APPENDIX A: Examples of Successful Projects

MSRC Purchase of 19 CNG Transit Buses

Omnitrans is the transit provider for San Bernardino County. Omnitrans is purchasing 19 40-foot CNG transit buses to replace existing diesel buses. The vehicles will be equipped with the Cummins L-10G dedicated CNG engine.

Cost-Effectiveness: $3 per lb

MV Funding Effectiveness: $5 per lb

Cost of Emission Reductions: $760,000

Motor Vehicle Funds Used: $1,315,524

Lifetime Emission Reductions: 257,983 lbs

		Description
Project Analysis Period (years):	**12**	
Capital Costs : (Portion of capital costs related to emissions reductions.)	**$760,000**	Capital costs are the differential cost between the new CNG buses and conventional new diesel buses. In this case, the differential was $40,000.
Annual Operating Costs: (Portion of operating costs required to sustain air quality benefits of project.)	**$0**	Operating costs for CNG vehicles can be less than for diesel. To be conservative, operating costs for both CNG and diesel transit buses are assumed to be equal.
Total Cost of Emission	**$760,000**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.
Data Sources and Assumptions for Cost Estimates:		Bus manufacturers: Neoplan and New Fyer.

NET EMISSIONS BENEFITS (12 years)	**ROG:**	**0 lbs**	OR	0	tons	
	NOx:	**256,677 lbs**	OR	128	tons	
	PM10:	**1,307 lbs**	OR	1	tons	

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	3.70	X	988,000	+	0.00	X	0	=	3,655,600	=	8,059
NOx	17.20	X	988,000	+	0.00	X	0	=	16,993,600	=	37,465
PM10	0.64	X	988,000	+	0.00	X	0	=	632,320	=	1,394

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	3.70	X	988,000	+	0.00	X	0	=	3,655,600	=	8,059
NOx	7.38	X	988,000	+	0.00	X	0	=	7,291,440	=	16,075
PM10	0.59	X	988,000	+	0.00	X	0	=	582,920	=	1,285

Assumptions to estimate travel reductions: Estimated annual bus mileage is provided by Omnitrans. 19 buses @ 52,000 miles per year per bus.

Assumptions to estimate emission factors: Emission factors for ROG and PM10 are default values. NOx factor for diesel bus is calculated as (4.0 g/bhp-hr)*(4.3 bhp-hr/mi.) = 17.2 g/mi. NOx factor for CNG bus using 260 hp Cummins L-10G engine is (1.8 g/bhp-hr)*(4.1 bhp-hr/mi.) = 7.38 g/mi.

MSRC Purchase of 13 CNG School Buses

Lapis Energy Organization, Inc. formed a joint venture with two school districts within the South Coast air district for the purchase and deployment of 13 compressed natural gas (CNG) school buses.

Cost-Effectiveness: **$6 per lb**

MV Funding Effectiveness: **$6 per lb**

Cost of Emission Reductions: $297,258

Motor Vehicle Funds Used: $326,984

Lifetime Emission Reductions: 52,162 lbs

Project Analysis Period (years): **20**

		Description
Capital Costs : (Portion of capital costs related to emissions reductions.)	**$297,258**	Differential purchase cost for CNG buses; 13 vehicles @ $22,866 each is $297,258.
Annual Operating Costs: (Portion of operating costs required to sustain air quality benefits of project.)	**$0**	Operating costs for both CNG buses and diesel buses are assumed to be equal in this analysis.
Total Cost of Emission	**$297,258**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.

Data Sources and Assumptions for Cost Estimates: Capital cost estimates based on vendor quotes.

NET EMISSIONS BENEFITS (20 years)	**ROG:**	**0**	**lbs**	OR	0	tons
	NOx:	**52,162**	**lbs**	OR	26	tons
	PM10:	**0**	**lbs**	OR	0	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.00	X	182,000	+	0.00	X	0	=	0	=	0
NOx	13.00	X	182,000	+	0.00	X	0	=	2,366,000	=	5,216
PM10	0.00	X	182,000	+	0.00	X	0	=	0	=	0

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	182,000	+	0.00	X	0	=	0	=	0
NOx	6.50	X	182,000	+	0.00	X	0	=	1,183,000	=	2,608
PM10	0.00	X	182,000	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Annual school bus mileage assumptions based upon information provided by school districts. Each of 13 buses traveled 14,000 miles per year.

