Final Report

Evaluation of Candidate Mobile Source Control Measures for LADCO States in 2009 and 2012

Prepared for

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TABLE OF CONTENTS

APPENDICES

TABLES

1 MCDI funded project data were provided by Dr. Jennifer Dunn of EPA Region 5, October 30, 2006.

FIGURES

EXECUTIVE SUMMARY

As part of the Midwest Regional Planning Organization (MRPO), the Lake Michigan Air Directors Consortium (LADCO) is working with its member states in the upper Midwest to develop the necessary technical support for new State Implementation Plans (SIPs) for regional haze, PM2.5, and 8-hour ozone. In June 2006, ENVIRON was retained by LADCO to evaluate candidate emission control measures for mobile sources to support the development of these SIPs for the LADCO States. In February 2006, ENVIRON completed a Phase I study for LADCO entitled "Evaluation of Candidate Mobile Source Control Measures"[1], focusing on reducing NOx emissions from mobile sources in LADCO states in 2009.

The objectives of this Phase II study are to identify and assess candidate control measures to address emissions of volatile organic compounds (VOC) and fine particles ($PM_{2.5}$) from mobile sources in the LADCO states in 2009 and 2012, and emissions of nitrogen oxides (NOx) from mobile sources in the LADCO states in 2012.

For the purposes of this study, emission impacts were calculated using a combination of emission inventory data supplied by LADCO and the 2002 National Emissions Inventory (NEI). Specifically, the 2009 and 2012 onroad emission inventories for the LADCO states were developed based on NEI 2002, Base K, and NMIM projected emissions. The 2009 and 2012 NONROAD emission inventories were based on emissions provided by LADCO, which were based on EPA NONROAD2004 model runs. The 2009 and 2012 locomotive and commercial marine vessel emissions inventories were based on annual BaseK emissions provided by LADCO. These emissions inventories are presented in Section 2 of the report.

As discussed in Section 2, heavy heavy-duty diesel vehicles (class 8 HDDVs) are the highest NOx and PM emission emitters, contributing more than 35% and 30% of the onroad NOx and PM emissions, respectively, in both 2009 and 2012. As for the NONROAD equipment, more than 75% of the NOx emissions and 55% of the PM emissions are contributed by the diesel equipment in both 2009 and 2012. Construction equipment accounts for more than 30% and 20%, and agricultural equipment accounts for about 30% and 25% of NOx and PM emissions, respectively, in both 2009 and 2012. As for locomotive emissions, line haul locomotives account for more than 70% and 75%, of NOx and PM emissions, respectively in both 2009 and 2012. For the commercial marine vessels, deep draft vessels are the largest contributors emitting more than 45% and 75% of NOx and PM emissions, respectively, in both 2009 and 2012.

For the Phase II Study, ENVIRON reviewed and updated the master list of control measures for mobile sources developed during the Phase I Study, and presented and discussed the updated master control measure list with the LADCO states. Similar to the Phase I Study, the objective of the qualitative screening analysis was to refine and reduce the master list to a shorter list for further technical and economic analyses, as well as for developing white papers on selected control measures for mobile sources.

As discussed in Section 3, general screening criteria included emission impacts in terms of potential emission reduction, emission benefit relative to mobile source category, technical and

[1] "Evaluation of Candidate Mobile Source Control Measures," Final Report to the Lake Michigan Air Directors Consortium, prepared by ENVIRON International Corp., Novato, CA, February 2006.

implementation feasibility, SIP creditable (permanent, quantifiable, surplus, enforceable), cost effectiveness, and public acceptability, with primary focus on reducing PM and NOx emissions.

To the extent that data and/or information were available, ENVIRON estimated preliminary potential emission benefits in 2009 and 2012 for the control strategies based on their control effectiveness or efficiency, and potential emission impacts based on the emission benefits and estimated ranges of penetration rates. From an analysis of these results and discussions with LADCO States, five control measures were selected for further technical and economic analyses and white paper development. These major selected control measures were:

- Fleet Modernization
- Anti-Idling Restrictions
- Accelerated Chip Reflashing for onroad HDDVs
- Aftertreatment Device Retrofits
- Light-Duty Smoking Vehicle Identification and Emissions Reduction

In Section 4 of this report, ENVIRON presents the results of the technical and economic analyses that provide refined emission reduction benefit and impact estimates for these selected control measures. For each selected control measure, ENVIRON developed a White Paper that includes a technical descriptions of the control measure; estimates of emission reductions, costs, and cost-effectiveness; and issues related to implementation.

In addition to performing the technical and economic assessments of these selected control measures, ENVIRON also developed several emission reduction scenarios to estimate potential emission reductions and associated costs using the results from the detailed technical and economic assessments of the selected control measures. There are a variety of possible emission reduction measures that can be implemented in the LADCO states to reduce NOx and PM emissions from mobile sources. These scenarios were evaluated for calendar years 2009 and 2012. These emission reduction scenarios provide a general idea of potential emission reductions from target sources, as well as available measures to cost effectively reduce these available or excess emissions and associated costs to achieve the potential emission reductions.

The emissions reduction scenario analysis is presented in Section 5, and demonstrates a few of many potential emission reduction scenarios for reducing NOx, PM and VOC emissions from on-road diesel vehicles and nonroad diesel equipment, focusing on the on-road HDDVs, and diesel construction and agricultural equipment as they are the primary sources of NOx and PM emissions in the mobile source emission inventories in the LADCO states. However, the Smoking Vehicles measure focuses on reducing PM emissions from high-emitting smoking light-duty gasoline vehicles, and the Anti-Idling measure also includes the estimation of the potential emission reductions from locomotives. The measures included in these scenarios have a range of costs, potential NO_x and PM emission reductions, and cost effectiveness.

To develop these emission reduction scenarios, ENVIRON identified major emission contributors based on emission inventories; generated or estimated vehicle or equipment population data; identified and selected control measures for target sources; applied potential emission reductions and associated cost estimates on a per vehicle or equipment basis, and cost-effectiveness values for selected measures; developed criteria for penetration or compliance rates based on cost effectiveness values and vehicle or equipment availability (turnover rates); and

estimated potential total emission reductions and measure costs for selected measures and combinations of selected measures.

Tables ES-1 and ES-2 show example emission reduction scenarios for on-road diesel vehicles in the LADCO states in 2009 and 2012. These emission reduction scenarios focus on Class 8 HDDVs (the largest truck class), as they contribute to approximately 38% of NOx and 28% of PM emissions in the 2009 on-road emission inventories in every LADCO state, and approximately 38% of NOx and 22% of PM emissions in the 2012 on-road LADCO emissions inventories. Based on projected 2009 VMT and average annual VMT, it was estimated that there will be nearly 400,000 Class 8 HDDVs operating in the LADCO states in 2009. Based on projected 2012 VMT and average annual VMT, it was estimated that there will be more than 415,000 Class 8 HDDVs operating in the LADCO states in 2012.

Table ES-1. Summary results of an example emission reduction scenario to reduce NOx, VOC and PM emissions from on-road diesel vehicles in the LADCO states in 2009.

Technology	Project Cost-Effectiveness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	60,761	-	$0	0.00	0.00	0.00
Sub Total							-	-	**0.00**	**0.00**	**0.00**
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	60,761	1,823	$72,912,642	1.31	0.10	0.02
MY 1990	$8,551	0.12	0.03	0.00	$40,000	8,641	259	$10,368,746	0.08	0.02	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	79,541	-	$0	0.00	0.00	0.00
Sub Total							**2,082**	**83,281,388**	**1.40**	**0.11**	**0.02**
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	60,761	1,823	$82,026,722	1.59	0.10	0.16
MY 1990	$8,015	0.20	0.03	0.04	$45,000	8,641	259	$11,664,839	0.14	0.02	0.03
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	79,541	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.22	0.00	0.11	$45,000	65,258	-	$0	0.00	0.00	0.00
Sub Total							**2,082**	**93,691,561**	**1.73**	**0.11**	**0.19**
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	65,258	1,958	117,465,107	2.86	0.07	0.87
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	110,395	3,312	198,710,622	4.46	0.18	0.73
Sub Total							**5,270**	**316,175,729**	**7.32**	**0.25**	**1.60**
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
Measure 46a: DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	60,761	3,038	$27,342,241	0.00	0.16	0.33
MY 1990	$2,069	0.00	0.03	0.06	$9,000	8,641	432	$3,888,280	0.00	0.03	0.07
MY 1991 – 1997	$3,534	0.00	0.01	0.09	$9,000	79,541	3,977	$35,793,479	0.00	0.14	0.96
MY 1998 – 2001	$3,026	0.00	0.01	0.15	$9,000	65,258	3,263	$29,366,277	0.00	0.11	1.31
MY 2002 – 2006	$2,601	0.00	0.02	0.09	$9,000	110,395	5,520	$49,677,656	0.00	0.29	1.35
Sub Total							**16,230**	**$146,067,931**	**0.00**	**0.72**	**4.01**
Measure 46b: Cleaire LNC + DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	60,761	2,430	$48,608,428	0.67	0.13	0.24
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	8,641	346	$6,912,497	0.08	0.03	0.05
MY 1991 – 1997	$6,645	0.11	0.01	0.08	$ 20,000	79,541	3,182	$63,632,851	0.92	0.11	0.70
MY 1998 – 2001	$5,816	0.14	0.01	0.13	$ 20,000	65,258	2,610	$52,206,714	1.00	0.09	0.95

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
MY 2002 – 2006	$5,487	0.13	0.02	0.08	$ 20,000	110,395	4,416	$88,315,832	1.62	0.23	0.99
Sub Total							**12,984**	**259,676,323**	**4.29**	**0.58**	**2.92**
Measure 46c: EGR + DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	60,761	2,430	$55,899,692	1.07	0.13	0.24
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	8,641	346	$7,949,372	0.12	0.03	0.05
MY 1991 – 1997	$6,281	0.17	0.01	0.08	$ 23,000	79,541	3,182	$73,177,779	1.47	0.11	0.70
MY 1998 – 2001	$5,192	0.22	0.01	0.13	$ 23,000	65,258	2,610	$60,037,721	1.61	0.09	0.95
MY 2002 – 2006	$4,710	0.21	0.02	0.08	$ 23,000	110,395	4,416	$101,563,207	2.59	0.23	0.99
Sub Total							**12,984**	**298,627,771**	**6.87**	**0.58**	**2.92**
Measure 46d: SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	60,761	1,215	$32,203,084	1.07	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	8,641	-	$0	0.00	0.00	0.00
MY 1991 – 1997	$11,810	0.34	0.00	0.00	$ 26,500	79,541	1,591	$42,156,764	1.47	0.00	0.00
MY 1998 – 2001	$9,224	0.45	0.00	0.00	$ 26,500	65,258	1,958	$51,880,422	2.41	0.00	0.00
MY 2002 – 2006	$10,173	0.43	0.00	0.00	$ 26,500	110,395	2,208	$58,509,239	2.59	0.00	0.00
Sub Total							**6,972**	**184,749,508**	**7.55**	**0.00**	**0.00**
Measure 46e: DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	60,761	3,038	$6,076,053	0.00	0.08	0.24
MY 1990	$920	0.00	0.01	0.04	$2,000	8,641	432	$864,062	0.00	0.02	0.05
MY 1991 – 1997	$1,431	0.00	0.01	0.06	$2,000	79,541	3,977	$7,954,106	0.00	0.06	0.69
MY 1998 – 2001	$1,156	0.00	0.01	0.11	$2,000	65,258	3,263	$6,525,839	0.00	0.05	0.95
MY 2002 – 2006	$1,093	0.00	0.01	0.06	$2,000	110,395	5,520	$11,039,479	0.00	0.14	0.98
Sub Total							**16,230**	**32,459,540**	**0.00**	**0.34**	**2.90**
Measure 46f: FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	60,761	2,430	$21,873,793	0.00	0.08	0.26
MY 1990	$3,257	0.00	0.02	0.06	$9,000	8,641	432	$3,888,280	0.00	0.02	0.07
MY 1991 – 1997	$4,945	0.00	0.01	0.09	$9,000	79,541	3,182	$28,634,783	0.00	0.06	0.77
MY 1998 – 2001	$3,941	0.00	0.01	0.15	$9,000	65,258	3,263	$29,366,277	0.00	0.06	1.31
MY 2002 – 2006	$3,809	0.00	0.01	0.09	$9,000	110,395	5,520	$49,677,656	0.00	0.17	1.35
Sub Total							**14,827**	**133,440,788**	**0.00**	**0.39**	**3.75**
Measure 46g: DOC + SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	60,761	1,823	$50,127,441	1.61	0.03	0.14
MY 1990	$8,611	0.26	0.01	0.04	$27,500	8,641	259	$7,128,513	0.18	0.01	0.03
MY 1991 – 1997	$8,404	0.34	0.00	0.06	$27,500	79,541	2,386	$65,621,378	2.21	0.02	0.41
MY 1998 – 2001	$6,571	0.45	0.004	0.10	$27,500	65,258	2,610	$71,784,232	3.21	0.03	0.75
MY 2002 – 2006	$7,245	0.43	0.006	0.06	$27,500	110,395	3,312	$91,075,702	3.89	0.05	0.58
Sub Total							**10,390**	**285,737,266**	**11.11**	**0.13**	**1.92**
Measure 46h: SCR + DPF Retrofit											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	60,761	2,430	$72,912,642	2.15	0.13	0.24
MY 1990	$5,060	0.26	0.03	0.05	$30,000	8,641	346	$10,368,746	0.24	0.03	0.05
MY 1991 – 1997	$6,505	0.34	0.01	0.08	$30,000	79,541	3,182	$95,449,277	2.95	0.11	0.69
MY 1998 – 2001	$5,427	0.45	0.01	0.13	$30,000	65,258	2,610	$78,310,071	3.21	0.09	0.95
MY 2002 – 2006	$5,335	0.43	0.02	0.08	$30,000	110,395	4,416	$132,473,748	5.19	0.23	0.98
Sub Total							**12,984**	**389,514,484**	**13.74**	**0.58**	**2.91**
Overall Projects											
MY 1989 and Earlier						60,761	22,481	469,982,738	9.48	0.91	1.85
MY 1990						8,641	3,111	63,033,334	0.85	0.19	0.39
MY 1991 – 1997								412,420,416			

Technology	Project Cost-Effectiveness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
						79,541	24,658		9.03	0.62	4.92
MY 1998 – 2001						65,258	24,146	496,942,660	14.31	0.57	8.03
MY 2002 – 2006						110,395	38,638	781,043,140	20.35	1.51	7.95
MY 2007+						69,954	0	0	0	0	0
Total						**394,549**	**113,034**	**2,223,422,288**	**54.03**	**3.80**	**23.14**
Measure 46i: Midwest Clean Diesel Initiative											
All Diesel Sources	**$1,492**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	N/A	$97,119,156	9.18	1.56	1.29
Sub Total								**$97,119,156**	**9.18**	**1.56**	**1.29**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
All MY Heavy HDDVs	$1,700	0.02	0.000	0.001	$7,500	394,549	59,182	$443,867,544	3.84	0.06	0.18
Sub Total						**394,549**	**59,182**	**$443,867,544**	**3.84**	**0.06**	**0.18**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Med-HDDVs	$371	0.04	0.00	0.00	$100	83,577	50,146	$5,014,633	5.28	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	75,162	60,129	$6,012,926	21.33	0.00	0.00
Sub Total							**110,276**	**11,027,558**	**26.61**	-	-
Grand Total						**394,549**	**282,491**	**$2,775,436,547**	**93.7**	**5.4**	**24.6**

As shown in Table ES-1, the 2009 emission reduction scenario for heavy HDDVs could achieve approximately 54 tons per day (tpd) of NOx emissions reduction, 3.8 tpd of PM emissions reduction, and approximately 23 tpd of ROG emissions reduction for selected incentive/voluntary measures (including fleet modernization and aftertreatment device retrofits) for a cost of about $2.2 billion with an average cost-effectiveness value of $7,100 per combined ton of NOx, 20xPM, and ROG emissions reduced. The total number of vehicles involved under this scenario for voluntary/incentive programs is about 113,000, which is about 34% of the total available fleet in 2009. Assuming that these control measures would begin in 2007, the 34% vehicle penetration rate would translate to about 11% turnover rate per year in a three-year time frame, which is a viable penetration rate to achieve.

Table ES-2. Summary results of an example emission reduction scenario to reduce NOx, VOC and PM emissions from on-road diesel vehicles in the LADCO states in 2012.

Technology	Project Cost-Effectiveness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	40,446	-	$0	0.00	0.00	0.00
Sub Total							-	-	**0.00**	**0.00**	**0.00**
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	40,446	2,427	$97,071,049	1.59	0.12	0.02
MY 1990	$11,401	0.09	0.02	0.00	$40,000	7,495	300	$11,991,524	0.07	0.02	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	69,085	-	$0	0.00	0.00	0.00
Sub Total							**2,727**	**109,062,573**	**1.66**	**0.13**	**0.02**
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,522	0.29	0.02	0.03	$45,000	40,446	2,427	$109,204,930	1.93	0.12	0.19
MY 1990	$10,687	0.15	0.02	0.03	$45,000	7,495	300	$13,490,464	0.12	0.02	0.03
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	69,085	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	56,650	-	$0	0.00	0.00	0.00
Sub Total								**122,695,395**			

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
							2,727		2.05	0.13	0.22
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	56,650	2,266	135,959,762	2.41	0.06	0.74
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	95,840	3,834	230,016,182	3.76	0.15	0.61
Sub Total							**6,100**	**365,975,944**	**6.17**	**0.21**	**1.35**
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
Measure 46a: DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	40,446	4,045	$36,401,643	0.00	0.19	0.39
MY 1990	$2,759	0.00	0.02	0.04	$9,000	7,495	749	$6,745,232	0.00	0.04	0.09
MY 1991 – 1997	$4,835	0.00	0.01	0.06	$9,000	69,085	5,527	$49,741,376	0.00	0.14	0.97
MY 1998 – 2001	$4,161	0.00	0.01	0.11	$9,000	56,650	4,532	$40,787,928	0.00	0.11	1.32
MY 2002 – 2006	$3,570	0.00	0.01	0.07	$9,000	95,840	9,584	$86,256,068	0.00	0.36	1.71
Sub Total							**24,437**	**$219,932,249**	**0.00**	**0.85**	**4.48**
Measure 46b: Cleaire LNC + DPF											
MY 1989 and Earlier	$6,074	0.09	0.02	0.03	$ 20,000	40,446	3,236	$64,714,033	0.81	0.15	0.29
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	7,495	600	$11,991,524	0.10	0.03	0.06
MY 1991 – 1997	$8,933	0.08	0.01	0.06	$ 20,000	69,085	4,145	$82,902,294	0.88	0.10	0.67
MY 1998 – 2001	$7,766	0.10	0.01	0.10	$ 20,000	56,650	3,399	$67,979,881	0.95	0.08	0.90
MY 2002 – 2006	$7,207	0.10	0.01	0.06	$ 20,000	95,840	5,750	$115,008,091	1.54	0.22	0.94
Sub Total							**17,130**	**342,595,822**	**4.28**	**0.59**	**2.86**
Measure 46c: EGR + DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.02	0.03	$ 23,000	40,446	3,236	$74,421,138	1.30	0.15	0.29
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	7,495	600	$13,790,252	0.16	0.03	0.06
MY 1991 – 1997	$8,593	0.12	0.01	0.06	$ 23,000	69,085	4,145	$95,337,638	1.40	0.10	0.67
MY 1998 – 2001	$7,136	0.16	0.01	0.10	$ 23,000	56,650	3,399	$78,176,863	1.52	0.08	0.90
MY 2002 – 2006	$6,461	0.16	0.01	0.06	$ 23,000	95,840	7,667	$176,345,740	3.28	0.29	1.25
Sub Total							**19,047**	**438,071,630**	**7.67**	**0.66**	**3.17**
Measure 46d: SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	40,446	1,618	$42,873,047	1.30	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	7,495	-	$0	0.00	0.00	0.00
MY 1991 – 1997	$15,979	0.25	0.00	0.00	$ 26,500	69,085	-	$0	0.00	0.00	0.00
MY 1998 – 2001	$12,445	0.33	0.00	0.00	$ 26,500	56,650	2,266	$60,048,895	2.03	0.00	0.00
MY 2002 – 2006	$13,569	0.31	0.00	0.00	$ 26,500	95,840	3,834	$101,590,480	3.28	0.00	0.00
Sub Total							**7,717**	**204,512,422**	**6.61**	**0.00**	**0.00**
Measure 46e: DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	40,446	4,045	$8,089,254	0.00	0.09	0.29
MY 1990	$1,227	0.00	0.01	0.03	$2,000	7,495	749	$1,498,940	0.00	0.02	0.06
MY 1991 – 1997	$1,959	0.00	0.00	0.05	$2,000	69,085	6,909	$13,817,049	0.00	0.08	0.88
MY 1998 – 2001	$1,590	0.00	0.00	0.08	$2,000	56,650	5,665	$11,329,980	0.00	0.06	1.20
MY 2002 – 2006	$1,500	0.00	0.01	0.05	$2,000	95,840	9,584	$19,168,015	0.00	0.17	1.24
Sub Total							**26,952**	**53,903,239**	**0.00**	**0.43**	**3.66**
Measure 46f: FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	40,446	3,236	$29,121,315	0.00	0.09	0.32
MY 1990	$4,343	0.00	0.01	0.04	$9,000	7,495	600	$5,396,186	0.00	0.02	0.07
MY 1991 – 1997	$6,767	0.00	0.01	0.06	$9,000	69,085	5,527	$49,741,376	0.00	0.08	0.97
MY 1998 – 2001	$5,418	0.00	0.01	0.11	$9,000	56,650	4,532	$40,787,928	0.00	0.06	1.32
MY 2002 – 2006	$5,228	0.00	0.01	0.07	$9,000	95,840	7,667	$69,004,855	0.00	0.17	1.37
Sub Total							**21,561**	**194,051,660**	**0.00**	**0.43**	**4.04**
Measure 46g: DOC + SCR Retrofit											

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	40,446	2,427	$66,736,346	1.95	0.03	0.17
MY 1990	$11,411	0.19	0.01	0.03	$27,500	7,495	300	$8,244,173	0.16	0.00	0.02
MY 1991 – 1997	$11,375	0.25	0.00	0.05	$27,500	69,085	2,763	$75,993,769	1.87	0.02	0.35
MY 1998 – 2001	$8,871	0.33	0.003	0.08	$27,500	56,650	3,399	$93,472,336	3.04	0.02	0.71
MY 2002 – 2006	$9,672	0.31	0.004	0.05	$27,500	95,840	5,750	$158,136,125	4.92	0.06	0.74
Sub Total							**14,639**	**402,582,749**	**11.95**	**0.15**	**1.99**
Measure 46h: SCR + DPF Retrofit											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	40,446	3,236	$97,071,049	2.60	0.15	0.29
MY 1990	$6,708	0.19	0.02	0.04	$30,000	7,495	600	$17,987,286	0.32	0.03	0.06
MY 1991 – 1997	$8,812	0.25	0.01	0.06	$30,000	69,085	4,145	$124,353,440	2.81	0.10	0.66
MY 1998 – 2001	$7,336	0.33	0.01	0.10	$30,000	56,650	3,399	$101,969,821	3.04	0.08	0.90
MY 2002 – 2006	$7,138	0.31	0.01	0.06	$30,000	95,840	5,750	$172,512,137	4.92	0.22	0.93
Sub Total							**17,130**	**513,893,733**	**13.69**	**0.59**	**2.84**
Overall Projects											
MY 1989 and Earlier						40,446	29,930	625,703,805	11.48	1.11	2.24
MY 1990						7,495	4,797	91,135,580	0.93	0.22	0.46
MY 1991 – 1997						69,085	33,161	491,886,942	6.96	0.64	5.17
MY 1998 – 2001						56,650	32,857	630,513,394	13.00	0.56	7.98
MY 2002 – 2006						95,840	59,421	1,128,037,693	21.71	1.65	8.78
MY 2007+						149,182	0	0	0	0	0
Total						**418,698**	**160,166**	**2,967,277,415**	**54.07**	**4.17**	**24.63**
Measure 46i: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$194,238,312	18.36	3.12	2.58
Sub Total								**$194,238,312**	**18.36**	**3.12**	**2.58**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
All MY Heavy HDDVs	$1,700	0.02	0.0002	0.001	$7,500	418,698	125,610	$942,071,519	6.07	0.08	0.33
Sub Total						**418,698**	**125,610**	**$942,071,519**	**6.07**	**0.08**	**0.33**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Med-HDDVs	$371	0.04	0.00	0.00	$100	72,630	43,578	$4,357,819	4.58	-	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	65,317	52,254	$5,225,357	18.54	-	0.00
Sub Total							95,832	9,583,176	23	-	-
Grand Total						418,698	285,775	$4,103,587,246	101.6	7.4	27.5

For the 2012 emission reduction scenario for onroad HDDV vehicles, Table ES-2 shows that the emission reductions achievable could be approximately 54 tpd for NOx emissions, 4.2 tpd of PM emissions, and 24.6 tpd for ROG emissions from these incentive/voluntary measures for a cost of about $3.0 billion. The average cost-effectiveness value is estimated to be about $7,100 per combined ton of NOx, 20xPM, and ROG emissions reduced. The total number of vehicles involved under this scenario for voluntary/incentive programs is about 286,000, which is about 68% of the total available fleet in 2012. Assuming that these control measures would begin in 2007, the 68% vehicle penetration rate would translate to about 11% turnover rate per year in a six-year time frame, which is a viable penetration rate to achieve.

As discussed in Section 2, diesel equipment contributes most of the NOx and PM emissions from nonroad sources. The largest emitting diesel equipment categories are construction and agricultural equipment, with each equipment type contributing 20-30% of the NOx and PM emissions from nonroad sources. The emissions reduction scenario for nonroad vehicles

includes voluntary after-treatment device retrofits and fleet modernization. Example potential emission reduction scenarios for the construction and agricultural equipment are summarized in Tables ES-3 to ES-6 for 2009 and 2012 NOx and PM reductions.

Table ES-3. Summary results of an example emission reduction scenario to reduce NOx, VOC and PM emissions from some major construction equipment in the LADCO states in 2009.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Excavators	648	$15,415,500	1.21	0.03	0.11
Rubber Tire Loaders	661	$23,665,000	1.12	0.03	0.12
Crawler Tractor/Dozer	498	$20,313,750	0.83	0.04	0.13
Tractors/Loaders/Backhoes	612	$6,481,250	0.19	0.02	0.01
Off-Highway Trucks	42	$6,906,726	0.45	0.00	0.00
Sub Total	**2,461**	**$72,782,226**	**3.81**	**0.11**	**0.37**
Measure 51a: DPF Retrofit					
Excavators	1,136	$8,493,632	0.00	0.05	0.15
Rubber Tire Loaders	1,177	$11,541,789	0.00	0.06	0.21
Crawler Tractor/Dozer	835	$8,558,526	0.00	0.05	0.16
Tractors/Loaders/Backhoes	1,647	$6,342,158	0.00	0.05	0.06
Off-Highway Trucks	52	$2,679,111	0.00	0.02	0.14
Sub Total	**4,847**	**$37,615,216**	**0.00**	**0.23**	**0.71**
Measure 51b: Lean NOx Catalyst					
Excavators	976	$17,022,105	0.50	0.05	0.13
Rubber Tire Loaders	760	$15,208,421	0.40	0.04	0.11
Crawler Tractor/Dozer	730	$16,103,158	0.35	0.04	0.14
Tractors/Loaders/Backhoes	1,496	$12,454,737	0.24	0.05	0.06
Off-Highway Trucks	52	$5,953,580	0.37	0.02	0.13
Sub Total	**4,014**	**$66,742,001**	**1.86**	**0.20**	**0.56**
Measure 51c: EGR+DPF Retrofit					
Excavators	976	$19,575,421	0.81	0.05	0.13
Rubber Tire Loaders	843	$20,201,263	0.73	0.04	0.12
Crawler Tractor/Dozer	730	$18,518,632	0.55	0.04	0.14
Tractors/Loaders/Backhoes	976	$9,916,632	0.26	0.03	0.04
Off-Highway Trucks	52	$6,846,617	0.59	0.02	0.13
Sub Total	**3,577**	**$75,058,565**	**2.94**	**0.18**	**0.55**
Measure 51d: SCR Retrofit					
Excavators	732	$16,908,395	1.34	0.00	0.00
Rubber Tire Loaders	626	$17,418,868	1.17	0.00	0.00
Crawler Tractor/Dozer	667	$20,370,132	1.03	0.00	0.00
Tractors/Loaders/Backhoes	461	$6,542,711	0.30	0.00	0.00
Off-Highway Trucks	73	$11,074,232	1.55	0.00	0.00
Sub Total	**2,559**	**$72,314,337**	**5.39**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	976	$1,702,211	0.00	0.02	0.10
Rubber Tire Loaders	1,177	$2,564,842	0.00	0.03	0.15
Crawler Tractor/Dozer	835	$1,901,895	0.01	0.02	0.12
Tractors/Loaders/Backhoes	1,496	$1,245,474	0.00	0.02	0.05
Off-Highway Trucks	52	$595,358	0.00	0.01	0.10

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Sub Total	**4,536**	**$8,009,779**	**0.01**	**0.10**	**0.51**
Measure 51f: FTF Retrofit					
Excavators	627	$4,572,000	0.00	0.02	0.09
Rubber Tire Loaders	617	$5,465,368	0.00	0.02	0.11
Crawler Tractor/Dozer	525	$4,905,474	0.01	0.02	0.09
Tractors/Loaders/Backhoes	900	$3,571,579	0.00	0.02	0.04
Off-Highway Trucks	52	$2,679,111	0.00	0.01	0.14
Sub Total	**2,721**	**$21,193,532**	**0.01**	**0.09**	**0.47**
Measure 51g: DOC+SCR Retrofit					
Excavators	976	$23,405,395	1.61	0.01	0.10
Rubber Tire Loaders	996	$30,034,342	1.92	0.01	0.14
Crawler Tractor/Dozer	667	$21,138,816	1.04	0.01	0.11
Tractors/Loaders/Backhoes	799	$11,620,921	0.51	0.01	0.03
Off-Highway Trucks	73	$11,492,127	1.55	0.01	0.11
Sub Total	**3,511**	**$97,691,601**	**6.63**	**0.06**	**0.49**
Measure 51h: SCR+DPF Retrofit					
Excavators	1,242	$32,404,737	2.08	0.06	0.15
Rubber Tire Loaders	1,059	$33,858,947	1.95	0.05	0.18
Crawler Tractor/Dozer	947	$30,473,684	1.36	0.05	0.15
Tractors/Loaders/Backhoes	1,677	$26,720,526	1.05	0.07	0.08
Off-Highway Trucks	73	$12,536,866	1.55	0.03	0.14
Sub Total	**4,998**	**$135,994,761**	**7.99**	**0.26**	**0.70**
Grand Total	**33,224**	**$587,402,018**	**28.64**	**1.24**	**4.37**

Table ES-4. Summary results of an example emission reduction scenario to reduce NOx, VOC and PM emissions from some major construction equipment in the LADCO states in 2012.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Excavators	379	$11,246,750	0.83	0.02	0.09
Rubber Tire Loaders	964	$40,720,750	1.83	0.04	0.15
Crawler Tractor/Dozer	511	$24,529,500	1.02	0.02	0.14
Tractors/Loaders/Backhoes	940	$10,559,000	0.30	0.02	0.03
Off-Highway Trucks	46	$9,082,072	0.47	0.00	0.00
Sub Total	**2,840**	**$96,138,072**	**4.44**	**0.10**	**0.41**
Measure 51a: DPF Retrofit					
Excavators	3,373	$25,842,316	0.00	0.14	0.26
Rubber Tire Loaders	3,167	$28,250,053	0.00	0.12	0.32
Crawler Tractor/Dozer	2,900	$28,918,895	0.00	0.13	0.30
Tractors/Loaders/Backhoes	5,708	$22,890,316	0.00	0.14	0.23
Off-Highway Trucks	122	$6,285,607	0.00	0.05	0.17
Sub Total	**15,270**	**$112,187,186**	**0.00**	**0.57**	**1.28**
Measure 51b: Lean NOx Catalyst					
Excavators	2,094	$35,753,684	0.84	0.09	0.17
Rubber Tire Loaders	1,393	$28,635,789	0.65	0.06	0.16

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Crawler Tractor/Dozer	1,418	$29,146,316	0.59	0.07	0.18
Tractors/Loaders/Backhoes	3,166	$26,604,211	0.48	0.10	0.14
Off-Highway Trucks	81	$9,273,846	0.50	0.03	0.12
Sub Total	**8,152**	**$129,413,846**	**3.05**	**0.35**	**0.77**
Measure 51c: EGR+DPF Retrofit					
Excavators	1,667	$29,525,947	1.02	0.07	0.14
Rubber Tire Loaders	1,393	$32,931,158	1.04	0.06	0.16
Crawler Tractor/Dozer	1,418	$33,518,263	0.93	0.07	0.18
Tractors/Loaders/Backhoes	2,245	$22,790,579	0.56	0.07	0.11
Off-Highway Trucks	81	$10,664,923	0.79	0.03	0.12
Sub Total	**6,804**	**$129,430,870**	**4.35**	**0.30**	**0.70**
Measure 51d: SCR Retrofit					
Excavators	1,064	$24,767,737	1.60	0.00	0.00
Rubber Tire Loaders	881	$26,550,211	1.61	0.00	0.00
Crawler Tractor/Dozer	1,063	$33,172,421	1.61	0.00	0.00
Tractors/Loaders/Backhoes	718	$10,374,053	0.45	0.00	0.00
Off-Highway Trucks	122	$18,507,620	2.30	0.00	0.00
Sub Total	**3,848**	**$113,372,041**	**7.57**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	770	$1,178,737	0.00	0.02	0.06
Rubber Tire Loaders	1,012	$2,017,789	0.00	0.02	0.11
Crawler Tractor/Dozer	665	$1,329,368	0.01	0.02	0.08
Tractors/Loaders/Backhoes	1,343	$1,112,947	0.00	0.02	0.06
Off-Highway Trucks	25	$286,230	0.00	0.00	0.04
Sub Total	**3,815**	**$5,925,072**	**0.01**	**0.08**	**0.35**
Measure 51f: FTF Retrofit					
Excavators	2,144	$16,349,684	0.00	0.05	0.19
Rubber Tire Loaders	2,093	$19,326,316	0.00	0.05	0.27
Crawler Tractor/Dozer	1,909	$18,868,263	0.01	0.05	0.23
Tractors/Loaders/Backhoes	4,685	$18,259,105	0.00	0.08	0.21
Off-Highway Trucks	122	$6,285,607	0.00	0.03	0.17
Sub Total	**10,953**	**$79,088,975**	**0.01**	**0.26**	**1.07**
Measure 51g: DOC+SCR Retrofit					
Excavators	1,667	$35,302,763	2.04	0.02	0.11
Rubber Tire Loaders	1,722	$53,145,921	2.93	0.02	0.18
Crawler Tractor/Dozer	1,063	$34,424,211	1.62	0.02	0.13
Tractors/Loaders/Backhoes	1,764	$26,486,842	1.12	0.02	0.08
Off-Highway Trucks	122	$19,206,021	2.30	0.01	0.12
Sub Total	**6,338**	**$168,565,758**	**10.01**	**0.10**	**0.63**
Measure 51h: SCR+DPF Retrofit					
Excavators	2,196	$56,891,053	2.90	0.09	0.18
Rubber Tire Loaders	2,093	$64,421,053	3.12	0.09	0.24
Crawler Tractor/Dozer	1,909	$62,894,211	2.57	0.09	0.21
Tractors/Loaders/Backhoes	3,357	$55,406,842	2.01	0.14	0.20
Off-Highway Trucks	122	$20,952,023	2.30	0.05	0.15
Sub Total	**9,677**	**$260,565,181**	**12.90**	**0.45**	**0.98**
Grand Total	**67,697**	**$1,094,687,002**	**42.34**	**2.21**	**6.17**

As shown in Tables ES-3 and ES-4, the example emission reduction scenario for major emissions contributors from construction equipment with all selected measures could reduce NOx emissions by approximately 29 tpd, PM emissions by more than 1.2 tpd, and ROG emissions by 4.4 tpd in the LADCO states in 2009 for a cost of about $600 million. The total equipment count in this scenario is about 33,000 units, which is about 34% of the available LADCO regional construction equipment population in 2009. In 2012 the potential NOx emissions reductions are approximately 42 tpd, the PM emissions reductions approximately 2.2 tpd, and the ROG emissions reductions approximately 6.2 tpd for a cost of about $1.1 billion. In 2012, this scenario estimates that approximately 68,000 units would be affected, which is about 79% of the available construction equipment population in 2012.

Table ES-5. Summary results of an example emission reduction scenario to reduce NOx, VOC and PM emissions from some major agricultural equipment in the LADCO states in 2009.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Agricultural Tractors	13,974	$185,035,850	5.54	0.32	0.41
Combines	121	$2,283,750	0.03	0.00	0.00
Sub Total	**14,095**	**$187,319,600**	**5.56**	**0.32**	**0.41**
Measure 51a: DPF Retrofit					
Agricultural Tractors	16,560	$73,719,000	0.00	0.48	0.65
Combines	579	$3,960,474	0.00	0.01	0.00
Sub Total	**17,139**	**$77,679,474**	**0.00**	**0.49**	**0.65**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	10,108	$128,844,316	2.23	0.36	0.36
Combines	168	$2,467,368	0.02	0.00	0.00
Sub Total	**10,276**	**$131,311,684**	**2.25**	**0.36**	**0.36**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	13,032	$111,681,947	2.94	0.30	0.36
Combines	168	$2,837,474	0.03	0.00	0.00
Sub Total	**13,200**	**$114,519,421**	**2.96**	**0.31**	**0.36**
Measure 51d: SCR Retrofit					
Agricultural Tractors	5,330	$67,778,632	3.09	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**5,330**	**$67,778,632**	**3.09**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	17,679	$14,344,211	0.00	0.18	0.47
Combines	825	$1,272,737	0.00	0.01	0.01
Sub Total	**18,504**	**$15,616,947**	**0.00**	**0.18**	**0.48**
Measure 51f: FTF Retrofit					
Agricultural Tractors	11,517	$36,177,632	0.00	0.15	0.39
Combines	168	$1,110,316	0.00	0.00	0.00
Sub Total	**11,685**	**$37,287,947**	**0.00**	**0.15**	**0.39**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	8,281	$110,220,000	4.67	0.06	0.32
Combines	0	$0	0.00	0.00	0.00
Sub Total	**8,281**	**$110,220,000**	**4.67**	**0.06**	**0.32**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	14,517	$179,733,158	6.98	0.33	0.48
Combines	168	$3,701,053	0.06	0.00	0.00
Sub Total	**14,685**	**$183,434,211**	**7.04**	**0.33**	**0.48**
Grand Total	**113,195**	**$925,167,916**	**25.57**	**2.20**	**3.45**

Table ES-6. Summary results of an example emission reduction scenario to reduce NOx, VOC and PM emissions from some major agricultural equipment in the LADCO states in 2012.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Agricultural Tractors	27,896	$384,923,950	11.31	0.60	1.00
Combines	313	$10,663,750	0.14	0.01	0.00
Sub Total	**28,209**	**$395,587,700**	**11.44**	**0.61**	**1.00**
Measure 51a: DPF Retrofit					
Agricultural Tractors	35,612	$194,630,211	0.00	0.97	1.72
Combines	1,744	$12,008,842	0.00	0.03	0.01
Sub Total	**37,356**	**$206,639,053**	**0.00**	**1.00**	**1.73**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	19,486	$259,364,737	4.40	0.70	0.86
Combines	313	$4,980,000	0.04	0.01	0.00
Sub Total	**19,799**	**$264,344,737**	**4.44**	**0.70**	**0.86**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	22,849	$205,178,158	5.15	0.53	0.86
Combines	313	$5,727,000	0.06	0.01	0.00
Sub Total	**23,162**	**$210,905,158**	**5.21**	**0.54**	**0.86**
Measure 51d: SCR Retrofit					
Agricultural Tractors	9,876	$131,193,132	5.72	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**9,876**	**$131,193,132**	**5.72**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	27,485	$25,822,000	0.00	0.31	1.12
Combines	2,248	$3,391,158	0.00	0.02	0.02
Sub Total	**29,733**	**$29,213,158**	**0.00**	**0.32**	**1.13**
Measure 51f: FTF Retrofit					
Agricultural Tractors	28,846	$120,026,842	0.00	0.39	1.56
Combines	434	$2,871,474	0.00	0.00	0.00
Sub Total	**29,280**	**$122,898,316**	**0.00**	**0.39**	**1.56**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	15,541	$190,948,421	7.87	0.11	0.57
Combines	0	$0	0.00	0.00	0.00
Sub Total	**15,541**	**$190,948,421**	**7.87**	**0.11**	**0.57**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	27,267	$373,061,053	13.82	0.61	1.26
Combines	313	$7,470,000	0.12	0.01	0.00
Sub Total	**27,580**	**$380,531,053**	**13.94**	**0.61**	**1.26**
Grand Total	**220,536**	**$1,725,621,674**	**48.62**	**3.28**	**7.26**

For the agricultural equipment, the example emission reduction scenario shown in Table ES-5 for major agricultural equipment including all selected measures could reduce 2009 NOx emissions by approximately 26 tpd, PM emissions by approximately 2 tpd, and ROG emissions by approximately 3.5 tpd for a cost of about $0.9 billion. The total equipment count involved in this scenario is about 113,000 units, which is about 35% of the available LADCO regional agricultural equipment population in 2009. Table ES-6 shows that this scenario for agricultural equipment could reduce 2012 NOx emissions by approximately 49 tpd, PM emissions by approximately 3.3 tpd, and ROG emissions by approximately 7.3 tpd. The total equipment count

involved in this scenario is 220,000 which is approximately 77% of the available agricultural population in 2012.

Based on these emission reduction scenarios, a total NOx reduction of more than 55 tpd, a total PM reduction of 3.2 tpd and a total ROG reduction of 8 tpd could be achieved in 2009 by implementing these selected measures for nonroad diesel equipment, focusing on construction and agricultural equipment. In 2012, a total NOx reduction of 91 tpd, a total PM reduction of approximately 5.5 tpd, and a total ROG reduction of 13.5 tpd could be achieved by implementing these measures for nonroad construction and agricultural equipment.

Table ES-7 shows the potential emissions reduction from implementation of a Smoking Vehicles Emissions Reduction Measure for light-duty on-road vehicles. The scenario is calculated based on an assumption that 1.43% of the LDGV fleet are smoking vehicles, and a penetration rate of 50% for enforcement and subsequent removal/replacement of the smoking vehicle. The analysis indicates that in 2009 the potential LADCO area PM reductions from smoking vehicles are 2.9 tons/day, and for 2012 the reductions are 3.0 tons/day. The per vehicle cost-effectiveness is $5,830/ton PM reduced, and the overall cost is approximately $344 million in 2009 and $365 million in 2012 for the LADCO area.

Table ES-7. An example emission reduction scenario for removal/replacement of smoking vehicles in LADCO states in 2009 and 2012.

Project Cost-Effectiveness ($/ton)	Estimated PM Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total PM Reduction (tons/day)
Measure 38/39/40/41: Smoking Vehicles Identification/Emissions Reduction						
2009						
$5,830	0.003	$1,000	48,131,991	344,144	$344,143,739	2.9
2012						
$5,830	0.003	$1,000	51,078,054	365,208	$365,208,088	3.0

Table ES-8 shows the emission reduction scenario for the Anti-Idling measure for locomotives. Based on the assumptions used in the analysis (described in detail in Section 4) and the 2009 locomotive emission inventories in the LADCO states, the potential emission reductions for the Anti-Idling measure were estimated to be about 5 tpd for NOx emissions, 0.2 tpd for PM emissions, and 0.5 tpd for ROG emissions for a cost of about $50 million. The potential emission reductions for the 2012 scenario were estimated to be doubled of those for the 2009 scenario as they were estimated by scaling the 2009 emission reductions over a six-year timeframe, assuming that the Anti-Idling measure would implement in 2007.

Table ES-8. An example emission reduction scenario for anti-idling restrictions on locomotives in LADCO states in 2009 and 2012.

