

ERC Project Assessment Documentation: Voluntary Old Car Retirement

11/26/2013

Project Name	ERC Cost Effectiveness (\$1,000's/Ton)	Total Emissions Inventory (tons/year)	Incentive Funding	Reductions Per Avg Project (lbs/yr)	District Cost/Project	Project Life
NOx						
Voluntary Auto Retirement	\$2,537	290.5	\$1,000 payment per retired vehicle	24.8	\$1,000	3
ROG						
Voluntary Auto Retirement	\$7,776	131.5	\$1,000 payment per retired vehicle	11.5	\$1,000	3
PM						
Voluntary Auto Retirement	NA	2.5	\$1,000 payment per retired vehicle	NA	\$1,000	3

Notes: - The inventory for on-road decreases over time as cleaner, lower emission vehicles replace older, higher emission vehicles. The inventory and reductions are averages over a 30 year period.

- EMFAC2011 shows no PM reductions in later years.

Emission Reduction and Cost Data Documentation Voluntary Old Car Retirement

Total Emission Inventory

Because cars are less polluting over time, the emission inventory decreases over time. The average emission inventory was calculated by averaging the average annual daily inventory using the data below:

Santa Barbara County On-Road Inventory Data

Class	Vehicle Model Yr	Inventory Yr'	ROG Exhaust (tons/day)	NOx (tons/day)	PM10 Exhaust (tons/day)
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre1994	2013	1.06	1.81	0.017
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 1997	2016	0.68	1.34	0.013
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2000	2019	0.39	0.97	0.008
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2003	2022	0.25	0.74	0.006
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2006	2025	0.20	0.58	0.004
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2009	2028	0.14	0.42	0.003
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2012	2031	0.10	0.30	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2015	2034	0.06	0.21	0.002
Average Daily Emissions			0.36	0.80	0.01
Average Annual Emissions			131.5	290.5	2.5

These data were taken from EMFAC2011 model runs for the vehicle class, model year, and inventory years as indicated.

Incentive Funding

Incentive funding per vehicle is based on historic funding amounts (\$1,000/vehicle), but could be higher or lower.

Reductions Per Average Project (auto retirement)

By statute the default project life for the generation of ERCs from voluntary auto retirement is three years (13 CCR Appendix D).

So reductions for each three year cycle were calculated. First EMFAC was run for each three cycle for LDA, LDT1, LDT2 covering all model years and then again for model year 20 years and older. These results are give below.

Santa Barbara County On-Road Emissions and Vehicle Data

Class	Vehicle Model Yr	Inventory Yr'	Total No. Vehicles	Total VMT Mi/Day	ROG Exhaust (tons/day)	NOx (tons/day)	PM10 Exhaust (tons/day)
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre1994	2013	21,995	613,250	1.056	1.810	0.017
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2013	230,612	9,648,295	1.653	3.956	0.034
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 1997	2016	20,318	573,263	0.683	1.343	0.013
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2016	239,641	10,144,188	1.026	2.755	0.028
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2000	2019	19,553	557,285	0.394	0.971	0.008
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2019	250,221	10,607,301	0.634	2.022	0.027
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2003	2022	19,692	565,692	0.252	0.738	0.006
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2022	257,250	10,787,302	0.488	1.650	0.028
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2006	2025	19,802	563,393	0.198	0.581	0.004
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2025	261,436	10,882,318	0.399	1.421	0.029
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2009	2028	18,620	525,609	0.140	0.422	0.003
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2028	263,450	10,923,203	0.340	1.270	0.030

Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2012	2031	19,127	543,972	0.095	0.296	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2031	265,117	11,011,487	0.296	1.145	0.031
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2015	2034	20,625	592,690	0.064	0.206	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2034	266,067	11,066,507	0.263	1.052	0.031

Per vehicle VMT emission rates were then calculated for the average vehicle and for the average vehicle 20 years and older as indicated below.

Vehicle Class	Vehicle Model Yr	Inventory Yr'	VMT/veh/Day	ROG lbs /VMT	NOx lbs /VMT	PM10 lbs /VMT
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre1994	2013	28	1.26	2.15	0.021
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2013	42	0.13	0.30	0.003
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 1997	2016	28	0.87	1.71	0.016
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2016	42	0.07	0.20	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2000	2019	29	0.52	1.27	0.011
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2019	42	0.04	0.14	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2003	2022	29	0.33	0.95	0.007
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2022	42	0.03	0.11	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2006	2025	28	0.26	0.75	0.006

Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2025	42	0.03	0.10	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2009	2028	28	0.19	0.59	0.004
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2028	41	0.02	0.08	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2012	2031	28	0.13	0.40	0.003
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2031	42	0.02	0.08	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	Pre 2015	2034	29	0.08	0.25	0.002
Gas+Diesel LDA, LDT1, LDT2 vehicle	All	2034	42	0.02	0.07	0.002

Reductions were then calculated by multiplying the difference between the average emission rate for all vehicles and the average emission rate for vehicles 20 years and older by the old car VMT per year. These results are given below.