Assumptions to estimate emission factors: CNG-engine NOx factor corresponds to Cummins C8.3-250 engine @ 2.0 g/bhp-hr. Conversion factor applied is 3.25 bhp-hr/mi. Compared to typical new bus engine certified to 4.0 g/bhp-hr.

MSRC Refuse Haulers CNG Repowering

Waste Management will repower 14 heavy-duty, diesel-powered, waste collection trucks with Cummins L-10G-260 natural gas engines and fuel systems. Vehicles will be employed in Orange County, the Coachella Valley, and the San Gabriel Valley. Initially, the contractor will repower one vehicle which will serve as a model to develop and document the engineering process. The contractor, with co-funding assistance from the Southern California Gas Company, will install compressed natural gas refueling infrastructure to support the vehicles. The contractor will also implement training and a public awareness campaign.

Cost-Effectiveness: $8 per lb

MV Funding Effectiveness: $5 per lb

Cost of Emission Reductions: $1,446,000

Motor Vehicle Funds Used: $852,200

Lifetime Emission Reductions: 174,782 lbs

Project Analysis Period (years): **9**

		Description
Capital Costs : (Portion of capital costs related to emissions reductions.)	**$1,446,000**	Capital Costs associated with this alternative fuel conversion project include: Vehicle repowering: 14 vehicles = $937,200; training labor costs: $60,000; project replication labor costs: $41,500; public outreach: $82,300; administrative labor costs are $325,000.
Annual Operating Costs: (Portion of operating costs required to sustain air quality benefits of project.)	**$0**	Annual operations costs associated with the use of CNG refuse trucks are not yet available. For the purpose of this analysis, the assumption will be made that the operations costs of the CNG refuse trucks are comparable to the diesel vehicles they replaced.
Total Cost of Emission	**$1,446,000**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.
Data Sources and Assumptions for Cost Estimates:		Waste Management of Orange County; TerraFuel Systems, Inc.; Southern California Gas Company.

NET EMISSIONS BENEFITS (9 years)	**ROG:**	**0 lbs**	OR	0	tons
	NOx:	**174,782 lbs**	OR	87	tons
	PM10:	**0 lbs**	OR	0	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.00	X	40,040	+	0.00	X	0	=	0	=	0
NOx	440.00	X	40,040	+	0.00	X	0	=	17,617,600	=	38,840
PM10	0.00	X	40,040	+	0.00	X	0	=	0	=	0

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	40,040	+	0.00	X	0	=	0	=	0
NOx	220.00	X	40,040	+	0.00	X	0	=	8,808,800	=	19,420
PM10	0.00	X	40,040	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Engines operage 11 hours per day, 5 days per week, 52 weeks per year. This equates to 2,860 hours of operation per vehicle per year. Fourteen vehicles means 40,040 hours per year. NOTE THAT HOURS PER YEAR REPLACE ANNUAL VMT REDUCED AND GAINED IN THE ABOVE EQUATIONS.

Assumptions to estimate emission factors: Emission benefits realized by this project result from the use of CNG as opposed to diesel fuel in 14 refuse haulers. NOx value for Cummins L10G-260 engine = 2 g/bhp-hr; average horsepower requirement for refuse collection driving cycle = 110 hp. The comparable emission factor for a new diesel engine is 4 gm/bhp-hr. NOx factor for diesel engine is calculated as (4.0 g/bhp-hr)*(110 hp) = 440 g/hr. NOx factor for CNG engine is calculated as (2.0 g/bhp-hr)*(110 hp) = 220 g/hr. NOTE THAT THE EMISSION FACTORS EXPRESSED AS G/HR REPLACE G/MI IN THE ABOVE EQUATIONS.