Technology	Project Cost-Effectiveness ($/ton)	Estimated Reductions per locomotive (tons/yr)			Cost per Unit ($)	# of Units Available	Units Estimated	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Measure 33/34/35/37: Anti-Idling Restriction on Locomotives											
2009											
Switching	$1,400	1.28	0.04	0.10	$30,000	NA	757	$22,713,439	2.65	0.08	0.22
Line-Haul	$1,400	0.84	0.06	0.11	$30,000	NA	898	$26,953,254	2.07	0.15	0.27
Total		2.12	0.10	0.22			1,656	$49,666,693	4.72	0.23	0.49
2012											
Switching	$1,400	1.28	0.04	0.10	$30,000	NA	1,514	$45,426,878	5.31	0.16	0.44
Line-Haul	$1,400	0.84	0.06	0.11	$30,000	NA	1,797	$53,906,508	4.14	0.29	0.55
Total		2.12	0.10	0.22		NA	3,311	$99,333,386	9.44	0.45	0.98

A similar emissions reduction scenario analysis to that presented above for onroad HDDVs and nonroad construction and agricultural equipment has been conducted for each of the states in the LADCO region. Although there were some differences in the nonroad construction and agricultural equipment types that were the major NOx and PM contributors in each state, these differences were minor and the state-by-state analysis was conducted for the same equipment types as that for the LADCO region. Tables ES-9 and ES-10 show the potential emissions reduction from the scenario analysis conducted for each state for 2009 and 2012 respectively. The criteria for penetration rate were identical to those in the LADCO region analysis.

Table ES-9. State-by-state potential NOx emission reductions for the three emission reduction scenarios in 2009.

	2009 NOx PM and ROG Emission Reductions (tpd)								
	On-Road HDDV			Construction Equipment			Agricultural Equipment		
	NOx	PM	ROG	NOx	PM	ROG	NOx	PM	ROG
Illinois	26.21	1.78	6.65	8.43	0.37	1.29	9.49	0.81	1.28
Indiana	15.86	0.84	4.26	4.28	0.18	0.66	5.13	0.44	0.69
Michigan	16.41	0.97	4.17	4.92	0.23	0.75	2.86	0.25	0.39
Ohio	22.83	1.14	6.24	7.74	0.33	1.18	4.25	0.36	0.57
Wisconsin	12.25	0.67	3.28	3.25	0.14	0.50	3.83	0.33	0.52
Total	**93.56**	**5.41**	**24.60**	**28.63**	**1.24**	**4.38**	**25.56**	**2.19**	**3.45**

Table ES-10. State-by-state potential NOx emission reductions for the three emission reduction scenarios in 2012.

	2012 NOx PM and ROG Emission Reductions (tpd)								
	On-Road HDDV			Construction Equipment			Agricultural Equipment		
	NOx	PM	ROG	NOx	PM	ROG	NOx	PM	ROG
Illinois	30.60	2.68	7.72	12.44	0.65	1.82	18.04	1.59	3.34
Indiana	16.41	1.07	4.68	6.36	0.32	0.92	9.77	0.86	1.81
Michigan	18.56	1.37	4.74	7.39	0.42	1.11	5.43	0.48	1.00
Ohio	23.08	1.37	6.77	11.48	0.58	1.65	8.08	0.71	1.49
Wisconsin	12.79	0.86	3.61	4.68	0.24	0.67	7.29	0.64	1.35
Total	**101.43**	**7.34**	**27.52**	**42.35**	**2.22**	**6.18**	**48.62**	**4.29**	**8.99**

1. INTRODUCTION

As part of the Midwest Regional Planning Organization (MRPO), the Lake Michigan Air Directors Consortium (LADCO) is working with its member states in the upper Midwest to develop the necessary technical support for new State Implementation Plans (SIPs) for regional haze, PM2.5, and 8-hour ozone. In June 2006, ENVIRON was retained by LADCO to evaluate candidate emission control measures for mobile sources to support the development of these SIPs for the LADCO States. In February 2006, ENVIRON completed a Phase I study for LADCO entitled "Evaluation of Candidate Mobile Source Control Measures"[1], focusing on reducing NOx emissions from mobile sources in LADCO states in 2009.

The objectives of this Phase II study are to identify and assess candidate control measures to address emissions of volatile organic compounds (VOC) and fine particles ($PM_{2.5}$) from mobile sources in the LADCO states in 2009 and 2012, and emissions of nitrogen oxides (NOx) from mobile sources in the LADCO states in 2012.

This report discusses the selection of control measures, the 2009 and 2012 emission inventories used in the study, results of the control measures assessment, and technical approach, and data and assumptions used in the emission reduction scenario analysis based on selected control measures for on-road diesel vehicles, nonroad diesel equipment and light-duty gasoline vehicles.

Following this Introduction section, Section 2 presents the emissions inventories used in this study. Section 3 presents the selection of control measures. Section 4 presents the results of the technical and economic analyses of the selected control measures. Section 5 presents potential emission reduction scenarios for on-road vehicles and non-road equipment in 2009 and 2010 for the LADCO States.

[1] "Evaluation of Candidate Mobile Source Control Measures," Final Report to the Lake Michigan Air Directors Consortium, prepared by ENVIRON International Corp., Novato, CA, February 2006.

2. EMISSIONS INVENTORY DEVELOPMENT

Onroad Emission Inventory

For the purposes of this study, emission impacts are to be calculated using a combination of emission inventory data supplied by LADCO and the 2002 National Emissions Inventory (NEI). Specifically, the 2009 and 2012 onroad emission inventories for the LADCO states were developed based on NEI 2002, Base K, and NMIM projected emissions[1]. A summary of the methodology used to develop 2009 and 2012 LADCO onroad emissions is as follows:

- 2009 and 2012 TOG and NOx emissions for gasoline and diesel vehicles were set equal to 2009 and 2012 BaseK emissions. NEI 2002 emissions were used to distribute diesel and gasoline emissions by vehicle type.

- NEI 2002 PM and CO emissions were projected to 2009 and 2012 based on EPA NMIM runs for 2002, 2009 and 2012. In NMIM runs, the EPA default county database file was used. The default county database includes 2002 VMT, but not 2009 or 2012 VMT. The 2009 and 2012 VMT applied in NMIM was developed assuming a uniform yearly VMT growth rate of 2% across all vehicle types and counties.

- Emissions distributions by vehicle type were corrected to reflect ENVIRON, 2004[2] vehicle miles traveled by vehicle type for all pollutants.

The 2009 and 2012 onroad emission inventories by vehicle type for the LADCO States are presented in Tables 2-1 and 2-2, respectively. Figures 2-1 and 2-2 are a graphical representation of the onroad emissions inventories by vehicle type for 2009 and 2012. In 2009, gasoline vehicles emissions account for the majority of total organic gas (TOG), carbon monoxide (CO), nitrogen oxides (NOx), and particulate matter less than 10 microns (PM_{10}) emissions, or 95%, 99%, 51%, and 60%, respectively; diesel vehicle emissions account for 50% of particulate matter less than 2.5 microns ($PM_{2.5}$) emissions. The 2012 onroad emissions inventory also shows similar emission trends by vehicle fuel types. By vehicle types, heavy heavy-duty diesel vehicles (class 8 HDDVs) are the highest NOx and PM emission emitters, contributing more than 35% of the total onroad NOx emissions in both 2009 and 2012, and about 35% in 2009 and 30% in 2012 of the total onroad $PM_{2.5}$ emissions.

From 2009 to 2012, onroad emissions from gasoline vehicles decrease by about 18% for TOG and NOx emissions, 13% for CO emissions, and 2% for PM_{10} and $PM_{2.5}$ emissions. As for diesel vehicles, the emissions decrease by about 9% for TOG emissions, about 36% for CO, about 33% for PM emissions, and about 21% for NOx emissions from 2009 to 2012. Emissions contributions from gasoline and diesel vehicles remain relatively constant from 2009 to 2012 for TOG, CO, and NOx emissions. However, PM emission contributions from diesel vehicles decrease from 40% to 31% for PM_{10}, and 50% to 41% for $PM_{2.5}$ from 2009 to 2012.

[1] Work is underway by LADCO and ENVIRON to prepare an updated and refined base year emissions inventory for 2005. This new inventory for on-road mobile sources uses detailed data from more than 20 transportation networks in the upper Midwest, along with detailed temporal profiles of vehicle activity from state DOT traffic counters, to estimate link-level emissions using the CONCEPT emissions model. Modeling is underway and results will be provided on the LADCO web site when they are available.

[2] ENVIRON, 2004. LADCO/MPCA Total Volume and Vehicle Classification Temporal Profiles. September 2004.

Table 2-1. 2009 Onroad Emissions by Vehicle Type for the LADCO States.

Vehicle Type	Emissions (tons/day)				
	TOG	CO	NOx	PM_{10}	$PM_{2.5}$
LDGV	631	8,573	594	17.5	9.4
LDGT1	453	6,334	477	12.2	6.8
LDGT2	208	2,610	193	4.2	2.4
HDGV	23	198	53	1.2	0.9
Motorcycle	5	53	4	0.2	0.1
LDDV	1	1	1	0.4	0.1
LDDT	2	2	3	0.4	0.2
Class 2b diesel	3	8	39	1.1	0.9
Class 3, 4, 5 diesel	3	8	39	0.9	0.7
Class 6, 7 diesel	13	28	165	3.6	3.1
Class 8 diesel	51	147	1,004	15.9	13.6
Buses	2	5	26	0.9	0.8
All State Total	**1,396**	**17,968**	**2,598**	**58.4**	**38.9**

Table 2-2. 2012 Onroad Emissions by Vehicle Type for the LADCO States.

Vehicle Type	Emissions (tons/day)				
	TOG	CO	NOx	PM_{10}	$PM_{2.5}$
LDGV	518	7,621	485	17.4	9.3
LDGT1	371	5,354	389	12.1	6.8
LDGT2	171	2,187	158	4.1	2.3
HDGV	19	170	43	0.9	0.6
Motorcycle	4	53	3	0.2	0.1
LDDV	1	1	1	0.2	0.1
LDDT	2	2	2	0.2	0.1
Class 2b diesel	3	5	31	0.7	0.6
Class 3, 4, 5 diesel	3	5	31	0.6	0.5
Class 6, 7 diesel	12	18	130	2.3	2.0
Class 8 diesel	47	95	793	10.8	9.2
Buses	2	4	20	0.6	0.5
All State Total	**1,152**	**15,513**	**2,086**	**50.2**	**32.2**

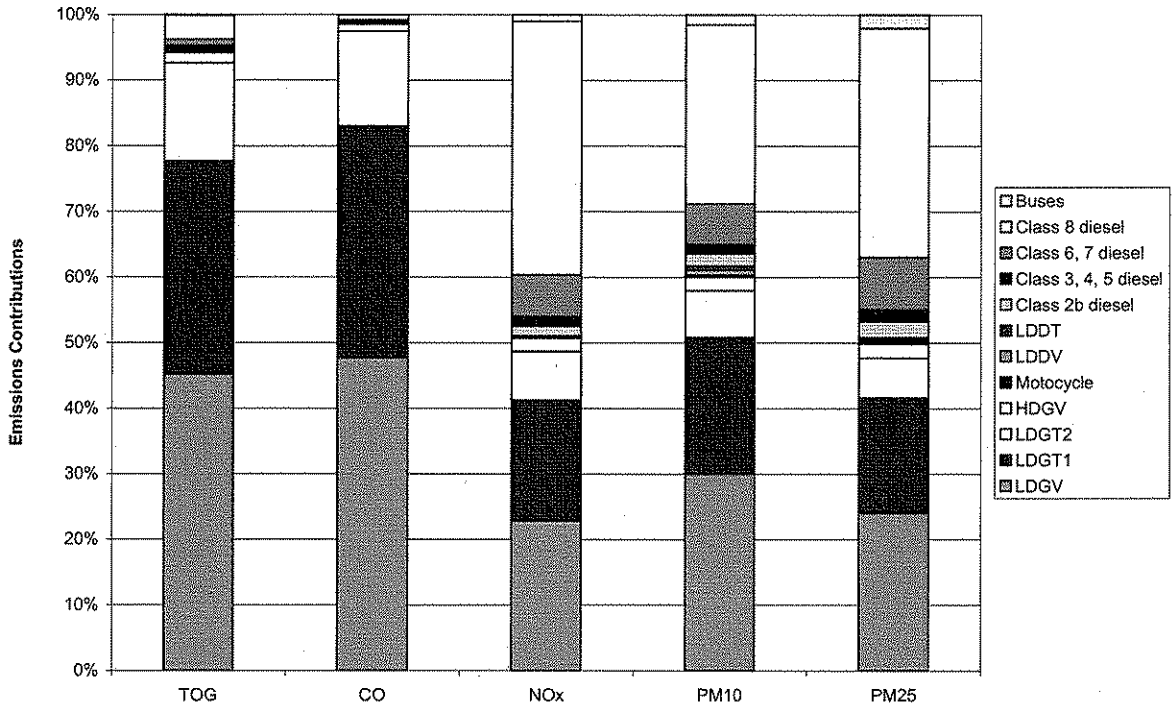

Figure 2-1. 2009 LADCO Onroad Emissions by Source (tpd).

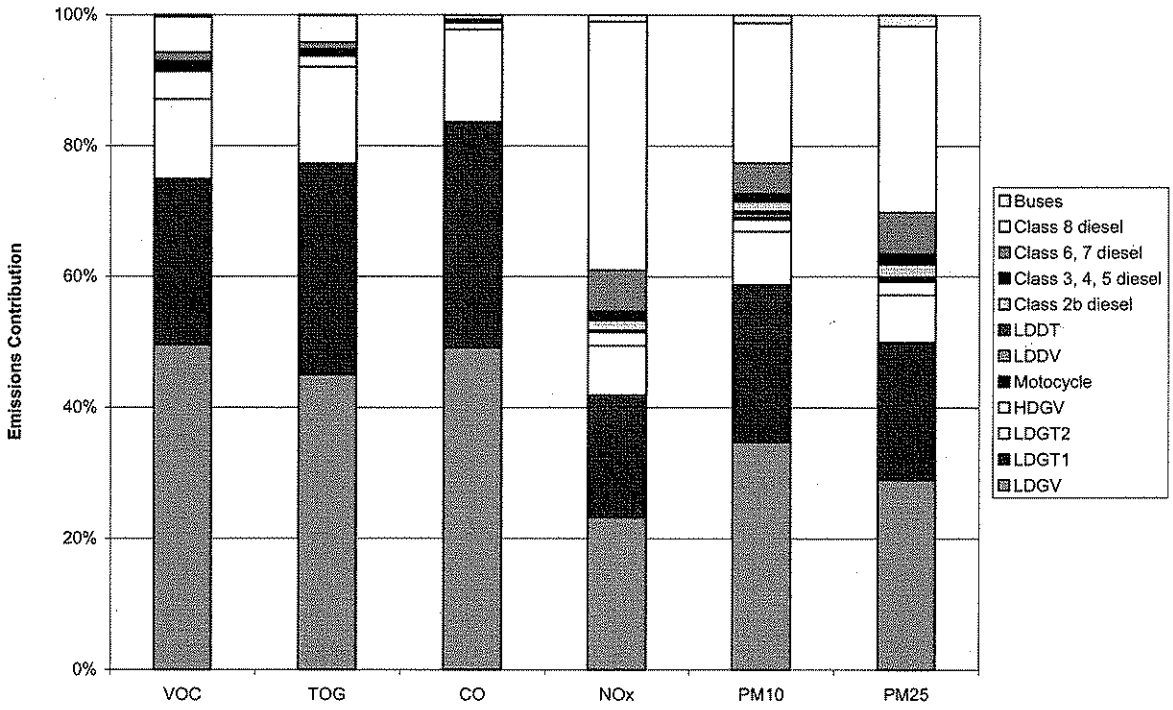

Figure 2-2. 2012 LADCO Onroad Emissions by Source (tpd).

Nonroad Emission Inventory

The 2009 and 2012 NONROAD emission inventories presented in Table 2-3 and 2-4, respectively, are based on emissions provided by LADCO[3] which were based on EPA NONROAD2004 model runs. Figure 2.3 and Figure 2.4 show these NONROAD emission inventories by equipment category. As shown in Figure 2.3 and Figure 2.4, NONROAD VOC, NOx, PM_{10}, and $PM_{2.5}$ emissions are reduced overall by about 10%, 14%, 10%, and 10%, respectively from 2009 to 2012, while NONROAD CO emissions increase slightly from 2009 to 2012. Construction and agricultural equipment are the largest contributors to NOx, PM_{10}, and $PM_{2.5}$ emissions in 2009 and 2012. Construction equipment accounts for 33%, 23%, and 23% or NOx, PM_{10}, and $PM_{2.5}$ emissions, respectively in 2009 and 32%, 22%, and 22% of NOx, PM_{10}, and $PM_{2.5}$ emissions, respectively in 2012. Agricultural equipment accounts for 30%, 26%, and 26% of NOx, PM_{10}, and $PM_{2.5}$ emissions, respectively in 2009 and 31%, 24%, and 24% of NOx, PM_{10}, and $PM_{2.5}$ emissions, respectively in 2012. Recreational equipment is the largest NONROAD contributor to VOC emissions accounting for 44% and 43% of VOC emissions in 2009 and 2012, respectively. Lawn and garden equipment is the largest contributor to CO emissions accounting for 45% and 44% of CO emissions in 2009 and 2012, respectively.

Table 2-3. LADCO All States 2009 NONROAD emissions by fuel and equipment type (tpd).

Pol	Equipment Type	Fuel Type				Total (tpd)
		CNG	Diesel	Gasoline	LPG	
VOC	Agricultural Equipment	0.0	25.0	4.6	0.0	29.6
	Airport Ground Support Equipment	0.0	0.3	0.0	0.0	0.3
	Commercial Equipment	0.0	5.2	41.8	1.2	48.2
	Construction and Mining Equipment	0.0	23.7	16.5	0.2	40.4
	Industrial Equipment	0.1	5.4	3.4	19.2	28.1
	Lawn and Garden Equipment	0.0	1.6	186.9	0.1	188.6
	Logging Equipment	0.0	0.2	1.1	0.0	1.3
	Pleasure Craft	0.0	0.8	251.6	0.0	252.4
	Railroad Equipment	0.0	0.2	0.0	0.0	0.3
	Recreational Equipment	0.0	0.2	456.2	0.0	456.5
	Underground Mining Equipment	0.0	0.1	0.0	0.0	0.1
VOC Total (tpd)		**0.1**	**62.7**	**962.2**	**20.7**	**1,045.7**
CO	Agricultural Equipment	0.1	128.4	152.2	0.1	280.7
	Airport Ground Support Equipment	0.0	1.5	1.8	0.3	3.7
	Commercial Equipment	5.1	21.3	2,111.0	20.3	2,157.8
	Construction and Mining Equipment	0.0	134.4	524.6	5.8	664.9
	Industrial Equipment	33.0	31.4	132.6	449.4	646.3
	Lawn and Garden Equipment	0.0	6.5	4,899.3	2.4	4,908.2
	Logging Equipment	0.0	0.8	14.2	0.0	15.0
	Pleasure Craft	0.0	3.8	999.6	0.0	1,003.4
	Railroad Equipment	0.0	1.1	3.0	0.0	4.1
	Recreational Equipment	0.0	0.9	1,661.7	0.2	1,662.9
	Underground Mining Equipment	0.0	0.6	0.0	0.0	0.6
CO Total (tpd)		**38.2**	**330.7**	**10,500.0**	**478.5**	**11,347.4**
NOx	Agricultural Equipment	0.0	257.8	2.7	0.0	260.5
	Airport Ground Support Equipment	0.0	3.5	0.0	0.0	3.6
	Commercial Equipment	1.4	34.1	16.5	5.4	57.4
	Construction and Mining Equipment	0.0	285.0	5.4	0.8	291.2
	Industrial Equipment	5.1	60.1	3.5	69.1	137.8
	Lawn and Garden Equipment	0.0	13.7	35.8	0.4	49.8

[3] Hetherington, 2006. Email from Grant Hetherington of Bureau of Air Management, Wisconsin Department of Natural Resources to Lit Chan of ENVIRON. July 5, 2006.

Pol	Equipment Type	Fuel Type				Total (tpd)
		CNG	Diesel	Gasoline	LPG	
	Logging Equipment	0.0	2.0	0.1	0.0	2.1
	Pleasure Craft	0.0	22.5	43.3	0.0	65.8
	Railroad Equipment	0.0	1.4	0.0	0.0	1.4
	Recreational Equipment	0.0	0.7	11.6	0.1	12.4
	Underground Mining Equipment	0.0	0.6	0.0	0.0	0.6
NOx Total (tpd)		**6.6**	**681.4**	**118.8**	**75.8**	**882.6**
PM_{10}	Agricultural Equipment	0.0	26.0	0.1	0.0	26.0
	Airport Ground Support Equipment	0.0	0.2	0.0	0.0	0.2
	Commercial Equipment	0.0	3.8	1.0	0.0	4.9
	Construction and Mining Equipment	0.0	20.9	1.5	0.0	22.4
	Industrial Equipment	0.1	4.9	0.1	0.9	5.9
	Lawn and Garden Equipment	0.0	1.2	9.3	0.0	10.5
	Logging Equipment	0.0	0.1	0.1	0.0	0.3
	Pleasure Craft	0.0	0.4	14.6	0.0	15.0
	Railroad Equipment	0.0	0.2	0.0	0.0	0.2
	Recreational Equipment	0.0	0.1	13.3	0.0	13.4
	Underground Mining Equipment	0.0	0.1	0.0	0.0	0.1
PM_{10} Total (tpd)		**0.1**	**58.0**	**39.9**	**0.9**	**98.9**
$PM_{2.5}$	Agricultural Equipment	0.0	23.9	0.1	0.0	24.0
	Airport Ground Support Equipment	0.0	0.2	0.0	0.0	0.2
	Commercial Equipment	0.0	3.5	0.9	0.0	4.5
	Construction and Mining Equipment	0.0	19.2	1.4	0.0	20.6
	Industrial Equipment	0.1	4.5	0.0	0.9	5.5
	Lawn and Garden Equipment	0.0	1.1	8.5	0.0	9.6
	Logging Equipment	0.0	0.1	0.1	0.0	0.2
	Pleasure Craft	0.0	0.4	13.4	0.0	13.8
	Railroad Equipment	0.0	0.2	0.0	0.0	0.2
	Recreational Equipment	0.0	0.1	12.2	0.0	12.3
	Underground Mining Equipment	0.0	0.1	0.0	0.0	0.1
$PM_{2.5}$ Total (tpd)		**0.1**	**53.4**	**36.7**	**0.9**	**91.1**

Table 2-4. LADCO All States 2012 NONROAD Emissions by fuel and equipment type (tpd).

Pol	Equipment Type	Fuel Type				Total (tpd)
		CNG	Diesel	Gasoline	LPG	
VOC	Agricultural Equipment	0.0	20.8	4.2	0.0	25.0
	Airport Ground Support Equipment	0.0	0.2	0.0	0.0	0.3
	Commercial Equipment	0.0	4.6	43.4	0.9	49.0
	Construction and Mining Equipment	0.0	20.2	15.9	0.1	36.2
	Industrial Equipment	0.0	4.4	2.0	8.2	14.7
	Lawn and Garden Equipment	0.0	1.4	179.3	0.0	180.8
	Logging Equipment	0.0	0.1	1.2	0.0	1.3
	Pleasure Craft	0.0	0.8	225.1	0.0	225.9
	Railroad Equipment	0.0	0.2	0.0	0.0	0.3
	Recreational Equipment	0.0	0.2	406.2	0.0	406.5
	Underground Mining Equipment	0.0	0.1	0.0	0.0	0.1
VOC Total (tpd)		**0.1**	**53.1**	**877.5**	**9.3**	**939.9**
CO	Agricultural Equipment	0.0	108.9	153.3	0.0	262.3
	Airport Ground Support Equipment	0.0	1.4	1.6	0.2	3.1
	Commercial Equipment	5.0	20.2	2,276.8	17.6	2,319.6
	Construction and Mining Equipment	0.0	113.7	511.3	3.1	628.1
	Industrial Equipment	18.5	29.4	90.9	249.4	388.2
	Lawn and Garden Equipment	0.0	6.3	5,085.9	1.2	5,093.5
	Logging Equipment	0.0	0.6	15.6	0.0	16.2
	Pleasure Craft	0.0	3.9	976.7	0.0	980.6
	Railroad Equipment	0.0	1.0	3.1	0.0	4.1
	Recreational Equipment	0.0	0.9	1,661.6	0.2	1,662.7
	Underground Mining Equipment	0.0	0.5	0.0	0.0	0.5
CO Total (tpd)		**23.5**	**286.8**	**10,776.9**	**271.8**	**11,358.9**
NOx	Agricultural Equipment	0.0	231.8	2.4	0.0	234.2
	Airport Ground Support Equipment	0.0	3.1	0.0	0.0	3.1
	Commercial Equipment	1.3	33.3	16.7	4.4	55.7
	Construction and Mining Equipment	0.0	235.9	4.3	0.5	240.7
	Industrial Equipment	2.5	51.5	1.7	32.6	88.2
	Lawn and Garden Equipment	0.0	13.7	35.0	0.2	48.9
	Logging Equipment	0.0	1.4	0.1	0.0	1.5
	Pleasure Craft	0.0	22.4	46.3	0.0	68.7
	Railroad Equipment	0.0	1.3	0.0	0.0	1.3
	Recreational Equipment	0.0	0.7	14.1	0.0	14.9
	Underground Mining Equipment	0.0	0.6	0.0	0.0	0.6
NOx Total (tpd)		**3.8**	**595.6**	**120.6**	**37.8**	**757.8**
PM_{10}	Agricultural Equipment	0.0	21.7	0.1	0.0	21.8
	Airport Ground Support Equipment	0.0	0.2	0.0	0.0	0.2
	Commercial Equipment	0.0	3.5	1.1	0.0	4.6
	Construction and Mining Equipment	0.0	18.0	1.5	0.0	19.5
	Industrial Equipment	0.1	4.3	0.0	0.9	5.3
	Lawn and Garden Equipment	0.0	1.1	9.5	0.0	10.6
	Logging Equipment	0.0	0.1	0.1	0.0	0.2
	Pleasure Craft	0.0	0.4	14.3	0.0	14.6
	Railroad Equipment	0.0	0.2	0.0	0.0	0.2
	Recreational Equipment	0.0	0.1	12.1	0.0	12.2
	Underground Mining Equipment	0.0	0.1	0.0	0.0	0.1
PM_{10} Total (tpd)		**0.1**	**49.7**	**38.7**	**1.0**	**89.5**
$PM_{2.5}$	Agricultural Equipment	0.0	20.0	0.1	0.0	20.0
	Airport Ground Support Equipment	0.0	0.2	0.0	0.0	0.2
	Commercial Equipment	0.0	3.2	1.0	0.0	4.3
	Construction and Mining Equipment	0.0	16.6	1.4	0.0	18.0
	Industrial Equipment	0.1	4.0	0.0	0.9	5.0
	Lawn and Garden Equipment	0.0	1.0	8.8	0.0	9.8
	Logging Equipment	0.0	0.1	0.1	0.0	0.2
	Pleasure Craft	0.0	0.4	13.1	0.0	13.5
	Railroad Equipment	0.0	0.1	0.0	0.0	0.1
	Recreational Equipment	0.0	0.1	11.1	0.0	11.3
	Underground Mining Equipment	0.0	0.1	0.0	0.0	0.1
$PM_{2.5}$ Total (tpd)		**0.1**	**45.7**	**35.6**	**1.0**	**82.4**

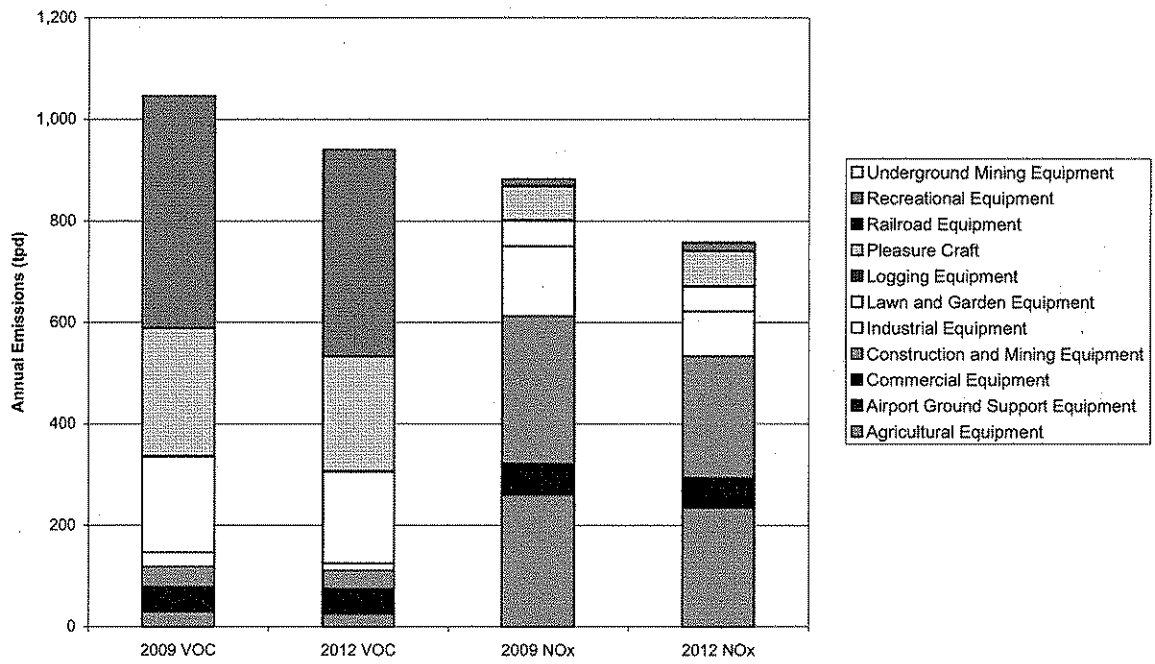

Figure 2-3. LADCO 2009 and 2012 VOC and NOx NONROAD Emissions by Equipment Type (tons per day).

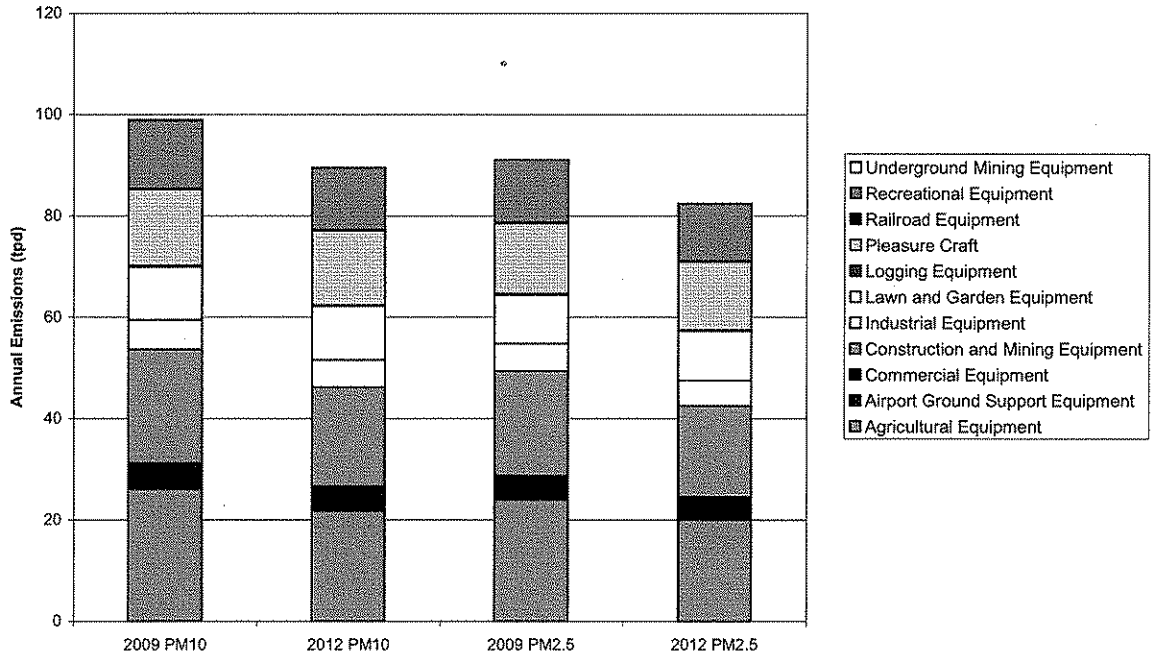

Figure 2-4. LADCO 2009 and 2012 PM10 and PM2.5 NONROAD Emissions by Equipment Type (tons per day).

Locomotive Emission Inventory

The 2009 and 2012 locomotive emission inventories are based on annual BaseK emissions received from LADCO[4,5]. The 2009 and 2012 locomotive emission inventories for the LADCO states are shown in Tables 2-5 and 2-6, respectively. As shown in these tables, locomotive emissions decrease from 2009 to 2012 by 2% for VOC and NOx emissions, and 5%, for PM_{10} and $PM_{2.5}$ emissions. In 2009, Class I line haul locomotive account for 74%, 72%, 78%, and 78% of VOC, NOx, PM_{10}, and $PM_{2.5}$ emissions, respectively. In 2012, Class I line haul locomotive account for 73%of VOC and NOx emissions, and 78% of PM_{10} and $PM_{2.5}$ emissions.

Table 2-5. 2009 LADCO All States Locomotive Emissions Projection (tons per day).

Locomotive Type	VOC	NOx	PM_{10}	$PM_{2.5}$
Class I Line Haul	15.6	240.5	8.3	7.5
Class II/III	0.7	16.6	0.4	0.3
Passenger	0.3	5.3	0.2	0.1
Commuter	0.7	13.3	0.4	0.3
Yard	4.0	59.0	1.4	1.3
Totals	**21.2**	**334.7**	**10.6**	**9.6**

Table 2-6. 2012 LADCO All States Locomotive Emissions Projection (tons per day).

Locomotive Type	VOC	NOx	PM_{10}	$PM_{2.5}$
Class I Line Haul	15.2	238.3	7.9	7.1
Class II/III	0.7	16.5	0.4	0.3
Passenger	0.3	4.5	0.1	0.1
Commuter	0.7	11.3	0.4	0.3
Yard	4.0	56.1	1.4	1.3
Totals	**20.8**	**326.7**	**10.1**	**9.1**

Commercial Marine Vessel Emission Inventory

The 2009 and 2012 commercial marine emission inventories are based on annual BaseK emissions provided by LADCO[4,5]. The 2009 and 2012 commercial marine vessel emission inventories for the LADCO states are shown in Tables 2-7 and 2-8, respectively. As shown in these tables, commercial marine vessel emissions remain relatively constant from 2009 to 2012 for VOC, NOx, PM_{10}, and $PM_{2.5}$. Figures 2-5 and 2-6 show the emission contributions by vessel types in 2009 and 2012, respectively. As shown in these figures, deep draft vessels are the largest contributors to commercial marine vessel emissions. In 2009, deep draft vessels account for 46%, 49%, 76%, and 76% of VOC, NOx, PM_{10}, and $PM_{2.5}$ emissions, respectively. In 2012, deep draft vessels account for 45%, 49%, 76%, and 76% of VOC, NOx, PM_{10}, and $PM_{2.5}$ emissions, respectively.

[4] LADCO, 2006a. 2009 Locomotive and Commercial Marine BaseK Emissions received from Mark Janssen. September 2006.
[5] LADCO, 2006b. 2012 Locomotive and Commercial Marine BaseK Emissions received from Mark Janssen. October 2006.

Table 2-7. 2009 LADCO Commercial Marine Vessel Emissions (tons per day).

Ship Type	Fuel Type	VOC	NOx	PM_{10}	$PM_{2.5}$
Tugs	Diesel	0.6	28.0	0.6	0.6
Ferries	Diesel	0.1	2.9	0.1	0.1
Push Boats	Diesel	2.2	91.7	2.2	1.9
Excursion	Diesel	0.0	0.9	0.0	0.0
Dredge	Diesel	0.0	0.1	0.0	0.0
Support Vessels	Diesel	0.0	0.1	0.0	0.0
Fishing Vessels	Diesel	0.0	0.0	0.0	0.0
Military Vessels	Diesel	0.0	0.4	0.0	0.0
Deep Draft Vessels - Port	Residual	0.7	22.4	1.4	1.3
Deep Draft Vessels - Underway	Residual	2.2	94.9	7.7	7.0
Fishing Vessels	Gasoline	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	0.5	0.0	0.0	0.0
Totals		**6.3**	**241.4**	**12.1**	**10.9**

Table 2-8. 2012 LADCO Commercial Marine Vessel Emissions (tons per day).

Ship Type	Fuel Type	VOC	NOx	PM_{10}	$PM_{2.5}$
Tugs	Diesel	0.7	27.2	0.6	0.6
Ferries	Diesel	0.1	2.7	0.1	0.1
Push Boats	Diesel	2.2	88.9	2.2	2.0
Excursion	Diesel	0.0	0.9	0.0	0.0
Dredge	Diesel	0.0	0.1	0.0	0.0
Support Vessels	Diesel	0.0	0.1	0.0	0.0
Fishing Vessels	Diesel	0.0	0.0	0.0	0.0
Military Vessels	Diesel	0.0	0.4	0.0	0.0
Deep Draft Vessels - Port	Residual	0.7	22.4	1.4	1.3
Deep Draft Vessels - Underway	Residual	2.2	94.9	7.7	7.0
Fishing Vessels	Gasoline	0.1	0.0	0.0	0.0
Military Vessels	Gasoline	0.5	0.0	0.0	0.0
Totals		**6.4**	**237.7**	**12.1**	**10.9**

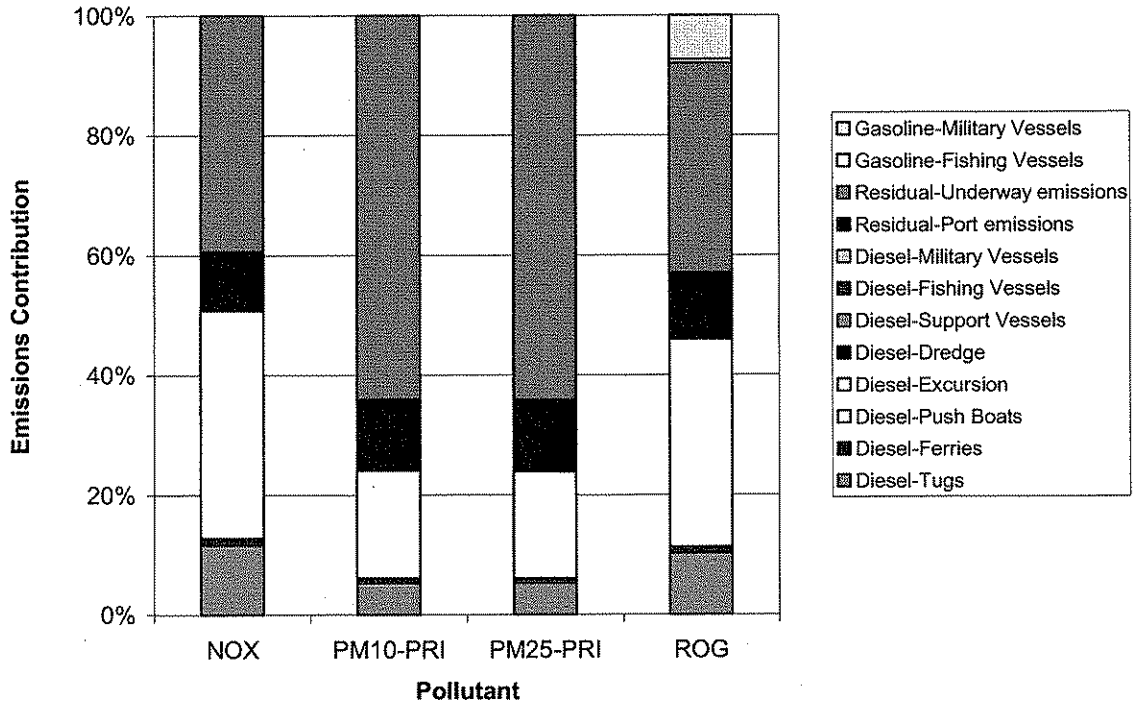

Figure 2-5. 2009 LADCO Commercial Marine Emissions Contributions.

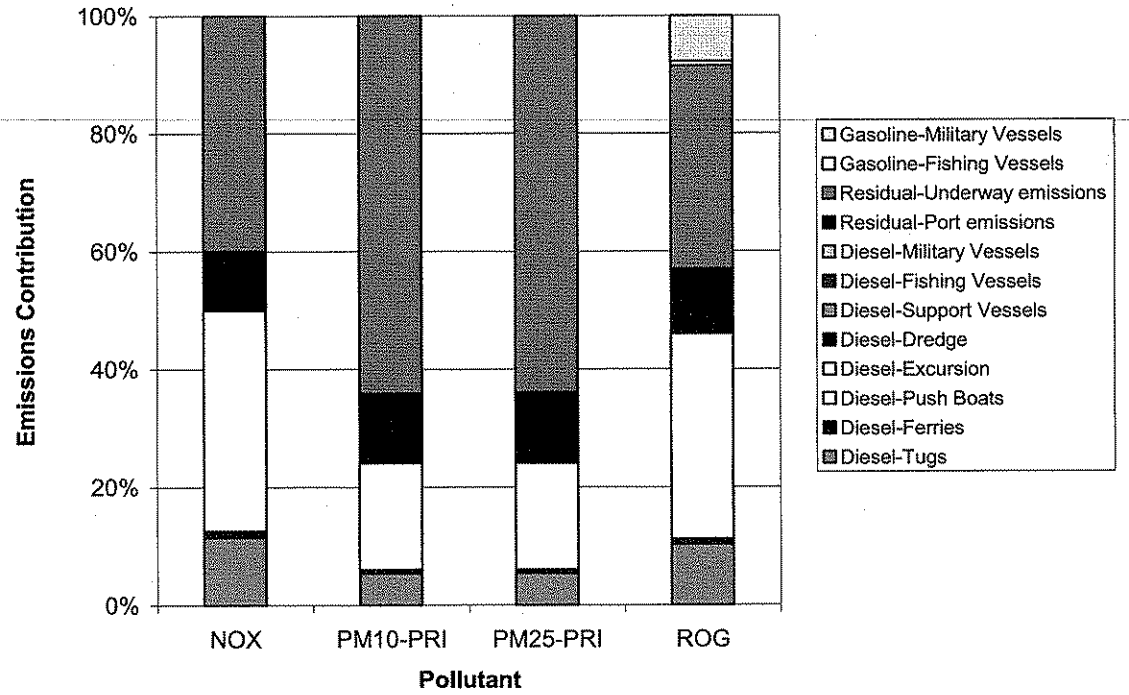

Figure 2-6. 2012 LADCO Commercial Marine Emissions Contributions.

3. SELECTION OF CONTROL MEASURES AND EMISSIONS INVENTORY DEVELOPMENT

Qualitative Screening Analysis

For the Phase II Study, ENVIRON reviewed and updated the master list of control measures for mobile sources developed during the Phase I Study, and presented and discussed the updated master control measure list with the LADCO states. Similar to the Phase I Study, the objective of the qualitative screening analysis was to refine and reduce the master list to a shorter list for further technical and economic analyses, as well as for developing white papers on selected control measures for mobile sources. The following general criteria were used to qualitatively evaluate the candidate control measures:

- Emission impacts in terms of potential emission reduction
- Emission benefit relative to mobile source category
- Technical feasibility
- SIP creditable (permanent, quantifiable, surplus, enforceable)
- Cost effectiveness
- Implementation feasibility
- Public acceptability

Of these criteria, the potential emissions reduction was deemed to be of the highest importance.

The qualitative screening assessment was performed on more than 70 emission control measures listed in the master list in Table 3-1, in the following control measure categories:

- Alternative fuels,
- Conventional fuels;
- Equipment modernization programs,
- Fleet modernization programs,
- Idling restriction/reduction programs,
- Inspection/maintenance programs,
- Low-emission vehicles (LEV) programs,
- Retrofitting programs,
- Ozone action days/public awareness programs,
- Intelligent transportation system (ITS) programs, and
- VMT reduction programs.

To the extent that data and/or information were available, ENVIRON estimated preliminary potential emission benefits in 2009 and 2012 for the control strategies based on their control effectiveness or efficiency, and potential emission impacts based on the emission benefits and estimated ranges of penetration rates. Section 4 of this report presents the results of the technical and economic analyses that provide refined emission reduction benefit and impact estimates for those selected control measures.