Cycle	Inventory Yr	ROG Reduction lbs/retired veh/yr	NOx Reduction lbs/retired veh/yr	PM10 Reduction lbs/retired veh/yr
Year 2013 retire pre 1994	2013	31.6	51.7	0.51
Year 2016 retire pre 1997	2016	22.5	42.7	0.39
Year 2019 retire pre 2000	2019	13.5	32.3	0.26
Year 2022 retire pre 2003	2022	8.4	24.1	0.15
Year 2025 retire pre 2006	2025	6.5	18.7	0.11
Year 2028 retire pre 2009	2028	4.8	14.2	0.06
Year 2031 retire pre 2012	2031	3.1	9.1	0.02
Year 2034 retire pre 2015	2034	1.8	5.3	NA
Year 2037 retire pre 2018	2037	1.2	3.7	NA
Year 2040 retire pre 2021	2040	0.6	2.2	NA
Avg Reduction per year over 30 years		11.5	24.8	NA

EMFAC2011 does not estimate emission past 2035, so data for 2037 and 2040 were estimated by interpolation. EMFAC2011 shows no PM reductions 2034 and later.

ERC Cost Effectiveness

For ERCs a 30 years reductions are needed. In the first year (2013) there are 21,995 LDA, LDT1, and LDT2 vehicles 20 years and older. Each subsequent three year cycle approximately 6,800 additional vehicles become 20 years and older. So the total potential population of vehicles 20 years and older is 22,000 vehicles (2013) plus 6,800 additional each 3 year for a total of 22,000 + 9 X 6,800 or 83,200 vehicles.

The question is how to apportion these vehicles over the 30 year period so roughly the same amount of pollution is reduced each year. To accomplish this we used the relative emission reductions per cycle as indicated below.

Cycle	NOx Reduction lbs/retired veh/yr	# to gen one ton	% of total to gen one ton	No Vehicle retired to gen max tons over 30 years	NOx Reduced tons per year	Cost at \$1,000 per in \$1,000s
Year 2013 retire pre 1994	51.7	39	1.523%	1,267	32.8	\$1,267
Year 2016 retire pre 1997	42.7	47	1.846%	1,536	32.8	\$1,536
Year 2019 retire pre 2000	32.3	62	2.440%	2,030	32.8	\$2,030
Year 2022 retire pre 2003	24.1	83	3.262%	2,714	32.8	\$2,714
Year 2025 retire pre 2006	18.7	107	4.209%	3,502	32.8	\$3,502
Year 2028 retire pre 2009	14.2	141	5.562%	4,628	32.8	\$4,628
Year 2031 retire pre 2012	9.1	219	8.621%	7,172	32.8	\$7,172
Year 2034 retire pre 2015	5.3	378	14.869%	12,371	32.8	\$12,371
Year 2037 retire pre 2018	3.7	537	21.135%	17,585	32.8	\$17,585
Year 2040 retire pre 2021	2.2	928	36.534%	30,396	32.8	\$30,396
Total	204.0	2,540	100%	83,200	8485.3	\$83,200

ERC NOx Cost Effectiveness is therefore: \$83,200,000/32.8 tons reduced or \$2,536,585 per ton.

Note that if the program was confined to say 15 years rather than 30 it would be far more cost effective.

If we focus on ROG the maximum annual reductions would be:

Cycle	ROG Reduction lbs/retired veh/yr	# to gen one ton	% of total to gen one ton	No Vehicle retired to gen max tons over 30 years	NOx Reduced tons per year	Cost at \$1,000 per in \$1,000s
Year 2013 retire pre 1994	31.6	63	0.812%	675	10.7	\$675
Year 2016 retire pre 1997	22.5	89	1.141%	950	10.7	\$950
Year 2019 retire pre 2000	13.5	148	1.901%	1,582	10.7	\$1,582
Year 2022 retire pre 2003	8.4	238	3.052%	2,539	10.7	\$2,539
Year 2025 retire pre 2006	6.5	306	3.916%	3,258	10.7	\$3,258
Year 2028 retire pre 2009	4.8	414	5.298%	4,408	10.7	\$4,408
Year 2031 retire pre 2012	3.1	649	8.313%	6,917	10.7	\$6,917
Year 2034 retire pre 2015	1.8	1,140	14.610%	12,155	10.7	\$12,155
Year 2037 retire pre 2018	1.2	1,666	21.346%	17,760	10.7	\$17,760
Year 2040 retire pre 2021	0.6	3,092	39.610%	32,956	10.7	\$32,956
Total	94.0	7,805	100%	83200	10.7	\$83,200

And the ROG cost effectiveness would be \$83,200,000 / 10.7 tons or \$7,775,7001 per ton

PM cost effectiveness could not be calculated because EMFAC does not show PM reductions past 2031.