Sacramento Repower of Greenwaste Pickup Vehicle

The City of Sacramento repowered two Case tractors (off-road vehicles) that pick up greenwaste in the City. New certified diesel engines replaced old uncertified diesel engines that would have been rebuild to old emission levels. Important components to this project are that the owner would not have ordinarily purchased a new engine at this time, but would have rebuilt the old one; and, also, that the vehicle could not be converted to an alternative fueled cleaner burning engine (i.e., compressed natural gas) cost-effectively.

Cost-Effectiveness: **$1 per lb**

MV Funding Effectiveness: **<$1 per lb**

Cost of Emission Reductions:	$8,000
Motor Vehicle Funds Used:	$2,000
Lifetime Emission Reductions:	7,742 lbs

Project Analysis Period (years): **7**

		Description
Capital Costs : (Portion of capital costs related to emissions reductions.)	**$8,000**	The cost, which is the difference between the cost of the new diesel engines and the cost to rebuild the old diesel engines, is estimated to be $4,000 per tractor.
Annual Operating Costs: (Portion of operating costs required to sustain air quality benefits of project.)	**$0**	
Total Cost of Emission	**$8,000**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.

Data Sources and Assumptions for Cost Estimates:

	ROG:	**0 lbs**	OR	0	tons	
NET EMISSIONS BENEFITS (7 years)	**NOx:**	**7,742 lbs**	OR	4	tons	
	PM10:	**0 lbs**	OR	0	tons	

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.00	X	2,056	+	0.00	X	0	=	0	=	0
NOx	520.00	X	2,056	+	0.00	X	0	=	1,069,120	=	2,357
PM10	0.00	X	2,056	+	0.00	X	0	=	0	=	0

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	2,056	+	0.00	X	0	=	0	=	0
NOx	276.00	X	2,056	+	0.00	X	0	=	567,456	=	1,251
PM10	0.00	X	2,056	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Estimated vehicle usage provided by City of Sacramento is 1028 hours per year per vehicle. (1028 X 2 = 2056). NOTE THAT HOURS PER YEAR REPLACE ANNUAL VMT REDUCED AND GAINED IN THE ABOVE EQUATIONS.

Assumptions to estimate emission factors: Emission benefits are based on NOx only. NOx factor for baseline old diesel engine is calculated as (80 hp)*(13 g/bhp-hr)*(0.5) = 520 g/hr. NOx factor for lower emitting new diesel engine is calculated as (80 hp)*(6.9 g/bhp-hr)*(0.5) = 276 g/hr. NOTE THAT THE EMISSION FACTORS EXPRESSED AS G/HR REPLACE G/MI IN THE ABOVE EQUATIONS.

Sacramento Purchase of Class 8 Heavy-Duty Trucks

Raley's Corporation purchased eight new Class 8 trucks to deliver products from its Sacramento distribution center. These new trucks were equipped with Cummins L10-300G LNG engines rather than new diesel engines.

Cost-Effectiveness: **$4 per lb**

MV Funding Effectiveness: **$4 per lb**

Cost of Emission Reductions: $320,000

Motor Vehicle Funds Used: $320,000

Lifetime Emission Reductions: 77,039 lbs

Project Analysis Period (years):	**12**	
		Description
Capital Costs :	**$320,000**	Estimated difference in costs between the new LNG trucks and new diesel trucks is $40,000 per truck.
(Portion of capital costs related to emissions reductions.)		
Annual Operating Costs:	**$0**	Operating costs are assumed to be equal for this analysis.
(Portion of operating costs required to sustain air quality benefits of project.)		
Total Cost of Emission	**$320,000**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.
Data Sources and Assumptions for Cost Estimates:		Engine distributor and engine manufacturer.