Table 3-1. Master list for mobile source control measures.

Control ID	Category	Source	Vehicle/Equipment Types	Control Measures
1	Alternative Fuels	On-Road	LDV & HDV	Alternative fuel pilot projects
2	Alternative Fuels	On-Road	LDV & HDV	Private sector clean fuel fleets
3	Alternative Fuels	On-Road	LDV & HDV	Public sector clean fuel fleets
4	Alternative Fuels	On-Road	LDV & HDV	Alternative fuel vehicle conversion
5	Alternative Fuels	On-Road	LDV & HDV	Clean fuel incentives
6	Alternative Fuels	On-Road	Buses	Alternative fuel, hybrid, fuel cell school/transit bus programs
7	Alternative Fuels	On-Road	HDDV	Alternative fuel refuse truck programs
8	Alternative Fuels	Non-Road	Locomotive	Hybrid diesel electric or LNG switching engine locomotive pilot programs
9	Alternative Fuels	Non-Road	Lawn & Garden Equipment	Accelerate the turnover of residential gasoline lawn & garden equipment to electric
10	Alternative Fuels	Non-Road	Industrial Equipment	Accelerate the turnover of industry equipment to alternative fuels or electric
11	Alternative Fuels	Non-Road	Ground Support Equipment	Airport ground support equipment electrification
12	Alternative Fuels	Non-Road	Marine	Shoreside power for marine vessels at berth
13	Conventional Fuels	On & Non-Road	Gasoline Vehicles/Equipment	RFG/California RFG
14	Conventional Fuels	On & Non-Road	Gasoline Vehicles/Equipment	Lower RVP Gasoline
15	Conventional Fuels	Non-Road	Diesel Equipment	Early phase in of ULSD fuels for nonroad equipment
15a	Conventional Fuels	Non-Road	Marine	Low sulfur marine distillate fuels (MGO or MDO) for auxiliary engines in marine vessels
16	Conventional Fuels	On & Non-Road	Diesel Vehicles/Equipment	Reformulated diesel fuels (e.g. Fischer-Trope diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)
17	Conventional Fuels	On & Non-Road	Diesel Vehicles/Equipment	Diesel fuel additives
18	Conventional Fuels	On-Road	LDV	Gas cap replacement program (give free vouchers to failed vehicles w/ faulty or missing gas caps) Toledo Metro COG has such program (Ohio & Michigan)
19	Conventional Fuels	On & Non-Road	Area Sources	Stage II Vapor Recovery
20	Equipment Modernization	Non-Road	Diesel Equipment	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines
21	Equipment Modernization	Non-Road	Large SI Equipment	Accelerate the turnover of large SI engines to engines meeting Large SI Non-Road Engine Standards
22	Equipment Modernization	Non-Road	Recreation & L&G SI Engines	Replace 2-stroke engines with 4-stroke engines in recreation vehicles/marine & L&G equipment
23	Equipment Modernization	Non-Road	Locomotive	Accelerate the turnover of older locomotives to Tier 2, and possible Tier 3, locomotives
24	Equipment Modernization	Non-Road	Marine	Accelerate the turnover of older catergories 1 and 2 commercial marine engines to Tier 2, and possible Tier 3, engines
25	Equipment Modernization	Non-Road	Agricultural Equipment	Accelerate the turnover of older agricultural engines to Tier 2/Tier3/Tier 4 nonroad engines or onroad engines
26	Equipment Modernization	Non-Road	Lawn & Garden Equipment	Residential L&G equipment (e.g. lawnmowers) exchange/rebate/buy back programs
27	Equipment Modernization	Non-Road	Construction Equipment	Contract-based incentives/requirements (Green Contracting) to contractors on construction projects
28	Fleet Modernization	On-Road	LDV	Accelerated replacement of current LD vehicles with LEVs or Tier 2 vehicles
29	Fleet Modernization	On-Road	LDV & HDV	Accelerated replacement of current LD and HD vehicles with AFVs
30	Fleet Modernization	On-Road	LDV	Buy back and scrap pre-1980 LDVs and high emitters
31	Fleet Modernization	On-Road	HDDV	Repower HDDVs with older, high emitting engines with low emission diesel engines
32	Fleet Modernization	On-Road	HDDV	Accelerate the turnover of older HDDVs to cleaner late model HDDVs
33	Idling Restriction/Reduction	On-Road	HDDV	Idling restrictions for public and private diesel fleets
34	Idling Restriction/Reduction	On & Non-Road	HDDV/Nonroad Diesel Equipment	Idling reduction programs
35	Idling Restriction/Reduction	On-Road	HDDV	Truck stop electrification
36	Idling Restriction/Reduction	Non-Road	Locomotive	Idling restrictions on linehaul and switching locomotives (automatic start-stop devices)
37	Idling Restriction/Reduction	Non-Road	Construction Equipment	Idling restrictions on construction equipment
38	I/M Programs	On-Road	LDV & HDV	Enforce smoking vehicle program
39	I/M Programs	On-Road	LDV	Remote-sensing programs to capture high emitters
40	I/M Programs	On-Road	LDV	LDV I/M programs (IM-240, RSD, ASM, RG240 etc.) - OBD only
41	I/M Programs	On-Road	HDDV	HDDV I/M programs (smoke/opacity test; diesel OBD etc.)
42	I/M Programs	On-Road	HDDV	HDDV accelerated reflashing programs
43	LEV Programs	On-Road	LDV	LEV programs/requirements for public and private fleets
44	LEV Programs	On-Road	LDV	Scrappage of high emitter LDVs and replace with LEVs
45	LEV Programs	On-Road	LDV	ULEV/SULEV/ZEV pilot programs
46	Retrofitting	On-Road	HDDV	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)
46a	Retrofitting	On-Road	HDDV	Adopt CARB's Air Toxic Control Measures for in-use transit buses and solid waste collection trucks (i.e. requiring 90%+ reduction in PM emissions)
47	Retrofitting	On-Road	HDDV	Retrofit programs for HD diesel vehicles to AFVs (NG, dual-fuel etc.)
48	Retrofitting	On-Road	HDGV	Aftertreatment retrofit programs for HD gasoline vehicles (3-way catalysts)
49	Retrofitting	On-Road	HDGV	Retrofit programs for HD gasoline vehicles to AFVs (NG, LPG, bi-fuel etc.)
50	Retrofitting	On-Road	LDV	Retrofit programs for LDVs to AFVs or bi-fuel vehicles
51	Retrofitting	Non-Road	Diesel Equipment	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)

Control ID	Category	Source	Vehicle/Equipment Types	Control Measures
51a	Retrofitting	Non-Road	Diesel Equipment	Adopt CARB's Air Toxic Control Measures for cargo handling equipment; portable diesel-fuel engines; transport refrigeration units or TRUs (i.e. requiring 90%+ reduction in PM emissions)
52	Retrofitting	Non-Road	Diesel Equipment	Alternative fuel retrofit programs for nonroad diesel equipment
53	Retrofitting	Non-Road	SI Equipment	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control; catalysts)
54	Retrofitting	Non-Road	SI Equipment	Alternative fuel retrofit programs for nonroad gasoline equipment
55	Retrofitting	Non-Road	Locomotive	Retrofit programs for switching locomotive engines
56	Retrofitting	Non-Road	Marine	Retrofit programs for commercial marine engines (e.g slide-valve fuel injection; water injection; DPFs; catalysts; EGR, DOCs etc.)
57	Retrofitting	Non-Road	Marine	Repower/replace auxiliary engines of commercial marine with low emitting engines
58	Retrofitting	nonroad	Aircraft	Aircraft Electrification: Idling
59	Ozone Action Days/Public Awareness	Various	LDV	Employer-based ozone action days
60	Ozone Action Days/Public Awareness	Non-Road	Lawn & Garden Equipment	L&G equipment usage control/restriction programs
61	Ozone Action Days/Public Awareness	Various	LDV	Public awareness & outreach programs
62	Ozone Action Days/Public Awareness	Various	LDV	School-based public awareness programs
63	Ozone Action Days/Public Awareness	Various	LDV	Education and promotion campaigns
64	Intelligent Transport systems	On-Road	LDV	Dynamic message signs
65	Intelligent Transport systems	On-Road	LDV	Video monitor system deployment
65a	Intelligent Transport systems	On-Road	LDV	Improved Traffic Light Signalization (e.g. periodic retiming)
65b	Intelligent Transport systems	On-Road	LDV	Traffic incident management (removal of crashed vehicles or other traffic obstructions within a certain period)
66	Intelligent Transport systems	On-Road	LDV	Internet site/system to provide road and route information
67	Intelligent Transport systems	On-road	LDV	Speed limit restriction (65mph)
68	VMT Reduction Programs	Various	LDV	Ridesharing (e.g. carpool, vanpool) programs
69	VMT Reduction Programs	On-Road	LDV	Enhance/expand regional transit plan
70	VMT Reduction Programs	Various	LDV	Build, extend and expand HOV lanes
71	VMT Reduction Programs	On-Road	LDV	Bicycle and pedestrian accommodation programs
72	VMT Reduction Programs	On-Road	LDV	Telecommuting
73	VMT Reduction Programs	Various	Various	Green space preservation
74	VMT Reduction Programs	Various	Various	Mixed land-use development

Similar to the Phase I Study, the screening evaluation for these control measures was based on approximate contribution levels to the NOx, PM, and VOC emission inventories, and past experience in program effectiveness and feasibility for these measures. As discussed earlier, while the criteria included emission benefits, emission impacts, cost effectiveness, technical feasibility, likely public acceptance, and EPA creditability, the qualitative screening analysis was heavily weighted on the emission impacts. For each measure, the preliminary emission reduction potential was provided. In addition, numerical values of 1, 2, and 3 were assigned to each of the ranking criteria representing low, medium, or high ranks. The values of these criteria were then totaled up to represent the overall ranking for the control measures.

Source apportionment analyses were examined by LADCO to determine the importance of on-road and non-road sources on ozone and PM2.5 concentrations in nonattainment areas in the region. Model-based source apportionment information was developed by using the OSAT/APCA algorithm for ozone and PSAT algorithm for PM2.5 in CAMx modeling. This source apportionment modeling shows that on-road NOx emissions are the dominant source of ozone and PM-nitrate concentrations in the region. Monitoring-based source apportionment was developed with Positive Matrix Factorization (PMF) and Chemical Mass Balance (CMB) analyses using data from LADCO's Urban Organics Study. This information suggests that mobile sources are the dominant source of primary organic carbon concentrations in these areas. Although further analyses are underway to better define the smoker/non-smoker and gasoline/diesel splits, initial results indicate that smoking vehicles may comprise a significant portion of the PM emissions. Thus, the emission impact assessment in the qualitative screening analysis was focused on reducing NOx and PM emissions.

In addition to estimating the control efficiencies, low and high penetration or compliance rates were assumed for each control measure based on vehicle/equipment availability and turnover rates (assuming that control measures would be implemented in 2007), as well as past experiences and engineering judgment. For example, a 10% penetration rate per year for a control measure starting in 2007 would provide a total 30% penetration rate in 2009, and 60% penetration rate in 2012.

Information on past experience of control measures was based on a variety of reports and studies. These include the EPA Transportation Control Measure and Congestion Mitigation Air Quality Program reports; SIP-related reports for Sacramento, Los Angeles, San Joaquin Valley, San Francisco, and Washington, DC; and Ozone Early Action Compacts (EACs)'s for San Antonio and Dallas-Fort Worth, TX, Triad, NC, Tulsa, OK, Kansas City, KS, Northern Shenandoah Valley, VA, Eastern Panhandle Region, WV, and Tennessee, as well as other relevant references or studies.

Screening Results

Similar to the Phase I Study, ENVIRON ranked and prioritized the control measures in the master list based on preliminary emission reduction potential for each control measure using the emission inventories described in Section 2 (Tables 2-1 through 2-8) and information/data from past experience of control measures. The summary of the screening results for the top ten control measures prioritized by the highest potential NOx and PM emission reductions in 2009 and 2012 are shown in Tables 3-2 and 3-3, respectively. The low and high values represent the low-end and high-end estimates of assumed ranges of penetration or compliance rates. The summary of the screening results for the top ten control measures prioritized by the overall ranking in 2009 and 2012 are shown in Tables 3-4 and 3-5, respectively.

With these ranking results and discussions with LADCO States, five control measures were selected for further technical and economic analyses and white paper development. These major selected control measures were Fleet Modernization, Anti-Idling Restrictions, Accelerated Chip Reflashing for onroad HDDVs, Aftertreatment Device Retrofits, and Light-Duty Smoking Vehicle Identification and Emissions Reduction.

Table 3-2. Preliminary screening results for the top ten control measures order by potential NOx, PM, and VOC emission reductions in 2009.

NOx 2009 Control Measures by Emissions Reduction				PM 2009 Control Measures by Emissions Reduction				VOC 2009 Control Measures by Emissions Reduction			
Control ID	Control Measures	NOx Emission Reduction (High) [tpd]	NOx Emission Reduction (Low) [tpd]	Control ID	Control Measures	PM Emission Reduction (High) [tpd]	PM Emission Reduction (Low) [tpd]	Control ID	Control Measures	VOC Emission Reduction (High) [tpd]	VOC Emission Reduction (Low) [tpd]
46	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)	160	80	51a	Adopt CARB's Air Toxic Control Measures for cargo handling equipment; portable diesel-fuel engines; transport refrigeration units or TRUs (i.e. requiring 90%+ reduction in PM emissions)	16	8	53	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control; catalysts)	267	134
26	Accelerated replacement of current LD vehicles with LEVs or Tier 2 vehicles	144	29	53	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control; catalysts)	11	6	22	Replace 2-stroke engines with 4-stroke engines in recreation vehicles/marine & L&G equipment	242	121
32	Accelerate the turnover of older HDDVs to cleaner late model HDDVs	106	21	18	Reformulated diesel fuels (e.g. Fischer-Tropa diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	10	5	13	RFG/California RFG	166	83
51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	104	52	51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	10	5	28	Accelerated replacement of current LD vehicles with LEVs or Tier 2 vehicles	140	28
29	Accelerated replacement of current LD and HD vehicles with AFVs	102	20	22	Replace 2-stroke engines with 4-stroke engines in recreation vehicles/marine & L&G equipment	10	5	40	LDV I/M programs (IM-240, RSD, ASM, RG240 etc.) - OBD only	137	85
42	HDDV accelerated reflashing programs	91	30	20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	8	4	14	Lower RVP Gasoline	123	77
20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	82	41	52	Alternative fuel retrofit programs for nonroad diesel equipment	7	1	19	Stage II Vapor Recovery	65	41
31	Repower HDDVs with older, high emitting engines with low emission diesel engines	76	15	46a	Adopt CARB's Air Toxic Control Measures for in-use transit buses and solid waste collection trucks (i.e. requiring 90%+ reduction in PM emissions)	7	4	29	Accelerated replacement of current LD and HD vehicles with AFVs	81	12
47	Retrofit programs for HD diesel vehicles to AFVs (NG, dual-fuel etc.)	76	15	40	LDV I/M programs (IM-240, RSD, ASM, RG240 etc.) - OBD only	7	4	50	Retrofit programs for LDVs to AFVs or bi-fuel vehicles	54	11
18	Reformulated diesel fuels (e.g. Fischer-Tropa diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	66	33	46	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)	5	2	68	Ridesharing (e.g. carpool, vanpool) programs	52	31

Represents control measures which appear more than once.

Table 3-3. Preliminary screening results for the top ten control measures order by potential NOx, PM and VOC emission reductions in 2012.

NOx 2012 Control Measures by Emissions Reduction				PM 2012 Control Measures by Emissions Reduction				VOC 2012 Control Measures by Emissions Reduction			
Control ID	Control Measures	NOx Emission Reduction (High) [tpd]	NOx Emission Reduction (Low) [tpd]	Control ID	Control Measures	PM Emission Reduction (High) [tpd]	PM Emission Reduction (Low) [tpd]	Control ID	Control Measures	VOC Emission Reduction (High) [tpd]	VOC Emission Reduction (Low) [tpd]
46	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)	260	130	51a	Adopt CARB's Air Toxic Control Measures for cargo handling equipment; portable diesel-fuel engines; transport refrigeration units or TRUs (i.e. requiring 90%+ reduction in PM emissions)	27	13	53	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control, catalysts)	487	244
28	Accelerated replacement of current LD vehicles with LEVs or Tier 2 vehicles	241	48	53	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control, catalysts)	21	11	22	Replace 2-stroke engines with 4-stroke engines in recreation vehicles/marine & L&G equipment	438	219
51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	180	90	22	Replace 2-stroke engines with 4-stroke engines in recreation vehicles/marine & L&G equipment	19	10	13	RFG/California RFG	294	147
32	Accelerate the turnover of older HDDVs to cleaner late model HDDVs	173	35	51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	18	9	28	Accelerated replacement of current LD vehicles with LEVs or Tier 2 vehicles	241	48
29	Accelerated replacement of current LD and HD vehicles with AFVs	169	34	16	Reformulated diesel fuels (e.g. Fischer-Trope diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	17	8	40	LDV I/M programs (IM-240, RSD, ASM, RG240 etc.) - OBD only	133	89
42	HDDV accelerated reflashing programs	149	60	20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	13	7	14	Lower RVP Gasoline	122	82
20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	143	71	52	Alternative fuel retrofit programs for nonroad diesel equipment	13	3	29	Accelerated replacement of current LD and HD vehicles with AFVs	108	21
31	Repower HDDVs with older, high emitting engines with low emission diesel engines	124	25	46a	Adopt CARB's Air Toxic Control Measures for in-use transit buses and solid waste collection trucks (i.e. requiring 90%+ reduction in PM emissions)	10	5	50	Retrofit programs for LDVs to AFVs or bi-fuel vehicles	94	19
47	Retrofit programs for HD diesel vehicles to AFVs (NG, dual-fuel etc.)	124	25	40	LDV I/M programs (IM-240, RSD, ASM, RG240 etc.) - OBD only	8	5	54	Alternative fuel retrofit programs for nonroad gasoline equipment	92	18
16	Reformulated diesel fuels (e.g. Fischer-Trope diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	110	55	29	Accelerated replacement of current LD and HD vehicles with AFVs	8	2	43	LEV programs/requirements for public and private fleets	85	17

Represents control measures which appear more than once.

Table 3-4. Preliminary screening results for the top ten control measures order by overall ranking in 2009.

NOx 2009 Control Measures by Overall Ranking			PM 2009 Control Measures by Overall Ranking			VOC 2009 Control Measures by Overall Ranking		
Control ID	Control Measures	NOx Overall Ranking (1-10)	Control ID	Control Measures	PM Overall Ranking (1-10)	Control ID	Control Measures	VOC Overall Ranking (1-10)
20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	10	15	Reformulated diesel fuels (e.g. Fischer-Trope diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	10	14	Lower RVP Gasoline	10
15	Reformulated diesel fuels (e.g. Fischer-Trope diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	10	20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	10	19	Stage II Vapor Recovery	10
25	Accelerate the turnover of older agricultural engines to Tier 2/Tier3/Tier 4 nonroad engines or onroad engines	10	41	HDDV I/M programs (smoke/opacity test; diesel OBD etc.)	10	53	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control; catalysts)	8
68	Ridesharing (e.g. carpool, vanpool) programs	9	25	Accelerate the turnover of older agricultural engines to Tier 2/Tier3/Tier 4 nonroad engines or onroad engines	10	21	Accelerate the turnover of large SI engines to engines meeting Large SI Non-Road Engine Standards	8
46	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)	8	32	Accelerate the turnover of older HDDVs to cleaner late model HDDVs	10	22	Replace 2-stroke engines with 4-stroke engines in recreation vehicles/marine & L&G equipment	8
32	Accelerate the turnover of older HDDVs to cleaner late model HDDVs	8	51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	10	13	RFG/California RFG	8
51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	8	51a	Adopt CARB's Air Toxic Control Measures for cargo handling equipment; portable diesel-fuel engines; transport refrigeration units or TRUs (i.e. requiring 90%+ reduction in PM emissions)	10	54	Alternative fuel retrofit programs for nonroad gasoline equipment	8
42	HDDV accelerated reflashing programs	8	46a	Adopt CARB's Air Toxic Control Measures for in-use transit buses and solid waste collection trucks (i.e. requiring 90%+ reduction in PM emissions)	10	9	Accelerate the turnover of residential gasoline lawn & garden equipment to electric	8
31	Repower HDDVs with older, high emitting engines with low emission diesel engines	8	46	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)	10	18	Gas cap replacement program (give free vouchers to failed vehicles w/ faulty or missing gas caps) Toledo Metro COG has such program (Ohio & Michigan)	8
40	LDV I/M programs (IM-240, RSD, ASM, RG240 etc.) - OBD only	8	31	Repower HDDVs with older, high emitting engines with low emission diesel engines	10	40	LDV I/M programs (IM-240, RSD, ASM, RG240 etc.) - OBD only	7

Represents control measures which appear more than once.

Table 3-5. Preliminary screening results for the top ten control measures order by overall ranking in 2012.

NOx 2012 Control Measures by Overall Ranking			PM 2012 Control Measures by Overall Ranking			VOC 2012 Control Measures by Overall Ranking		
Control ID	Control Measures	NOx Overall Ranking (1-10)	Control ID	Control Measures	PM Overall Ranking (1-10)	Control ID	Control Measures	VOC Overall Ranking (1-10)
20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	10	18	Reformulated diesel fuels (e.g. Fischer-Trope diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	10	14	Lower RVP Gasoline	10
18	Reformulated diesel fuels (e.g. Fischer-Trope diesel; emulsified diesel; CA diesel; Biodiesel w/ additives)	10	20	Accelerated purchase of Tier2/Tier 3/Tier 4 nonroad engines or onroad engines	10	19	Stage II Vapor Recovery	10
53	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control; catalysts)	10	25	Accelerate the turnover of older agricultural engines to Tier 2/Tier3/Tier 4 nonroad engines or onroad engines	10	53	Retrofit programs for nonroad gasoline/SI engine equipment (A/F control; catalysts)	8
25	Accelerate the turnover of older agricultural engines to Tier 2/Tier3/Tier 4 nonroad engines or onroad engines	10	32	Accelerate the turnover of older HDDVs to cleaner late model HDDVs	10	21	Accelerate the turnover of large SI engines to engines meeting Large SI Non-Road Engine Standards	8
13	RFG/California RFG	9	41	HDDV I/M programs (smoke/opacity test; diesel OBD etc.)	10	51a	Adopt CARB's Air Toxic Control Measures for cargo handling equipment; portable diesel-fuel engines; transport refrigeration units or TRUs (i.e. requiring 90%+ reduction in PM emissions)	8
88	Ridesharing (e.g. carpool, vanpool) programs	9	51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	10	22	Replace 2-stroke engines with 4-stroke engines in recreation vehicles/marine & L&G equipment	8
46	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)	8	51a	Adopt CARB's Air Toxic Control Measures for cargo handling equipment; portable diesel-fuel engines; transport refrigeration units or TRUs (i.e. requiring 90%+ reduction in PM emissions)	10	13	RFG/California RFG	8
51	Aftertreatment retrofit programs for nonroad diesel equipment (DPFs, catalysts, EGR etc.)	8	46a	Adopt CARB's Air Toxic Control Measures for in-use transit buses and solid waste collection trucks (i.e. requiring 90%+ reduction in PM emissions)	10	54	Alternative fuel retrofit programs for nonroad gasoline equipment	8
32	Accelerate the turnover of older HDDVs to cleaner late model HDDVs	8	46	Aftertreatment retrofit programs for HD diesel vehicles (DPFs, catalysts, EGRs etc.)	10	9	Accelerate the turnover of residential gasoline lawn & garden equipment to electric	8
42	HDDV accelerated reflashing programs	8	31	Repower HDDVs with older, high emitting engines with low emission diesel engines	10	18	Gas cap replacement program (give free vouchers to failed vehicles w/ faulty or missing gas caps) Toledo Metro COG has such program (Ohio & Michigan)	8

Represents control measures which appear more than once.

4. TECHNICAL AND ECONOMIC ANALYSIS OF SELECTED CONTROL MEASURES

As discussed in Section 3, five major mobile source control measures were selected for further technical and economic analyses based on the screening analysis of more than 70 measures. These selected control measures were as follows:

On-road Heavy Heavy-Duty Diesel Vehicles

- Measure 31: Fleet Modernization
- Measure 33/34/35: Anti-Idling Restrictions
- Measure 42: Accelerate Low NOx Calibration/Reflash Program
- Measure 46a-i: Aftertreatment Device Retrofits
  - Measure 46a: DPF Retrofit
  - Measure 46b: Lean NOx Catalyst + DPF
  - Measure 46c: EGR+DPF Retrofit
  - Measure 46d: SCR Retrofit
  - Measure 46e: DOC Retrofit
  - Measure 46f: Flow-Through Filter (FTF) Retrofit
  - Measure 46g: DOC+SCR Retrofit
  - Measure 46h: SCR+DPF Retrofit
  - Midwest Clean Diesel Initiative

NONROAD Diesel Construction and Agricultural Equipment

- Measure 20: Equipment Fleet Modernization
- Measure 33/34/35: Anti-Idling Restrictions
- Measure 51a-i: Aftertreatment Device Retrofits for Nonroad Equipment
  - Measure 51a: DPF Retrofit
  - Measure 51b: Lean NOx Catalyst + DPF
  - Measure 51c: EGR+DPF Retrofit
  - Measure 51d: SCR Retrofit
  - Measure 51e: DOC Retrofit
  - Measure 51f: Flow-Through Filter (FTF) Retrofit
  - Measure 51g: DOC+SCR Retrofit
  - Measure 51h: SCR+DPF Retrofit
  - Midwest Clean Diesel Initiative

Locomotives

- Measure 33/34/35: Anti-Idling Restrictions

On-road Light-Duty Vehicles

- Measure 38/39/40/41: Smoking Vehicles Identification and Emissions Reduction

Detailed descriptions of these selected control measures are presented in this section. Each measure description includes a technical description of the control measure; estimates of emission reductions, costs, and cost-effectiveness; and issues related to implementation. Tables for each control measure providing details on the affected fleet emissions reductions and costs, and cost-effectiveness, are provided in Appendices corresponding to their measure identifications. It should be noted that these emissions reduction estimates and cost-

effectiveness estimates are made on the basis of assumed annual VMTs for vehicles of different age groups using the default MOBILE6 annual mileage accumulation. These assumptions are discussed below. However, based on discussions with officials for several incentive programs to reduce emissions from heavy-duty diesel trucks, including the Sacramento Emergency Clean Air Transportation (SECAT) program and Texas Emissions Reduction Plan, these VMT estimates may be under-predicting the actual annual VMT. If so, the emissions reduction benefits described here may also be underestimated.

Measure 31/32: On-Road Fleet Modernization via Diesel Engine or Vehicle Replacement

Description - By far the most widely employed method for reducing emissions from diesel engines is the replacement of the engines with new lower-emitting engines or replacement of the entire vehicle or piece of equipment with cleaner diesel engines, including remanufactured or new engines. The expected percentage emission reduction from this approach will depend upon the engine model year to be replaced and the emission standard that the new engine meets.

This measure focuses on the fleet modernization of Class 8 HDDVs as they are identified as the major NOx emission contributors to the on-road NOx emission inventory in the LADCO States.

The EPA has adopted a tighter combined NOx and NMHC emission standard for model years 2004 to 2006 HD engines, and much more stringent NOx and PM emission standards for model year 2007 and later HD engines. These emission standards, along with those for early model year HD engines, are presented in Table M31/32-1. As shown in this table, the combined NOx and NMHC emissions for MY 2004-2006 HD engines are reduced by more than 50%, as compared to MY 1998 HD engines. The emissions from MY 2007 and later HD engines are further reduced by more than 85% for the combined NOx and NMHC emissions and 90% for the particulate matter (PM) emissions, as compared to MY 2004/2006 HD engines.

Table M31/32-1. EPA emission standards for heavy-duty engines for on-road vehicles.

	Pollutant (g/bhp-hr)			
Model Year	Hydrocarbons (HC)	Carbon Monoxide (CO)	Nitrogen Oxides (NOx)	Particulate Matter (PM)
1988-1989*	1.3	15.5	10.7	0.60
1990	1.3	15.5	6.0	0.60
1991	1.3	15.5	5.0	0.25
1992-1994	1.3	15.5	5.0	0.10
1998-2003	1.3	15.5	4.0	0.10 (truck) 0.05 (urban bus)
2004–2006	**2.5 combined NMHC+NOx	15.5	**2.5 combined NMHC+NOx	0.10 (truck) 0.05 (urban bus)
2007+	0.14 NMHC	15.5	0.20	0.01

* The adopted Federal NOx emission limit of 6.0 g/bhp-hr was adopted in 1988, but was postponed until 1990.
** The 2004 standards apply to all GVW classes, and are defined as a combined non-methane hydrocarbon plus nitrogen oxides (NMHC + NOx) emission standard of 2.5 g/bhp-hr.

This control measure consists of replacing the engine or the entire vehicle with a new engine meeting the current emission standard or better, or a remanufactured engine that has lower emissions than the older engine. The actual emission reduction realized will depend upon the actual engine replaced and the emission standard that the new engine meets. Like any scrappage program, the scrapped engine or vehicle should be in good working order and would otherwise be used for many years to come if not replaced under this program. The life of the emission credit generated will be equivalent to the remaining life of the engine or vehicle to be replaced.

Five cases of diesel engine or vehicle replacement were investigated for on-road HDDVs in this measure:

- Replacing pre-1987 engines (10.7 g/bhp-hr) with remanufactured MY 1990 (6 g/bhp-hr) engines or with remanufactured MY2001/2 (4 g/bhp-hr) engines or with new MY2002/4 (2.5 g/bhp-hr) engines;
- Replacing MY 1990 (6 g/bhp-hr) engines with remanufactured MY2001/2 (4 g/bhp-hr) engines or with new MY2002/4 (2.5 g/bhp-hr) engines;
- Replacing 1991 to 1997 (5 g/bhp-hr) engines with remanufactured MY2001/2 (4 g/bhp-hr) engines or with new MY2002/4 (2.5 g/bhp-hr) engines;
- Replacing MY 1998 to 2001 engines with new MY2002/4 (2.5 g/bhp-hr) engines or with new MY 2007 (0.2 g/bhp-hr) engines.
- Replacing MY 2002/4 (2.5 g/bhp-hr) engines with new MY 2007 (0.2 g/bhp-hr) engines.

Emissions - NOx emission factors for on-road HDDVs were calculated based on the emission standards and conversion factors for HDDVs from the EPA's MOBILE6 model[1]. Engine activity was assumed based on default MOBILE6 annual mileage accumulation in which activity is assumed to vary by vehicle age (older trucks are assumed to be less active than newer trucks). Table M31/32-2 lists estimated HDDV8 annual mileage accumulation for the model year ranges used in this study within the nonattainment or maintenance area that the SIP or conformity analysis or emission credit applies to. The analysis also assumed 8 years of project life. Detailed emissions by different model year groups in 2009 and 2012 are provided in Tables M31/32-3 and M31/32-4, respectively.

Table M31/32-2. Annual HDDV Class 8 annual VMT.

	Calendar Year 2009	Calendar Year 2012
MY 1989 & Earlier	11,000	10,000
MY 1990	16,000	12,000
MY 1991 - 1997	26,000	19,000
MY 1998 - 2001	44,000	32,000
MY 2002 - 2006	70,000	51,000
MY 2007+	101,000	88,000
MY 1993 - 1998	30,000	22,000

Cost – For the on-road HDDVs, ENVIRON assumed that the incremental engine or vehicle replacement costs for the remanufactured MY 1990, and MY 2001 and 2002 engines were $35,000 and $40,000, respectively, and $45,000 for the new MY 2002 and 2004 engines. These cost estimates were consistent with the engine replacement costs funded by the California Carl Moyer[2] and Sacramento Emergency Clean Air Transportation (SECAT)[3] Programs, and Texas Emission Reduction Plan[4] or VMEP programs (e.g. in Houston-Galveston and Dallas Fort-Worth areas). Since limited cost data are available, ENVIRON assumed that the incremental engine or vehicle replacement cost for MY 2007 engines was about 33% more than the MY 2004 engines or about $60,000. Capital recover factor for the project life was calculated using an assumed 3% discount rate.

Emission Reductions - The emission reduction would depend on the model year or equipment type or horsepower range of the engine replaced and the emission standard that the remanufactured or new engine meets.

[1] EPA Technical Support Document for MOBILE 6: M6.HDE.002 (http://www.epa.gov/otaq/mobile.htm)
[2] http://www.arb.ca.gov/msprog/moyer/moyer.htm
[3] http://www.4secat.com/
[4] http://www.tceq.state.tx.us/implementation/air/terp/index.html

Tables M31/32-3 and M31/32-4 show the potential emission reductions for on-road HDDVs for replacing vehicles with older, high emitting engines with vehicles with remanufactured or new lower emission engines in 2009 and 2012, respectively. The annual NOx emissions reduction values for on-road HDDVs range from 0.09 to 0.49 tpy per vehicle, the annual PM emissions reductions range from 0.00 to 0.03 tpy per vehicle, and the annual ROG emissions reductions range form 0.00 to 0.16 tpy per vehicle in 2009. For the 2012 scenario year, the annual NOx emissions reductions range from 0.07 to 0.36 tpy per vehicle, PM emissions reductions range from 0.00 to 0.02 tpy per vehicle, and ROG emission reductions range from 0.00 to 0.12 tpy per vehicle.

Cost-Effectiveness - The cost-effectiveness of the fleet modernization measure would depend on the model year and equipment type or horsepower range of the engine replaced.

As shown in Tables M31/32-3 and M31/32-4, the following vehicle replacements would have a cost-effectiveness of more than the Carl Moyer cost effectiveness limit of $14,300 per weighted ton of NOx+ROG+20*PM emissions:

- Replacing MY 1989 & Earlier vehicles with MY 1990 vehicles
- Replacing MY 1991-1997 vehicles with MY 2001/2 or MY 2002/4 vehicles
- Replacing MY 1998-2001/2 vehicles with MY 2002/4 vehicles

All other replacements have a cost-effectiveness of less than $14,300/ton.

Technical Implementation Feasibility and Public Acceptance - The measure is feasible, as it has already been implemented in emission reduction programs in many states in the U.S (e.g. California, Texas etc.) However, guidelines or mechanism, especially on eligible vehicles and project/emission credit life, should be clearly defined to avoid potential issues related to surplus emissions versus normal turnover rates.

Table M31/32-2. Potential NOx, PM and ROG emissions reductions and cost-effectiveness values for fleet modernization program for on-road HDDVs in 2009.

	MY1989 & Earlier					MY 1990				MY 1991 - 1997				MY 1998 - 2001/2			MY 2002/4	
	Diesel Baseline	MY 1990 Engines	MY 2001/2 Engine	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2001/2 Engine	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2001/2 Engine	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2007 Engine
NOx (g/bhp-hr)	10.7	6.0	4.0	2.4	0.2	6.0	4.0	2.4	0.2	5.0	4.0	2.4	0.2	4.0	2.4	0.2	2.4	0.2
PM (g/bhp-hr)	0.6	0.6	0.1	0.1	0.01	0.6	0.1	0.1	0.01	0.2	0.1	0.1	0.01	0.1	0.1	0.01	0.1	0.01
HC (g/bhp-hr)	1.3	1.3	1.3	0.5	0.1	1.3	1.3	0.5	0.1	1.3	1.3	0.5	0.1	1.3	0.5	0.1	0.5	0.1
Annual Mileage	11,000	11,000	11,000	11,000	11,000	16,000	16,000	16,000	16,000	26,000	26,000	26,000	26,000	44,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 35,000	$40,000	$45,000	$60,000		$40,000	$45,000	$60,000		$40,000	$45,000	$60,000		$45,000	$60,000	$45,000	$60,000
Useful Life (years)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Annualized Capital Cost ($/yr)		$4,986	$5,698	$6,411	$8,547		$5,698	$6,411	$8,547		$5,698	$6,411	$8,547		$6,411	$8,547	$6,411	$8,547
Conversion Factor (bhp-hr/mi)	3.11	3.05	2.90	2.90	2.90	3.05	2.90	2.90	2.90	2.95	2.90	2.90	2.90	2.90	2.90	2.90	2.9	2.9
NOx (g/mi)	33.24	18.30	11.58	6.95	0.58	18.30	11.58	6.95	0.58	14.75	11.58	6.95	0.58	11.58	6.95	0.58	6.96	0.58
PM (g/mi)	1.86	1.83	0.29	0.29	0.03	1.83	0.29	0.29	0.03	0.52	0.29	0.29	0.03	0.29	0.29	0.03	0.29	0.03
HC (g/mi)	4.04	3.97	3.76	1.45	0.41	3.97	3.76	1.45	0.41	3.83	3.76	1.45	0.41	3.76	1.45	0.41	1.45	0.41
NOx (tons/year)	0.40	0.22	0.14	0.08	0.01	0.32	0.20	0.12	0.01	0.42	0.33	0.20	0.02	0.56	0.34	0.03	0.54	0.04
PM (tons/year)	0.02	0.02	0.00	0.00	0.000	0.03	0.01	0.01	0.001	0.01	0.01	0.01	0.001	0.01	0.01	0.001	0.02	0.002
HC (tons/year)	0.05	0.05	0.05	0.02	0.00	0.07	0.07	0.03	0.01	0.11	0.11	0.04	0.01	0.18	0.07	0.02	0.11	0.03
NOx Reduction (tons/year)		0.18	0.26	0.32	0.40		0.12	0.20	0.31		0.09	0.22	0.41		0.22	0.31		0.49
PM Reduction (tons/year)		0.00	0.02	0.02	0.02		0.03	0.03	0.03		0.01	0.01	0.01		0.00	0.01		0.02
HC Reduction (tons/year)		0.00	0.00	0.03	0.04		0.00	0.04	0.06		0.00	0.07	0.10		0.11	0.16		0.08
Cost-Effectiveness ($/ton)		$26,154	$8,783	$8,657	$9,530		$8,551	$8,015	$8,320		$25,529	$14,569	$10,557		$17,472	$11,131		$8,572
One-Year Cost-Effectiveness (NOx Only)		$193,146	$152,270	$141,130	$151,489		$337,500	$224,762	$191,986		$440,778	$201,342	$147,782		$200,306	$194,236		$121,881

Table M31/32-2. Potential NOx, PM and ROG emissions reductions and cost-effectiveness values for fleet modernization program for on-road HDDVs in 2012.

	MY1989 & Earlier					MY 1990				MY 1991 - 1997				MY 1998 - 2001/2			MY 2002/4	
	Diesel Baseline	MY 1990 Engines	MY 2001/2 Engine	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2001/2 Engine	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2001/2 Engine	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2002/4 Engine	MY 2007 Engine	Diesel Baseline	MY 2007 Engine
NOx (g/bhp-hr)	10.7	6.0	4.0	2.4	0.2	6.0	4.0	2.4	0.2	5.0	4.0	2.4	0.2	4.0	2.4	0.2	2.4	0.2
PM (g/bhp-hr)	0.6	0.6	0.1	0.1	0.01	0.6	0.1	0.1	0.01	0.2	0.1	0.1	0.01	0.1	0.1	0.01	0.1	0.01
HC (g/bhp-hr)	1.3	1.3	1.3	0.5	0.1	1.3	1.3	0.5	0.1	1.3	1.3	0.5	0.1	1.3	0.5	0.1	0.5	0.1
Annual Mileage	10,000	10,000	10,000	10,000	10,000	12,000	12,000	12,000	12,000	19,000	19,000	19,000	19,000	32,000	32,000	32,000	51,000	51,000
Incremental Capital Cost		$ 35,000	$40,000	$45,000	$52,500		$40,000	$45,000	$52,500		$40,000	$45,000	$52,500		$45,000	$52,500	$45,000	$52,500
Useful Life (years)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Annualized Capital Cost ($/yr)		$4,986	$5,698	$6,411	$7,479		$5,698	$6,411	$7,479		$5,698	$6,411	$7,479		$6,411	$7,479	$6,411	$7,479
Conversion Factor (bhp-hr/mi)	3.11	3.05	2.90	2.90	2.90	3.05	2.90	2.90	2.90	2.95	2.90	2.90	2.90	2.90	2.90	2.90	2.9	2.9
NOx (g/mi)	33.24	18.30	11.58	6.95	0.58	18.30	11.58	6.95	0.58	14.75	11.58	6.95	0.58	11.58	6.95	0.58	6.96	0.58
PM (g/mi)	1.86	1.83	0.29	0.29	0.03	1.83	0.29	0.29	0.03	0.52	0.29	0.29	0.03	0.29	0.29	0.03	0.29	0.03
HC (g/mi)	4.04	3.97	3.76	1.45	0.41	3.97	3.76	1.45	0.41	3.83	3.76	1.45	0.41	3.76	1.45	0.41	1.45	0.41
NOx (tons/year)	0.37	0.20	0.13	0.08	0.01	0.24	0.15	0.09	0.01	0.31	0.24	0.15	0.01	0.41	0.25	0.02	0.39	0.03
PM (tons/year)	0.02	0.02	0.00	0.00	0.000	0.02	0.00	0.00	0.000	0.01	0.01	0.01	0.001	0.01	0.01	0.001	0.02	0.002
HC (tons/year)	0.04	0.04	0.04	0.02	0.00	0.05	0.05	0.02	0.01	0.08	0.08	0.03	0.01	0.13	0.05	0.01	0.08	0.02
NOx Reduction (tons/year)		0.16	0.24	0.29	0.36		0.09	0.15	0.23		0.07	0.16	0.30		0.16	0.22		0.36
PM Reduction (tons/year)		0.00	0.02	0.02	0.02		0.02	0.02	0.02		0.00	0.00	0.01		0.00	0.01		0.01
HC Reduction (tons/year)		0.00	0.00	0.03	0.04		0.00	0.03	0.05		0.00	0.05	0.07		0.08	0.12		0.06
Cost-Effectiveness ($/ton)		$28,769	$9,661	$9,522	$9,173		$11,401	$10,687	$9,707		$34,934	$19,936	$12,641		$24,024	$13,392		$10,295
One-Year Cost-Effectiveness (NOx Only)		$212,460	$167,497	$155,243	$145,808		$450,000	$299,683	$223,984		$603,170	$275,521	$176,949		$275,421	$233,691		$146,377

Measure 20/25: Nonroad Equipment Modernization via Diesel Engines or Equipment Replacement

Description - By far the most widely employed method for reducing emissions from diesel engines is the replacement of the engines with new lower-emitting engines or replacement of the entire vehicle or piece of equipment with cleaner diesel engines, including remanufactured or new engines. The expected percentage emission reduction from this approach will depend upon the engine model year to be replaced and the emission standard that the new engine meets.

This measure focuses on nonroad construction and agricultural equipment as they are identified as major NOx emissions contributors to the NONROAD NOx emission inventories in the LADCO States. The emissions reductions from replacing these engines or vehicles with newer engines or models will also impact PM and ROG emissions.

The EPA adopted the first Tier 1 emission standards for non-road compression-ignition (CI) engines at or above 50 hp (37 kW) in June 1994. Subsequently in October 1998, the EPA adopted Tier 1 emission standards for non-road CI engines below 50 hp, as well as Tier 2 and Tier 3 emission standards for all engine sizes of these non-road CI engines. The Tier 1 standards were phased in from 1996 to 2000. The more stringent Tier 2 standards for all engine sizes were phased in from 2001 to 2006, and yet more stringent Tier 3 standards are to be phased in from 2006 to 2008. In June 2004 the EPA adopted more stringent Tier 4 standards which would further greatly reduce NOx and PM emissions from nonroad diesel vehicles. These reductions would generally require the use of advanced exhaust gas aftertreatment technology, consistent with the phase-in of more stringent sulfur content standards for diesel fuel. The Tier 4 standards are expected to be phased in over the 2008 – 2015 time frame, and thus have only limited applicability to the 2009 and 2012 emissions reduction scenario analyses conducted here for the LADCO region. The NOx+NMHC emission standards for Tier 1 – 3 engines, along with Tier 0 uncontrolled emission levels, are summarized in Table M20/25-1. The new Tier 4 emissions standards are summarized in Tables M20/25-2, and M20/25-3.

