fraction of vehicles in the current study received a good rating compared to what was found in 2013. One-hundred of the 181 vehicles assessed were equipped with On-Board Diagnostics II (OBDII) systems. Forty-eight percent had their “check engine” lamp illuminated and an additional 11 percent had a malfunctioning lamp. As with the quality ratings, these results do not differ significantly from the 2013 study.

Figure F- 1: Results of Qualitative Vehicle Ratings

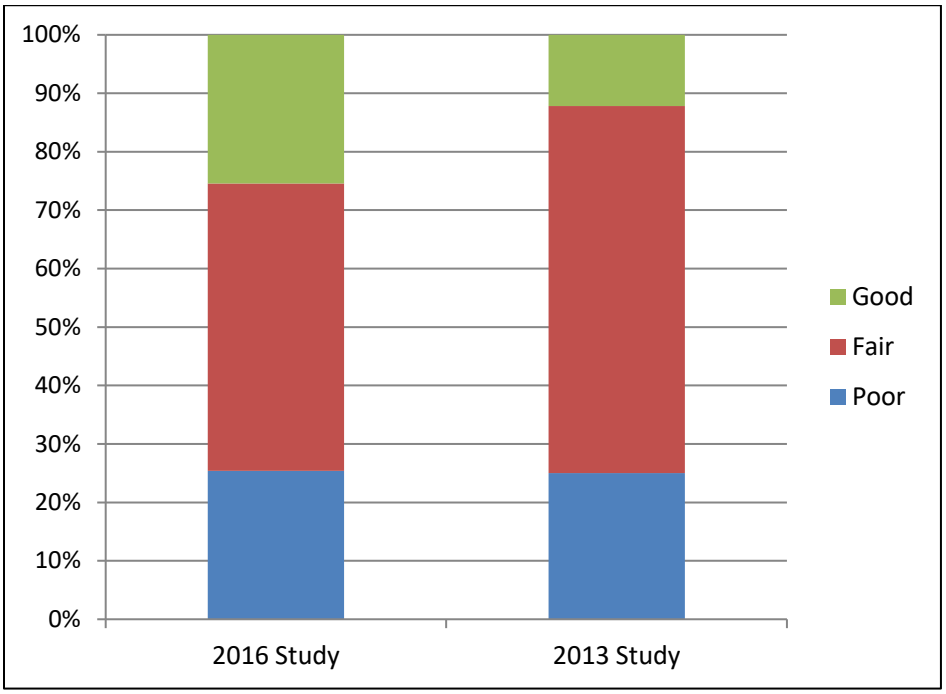
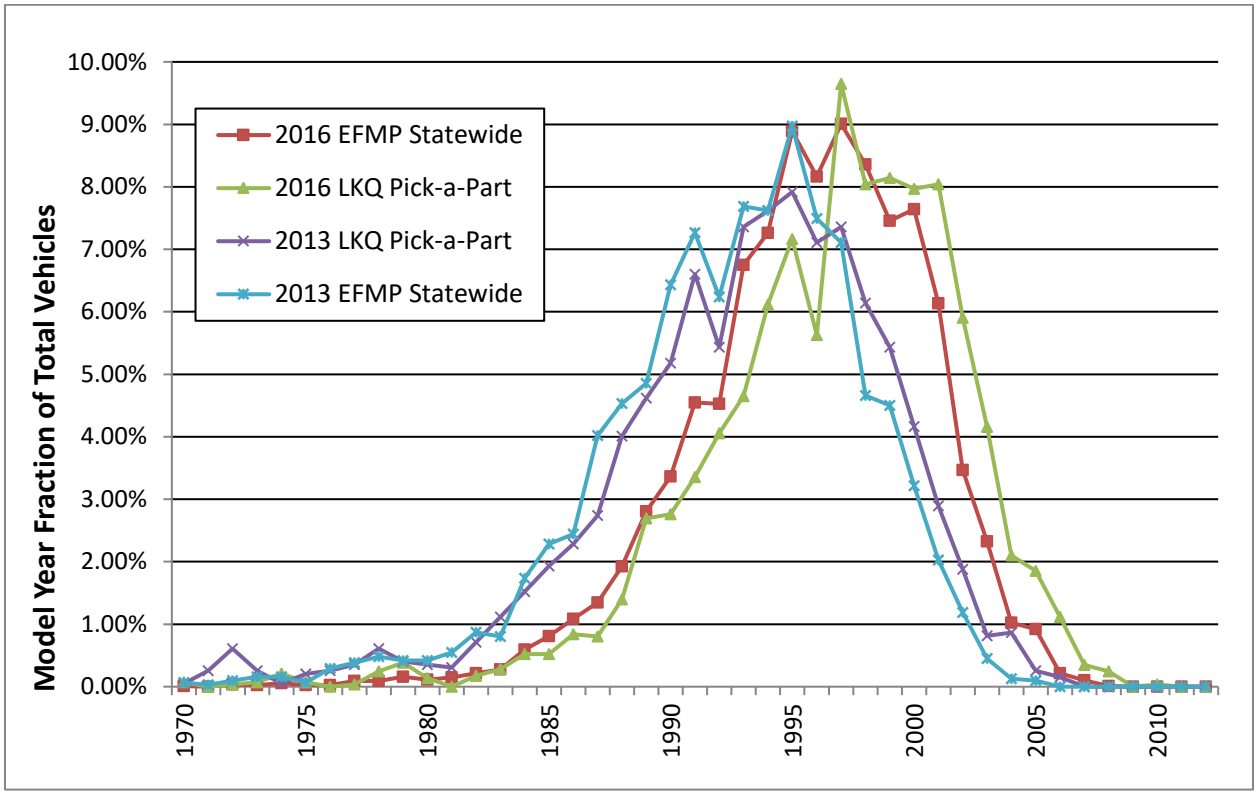