	ROG:	**0**	**lbs**	OR	0	tons
NET EMISSIONS BENEFITS (12 years)	**NOx:**	**77,039**	**lbs**	OR	39	tons
	PM10:	**0**	**lbs**	OR	0	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.00	X	560,000	+	0.00	X	0	=	0	=	0
NOx	10.40	X	560,000	+	0.00	X	0	=	5,824,000	=	12,840
PM10	0.00	X	560,000	+	0.00	X	0	=	0	=	0

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	560,000	+	0.00	X	0	=	0	=	0
NOx	5.20	X	560,000	+	0.00	X	0	=	2,912,000	=	6,420
PM10	0.00	X	560,000	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Estimated vehicle usage provided by Raley's - 70,000 miles per year per truck. (8 X 70,000 = 560,000 miles/yr)

Assumptions to estimate emission factors: Analysis based on NOx reductions only. NOx factor for baseline (new diesel) engine is 4.0 g/bhp-hr X 2.6 bhp-hr/mi = 10.4 g/mi. NOx factor for LNG engine is 2.0 g/bhp-hr X 2.6 bhp-hr/mi = 5.2 g/mi.

San Joaquin Valley Agricultural Sprayer Engine Re-power

Phippen Brothers proposes to re-power 2 agricultural sprayers with new diesel engines. The new diesel engines will emit 6.9 g/bhp-hr of NOx compared to the old engines rebuilt to emit 12.9 g/bhp-hr.

Cost-Effectiveness: **$2 per lb**

MV Funding Effectiveness: **$1 per lb**

Cost of Emission Reductions: $8,000

Motor Vehicle Funds Used: $6,000

Lifetime Emission Reductions: 4,894 lbs

Project Analysis Period (years): **10**

		Description
Capital Costs : (Portion of capital costs related to emissions reductions.)	**$8,000**	The cost of the new diesel engines is $10,000 each. The cost to rebuild the old engines is $6,000 each. The cost difference for two engines is $8,000.
Annual Operating Costs: (Portion of operating costs required to sustain air quality benefits of project.)	**$0**	Assumed to be the same for rebuild and for new engines.
Total Cost of Emission	**$8,000**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.
Data Sources and Assumptions for Cost Estimates:		Project proponent.

NET EMISSIONS BENEFITS (10 years)

ROG:	**0 lbs**	OR	0	tons
NOx:	**4,894 lbs**	OR	2	tons
PM10:	**0 lbs**	OR	0	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.00	X	740	+	0.00	X	0	=	0	=	0
NOx	645.00	X	740	+	1.00	X	0	=	477,300	=	1,052
PM10	0.00	X	740	+	0.00	X	0	=	0	=	0

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	740	+	0.00	X	0	=	0	=	0
NOx	345.00	X	740	+	1.00	X	0	=	255,300	=	563
PM10	0.00	X	740	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Two diesel engines operating 370 hrs/yr each. NOTE THAT HOURS PER YEAR REPLACE ANNUAL VMT REDUCED AND GAINED IN THE ABOVE EQUATIONS.

Assumptions to estimate emission factors: The agricultural sprayer has an 100 hp engine. Assume load factor is 0.5. The rebuilt old diesel engine emits 12.9 g/bhp-hr and the new diesel engine will emit 6.9 g/bhp-hr. NOTE THAT THE EMISSION FACTORS EXPRESSED AS G/HR REPLACE G/MI IN THE ABOVE EQUATIONS.

San Joaquin Valley Street Sweeper Purchase

The City of Clovis proposes to purchase a new CNG street sweeper. The NOx emissions for the new CNG vehicle will be 1 g/bhp-hr compared to a new diesel street sweeper that emits 5 g/bhp-hr of NOx.

Cost-Effectiveness: **$6 per lb**

MV Funding Effectiveness: **$6 per lb**

Cost of Emission Reductions: $32,209

Motor Vehicle Funds Used: $32,209

Lifetime Emission Reductions: 5,819 lbs

Project Analysis Period (years): **15**

		Description
Capital Costs : (Portion of capital costs related to emissions reductions.)	**$32,209**	The new CNG street sweeper costs $156,538 compared to a new diesel sweeper at $124,329. The cost difference is $32,209.
Annual Operating Costs: (Portion of operating costs required to sustain air quality benefits of project.)	**$0**	Operating costs are assumed to be the same.
Total Cost of Emission	**$32,209**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.

Data Sources and Assumptions for Cost Estimates: Project proponent.