Table M20/25-1. HC, NOx and PM emissions standards and uncontrolled levels for nonroad diesel engines in the Tier 1 – 3 categories, and the Tier 0 uncontrolled engines.

Engine Power (hp)	Model Year	Regulation	Emission Standard (g/hp-hr)			
			HC	NOx + NMHC	NOx	PM
25 to < 50	Pre-1998	Tier 0 (uncontrolled)	-	-	7.2	0.6
25 to < 50	1999 – 2003	Tier 1	-	7.1	-	0.6
	2004 +	Tier 2	-	5.6	-	0.45
50 to < 100	Pre-1998	Tier 0 (uncontrolled)	-	-	8.8	0.6
	1998 – 2003	Tier 1	-	-	6.9	-
	2004 – 2007	Tier 2	-	5.6	-	0.22
	2008+	Tier 3	-	3.5	-	-[†]
100 to < 175	Pre-1997	Tier 0 (uncontrolled)	-	-	9.5	0.4
	1997 – 2002	Tier 1	-	-	6.9	-
	2003 – 2006	Tier 2	-	4.9	-	0.22
	2007+	Tier 3	-	3.0	-	-[†]
175 to < 300	Pre-1996	Tier 0 (uncontrolled)	-	-	9.3	0.4

Engine Power (hp)	Model Year	Regulation	Emission Standard (g/hp-hr)			
			HC	NOx + NMHC	NOx	PM
	1996 – 2002	Tier 1	1.0	-	6.9	0.4
	2003 – 2005	Tier 2	-	4.9	-	0.15
	2006+	Tier 3	-	3.0	-	-†
300 to < 600	Pre-1996	Tier 0 (uncontrolled)	-	-	9.5	0.4
	1996 – 2000	Tier 1	1.0	-	6.9	0.4
	2001 – 2005	Tier 2	-	4.8	-	0.15
	2006+	Tier 3	-	3.0	-	-†
600 to < 750	Pre-1996	Tier 0 (uncontrolled)	-	-	9.7	0.4
	1996 – 2001	Tier 1	1.0	-	6.9	0.4
	2002 – 2005	Tier 2	-	4.8	-	0.15
	2006+	Tier 3	-	3.0	-	-†

† Not adopted, engines must meet Tier 2 PM standard

Table M20/25-2. HC, NOx and PM emissions standards and uncontrolled levels for nonroad diesel engines in the Tier 4 category up to 750hp.

Engine Power	Year	CO	NMHC	NMHC+NOx	NOx	PM
kW < 8 (hp < 11)	2008	8.0 (6.0)	-	7.5 (5.6)	-	0.4[a] (0.3)
8 ≤ kW < 19 (11 ≤ hp < 25)	2008	6.6 (4.9)	-	7.5 (5.6)	-	0.4 (0.3)
19 ≤ kW < 37 (25 ≤ hp < 50)	2008	5.5 (4.1)	-	7.5 (5.6)	-	0.3 (0.22)
	2013	5.5 (4.1)	-	4.7 (3.5)	-	0.03 (0.022)
37 ≤ kW < 56 (50 ≤ hp < 75)	2008	5.0 (3.7)	-	4.7 (3.5)	-	0.3[b] (0.22)
	2013	5.0 (3.7)	-	4.7 (3.5)	-	0.03 (0.022)
56 ≤ kW < 130 (75 ≤ hp < 175)	2012-2014[c]	5.0 (3.7)	0.19 (0.14)	-	0.40 (0.30)	0.02 (0.015)
130 ≤ kW < 560 (175 ≤ hp < 750)	2011-2014[d]	3.5 (2.6)	0.19 (0.14)	-	0.40 (0.30)	0.02 (0.015)

a – hand-startable, air-cooled, DI engines may be certified to Tier 2 standards through 2009 and to an optional PM standard of 0.6 g/kWh starting in 2010

b – 0.4 g/kWh (Tier 2) if manufacturer complies with the 0.03 g/kWh standard from 2012

c – PM/CO: full compliance from 2012; NOx/HC: Option 1 (if banked Tier 2 credits used) – 50% engines must comply in 2012-2013; Option 2 (if no Tier 2 credits claimed) – 25% engines must comply in 2012-2014, with full compliance from 2014.12.31

d – PM/CO: full compliance from 2011; NOx/HC: 50% engines must comply in 2011-2013

Table M20/25-3. HC, NOx and PM emissions standards and uncontrolled levels for nonroad diesel engines in the Tier 4 category larger than 750hp.

Year	Category	CO	NMHC	NOx	PM
2011-2014	Generator sets > 900 kW	3.5 (2.6)	0.40 (0.30)	0.67 (0.50)	0.10 (0.07)
	All engines except gensets > 900 kW	3.5 (2.6)	0.40 (0.30)	3.5 (2.6)	0.10 (0.07)
2015	Generator sets	3.5 (2.6)	0.19 (0.14)	0.67 (0.50)	0.03 (0.022)
	All engines except gensets	3.5 (2.6)	0.19 (0.14)	3.5 (2.6)	0.04 (0.03)

This control measure consists of replacing the engine or the entire vehicle with a new engine meeting the current emission standard or better, or a remanufactured engine that has lower emissions than the older engine. The actual emission reduction realized will depend upon the actual engine replaced and the emission standard that the new engine meets. Like any scrappage program, the scrapped engine or vehicle should be in good working order and would otherwise be used for many years to come if not replaced under this program. The life of the emission credit generated will be equivalent to the remaining life of the engine or vehicle to be replaced.

For non-road agricultural and construction equipment modernization program, replacing Tier 0 and Tier 1 baseline engines with Tier 2 engines, replacing Tier 0, Tier 1, and Tier 2 baseline engines with Tier 3 engines, and replacing Tier 2 with Tier 4 engines were investigated for several major non-road construction and agricultural equipment types based on their contribution to the NOx emissions.

Emissions - For non-road equipment, the NOx, PM and ROG emission factors were calculated based on the Tier 0, Tier 1, Tier 2, Tier 3 and Tier 4 non-road emission standards, as well as load factors and activity data extracted from the EPA's NONROAD model[5].

Cost – ENVIRON estimated that Tier 2 engines cost about $100 per horsepower and that Tier 3 and Tier 4 engines cost about $120 per horsepower. Since limited cost data are available, ENVIRON assumed that the incremental engine or equipment replacement cost for Tier 3 and 4 engines was about 20% more than the Tier 2 engines. The overall range of costs for equipment replacement for all vehicle types was about $3,750 to $244,000, depending on the horsepower range.

Emission Reductions - The emission reduction would depend on the technology group (i.e. Tier 0, Tier 1, Tier 2 or Tier 3), equipment type or horsepower range of the engine replaced and the emission standard that the remanufactured or new engine meets. The emission reduction values for equipment modernization via replacing lower emission engines or equipment for construction and agricultural equipment are summarized in Table M20/25-4.

Table M20/25-4. Emission reduction values for engine or equipment replacement.

	Emission Reduction per Equipment (tpy)											
	Tier 0 with Tier 2			Tier 1 with Tier 3			Tier 2 with Tier 3			Tier 2 with Tier 4[A]		
	NOx	PM	ROG	NOx	PM	ROG	NOx	PM	ROG	NOx	PM	ROG
Agr.	0.02 – 0.69	0.00 – 0.04	N/A	0.05 – 0.56	0.00 – 0.01	0.01 – 0.12	0.02 – 0.24	N/A	0.00 – 0.01	0.04 – 0.59	0.00 – 0.01	0.00 – 0.01
Const.	0.04 – 8.95	0.01 – 0.56	N/A	0.10 – 2.00	0.01 – 0.02	0.02 – 0.42	0.06 – 0.84	N/A	0.01 – 0.04	0.14 – 3.41	0.00 – 0.03	0.00 – 0.05

a – Tier 2 replacement with Tier 4 engines applicable only to 2012 scenario analysis

Cost-Effectiveness - The cost-effectiveness of the engine or equipment replacement would depend on the technology group, equipment type or horsepower range of the engine replaced. The range of cost effectiveness values for non-road equipment engine or equipment replacement is summarized in Table M20/25-5.

[5] http://www.epa.gov/otaq/nonrdmdl.htm

Table M20/25-5. Cost effectiveness values for engine or equipment replacement.

	Cost-Effectiveness Values ($/ton)			
	Tier 0 with Tier 2	**Tier 1 with Tier 3**	**Tier 2 with Tier 3**	**Tier 2 with Tier 4[a]**
Agricultural	$3300 - $11100	$3900 - $25000	$20300 - $75000	$5300 - $24700
Construction	$800 - $7700	$1500 - $12500	$6000 - $13000	$2100 - $15400

a – Tier 2 replacement with Tier 4 engines applicable only to 2012 scenario analysis

Technical Implementation Feasibility and Public Acceptance - The measure is feasible, as the emission reductions are based on available certified lower emission engines or equipment with lower emission engines. In addition, such equipment fleet modernization program has already been implemented in many states in the U.S (e.g. California, Texas etc.) However, guidelines or mechanism, especially on eligible equipment or engines, and project/emission credit life, should be clearly defined to avoid potential issues related to surplus emissions versus normal turnover rates.

The following list of tables can be found in Appendix A.

Appendix M20/25

Table M20/25-Con. Potential NOx emission reduction and cost-effectiveness values for equipment modernization for major nonroad construction equipment.

Table M20/25-Ag. Potential NOx emission reduction and cost-effectiveness values for equipment modernization for major nonroad agricultural equipment.

Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs, Nonroad Diesel Equipment, and Locomotives

Description - This measure would reduce idling from onroad heavy-duty diesel vehicles through the use of auxiliary power units (APUs), automatic engine shut-off systems, or truck stop electrification, as described in the EPA's SmartWay website of the EPA Clean Freight Strategies for Idle Reduction;[6] idling from nonroad diesel equipment via idling restriction and/or the use of automatic engine shut-off systems; and idling from locomotives through the use of APUs and automatic shut-off systems. Technology approaches for an automatic shut-off system could be as simple as a timer on the ignition or more complex like the use engine and oil heaters and an engine shut-off software. Truck stop electrification (TSE) or off-board idling reduction technologies could be a simple onboard power connector and an electric outlet kiosk to a full off-board cooling or heating ventilation and power connections.

Idling emissions from HD diesel vehicles are generally from intercity tractor-trailers that are parked in truck stops, rest areas, ports, and to a lesser extent, distribution centers, if idling emissions are not regulated. Even though it is not encouraged or even illegal, extensive truck idling can be found in some truck stops or rest areas, mainly for heating or cooling cab/sleeper compartments, powering cab/sleeper appliances or auxiliary devices, and in some ports for waiting in line to deliver or pick-up goods. Many studies reported that intercity tractor-trailers idle average about 6 hours per day.[7,8] However, most engine manufacturers recommend that engines run for roughly 3 to 5 minutes for engine warm-up and cool down.[9] In general, a typical heavy-duty diesel engine, including those for nonroad diesel equipment, would consume about one gallon of fuel for every hour of idling.[10]

Locomotive engines are often kept idling when standing still and may idle for as long as eight hours while cars are switched or while the train waits on a siding for other trains to pass. Idling may also be needed to keep the engine warm in cold weather, to keep car interiors at a comfortable temperature, to keep car accessories from freezing, and to prevent potential engine restart problems. However, locomotives are often kept idling even when there are no operational reasons to do so. In order to reduce idling time, fuel consumption, and pollutant emissions, an APU can be used to provide power when a locomotive is idling. The CSX Corporation has developed an APU that automatically shuts down the main locomotive engine while maintaining all vital main engine systems, such as climate control and heating engine fluids in cold weather. The EPA has tested an APU system from Kim Hotstart Manufacturing Company combined with an automatic shut-down system from ZTR Control Systems in a pilot study conducted on a locomotive in Chicago, and found both systems to operate acceptably at temperatures as low as 0°F.[11]

Many states and local governments have adopted some kind of anti-idling regulations. A list compiled by the EPA indicated that, as of April 2006, there were approximately fifteen states

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[6] http://www.epa.gov/otaq/smartway/documents/apu.pdf

[7] "Analysis of Technology Options to Reduce the Fuel Consumption of Idling Trucks." Paper ANL/ESD-43-2000, Center of Transportation Research, Argonne National Laboratory, Chicago IL, 2000 http://www.transportation.anl.gov/pdfs/TA/15.pdf

[8] "Heavy-Duty Truck Idling Characteristics: Results from a Nationwide Truck Survey." Institute of Transportation Studies, University of California, Davis CA, 2004. http://www.its.ucdavis.edu/publications/2004/UCD-ITS-RP-04-38.pdf

[9] "Truck Engine Idling – Fact Sheet," U.S. Environmental Protection Agency – New England, Boston MA, April 2002.

[10] http://www.epa.gov/smartway/documents/epaidlingtesting.pdf

[11] EPA (2004), "Case Study: Chicago Locomotive Idle Reduction Project," Report, United States Environmental Protection Agency, Office of Transportation and Air Quality, March 2004, EPA420-R-04-003].

and dozens of local counties that have promulgated laws that restrict the amount of time that an onroad vehicle can idle its main engine.[12] A continually updated list of state and local anti-idling laws is maintained by the American Transportation Research Institute (ATRI).[13] The maximum idling time or idling time limit from these anti-idling laws ranges from 0 to 15 minutes, with 5 minutes as the most common idling restriction time. As shown in the latest ATRI anti-idling laws list, the State of Illinois recently adopted an anti-idling law, which was promulgated in House Bill 4782[14], to restrict operators of heavy-duty trucks with 8,000 lbs GVWR and over to idle not more than a total of 10 minutes within any 60 minute period, with a few circumstantial exceptions.[15]

Locomotive engines are also coming under potential anti-idling laws. In 2006 California's South Coast Air Quality Management District (SCAQMD) adopted regulations limiting idling of locomotives in switch yards to a maximum of 30 minutes, although this regulation is being challenged by rail companies and locomotive manufacturers.[16]

In addition to these anti-idling regulations, the EPA Diesel Retrofit and SmartWay programs are actively educating truckers to minimize, if not eliminate, idling emissions by providing information of alternative technologies for powering climate controls and appliances in cab/sleeper. In addition to the in-use idling restriction regulation for commercial trucks, CARB has also adopted a truck idling reduction regulation that will require new MY2008 trucks to be equipped with idle shutdown timers that will turn off the engine if the vehicle is left to idle for more than 5 minutes.[17]

This measure would focus on heavy HDDVs such as class 8a and 8b trucks, nonroad construction and agricultural equipment, and locomotives as these emission sources are identified as the most significant NOx and PM emissions sources in the LADCO States. Both NOx and PM emissions are expected to be reduced by this measure.

Emissions – EPA estimates that the emissions from idling constitute no more than 3.4% of truck exhaust emissions[18]. For nonroad diesel equipment, the EPA emission testing procedure for off-road engines weighs 15% of the time they are in operation is idling. In general, depending on the operational characteristics, the idling emissions for nonroad diesel engines are about 1 to 2% of the total exhaust emissions. For locomotive engines, the EPA emission testing procedures provides a weighting factor of 38% for linehaul engine idling emissions and 59% for switching engine idling emissions.[19] The EPA estimates that locomotive idling accounts for 3-5% of NOx emissions from line-haul engines and 16-20% of NOx emissions from switching engines. The EPA also estimates that idling accounts for 2-15% of PM emissions from line-haul engines and 9-35% of PM emissions from switching engines[10].

[12] http://www.epa.gov/otaq/smartway/documents/420b06004.pdf
[13] http://atri-online.org/research/idling/Truck_Idling_Regulations.htm
[14] http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=094-0845
[15] The anti-idling law applies to the counties of Cook, DuPage, Lake, Kane, McHenry, Will, Madison, St. Clair, and Monroe and cities of Aux Sable and Goose Lake in Grundy County and city of Oswego in Kendall County.
[16] http://www.aqmd.gov/news1/2006/LocomotiveCourtChallengePR.html]
[17] http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm
[18] "Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity," Office of Transportation and Air Quality, Environmental Protection Agency, EPA420-B-04-001, January 2004. (http://www.epa.gov/smartway/documents/420b04001.pdf)
[19] EPA (2004), "Guidance for Quantifying and Using Long Duration Switch Yard Locomotive Idling Emission Reductions in State Implementation Plans," United States Environmental Protection Agency, Office of Transportation and Air Quality, January 2004, EPA420-B-04-002].

Costs – For heavy-duty diesel trucks, the cost of an automatic shut-off system ranges from $1,325 to $2,500, while the cost of an auxiliary power unit ranges from $6,000 to $9,000.[20] In its Initial Statement of Reasons, CARB estimated that the capital and installation costs of an APU would be about $8,000 to $9,000, with an annual APU maintenance cost of about $460 to $530.[21] CARB also indicated that the use of APU instead of the main engine would provide a fuel saving of about $2,800 to $3,600, and annual main engine maintenance saving of $300 to $315. Accounting for the annualized APU capital and maintenance costs, CARB estimated that there would be an annual net saving of $200 to $430 from the fuel and main engine maintenance savings with the use of an APU instead of the truck main engine.[12]

IdleAire provides one of the truck stop electrification technologies, which provides cooling or heating ventilation and power connections to the truck cab through the passenger side window. Based on a study done by the University of Tennessee, the initial capital cost of a truck stop parking space, for 100 HD diesel trucks, that is equipped with an IdleAire truck stop electrification system in Knox County, Tennessee, was about one million dollars.[22]

Shorepower is an alternative TSE technology manufactured by Shurepower[23]. The Shurepower system consists of a central kiosk containing power regulating equipment and internet-connected power management and customer interface systems. The kiosk then provides power to individual trucks through a series of docking stations. HVAC and other electric appliances must be provided by the individual truck owner/operator. Although similar to off-board TSE technologies, in terms of emissions reduction, the Shurepower's TSE system has a significantly lower initial capital cost. Shurepower estimates that the cost of the system will be $3,500 to $6,000 per parking space.[24] At minimum truck owners/operators can install a $200 simple power connector to interface with the Shurepower kiosk. However, a state-of-the-art power management and HVAC system is estimated to cost the owner/operator $4,000.[19] A demonstration project of the Shurepower system has been implemented in the upstate New York and its performance in terms of power consumption and utilization statistics is being studied.[25]

CSX provides one APU system for locomotives and the capital cost is approximately $30,000 per unit, without including potential fuel-savings benefits. This cost estimate is consistent with the cost estimates for the Kim Hotstart and ZTR APU/automatic shut-off systems reported in the Vancouver Switchyard Locomotive Idle Reduction Project[26] and the Chicago Locomotive Idle Reduction Project[27]. Although these systems are more common in Europe, they have seen only limited use in the U.S. and thus they have a very small market share.

Emissions Reduction – For onroad HDDVs, a reduction of 50 to 100% in idling emissions would result in about 1.7 to 3.4% reduction of the total exhaust emissions. For nonroad diesel equipment, a reduction of 50 to 100% in idling reductions would result in an average of about

[20] http://www.epa.gov/smartway/idlingtechnologies.htm
[21] http://www.arb.ca.gov/regact/idling/idling.htm
[22] "Draft Report: Emission Inventories and Potential Emission Control Strategies for Ozone Earl Action Compact Areas in Tennessee." Department of Civil and Environmental Engineering, University of Tennessee, April 13, 2003.
[23] http://www.shurepower.com/tse.htm
[24] http://www.nyserda.org/publications/Shorepower.pdf
[25] http://www.epa.gov/smartway/documents/dewitt-study.pdf
[26] "Vancouver, WA Switchyard Locomotive Idle Reduction Project." Final Report to U.S Environmental Protection Agency, Southwest Clean Air Agency, Vancouver, WA, October 2005.
[27] "Case Study: Chicago Locomotive Idle Reduction Project." EPA420-R-04-003, U.S. Environmental Protection Agency, March 2004.

0.75 to 1.5% reduction of the total exhaust emissions. For locomotive engines, a reduction of 50 to 100% of the idling emissions would result in a total exhaust emission reduction of 1.5 to 5% in linehaul engines and 8% to 20% in switching engines.

Cost-Effectiveness – The use of APU for onroad HDDVs would result in a net saving. As for the truck stop electrification, the estimated cost effectiveness value for that program was about $1,700 per ton of NOx emission reduced, according to the University of Tennessee Study. The Vancouver, WA and Chicago case studies calculated the cost effectiveness of a combination APU/automatic shut-off system for a locomotive at approximately $1,400 per ton of NOx and PM emissions reduced, assuming a conservative 10-year useful life of the equipment and not including fuel savings costs.

Technical Implementation Feasibility and Public Acceptance – For onroad vehicles, this measure would require retrofits of truck stops or other places where extended vehicle idling occurs with systems to provide HVAC and/or electric power to parked trucks, or the installation of APUs or automatic shut-off systems or on-board electrical HVAC system on trucks. The capital cost of truck stop power systems, APU units or automatic shut-off systems, or on-board electrical HVAC system would most likely to require some of financial/loan or incentive programs to assist truck operators or truck stop operators to cover these initial costs. The loans of these initial costs would be paid off from potential fuel saving for truck operators, or from fees charged to the truck stops for truck stop operators.

For nonroad diesel, this measure is often considered as an operational control, and the measure effectiveness would depend on the operational characteristic of the equipment. However, the use of automatic shut-off systems, instead of solely idling time restriction, would be useful for demonstrating compliance.

For locomotives, anti-idling strategies have been implemented for some engines. This method is primarily for cold temperature idle shut offs which would be very useful during winter months in the LADCO states area when cold temperatures are anticipated. Idle shutoff technology implementations have been funded under the Carl Moyer program in California and the Texas Emission Reduction Plan (TERP) program. Rail companies generally have little capital to invest in new emissions technologies so it is anticipated that financial incentive programs would be needed to cover initial costs. The measure could also gain acceptance through voluntary grants for installation of anti-idling equipment.

Measure 42: Accelerated Low NOx Calibration/Chip Reflashing Program for On-Road Heavy-Duty Diesel Vehicles

Description – The Environmental Protection Agency (EPA), the Department of Justice, and California Air Resources Board (CARB) discovered that seven large diesel engine manufacturers had designed engines with advanced computer controls (software) that maximized fuel economy and created "off-cycle" NOx emissions during certain periods of vehicle operation, such as long-haul or steady-state driving, during the 1990s. As part of the federal Consent Decrees signed in 1998 between them, the EPA and the Department of Justice, seven engine manufacturers are required to partially mitigate their off-cycle NOx emissions via a number of mitigation measures, including development of low NOx software and installation of low NOx software upgrades free of charge upon rebuild or upon request on applicable vehicles that produce off-cycle emissions[28]. Most 1993-1999 model year Class 7 and Class 8 HDDVs with model year 1993-1998 engines manufactured by Caterpillar, Cummins, Detroit Diesel Corporation, Mack/Renault, Volvo and International have an obligation to have low NOx software installed. However, years later, evidence has shown that the installation of the low NOx software has not been done on as many applicable trucks as anticipated. California, in 1993, estimated that only less than 10% of the applicable trucks had been installed with low NOx software over a 4 year period after signing of the Consent Decrees[29]. This finding was consistent with the Low NOx Rebuilt Program Summary reported by the EPA as of January 2006.[30]

Resulting from the finding, CARB, in 2004, adopted the heavy-duty diesel engine software upgrade regulation (chip reflashing) to accelerate the low NOx software upgrade[2]. The program requires that:

- 1993 and 1994 model year Low NOx Calibration Engines (i.e. engines with off-cycle NOx emissions) must have a Low NOx Calibration Kit installed by April 30, 2005;
- 1995 and 1996 model year must have a Low NOx Calibration Kit installed by August 31, 2005;
- 1997 and 1998 model year Low NOx Rebuild Engines other than MHDDE, must have a Low NOx Calibration Kit installed by December 31, 2005; and
- 1997 and 1998 model year MHDDE Low NOx Rebuild Engines must have a Low NOx Calibration Kit installed by December 31, 2006.

The adoption of the regulation led to a lawsuit between the Engine Manufacturer's Association (EMA) and four engine manufacturers (Caterpillar, Cummins, Mack/Renault, and Volvo) and the CARB. The EMA and engine manufacturers sued the CARB on lack of authority to adopt the Low NOx Software Upgrade Regulation and that adopting the regulation breaches the Consent Decree Settlement. The Sacramento County Superior Court, on October 16, 2006, has ruled that the Low NOx Software Upgrade Regulation is invalid, and the CARB is suspending further enforcement of the regulation pending entry of a formal order and judgment[31].

This control measure would be to use existing authorities, adopt a mandatory program, or develop a voluntary accelerated program to have low NOx calibration kits installed.

[28] http://www.epa.gov/compliance/resources/cases/civil/caa/diesel/condec.html
[29] http://www.arb.ca.gov/regact/chip04/chip04.htm
[30] www.epa.gov/compliance/resources/cases/civil/caa/**diesel**/progress.pdf
[31] http://www.saccourt.com/courtrooms/trulings/dept45/d45-10.16.06-05cs00386.doc

Emissions – NOx emission factor for MY 1993-1998 medium and heavy HDDVs with low NOx calibration kit installed was estimated at 6.0 g/bhp-hr (after rebuild NOx level) based on the EPA's MOBILE6 model[32]. For this analysis, ENVIRON assumed that the Low NOx Calibration/Chip Reflashing Program would reduce NOx emissions by about 5% to 40%, with an average of 23% based on a study to assess the low NOx rebuild on in-use service trucks conducted by the University of California, Riverside.[33] As part of an emissions factor development project (CRC E55/59 project), the California ARB presented test data on four trucks tested with and without chip reflashing, showing approximately a 17% NOx reduction but a 7% PM increase. This is consistent with the assumptions made in this analysis based on the University of California, Riverside study, as well as the EPA estimate in the MOBILE6 model of a 40% NOx reduction.

Cost - ENVIRON assumed that the phase-in of the Low NOx Calibration/Chip Reflashing Program would entail no incremental capital cost, as per the Consent Decrees. Most engine manufacturers reported that the increase in fuel consumption is negligible[34], and CARB expected that the average fuel economy penalty, if any, to be below one percent.[7,35] Although the American Trucking Association reported a potential fuel consumption penalty of up to 3%[36], it is not clear what this figure is based on. Consequently, for the purposes of this paper, it will be assumed that there is no significant fuel penalty. A more important concern is the potential downtime cost which would be incurred if truck operators had to make an unscheduled service visit just to reflash their truck engines. CARB estimated the out-of-service time to be two hours and the dollar amount for vehicle time out-of-service at $100 per vehicle.[37]

Emission Reductions – As shown in Table M42-1, potential NOx emission reductions for the Low NOx Calibration Program were estimated to be 0.04 tpy per vehicle for MY 1993-1998 medium-HDDVs, and 0.13 tpy per vehicle for MY 1993-1998 heavy-HDDVs. Note that these potential emission reductions were estimated on a per vehicle basis. Engine activity was assumed based on default MOBILE6 annual mileage accumulation in which activity is assumed to vary by vehicle age (older trucks are assumed to be less active than newer trucks). In this case medium HDDVs were assumed to have an annual VMT of 12,000 miles and heavy HDDVs were assumed to have an annual VMT of 30,000 miles. In both cases the NOx control factor was assumed to be 23%.

A more refined estimate can be made by applying the MOBILE6 model and actual transportation model VMT data. USEPA has recommended the use of this methodology to determine SIP emission reduction credits. It should be noted that this analysis must account for more realistic compliance rates than currently assumed by MOBILE6. For example, MOBILE6.2 modeling by Wisconsin DNR showed 4% higher base year (2002) NOx emissions (based on an actual compliance rate of 10% compared to the assumed compliance rate of 90% in the MOBILE model) and 4% higher future year (2009) NOx emissions (based on an expected compliance rate of 30% compared to the assumed compliance rate of 90%). If a chip reflashing program is able to achieve a 60% compliance rate by 2009 for the 2009 scenario year analysis and by 2012 for

[32] "Development and Use of Heavy Duty Defeat Device Emission Effects for MOBILE5 and MOBILE6," M6.HDE.003 (http://www.epa.gov/otaq/models/mobile6/m6tech.htm)
[33] "Evaluation of the Effectiveness of Low NOx ECM Reprogramming to In Service Heavy-Duty Vehicles," UC Riverside CE-CERT, CRC Poster Session, 1998.
[34] www.epa.gov/compliance/resources/cases/civil/caa/**diesel**/progress.pdf
[35] http://www.arb.ca.gov/msprog/hdsoftware/regdocs/isor.pdf
[36] http://www.arb.ca.gov/board/mt/mt121103.txt
[37] ftp://ftp.arb.ca.gov/carbis/board/books/121103/03-8-4.pdf (page 46).

the 2012 scenario year analysis, then the future year NOx emissions would only be about 2% higher than currently estimated by the MOBILE model.

In addition, to properly estimate the emissions reductions it would be necessary to determine the fraction of the MY 1993-1998 truck VMT that originated from in-state transit versus out-of-state transit. In practice this is difficult to approximate and this type of analysis has not been conducted for the LADCO region. The only study conducted to-date on the issue of in-state versus out-of-state truck VMT was conducted in Texas, however this analysis assumes that all of the MY 1993-1998 heavy-duty truck VMT would occur in-state because out-of-state long-haul trips would tend to use newer model trucks.

Cost-Effectiveness - As shown in Table M42-1, lifetime cost-effectiveness values for medium-HDDVs and heavy-HDDVs are estimated to be $625 and $463 per ton of NOx reduced, respectively.

Technical Implementation Feasibility and Public Acceptance - The measure is feasible given that low NOx calibration kits are available, and the manufacturers are required to install them on trucks upon rebuild or upon request. Furthermore, engine manufacturers have expressed interest in working cooperatively with states to develop and implement voluntary low NOx reflashing programs.

Implementation options include using existing authorities, such as anti-tampering compliance authority, pursuing a mandatory program based on the current draft OTC model rule, or working with the engine manufacturers on a voluntary program. Further analysis is needed to determine whether all the affected states have sufficient existing authority. A mandatory program could ensure higher compliance rates, but may be subject to legal challenges, as was the case in California. A cooperative voluntary program would avoid any problems and delays due to legal challenges, but there is less certainty in achieving the desired compliance rates (and emission reductions).

Table M42-1. Potential NOx emission reductions and cost-effectiveness values for the Low NOx Calibration Program for MY 1993-1998 medium- and heavy-HDDVs.

Cost of Diesel:	2.33
Incremental Fuel Consumption	0%
NOx Reduction	23%
HC to ROG Conversion	1.26639

	Medium-HDDVs MY1993-MY1998		Heavy-HDDVs MY1993-MY1998	
	Off-Cycle Baseline	Reflashed	Off-Cycle Baseline	Reflashed
Annual mileage	12,000	12,000	30,000	30,000
Incremental Capital Cost		100		100
Useful Life (years)	8	8	8	8
Annualized Capital Cost ($/yr)		$14		$14
Diesel mpg	5.35	5.35	5.35	5.35
Fuel Cost/mile	$0.44	$0.44	$0.44	$0.44
Fuel Cost/year	$5,231	$5,231	$5,231	$5,231
Incremental Fuel Cost/year		$0		$0
Emission Std (g/bhp-hr)	7.4	6	7.4	6
Conversion Factor (bhp-hr/mi)	2.15	2.15	2.90	2.90
NOx g/mile	15.80	12.90	21.32	17.40
NOx tons/year	0.21	0.17	0.70	0.58
NOx Reduction tons/year		0.04		0.13
Cost-Effectiveness ($/ton)		$371		$110
CE Including Fuel ($/ton)		$371		$110
One-Year Cost-Effectiveness (NOx Only)		$2,604		$772

Measure 46/51: Retrofit Technologies for Diesel Engines

Description - This control measure includes encouraging fleet owners and operators to retrofit on-road HDDVs and non-road equipment with emission-reduction devices to reduce NOx, PM and VOC diesel exhaust emissions. The primary purpose of these devices is to significantly reduce NOx and PM emissions, but some NOx or PM retrofit devices would also reduce VOC emissions, and some PM retrofit devices would also reduce smoke and odor from diesel exhaust emissions. In addition, this measure evaluates a voluntary retrofit program partially funded by and organized by the US EPA Region 5, called the Midwest Clean Diesel Initiative (MCDI). Information provided by EPA was used to evaluate the MCDI in a methodology similar to that of the other retrofit technologies considered in this measure. Also, a conceptual region-wide Midwest States Retrofit Program based on these retrofit technologies is also presented.

This measure focuses on the retrofit technologies for Class 8 HDDVs and major construction and agricultural equipment types as they are identified as the major NOx emission contributors to the NOx and PM emission inventory in the LADCO States. The potential emission reductions, cost, and cost effectiveness values presented in this retrofit measure will be used to assess and project the potential emission reductions of the Midwest Clean Diesel Initiative and a Midwest States Retrofit Program in the LADCO states in 2009 and 2012.

The technologies available to reduce NOx and PM emissions from mobile sources include retarded engine timing modification, Exhaust Gas Recirculation (EGR), lean NOx catalyst, and Selective Catalytic Reduction (SCR). Diesel PM retrofit devices are similar in appearance to mufflers. Using catalytic processes and/or filter technology reduces PM, VOC and CO emissions. The two devices that have been employed to date include diesel oxidation catalysts (DOCs), and the much more effective, diesel particulate traps and filters (DPFs) or flow through filters (FTFs). The NOx control retrofits will not reduce PM emissions by themselves and may increase PM emissions. Often a NOx control device is accompanied by a particulate control device in a package offered by the vendor. This is especially true for retarded timing and EGR NOx control strategies.

In its Diesel Emission Control Strategies Verification website, CARB lists the verified diesel emission control systems (VDECS) to date that reduce NOx and PM emissions[38]; EPA also provides a list of verified technologies in its retrofit website[39]. Intended to reduce verification burden to technology vendors and expedite the verification process, the EPA and CARB signed a Memorandum of Agreement for the coordination and reciprocity in the diesel retrofit device verification process.

Examples of verified and demonstrated emission reductions effectiveness are shown in Table M46/51-1.

[38] http://www.arb.ca.gov/diesel/verdev/verifiedtechnologies/cvt.htm
[39] http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm

Table M46/51-1. NOx and PM retrofit control technologies.

Emission Control Device	Verification Status	NOx Control Efficiency	PM Control Efficiency
Lean NOx reduction catalyst or LNC+DPF (Example Vendor: Cleaire's Longview)	CARB Verified	25+%	85+%
EGR+DPF (Example Vendor: Johnson Matthey EGRT; STT Emtec System;)	CARB Verified/EPA Certification Process	40+%	85+%
DOC (Example Vendor: a few aftertreatment vendors)	CARB/EPA verified	0	25+%
Flow Through Filter or FTF (Example vendor: a few aftertreatment vendors)	CARB/EPA verified	0	50+%
DPF (Example vendor: a few aftertreatment vendors)	CARB/EPA verified	0	85+%
DOC+SCR (example vendor: Extengine)	CARB Verified for some offroad engines	80+%	25+%
SCR (Example Vendor: Extengine etc.)	CARB/EPA Verification Process.	80+%	0
SCR+DPF (Example Vendor: Extengine etc.)	CARB/EPA Verification Process	80+%	85+%

Emissions – NOx and PM emission factors for on-road HDDVs were calculated based on the emission standards and conversion factors for HDDVs from EPA's MOBILE6 model[40]. Engine activity was assumed based on default Mobile6 annual mileage accumulation in which activity is assumed to vary by vehicle age (older trucks are assumed to be less active than newer trucks). Table M46/51-2 lists estimated HDDV8 annual mileage accumulation for the model year ranges used in this study within the nonattainment or maintenance area that the SIP or conformity analysis or emission credit applies to. The analysis also assumed 8 years of project life. Detailed emissions by different model year groups are provided in Appendix M46/51.

Table M46/51-2. Annual HDDV Class 8 annual VMT.

	Calendar Year 2009	Calendar Year 2012
MY 1989 & Earlier	11,000	10,000
MY 1990	16,000	12,000
MY 1991 - 1997	26,000	19,000
MY 1998 - 2001	44,000	32,000
MY 2002 - 2006	70,000	51,000
MY 2007	101,000	88,000
MY 1993 - 1998	30,000	22,000

For non-road equipment, the PM and NOx emission factors were calculated based on the Tier 0, Tier 1, Tier 2, Tier 3, and Tier 4 non-road emission standards, as well as load factors and activity data extracted from EPA's NONROAD model[41]. The useful life for these retrofit technologies was assumed to be 10 years. Detailed emission rates, load factors, and activity data for major construction and agricultural equipment types are provided in Appendix M46/51.

In the analysis for this measure, the NOx and PM control efficiencies for the LNC+DPF system were assumed to be 25% and 85%, respectively. The NOx control efficiencies for the

[40] EPA Technical Support Document for MOBILE 6: M6.HDE.002 (http://www.epa.gov/otaq/mobile.htm)
[41] http://www.epa.gov/otaq/nonrdmdl.htm

EGR+DPF and SCR systems were assumed to be 40% and 80%, respectively; the PM control efficiency for the EGR+DPF system was assumed to be 85%. The PM control efficiencies for the DOC and FTF systems were assumed to be 40% and 50%, respectively. The control efficiencies are consistent with the emission reduction range provided in the EPA website on verified technologies[42], and discussion in the EPA Draft Guidance for Qualifying and Using Emission Reductions from Mobile Source Retrofit Projects in State Implementation Plans and Transportation and General Conformity (EPA Draft Retrofit Guidance).

Cost – The major costs for these retrofit systems include both capital and operational costs. The average capital costs for installation of these systems are estimated to be $85 per hp for LNC+DPF systems, $95 per hp for EGR+DPF systems, $110 per hp for SCR systems, and $130 per hp for SCR+DPF systems. The cost for a DOC for onroad HDDV applications ranges from $1,500 to $2,500, and about $5 per hp for nonroad diesel engines. The cost for a DPF or FTF for onroad HDDV applications ranges from $8,000 to $10,000, and about $30 to $50 per hp for nonroad diesel engines. These costs were consistent with the incremental capital costs funded by other similar programs (e.g. Sacramento Emergency Clean Air Transportation Program, Texas Emission Reduction Plan, or Houston-Galveston and Dallas Fort-Worth VMEP programs, Clean Diesel Initiatives), as well as those provided by the Manufacturers of Emissions Control Association[43]. Note that the cost estimates for these retrofit systems for on-road heavy HDDVs (e.g. Class 8 trucks) are slightly higher than the cost estimates for those systems used in school buses or medium HDDVs.

Table M46/51-3 provides a summary of the estimated capital costs. For a LNC+DPF, DOC, or DPF system, a 2% increase in the fuel consumption was assumed. For the EGR+DPF system, it was assumed that it would increase fuel consumption by 3%. For any SCR system, it was assumed that the urea consumption was equivalent to about 2% of the fuel consumption. Capital recover factor for the project life was calculated using an assumed 3% discount rate.

Table 46/51-3. Estimated average capital cost for some NOx and PM retrofit control technologies.

Measure	Control Technology	Capital Cost
Measure 46/51a	DPF	$8,000-$10,000 or ~$30-$50/hp
Measure 46/51b	LNC+DPF	~$85/hp
Measure 46/51c	EGR+DPF	~$95/hp
Measure 46/51d	SCR	~$110/hp
Measure 46/51e	DOC	$1,500-$2,500 or $5/hp
Measure 46/51f	FTF	$8,000-$10,000 or ~$30-$50/hp
Measure 46/51g	DOC+SCR	~$120/hp
Measure 46/51h	SCR+DPF	~$130/hp

Emission Reductions - The emission reduction values for different retrofit technologies for on-road HDDVs and major non-road construction and agricultural equipment are presented in Appendix M46/51. Annual emission reduction values associated with each control measure vary depending on the equipment types and horsepower ranges.

[42] http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm
[43] http://www.meca.org/galleries/default-file/MECA%20Diesel%20Retrofit%20White%20Paper%200406%20(revised).pdf

Emissions reductions can be summarized for each of the three vehicle types considered in this analysis: onroad class 8a and 8b diesel engines, nonroad construction equipment, and nonroad agricultural equipment.

Onroad (Class 8a and 8b) HDDVs – For onroad vehicles the NOx reductions range from 0 to 0.45 tons/year per vehicle. The maximum NOx reductions come from the three retrofit technologies that affect NOx emissions – EGR, LNC, and SCR technologies. Of these, the most effective is SCR which can reduce NOx up to 0.45 tons/year per vehicle, and the least effective is the LNC which offers a maximum reduction of 0.14 tons/year per vehicle. A number of control technologies offer no NOx reduction potential including a DOC, FTF, or DPF. PM reductions range from roughly 0.004 tons/year per vehicle to as high as 0.03 tons/year per vehicle. The highest emissions reductions are seen from a DPF retrofit, or any retrofit of a combination of devices including a DPF. It should be noted that only a SCR system would offer no PM reduction. Thus overall the retrofit technology that offers the greatest combined NOx and PM reduction is the SCR+DPF retrofit.

Nonroad Construction Equipment – For nonroad construction vehicles, five categories of equipment were considered: excavators, rubber tire loaders, crawler tractors/dozers, tractors/loaders/backhoes, and off-highway trucks. These categories and the HP ranges for each equipment type were chosen based on the NONROAD emission results indicating that these equipment type/HP range are among the highest contributions to total NOx and PM emissions for the LADCO states. Excavators and crawler tractors/dozers were chosen as the representative equipment for potential emission reduction reporting since their HP ranges and cost-effectiveness values were in the middle of the range for the five equipment types. NOx reductions for these two equipment types ranged from 0 to 2.91 tons/year per equipment for excavators and 0 to 3.83 tons/year per equipment for crawler tractors/dozers. Similar to onroad vehicles, the most effective control technology in terms of NOx reduction is the SCR, and least effective was the LNC. Again the DOC, FTF and DPF control technologies offered no NOx reduction potential. PM emissions reductions ranged from 0.01 to 0.13 tons/year per equipment for excavators and 0.01 to 0.17 tons/year per equipment for crawler tractors/dozers. The control technology which offered the greatest potential PM reductions is the DPF, or any measure that includes a DPF.

Nonroad Agricultural Equipment – For agricultural vehicles only two categories of equipment were considered - agricultural tractors and combines. Again, this was based on the NONROAD emission results identifying these equipment types as the largest emission contributors to total agricultural equipment emissions for the LADCO states. Agricultural tractors span a wide range of horsepower from 25 HP to 600 HP with Tier 0 to Tier 3 engines. In general, the maximum NOx and PM reductions for agricultural tractors are from retrofits applied to high horsepower (300-600 HP) with Tier 0 engines. The minimum NOx and PM reductions for agricultural tractors are from retrofits applied to any horsepower with Tier 3 engines. NOx reductions range from a minimum of 0.02 tons/year per equipment for 50-75 HP Tier 3 agricultural tractors retrofitted with a LNC to 1.06 tons/year per equipment for 300-600 HP Tier 0 agricultural tractors retrofitted with a SCR system. Again, DOC, FTF and DPF retrofits do not have any potential NOx reductions. PM reductions range from a minimum of 0.001 tons/year per equipment for 50-75 HP Tier 3 equipment retrofitted with a DOC, to 0.05 tons/year per equipment for 300-600 HP Tier 0 equipment retrofitted with a DPF. A combined SCR+DPF retrofit would provide the highest combined NOx and PM reductions.

Agricultural combines do not have as wide a range of horsepower categories as agricultural tractors. Only combines in the 100-175 HP and 175-300 HP categories were considered. The NOx reductions range from a minimum of 0.01 tons/year per equipment for 100-175 HP Tier 3 combines retrofitted with a LNC to 0.17 tons/year per equipment for 175-300 HP Tier 0 combines retrofitted with a SCR system. The PM reductions range from a minimum of 0.001 tons/year per equipment for 100-175 HP Tier 3 combines retrofitted with a DOC to 0.01 tons/year per equipment for 175-300 HP Tier 0 combines retrofitted with a DPF. Similar to agricultural tractors, the most effective retrofit at reducing combined NOx and PM emissions from agricultural combines was the SCR+DPF retrofit.