Figure F-2 below compares the model year profiles of the vehicles retired through EFMP and those retired naturally during the same period (December 1, 2015 through January 15, 2016) at an LKQ Pick-a-Part dismantler yard. The similarity of the profiles suggests the EFMP incentive isn’t attracting vehicles any younger than those already approaching the end of their remaining useful life. If the vehicle age is assumed to be a reliable indication of vehicle quality, then these results indicate the program isn’t achieving the objective of getting drivers to retire their vehicle earlier than would occur without the $1,500 incentive. The same conclusion was made in the 2013 study, based on the model year profiles constructed for that time period and also shown in Figure F-2. However, model year is an imperfect measure of quality and it may be possible that for any given model year EFMP is getting relatively higher quality subset of vehicles.

Figure F- 2: Model Year Distribution of EFMP vs. Natural Retirement



After the study was complete, the CARB field reps were asked to contrast the quality of the vehicles inspected in the current study to those in the 2013 sample. All six of the CARB field reps agreed that the overall quality of vehicles was higher in 2016. Each of the six CARB field reps also estimated that, at a minimum, 50 percent of the tested vehicles were likely being driven at the time of retirement.

Quantitative Results

Of the 181 vehicles assessed qualitatively, 175 were tested quantitatively on the ASM dynamometer. Six vehicles couldn't be tested because they were either all-wheel drive or their traction control feature couldn't be disengaged. Despite the new requirement that all vehicles must successfully complete (pass or fail) an ASM test within six months, six vehicles, or 3.4 percent of the total tested, couldn't complete the test due to mechanical issues (e.g. transmission, overheating, and/or misfiring cylinder). In the 2013 study, which was conducted prior to this requirement, just over 12 percent of the vehicles tested failed to complete the ASM test.

Figure F-3 summarizes the Smog Check results and compares them to the 2013 study results, as well as the fleet average for each study period. Fifty-seven percent of the vehicles tested failed the Smog Check, with 18 percent failing as gross polluters. By comparison, 21 percent of similarly aged vehicles in the current California fleet fail, with 3 percent failing as gross polluters. Compared to 2013, the retired vehicles tested in the current study are marginally cleaner while the failure rates in both studies are more than twice their respective fleet average. These

results suggest the program is continuing to successfully capture high emitting subset of vehicles. Table F-2 below displays the pass/fail results by model year.