NET EMISSIONS BENEFITS (15 years)	**ROG:**	**0**	**lbs**	OR	0	tons
	NOx:	**5,819**	**lbs**	OR	3	tons
	PM10:	**0**	**lbs**	OR	0	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.00	X	332	+	0.00	X	0	=	0	=	0
NOx	663.00	X	332	+	1.00	X	0	=	220,116	=	485
PM10	0.00	X	332	+	0.00	X	0	=	0	=	0

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	332	+	0.00	X	0	=	0	=	0
NOx	133.00	X	332	+	1.00	X	0	=	44,156	=	97
PM10	0.00	X	332	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Assume operating hours per year are 332. NOTE THAT HOURS PER YEAR REPLACE ANNUAL VMT REDUCED AND GAINED IN THE ABOVE EQUATIONS.

Assumptions to estimate emission factors: Analysis is based on a road sweeper model #4000 CNG by Johnston Sweeper Co. The new CNG engine is a Cummins 5.9 and that emits 1 g/bhp-hr of NOx compared to a new diesel engine emitting 5 g/bhp-hr of NOx. Engines operate at 195 hp and assume 0.68 load. NOTE THAT THE EMISSION FACTORS EXPRESSED AS G/HR REPLACE G/MI IN THE ABOVE EQUATIONS.

San Diego Old Vehicle Buy Back Program

Pre-1982 vehicles were purchased and scrapped.

Cost-Effectiveness: **$2 per lb**

MV Funding Effectiveness: **$2 per lb**

Cost of Emission Reductions: $1,980,000

Motor Vehicle Funds Used: $1,980,000

Lifetime Emission Reductions: 1,009,741 lbs

Project Analysis Period (years):	**3**	
		Description
Capital Costs :	**$1,980,000**	Cost of vehicle purchase. $500 for model year 1975-81 vehicles and $600 for pre-1975 model year vehicles.
(Portion of capital costs related to emissions reductions.)		
Annual Operating Costs:	**$0**	
(Portion of operating costs required to sustain air quality benefits of project.)		
Total Cost of Emission	**$1,980,000**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.
Data Sources and Assumptions for Cost Estimates:		District assumptions based on South Coast AQMD's experience.

	ROG:	**702,428**	**lbs**	OR	351	tons
NET EMISSIONS BENEFITS (3 years)	**NOx:**	**307,312**	**lbs**	OR	154	tons
	PM10:	**0**	**lbs**	OR	0	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	6.20	X	22,126,000	+	0.00	X	0	=	137,181,200	=	302,434
NOx	3.30	X	22,126,000	+	0.00	X	0	=	73,015,800	=	160,973
PM10	0.00	X	22,126,000	+	0.00	X	0	=	0	=	0

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	1.40	X	22,126,000	+	0.00	X	0	=	30,976,400	=	68,292
NOx	1.20	X	22,126,000	+	0.00	X	0	=	26,551,200	=	58,536
PM10	0.00	X	22,126,000	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: "Mobile Source Emission Reduction Credits Guidelines, February 1996."

Assumptions to estimate emission factors: "Mobile Source Emission Reduction Credits Guidelines, February 1996."

Santa Barbara Commuter Express CNG Bus Service

A subscription commute bus service was operated using 5, full-sized 40-passenger compressed natural gas (CNG) buses.

Cost-Effectiveness: **$3 per lb**

MV Funding Effectiveness: **$1 per lb**

Cost of Emission Reductions: $891,268

Motor Vehicle Funds Used: $190,000

Lifetime Emission Reductions: 269,616 lbs

Project Analysis Period (years): **15**

Description

Capital Costs : **$0** Five CNG buses at $250,000 each were donated for this commute service at the end of the local demonstration project, so no capital costs are included. (If cost of buses were factored into this project, the cost effectiveness would be $10/lb.)

(Portion of capital costs related to emissions reductions.)

Annual Operating Costs: **$96,600** Fuel costs, driver salaries, bus maintenance and insurance, and adminstration, minus bus rider fares.

(Portion of operating costs required to sustain air quality benefits of project.)

Total Cost of Emission **$891,268** Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.