Cost-Effectiveness – The cost-effectiveness calculations for each control measure in this analysis can be summarized for each of the three major equipment types considered: onroad class 8a and 8b diesel engines, and nonroad construction and agricultural equipment. The methodology used in the cost-effectiveness calculations is based on that described in the Carl Moyer Program instituted by the California Air Resources Board[44]. The Carl Moyer program uses a cost-effectiveness calculation to account for reductions in NOx, PM, and ROG emissions:

$$CE = \frac{[ACC]}{[NOx\,\mathrm{Re}d + 20 * PM\,\mathrm{Re}d + ROG\,\mathrm{Re}d]}$$

where *CE* is the cost-effectiveness, *ACC* is the annualized capital cost of the control technology (assumed here as the initial capital cost amortized over the useful life of the control technology at a discount rate of 3%), and *NOxRed, PMRed,* and *ROGRed* are the NOx reductions, PM reductions and ROG reductions, respectively, in tons/year per vehicle. This calculation leads to lower cost-effectiveness values than when using NOx reductions alone. A summary of cost-effective values for onroad HDDVs, and nonroad construction and agricultural equipment are discussed here, and detail cost-effectiveness values are shown in Appendix M46/51.

Onroad (Class 8a and 8b) HDDVs – For onroad vehicles, class 8a and 8b heavy-duty diesel vehicles were considered with model years ranging from 1989 and earlier to model years 2002-2006. Model years were grouped based on any change in the emissions standards. Older model year engines generally have the lowest cost-effectiveness values because they have the greatest reductions in emissions, while model year 2002-2006 engines have the highest cost-effectiveness values because their emissions are already relatively low. Note that although some vehicles were compared to model year 2007+ engines, these engines are expected to meet these lower emissions levels by using some or all of the retrofit technology considered here and thus are not evaluated separately. Using the Carl Moyer cost-effectiveness methodology, it was determined that the most cost-effective control technologies were a DOC and a DPF. However, neither of these two technologies provides NOx emissions reductions. The DOC has a control efficiency of 40% for PM, and the DPF has a control efficiency of 85% for PM. The cost-effectiveness values for a DOC ranged from $920/ton pollutant to $1,431/ton pollutant. The cost-effectiveness values for a DPF ranged from $2069/ton pollutant to $3,534/ton pollutant. To address the combined NOx, PM and VOC emissions, combined control technologies are the most cost-effective. The two most cost-effective combined control technologies are combined EGR and DPF system and SCR with DPF system. The cost-effectiveness values for an EGR+DPF system ranged from $4,415/ton pollutant to $6,281/ton pollutant. The cost-effectiveness values for a SCR+DPF system ranged from $5,060/ton pollutant to $6,505/ton pollutant.

[44] http://www.arb.ca.gov/msprog/moyer/moyer.htm

Nonroad Construction Equipment - For construction vehicles, five categories of equipment were considered: excavators, rubber tire loaders, crawler tractors/dozers, tractors/loaders/backhoes, and off-highway trucks. Excavators and crawler tractors/dozers were chosen as the representative equipment since their HP ranges and cost-effectiveness values were in the middle of the range for these equipment types. For these two equipment types the cost-effectiveness was in the range of $1,208-$9,529/ton pollutant depending on the EPA Tier standard of the engine being retrofitted. In general, the higher Tier engines (Tier 2 and Tier 3) have higher cost-effectiveness values because the pollutant reduction was more modest than that for Tier 0 or Tier 1 engines. In general, the higher HP category engines have higher cost-effectiveness values because the annualized capital cost of the equipment scaled with HP.

Similarly to the onroad analysis, the DOC and DPF retrofits were most cost-effective however they address only some of the pollutants. The most cost-effective combined pollutant technology was a SCR+DPF system which had a control efficiency of 80% for NOx, 85% for PM, and 73% for ROG. For excavators the cost-effectiveness ranged from $1,426/ton pollutant for 100-175 HP Tier 0 engines to $5,400/ton pollutant for 300-600 HP Tier 3 engines. For crawler tractors/dozers the cost-effectiveness ranged from $1,621/ton pollutant for 100-175 HP Tier 0 engines to $6,139/ton pollutant for 600-750 HP Tier 3 engines.

Nonroad Agricultural Equipment – For agricultural vehicles only two categories of equipment were considered, agricultural tractors and combines. Due to differences in activity hours and HP ranges, these equipment had overall higher cost-effectiveness values than construction equipment and a wider range of cost-effectiveness values. Similar to construction vehicles, the higher HP ranges had higher cost-effectiveness values due to the increased annualized capital cost of the control technology, and the higher Tier standard engines had higher cost-effectiveness values due to the smaller pollutant reductions per vehicle.

For agricultural tractors there is a wide range of HP categories considered from 25 to 600 HP and thus a wide range of cost-effectiveness values. The most cost-effective control technology in reducing all pollutants is a combined SCR+DPF, which has a cost-effectiveness of $3,460/ton pollutant for Tier 0 25-50 HP engines, up to $9,635/ton pollutant for Tier 2 300-600 HP engines. Tier 3 agricultural tractor engines have high cost-effectiveness values ranging from $8,563/ton pollutant for 50-75 HP engines to $13,207/ton pollutant for 300-600 HP engines.

For combines, the relatively low yearly activity leads to small reductions in pollutant emissions and thus high cost-effectiveness values. The most cost-effective control technology is a DOC, with cost-effectiveness values ranging from $4,338/ton pollutant for a Tier 0 100-175 HP engines, to $18,105/ton pollutant for a Tier 3 175-300 HP engine. However, as noted above, a DOC does not address NOx emissions so the most cost-effective control technology to reduce combined emissions is a combined SCR+DPF. The SCR+DPF has a cost-effectiveness ranging from $10,495/ton pollutant for Tier 0 100-175 HP engines to $39,744/ton pollutant for Tier 3 175-300 HP engines.

Technical Implementation Feasibility and Public Acceptance – These NOx and PM retrofit strategies are feasible, as they have already been implemented in the Midwest States, California, Texas and elsewhere in the U.S. While most of these retrofit technologies are verified technologies, some of these technologies are unverified or verified for limited and specific onroad or non-road applications. Therefore, until they are verified, guidelines and enforcement

mechanism should be developed to assure the emission reductions are real if one chooses to fund demonstration projects that focus on technology research, development and deployment of these unverified but promising technologies. These demonstration projects would include emission measurement to assess the emission performance and durability of those unverified technologies, as well as to provide applicable data for the CARB and EPA verification processes.

Midwest Clean Diesel Initiative (MCDI)

Description - The Midwest Clean Diesel Initiative (MCDI) is a collaboration of federal, state and local agencies, along with communities, non-profit organizations and private companies working together to reduce emissions from diesel engines in the Midwest[45]. The US EPA administers the program and keeps track of funding and emissions reduction information. The program estimates that there are approximately 3.3 million diesel-powered engines in the Midwest that can be affected through voluntary action[45]. The program's goal is to reduce emissions from one million diesel-powered engines by 2010[45].

The MCDI is investigating operational changes in diesel engines, technological improvements including retrofits of after-treatment devices, and use of cleaner fuels as methods to reduce diesel engine emissions. The focus of the program has been on three key sectors: ports, agriculture-freight and rail. Specifically, the MCDI has already provided funding for various programs that have addressed emissions from construction equipment, locomotives, municipal vehicles, school buses, transit buses, and heavy-duty trucks. A summary of the number of programs, types of programs, funding and total emissions reductions by state is shown in Table M46/51-3.

As shown in Table M46/51-4, the MCDI has funded more than 230 projects involving more than 350,000 diesel engines. Funded retrofit technologies were mostly DOCs and DPFs coupled with ULSD, and other technologies included anti-idling strategies (e.g. heaters, APU etc.) and biodiesel fuel.

Table M46/51-4. Summary information on the MCDI program by state in the six Midwest states[46] (Note: Minnesota is included in the table for completeness).

State	No. of Projects	No. of Engines	Project Type(s)	Overall Lifetime Emissions Reductions (tons)			
				CO	VOC	NOx	$PM_{2.5}$
Illinois	95	171,224	DOC, DPF, Heater, ULSD, B20, Anti-Idling Policy, Other	3,498	665	5,364	310
Indiana	28	2,649	DOC, DPF, Heater, ULSD, APU, Engine Upgrades, Anti-Idling Policy	240	82	144	18
Michigan	8	1,543	DOC, DPF, Heater, B20	100	45	75	9
Minnesota	23	147,853	DOC, Heater, APU, CCR, Engine Upgrades, B2, Anti-Idling Policy	15	5	0	584
Ohio	28	1,622	DOC, DPF, Heater, ULSD, B20, CCR	269	53	2	19
Wisconsin	8	27,359	DOC, Heater	93	35	0	15
Total	**236**	**352,893**		**4,215**	**885**	**5,585**	**955**

[45] http://www.epa.gov/midwestcleandiesel
[46] MCDI funded project data were provided by Dr. Jennifer Dunn of EPA Region 5, October 30, 2006.

Emissions - Retrofit technologies were given control efficiencies based on EPA's verified technologies for the analysis of emissions reductions for the MCDI[39]. Anti-idling policies assumed a fraction of the vehicle activity would be affected by the policy, and this fraction was used to determine the emissions impact. For alternative fuels, the EPA's verified technologies list was used to determine specific emissions reductions. The emissions factors for onroad vehicles came from the MOBILE6 model using standard onroad diesel fuel and average conditions during the summer, and the nonroad vehicle emissions factors came from the NONROAD2004 model. For transit and school buses, the program assumed an average project life of 12 years, and for municipal and freight trucks the program assumed an average project life of 20 years. For nonroad vehicles the MCDI analysis assumes the following project life:

Project life = average vehicle life - current age

where average vehicle life = expected engine life/(annual hours of operation x load factor)

This analysis will yield different project lifetimes for different nonroad vehicle types.

Cost - For the MCDI program, the costs were determined using compiled funding information provided by EPA. This funding summarizes the total costs, including both federal sources and leveraged sources for each project by state. Federal sources include the EPA's Clean School Bus, National Clean Diesel, RGI/Grt Cities, Sensitive Population, and SmartWay programs, as well as grants from OTAQ, and the US DOT's CMAQ program. Other sources of funding include state, and local governments, federal and state SEP, and private sources. A summary of the funding broken down by state and fiscal year of funding is shown in Table M46/51-5 for all projects through fiscal year 2006.

Table M46/51-5. Funding information on the MCDI program by state in the six Midwest states for FY 2002-2006.

Fiscal Year	Illinois	Indiana	Michigan	Minnesota	Ohio	Wisconsin
2002	$150,000	-	-	-		-
2003	$6,861,984	$150,000	$123,500	$65,000	$684,475	-
2004	$524,900	$250,000	$95,357	-	$40,000	$1,338,000
2005	$6,300,679	$591,800	$82,600	$270,000	$540,000	$139,750
2006	$2,677,833	$2,280,146	$6,583,714	-	$1,193,689	$1,429,625
Total:	$16,515,396	$3,271,946	$6,885,171	$335,000	$2,458,164	$2,907,375
Annual Average	$3,303,079	$817,987	$1,721,293	$167,500	$614,541	$969,125

As shown in Table M46/51-5, the majority of funding has been directed towards Illinois, with a large fraction of that funding going to projects in the Chicago metropolitan area. Annual average funding levels for each state were calculated for annual emission reduction projections.

Emissions Reductions -For the MCDI program, emissions reductions were calculated by multiplying the retrofit technology control factors and the emissions factors for the various onroad and nonroad diesel vehicles addressed by the program. The project emissions reductions are calculated for the years-to-date that the individual project has been active, from inception date to termination date or to present date if the project is ongoing. The EPA has provided estimates of the number of vehicles affected by each project, and this is used to determine an

emissions reduction per vehicle. The overall emissions reductions are summarized in Table M46/51-6 and detailed reductions by project type are presented in the Appendix. As shown in Table M46/51-6, the greatest gaseous emission reductions were largely due to anti-idling policies or technologies, such as the use of heaters and APUs. PM emissions reductions were due to anti-idling policies, as well as retrofit technologies such as DOCs and DPFs.

Cost-Effectiveness -Detailed cost-effectiveness calculations are presented in Table M46/51-5. The cost-effectiveness is presented by technology type on an individual pollutant basis, as well as the Carl Moyer methodology. The calculation for cost-effectiveness is conducted both on an overall program funding and emissions reduction basis, and on a yearly average funding and emissions reduction basis. For one-year cost-effectiveness, the projects are assumed to have a lifetime of 5 years, consistent with the approach used in the Carl Moyer methodology for retrofit technology useful lifetimes[47]. The project cost-effectiveness of CO reduction ranges from $4,721/ton to $69,426/ton; the project cost-effectiveness of VOC reduction ranges from $24,830/ton to $151,859/ton; the project cost-effectiveness of NOx reduction ranges from $3,079/ton to $1,524,600/ton; the project cost-effectiveness of PM reduction ranges from $53,349/ton to $764,498/ton. Using the Carl Moyer methodology the project cost-effectiveness ranges from $1,360/ton to $23,358/ton. Except Michigan, the average cost-effectiveness value for overall MCDI funded projects for each state was below the Carl Moyer cost effectiveness limit of $14,300 per weighted ton of NOx+ROG+20*PM emissions. It should be noted that the figures for Illinois are the most complete because a large number of projects are funded in that state through the MCDI.

Table M46/51-6. Summary information on the overall emission reductions and cost-effectiveness estimates of the MCDI program by state in the six Midwest states.

Pollutant	Illinois	Indiana	Michigan	Minnesota	Ohio	Wisconsin
Estimated Emission Reductions (tons/year)[1]						
CO	700	48	20	3	54	19
VOC	133	16	9	1	11	7
NOx	1,073	29	15	0	0	0
PM	62	4	2	NA[2]	4	3
Project Cost-Effectiveness Values ($/ton)						
CO	4,721	13,655	69,426	22,086	9,124	31,363
VOC	24,830	40,065	151,859	62,570	46,055	83,917
NOx	3,079	22,726	92,028	NA	1,524,600	NA
PM	53,349	183,832	764,498	NA	126,082	198,665
Carl Moyer	1,360	5,723	23,358	NA	5,607	8,998

Note:
[1]Note that these emissions reductions are tons/year, not the overall emissions reductions for the project with an assumed lifetime of 5 years
[2]PM emission reduction from the biodiesel B2 project was not included here.

Technical Implementation Feasibility and Public Acceptance - Various projects under the MCDI program have already been funded and implemented in the LADCO states from as early as 2003. Because such a broad range of technology types are included in the program, it is difficult to generalize the overall feasibility of the program. Anti-idling policies and technologies have been implemented and have shown substantial emissions reductions. Other retrofit technologies would be subject to similar recommendations as described in the Technical Implementation Feasibility and Public Acceptance for Retrofits Technologies. Because funding

[47] "The Carl Moyer Program Guidelines: Part IV Appendices," California Air Resources Board, 2005.

sources are leveraged from a number of sources it is expected that there would be sufficient resources to track the implementation and results of these projects.

Midwest States Retrofit Program

Description - In addressing emissions from in-use diesel engines, federal, state, and county-level air pollution regulatory agencies, have embarked on a number of initiatives in recent years to reduce emissions from in-use on-road HDDVs and non-road diesel equipment in addition to the emission reductions gained through EPA regulations. Many emission control programs for on-road HDDVs and non-road equipment have been or are being implemented at the federal, state, and local levels in the U.S. for the past few years to reduce in-use emissions from these sources. While some are regulatory or voluntary programs, most of the emission control programs are monetary incentive programs. The major emission control programs that are applicable to on-road HDDV fleets and/or non-road equipment are as follows:

- Federal Programs
  - U.S. Department of Transportation's (U.S. DOT)'s SAFETEA-LU, which replaced the Transportation Equity Act for the 21st Century (TEA-21)
    - Congestion Mitigation and Air Quality Improvement Program (CMAQ)
  - U.S. Department of Energy's (U.S. DOE) Energy Policy Act of 2005 (EPAct)
    - State & Alternative Fuel Provider Program
    - Federal Fleet Program
    - Private & Local Government Fleet Program
    - Alternative Fuel Petition Program
    - Clean Cities Program
  - U.S. EPA's Office of Air & Radiation Programs
    - National Clean Diesel Campaign (NCDC)
      - Voluntary Diesel Retrofit Program
      - Clean School Bus USA
      - Clean Construction USA
      - Clean Agriculture USA
      - West Coast Diesel Emissions Reduction Collaboration
      - Midwest Clean Diesel Initiative
      - Northeast Diesel Collaboration

- California Programs
  - California Air Resources Board (CARB)
    - Diesel Risk Reduction Plan
    - Carl Moyer Program
  - California Department of Transportation's (Caltrans) Greening the Fleet Program
  - South Coast Air Quality Management District's (SCAQMD) MSRC Funding Program (AB 2766)
  - Sacramento Emergency Clean Air & Transportation (SECAT) Program (AB 2511)
  - San Joaquin Valley Emergency Clean Air Attainment Program (AB 2511)
  - Gateway Cities Clean Air Program
  - Port of Los Angeles and Port of Oakland Clean Air Programs
  - Bay Area Air Quality Management District's (BAAQMD) Transportation Fund for Clean Air (TFCA) Program
- Programs in Other States

- Texas Commission on Environmental Quality's (TCEQ) Texas Emissions Reduction Plan or TERP (SB 5)
- Houston-Galveston Area Council (H-GAC)'s Clean Cities/Clean Vehicles Program
- New York State Department of Environment Conservation's Clean Water/Clean Air Bond Act Program
- Puget Sound Clean Air Agency's Diesel Solutions Program

This measure would involve the development and implementation of a region-wide Midwest States Retrofit Program to reduce emissions from in-use diesel vehicles and equipment via retrofitting emission reduction devices such as those retrofit technologies discussed in the white paper. It would be an incentive-based voluntary program that would be similar to programs such as the Carl Moyer and SECAT programs in California, and the TERP program in Texas.

The Midwest States Retrofit Program would be established to reduce emissions from diesel engines from the onroad and nonroad sources in the nonattainment and near nonattainment areas (and Early Action Compact areas) of the LADCO states through voluntary incentive programs. The Midwest States Retrofit Program would fund through general transportation fund or revenues generated from fuel taxes, or transportation fees or surcharges. The Midwest States Retrofit Program would provide monetary grants to eligible projects in nonattainment areas and affected counties. The grants would offset the incremental costs associated with retrofitting high emitting diesel engines with emission reduction devices.

Once the funding sources and allocations have been established based on program emission reduction goals or objectives, LADCO would work with stakeholders to develop project eligibility, selection criteria, and monitoring and reporting based on well-established and successful programs, such as the Carl Moyer, SECAT and TERP programs. These requirements would be incorporated in the program guideline, request for applications, and contract documents.

Prior to releasing request for applications, LADCO would organize workshops and outreach activities to inform and solicit comments from interest parties and stakeholders on the Midwest States Retrofit Program. Request for applications would then be published to solicit emission reduction retrofit applications. Applications would then be reviewed by pre-determined application review committee(s). The committee(s) would approve or reject, and prioritize applications based on the established evaluation criteria.

Emissions and Emission Reductions – Emission and emission reduction estimates would be calculated based on the guidelines developed for the Midwest States Retrofit Program. The guidelines would ensure that the emission and emission reduction estimates would be SIP creditable.

Cost and Cost-Effectiveness – Costs for retrofit technologies would depend on the technology and application types as presented in Table 46/51-2. The cost effectiveness of an application would depend on the cost and potential emission reductions. Once an overall project cost-effectiveness limit is set (e.g. the Carl Moyer's cost-effectiveness limit of $14,300 per weighted ton of ROG+NOx+PM emissions), the overall project cost effective value would be equal or less than that limit.

Technical Implementation Feasibility and Public Acceptance – A Midwest States Retrofit Program is feasible as similar programs have already been implemented in the Midwest States, California, Texas and elsewhere in the U.S. However, it would require substantial effort to establish the funding mechanism and sources, as well as to develop, implement and monitor such a program. Once established, voluntary incentive retrofits program generally is one of the most cost effective measures to reduce in-use emissions from vehicles and equipment, as demonstrated in California and Texas, and elsewhere in the U.S. While it is not exactly a retrofit technology, fleet modernization strategy via repowering high-emitting engines with lower emitting engines, or replacing older vehicle/equipment with newer, cleaner vehicle/equipment should be considered one of the retrofit options.

The following list of tables can be found in Appendix A.

Appendix M46/51

Table M46/51-OR. Potential NOx emission reduction and cost-effectiveness values for the use of retrofit technologies for on-road HDDVs.

Table M46/51-Con. Potential NOx emission reduction and cost-effectiveness values for the use of retrofit technologies for non-road construction equipment.

Table M46/51-Ag. Potential NOx emission reduction and cost-effectiveness values for the use of retrofit technologies for non-road agricultural equipment.

Table 46/51-MCDI-1. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Illinois.

Table 46/51-MCDI-2. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Indiana.

Table 46/51-MCDI-3. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Michigan.

Table 46/51-MCDI-4. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Minnesota.

Table 46/51-MCDI-5. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Ohio.

Table 46/51-MCDI-6. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Wisconsin.

Measure 38/39/40/41: Particulate Matter Emission Reduction Programs for High Emitting Vehicles

Description – This control measure involves reducing organic carbon emissions from smoking vehicles, focusing mostly on light-duty gasoline vehicles (LDGVs). High-emitting vehicles of the type that fail an inspection test are usually high-emitters of gaseous emissions (e.g. CO, NOx, HCs) and are often non-visible emitters. However, it is believed that visibly smoking vehicles will represent a large percentage of the high PM-emitting vehicles, and thus this measure focuses on visibly smoking vehicles. Smoking vehicles mainly result from a vehicle malfunction or from poorly-maintained vehicles. Well-maintained vehicles should not emit smoke. There are three categories of smoke emitted from LDGVs that have been identified: white smoke, black smoke and blue smoke.[48] Black smoke is believed to be related to incomplete fuel combustion and can be attributed to a number of factors including clogged air filters, fuel injection or emission system malfunction, ignition timing malfunction or a blocked manifold. Blue smoke is usually identified as engine oil being burned, and is most often due to oil leakage into the combustion chamber from worn piston rings and valves. White smoke is usually water vapor or coolant, and can be due only to a cold engine startup, in which case repair is not necessary. However other causes could be coolant leakage into the combustion chamber and subsequent emissions of coolant as an aerosol. The types of smoke from LDGVs and their likely causes are summarized in Table 38/39/40/41-1.

Table 38/39/40/41-1: Possible causes of smoking vehicles by smoke colors.

Smoke Color	Causes	Possible Reasons
Black or grey	Unburned hydrocarbons being emitted due to incomplete fuel combustion	Clogged air filter Fuel injection/timing malfunction Failed emission control system Blocked manifold
Blue	Combustion of engine/lubrication oil	Oil leakage into combustion chamber from worn piston rings or valve seals
White	Water vapor or coolant	Cold engine startup (water vapor): does not require repair Coolant leakage onto engine block

Smoking Vehicles - Studies have shown that visibly smoking vehicles can emit substantially higher PM emissions than non-smoking vehicles. However, some high PM-emitting vehicles do not visibly emit smoke. A recent study by the California Air Resources Board (CARB) indicated that for light-duty vehicles, smoking vehicles emit PM emissions as high as 0.27 g/mi, compared to 0.03 g/mi for well-maintained vehicles.[49] The CARB study also showed that particulate matter from high PM-emitting vehicles tended to be highly weighted towards ultra-fine particles. A detailed study conducted in the South Coast Air Quality Management District (SCAQMD) in California by the University of California, Riverside in 1999 indicated that smoking light-duty vehicles make up only 1.11%-1.75% of the total vehicle fleet yet account for a disproportionate amount of PM emissions in the district.[50] That study (CRC E24-2) also showed that PM emissions from LDGVs, especially older model high emitting or smoking vehicles, consisted of

[48] http://www.nctcog.org/trans/air/smoking/causes.asp

[49] "Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, Report to the Legislature." California Air Resources Board and Department of Consumer Affairs/Bureau of Automotive Repair, April 2004.

[50] "Population Density, Particulate Emission Characterization, and Impact on the Particulate Inventory of Smoking Vehicles in the South Coast Air Quality Management District," Durbin, T.D. et al., Center for Environmental Research and Technology, College of Engineering, University of California, Riverside, Journal of Air & Waste Management Association 49:28-38, 1999.

more than 65% organic carbon.[51] Other studies, such as an EPA study conducted in the Phoenix Arizona metropolitan area, have indicated that in fact LDGVs represent the major source of organic carbon PM emissions (higher than diesel engine sources) [52]. A recent study has been undertaken in the LADCO region on urban organic carbon emissions and also found that mobile sources were major sources of $PM_{2.5}$ organic carbon[53].

PM emissions from these high-emitting vehicles have not been addressed by modeling by either CARB or EPA. For light duty gasoline vehicles, EPA's MOBILE6.2 model incorporates high emitter adjustments to account for possible bias in emission and deterioration factors derived from federal test procedure data for hydrocarbons, carbon monoxide, and nitrogen oxides based on Dayton, Ohio inspection and maintenance test data. However, no such high emitter adjustments are incorporated into MOBILE6.2 for PM emissions for light duty or heavy duty vehicles.[54] A consortium led by the EPA has initiated a program to evaluate exhaust emissions from light-duty, gasoline powered vehicles in the Kansas City Metropolitan Area, including assessment of PM emissions from high emitting or smoking vehicles.[55,56] One of the objectives of the Kansas City Light Duty Vehicles Study is to develop an emissions database to improve mobile source inventories, including PM emissions from high emitting or smoking vehicles. Preliminary results from that study indicated that high emitting LDGVs contributed a disproportionate share (75%) of the total PM emissions[57].

Remote Sensing Devices - Remote sensing of visibly smoking vehicles is possible and has been investigated in a number of locations. The Regional Air Quality Council (RAQC) in the State of Colorado has explored the possibility of using remote sensing to detect high-emitting vehicles in the Denver metropolitan area.[58] The remote sensing technology is optically-based and focuses on measuring gaseous emissions, including HC, CO and NOx emissions. Infrared (IR) and ultraviolet (UV) light is directed across the road and passively reflected back to detectors that monitor light intensity at characteristic wavelengths. The amount of IR or UV light absorbed is translated into the exhaust concentration of the regulated pollutant of interest, CO, CO_2, HC, and NOx. However, the RSD was incapable of measuring PM emissions.
Opacity measurement capability in RSDs has been studied and implemented in a research program conducted by the University of Denver.[59] The research indicated that opacity measurement using a laser-based system would be possible and should be able to measure vehicle opacity and therefore identify smoking vehicles as part of the RAQC remote sensing program. However, the University of Denver researcher cautioned that opacity measurements do not necessarily correlate to high-PM-emitting vehicles as it measures only particle size

[51] "Measurement of Primary Particulate Matter Emissions from Light-Duty Motor Vehicles" CRC Project E-24-2, Final Report to Coordinating Research Council and South Coast Air Quality Management District, Center for Environmental Research and Technology, College of Engineering, University of California, Riverside, December 1998.
[52] "Source Apportionment of Phoenix PM2.5 Aerosol with the Unmix Receptor Model," Lewis, C.W. etal., National Exposure Research Laboratory, U.S. EPA, J. of Air & Waste Manage. Assoc., 53: 325-338, 2003.
[53] Midwest Urban Organics Study: Lessons Learned," Brown, S.G., et al., University of Wisconsin, Madison and Sonoma Technology Inc., prepared for LADCO, STI-903520-2945, 2006.
[54] "Analysis of Emissions Deterioration Using Ohio and Wisconsin IM240 Data" United States Environmental Protection Agency, Air and Radiation, EPA420-R-02-003, 2002.
[55] http://www.epa.gov/ttn/chief/conference/ei13/mobile/baldauf_pres.pdf
[56] http://www.epa.gov/ttn/chief/conference/ei13/mobile/baldauf.pdf
[57] "Characterizing Exhaust Emission of Regulated Pollutants from the Kansas City Light-Duty Vehicle Emission Study (E-69)." 16th CRC On-Road Vehicle Emissions Workshop, San Diego CA, March 30, 2006.
[58] "An Analysis of Strategies to Identify, Repair and Retire Smoking and High-Emitting Vehicles in the Denver Metropolitan Region" Denver Regional Air Quality Council, 2002.
[59] (2002) "Opacity Enhancement of the On-Road Remote Sensor for HC, CO and NO," Final Report for E-56-2, Coordinating Research Council (CRC), Stedman, D.H., et al, University of Denver.

distribution and not particle mass distribution or particle number distribution. However it should be noted that a high value for the smoke number using the RSD will most likely translate to a high PM-emitting vehicle even if not all of the parameters of the PM are measured[60].

More recently a study by ESP Corp. for the Virginia Department of Environmental Quality has shown that a new shorter wavelength UV RSD developed by ESP has the potential to detect high PM-emitting vehicles[61]. The new RSD operates at a wavelength of 250 nm, and so is able to detect smaller particles and is not sensitive to fuel flow rate due to the ability of the RSD to detect other hydrocarbons. This new RSD in development is calibrated only for black smoke from gasoline vehicles, and additional calibration is necessary to detect blue and white smoke from smoking vehicles. However the study shows that at this stage the RSD is able to identify smoking vehicles which will likely be high PM-emitting vehicles, even though a direct measurement of PM emissions is not possible now.

In the RAQC study, it was claimed that the remote sensing device would have a 100% effectiveness in identifying gaseous high-emitting vehicles and was limited only in the extent of coverage of the remote sensing devices. It was suggested that some PM high-emitters would also be identified through this remote sensing program. Based on a research study at the University of Denver, the RAQC determined that 60% of PM high-emitters would be captured by remote sensing of visibly smoking vehicles, but that 40% would be undetected because they are non-visible PM high-emitters.[10,11] However, it should be noted that there is no strong demonstrated correlation between high gaseous emissions and high PM emissions. A study conducted by NREL and the EPA indicated that only HC emissions have a moderate correlation with PM emissions but this cannot be generalized for all vehicles and all operating conditions[62]. Remote-sensing has also been evaluated by the California ARB in the Fresno area in a study conducted in 2005[63]. The study was able to identify high gaseous emitters, by remote sensing of CO, HC and to some extent NOx. Of the 48 vehicles identified in this study, follow-up investigation of the repairs indicated that the program was able to reduce CO and HC emissions by 94% and 65% respectively. NOx emissions were reduced by 54%. A combined cost-effectiveness of the remote-sensing program for all pollutant reduction was given as $1850/ton, however the program did not measure PM emissions. It is likely that some of the high gaseous emitters caught in this program would also be high PM-emitters, but that was not verified.

Smoking Vehicles Hotlines Programs - Different states have adopted mitigation measures to address visibly smoking vehicles. These are primarily "hotlines", 800 numbers that residents can use to call the local air quality regulatory agency to report a smoking vehicle. This is then followed by the regulatory agency contacting the vehicle owner/operator and requesting that repairs be made or issuing a fine for operation of a smoking vehicle. Many Air Quality Management Districts in California have reporting programs for visibly smoking vehicles[64], as

[60] Stedman, D., Personal Communication, January 2007.
[61] "Virginia Remote Sensing Device Study, Addendum – Vehicle Opacity," ESP Corp., prepared for Virginia Dept. of Environmental Quality, February 2003.
[62] "Analysis of Second Analysis of Second-by by-Second Emissions and Air Second Emissions and Air Toxics Data from Gasoline Vehicles Toxics Data from Gasoline Vehicles," Lawson, D.R., et al., National Renewable Energy Research Laboratory, CRC Mobile Source Air Toxics Workshop, 2004.
in DOE in DOE's Gasoline/Diesel PM Split Study s Gasoline/Diesel PM Split Study
[63] http://raqc.org/presentations/1302/Lawson073106.pdf

[64] http://www.arb.ca.gov/enf/complaints/smoke.htm

well as the Denver metropolitan area in Colorado.[65] The CARB indicated that, of those vehicle owners identified in visibly smoking vehicle hotline programs, over 40% of vehicle owners who were sent advisory letters sent information back to the agency indicating that they had attended to their vehicles and made repairs if necessary.[66] However, it should be noted that a reply from a vehicle owner identified as operating a smoking vehicle does not necessarily mean that the repairs have been conducted.

The Denver RAQC reported an operating cost of $14,000 annually for its Smoking Vehicle Hotline Program (not inclusive of public outreach costs), which receives an average of 6,000 complaints annually.[12] In the Denver RAQC report, four successful public outreach programs were cited with costs ranging from $5,000 to $80,000 per campaign depending on the method and scope of the outreach program. However, it was estimated that among vehicle owners contacted, only 5% of the calls resulted in voluntary repairs being made to smoking vehicles.

Smoking Vehicles Policy Enforcement - Another mitigation measure is through citations given by local and state police, which has been implemented in the SCAQMD in California, the Denver Metropolitan Area and the Salt Lake City metropolitan area in Utah.[12,13,67] However, it has been reported in California that police enforcement of smoking-vehicle policies is not sufficient to ensure that these high emitters are removed from service and/or repaired because the police are able to target only a small fraction of smoking vehicles (less than 1%) and the vehicle operator can choose to simply pay a fine and not conduct the necessary maintenance or repair[12].

In the Denver metropolitan area field inspectors can issue a court summons to the owner/operator of a smoking vehicle which would result in a court appearance. Subsequently the owner/operator is required to prove that necessary repairs have been made to the smoking vehicle.

Inspection/Maintenance Program with Visual Smoke Procedure – Conventional I/M programs would not be properly equipped to detect smoking vehicles and have not demonstrated any reductions in PM emissions from high-emitting vehicles[68]. California is currently considering implementing a visual smoke observation as part of the regular vehicle inspection and registration requirements in the state for light-duty gasoline vehicles.[69] The program would be similar to the visual smoke test currently in place in Nevada's I/M program for LDGVs[70]. Any visible smoke observed exiting from the vehicle's tailpipe during an inspection will cause the vehicle to fail the inspection. According to CARB[13], Nevada's smoke test has identified a substantial number of vehicle failures. For example, during the 2003 calendar year, emission inspectors in Washoe County performed 188,600 tests on 1976 to 1995 model year vehicles, and 920 or 0.5 percent of these vehicles were identified as having excessive smoke. The Nevada's Clark County program netted similar test results in 2003 with a 0.89 percent failure rate after testing 373,725 vehicles.

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[65] "An Analysis of Strategies to Identify, Repair and Retire Smoking and High-Emitting Vehicles in the Denver Metropolitan Region" Denver Regional Air Quality Council, 2002.
[66] "Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, Report to the Legislature." California Air Resources Board and Department of Consumer Affairs/Bureau of Automotive Repair, April 2004.
[67] "Smoking Vehicle Enforcement Program to Expand County-Wide," News Release, Salt Lake Valley Health Department, State of Utah, 2002.
[68] "Evaluating Vehicle Emissions Inspection and Maintenance Programs," National Research Council, Committee on Vehicle Emission Inspection and Maintenance Programs, 2001.
[69] "AB1870 – (Lieber) Cleaning Up Smoking Vehicles," Lieber, S., Office of Assemblywoman Sally Lieber. 2006.
[70] http://www.dmvnv.com/pdfforms/1Gbook.pdf

An additional mitigation measure might be based on the smoke opacity tests for heavy heavy-duty diesel trucks such as those conducted in California.[71] In these tests the truck is inspected for smoke emissions using an opacity meter that measures light extinction across the tailpipe of the truck and a pass/fail test criterion is based upon a maximum allowable smoke opacity value. In the case of California's HHDV smoke inspection program, all model year HHDVs 1991 and earlier must not exceed a 55% smoke opacity, and all model year HHDVs 1991 and later must not exceed a 40% smoke opacity[71]. Such a program may be applicable in the LADCO region, but it requires significant capital investment in the form of opacity meters as well as changes in the existing regulatory code for vehicles.

Vehicle Scrappage Programs - Vehicle scrappage programs, also called vehicle retirement programs, have been implemented in California and elsewhere in the U.S. The accelerated vehicle replacement program would target fleet light-duty vehicles 10 years old or older, and the scrappage program would target all light-duty vehicles 25 years old or older, including high emitting or smoking vehicles. The actual emission reduction realized would depend upon the model year of the replaced/scrapped vehicle, and the replacement vehicle. Like any replacement or scrappage program, the replaced or scrapped vehicle should be in good working order and would otherwise be used for many years to come if not replaced under these programs. The life of the emission credit generated will be equivalent to the remaining life of the engine or vehicle to be replaced. These programs should follow the EPA guidance document on accelerated vehicle retirement or scrappage for LDVs.[72]

In California, various Air Quality Management Districts have implemented voluntary accelerated vehicle retirement (VAVR) programs under the direction of the Carl Moyer Program. These programs provide financial assistance for vehicle owners/operators who voluntarily choose to retire aged vehicles. Between 2000 and 2003, these districts scrapped over 21,000 vehicles or over 5,000 vehicles per year. In the San Francisco Bay Area Air Quality Management District (BAAQMD) for example, the voluntary vehicle retirement program offers $650 to owner/operators of light-duty vehicles older than model year 1985 to be retired and scrapped under the direction of the BAAQMD[73]. The California Bureau of Automotive Repair separately runs a state-wide voluntary vehicle scrappage program that provides up to $1,000 to owner/operators towards accelerated retirement of a vehicle.[74]

In 2006 the ARB began a review process to modify the VAVR programs in California to potentially include RSD as a methodology for identifying vehicles for retirement or scrappage[75]. The ARB analysis confirms that RSD programs would not have a 100% accuracy rate in determining whether a vehicle was a gaseous or PM high-emitter, but could instead be used as a screening device to determine if a vehicle should then be brought to an authorized smog check facility for more detailed testing. Under this modified VAVR program, the SCAQMD is

[71] "Facts about California's Heavy-Duty Vehicle Inspection Program," HD Vehicle Information Series 1, California Air Resources Board, http://www.arb.ca.gov/msprog/hdvip/pamphl1.pdf,
[72] "Guidance for the Implementation of Accelerated Retirement of Vehicles Programs," EPA 420-R-93-018, Environmental Protection Agency, Ann Arbor, MI, February 1993.
[73] "Vehicle Buy Back Program Information," Bay Area Air Quality Management District (BAAQMD), http://www.baaqmd.gov/pln/grants_and_incentives/vehicle_buyback/index.htm, 2006.
[74] "Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program, Report to the Legislature." California Air Resources Board and Department of Consumer Affairs/Bureau of Automotive Repair, April 2004.
[75] "Proposed Amendments to the Air Resources Board's Regulations for Voluntary Accelerated Light-Duty Vehicle Retirement," Staff Report, California Air Resources Board, Oct. 20, 2006.

planning to use RSD, along with smog checks and the district's own Smoking Vehicles Database to better identify high-emitting vehicles operating in the district. Currently the SCAQMD has budgeted approximately $900,000 for this work and expects to identify approximately 1,000,000 unique vehicle records through the use of RSD combined with other vehicle databases[75].

The effectiveness of vehicle scrappage programs has not been clearly demonstrated. Some research efforts have indicated that vehicle scrappage programs tend to target "marginal" emitters, but do not substantially reduce the numbers of high-emitting vehicles on the road[76], because these vehicles are not easily identifiable and thus cannot be targeted by a scrappage program.

Emissions – As discussed above, MOBILE6 estimates emissions for high emitters for VOC, CO, and NOx, but not for PM emissions. At the time that MOBILE6 was developed, there was not sufficient test data to develop high emitter rates for PM emissions. However, PM emissions from smoking vehicles were reported in a few studies, such as the CARB/SwRI's LDGV PM data; CRC Project E-24-1 in Denver, CO; CRC Project E-24-2 in Los Angeles, CA; and the recent Kansas City Light Duty Vehicle Study. The CARB/SwRI reported that PM emissions from smoking vehicles were as high as 0.23 g/mile, as compared to about 0.03 g/mile for well-maintained vehicles. The CRC studies reported that smoking vehicles emitted even higher PM emissions ranging from 0.33 to 0.39 g/miles. While the data are still being analyzed, preliminary results from the Kansas City LDV Study showed that PM emissions from high emitters were as high as 0.30 g/mile, and that these vehicles contributed to more than 75% of the total PM emissions in the test fleet.

Cost – As described above, the Denver metropolitan area has instituted a smoking vehicle hotline program that has collected some cost information. The program was estimated to have program start up costs between $5,000 - $80,000 for several outreach programs, and approximately $14,000 per year in operational cost. However, it should be noted that this program does not include any financial assistance programs for low-income residents in the Denver metropolitan area for repairing smoking vehicles. The ARB in California has a financial assistance program as part of the smoking vehicle program that provides low-income households that have been cited for a smoking vehicle with up to $500 towards repairs that would lead to the vehicle passing the smog check in California[77]. This program also offers up to $1,000 for a vehicle owner to voluntarily retire an older smoking vehicle.

The Denver metropolitan area is currently considering the implementation of a remote sensing program for high-emitting vehicles. This program will only be able to identify visibly smoking vehicles, which is expected to capture roughly 60% of high-PM-emitting vehicles. This program is expected to incur an initial cost of $50,000and operational costs of up to $150,000 per year. It may be possible to offset these costs by an increase in vehicle inspection fees.

Emission Reductions – Based on the available PM data, PM emissions from smoking vehicles could be reduced by more than 90% if they are to be repaired, if possible, to become well-maintained vehicles, or to be replaced with well-maintained vehicles (i.e. reducing PM emissions from a range of 0.23-0.39 g/mile to 0.03 g/mile.) Table 38/39/40/41-2 shows the potential

[76] "The Costs of "M" in I/M – Reflections on Inspection/Maintenance Programs," Lawton, D.R., J. Air & Waste Manage. Assoc., 45:465-476, 1995.
[77] "Smog-Check Program Fact Sheet – Consumer Assistance Program," California Department of Consumer Affairs, Bureau of Automotive Repair, 2006.

emission benefits of repairing or replacing a smoking vehicle. Assuming an annual VMT of 10,000 miles, the potential PM emission reduction to replace or maintain a smoking vehicle was estimated to be about 0.003 tons/year per vehicle. The useful life was assumed to be 3 years for the scrappage program as per the EPA LDV Vehicle Replacement Guidance[78].

Cost-Effectiveness – As shown in Table 38/39/40/41-2, repairing and replacing a smoking vehicle with an assumed repair cost or incentive rebate of $1,000 would yield a Carl Moyer cost-effectiveness value of about $6,000 per tons of PM emissions reduced.

Technical Implementation Feasibility and Public Acceptance – This Organic Carbon Emission Reduction Programs on Smoking Vehicles Measure is feasible but the effectiveness of the measure would depend on the mean to identify and mitigate these vehicles. Based on the experiences in California and Colorado, an effective smoking vehicle emission reduction program would include effective smoking vehicle identification and mitigation programs. An effective smoking vehicle identification program would include a combination of public and regulatory participations, such as smoking vehicle outreach and hotline programs, and law enforcement program (traffic police and/or dedicated field/roadside inspectors); visual smoke inspection in I/M programs; and when technology is available, supplement the I/M programs with roadside remote sensing device to capture smoking vehicles. Mitigation measures would include repair or fine or lost of registration policy, and providing incentive to retire smoking vehicles via voluntary accelerated vehicle retirement (VAVR) programs.

Table 38/39/40/41-2: Potential emission benefits and cost effectiveness of smoking vehicle emission reduction measure.

	LDVs	
	Smoking	Well-Maintained
Annual mileage	10,000	10,000
Incremental Capital Cost		$1,000
Useful Life (years)	3	3
Annualized Capital Cost ($/yr)		$354
PM Emissions (g/mile)	0.31	0.03
PM (tons/year)	0.0034	0.0003
PM Reduction (tons/year)		0.003
Carl Moyer Cost-Effectiveness ($/ton)		$5,830

[78] "Guidance for the Implementation of Accelerated Retirement of Vehicles Programs," EPA 420-R-93-018, Environmental Protection Agency, Ann Arbor, MI, February 1993.

5. EMISSION REDUCTION SCENARIOS

Introduction

There are a variety of possible emission reduction measures that can be implemented in the LADCO states to reduce NOx and PM emissions from mobile sources. These measures will also address VOC emissions although onroad and nonroad diesel engines are not a major source of VOC emissions. Per LADCO request, several emission reduction scenarios were developed to estimate potential emission reductions and associated costs using the results from the detailed cost benefit analyses of the selected control measures. These scenarios are evaluated for calendar years 2009 and 2012.

This section presents a few of many potential emission reduction scenarios for reducing NOx, PM and VOC emissions from on-road diesel vehicles and nonroad diesel equipment, focusing on the on-road HDDVs, and diesel construction and agricultural equipment as they are the primary sources of NOx and PM emissions in the mobile source emission inventories in the LADCO states. However, the Smoking Vehicles measure focuses on reducing PM emissions from high-emitting smoking light-duty gasoline vehicles, and the Anti-Idling measure also includes the estimation of the potential emission reductions from locomotives. The measures included in these scenarios have a range of costs, potential NO_x and PM emission reductions, and cost effectiveness. Some of the measures (technologies) discussed are as yet unverified technologies by the Environmental Protection Agency (EPA) or the California Air Resources Board (CARB) but have been implemented and funded in some emission reduction programs, such as the TERP and SECAT programs.