Figure F- 3: Smog Check Results and Comparison to Fleet Average for 2016 and 2013 Studies

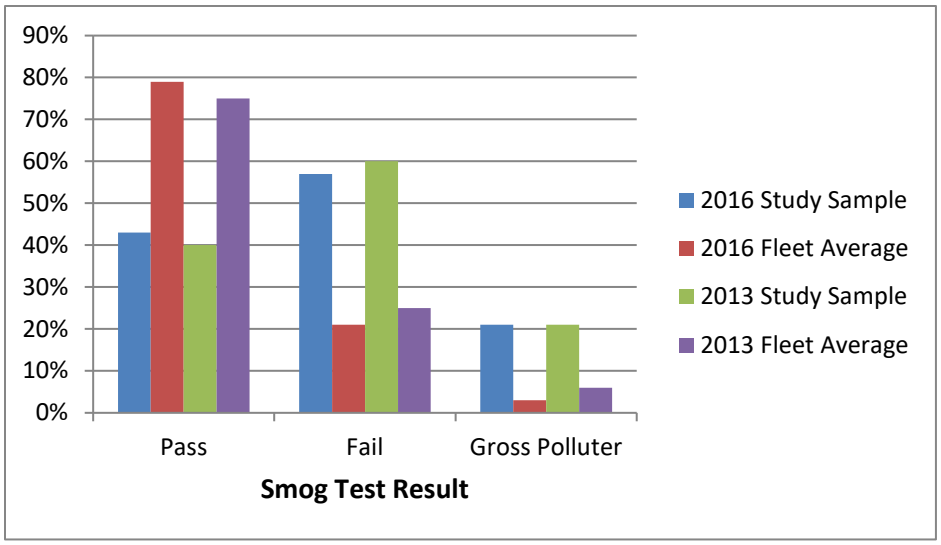


Table F- 2: Summary Table for Quantitative Testing

Model Year	Count	Odometer Reading			ASM Test Results					
		Average	Min	Max	Failed Non-GP	Failed GP	Test Abort	Total Failed	Pass	Fail Rate
1984	2	104,299	42,034	166,564	1	0	0	1	1	50%
1986	2	79,483	31,753	127,212	0	1	0	1	1	50%
1987	1	114,191	14,191	114,191	0	0	0	0	1	0%
1988	1	276,772	76,772	276,772	1	0	0	1	0	100%
1989	8	251,625	49,937	374,705	5	1	0	6	2	75%
1990	4	222,127	49,662	347,645	2	2	0	4	0	100%
1991	10	225,622	82,275	398,195	3	3	1	7	3	70%
1992	5	195,406	84,758	270,871	2	2	0	4	1	80%
1993	13	208,518	14,547	394,302	7	4	0	11	2	85%
1994	11	172,782	5,852	257,957	4	2	0	6	5	55%
1995	18	199,330	73,064	373,987	6	3	1	10	8	56%
1996	13	226,235	28,918	319,953	6	3	0	9	4	69%
1997	21	203,285	50,558	293,702	10	2	1	13	8	62%
1998	9	204,577	62,257	240,291	0	0	1	1	8	11%
1999	14	184,850	-	271,585	4	1	0	5	9	36%
2000	16	213,219	98,350	379,683	7	2	0	9	7	56%
2001	15	168,656	-	276,398	2	4	1	7	8	47%
2002	3	160,907	34,912	178,333	1	1	0	2	1	67%
2003	4	143,221	91,431	205,580	0	0	0	0	4	0%
2004	4	206,917	32,098	379,683	1	0	1	2	2	50%
2005	1	107,151	07,151	107,151	0	0	0	0	1	0%
TOTAL	**175**	**198,077**			**62**	**31**	**6**	**99**	**76**	**57%**

Conclusion

The results of the qualitative and quantitative program assessment yield mixed results as to whether the regulatory changes improved vehicle quality and thus remaining useful life. On one hand, many of the qualitative measures show very little change across studies. For example, number of vehicles rated as poor, fair, or good, the Smog Check fail rates, and the model year profile all suggest little impact by the regulations. The similarity in Smog Check results across both studies indicates that the program is nonetheless continuing to achieve its objective of attracting a high-polluting segment of the fleet.

On the other hand, the 2016 study is not able to corroborate the 2013 study's conclusion that "the majority of vehicles… required significant effort to be started and prepared for testing." The consensus of opinion among CARB field reps, albeit after a gap of three years, is that the overall quality of vehicles is higher in 2016 than in 2013. Moreover, that only 3 percent of the vehicles tested were unable to complete the ASM test due to mechanical failures, compared to 12 percent in 2013, indicates an overall improvement in the quality after the regulatory changes. This difference is consistent with the 2013 study's prediction that the ASM test requirement would enhance the quality of the participating vehicles.

