

ERC Project Assessment Documentation: Replacement of Mobile Agricultural Equipment with Tier 4 Powered Equipment

11/26/2013

NOx						
Project Name	ERC Cost Effectiveness (\$/Ton in \$1,000s)	Total Emissions Inventory (tons/year)	Incentive Funding	Reductions Per Avg Project (lbs/yr)	District Cost/ Project	Project Life (yrs)
Mobile Agricultural Equip. Replace.	\$1,224	309.88	80% of new equipment cost	308.03	\$62,830	10

ROG						
Project Name	ERC Cost Effectiveness (\$/Ton in \$1,000s)	Total Emissions Inventory (tons/year)	Incentive Funding	Reductions Per Avg Project (lbs/yr)	District Cost/ Project	Project Life (yrs)
Mobile Agricultural Equip. Replace.	\$15,785	26.87	80% of new equipment cost	23.89	\$62,830	10

PM						
Project Name	ERC Cost Effectiveness (\$/Ton in \$1,000s)	Total Emissions Inventory (tons/year)	Incentive Funding	Reductions Per Avg Project (lbs/yr)	District Cost/ Project	Project Life (yrs)
Mobile Agricultural Equip. Replace.	\$30,603	12.22	80% of new equipment cost	12.32	\$62,830	10

Note: Inventory will decrease over time as older higher emission equipment is replaced with newer lower emission equipment.

Emission Reduction and Cost Documentation Mobile Ag Equipment Replacement

Total Emission Inventory

The total inventory of farm equipment is comprised of equipment that could be replaced and generate emission reductions. ARB data says that farm equipment has a life of 16 years. Tier 1 standards took effect between 1996 and 1999 for mobile farm equipment, which suggests that average Tier 1 equipment has average remaining life of ~3.5 years. However, ARB/EPA "flex" engine provisions allow the use of some fraction of new lower tier engines after a higher tier standard takes effect. So it is difficult to determine the average age for engines that meet different tiers.

For this initial assessment, we are going to simply assume that 1/3 of the engines are Tier 1, 1/3 and Tier 2 and the final 1/3 are Tier 3.

The first step is to estimate the population of farm equipment in Santa Barbara County. This was accomplished by apportioning statewide equipment estimates to Santa Barbara County using relative statewide and county crop land acreages.

Farm Equipment	HP range	Avg HP	Statewide Farm Equipment Population	SB Cropland % of CA	Equip in SB Co.	Equip Life
	50 and less	39	43932	1.300%	571	16
	51 to 120	83	50809	1.300%	661	16
	121 to 175	142	28614	1.300%	372	16
	176 to 250	203	18483	1.300%	240	16
	251 to 500	332	3671	1.300%	48	16
Total Equipment					1,892	

Average hp per equipment was then estimated.

Farm Equipment	Avg HP	Equip in SB Co.	total hp
	39	571	22,274
	83	661	54,823
	142	372	52,821
	203	240	48,777
	332	48	15,844
Avg hp per engine			103

Emissions were estimated assuming 1/3 of the equipment is Tier 1, 1/3 is Tier 2 and 1/3 is Tier 3

Farm Equipment	HP	No. Equip By Tier	Engine Load	Hrs/yr	Tier	Base NOx (g/bhp-hr)	Base ROG (g/hp-hr)	Base PM (g/bhp-hr)	Baseline NOx (tons/yr)	Baseline ROG (tons/yr)	Baseline PM (tons/yr)
	103	631	0.7	475	1	6.54	0.82	0.274	155.54	19.50	6.52
	103	631	0.7	475	2	4.17	0.19	0.128	99.17	4.52	3.04
	103	631	0.7	475	3	2.32	0.12	0.112	55.18	2.85	2.66
Total									309.88	26.87	12.22

References Statewide and Santa Barbara cropland acreages, 2007 Census of Agriculture, USDA.
Statewide equipment population, engine hp, load and engine hours. ARB Off-Road Model,
Emission factors, 2011 Carl Moyer Program Guidance, Appendix D, Table D-11 and D-12.

Incentive Funding Amount

It was assumed that funding at 80% of the total cost would be sufficient to obtain farmer participation. The cost per hp was derived by doing a Google search of the cost of new farm equipment and averaging the results.

Model	HP	Cost	Cost/HP
8245R	245	\$200,000	\$816
8360R	360	\$300,000	\$833
6105D	105	\$60,000	\$571
6170R	170	\$170,000	\$1,000
4045D	45	\$34,000	\$756
5083EN	83	\$50,000	\$602
AVG Cost			\$763

The incentive funding amount was therefore 80% of \$763/hp or \$610/hp

Emission Reductions Per Project

Emission reductions per project were calculated as the average of Tier 1, Tier 2 and Tier 3 to Tier 4 repower as indicated below.

HP	Existing Tier	Base NOx (g/bhp-hr)	Base ROG (g/hp-hr)	Base PM (g/bhp-hr)	Tier 4 NOx (g/bhp-hr)	Tier 4 ROG (g/bhp-hr)	Tier 4 PM (g/bhp-hr)	NOx lbs/yr reduced	ROG lbs/yr reduced	PM lbs/yr reduced
103	1	6.54	0.82	0.274	0.26	0.06	0.008	473.7	57.3	20.1
103	2	4.17	0.19	0.128	0.26	0.06	0.008	295.0	9.8	9.1
103	3	2.32	0.12	0.112	0.26	0.06	0.008	155.4	4.5	7.8
Average								308.0	23.9	12.3

District Cost/Project

As indicated above, the average equipment is 103 hp, the average district contribution is \$610/hp, or \$62,830 per equipment.

Project Life

The project of 10 years was taken from Chapter 7: Off-Road Compression Ignition Equipment, ARB, 10/30/13.

ERC Cost-Effectiveness

ERC cost effectiveness is total reductions in tons per year divided by the total cost over 30 years.

Total Emission Reductions

As indicated we estimated that there are 1,892 piece of mobile agricultural equipment in the county. The Moyer program indicates a 10 year project life for farm equipment replacement projects. Assuming the population does not change, and 1/3 of the equipment is replaced during each ten year cycle, and the reductions are as indicated above the total tons per year would be:

NOx reduced lbs/yr/equip.	ROC reduced lbs/yr/equip.	PM reduced lbs/yr/equip.	# equipment replaced per 10 cycle	NOx reduced tons/yr	ROC reduced tons/yr	PM reduced tons/yr
308.0	23.9	12.3	631	97.1	7.5	3.9

Total Costs

Total costs in \$1,000s would be the no of equipment 1,892 X district cost per \$62,830, or

\$118,874

NOx ERC Cost/Ton (\$1,000s)	ROC ERC Cost/Ton (\$1,000s)	PM ERC Cost/Ton (\$1,000s)
\$1,224	\$15,785	\$30,603