The general approach for developing these emission reduction scenarios was as follows[1]:

- Identify major emission contributors based on emission inventories;
- Generate/estimate vehicle or equipment population data;
- Identify and select control measures for target sources;
- Estimate potential emission reductions and associated cost estimates on a per vehicle or equipment basis, and cost-effectiveness values for selected measures;
- Develop criteria for penetration or compliance rates based on cost effectiveness values and vehicle or equipment availability (turnover rates); and
- Estimate potential total emission reductions and measure costs for selected measures and combinations of selected measures[2].

The emission reduction scenario analysis provides a general idea of whether there are available or excess emissions, and potential emission reductions from target sources, as well as available measures to cost effectively reduce these available or excess emissions and associated costs to achieve the potential emission reductions.

[1] A summary of emission inventory and vehicle population estimates, and emission control measure and emission reduction scenario analysis is provided in Appendix C.

[2] A more refined estimate can be made by applying the MOBILE6 model and actual transportation model VMT data. USEPA has recommended the use of this methodology to determine SIP emission reduction credits.

Emission Reduction Scenario for On-road Heavy-Duty Diesel Vehicles

Tables 5-1 and 5-2 show example emission reduction scenarios for on-road diesel vehicles in the LADCO states in 2009 and 2012. These emission reduction scenarios focus on Class 8 HDDVs (the largest truck class), as they contribute to approximately 38% of NOx and 28% of PM emissions in the 2009 on-road emission inventories in every LADCO state, and approximately 38% of NOx and 22% of PM emissions in the 2012 on-road LADCO emissions inventories. Based on projected 2009 VMT and average annual VMT, it was estimated that there will be nearly 400,000 Class 8 HDDVs operating in the LADCO states in 2009. Based on projected 2012 VMT and average annual VMT, it was estimated that there will be more than 415,000 Class 8 HDDVs operating in the LADCO states in 2012.

This emissions reduction scenario includes the following control measures: voluntary after-treatment device retrofits, fleet modernization, reductions associated with the Midwest Clean Diesel Initiative, anti-idling restrictions, and a mandatory chip reflashing program.

For the after-treatment device retrofits and fleet modernization scenarios, ENVIRON assumed penetration rates based on cost-effectiveness values using the following criteria (with measures implemented in 2007):

Cost-Effectiveness (CE) Value ($/ton of NOx reduced)	Penetration Rate (%)	
	2009	2012
CE < 4,000	5	10
4,000 < CE < 7,000	4	8
7,000 < CE < 10,000	3	6
10,000 < CE < 14,300	2	4
14,300 and over	0	0

The penetration rates were assumed to be doubled for the 2012 scenario to reflect the fact that those measures would have been implemented for twice as long (e.g. 3 years for 2007 to 2009, and 6 years for 2007 to 2012).

For the Low NOx Calibration/Reflashing measure, ENVIRON assumed that it would be implemented in 2007, with cumulative compliance rates of 60% and 80% in 2009 and 2012 for applicable model year (1993 to 1998) medium HDDVs and heavy HDDVs, respectively. The implementation options would include using existing authorities, such as anti-tampering compliance authority, pursuing a mandatory program based on the current draft OTC model rule, or working with the engine manufacturers on a voluntary program. These compliance rates account for HDDVs that have been reflashed or do not have calibration that produces excess off-cycle emissions. It is assumed that by 2012 all of these vehicles have either complied with the reflashing measure or are no longer operating. For the Anti-idling measure, ENVIRON assumed that 15% and 30% of the Class 8 HDDV would participate in the program in 2009 and 2012, respectively.

As shown in Table 5-1, the 2009 emission reduction scenario for heavy HDDVs could achieve approximately 54 tons per day (tpd) of NOx emissions reduction, 3.8 tpd of PM emissions reduction, and approximately 23 tpd of ROG emissions reduction for selected incentive/voluntary measures (including fleet modernization and aftertreatment device retrofits)

for a cost of about $2.2 billion with an average cost-effectiveness value of $7,100 per combined ton of NOx, 20xPM, and ROG emissions reduced. The total number of vehicles involved under this scenario for voluntary/incentive programs is about 113,000, which is about 34% of the total available fleet in 2009. Note that the grand total of vehicles recommended, shown at the bottom of Table 5-1, includes vehicles to which Measure 42 (Low NOx Calibration/Reflash) and Measure 46 apply thus these vehicles may be double-counted. Assuming that these control measures would begin in 2007, the 34% vehicle penetration rate would translate to about 11% turnover rate per year in a three-year time frame, which is a viable penetration rate to achieve.

Assuming the Low NOx Calibration/Reflashing measure would effectively provide cumulative compliance rates of 60% and 80% in 2009 for applicable model year (1993 to 1998) medium HDDVs and heavy HDDVs, the measure would reduce about 27 tpd of NOx emissions for a cost of about $11 million in 2009 from the applicable HDDVs. The cost-effectiveness value for the Low NOx Calibration/Reflashing measure was estimated to be about $370 per ton of NOx emissions reduced for heavy duty trucks.

Assuming that 15% of the Class 8 trucks participated in the measure in 2009, the Anti-Idling measure would provide about 4 tpd of NOx emission reduction, 0.06 tpd of PM emission reduction, and 0.18 tpd of ROG emission reduction for a cost of about $444 million. The cost-effectiveness value for this measure was estimated to be about $1,700 per ton of NOx, 20xPM and ROG emissions reduced.

Assuming that the MCDI would continue to receive a similar level of funding of $23 million per year on average (as reported to-date by USEPA), the MCDI would provide about additional 9, 2 and 1 tpd of NOx , PM and ROG emission reductions, respectively, in 2009 for a cost about $97 million, as determined by USEPA through MOBILE6 and NONROAD modeling.

The total potential emission reductions from this 2009 onroad emission reduction scenario are about 94 tpd for NOx emissions, 5.4 tpd for PM emissions, and 24.6 tpd for ROG emissions for a total cost of about $2.8 billion.

As for the 2012 emission reduction scenario for onroad HDDV vehicles, Table 5-2 shows that the emission reductions achievable could be approximately 54 tpd for NOx emissions, 4.2 tpd of PM emissions, and 24.6 tpd for ROG emissions from these incentive/voluntary measures for a cost of about $3.0 billion. The average cost-effectiveness value is estimated to be about $7,100 per combined ton of NOx, 20xPM, and ROG emissions reduced. The total number of vehicles involved under this scenario for voluntary/incentive programs is about 286,000, which is about 68% of the total available fleet in 2012. Assuming that these control measures would begin in 2007, the 68% vehicle penetration rate would translate to about 11% turnover rate per year in a six-year time frame, which is a viable penetration rate to achieve.

The compliance rates and cost-effectiveness in 2012 for the Low NOx Calibration/Reflashing measure are the same as those in 2009. The number of vehicles available for reflashing is less in 2012 due to vehicle retirement/scrappage. For 2012 the potential emissions reductions are 23 tpd of NOx for a cost of approximately $9.6 million.

For the 2012 emission reduction scenario, the HDDVs participated in the Anti-Idling measure are assumed to be doubled to reflect the fact that the measure would have been implemented for six years starting in 2007. The potential emission reductions are estimated to be about 6 tpd of

NOx emission reduction, 0.08 tpd of PM emission reduction, and 0.33 tpd of ROG emission reduction.

Again, assuming that MCDI would receive similar level of annual funding, the MCDI measure would provide about 18 tpd of NOx emission reduction, 3 tpd each of PM and ROG emission reductions for a cost of about $190 million.

The total potential emission reductions for the 2012 emission reduction scenario for the onroad HDDVs are about 102 tpd for NOx emissions, 7.4 tpd for PM emissions, and 27.5 tpd for ROG emissions for a total cost of about $4.1 billion.

Table 5-1. An example emission reduction scenario to reduce NOx, PM and VOC emissions from on-road diesel vehicles in the LADCO states in 2009.

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	60,761	-	$0	0.00	0.00	0.00
Sub Total							-	-	**0.00**	**0.00**	**0.00**
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	60,761	1,823	$72,912,642	1.31	0.10	0.02
MY 1990	$8,551	0.12	0.03	0.00	$40,000	8,641	259	$10,368,746	0.08	0.02	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	79,541	-	$0	0.00	0.00	0.00
Sub Total							**2,082**	**83,281,388**	**1.40**	**0.11**	**0.02**
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	60,761	1,823	$82,026,722	1.59	0.10	0.16
MY 1990	$8,015	0.20	0.03	0.04	$45,000	8,641	259	$11,664,839	0.14	0.02	0.03
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	79,541	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.22	0.00	0.11	$45,000	65,258	-	$0	0.00	0.00	0.00
Sub Total							**2,082**	**93,691,561**	**1.73**	**0.11**	**0.19**
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	65,258	1,958	117,465,107	2.86	0.07	0.87
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	110,395	3,312	198,710,622	4.46	0.18	0.73
Sub Total							**5,270**	**316,175,729**	**7.32**	**0.25**	**1.60**
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
Measure 46a: DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	60,761	3,038	$27,342,241	0.00	0.16	0.33
MY 1990	$2,069	0.00	0.03	0.06	$9,000	8,641	432	$3,888,280	0.00	0.03	0.07
MY 1991 – 1997	$3,534	0.00	0.01	0.09	$9,000	79,541	3,977	$35,793,479	0.00	0.14	0.96
MY 1998 – 2001	$3,026	0.00	0.01	0.15	$9,000	65,258	3,263	$29,366,277	0.00	0.11	1.31
MY 2002 – 2006	$2,601	0.00	0.02	0.09	$9,000	110,395	5,520	$49,677,656	0.00	0.29	1.35
Sub Total							**16,230**	**$146,067,931**	**0.00**	**0.72**	**4.01**
Measure 46b: Cleaire LNC + DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	60,761	2,430	$48,608,428	0.67	0.13	0.24
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	8,641	346	$6,912,497	0.08	0.03	0.05
MY 1991 – 1997	$6,645	0.11	0.01	0.08	$ 20,000	79,541	3,182	$63,632,851	0.92	0.11	0.70
MY 1998 – 2001	$5,816	0.14	0.01	0.13	$ 20,000	65,258	2,610	$52,206,714	1.00	0.09	0.95
MY 2002 – 2006	$5,487	0.13	0.02	0.08	$ 20,000	110,395	4,416	$88,315,832	1.62	0.23	0.99
Sub Total							**12,984**	**259,676,323**	**4.29**	**0.58**	**2.92**

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Measure 46c: EGR + DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	60,761	2,430	$55,899,692	1.07	0.13	0.24
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	8,641	346	$7,949,372	0.12	0.03	0.05
MY 1991 – 1997	$6,281	0.17	0.01	0.08	$ 23,000	79,541	3,182	$73,177,779	1.47	0.11	0.70
MY 1998 – 2001	$5,192	0.22	0.01	0.13	$ 23,000	65,258	2,610	$60,037,721	1.61	0.09	0.95
MY 2002 – 2006	$4,710	0.21	0.02	0.08	$ 23,000	110,395	4,416	$101,563,207	2.59	0.23	0.99
Sub Total							**12,984**	**298,627,771**	**6.87**	**0.58**	**2.92**
Measure 46d: SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	60,761	1,215	$32,203,084	1.07	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	8,641	-	$0	0.00	0.00	0.00
MY 1991 – 1997	$11,810	0.34	0.00	0.00	$ 26,500	79,541	1,591	$42,156,764	1.47	0.00	0.00
MY 1998 – 2001	$9,224	0.45	0.00	0.00	$ 26,500	65,258	1,958	$51,880,422	2.41	0.00	0.00
MY 2002 – 2006	$10,173	0.43	0.00	0.00	$ 26,500	110,395	2,208	$58,509,239	2.59	0.00	0.00
Sub Total							**6,972**	**184,749,508**	**7.55**	**0.00**	**0.00**
Measure 46e: DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	60,761	3,038	$6,076,053	0.00	0.08	0.24
MY 1990	$920	0.00	0.01	0.04	$2,000	8,641	432	$864,062	0.00	0.02	0.05
MY 1991 – 1997	$1,431	0.00	0.01	0.06	$2,000	79,541	3,977	$7,954,106	0.00	0.06	0.69
MY 1998 – 2001	$1,156	0.00	0.01	0.11	$2,000	65,258	3,263	$6,525,839	0.00	0.05	0.95
MY 2002 – 2006	$1,093	0.00	0.01	0.06	$2,000	110,395	5,520	$11,039,479	0.00	0.14	0.98
Sub Total							**16,230**	**32,459,540**	**0.00**	**0.34**	**2.90**
Measure 46f: FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	60,761	2,430	$21,873,793	0.00	0.08	0.26
MY 1990	$3,257	0.00	0.02	0.06	$9,000	8,641	432	$3,888,280	0.00	0.02	0.07
MY 1991 – 1997	$4,945	0.00	0.01	0.09	$9,000	79,541	3,182	$28,634,783	0.00	0.06	0.77
MY 1998 – 2001	$3,941	0.00	0.01	0.15	$9,000	65,258	3,263	$29,366,277	0.00	0.06	1.31
MY 2002 – 2006	$3,809	0.00	0.01	0.09	$9,000	110,395	5,520	$49,677,656	0.00	0.17	1.35
Sub Total							**14,827**	**133,440,788**	**0.00**	**0.39**	**3.75**
Measure 46g: DOC + SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	60,761	1,823	$50,127,441	1.61	0.03	0.14
MY 1990	$8,611	0.26	0.01	0.04	$27,500	8,641	259	$7,128,513	0.18	0.01	0.03
MY 1991 – 1997	$8,404	0.34	0.00	0.06	$27,500	79,541	2,386	$65,621,378	2.21	0.02	0.41
MY 1998 – 2001	$6,571	0.45	0.004	0.10	$27,500	65,258	2,610	$71,784,232	3.21	0.03	0.75
MY 2002 – 2006	$7,245	0.43	0.006	0.06	$27,500	110,395	3,312	$91,075,702	3.89	0.05	0.58
Sub Total							**10,390**	**285,737,266**	**11.11**	**0.13**	**1.92**
Measure 46h: SCR + DPF Retrofit											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	60,761	2,430	$72,912,642	2.15	0.13	0.24
MY 1990	$5,060	0.26	0.03	0.05	$30,000	8,641	346	$10,368,746	0.24	0.03	0.05
MY 1991 – 1997	$6,505	0.34	0.01	0.08	$30,000	79,541	3,182	$95,449,277	2.95	0.11	0.69
MY 1998 – 2001	$5,427	0.45	0.01	0.13	$30,000	65,258	2,610	$78,310,071	3.21	0.09	0.95
MY 2002 – 2006	$5,335	0.43	0.02	0.08	$30,000	110,395	4,416	$132,473,748	5.19	0.23	0.98
Sub Total							**12,984**	**389,514,484**	**13.74**	**0.58**	**2.91**
Overall Projects											
MY 1989 and Earlier						60,761	22,481	469,982,738	9.48	0.91	1.85
MY 1990						8,641	3,111	63,033,334	0.85	0.19	0.39
MY 1991 – 1997						79,541	24,658	412,420,416	9.03	0.62	4.92
MY 1998 – 2001						65,258	24,146	496,942,660	14.31	0.57	8.03
MY 2002 – 2006								781,043,140			

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
						110,395	38,636		20.35	1.51	7.95
MY 2007+						69,954	0	0	0	0	0
Total						**394,549**	**113,034**	**2,223,422,288**	**54.03**	**3.80**	**23.14**
Measure 46i: Midwest Clean Diesel Initiative											
All Diesel Sources	**$1,492**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	N/A	$97,119,156	9.18	1.56	1.29
Sub Total								**$97,119,156**	**9.18**	**1.56**	**1.29**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
All MY Heavy HDDVs	$1,700	0.02	0.000	0.001	$7,500	394,549	59,182	$443,867,544	3.84	0.06	0.18
Sub Total						**394,549**	**59,182**	**$443,867,544**	**3.84**	**0.06**	**0.18**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Med-HDDVs	$371	0.04	0.00	0.00	$100	83,577	50,146	$5,014,633	5.28	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	75,162	60,129	$6,012,926	21.33	0.00	0.00
Sub Total							**110,276**	**11,027,558**	**26.61**	-	-
Grand Total						**394,549**	**282,491**	**$2,775,436,547**	**93.7**	**5.4**	**24.6**

Table 5-2. An example emission reduction scenario to reduce NOx, PM and VOC emissions from on-road diesel vehicles in the LADCO states in 2012.

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	40,446	-	$0	0.00	0.00	0.00
Sub Total							-	-	**0.00**	**0.00**	**0.00**
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	40,446	2,427	$97,071,049	1.59	0.12	0.02
MY 1990	$11,401	0.09	0.02	0.00	$40,000	7,495	300	$11,991,524	0.07	0.02	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	69,085	-	$0	0.00	0.00	0.00
Sub Total							**2,727**	**109,062,573**	**1.66**	**0.13**	**0.02**
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,522	0.29	0.02	0.03	$45,000	40,446	2,427	$109,204,930	1.93	0.12	0.19
MY 1990	$10,687	0.15	0.02	0.03	$45,000	7,495	300	$13,490,464	0.12	0.02	0.03
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	69,085	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	56,650	-	$0	0.00	0.00	0.00
Sub Total							**2,727**	**122,695,395**	**2.05**	**0.13**	**0.22**
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	56,650	2,266	135,959,762	2.41	0.06	0.74
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	95,840	3,834	230,016,182	3.76	0.15	0.61
Sub Total							**6,100**	**365,975,944**	**6.17**	**0.21**	**1.35**
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
Measure 46a: DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	40,446	4,045	$36,401,643	0.00	0.19	0.39
MY 1990	$2,759	0.00	0.02	0.04	$9,000	7,495	749	$6,745,232	0.00	0.04	0.09
MY 1991 – 1997	$4,835	0.00	0.01	0.06	$9,000	69,085	5,527	$49,741,376	0.00	0.14	0.97
MY 1998 – 2001	$4,161	0.00	0.01	0.11	$9,000	56,650	4,532	$40,787,928	0.00	0.11	1.32
MY 2002 – 2006	$3,570	0.00	0.01	0.07	$9,000	95,840	9,584	$86,256,068	0.00	0.36	1.71
Sub Total							**24,437**	**$219,932,249**	**0.00**	**0.85**	**4.48**
Measure 46b: Cleaire LNC + DPF											
MY 1989 and	$6,074	0.09	0.02	0.03	$ 20,000	40,446		$64,714,033	0.81	0.15	0.29

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Earlier							3,236				
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	7,495	600	$11,991,524	0.10	0.03	0.06
MY 1991 – 1997	$8,933	0.08	0.01	0.06	$ 20,000	69,085	4,145	$82,902,294	0.88	0.10	0.67
MY 1998 – 2001	$7,766	0.10	0.01	0.10	$ 20,000	56,650	3,399	$67,979,881	0.95	0.08	0.90
MY 2002 – 2006	$7,207	0.10	0.01	0.06	$ 20,000	95,840	5,750	$115,008,091	1.54	0.22	0.94
Sub Total							**17,130**	**342,595,822**	**4.28**	**0.59**	**2.86**
Measure 46c: EGR + DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.02	0.03	$ 23,000	40,446	3,236	$74,421,138	1.30	0.15	0.29
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	7,495	600	$13,790,252	0.16	0.03	0.06
MY 1991 – 1997	$8,593	0.12	0.01	0.06	$ 23,000	69,085	4,145	$95,337,638	1.40	0.10	0.67
MY 1998 – 2001	$7,136	0.16	0.01	0.10	$ 23,000	56,650	3,399	$78,176,863	1.52	0.08	0.90
MY 2002 – 2006	$6,461	0.16	0.01	0.06	$ 23,000	95,840	7,667	$176,345,740	3.28	0.29	1.25
Sub Total							**19,047**	**438,071,630**	**7.67**	**0.66**	**3.17**
Measure 46d: SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	40,446	1,618	$42,873,047	1.30	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	7,495	-	$0	0.00	0.00	0.00
MY 1991 – 1997	$15,979	0.25	0.00	0.00	$ 26,500	69,085	-	$0	0.00	0.00	0.00
MY 1998 – 2001	$12,445	0.33	0.00	0.00	$ 26,500	56,650	2,266	$60,048,895	2.03	0.00	0.00
MY 2002 – 2006	$13,569	0.31	0.00	0.00	$ 26,500	95,840	3,834	$101,590,480	3.28	0.00	0.00
Sub Total							**7,717**	**204,512,422**	**6.61**	**0.00**	**0.00**
Measure 46e: DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	40,446	4,045	$8,089,254	0.00	0.09	0.29
MY 1990	$1,227	0.00	0.01	0.03	$2,000	7,495	749	$1,498,940	0.00	0.02	0.06
MY 1991 – 1997	$1,959	0.00	0.00	0.05	$2,000	69,085	6,909	$13,817,049	0.00	0.08	0.88
MY 1998 – 2001	$1,590	0.00	0.00	0.08	$2,000	56,650	5,665	$11,329,980	0.00	0.06	1.20
MY 2002 – 2006	$1,500	0.00	0.01	0.05	$2,000	95,840	9,584	$19,168,015	0.00	0.17	1.24
Sub Total							**26,952**	**53,903,239**	**0.00**	**0.43**	**3.66**
Measure 46f: FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	40,446	3,236	$29,121,315	0.00	0.09	0.32
MY 1990	$4,343	0.00	0.01	0.04	$9,000	7,495	600	$5,396,186	0.00	0.02	0.07
MY 1991 – 1997	$6,767	0.00	0.01	0.06	$9,000	69,085	5,527	$49,741,376	0.00	0.08	0.97
MY 1998 – 2001	$5,418	0.00	0.01	0.11	$9,000	56,650	4,532	$40,787,928	0.00	0.06	1.32
MY 2002 – 2006	$5,228	0.00	0.01	0.07	$9,000	95,840	7,667	$69,004,855	0.00	0.17	1.37
Sub Total							**21,561**	**194,051,660**	**0.00**	**0.43**	**4.04**
Measure 46g: DOC + SCR Retrofit											
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	40,446	2,427	$66,736,346	1.95	0.03	0.17
MY 1990	$11,411	0.19	0.01	0.03	$27,500	7,495	300	$8,244,173	0.16	0.00	0.02
MY 1991 – 1997	$11,375	0.25	0.00	0.05	$27,500	69,085	2,763	$75,993,769	1.87	0.02	0.35
MY 1998 – 2001	$8,871	0.33	0.003	0.08	$27,500	56,650	3,399	$93,472,336	3.04	0.02	0.71
MY 2002 – 2006	$9,672	0.31	0.004	0.05	$27,500	95,840	5,750	$158,136,125	4.92	0.06	0.74
Sub Total							**14,639**	**402,582,749**	**11.95**	**0.15**	**1.99**
Measure 46h: SCR + DPF Retrofit											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	40,446	3,236	$97,071,049	2.60	0.15	0.29
MY 1990	$6,708	0.19	0.02	0.04	$30,000	7,495	600	$17,987,266	0.32	0.03	0.06
MY 1991 – 1997	$8,812	0.25	0.01	0.06	$30,000	69,085	4,145	$124,353,440	2.81	0.10	0.66
MY 1998 – 2001	$7,336	0.33	0.01	0.10	$30,000	56,650	3,399	$101,969,821	3.04	0.08	0.90
MY 2002 – 2006	$7,138	0.31	0.01	0.06	$30,000	95,840	5,750	$172,512,137	4.92	0.22	0.93
Sub Total							**17,130**	**513,893,733**	**13.69**	**0.59**	**2.84**

Technology	Project Cost-Effective-ness ($/ton)	Estimated Reductions per Vehicle (tons/yr)			Cost per Unit ($)	Number of Units Available	Units Recomm-ended	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Overall Projects											
MY 1989 and Earlier						40,446	29,930	625,703,805	11.48	1.11	2.24
MY 1990						7,495	4,797	91,135,580	0.93	0.22	0.46
MY 1991 – 1997						69,085	33,161	491,886,942	6.96	0.64	5.17
MY 1998 – 2001						56,650	32,857	630,513,394	13.00	0.56	7.98
MY 2002 – 2006						95,840	59,421	1,128,037,693	21.71	1.65	8.78
MY 2007+						149,182	0	0	0	0	0
Total						**418,698**	**160,166**	**2,967,277,415**	**54.07**	**4.17**	**24.63**
Measure 46i: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$194,238,312	18.36	3.12	2.58
Sub Total								**$194,238,312**	**18.36**	**3.12**	**2.58**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
All MY Heavy HDDVs	$1,700	0.02	0.0002	0.001	$7,500	418,698	125,610	$942,071,519	6.07	0.08	0.33
Sub Total						**418,698**	**125,610**	**$942,071,519**	**6.07**	**0.08**	**0.33**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-In)											
MY 1993-1998 Med-HDDVs	$371	0.04	0.00	0.00	$100	72,630	43,578	$4,357,819	4.58	-	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	65,317	52,254	$5,225,357	18.54	-	0.00
Sub Total							**95,832**	**9,583,176**	**23**	-	-
Grand Total						**418,698**	**285,775**	**$4,103,587,246**	**101.6**	**7.4**	**27.5**

Emission Reduction Scenarios for Construction and Agricultural Diesel Equipment

As discussed in Section 2, diesel equipment contributes most of the NOx and PM emissions from nonroad sources. The largest emitting diesel equipment categories are construction and agricultural equipment, with each equipment type contributing 20-30% of the NOx and PM emissions from nonroad sources.

This emissions reduction scenario includes voluntary after-treatment device retrofits and fleet modernization. Example potential emission reduction scenarios for the construction and agricultural equipment are summarized in Tables 5-3 to 5-6 for 2009 and 2012 NOx and PM reductions. For these scenarios, ENVIRON assumed different penetration rates by cost-effectiveness values. The penetration rates were based on the following cost-effectiveness criteria:

Cost-Effectiveness (CE) Value ($/ton of NOx reduced)	Penetration Rate (%)	
	2009	2012
CE < 4,000	8	20
4,000 < CE < 7,000	4	12
7,000 < CE < 10,000	2	5
10,000 < CE < 14,300	1	3
14,300 and over	0	0

As shown in Tables 5-3 and 5-4, the example emission reduction scenario for major emissions contributors from construction equipment with all selected measures could reduce NOx emissions by approximately 29 tpd, PM emissions by more than 1.2 tpd, and ROG emissions by 4.4 tpd in the LADCO states in 2009 for a cost of about $600 million. The total equipment count

in this scenario is about 33,000 units, which is about 34% of the available LADCO regional construction equipment population in 2009.

In 2012 the potential NOx emissions reductions are approximately 42 tpd, the PM emissions reductions approximately 2.2 tpd, and the ROG emissions reductions approximately 6.2 tpd for a cost of about $1.1 billion. In 2012, this scenario estimates that approximately 68,000 units would be affected, which is about 79% of the available construction equipment population in 2012.

Assuming that a LADCO emission reduction program would begin in 2007, the equipment penetration rate for the targeted population would be 34% in 2009 and would translate to about 11% turnover rate per year in a three-year time frame. For the 2012 scenario the equipment penetration rate would be 79% of the targeted population and would translate into a 13% turnover rate per year over the 6-year time frame. Both of these are very viable penetration rates to achieve. Given the favorable average cost-effectiveness value and turnover rates, more aggressive cost-effectiveness criteria could be used to increase the penetration rates, and hence, the potential emission reductions, if funding were a secondary issue.

For the agricultural equipment, the example emission reduction scenario shown in Table 5-5 for major agricultural equipment including all selected measures could reduce 2009 NOx emissions by approximately 26 tpd, PM emissions by approximately 2 tpd, and ROG emissions by approximately 3.5 tpd for a cost of about $0.9 billion. The total equipment count involved in this scenario is about 113,000 units, which is about 35% of the available LADCO regional agricultural equipment population in 2009.

Table 5-6 shows that this scenario for agricultural equipment could reduce 2012 NOx emissions by approximately 49 tpd, PM emissions by approximately 4.3 tpd, and ROG emissions by approximately 9.0 tpd. The total equipment count involved in this scenario is 220,000 which is approximately 77% of the available agricultural population in 2012.

Assuming that a LADCO emission reduction program would begin in 2007, the equipment penetration rate for the targeted population would be 35% in 2009 and would translate to a turnover rate of about 12% per year in a three-year time frame. For the 2012 scenario the equipment penetration rate for the targeted population would be 77% and would translate to a turnover rate of about 13% per year in a 6-year time frame. These are both very viable penetration rates to achieve. Similar to the emission reduction scenario for the construction equipment, given the favorable average cost-effective value and turnover rates, a more aggressive cost-effectiveness criteria could be used to increase the penetration rates, and hence, the potential emission reductions, if funding were a secondary issue.

Based on these emission reduction scenarios, a total NOx reduction of more than 55 tpd, a total PM reduction of 3.2 tpd and a total ROG reduction of 8 tpd could be achieved in 2009 by implementing these selected measures for nonroad diesel equipment, focusing on construction and agricultural equipment. In 2012, a total NOx reduction of 91 tpd, a total PM reduction of approximately 6.5 tpd, and a total ROG reduction of 15.1 tpd could be achieved by implementing these measures for nonroad construction and agricultural equipment.

Table 5-3. An example emission reduction scenario for some major construction equipment in LADCO states in 2009.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Excavators	648	$15,415,500	1.21	0.03	0.11
Rubber Tire Loaders	661	$23,665,000	1.12	0.03	0.12
Crawler Tractor/Dozer	498	$20,313,750	0.83	0.04	0.13
Tractors/Loaders/Backhoes	612	$6,481,250	0.19	0.02	0.01
Off-Highway Trucks	42	$6,906,726	0.45	0.00	0.00
Sub Total	**2,461**	**$72,782,226**	**3.81**	**0.11**	**0.37**
Measure 51a: DPF Retrofit					
Excavators	1,136	$8,493,632	0.00	0.05	0.15
Rubber Tire Loaders	1,177	$11,541,789	0.00	0.06	0.21
Crawler Tractor/Dozer	835	$8,558,526	0.00	0.05	0.16
Tractors/Loaders/Backhoes	1,647	$6,342,158	0.00	0.05	0.06
Off-Highway Trucks	52	$2,679,111	0.00	0.02	0.14
Sub Total	**4,847**	**$37,615,216**	**0.00**	**0.23**	**0.71**
Measure 51b: Lean NOx Catalyst					
Excavators	976	$17,022,105	0.50	0.05	0.13
Rubber Tire Loaders	760	$15,208,421	0.40	0.04	0.11
Crawler Tractor/Dozer	730	$16,103,158	0.35	0.04	0.14
Tractors/Loaders/Backhoes	1,496	$12,454,737	0.24	0.05	0.06
Off-Highway Trucks	52	$5,953,580	0.37	0.02	0.13
Sub Total	**4,014**	**$66,742,001**	**1.86**	**0.20**	**0.56**
Measure 51c: EGR+DPF Retrofit					
Excavators	976	$19,575,421	0.81	0.05	0.13
Rubber Tire Loaders	843	$20,201,263	0.73	0.04	0.12
Crawler Tractor/Dozer	730	$18,518,632	0.55	0.04	0.14
Tractors/Loaders/Backhoes	976	$9,916,632	0.26	0.03	0.04
Off-Highway Trucks	52	$6,846,617	0.59	0.02	0.13
Sub Total	**3,577**	**$75,058,565**	**2.94**	**0.18**	**0.55**
Measure 51d: SCR Retrofit					
Excavators	732	$16,908,395	1.34	0.00	0.00
Rubber Tire Loaders	626	$17,418,868	1.17	0.00	0.00
Crawler Tractor/Dozer	667	$20,370,132	1.03	0.00	0.00
Tractors/Loaders/Backhoes	461	$6,542,711	0.30	0.00	0.00
Off-Highway Trucks	73	$11,074,232	1.55	0.00	0.00
Sub Total	**2,559**	**$72,314,337**	**5.39**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	976	$1,702,211	0.00	0.02	0.10
Rubber Tire Loaders	1,177	$2,564,842	0.00	0.03	0.15
Crawler Tractor/Dozer	835	$1,901,895	0.01	0.02	0.12
Tractors/Loaders/Backhoes	1,496	$1,245,474	0.00	0.02	0.05
Off-Highway Trucks	52	$595,358	0.00	0.01	0.10
Sub Total	**4,536**	**$8,009,779**	**0.01**	**0.10**	**0.51**
Measure 51f: FTF Retrofit					
Excavators	627	$4,572,000	0.00	0.02	0.09
Rubber Tire Loaders	617	$5,465,368	0.00	0.02	0.11

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Crawler Tractor/Dozer	525	$4,905,474	0.01	0.02	0.09
Tractors/Loaders/Backhoes	900	$3,571,579	0.00	0.02	0.04
Off-Highway Trucks	52	$2,679,111	0.00	0.01	0.14
Sub Total	**2,721**	**$21,193,532**	**0.01**	**0.09**	**0.47**
Measure 51g: DOC+SCR Retrofit					
Excavators	976	$23,405,395	1.61	0.01	0.10
Rubber Tire Loaders	996	$30,034,342	1.92	0.01	0.14
Crawler Tractor/Dozer	667	$21,138,816	1.04	0.01	0.11
Tractors/Loaders/Backhoes	799	$11,620,921	0.51	0.01	0.03
Off-Highway Trucks	73	$11,492,127	1.55	0.01	0.11
Sub Total	**3,511**	**$97,691,601**	**6.63**	**0.06**	**0.49**
Measure 51h: SCR+DPF Retrofit					
Excavators	1,242	$32,404,737	2.08	0.06	0.15
Rubber Tire Loaders	1,059	$33,858,947	1.95	0.05	0.18
Crawler Tractor/Dozer	947	$30,473,684	1.36	0.05	0.15
Tractors/Loaders/Backhoes	1,677	$26,720,526	1.05	0.07	0.08
Off-Highway Trucks	73	$12,536,866	1.55	0.03	0.14
Sub Total	**4,998**	**$135,994,761**	**7.99**	**0.26**	**0.70**
Grand Total	**33,224**	**$587,402,018**	**28.64**	**1.24**	**4.37**

Table 5-4. An example emission reduction scenario for some major construction equipment in LADCO states in 2012.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Excavators	379	$11,246,750	0.83	0.02	0.09
Rubber Tire Loaders	964	$40,720,750	1.83	0.04	0.15
Crawler Tractor/Dozer	511	$24,529,500	1.02	0.02	0.14
Tractors/Loaders/Backhoes	940	$10,559,000	0.30	0.02	0.03
Off-Highway Trucks	46	$9,082,072	0.47	0.00	0.00
Sub Total	**2,840**	**$96,138,072**	**4.44**	**0.10**	**0.41**
Measure 51a: DPF Retrofit					
Excavators	3,373	$25,842,316	0.00	0.14	0.26
Rubber Tire Loaders	3,167	$28,250,053	0.00	0.12	0.32
Crawler Tractor/Dozer	2,900	$28,918,895	0.00	0.13	0.30
Tractors/Loaders/Backhoes	5,708	$22,890,316	0.00	0.14	0.23
Off-Highway Trucks	122	$6,285,607	0.00	0.05	0.17
Sub Total	**15,270**	**$112,187,186**	**0.00**	**0.57**	**1.28**
Measure 51b: Lean NOx Catalyst					
Excavators	2,094	$35,753,684	0.84	0.09	0.17
Rubber Tire Loaders	1,393	$28,635,789	0.65	0.06	0.16
Crawler Tractor/Dozer	1,418	$29,146,316	0.59	0.07	0.18
Tractors/Loaders/Backhoes	3,166	$26,604,211	0.48	0.10	0.14
Off-Highway Trucks	81	$9,273,846	0.50	0.03	0.12
Sub Total	**8,152**	**$129,413,846**	**3.05**	**0.35**	**0.77**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 51c: EGR+DPF Retrofit					
Excavators	1,667	$29,525,947	1.02	0.07	0.14
Rubber Tire Loaders	1,393	$32,931,158	1.04	0.06	0.16
Crawler Tractor/Dozer	1,418	$33,518,263	0.93	0.07	0.18
Tractors/Loaders/Backhoes	2,245	$22,790,579	0.56	0.07	0.11
Off-Highway Trucks	81	$10,664,923	0.79	0.03	0.12
Sub Total	**6,804**	**$129,430,870**	**4.35**	**0.30**	**0.70**
Measure 51d: SCR Retrofit					
Excavators	1,064	$24,767,737	1.60	0.00	0.00
Rubber Tire Loaders	881	$26,550,211	1.61	0.00	0.00
Crawler Tractor/Dozer	1,063	$33,172,421	1.61	0.00	0.00
Tractors/Loaders/Backhoes	718	$10,374,053	0.45	0.00	0.00
Off-Highway Trucks	122	$18,507,620	2.30	0.00	0.00
Sub Total	**3,848**	**$113,372,041**	**7.57**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	770	$1,178,737	0.00	0.02	0.06
Rubber Tire Loaders	1,012	$2,017,789	0.00	0.02	0.11
Crawler Tractor/Dozer	665	$1,329,368	0.01	0.02	0.08
Tractors/Loaders/Backhoes	1,343	$1,112,947	0.00	0.02	0.06
Off-Highway Trucks	25	$286,230	0.00	0.00	0.04
Sub Total	**3,815**	**$5,925,072**	**0.01**	**0.08**	**0.35**
Measure 51f: FTF Retrofit					
Excavators	2,144	$16,349,684	0.00	0.05	0.19
Rubber Tire Loaders	2,093	$19,326,316	0.00	0.05	0.27
Crawler Tractor/Dozer	1,909	$18,868,263	0.01	0.05	0.23
Tractors/Loaders/Backhoes	4,685	$18,259,105	0.00	0.08	0.21
Off-Highway Trucks	122	$6,285,607	0.00	0.03	0.17
Sub Total	**10,953**	**$79,088,975**	**0.01**	**0.26**	**1.07**
Measure 51g: DOC+SCR Retrofit					
Excavators	1,667	$35,302,763	2.04	0.02	0.11
Rubber Tire Loaders	1,722	$53,145,921	2.93	0.02	0.18
Crawler Tractor/Dozer	1,063	$34,424,211	1.62	0.02	0.13
Tractors/Loaders/Backhoes	1,764	$26,486,842	1.12	0.02	0.08
Off-Highway Trucks	122	$19,206,021	2.30	0.01	0.12
Sub Total	**6,338**	**$168,565,758**	**10.01**	**0.10**	**0.63**
Measure 51h: SCR+DPF Retrofit					
Excavators	2,196	$56,891,053	2.90	0.09	0.18
Rubber Tire Loaders	2,093	$64,421,053	3.12	0.09	0.24
Crawler Tractor/Dozer	1,909	$62,894,211	2.57	0.09	0.21
Tractors/Loaders/Backhoes	3,357	$55,406,842	2.01	0.14	0.20
Off-Highway Trucks	122	$20,952,023	2.30	0.05	0.15
Sub Total	**9,677**	**$260,565,181**	**12.90**	**0.45**	**0.98**
Grand Total	**67,697**	**$1,094,687,002**	**42.34**	**2.21**	**6.17**

Table 5-5. An example emission reduction scenario for some major agricultural equipment in LADCO states in 2009.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Agricultural Tractors	13,974	$185,035,850	5.54	0.32	0.41
Combines	121	$2,283,750	0.03	0.00	0.00
Sub Total	**14,095**	**$187,319,600**	**5.56**	**0.32**	**0.41**
Measure 51a: DPF Retrofit					
Agricultural Tractors	16,560	$73,719,000	0.00	0.48	0.65
Combines	579	$3,960,474	0.00	0.01	0.00
Sub Total	**17,139**	**$77,679,474**	**0.00**	**0.49**	**0.65**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	10,108	$128,844,316	2.23	0.36	0.36
Combines	168	$2,467,368	0.02	0.00	0.00
Sub Total	**10,276**	**$131,311,684**	**2.25**	**0.36**	**0.36**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	13,032	$111,681,947	2.94	0.30	0.36
Combines	168	$2,837,474	0.03	0.00	0.00
Sub Total	**13,200**	**$114,519,421**	**2.96**	**0.31**	**0.36**
Measure 51d: SCR Retrofit					
Agricultural Tractors	5,330	$67,778,632	3.09	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**5,330**	**$67,778,632**	**3.09**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	17,679	$14,344,211	0.00	0.18	0.47
Combines	825	$1,272,737	0.00	0.01	0.01
Sub Total	**18,504**	**$15,616,947**	**0.00**	**0.18**	**0.48**
Measure 51f: FTF Retrofit					
Agricultural Tractors	11,517	$36,177,632	0.00	0.15	0.39
Combines	168	$1,110,316	0.00	0.00	0.00
Sub Total	**11,685**	**$37,287,947**	**0.00**	**0.15**	**0.39**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	8,281	$110,220,000	4.67	0.06	0.32
Combines	0	$0	0.00	0.00	0.00
Sub Total	**8,281**	**$110,220,000**	**4.67**	**0.06**	**0.32**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	14,517	$179,733,158	6.98	0.33	0.48
Combines	168	$3,701,053	0.06	0.00	0.00
Sub Total	**14,685**	**$183,434,211**	**7.04**	**0.33**	**0.48**
Grand Total	**113,195**	**$925,167,916**	**25.57**	**2.20**	**3.45**

Table 5-6. An example emission reduction scenario for some major agricultural equipment in LADCO states in 2012.

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total ROG (tpd)
Measure 20: Fleet Modernization (Tier 2, 3 or 4 Engines)					
Agricultural Tractors	27,896	$384,923,950	11.31	0.60	1.00
Combines	313	$10,663,750	0.14	0.01	0.00
Sub Total	**28,209**	**$395,587,700**	**11.44**	**0.61**	**1.00**
Measure 51a: DPF Retrofit					
Agricultural Tractors	35,612	$194,630,211	0.00	0.97	1.72
Combines	1,744	$12,008,842	0.00	0.03	0.01
Sub Total	**37,356**	**$206,639,053**	**0.00**	**1.00**	**1.73**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	19,486	$259,364,737	4.40	0.70	0.86
Combines	313	$4,980,000	0.04	0.01	0.00
Sub Total	**19,799**	**$264,344,737**	**4.44**	**0.70**	**0.86**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	22,849	$205,178,158	5.15	0.53	0.86
Combines	313	$5,727,000	0.06	0.01	0.00
Sub Total	**23,162**	**$210,905,158**	**5.21**	**0.54**	**0.86**
Measure 51d: SCR Retrofit					
Agricultural Tractors	9,876	$131,193,132	5.72	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**9,876**	**$131,193,132**	**5.72**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	27,485	$25,822,000	0.00	0.31	1.12
Combines	2,248	$3,391,158	0.00	0.02	0.02
Sub Total	**29,733**	**$29,213,158**	**0.00**	**0.32**	**1.13**
Measure 51f: FTF Retrofit					
Agricultural Tractors	28,846	$120,026,842	0.00	0.39	1.56
Combines	434	$2,871,474	0.00	0.00	0.00
Sub Total	**29,280**	**$122,898,316**	**0.00**	**0.39**	**1.56**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	15,541	$190,948,421	7.87	0.11	0.57
Combines	0	$0	0.00	0.00	0.00
Sub Total	**15,541**	**$190,948,421**	**7.87**	**0.11**	**0.57**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	27,267	$373,061,053	13.82	0.61	1.26
Combines	313	$7,470,000	0.12	0.01	0.00
Sub Total	**27,580**	**$380,531,053**	**13.94**	**0.61**	**1.26**
Grand Total	**220,536**	**$1,932,260,726**	**48.62**	**4.29**	**8.99**

Emissions Reduction Scenario for Smoking Vehicles

Table 5-7 shows potential PM emissions reduction scenarios for light-duty gasoline vehicles that have been identified as smoking vehicles and removed/replaced in 2009 and 2012. This measure uses an analysis similar to onroad HDDV retrofit or fleet modernization measures, by assuming certain vehicle parameters and calculating a potential PM emissions reduction on a per vehicle basis. Unlike the other control measures, it is not possible to provide a more refined estimate using available emissions models, because the MOBILE6 model does not adequately account for high emitting vehicles. Further discussion with USEPA may be necessary to determine the

appropriate methodology for estimating SIP emission reduction credits. The assumptions used in this analysis are detailed as follows:

	LDVs	
	Smoking	Well-Maintained
Annual mileage	10,000	10,000
Incremental Capital Cost		$1,000
Useful Life (years)	3	3
Annualized Capital Cost ($/yr)		$354
PM Emissions g/mile	0.31	0.03
PM tons/year	0.0034	0.0003
PM Reduction tons/year		0.003
Carl Moyer Cost-Effectiveness ($/ton)		$5,830

As discussed in the Smoking Vehicle White Paper, the PM emissions factors for smoking and non-smoking LDGVs have been obtained from a number of sources[3], which indicate that for non-smoking vehicles the PM emissions factors are approximately 0.03 g/mi, while for smoking vehicles they may be as high as 0.3 g/mi. The measure calculation is based upon an assumed repair cost or incentive rebate of $1,000 to remove or replace the smoking vehicle.