Data Sources and Assumptions for Cost Estimates: $25/day fuel cost per bus; $225/day other operating costs per bus (maintenance, driver salary, insurance, marketing and administration). Source: Santa Barbara APCD

NET EMISSIONS BENEFITS (15 years)	**ROG:**	**70,169 lbs**	OR	35	tons
	NOx:	**108,157 lbs**	OR	54	tons
	PM10:	**91,290 lbs**	OR	46	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.36	X	6,358,540	+	3.26	X	16,735	=	2,343,631	=	5,167
NOx	0.71	X	6,358,540	+	1.56	X	16,735	=	4,540,670	=	10,011
PM10	0.45	X	6,358,540	+	0.00	X	16,735	=	2,861,343	=	6,308

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	1.10	X	201,600	+	0.00	X	0	=	221,760	=	489
NOx	6.30	X	201,600	+	0.00	X	0	=	1,270,080	=	2,800
PM10	0.50	X	201,600	+	0.00	X	0	=	100,800	=	222

Assumptions to estimate travel reductions: Travel reductions: 80-mile one-way average commute trip. 40 passengers per bus. 5 buses. 83% of participants drove alone to work prior to taking the commuter bus. 80% of the ex-solo drivers drive to the bus. 252 days of operation. (Source: Santa Barbara APCD). Assumption: 5-mile one-way average access trip. Disbenefits: 80-mile one-way bus trip. 252 days of operation. 5 buses. Average life of buses is assumed to be 3 years longer than the average 12-year life of an urban transit bus because of exclusive highway use.

Assumptions to estimate emission factors: Emission factors for auto trips are from "Methods to Find Cost-Effectiveness of Air Quality Projects, April 1997." Bus emission factors are based on MVEI 7G, urban buses, Model Year 1998, and average speed 45 mph. NOx emission rate from model is based on 4.0 g/bhp-hr NOx. CNG bus emission rate is assumed to have one-half the NOx emissions of the model run.

San Diego Long-Distance Commuter Vanpools

Funds to subsidize the cost of long-distance commute vanpools. The San Diego Association of Governments (SANDAG) entered into agreements with two vanpool providers for vehicle leasing, insurance and maintenance, and with four transportation management associations for marketing and vanpool formation.

Cost-Effectiveness: **$5 per lb**

MV Funding Effectiveness: **$2 per lb**

Cost of Emission Reductions: $373,796

Motor Vehicle Funds Used: $170,352

Lifetime Emission Reductions: 70,947 lbs

Project Analysis Period (years): **1**

		Description
Capital Costs : (Portion of capital costs related to emissions reductions.)	**$0**	Cost of vans are included in the annual lease under operating costs.
Annual Operating Costs: (Portion of operating costs required to sustain air quality benefits of project.)	**$399,200**	Financial subsidy of $300 per vanpool per month. 97 participating vanpoools. Vanpool riders pay remaining cost of lease (which includes maintenance) and fuel. $50,000 administrative costs.
Total Cost of Emission	**$373,796**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.

Data Sources and Assumptions for Cost Estimates: Source: SANDAG

NET EMISSIONS BENEFITS (1 years)	**ROG:**	**20,961**	**lbs**	OR	10	tons
	NOx:	**35,082**	**lbs**	OR	18	tons
	PM10:	**14,905**	**lbs**	OR	7	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.55	X	17,351,421	+	4.98	X	98,031	=	10,031,476	=	22,116
NOx	1.02	X	17,351,421	+	2.05	X	98,031	=	17,899,413	=	39,462
PM10	0.45	X	17,351,421	+	0.00	X	98,031	=	7,808,139	=	17,214

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.18	X	2,328,000	+	2.16	X	48,500	=	523,800	=	1,155
NOx	0.82	X	2,328,000	+	1.60	X	48,500	=	1,986,560	=	4,380
PM10	0.45	X	2,328,000	+	0.00	X	48,500	=	1,047,600	=	2,310

Assumptions to estimate travel reductions: Reductions: 97 participating vanpools. Average ridership is 10.5. 77% of participants were former solo drivers or carpool drivers (not passengers). 75% of participants drive a vehicle to the vanpool; average one-way access trip is 5 miles. Average one-way commute trip is 48 miles. 250 commute days per year. Disbenefits: 97 vans, two 48-mile one-way trips per day, 250 days per year. (Source: SANDAG and vanpool participant surveys)

Assumptions to estimate emission factors: Emission factors are from "Methods to Find Cost-Effectiveness of Air Quality Projects, April 1997." Van emissions are for model year 1995.