However, as the 2013 study warned, the ASM test likely filters out many, but not all of the end-of-life vehicles. It is also important to consider that the overall quality of vehicle fleet is improved since the study conducted in 2013, which could explain at least a portion of the relative improvements noted in this study.

The mixed results of this study highlighted above suggest the regulatory changes produced a modest improvement in vehicle quality, but did not comprehensively eliminate the program's acceptance of vehicles have already effectively reached end-of-life.

Next Steps

An important next step is for CARB to work with BAR to identify and evaluate new screening methods to improve the quality of retired vehicles and ensure the cost-effectiveness of the program is maximized. The Retirement-Only program is very popular and receives more applications than can be funded each year. As such, it is important to ensure the program is selecting the subset of vehicles that will provide the greatest emission benefits—not just the dirtiest vehicles, but also those with at least three years of remaining useful life. An example of setting a higher standard could be to decrease from 180 days to 90 days (or less) the window within which the ASM test must be completed prior to the time of retirement. The smaller this window the more frequently any given car will have to prove its ability to complete the test, which would decrease the likelihood of a sub-standard vehicle making it through the screening process.

While this study focused on the Retirement-Only component of EFMP, the Retire-and-Replace program has now been operating since July of 2015 in the South Coast and

San Joaquin Valley air districts. In the program's first twelve months 1,117 cars were replaced. Meanwhile, Assembly Bill 1613 (Chapter 370, Statutes of 2016) significantly increased funding for the Retire-and-Replace program, and allowed EFMP Plus-Up program to expand funding to additional districts throughout the state.

Another important next step is to work with BAR and the implementing air districts to review the quality of vehicles retired through the Retire-and-Replace programs to evaluate how effectively they are targeting high emitting vehicles with remaining useful life. As each air district designs their own test to determine sufficient remaining useful life and defines a high emitter targeting, such a follow-up study could compare and contrast the effectiveness of the various test procedures. These results could potentially inform changes to EFMP guidelines and the design of air district Retire-and-Replace programs throughout the state.

Figure F- 4: Qualitative Checklist

EFMP Vehicles -- Qualitative Assessment Checklist

Dismantler: _____ Date: _____

VIN: _____ **CAP ID:** _____

Make: _____ **Model:** _____

☐ Odometer in-op ☐ 5 digit odometer

Model Year: _____ **Odometer Reading:** _____

Registration, if available: ☐ Current ☐ Expiration **Expiration Date:** _____

	Non-Mechanical:	*Please check the appropriate description:* *Good - Minor blemishes / Normal wear*	*Fair - Substantial wear / Cosmetic defects*	*Poor - Needs major repair or replacement*
1	**Tire Condition:**	☐ Good	☐ Fair	☐ Poor
2	**Windshield & Glass:**	☐ Good	☐ Fair	☐ Poor
3	**Interior Condition:**	☐ Good	☐ Fair	☐ Poor
4	**Exterior Condition:**	☐ Good	☐ Fair	☐ Poor
5	**Pictures:**	☐ *Interior:*	☐ *Exterior:*	

	Mechanical:	*Please check the box and circle the applicable issue(s):*
6	**Emissions Control Systems:**	☐ Okay ☐ Missing | Modified | Tampered
7	**Check Engine Light:**	☐ Off ☐ On ☐ If off, CEL operational (key "on", engine "off")
8	**Engine:**	☐ Okay ☐ Problem: Won't start | Misfire | Smokes | Noise | Other
9	**Transmission:**	☐ Okay ☐ Problem: Won't engage | Hard shift | Clutch | Other
10	**Front end:**	☐ Okay ☐ Problem: Irregular tire wear | Excessive steering play | Other
11	**Brakes:**	☐ Okay ☐ Problem: Locks up | Soft pedal | No brakes
12	**Coolant System:**	☐ Okay ☐ Problem: Overheats | Leaks: radiator, hoses, engine
13	**Overall Condition:**	☐ Good ☐ Fair ☐ Poor
14	**Vehicle Testability:**	☐ *Vehicle was tested* ***Vehicle could NOT be tested due to:*** _____
15	**Additional Observations:**	