The scenario is calculated based on an assumption that 1.43% of the LDGV fleet are smoking vehicles, and a penetration rate of 50% for enforcement and subsequent removal/replacement of the smoking vehicle. The analysis indicates that in 2009 the potential LADCO area PM reductions from smoking vehicles are 2.9 tons/day, and for 2012 the reductions are 3.0 tons/day. The per vehicle cost-effectiveness is $5,830/ton PM reduced, and the overall cost is approximately $344 million in 2009 and $365 million in 2012 for the LADCO area.

Table 5-7. An example emission reduction scenario for removal/replacement of smoking vehicles in LADCO states in 2009 and 2012.

Project Cost-Effectiveness ($/ton)	Estimated PM Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total PM Reduction (tons/day)
Measure 38/39/40/41: Smoking Vehicles Identification/Emissions Reduction						
2009						
$5,830	0.003	$1,000	48,131,991	344,144	$344,143,739	2.9
2012						
$5,830	0.003	$1,000	51,078,054	365,208	$365,208,088	3.0

Locomotive Anti-Idling Emissions Reduction Scenario

Table 5-8 shows the emission reduction scenario for the Anti-Idling measure for locomotives. As discussed in the Anti-Idling White Paper, the EPA estimates that locomotive idling accounts for 3-5% of NOx emissions from line-haul engines and 16-20% of NOx emissions from switching engines, as well as 2-15% of PM emissions from line-haul engines and 9-35% of PM emissions from switching engines. The average of these emission reduction ranges were used to

[3] "Measure 38/39/40/41: Organic Carbon Emission Reduction Programs – Smoking Vehicles" White Paper prepared by ENVIRON International Corp. to LADCO, December 2006.

estimate the potential emission reductions of anti-idling for locomotives. The average emission reduction for PM emissions were also used in estimating the ROG emission reduction. Thus, the average control factors for idling reduction for locomotives are as follows:

	Control Factors		
	NOx	PM	ROG
Switching Locomotives	18%	22%	22%
Linehaul Locomotives	4%	9%	9%

For this analysis, ENVIRON assumed that the Anti-Idling measure would effectively reduce 50% and 75% of the idling emissions from switching locomotives and linehaul locomotives, respectively. In addition, ENVIRON also assumed that the Anti-Idling measure would impact 25% and 50% of total switching locomotives and linehaul locomotives, respectively, in the LADCO states.

Based on the assumptions and the 2009 locomotive emission inventories in the LADCO states, the potential emission reductions for the Anti-Idling measure were estimated to be about 5 tpd for NOx emissions, 0.2 tpd for PM emissions, and 0.5 tpd for ROG emissions for a cost of about $50 million.

The potential emission reductions for the 2012 scenario were estimated to be doubled of those for the 2009 scenario as they were estimated by scaling the 2009 emission reductions over a six-year timeframe, assuming that the Anti-Idling measure would implement in 2007.

Table 5-8. An example emission reduction scenario for anti-idling restrictions on locomotives in LADCO states in 2009 and 2012.

Technology	Project Cost-Effectiveness ($/ton)	Estimated Reductions per locomotive (tons/yr)			Cost per Unit ($)	# of Units Available	Units Estimated	Total Cost	Total Emissions Reductions (tons/day)		
		NOx	PM	ROG					NOx	PM	ROG
Measure 33/34/35/37: Anti-Idling Restriction on Locomotives											
2009											
Switching	$1,400	1.28	0.04	0.10	$30,000	NA	757	$22,713,439	2.65	0.08	0.22
Line-Haul	$1,400	0.84	0.06	0.11	$30,000	NA	898	$26,953,254	2.07	0.15	0.27
Total		2.12	0.10	0.22			1,656	$49,666,693	4.72	0.23	0.49
2012											
Switching	$1,400	1.28	0.04	0.10	$30,000	NA	1,514	$45,426,878	5.31	0.16	0.44
Line-Haul	$1,400	0.84	0.06	0.11	$30,000	NA	1,797	$53,906,508	4.14	0.29	0.55
Total		2.12	0.10	0.22		NA	3,311	$99,333,386	9.44	0.45	0.98

State-by-State Emissions Reduction Scenario

A similar emissions reduction scenario analysis to that presented above for onroad HDDVs and nonroad construction and agricultural equipment has been conducted for each of the states in the LADCO region. In addition to the five LADCO states, a similar analysis was conducted for Minnesota (MN). The emissions inventory and results of the emissions reduction scenario for Minnesota are included in the report as Appendix D, and are presented in a similar format to the analysis for the LADCO states.

Although there were some differences in the nonroad construction and agricultural equipment types that were the major NOx and PM contributors in each state, these differences were minor and the state-by-state analysis was conducted for the same equipment types as that for the LADCO region. Tables 5-9 and 5-10 show the potential emissions reduction from the scenario analysis conducted for each state for 2009 and 2012 respectively. The criteria for penetration rate were identical to those in the LADCO region analysis.

Table 5-9. 2009 state-by-state emissions reduction potentials from the scenario analysis conducted for the LADCO region.

	2009 NOx PM and ROG Emission Reductions (tpd)								
	On-Road HDDV			Construction Equipment			Agricultural Equipment		
	NOx	PM	ROG	NOx	PM	ROG	NOx	PM	ROG
Illinois	26.21	1.78	6.65	8.43	0.37	1.29	9.49	0.81	1.28
Indiana	15.86	0.84	4.26	4.28	0.18	0.66	5.13	0.44	0.69
Michigan	16.41	0.97	4.17	4.92	0.23	0.75	2.86	0.25	0.39
Ohio	22.83	1.14	6.24	7.74	0.33	1.18	4.25	0.36	0.57
Wisconsin	12.25	0.67	3.28	3.25	0.14	0.50	3.83	0.33	0.52
Total	**93.56**	**5.41**	**24.60**	**28.63**	**1.24**	**4.38**	**25.56**	**2.19**	**3.45**

Table 5-10. 2012 state-by-state emissions reduction potentials from the scenario analysis conducted for the LADCO region.

	2012 NOx PM and ROG Emission Reductions (tpd)								
	On-Road HDDV			Construction Equipment			Agricultural Equipment		
	NOx	PM	ROG	NOx	PM	ROG	NOx	PM	ROG
Illinois	30.60	2.68	7.72	12.44	0.65	1.82	18.04	1.59	3.34
Indiana	16.41	1.07	4.68	6.36	0.32	0.92	9.77	0.86	1.81
Michigan	18.56	1.37	4.74	7.39	0.42	1.11	5.43	0.48	1.00
Ohio	23.08	1.37	6.77	11.48	0.58	1.65	8.08	0.71	1.49
Wisconsin	12.79	0.86	3.61	4.68	0.24	0.67	7.29	0.64	1.35
Total	**101.43**	**7.34**	**27.52**	**42.35**	**2.22**	**6.18**	**48.62**	**4.29**	**8.99**

APPENDIX A

Appendix M20/25 and Appendix M46/51

Appendix M20/25

Table M20/25-Con. Potential NOx emission reduction and cost-effectiveness values for equipment modernization for major nonroad construction equipment.

Table M20/25-Ag. Potential NOx emission reduction and cost-effectiveness values for equipment modernization for major nonroad agricultural equipment.

Appendix M46/51

Table 46/51-MCDI-1. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Illinois.

Table 46/51-MCDI-2. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Indiana.

Table 46/51-MCDI-3. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Michigan.

Table 46/51-MCDI-4. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Minnesota.

Table 46/51-MCDI-5. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Ohio.

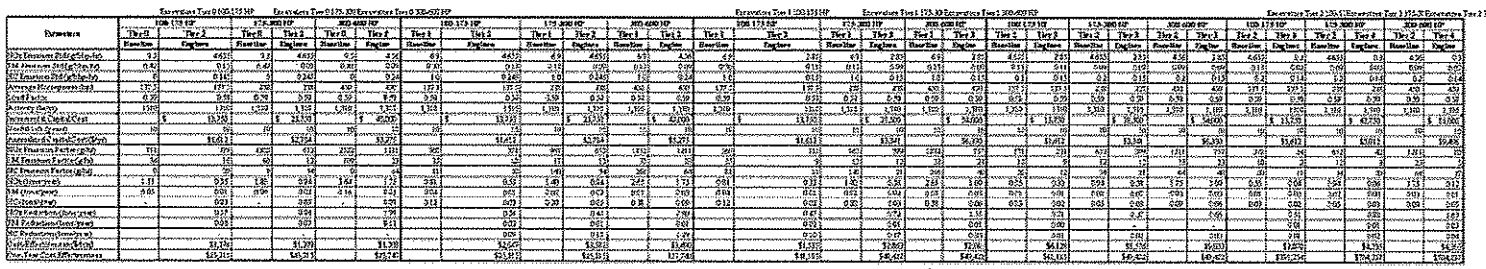
Table 46/51-MCDI-6. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Wisconsin.

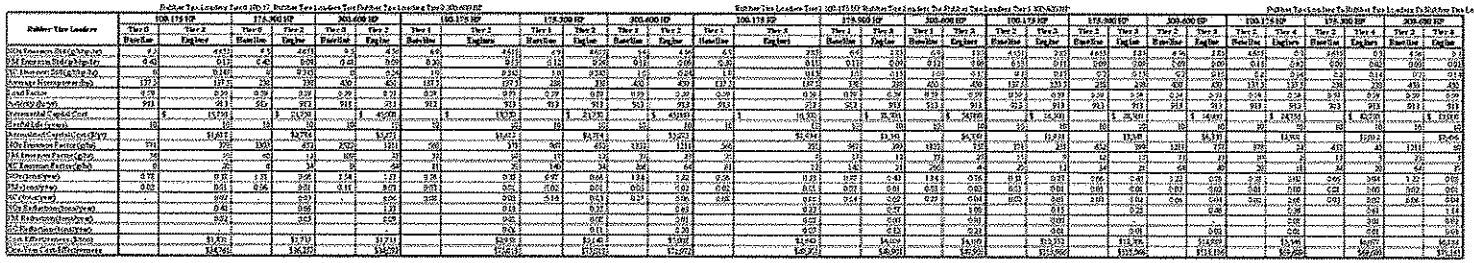
Table M46/51-OR. Potential NOx emission reduction and cost-effectiveness values for the use of retrofit technologies for on-road HDDVs.

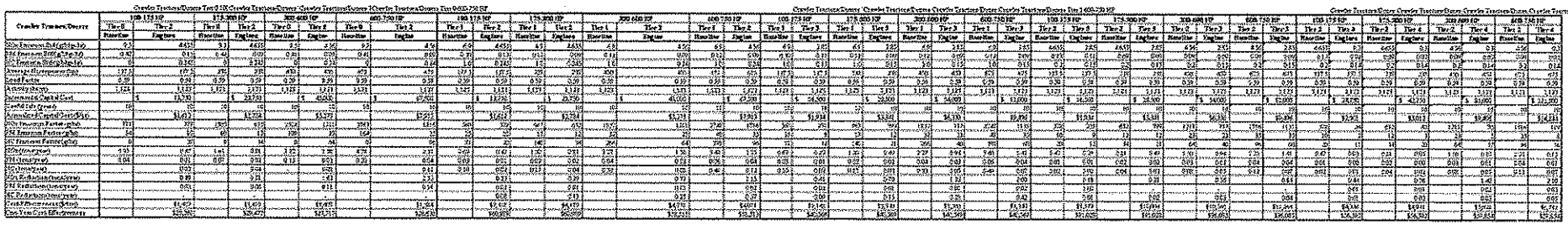
Table M46/51-Con. Potential NOx emission reduction and cost-effectiveness values for the use of retrofit technologies for non-road construction equipment.

Table M46/51-Ag. Potential NOx emission reduction and cost-effectiveness values for the use of retrofit technologies for non-road agricultural equipment.

Table M20/25-Con. Potential NOx emission reduction and cost-effectiveness values for equipment modernization for major nonroad construction equipment.







Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0	Tier 2	Tier 0	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 3	Tier 1	Tier 3	Tier 2	Tier 3	Tier 2	Tier 3	Tier 2	Tier 4	Tier 2	Tier 4
	Baseline	Engines	Baseline	Engines	Baseline	Engines	Baseline	Engine	Baseline	Engines	Baseline	Engine	Baseline	Engines	Baseline	Engine	Baseline	Engines	Baseline	Engine
NOx Emission Std (g/bhp-hr)	8.80	5.32	9.50	4.66	6.90	5.32	6.90	4.66	6.90	3.33	6.90	2.85	5.32	3.33	4.66	2.85	5.32	0.30	4.66	0.30
PM Emission Std (g/bhp-hr)	0.55	0.19	0.42	0.13	0.55	0.19	0.30	0.13	0.55	0.19	0.30	0.11	0.19	0.19	0.13	0.11	0.19	0.02	0.13	0.02
HC Emission Std (g/bhp-hr)	0.00	0.28	0.00	0.25	1.00	0.28	1.00	0.25	1.00	0.18	1.00	0.15	0.28	0.18	0.25	0.15	0.28	0.14	0.25	0.14
Average Horsepower (hp)	88	88	138	138	88	88	138	138	88	88	138	138	88	88	138	138	88	88	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Incremental Capital Cost		$ 8,750		$ 13,750		$ 8,750		$ 13,750		$ 10,500		$ 16,500		$ 10,500		$ 16,500		$ 15,750		$ 24,750
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,026		$1,612		$1,026		$1,612		$1,231		$1,934		$1,231		$1,934		$1,846		$2,901
NOx Emission Factor (g/hr)	162	98	274	134	127	98	199	134	127	61	199	82	98	61	134	82	98	6	134	9
PM Emission Factor (g/hr)	10	4	12	4	10	4	9	4	10	4	9	3	4	4	4	3	4	0	4	1
HC Emission Factor (g/hr)	0	5	0	7	18	5	29	7	18	3	29	4	5	5	7	4	5	3	7	4
NOx (tons/year)	0.24	0.15	0.41	0.20	0.19	0.15	0.30	0.20	0.19	0.09	0.30	0.12	0.15	0.09	0.20	0.12	0.15	0.01	0.20	0.01
PM (tons/year)	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	-	0.01	-	0.01	0.03	0.01	0.04	0.01	0.03	0.00	0.04	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01
NOx Reduction (tons/year)		0.10		0.21		0.04		0.10		0.10		0.18		0.06		0.08		0.14		0.19
PM Reduction (tons/year)		0.01		0.01		0.01		0.01		0.01		0.01		-		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.03		0.02		0.04		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$3,495		$7,675		$23,534		$16,563		$12,481		$11,017		$22,366		$24,720		$13,333		$15,369
One-Year Cost-Effectiveness		$91,144		$65,466		$200,747		$141,283		$106,466		$93,979		$190,785		$210,868		$113,730		$131,096

Off-Highway Trucks Tier 0 750+ HP

Off-Highway Trucks Tier 2 750+ HP

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0	Tier 2	Tier 1	Tier 2	Tier 2	Tier 4
	Baseline	Engines	Baseline	Engines	Baseline	Engines
NOx Emission Std (g/bhp-hr)	9.70	4.56	6.9	4.56	4.56	2.6
PM Emission Std (g/bhp-hr)	0.41	0.09	0.12	0.09	0.09	0.07
HC Emission Std (g/bhp-hr)	0.00	0.24	1.00	0.24	0.24	0.30
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Incremental Capital Cost		$ 135,959		$ 135,959		$ 244,726
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$15,939		$15,939		$28,689
NOx Emission Factor (g/hr)	7781	3658	5535	3658	3658	2086
PM Emission Factor (g/hr)	329	71	96	71	71	56
HC Emission Factor (g/hr)	0	193	802	193	193	241
NOx (tons/year)	16.89	7.94	12.01	7.94	7.94	4.53
PM (tons/year)	0.72	0.15	0.21	0.15	0.15	0.12
HC (tons/year)	-	0.42	1.74	0.42	0.42	0.52
NOx Reduction (tons/year)		8.95		4.07		3.41
PM Reduction (tons/year)		0.56		0.06		0.03
HC Reduction (tons/year)		-		1.32		-
Cost-Effectiveness ($/ton)		$790		$2,322		$7,103
One-Year Cost-Effectiveness		$15,193		$33,373		$71,717

Measure 20/25: Diesel Equipment Fleet Modernization via Replacing Tier 0 and Tier 1 Engines with Tier 2 and/or Tier 3 Engines and Replacing Tier 2 Engines with Tier 4 Engines.
HC to ROG Conversion 1.26639

Agricultural Tractors Tier (Agricultural Tractors Tier (Agricultural Tractors Tier Agricultural Tractors Tier · Agricultural Tractors Tier Agricultural Tractors Tier 0 300-600 HP

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	Tier 2 Engines	Tier 0 Baseline	Tier 2 Engine	Tier 0 Baseline	Tier 2 Engines	Tier 0 Baseline	Tier 2 Engine	Tier 0 Baseline	Tier 2 Engines	Tier 0 Baseline	Tier 2 Engine
NOx Emission Std (g/bhp-hr)	7.2	5.32	8.8	5.32	8.8	5.32	9.5	4.655	9.3	4.655	9.5	4.56
PM Emission Std (g/bhp-hr)	0.55	0.28	0.55	0.19	0.55	0.19	0.42	0.13	0.42	0.09	0.41	0.09
HC Emission Std (g/bhp-hr)	0.00	0.28	0.00	0.28	0.00	0.28	0.00	0.25	0.00	0.25	0.00	0.24
Average Horsepower (hp)	38	38	63	66	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Incremental Capital Cost		$ 3,750		$ 6,600		$ 8,750		$ 13,750		$ 23,750		$ 45,000
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$440		$774		$1,026		$1,612		$2,784		$5,275
NOx Emission Factor (g/hr)	159	118	325	207	454	275	771	378	1303	652	2522	1211
PM Emission Factor (g/hr)	12	6	20	7	28	10	34	10	60	12	109	23
HC Emission Factor (g/hr)	0	6	0	11	0	14	0	20	0	34	0	64
NOx (tons/year)	0.08	0.06	0.17	0.11	0.24	0.14	0.40	0.20	0.68	0.34	1.32	0.63
PM (tons/year)	0.01	0.00	0.01	0.00	0.01	0.01	0.02	0.01	0.03	0.01	0.06	0.01
HC (tons/year)	-	0.00	-	0.01	-	0.01	-	0.01	-	0.02	-	0.03
NOx Reduction (tons/year)		0.02		0.06		0.09		0.21		0.34		0.69
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.02		0.04
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$5,256		$3,949		$3,567		$3,520		$3,335		$3,330
One-Year Cost-Effectiveness		$172,187		$107,426		$93,020		$66,813		$69,690		$65,529

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1 Baseline	Tier 2 Engines	Tier 1 Baseline	Tier 2 Engine	Tier 1 Baseline	Tier 2 Engines	Tier 1 Baseline	Tier 2 Engines	Tier 1 Baseline	Tier 2 Engines	Tier 1 Baseline	Tier 2 Engines
NOx Emission Std (g/bhp-hr)	6.745	5.32	6.9	5.32	6.9	5.32	6.9	4.655	6.9	4.655	6.9	4.56
PM Emission Std (g/bhp-hr)	0.48	0.28	0.55	0.19	0.55	0.19	0.30	0.13	0.12	0.09	0.12	0.09
HC Emission Std (g/bhp-hr)	0.36	0.28	1.00	0.28	1.00	0.28	1.00	0.25	1.00	0.25	1.00	0.24
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Incremental Capital Cost		$ 3,750		$ 6,250		$ 8,750		$ 13,750		$ 23,750		$ 45,000
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$440		$733		$1,026		$1,612		$2,784		$5,275
NOx Emission Factor (g/hr)	149	118	254	196	356	275	560	378	967	652	1832	1211
PM Emission Factor (g/hr)	11	6	20	7	28	10	25	10	17	12	32	23
HC Emission Factor (g/hr)	8	6	37	10	52	14	81	20	140	34	266	64
NOx (tons/year)	0.08	0.06	0.13	0.10	0.19	0.14	0.29	0.20	0.51	0.34	0.96	0.63
PM (tons/year)	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
HC (tons/year)	0.004	0.003	0.019	0.005	0.027	0.008	0.042	0.010	0.073	0.018	0.139	0.033
NOx Reduction (tons/year)		0.02		0.03		0.04		0.10		0.16		0.33
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.00		0.00
HC Reduction (tons/year)		0.00		0.01		0.02		0.03		0.06		0.11
Cost-Effectiveness ($/ton)		$6,875		$3,916		$3,916		$5,646		$9,880		$9,626
One-Year Cost-Effectiveness		$227,166		$204,880		$204,880		$144,192		$144,192		$138,338

Agricultural Tractors Tier · Agricultural Tractors Tier : Agricultural Tractors Tier Agricultural Tractors Tier Agricultural Tractors Tier 1 300-600 HP

	50-75 HP	75-100 HP	100-175 HP	175-300 HP	300-600 HP

Agricultural Tractors	Tier 1 Baseline	Tier 3 Engine	Tier 1 Baseline	Tier 3 Engines	Tier 1 Baseline	Tier 3 Engine	Tier 1 Baseline	Tier 3 Engines	Tier 1 Baseline	Tier 3 Engine
NOx Emission Std (g/bhp-hr)	6.9	3.325	6.9	3.325	6.9	2.85	6.9	2.85	6.9	2.85
PM Emission Std (g/bhp-hr)	0.55	0.19	0.55	0.19	0.30	0.11	0.12	0.09	0.12	0.09
HC Emission Std (g/bhp-hr)	1.00	0.18	1.00	0.18	1.00	0.15	1.00	0.15	1.00	0.15
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Incremental Capital Cost		$ 7,500		$ 10,500		$ 16,500		$ 28,500		$ 54,000
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$879		$1,231		$1,934		$3,341		$6,330
NOx Emission Factor (g/hr)	254	123	356	172	560	231	967	399	1832	757
PM Emission Factor (g/hr)	20	7	28	10	25	9	17	12	32	23
HC Emission Factor (g/hr)	37	6	52	9	81	12	140	21	266	40
NOx (tons/year)	0.13	0.06	0.19	0.09	0.29	0.12	0.51	0.21	0.96	0.40
PM (tons/year)	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.01
HC (tons/year)	0.02	0.00	0.03	0.00	0.04	0.01	0.07	0.01	0.14	0.02
NOx Reduction (tons/year)		0.07		0.10		0.17		0.30		0.56
PM Reduction (tons/year)		0.01		0.01		0.01		0.00		0.00
HC Reduction (tons/year)		0.02		0.02		0.04		0.06		0.12
Cost-Effectiveness ($/ton)		$3,853		$3,853		$5,079		$7,897		$7,897
One-Year Cost-Effectiveness		$108,658		$108,658		$95,914		$95,914		$95,914

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	Tier 3 Engine	Tier 2 Baseline	Tier 3 Engines	Tier 2 Baseline	Tier 3 Engine	Tier 2 Baseline	Tier 3 Engines	Tier 2 Baseline	Tier 3 Engine
NOx Emission Std (g/bhp-hr)	5.32	3.325	5.32	3.325	4.655	2.85	4.655	2.85	4.56	2.85
PM Emission Std (g/bhp-hr)	0.19	0.19	0.19	0.19	0.13	0.11	0.09	0.09	0.09	0.09
HC Emission Std (g/bhp-hr)	0.28	0.18	0.28	0.18	0.25	0.15	0.25	0.15	0.24	0.15
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Incremental Capital Cost		$ 7,500		$ 10,500		$ 16,500		$ 28,500		$ 54,000
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$879		$1,231		$1,934		$3,341		$6,330
NOx Emission Factor (g/hr)	196	123	275	172	378	231	652	399	1211	757
PM Emission Factor (g/hr)	7	7	10	10	10	9	12	12	23	23
HC Emission Factor (g/hr)	10	6	14	9	20	12	34	21	64	40
NOx (tons/year)	0.10	0.06	0.14	0.09	0.20	0.12	0.34	0.21	0.63	0.40
PM (tons/year)	0.004	0.004	0.005	0.005	0.005	0.005	0.006	0.006	0.012	0.012
HC (tons/year)	0.005	0.003	0.008	0.005	0.010	0.006	0.018	0.011	0.033	0.021
NOx Reduction (tons/year)		0.04		0.05		0.08		0.13		0.24
PM Reduction (tons/year)		-		-		0.00		-		-
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01
Cost-Effectiveness ($/ton)		$21,400		$21,400		$20,282		$23,653		$24,967
One-Year Cost-Effectiveness		$194,713		$194,713		$215,210		$215,210		$227,166

Agricultural Tractors Tier 2 Agricultural Tractors Tier 2 Agricultural Tractors Tier Agricultural Tractors Tier Agricultural Tractors Tier Agricultural Tractors Tier 2 300-600 HP

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	Tier 4 Engines	Tier 2 Baseline	Tier 4 Engine	Tier 2 Baseline	Tier 4 Engines	Tier 2 Baseline	Tier 4 Engine	Tier 2 Baseline	Tier 4 Engines	Tier 2 Baseline	Tier 4 Engine
NOx Emission Std (g/bhp-hr)	5.32	5.32	5.32	3.325	5.32	0.3	4.655	0.3	4.655	0.3	4.56	0.3
PM Emission Std (g/bhp-hr)	0.28	0.30	0.19	0.30	0.19	0.02	0.13	0.02	0.09	0.02	0.09	0.02
HC Emission Std (g/bhp-hr)	0.28	0.28	0.28	0.18	0.28	0.14	0.25	0.14	0.25	0.14	0.24	0.14
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475.00	475	475	475	475.00	475	475	475	475.00	475	475	475
Incremental Capital Cost		$ 4,500		$ 7,500		$ 10,500		$ 16,500		$ 28,500		$ 54,000
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$528		$879		$1,231		$1,934		$3,341		$6,330
NOx Emission Factor (g/hr)	118	118	196	123	275	15	378	24	652	42	1211	80
PM Emission Factor (g/hr)	6	7	7	11	10	1	10	2	12	3	23	5
HC Emission Factor (g/hr)	6	6	10	6	14	7	20	11	34	20	64	37
NOx (tons/year)	0.06	0.06	0.10	0.06	0.14	0.01	0.20	0.01	0.34	0.02	0.63	0.04
PM (tons/year)	0.003	0.003	0.004	0.006	0.005	0.001	0.005	0.001	0.006	0.001	0.012	0.003
HC (tons/year)	0.003	0.003	0.005	0.003	0.008	0.004	0.010	0.006	0.018	0.010	0.033	0.019
NOx Reduction (tons/year)		-		0.04		0.14		0.18		0.32		0.59
PM Reduction (tons/year)		-		-		0.00		0.00		0.00		0.01
HC Reduction (tons/year)		-		0.00		0.00		0.00		0.01		0.01
Cost-Effectiveness ($/ton)		$0		$0		$5,272		$6,850		$7,787		$7,924
One-Year Cost-Effectiveness		-		$194,713		$77,381		$89,197		$89,197		$91,186

Combines Tier 0 175-300 I Combines Tier 0 100-175 HP Combines Tier 1 175-300 Combines Tier 1 100-175 HP

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0 Baseline	Tier 2 Engines	Tier 0 Baseline	Tier 2 Engine	Tier 1 Baseline	Tier 2 Engines	Tier 1 Baseline	Tier 2 Engine	Tier 1 Baseline	Tier 3 Engines	Tier 1 Baseline	Tier 3 Engine	Tier 2 Baseline	Tier 3 Engines	Tier 2 Baseline	Tier 3 Engine

NOx Emission Std (g/bhp-hr)	9.3	4.655	9.5	4.655	6.9	4.655	6.9	4.655	6.9	2.85	6.9	2.85	4.655	2.85	4.655	2.85
PM Emission Std (g/bhp-hr)	0.42	0.09	0.42	0.13	0.12	0.09	0.30	0.13	0.12	0.09	0.30	0.11	0.09	0.09	0.13	0.11
HC Emission Std (g/bhp-hr)	0.00	0.25	0.00	0.25	1.00	0.25	1.00	0.25	1.00	0.15	1.00	0.15	0.25	0.15	0.25	0.15
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Incremental Capital Cost		$ 23,750		$ 13,750		$ 23,750		$ 13,750		$ 28,500		$ 16,500		$ 28,500		$ 16,500
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$2,784		$1,612		$2,784		$1,612		$3,341		$1,934		$3,341		$1,934
NOx Emission Factor (g/hr)	1303	652	771	378	967	652	560	378	967	399	560	231	652	399	378	231
PM Emission Factor (g/hr)	60	12	34	10	17	12	25	10	17	12	25	9	12	12	10	9
HC Emission Factor (g/hr)	0	34	0	20	140	34	81	20	140	21	81	12	34	21	20	12
NOx (tons/year)	0.22	0.11	0.13	0.06	0.16	0.11	0.09	0.06	0.16	0.07	0.09	0.04	0.11	0.07	0.06	0.04
PM (tons/year)	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HC (tons/year)	-	0.01	-	0.00	0.02	0.01	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00
NOx Reduction (tons/year)		0.11		0.06		0.05		0.03		0.09		0.05		0.04		0.02
PM Reduction (tons/year)		0.01		0.00		0.00		0.00		0.00		0.00		-		0.00
HC Reduction (tons/year)		-		-		0.02		0.01		0.02		0.01		0.00		0.00
Cost-Effectiveness ($/ton)		$10,560		$11,148		$31,285		$17,880		$25,008		$16,083		$74,900		$64,225
One-Year Cost-Effectiveness		$220,686		$211,576		$456,608		$456,608		$303,729		$303,729		$681,497		$681,497

Table 46/51-MCDI-1. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Illinois.

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
DOC	2511	375.20	194.41	0.00	37.19	0.15	0.08	0.00	0.01
DPF	195	128.60	23.11	0.00	8.55	0.66	0.12	0.00	0.04
Heater	404	51.30	11.94	112.68	0.96	0.13	0.03	0.28	0.00
ULSD	2953	0.00	0.00	0.00	22.07	0.00	0.00	0.00	0.01
B20	3265	29.17	17.97	0.00	20.76	0.01	0.01	0.00	0.01
APU	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Shut-down	6	0.00	0.00	101.59	3.30	0.00	0.00	16.93	0.55
B100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engine Upgrade	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idling Policy	159269	2853.8	405.85	5149.4	46.70	0.02	0.00	0.03	0.00
Replace	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repower	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TSE	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	3264	60.05	11.87	0.00	170.03	0.02	0.00	0.00	0.05
Unknown	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hybrid	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**171867**	**3498**	**665**	**5364**	**310**	-	-	-	-

Table 46/51-MCDI-2. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Indiana.

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
DOC	1165	162.46	65.05	0.00	16.00	0.14	0.06	0.00	0.01
DPF	10	2.85	1.08	0.00	0.26	0.29	0.11	0.00	0.03
Heater	288	5.03	1.01	10.33	0.09	0.02	0.00	0.04	0.00
ULSD	30	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00
B20	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APU	7	1.81	0.26	2.79	0.00	0.26	0.04	0.40	0.00
Auto Shut-down	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engine Upgrade	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
Idling Policy	832	67.47	14.27	130.85	1.33	0.08	0.02	0.16	0.00
Replace	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repower	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TSE	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	310	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hybrid	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2649**	**240**	**82**	**144**	**18**	-	-	-	-

Table 46/51-MCDI-3. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Michigan.

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
DOC	721	88.38	36.71	0.00	6.68	0.12	0.05	0.00	0.01
DPF	7	9.68	0.79	0.00	0.56	1.38	0.11	0.00	0.08
Heater	148	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ULSD	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B20	108	1.10	6.72	0.00	0.9	0.01	0.06	0.00	0.01
APU	0	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Shut-down	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engine Upgrade	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idling Policy	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Replace	9	0.00	0.90	59.85	0.70	0.00	0.10	6.65	0.08
Repower	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TSE	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	546	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hybrid	3	0.00	0.22	14.96	0.17	0.00	0.07	4.99	0.06
Total	**1543**	**100**	**45**	**75**	**9**	-	-	-	-

Table 46/51-MCDI-4. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Minnesota.

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
DOC	115	15.17	5.35	0.00	1.54	0.13	0.05	0.00	0.01
DPF	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heater	322	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ULSD	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B20	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APU	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Shut-down	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	143700	0.00	0.00	0.00	582.1	0.00	0.00	0.00	0.00
B5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCR	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engine Upgrade	823	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idling Policy	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Replace	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repower	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TSE	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	2875	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hybrid	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**147853**	**15**	**5**	**0**	**584**	-	-	-	-

Table 46/51-MCDI-5. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Ohio.

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
DOC	608	81.74	25.77	0.00	7.01	0.13	0.04	0.00	0.01
DPF	190	158.40	23.64	0.00	10.39	0.83	0.12	0.00	0.05
Heater	65	0.73	0.17	1.61	0.01	0.01	0.00	0.02	0.00
ULSD	92	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00
B20	323	28.53	3.79	0.00	1.66	0.09	0.01	0.00	0.01
APU	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Shut-down	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCR	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engine Upgrade	48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idling Policy	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
Replace	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repower	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TSE	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	279	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hybrid	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**1622**	**269**	**53**	**2**	**19**	**-**	**-**	**-**	**-**

Table 46/51-MCDI-6. Overall emissions reductions and emissions reductions per vehicle for MCDI-funded projects in Wisconsin.

Technology Type	Number of Engines	Emissions Reductions (overall)				Emissions Reductions (per vehicle)			
		CO (t)	VOC (t)	NOx (t)	$PM_{2.5}$ (t)	CO (t/veh)	VOC (t/veh)	NOx (t/veh)	$PM_{2.5}$ (t/veh)
DOC	1100	92.70	34.65	0.00	14.63	0.08	0.03	0.00	0.00
DPF	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heater	10333	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ULSD	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B20	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
APU	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Auto Shut-down	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B100	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B11	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGR	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engine Upgrade	10781	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idling Policy	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Replace	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Repower	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TSE	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	5135	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unknown	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hybrid	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**27359**	**93**	**35**	**0**	**15**	**-**	**-**	**-**	**-**

Measure 46a: Catalyst Diesel Particulate Trap (DPF) Retrofit

Cost of Diesel:	2.33
Incremental Fuel Cost	2%
NOx Reduction	0%
PM Reduction	85%
HC Reduction	80%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	DPF	Baseline	DPF	Baseline	DPF	Baseline	DPF	Baseline	DPF
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 9,000		$ 9,000		$ 9,000		$ 9,000		$ 9,000
Useful Life (years)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Annualized Capital Cost ($/yr)		$1,282		$1,282		$1,282		$1,282		$1,282
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.44	$0.44	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
Fuel Cost/year	$4,795	$4,795	$6,729	$6,729	$10,935	$10,935	$18,505	$18,505	$29,440	$29,440
NOx Emission Std (g/bhp-hr)	10.7		6		5		4		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	33.24	18.30	18.30	14.75	14.75	11.58	11.58	6.95	6.95
PM g/mile	1.86	0.28	1.83	0.27	0.52	0.08	0.29	0.04	0.29	0.04
HC g/mile	4.04	0.81	3.97	0.79	3.83	0.77	3.76	0.75	1.45	0.29
NOx tons/year	0.40	0.40	0.32	0.32	0.42	0.42	0.56	0.56	0.54	0.54
PM tons/year	0.02	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.02	0.00
HC tons/year	0.05	0.01	0.07	0.01	0.11	0.02	0.18	0.04	0.11	0.02
NOx Reduction tons/year		0.00		0.00		0.00		0.00		0.00
PM Reduction tons/year		0.02		0.03		0.01		0.01		0.02
HC Reduction tons/year		0.04		0.06		0.09		0.15		0.09
Cost-Effectiveness ($/ton)		$2,954		$2,069		$3,534		$3,026		$2,601
One-Year Cost-Effectiveness (NOx Only)		-		-		-		-		-

Measure 46b- Lean NOx Catalyst + DPF

Cost of Diesel:	2.33
Increamental Fuel Consumption	2%
NOx Reduction	25%
PM Reduction	85%
HC Reduction	73%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	LNC+DPF	Baseline	LNC+DPF	Baseline	LNC+DPF	Baseline	LNC+DPF	Baseline	LNC+DPF
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 20,000		$ 20,000		$ 20,000		$ 20,000		$ 20,000
Useful Life (years)	8	8	8	8	8	8	8	8	8	8
Annualized Capital Cost ($/yr)		$2,849		$2,849		$2,849		$2,849		$2,849
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.40	$0.40	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38
Fuel Cost/year	$4,373	$4,461	$6,137	$6,260	$9,973	$10,172	$16,877	$17,215	$26,850	$27,387
Incremental Fuel Cost/year		$87		$123		$199		$338		$537
NOx Emission Std (g/bhp-hr)	10.7		6.0		5.0		4.0		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	24.93	18.30	13.73	14.75	11.06	11.58	8.69	6.95	5.21
PM g/mile	1.86	0.28	1.83	0.27	0.52	0.08	0.29	0.04	0.29	0.04
HC g/mile	4.04	1.09	3.97	1.07	3.83	1.04	3.76	1.02	1.45	0.39
NOx tons/year	0.40	0.30	0.32	0.24	0.42	0.32	0.56	0.42	0.54	0.40
PM tons/year	0.02	0.00	0.03	0.00	0.01	0.002	0.01	0.002	0.02	0.003
HC tons/year	0.05	0.01	0.07	0.02	0.11	0.03	0.18	0.05	0.11	0.03
NOx Reduction tons/year		0.10		0.08		0.11		0.14		0.13
PM Reduction tons/year		0.02		0.03		0.01		0.01		0.02
HC Reduction tons/year		0.04		0.05		0.08		0.13		0.08
Cost-Effectiveness ($/ton)		$5,372		$4,105		$6,210		$5,200		$4,617
CE Including Fuel ($/ton)		$5,536		$4,281		$6,645		$5,816		$5,487
One-Year Cost-Effectiveness (NOx Only)		$198,424		$247,822		$189,257		$142,413		$149,195

Measure 46c: EGR+DPF Retrofit

Cost of diesel:	2.33
Incremental Fuel Consumption	3%
NOx Reduction	40%
PM Reduction	85%
HC Reduction	73%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	EGR+DPF	Baseline	EGR+DPF	Baseline	EGR+DPF	Baseline	EGR+DPF	Baseline	EGR+DPF
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 23,000		$ 23,000		$ 23,000		$ 23,000		$ 23,000
Useful Life (years)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Annualized Capital Cost ($/yr)		$3,276		$3,276		$3,276		$3,276		$3,276
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.44	$0.44	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
Fuel Cost/year	$4,795	$4,797	$6,729	$6,731	$10,935	$10,938	$18,505	$18,511	$29,440	$29,449
Incremental Fuel Cost/year		$1		$2		$3		$6		$9
NOx Emission Std (g/bhp-hr)	10.7		6.0		5.0		4.0		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	19.95	18.30	10.98	14.75	8.85	11.58	6.95	6.95	4.17
PM g/mile	1.86	0.28	1.83	0.27	0.52	0.08	0.29	0.04	0.29	0.04
HC g/mile	4.04	1.09	3.97	1.07	3.83	1.04	3.76	1.02	1.45	0.39
NO tons/year	0.40	0.24	0.32	0.19	0.42	0.25	0.56	0.34	0.54	0.32
PM tons/year	0.02	0.00	0.03	0.00	0.01	0.002	0.01	0.002	0.02	0.003
HC tons/year	0.05	0.01	0.07	0.02	0.11	0.03	0.18	0.05	0.11	0.03
NOx Reduction tons/year		0.16		0.13		0.17		0.22		0.21
PM Reduction tons/year		0.02		0.03		0.01		0.01		0.02
HC Reduction tons/year		0.04		0.05		0.08		0.13		0.08
Cost-Effectiveness ($/ton)		$5,545		$4,412		$6,275		$5,183		$4,697
CE Including Fuel ($/ton)		$5,548		$4,415		$6,281		$5,192		$4,710
One-Year Cost-Effectiveness (NOx Only)		$142,617		$178,122		$136,028		$102,359		$107,234

Measure 46d: SCR Retrofit

Cost of Diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Reduction	80%
PM Reduction	0%
HC Redution	0%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	SCR	Baseline	SCR	Baseline	SCR	Baseline	SCR	Baseline	SCR
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 26,500		$ 26,500		$ 26,500		$ 26,500		$ 26,500
Useful Life (years)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Annualized Capital Cost ($/yr)		$3,775		$3,775		$3,775		$3,775		$3,775
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.44	$0.44	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
Fuel Cost/year	$4,795	$4,795	$6,729	$6,729	$10,935	$10,935	$18,505	$18,505	$29,440	$29,440
Urea Cost/year		$96		$135		$219		$370		$589
NOx Emission Std (g/bhp-hr)	10.7		6.0		5.0		4.0		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	6.65	18.30	3.66	14.75	2.95	11.58	2.32	6.95	1.39
PM g/mile	1.86	1.86	1.83	1.83	0.52	0.52	0.29	0.29	0.29	0.29
HC g/mile	4.04	4.04	3.97	3.97	3.83	3.83	3.76	3.76	1.45	1.45
NOx tons/year	0.40	0.08	0.32	0.06	0.42	0.08	0.56	0.11	0.54	0.11
PM tons/year	0.02	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.02	0.02
HC tons/year	0.05	0.05	0.07	0.07	0.11	0.11	0.18	0.18	0.11	0.11
NOx Reduction tons/year		0.32		0.26		0.34		0.45		0.43
PM Reduction tons/year		0.00		0.00		0.00		0.00		0.00
HC Reduction tons/year		0.00		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$11,704		$14,618		$11,163		$8,400		$8,800
CE Including Urea Cost ($/ton)		$12,002		$15,139		$11,810		$9,224		$10,173
One-Year Cost-Effectiveness (NOx Only)		$82,160		$102,614		$78,364		$58,968		$61,776

Measure 46e: Diesel Oxidation Catalyst (DOC) Retrofit

Cost of Diesel:	2.33
Incremental Fuel Cost	2%
NOx Reduction	0%
PM Reduction	40%
HC Reduction	58%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	DOC	Baseline	DOC	Baseline	DOC	Baseline	DOC	Baseline	DOC
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 2,000		$ 2,000		$ 2,000		$ 2,000		$ 2,000
Useful Life (years)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Annualized Capital Cost ($/yr)		$285		$285		$285		$285		$285
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.44	$0.44	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
Fuel Cost/year	$4,795	$4,795	$6,729	$6,729	$10,935	$10,935	$18,505	$18,505	$29,440	$29,440
NOx Emission Std (g/bhp-hr)	10.7		6		5		4		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	33.24	18.30	18.30	14.75	14.75	11.58	11.58	6.95	6.95
PM g/mile	1.86	1.12	1.83	1.10	0.52	0.31	0.29	0.17	0.29	0.17
HC g/mile	4.04	1.70	3.97	1.67	3.83	1.61	3.76	1.58	1.45	0.61
NOx tons/year	0.40	0.40	0.32	0.32	0.42	0.42	0.56	0.56	0.54	0.54
PM tons/year	0.02	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.01
HC tons/year	0.05	0.02	0.07	0.03	0.11	0.05	0.18	0.08	0.11	0.05
NOx Reduction tons/year		0.00		0.00		0.00		0.00		0.00
PM Reduction tons/year		0.01		0.01		0.01		0.01		0.01
HC Reduction tons/year		0.03		0.04		0.06		0.11		0.06
Cost-Effectiveness ($/ton)		$1,314		$920		$1,431		$1,156		$1,093
One-Year Cost-Effectiveness (NOx Only)		-		-		-		-		-