Santa Rosa Employee Transit Subsidy Project

Transit passes were subsidized for County of Sonoma employees at the main Santa Rosa facility.

Cost-Effectiveness: $10 per lb

MV Funding Effectiveness: $5 per lb

Cost of Emission Reductions: $47,286

Motor Vehicle Funds Used: $24,000

Lifetime Emission Reductions: 4,848 lbs

Project Analysis Period (years): **1**

		Description
Capital Costs :	**$0**	
(Portion of capital costs related to emissions reductions.)		
Annual Operating Costs:	**$50,500**	Transit pass subsidies. $6,500 for administration and marketing.
(Portion of operating costs required to sustain air quality benefits of project.)		
Total Cost of Emission	**$47,286**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.

Data Sources and Assumptions for Cost Estimates:

NET EMISSIONS BENEFITS (1 years)	**ROG:**	**1,784 lbs**	OR	1	tons	
	NOx:	**2,319 lbs**	OR	1	tons	
	PM10:	**745 lbs**	OR	0	tons	

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.71	X	750,750	+	6.13	X	45,045	=	809,158	=	1,784
NOx	1.26	X	750,750	+	2.35	X	45,045	=	1,051,801	=	2,319
PM10	0.45	X	750,750	+	0.00	X	45,045	=	337,838	=	745

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	0	+	0.00	X	0	=	0	=	0
NOx	0.00	X	0	+	0.00	X	0	=	0	=	0
PM10	0.00	X	0	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Average number of participants per month was 156. 77% of the participants drove alone prior to receiving transit passes. Average one-way trip distance was 14 miles. (Data source: County of Sonoma; participant surveys) Assumptions: 250 commute days. 25% of participants drove a vehicle an average of 2 miles to the bus stop.

Assumptions to estimate emission factors: Emission factors are based on "Methods to Find Cost-Effectiveness of Air Quality Projects, April 1997." Factors are for calender year 1996.

County of San Bernardino Employee Trip Reduction Program

The County of San Bernardino conducts a comprehensive employee trip reduction program, which includes vanpool and carpool programs, telecommuting, compressed work schedules and guaranteed emergency transportation.

Cost-Effectiveness: **$6 per lb**

MV Funding Effectiveness: **$5 per lb**

Cost of Emission Reductions: $172,342

Motor Vehicle Funds Used: $140,505

Lifetime Emission Reductions: 26,886 lbs

Project Analysis Period (years): **1**

		Description
Capital Costs :	**$0**	
(Portion of capital costs related to emissions reductions.)		
Annual Operating Costs:	**$184,055**	General operating costs and ridesharing incentives.
(Portion of operating costs required to sustain air quality benefits of project.)		
Total Cost of Emission	**$172,342**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.

Data Sources and Assumptions for Cost Estimates:

	ROG:	**8,922 lbs**	OR	4	tons	
NET EMISSIONS BENEFITS (1 years)	**NOx:**	**12,793 lbs**	OR	6	tons	
	PM10:	**5,171 lbs**	OR	3	tons	

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.55	X	5,212,680	+	4.98	X	236,940	=	4,046,935	=	8,922
NOx	1.02	X	5,212,680	+	2.05	X	236,940	=	5,802,661	=	12,793
PM10	0.45	X	5,212,680	+	0.00	X	236,940	=	2,345,706	=	5,171

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	0	+	0.00	X	0	=	0	=	0
NOx	0.00	X	0	+	0.00	X	0	=	0	=	0
PM10	0.00	X	0	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: 250 commute days. 359,000 yearly vehicle trips reduced (County employee commute survey), then discounted based on assumptions of 1.13 baseline AVR (0.88 vehicle trip rate) and 25% non-solo driver access trips of 2 miles. Average one-way commute distance, 17 miles (San Bernardino Association of Governments).

Assumptions to estimate emission factors: Emission factors are from "Methods to Find Cost-Effectiveness of Air Quality Projects, April 1997."

Bernal-Sherwood Bikeway Facility

The Bernal-Shervood Bike Lanes are a critical link in the City of Salinas comprehensive Bikeways Plan. This link provides circulation between north and south Salinas that will allow 80,000 residents bicycle access to downtown, north and south Salinas education, employment, shopping , and recreational sites. The access is currently blocked by US highway 101 and railroad tracks. The project includes installation of new pavement, signage, and Class II bike lane striping along 500' of Bernal Drive plus signage and striping for Class II bike lanes on 1.03 miles of Sherwood Drive.

Cost-Effectiveness: $3 per lb

MV Funding Effectiveness: $2 per lb

Cost of Emission Reductions: $155,852

Motor Vehicle Funds Used: $100,000

Lifetime Emission Reductions: 49,975 lbs

Project Analysis Period (years):	**15**	
		Description
Capital Costs :	**$135,000**	Installation of new pavement (500'), signage, and Class II bike lanes (1.03 miles).
(Portion of capital costs related to emissions reductions.)		
Annual Operating Costs:	**$2,260**	Routine maintenance ($2000 per mile per year) including sweeping, striping, and pot-hole repair for 1.13 miles of bike lanes.
(Portion of operating costs required to sustain air quality benefits of project.)		
Total Cost of Emission	**$155,852**	Capital costs plus net present value of operating costs where inflation rate is assumed to be 3% and discount rate is 10%.
Data Sources and Assumptions for Cost Estimates:		City of Salinas. Default of $2,000 per mile per year for mainenance for Class II bike facilities is from "Methods to Find the Cost-Effectiveness of Air Quality Projects (April, 1997)"

	ROG:	**25,847**	**lbs**	OR	13	tons
NET EMISSIONS BENEFITS (15 years)	**NOx:**	**18,770**	**lbs**	OR	9	tons
	PM10:	**5,357**	**lbs**	OR	3	tons

Direct Benefits:

	emission factor VMT (gm/mi)		annual VMT reduced		emission factor TRIPS (gm/trip)		annual TRIPS reduced		annual emission reduction (gm)		annual emission reduction (lbs)
ROG	0.36	X	360,000	+	3.26	X	200,000	=	781,600	=	1,723
NOx	0.71	X	360,000	+	1.56	X	200,000	=	567,600	=	1,251
PM10	0.45	X	360,000	+	0.00	X	200,000	=	162,000	=	357

DisBenefits (if any):

	emission factor VMT (gm/mi)		annual VMT gained		emission factor TRIPS (gm/trip)		annual TRIPS gained		annual emission increase (gm)		annual emission increase (lbs)
ROG	0.00	X	0	+	0.00	X	0	=	0	=	0
NOx	0.00	X	0	+	0.00	X	0	=	0	=	0
PM10	0.00	X	0	+	0.00	X	0	=	0	=	0

Assumptions to estimate travel reductions: Assumes 6.8% bike modal split at buildout of bike system. This is based on several pieces of info: (1) Upon completion of the Bikeways Plan in year 2000, the city will have 71.7 miles of bikeways vs. 80 miles of arterial streets for a bike/arterial mileage ratio of .89. (2) The 1990 census data shows that 30% of city population age 18-30 were enrolled in Hartnell College in 1990. (3) CMAQ Methodologies state that 6.8% can be used as bike mode split for university towns where ratio of bike lane miles to arterial/freeway miles is greater than .35. The local transportation model indicates that total daily person trips for Salinas is 600,000. Assume bike trips are made 329 days/year (10% of days will be bad weather). Assume average bike trip is 1.8 miles (NPTS). The methodology for estimating trips and vmt reduced is based on "Emission Reduction Calculations for Congestion Management and Air Quality Improvement Projects."

Assumptions to estimate emission factors: Emission factors and project life are from "Methods to Find Cost-Effectiveness of Air Quality Projects, April 1997."