Measure 46f: Flow Through Filter (FTF) Retrofit

Cost of Diesel:	2.33
Incremental Fuel Cost	2%
NOx Reduction	0%
PM Reduction	50%
HC Reduction	80%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	FTF	Baseline	FTF	Baseline	FTF	Baseline	FTF	Baseline	FTF
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 9,000		$ 9,000		$ 9,000		$ 9,000		$ 9,000
Useful Life (years)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Annualized Capital Cost ($/yr)		$1,282		$1,282		$1,282		$1,282		$1,282
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.44	$0.44	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
Fuel Cost/year	$4,795	$4,795	$6,729	$6,729	$10,935	$10,935	$18,505	$18,505	$29,440	$29,440
NOx Emission Std (g/bhp-hr)	10.7		6		5		4		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	33.24	18.30	18.30	14.75	14.75	11.58	11.58	6.95	6.95
PM g/mile	1.86	0.93	1.83	0.92	0.52	0.26	0.29	0.14	0.29	0.14
HC g/mile	4.04	0.81	3.97	0.79	3.83	0.77	3.76	0.75	1.45	0.29
NOx tons/year	0.40	0.40	0.32	0.32	0.42	0.42	0.56	0.56	0.54	0.54
PM tons/year	0.02	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.01
HC tons/year	0.05	0.01	0.07	0.01	0.11	0.02	0.18	0.04	0.11	0.02
NOx Reduction tons/year		0.00		0.00		0.00		0.00		0.00
PM Reduction tons/year		0.01		0.02		0.01		0.01		0.01
HC Reduction tons/year		0.04		0.06		0.09		0.15		0.09
Cost-Effectiveness ($/ton)		$4,650		$3,257		$4,945		$3,941		$3,809
One-Year Cost-Effectiveness (NOx Only)		-		-		-		-		-

Measure 46g: DOC+SCR Retrofit

Cost of Diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Reduction	80%
PM Reduction	25%
HC Reduction	58%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	DOC+SCR	Baseline	DOC+SCR	Baseline	DOC+SCR	Baseline	DOC+SCR	Baseline	DOC+SCR
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 27,500		$ 27,500		$ 27,500		$ 27,500		$ 27,500
Useful Life (years)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Annualized Capital Cost ($/yr)		$3,918		$3,918		$3,918		$3,918		$3,918
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.44	$0.44	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
Fuel Cost/year	$4,795	$4,795	$6,729	$6,729	$10,935	$10,935	$18,505	$18,505	$29,440	$29,440
Urea Cost/year		$96		$135		$219		$370		$589
NOx Emission Std (g/bhp-hr)	10.7		6.0		5.0		4.0		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	6.65	18.30	3.66	14.75	2.95	11.58	2.32	6.95	1.39
PM g/mile	1.86	1.40	1.83	1.37	0.52	0.39	0.29	0.22	0.29	0.22
HC g/mile	4.04	1.72	3.97	1.69	3.83	1.63	3.76	1.60	1.45	0.62
NOx tons/year	0.40	0.08	0.32	0.06	0.42	0.08	0.56	0.11	0.54	0.11
PM tons/year	0.02	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.02
HC tons/year	0.05	0.02	0.07	0.03	0.11	0.05	0.18	0.08	0.11	0.05
NOx Reduction tons/year		0.32		0.26		0.34		0.45		0.43
PM Reduction tons/year		0.01		0.01		0.00		0.004		0.006
HC Reduction tons/year		0.03		0.04		0.06		0.10		0.06
Cost-Effectiveness ($/ton)		$8,313		$8,325		$7,960		$6,004		$6,298
CE Including Urea Cost ($/ton)		$8,517		$8,611		$8,404		$6,571		$7,245
One-Year Cost-Effectiveness (NOx Only)		$85,260		$106,486		$81,321		$61,193		$64,107

Measure 46h: SCR+DPF Retrofit

Cost of Diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Reduction	80%
PM Reduction	85%
HC Reduction	73%
HC to ROG Conversion	1.26639

	MY1989 & Earlier		MY 1990		MY 1991 - 1997		MY 1998 - 2001		MY 2002 - 2006	
	Baseline	SCR+DPF	Baseline	SCR+DPF	Baseline	SCR+DPF	Baseline	SCR+DPF	Baseline	SCR+DPF
Annual mileage	11,000	11,000	16,000	16,000	26,000	26,000	44,000	44,000	70,000	70,000
Incremental Capital Cost		$ 30,000		$ 30,000		$ 30,000		$ 30,000		$ 30,000
Useful Life (years)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Annualized Capital Cost ($/yr)		$4,274		$4,274		$4,274		$4,274		$4,274
Diesel mpg	5.35	5.35	5.54	5.54	5.54	5.54	5.54	5.54	5.54	5.54
Fuel Cost/mile	$0.44	$0.44	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42	$0.42
Fuel Cost/year	$4,795	$4,795	$6,729	$6,729	$10,935	$10,935	$18,505	$18,505	$29,440	$29,440
Urea Cost/year		$96		$135		$219		$370		$589
NOx Emission Std (g/bhp-hr)	10.7		6.0		5.0		4.0		2.4	
PM Emission Std (g/bhp-hr)	0.6		0.6		0.2		0.1		0.1	
HC Emission Std (g/bhp-hr)	1.3		1.3		1.3		1.3		0.5	
Conversion Factor (bhp-hr/mi)	3.11		3.05		2.95		2.90		2.90	
NOx g/mile	33.24	6.65	18.30	3.66	14.75	2.95	11.58	2.32	6.95	1.39
PM g/mile	1.86	0.28	1.83	0.27	0.52	0.08	0.29	0.04	0.29	0.04
HC g/mile	4.04	1.11	3.97	1.09	3.83	1.05	3.76	1.03	1.45	0.40
NOx tons/year	0.40	0.08	0.32	0.06	0.42	0.08	0.56	0.11	0.54	0.11
PM tons/year	0.02	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.02	0.00
HC tons/year	0.05	0.01	0.07	0.02	0.11	0.03	0.18	0.05	0.11	0.03
NOx Reduction tons/year		0.32		0.26		0.34		0.45		0.43
PM Reduction tons/year		0.02		0.03		0.01		0.012		0.019
HC Reduction tons/year		0.04		0.05		0.08		0.13		0.08
Cost-Effectiveness ($/ton)		$5,684		$4,905		$6,189		$4,994		$4,689
CE Including Urea Cost ($/ton)		$5,812		$5,060		$6,505		$5,427		$5,335
One-Year Cost-Effectiveness (NOx Only)		$93,011		$116,167		$88,714		$66,756		$69,935

Measure 51a: DPF Retrofits

Cost of diesel:	2.33
Incremental Fuel Consumption	2%
NOx Reduction	0%
PM Reduction	85%
HC Reduction	80%
HC to ROG Conversion	1.26539

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF
NOx Emission Std (g/bhp-hr)	9.5	9.5	9.3	9.30	9.5	9.30	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.20	1.00	0.20	1.00	0.20	0.25	0.05	0.25	0.05	0.24	0.05	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	9431	9619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481
Fuel Cost ($/yr)	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,711	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351
Incremental Fuel Cost/yr		$439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438
Incremental Capital Cost		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	771	771	1303	1303	2522	2522	569	569	967	967	1832	1832	378	378	652	652	1211	1211	231	231	399	399	757	757
PM Emission Factor (g/hr)	34	5	60	9	109	16	23	4	17	3	32	5	10	2	12	2	23	4	9	1	12	2	23	4
HC Emission Factor (g/hr)	0	0	0	0	0	0	61	12	169	33	298	59	20	4	34	7	64	13	12	2	21	4	40	8
NOx (tons/year)	1.11	1.11	1.88	1.88	3.64	3.64	0.81	0.81	1.40	1.40	2.65	2.65	0.55	0.55	0.94	0.94	1.75	1.75	0.33	0.33	0.58	0.58	1.09	1.09
PM (tons/year)	0.05	0.01	0.09	0.01	0.16	0.02	0.04	0.01	0.02	0.00	0.05	0.01	0.01	0.00	0.02	0.00	0.03	0.01	0.01	0.00	0.02	0.00	0.03	0.01
HC (tons/year)	-	-	-	-	-	-	0.12	0.02	0.20	0.04	0.38	0.08	0.03	0.01	0.05	0.01	0.09	0.02	0.02	0.00	0.03	0.01	0.06	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.04		0.07		0.13		0.03		0.02		0.04		0.01		0.02		0.03		0.01		0.02		0.03
HC Reduction (tons/year)		-		-		-		0.09		0.16		0.31		0.02		0.04		0.07		0.01		0.02		0.05
Cost-Effectiveness ($/ton)		$722		$722		$747		$844		$1,703		$1,708		$2,151		$2,990		$2,998		$2,536		$3,164		$3,164
CE Including Fuel ($/ton)		$1,242		$1,242		$1,284		$1,451		$2,937		$2,937		$3,698		$5,140		$5,155		$4,361		$5,441		$5,441
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF
NOx Emission Std (g/bhp-hr)	9.5	9.5	9.3	9.30	9.5	9.50	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.20	1.00	0.20	1.00	0.20	0.25	0.05	0.25	0.05	0.24	0.05	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6575	6704	11,353	11,580	21,510	21,941	6,573	6,704	11,351	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941
Fuel Cost ($/yr)	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122
Incremental Fuel Cost/yr		$306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002
Incremental Capital Cost		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	771	771	1303	1303	2522	2522	569	569	967	967	1832	1832	378	378	652	652	1211	1211	231	231	399	399	757	757
PM Emission Factor (g/hr)	34	5	60	9	109	16	23	4	17	3	32	5	10	2	12	2	23	4	9	1	12	2	23	4
HC Emission Factor (g/hr)	0	0	0	0	0	0	61	12	169	33	298	59	20	4	34	7	64	13	12	2	21	4	40	8
NOx (tons/year)	0.78	0.78	1.31	1.31	2.54	2.54	0.56	0.56	0.97	0.97	1.84	1.84	0.38	0.38	0.66	0.66	1.22	1.22	0.23	0.23	0.40	0.40	0.76	0.76
PM (tons/year)	0.03	0.01	0.06	0.01	0.11	0.02	0.02	0.00	0.02	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.02	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.02	0.14	0.03	0.27	0.05	0.03	0.01	0.03	0.01	0.06	0.01	0.01	0.00	0.02	0.00	0.04	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.03		0.05		0.09		0.02		0.01		0.03		0.01		0.01		0.02		0.01		0.01		0.02
HC Reduction (tons/year)		-		-		-		0.07		0.11		0.21		0.02		0.03		0.05		0.01		0.02		0.03
Cost-Effectiveness ($/ton)		$1,036		$1,036		$1,071		$1,210		$2,451		$2,451		$3,080		$4,289		$4,302		$3,639		$4,540		$4,540
CE Including Fuel ($/ton)		$1,556		$1,556		$1,609		$1,817		$3,679		$3,679		$4,634		$6,449		$6,469		$5,464		$6,816		$6,816
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF
NOx Emission Std (g/bhp-hr)	9.5	9.5	9.3	9.30	9.5	9.50	9.7	9.70	6.9	6.9	6.9	6.90	6.9	6.90	6.9	6.900	4.655	4.66	4.655	4.66	4.56	4.56	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.20	1.00	0.20	1.00	0.20	1.00	0.200	0.25	0.05	0.25	0.05	0.24	0.05	0.24	0.05	0.15	0.03	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481
Fuel Cost ($/yr)	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321
Incremental Fuel Cost/yr		$377		$ 651		$ 1,233		$ 1,849		$377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849
Incremental Capital Cost		$5,211		$9,000		$17,053		$25,579		$5,211		$9,000		$17,053		$25,579		$5,211		$9,000		$17,053		$25,579		$5,211		$9,000		$17,053		$25,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$611		$1,055		$1,999		$2,999		$611		$1,055		$1,999		$2,999		$611		$1,055		$1,999		$2,999		$611		$1,055		$1,999		$2,999
NOx Emission Factor (g/hr)	771	771	1303	1303	2523	2523	3863	3863	560	560	967	967	1832	1832	2748	2748	378	378	652	652	1211	1211	1816	1816	231	231	399	399	757	757	1135	1135
PM Emission Factor (g/hr)	34	5	60	9	109	16	164	25	25	4	17	3	32	5	55	8	10	2	17	2	23	4	35	5	5	1	12	2	23	4	35	5
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	81	16	162	32	266	53	399	80	20	4	34	7	64	13	95	19	12	2	21	4	40	8	60	12
NOx (tons/year)	0.95	0.95	1.61	1.61	3.12	3.12	4.78	4.78	0.69	0.69	1.20	1.20	2.27	2.27	3.40	3.40	0.47	0.47	0.81	0.81	1.50	1.50	2.25	2.25	0.29	0.29	0.49	0.49	0.94	0.94	1.41	1.41
PM (tons/year)	0.04	0.01	0.07	0.01	0.13	0.02	0.20	0.03	0.03	0.00	0.02	0.00	0.04	0.01	0.06	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	0.10	0.02	0.17	0.03	0.33	0.07	0.49	0.10	0.02	0.00	0.04	0.01	0.08	0.02	0.12	0.02	0.02	0.00	0.03	0.01	0.05	0.01	0.07	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.04		0.06		0.11		0.17		0.03		0.02		0.03		0.05		0.01		0.02		0.04		0.01		0.01		0.02		0.04		0.04
HC Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$842		$842		$871		$871		$581		$1,992		$1,992		$1,992		$2,599		$3,487		$3,492		$3,487		$7,459		$3,691		$3,691		$3,691
CE including Fuel ($/ton)		$1,362		$1,362		$1,408		$1,408		$1,581		$3,221		$3,221		$3,221		$4,057		$5,638		$5,655		$5,655		$6,783		$5,967		$5,967		$5,967
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	DPF	Tier 0 Baseline	DPF	Tier 1 Baseline	DPF	Tier 1 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF
NOx Emission Std (g/bhp-hr)	8.35	8.350	9.5	9.50	6.9	6.90	6.9	6.900	5.32	5.32	4.655	4.66	3.325	3.33	2.85	2.85
PM Emission Std (g/bhp-hr)	0.553	0.083	0.42	0.06	0.55	0.08	0.30	0.045	0.19	0.03	0.15	0.02	0.15	0.03	0.11	0.02
HC Emission Std (g/bhp-hr)	0.60	0.00	0.00	0.00	1.00	0.20	1.00	0.20	0.28	0.06	0.25	0.05	0.18	0.04	0.13	0.03
Average Horsepower (hp)	88	88	138	138	88	88	138	138	88	88	138	138	88	88	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648
Fuel Cost ($/yr)	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139
Incremental Fuel Cost/yr		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532
Incremental Capital Cost		$3,316		$5,211		$3,316		$5,211		$3,316		$5,211		$3,316		$5,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$389		$611		$389		$611		$389		$611		$389		$611
NOx Emission Factor (g/hr)	262	262	274	274	127	127	199	199	95	95	134	134	61	61	82	82
PM Emission Factor (g/hr)	10	2	12	2	10	2	9	1	4	1	4	1	4	1	3	0
HC Emission Factor (g/hr)	0	0	0	0	18	4	36	8	5	1	7	1	5	1	4	1
NOx (tons/year)	0.24	0.24	0.41	0.41	0.19	0.19	0.30	0.30	0.15	0.15	0.20	0.20	0.09	0.09	0.12	0.12
PM (tons/year)	0.02	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
HC (tons/year)	-	-	-	-	0.03	0.01	0.04	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.01		0.03		0.01		0.01		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.03		0.01		0.01		0.00		0.01
Cost-Effectiveness ($/ton)		$1,507		$1,951		$1,355		$1,260		$3,972		$5,812		$4,095		$6,853
CE including Fuel ($/ton)		$2,962		$3,651		$2,663		$4,264		$7,806		$10,876		$8,047		$12,824
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0 Baseline	DPF	Tier 1 Baseline	DPF	Tier 2 Baseline	DPF
NOx Emission Std (g/bhp-hr)	9.2	9.20	6.9	6.90	4.56	4.56
PM Emission Std (g/bhp-hr)	0.41	0.00	0.12	0.02	0.09	0.01
HC Emission Std (g/bh.p-hr)	0.00	0.00	1.00	0.20	0.24	0.05
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	142,962	140,159	142,963	140,159	142,962
Fuel Cost ($/yr)	326,570	333,102	326,570	333,102	326,570	333,102
Incremental Fuel Cost/yr		$ 6,531		$ 6,531		$ 6,531
Incremental Capital Cost		$51,521		$51,521		$51,521
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$6,040		$6,040		$6,040
NOx Emission Factor (g/hr)	7781	7781	5515	5515	3658	3658
PM Emission Factor (g/hr)	329	49	98	14	71	11
HC Emission Factor (g/hr)	0	0	802	160	193	39
NOx (tons/year)	16.89	16.89	12.01	(2.01)	7.94	7.94
PM (tons/year)	0.72	0.11	0.21	0.03	0.15	0.02
HC (tons/year)	-	-	1.74	0.35	0.42	0.08
NOx Reduction (tons/year)		-		-		-
PM Reduction (tons/year)		0.61		0.18		0.13
HC Reduction (tons/year)		-		1.39		0.33
Cost-Effectiveness ($/ton)		$497		$1,136		$1,993
CE (excluding Fuel ($/ton)		$1,034		$2,365		$4,152
One-Year Cost-Effectiveness		-		-		-

Measure 51b: Cleaire Lean NOx Catalyst + DPF Retrofits

Cost of diesel:	2.33
Incremental Fuel Consumption	2%
NOx Reduction	25%
PM Reduction	85%
HC Reduction	75%
HC to ROG Conversion	1.25639

Assuming 2% increase in fuel consumption

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF
NOx Emission Std (g/bhp-hr)	9.5	7.125	9.5	6.99	9.5	7.13	6.9	5.18	6.9	5.18	6.9	5.18	4.655	3.49	4.655	3.49	4.56	3.42	2.85	2.14	2.85	2.14	2.85	2.14
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	1.00	0.27	0.25	0.07	0.25	0.07	0.24	0.06	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	9431	9619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481
Fuel Cost ($/yr)	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351
Incremental Fuel Cost/yr		$439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438
Incremental Capital Cost		$11,579		$20,000		$37,895		$11,579		$20,000		$37,895		$11,579		$20,000		$37,895		$11,579		$20,000		$37,895
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,357		$2,345		$4,442		$1,357		$2,345		$4,442		$1,357		$2,345		$4,442		$1,357		$2,345		$4,442
NOx Emission Factor (g/hr)	771	578	1303	977	2522	1892	560	420	967	725	1832	1374	378	283	652	489	1211	908	233	173	399	300	757	568
PM Emission Factor (g/hr)	34	5	60	9	109	16	25	4	17	3	32	5	10	2	12	2	23	4	9	1	12	2	23	4
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	22	140	38	266	72	20	5	34	9	64	17	12	3	21	6	40	11
NOx (tons/year)	1.11	0.83	1.88	1.41	3.64	2.73	0.81	0.61	1.40	1.05	12.65	1.98	0.55	0.41	0.94	0.71	1.75	1.31	0.33	0.25	0.58	0.43	1.09	0.82
PM (tons/year)	0.05	0.01	0.09	0.01	0.16	0.02	0.04	0.01	0.02	0.00	0.05	0.01	0.01	0.00	0.02	0.00	0.03	0.01	0.01	0.00	0.02	0.00	0.03	0.01
HC (tons/year)	-	-	-	-	-	-	0.12	0.03	0.20	0.05	0.38	0.10	0.03	0.01	0.05	0.01	0.09	0.02	0.02	0.00	0.03	0.01	0.06	0.02
NOx Reduction (tons/year)		0.28		0.47		0.91		0.20		0.35		0.66		0.14		0.24		0.44		0.08		0.14		0.27
PM Reduction (tons/year)		0.04		0.07		0.13		0.03		0.02		0.04		0.01		0.02		0.03		0.01		0.02		0.03
HC Reduction (tons/year)		-		-		-		0.09		0.15		0.28		0.02		0.04		0.07		0.01		0.02		0.04
Cost-Effectiveness ($/ton)		$1,208		$1,214		$1,238		$1,482		$2,471		$2,471		$3,249		$4,015		$4,055		$4,206		$4,937		$4,937
CE Including Fuel ($/ton)		$1,599		$1,607		$1,639		$1,962		$3,271		$3,271		$4,301		$5,314		$5,367		$5,567		$6,535		$6,535
One-Year Cost-Effectiveness		$41,618		$42,513		$41,618		$57,300		$57,300		$57,300		$84,935		$84,935		$86,704		$138,727		$138,727		$138,727

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF
NOx Emission Std (g/bhp-hr)	9.5	7.125	9.5	6.99	9.5	7.13	6.9	5.18	6.9	5.18	6.9	5.18	4.655	3.49	4.655	3.49	4.56	3.42	2.85	2.14	2.85	2.14	2.85	2.14
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	1.00	0.27	0.25	0.07	0.25	0.07	0.24	0.06	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6573	6704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941
Fuel Cost ($/yr)	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122
Incremental Fuel Cost/yr		$306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002
Incremental Capital Cost		$11,579		$20,000		$37,895		$11,579		$20,000		$37,895		$11,579		$20,000		$37,895		$11,579		$20,000		$37,895
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,357		$2,345		$4,442		$1,357		$2,345		$4,442		$1,357		$2,345		$4,442		$1,357		$2,345		$4,442
NOx Emission Factor (g/hr)	771	578	1303	977	2522	1892	560	420	967	725	1832	1374	378	283	652	489	1211	908	233	173	399	300	757	568
PM Emission Factor (g/hr)	34	5	60	9	109	16	25	4	17	3	32	5	10	2	12	2	23	4	9	1	12	2	23	4
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	22	140	38	266	72	20	5	34	9	64	17	12	3	21	6	40	11
NOx (tons/year)	0.78	0.58	1.31	0.98	2.54	1.90	0.56	0.42	0.97	0.73	11.84	1.38	0.38	0.29	0.66	0.49	1.22	0.91	0.23	0.17	0.40	0.30	0.76	0.57
PM (tons/year)	0.03	0.01	0.06	0.01	0.11	0.02	0.02	0.00	0.02	0.00	0.05	0.01	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.02	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.02	0.14	0.04	0.27	0.07	0.02	0.01	0.03	0.01	0.06	0.02	0.01	0.00	0.02	0.01	0.04	0.01
NOx Reduction (tons/year)		0.19		0.33		0.63		0.14		0.24		0.46		0.10		0.16		0.30		0.06		0.10		0.19
PM Reduction (tons/year)		0.03		0.05		0.09		0.02		0.01		0.03		0.01		0.01		0.02		0.01		0.01		0.02
HC Reduction (tons/year)		-		-		-		0.06		0.10		0.20		0.01		0.03		0.05		0.01		0.02		0.03
Cost-Effectiveness ($/ton)		$1,733		$1,742		$1,777		$2,127		$3,545		$3,545		$4,662		$5,760		$5,818		$6,034		$7,083		$7,083
CE Including Fuel ($/ton)		$2,124		$2,135		$2,178		$2,607		$4,345		$4,345		$5,714		$7,060		$7,130		$7,396		$8,682		$8,682
One-Year Cost-Effectiveness		$59,715		$60,999		$59,715		$82,216		$82,216		$82,216		$121,867		$121,867		$124,406		$199,050		$199,050		$199,050

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF
NOx Emission Std (g/bhp-hr)	9.5	7.125	9.5	6.98	9.5	7.13	9.2	7.25	6.9	5.175	6.9	5.18	6.9	5.18	6.9	5.18	4.655	3.49	4.655	3.49	4.55	3.42	4.55	3.42	2.85	2.14	2.85	2.14	2.85	2.14	2.85	2.14
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.12	0.02	0.13	0.03	0.09	0.01	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	1.00	0.27	1.00	0.27	0.25	0.03	0.25	0.07	0.24	0.06	0.24	0.06	0.15	0.04	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481
Fuel Cost ($/yr)	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321
Incremental Fuel Cost/yr		$376		$ 651		$ 1,253		$ 1,849		$377		$ 651		$ 1,253		$ 1,849		$ 377		$ 651		$ 1,253		$ 1,849		$ 377		$ 651		$ 1,253		$ 1,849
Incremental Capital Cost		$11,579		$20,000		$37,895		$56,842		$11,579		$20,000		$37,895		$56,842		$11,579		$20,000		$37,895		$56,842		$11,579		$20,000		$37,895		$56,842
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,357		$2,345		$4,442		$6,664		$1,357		$2,345		$4,442		$6,664		$1,357		$2,345		$4,442		$6,664		$1,357		$2,345		$4,442		$6,664
NOx Emission Factor (g/hr)	771	578	1303	977	2572	1892	3863	2897	566	420	967	729	1823	1374	2748	2061	378	283	653	489	1211	908	1816	1362	231	173	399	300	757	568	1135	851
PM Emission Factor (g/hr)	34	5	60	9	109	16	164	25	25	4	43	7	77	12	116	18	17	3	29	4	54	8	80	12	10	2	18	3	34	5	50	8
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	81	22	140	38	266	72	398	108	20	5	34	9	64	17	96	26	12	3	21	6	40	11	60	16
NOx (tons/year)	0.95	0.72	1.61	1.21	3.17	2.34	4.78	3.59	0.69	0.52	1.20	0.90	2.27	1.70	3.40	2.55	0.47	0.35	0.81	0.61	1.50	1.12	2.25	1.69	0.29	0.21	0.49	0.37	0.94	0.70	1.41	1.05
PM (tons/year)	0.04	0.01	0.07	0.01	0.13	0.02	0.20	0.03	0.03	0.00	0.02	0.00	0.04	0.01	0.06	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	0.10	0.03	0.17	0.05	0.33	0.09	0.49	0.13	0.02	0.01	0.04	0.01	0.08	0.02	0.12	0.03	0.02	0.00	0.03	0.01	0.05	0.01	0.07	0.02
NOx Reduction (tons/year)		0.24		0.40		0.78		1.29		0.17		0.30		0.57		0.85		0.12		0.20		0.37		0.56		0.07		0.12		0.23		0.35
PM Reduction (tons/year)		0.04		0.06		0.11		0.17		0.03		0.02		0.03		0.05		0.01		0.01		0.02		0.04		0.01		0.01		0.02		0.04
HC Reduction (tons/year)		-		-		-		-		0.07		0.13		0.24		0.36		0.02		0.03		0.06		0.09		0.01		0.02		0.04		0.05
Cost-Effectiveness ($/ton)		$1,409		$1,416		$1,444		$1,457		$1,729		$2,682		$2,882		$2,882		$3,790		$4,683		$4,730		$4,730		$4,906		$5,759		$5,759		$5,759
CE Including Fuel ($/ton)		$1,800		$1,809		$1,845		$1,836		$2,209		$3,682		$3,682		$3,682		$4,842		$5,983		$6,042		$6,042		$6,268		$7,357		$7,357		$7,357
One-Year Cost-Effectiveness		$48,548		$49,597		$48,548		$47,547		$60,842		$66,842		$66,842		$66,842		$99,078		$99,078		$101,142		$101,142		$161,828		$161,828		$161,828		$161,828

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	LNC+DPF	Tier 0 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF
NOx Emission Std (g/bhp-hr)	8.8	6.60	9.5	7.13	6.9	5.18	6.9	5.18	5.32	3.99	4.655	3.49	3.725	2.49	2.85	2.14
PM Emission Std (g/bhp-hr)	0.55	0.08	0.42	0.06	0.55	0.08	0.30	0.05	0.19	0.03	0.13	0.02	0.19	0.03	0.11	0.02
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	0.28	0.08	0.25	0.07	0.18	0.05	0.15	0.04
Average Horsepower (hp)	88	88	138	138	88	88	138	138	88	88	138	138	88	88	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648
Fuel Cost ($/yr)	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139
Incremental Fuel Cost/yr		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532
Incremental Capital Cost		$7,368		$11,579		$7,368		$11,579		$7,368		$11,579		$7,368		$11,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$864		$1,357		$864		$1,357		$864		$1,357		$864		$1,357
NOx Emission Factor (g/hr)	162	121	236	306	127	95	199	149	98	73	134	101	61	46	82	62
PM Emission Factor (g/hr)	10	2	12	2	10	2	7	1	4	1	4	1	2	0	3	0
HC Emission Factor (g/hr)	0	0	0	0	18	5	29	8	3	1	7	2	3	1	4	1
NOx (tons/year)	0.24	0.18	0.41	0.31	0.19	0.14	0.30	0.22	0.15	0.11	0.20	0.15	0.09	0.07	0.12	0.09
PM (tons/year)	0.02	0.00	0.02	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
HC (tons/year)	-	-	-	-	0.03	0.01	0.04	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00
NOx Reduction (tons/year)		0.06		0.10		0.05		0.07		0.04		0.05		0.02		0.03
PM Reduction (tons/year)		0.01		0.02		0.01		0.01		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.03		0.01		0.01		0.00		0.00
Cost-Effectiveness ($/ton)		$2,711		$3,263		$2,602		$4,005		$6,452		$8,789		$7,355		$11,365
CE Including Fuel ($/ton)		$3,889		$4,542		$3,732		$5,576		$9,255		$12,222		$10,351		$15,830
One-Year Cost-Effectiveness		$121,409		$112,663		$154,840		$154,840		$200,827		$229,516		$321,323		$374,876

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0 Baseline	LNC+DPF	Tier 1 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF
NOx Emission Std (g/bhp-hr)	9.7	7.28	6.9	5.18	4.58	3.42
PM Emission Std (g/bhp-hr)	0.41	0.06	0.12	0.02	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	1.00	0.27	0.24	0.06
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	142,962	140,159	142,962	140,159	142,962
Fuel Cost ($/yr)	326,570	333,102	326,570	333,102	326,570	333,102
Incremental Fuel Cost/yr		$ 6,531		$ 6,531		$ 6,531
Incremental Capital Cost		$114,492		$114,492		$114,492
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$13,422		$13,422		$13,422
NOx Emission Factor (g/hr)	7781	5836	5535	4153	3658	2743
PM Emission Factor (g/hr)	329	49	96	16	71	11
HC Emission Factor (g/hr)	0	0	802	217	193	52
NOx (tons/year)	16.89	12.67	12.01	9.01	7.94	5.95
PM (tons/year)	0.72	0.11	0.21	0.03	0.15	0.02
HC (tons/year)	-	-	1.74	0.47	0.42	0.11
NOx Reduction (tons/year)		4.22		3.00		1.98
PM Reduction (tons/year)		0.61		0.18		0.13
HC Reduction (tons/year)		-		1.27		0.31
Cost-Effectiveness ($/ton)		$819		$1,644		$2,698
CE Including Fuel ($/ton)		$1,218		$2,444		$4,010
One-Year Cost-Effectiveness		$27,118		$38,123		$57,686

Measure 51e: EGR+DPF Retrofits

Cost of Diesel:	2.33
Incremental Fuel Consumption	3%
NOx Reduction	40%
PM Reduction	85%
HC Reduction	75%
HC to ROG Conversion	1.26639

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF
NOx Emission Std (g/bhp-hr)	9.3	5.7	9.3	5.58	9.3	5.70	6.9	4.14	6.9	4.14	6.9	4.14	4.655	2.79	4.655	2.79	4.56	2.74	2.85	1.71	2.85	1.71	2.85	1.71
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	1.00	0.27	0.25	0.07	0.25	0.07	0.24	0.06	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	9431	9714	16,289	16,778	30,864	31,790	9,431	9,714	16,289	16,778	30,864	31,790	9,431	9,714	16,289	16,778	30,864	31,790	9,431	9,714	16,289	16,778	30,864	31,790
Fuel Cost ($/yr)	21,973	22,633	37,954	39,093	71,913	74,070	21,973	22,633	37,954	39,093	71,913	74,070	21,973	22,633	37,954	39,093	71,913	74,070	21,973	22,633	37,954	39,093	71,913	74,070
Incremental Fuel Cost/yr		$659		$ 1,139		$ 2,157		$ 659		$ 1,139		$ 2,157		$ 659		$ 1,139		$ 2,157		$ 659		$ 1,139		$ 2,157
Incremental Capital Cost		$13,316		$23,000		$43,579		$13,316		$23,000		$43,579		$13,316		$23,000		$43,579		$13,316		$23,000		$43,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,561		$2,696		$5,109		$1,561		$2,696		$5,109		$1,561		$2,696		$5,109		$1,561		$2,696		$5,109
NOx Emission Factor (g/hr)	771	463	1303	782	2522	1513	569	326	967	580	1832	1099	378	227	652	391	1211	726	231	139	399	240	757	454
PM Emission Factor (g/hr)	34	5	60	9	109	16	25	4	42	6	79	12	10	2	17	3	32	5	9	1	17	3	33	5
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	22	140	38	266	72	26	7	46	12	86	23	12	3	21	6	40	11
NOx (tons/year)	1.11	0.67	1.88	1.13	3.64	2.19	0.81	0.48	1.40	0.84	2.65	1.59	0.55	0.33	0.94	0.57	1.75	1.05	0.33	0.20	0.58	0.35	1.09	0.66
PM (tons/year)	0.05	0.01	0.09	0.01	0.16	0.02	0.04	0.01	0.02	0.00	0.05	0.01	0.01	0.00	0.02	0.00	0.05	0.01	0.01	0.00	0.02	0.00	0.03	0.01
HC (tons/year)	-	-	-	-	-	-	0.12	0.03	0.20	0.05	0.38	0.10	0.03	0.01	0.05	0.01	0.09	0.02	0.02	0.00	0.03	0.01	0.06	0.02
NOx Reduction (tons/year)		0.45		0.75		1.46		0.32		0.56		1.06		0.22		0.38		0.70		0.13		0.23		0.44
PM Reduction (tons/year)		0.04		0.07		0.13		0.03		0.02		0.04		0.01		0.02		0.03		0.01		0.02		0.03
HC Reduction (tons/year)		-		-		-		0.09		0.15		0.28		0.02		0.04		0.07		0.01		0.02		0.04
Cost-Effectiveness ($/ton)		$1,209		$1,216		$1,236		$1,505		$2,328		$2,328		$3,125		$5,718		$5,762		$4,187		$4,803		$4,803
CE including Fuel ($/ton)		$1,720		$1,732		$1,758		$2,141		$3,311		$3,311		$4,444		$8,287		$8,351		$5,955		$6,831		$6,833
One-Year Cost-Effectiveness		$29,913		$30,536		$29,913		$41,185		$41,185		$41,185		$61,047		$61,047		$62,319		$99,710		$99,710		$99,710

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF
NOx Emission Std (g/bhp-hr)	9.3	5.7	9.3	5.58	9.3	5.70	6.9	4.14	6.9	4.14	6.9	4.14	4.655	2.79	4.655	2.79	4.56	2.74	2.85	1.71	2.85	1.71	2.85	1.71
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.30	0.03	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	1.00	0.27	0.25	0.07	0.25	0.07	0.24	0.06	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	912	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6573	6770	11,353	11,693	21,510	22,156	6,573	6,770	11,353	11,693	21,510	22,156	6,573	6,770	11,353	11,693	21,510	22,156	6,573	6,770	11,353	11,693	21,510	22,156
Fuel Cost ($/yr)	15,314	15,774	26,452	27,245	50,119	51,623	15,314	15,774	26,452	27,245	50,119	51,623	15,314	15,774	26,452	27,245	50,119	51,623	15,314	15,774	26,452	27,245	50,119	51,623
Incremental Fuel Cost/yr		$459		$ 794		$ 1,504		$ 459		$ 794		$ 1,504		$ 459		$ 794		$ 1,504		$ 459		$ 794		$ 1,504
Incremental Capital Cost		$13,316		$23,000		$43,579		$13,316		$23,000		$43,579		$13,316		$23,000		$43,579		$13,316		$23,000		$43,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,561		$2,696		$5,109		$1,561		$2,696		$5,109		$1,561		$2,696		$5,109		$1,561		$2,696		$5,109
NOx Emission Factor (g/hr)	771	467	1303	782	2522	1513	569	336	967	580	1832	1099	378	227	652	391	1211	726	231	139	399	240	757	454
PM Emission Factor (g/hr)	34	5	60	9	109	16	25	4	42	6	82	12	10	2	17	3	32	5	9	1	17	3	33	5
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	22	140	38	264	72	26	7	46	12	86	23	12	3	21	6	40	11
NOx (tons/year)	0.78	0.47	1.31	0.79	2.54	1.52	0.56	0.34	0.97	0.58	1.84	1.11	0.38	0.23	0.66	0.39	1.21	0.73	0.23	0.14	0.40	0.24	0.76	0.46
PM (tons/year)	0.03	0.01	0.05	0.01	0.11	0.02	0.02	0.00	0.02	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.02	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.03	0.14	0.04	0.27	0.07	0.02	0.01	0.03	0.01	0.06	0.02	0.01	0.00	0.02	0.01	0.04	0.01
NOx Reduction (tons/year)		0.31		0.52		1.02		0.23		0.39		0.74		0.15		0.26		0.48		0.09		0.16		0.30
PM Reduction (tons/year)		0.03		0.01		0.09		0.02		0.01		0.03		0.01		0.01		0.02		0.01		0.01		0.02
HC Reduction (tons/year)		-		-		-		0.06		0.10		0.20		0.01		0.02		0.05		0.01		0.02		0.03
Cost-Effectiveness ($/ton)		$1,735		$1,748		$1,773		$2,160		$3,340		$3,340		$4,484		$5,334		$5,398		$6,007		$6,891		$6,891
CE Including Fuel ($/ton)		$2,246		$2,262		$2,295		$2,796		$4,323		$4,323		$5,803		$6,904		$6,987		$7,776		$8,919		$8,919
One-Year Cost-Effectiveness		$42,920		$43,843		$42,920		$59,093		$59,093		$59,093		$87,592		$87,592		$89,417		$143,067		$143,067		$143,067

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF
NOx Emission Std (g/bhp-hr)	9.3	5.7	9.3	5.58	9.3	5.70	9.7	5.82	6.9	4.14	6.9	4.14	6.9	4.14	6.9	4.14	4.655	2.79	4.655	2.79	4.56	2.74	4.56	2.74	2.85	1.71	2.85	1.71	2.85	1.71	2.85	1.71
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.41	0.06	0.39	0.05	0.12	0.02	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.09	0.01	0.15	0.02	0.09	0.01	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	1.00	0.27	1.00	0.27	0.25	0.07	0.25	0.07	0.24	0.06	0.24	0.06	0.15	0.04	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8084	8327	13,964	14,383	26,458	27,252	39,687	40,878	8084	8327	13,964	14,383	26,458	27,252	39,687	40,878	8,084	8,327	13,964	14,383	26,458	27,252	39,687	40,878	8,084	8,327	13,964	14,383	26,458	27,252	39,687	40,878
Fuel Cost ($/yr)	18,837	19,402	32,536	33,512	61,647	63,497	92,471	95,245	18,837	19,402	32,536	33,512	61,647	63,497	92,471	95,245	18,837	19,402	32,536	33,512	61,647	63,497	92,471	95,245	18,837	19,402	32,536	33,512	61,647	63,497	92,471	95,245
Incremental Fuel Cost/yr		$565		$ 976		$ 1,849		$ 2,774		$565		$ 976		$ 1,849		$ 2,774		$ 565		$ 976		$ 1,849		$ 2,774		$ 565		$ 976		$ 1,849		$ 2,774
Incremental Capital Cost		$13,316		$23,000		$43,579		$65,368		$13,316		$23,000		$43,579		$65,368		$13,316		$23,000		$43,579		$65,368		$13,316		$23,000		$43,579		$65,368
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,561		$2,696		$5,109		$7,663		$1,561		$2,696		$5,109		$7,663		$1,561		$2,696		$5,109		$7,663		$1,561		$2,696		$5,109		$7,663
NOx Emission Factor (g/hr)	2718	462	3393	795	2572	1513	3883	2358	569	336	967	580	1832	1099	2748	1649	378	227	652	391	1211	726	1816	1090	231	139	399	240	757	454	1135	681
PM Emission Factor (g/hr)	24	5	60	9	109	10	164	25	23	4	17	3	32	5	48	7	10	2	12	2	23	4	35	5	9	1	12	2	23	4	35	5
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	81	22	140	38	266	72	395	108	20	5	34	9	64	17	96	26	12	3	21	6	40	11	60	16
NOx (tons/year)	0.95	0.57	1.61	0.97	3.12	1.87	4.78	2.87	0.69	0.42	1.20	0.72	2.27	1.36	3.40	2.04	0.47	0.28	0.81	0.48	1.50	0.90	2.25	1.35	0.28	0.17	0.49	0.30	0.94	0.56	1.41	0.84
PM (tons/year)	0.04	0.01	0.07	0.01	0.13	0.02	0.20	0.03	0.03	0.00	0.02	0.00	0.04	0.01	0.06	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	0.10	0.03	0.17	0.05	0.33	0.09	0.49	0.13	0.02	0.01	0.04	0.01	0.08	0.02	0.12	0.03	0.02	0.00	0.03	0.01	0.05	0.01	0.07	0.02
NOx Reduction (tons/year)		0.38		0.65		1.25		1.91		0.28		0.48		0.91		1.36		0.19		0.32		0.60		0.90		0.11		0.20		0.37		0.56
PM Reduction (tons/year)		0.04		0.06		0.11		0.17		0.03		0.02		0.03		0.05		0.01		0.01		0.02		0.04		0.01		0.01		0.02		0.04
HC Reduction (tons/year)		-		-		-		-		0.07		0.13		0.24		0.36		0.02		0.03		0.06		0.09		0.01		0.02		0.04		0.05
Cost-Effectiveness ($/ton)		$1,410		$1,421		$1,442		$1,431		$1,756		$2,715		$2,715		$2,715		$3,645		$4,337		$4,289		$4,389		$4,886		$5,602		$5,602		$5,602
CE including Fuel ($/ton)		$1,921		$1,935		$1,963		$1,949		$2,392		$3,698		$3,698		$3,698		$4,965		$5,906		$5,978		$5,978		$6,652		$7,630		$7,630		$7,630
One-Year Cost-Effectiveness		$34,894		$35,645		$34,894		$34,175		$49,043		$48,043		$48,043		$48,043		$71,212		$71,212		$72,696		$72,696		$116,314		$116,314		$116,314		$116,314

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	EGR+DPF	Tier 0 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF
NOx Emission Std (g/bhp-hr)	8.48	5.28	9.5	5.70	6.9	4.14	6.9	4.14	5.32	3.19	4.655	2.79	2.325	2.00	2.85	1.71
PM Emission Std (g/bhp-hr)	0.35	0.05	0.42	0.06	0.35	0.05	0.30	0.05	0.19	0.03	0.13	0.02	0.19	0.03	0.11	0.02
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	1.00	0.27	1.00	0.27	0.23	0.06	0.25	0.07	0.18	0.05	0.15	0.04
Average Horsepower (hp)	88	88	138	138	88	88	138	138	88	88	138	138	88	88	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,052	8,294	11,419	11,762	8,052	8,294	11,419	11,762	8,052	8,294	11,419	11,762	8,052	8,294	11,419	11,762
Fuel Cost ($/yr)	18,762	19,325	26,607	27,405	18,762	19,325	26,607	27,405	18,762	19,325	26,607	27,405	18,762	19,325	26,607	27,405
Incremental Fuel Cost/yr		$ 563		$ 798		$ 563		$ 798		$ 563		$ 798		$ 563		$ 798
Incremental Capital Cost		$8,474		$13,316		$8,474		$13,316		$8,474		$13,316		$8,474		$13,316
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$993		$1,561		$993		$1,561		$993		$1,561		$993		$1,561
NOx Emission Factor (g/hr)	162	97	274	165	127	76	199	120	93	59	134	81	61	37	92	49
PM Emission Factor (g/hr)	18	2	12	2	10	2	9	1	4	1	4	1	4	1	3	0
HC Emission Factor (g/hr)	0	0	0	0	18	5	29	8	5	1	7	2	5	1	4	1
NOx (tons/year)	0.24	0.15	0.41	0.25	0.19	0.11	0.30	0.18	0.15	0.09	0.20	0.12	0.09	0.06	0.12	0.07
PM (tons/year)	0.02	0.00	0.02	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
HC (tons/year)	-	-	-	-	0.03	0.01	0.04	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00
NOx Reduction (tons/year)		0.10		0.16		0.08		0.12		0.06		0.08		0.04		0.05
PM Reduction (tons/year)		0.01		0.02		0.01		0.01		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.03		0.01		0.01		0.00		0.00
Cost-Effectiveness ($/ton)		$2,798		$3,287		$2,755		$4,068		$6,372		$8,444		$7,572		$11,314
CE including Fuel ($/ton)		$4,383		$4,935		$4,317		$6,148		$9,983		$12,762		$11,863		$17,099
One-Year Cost-Effectiveness		$87,263		$50,833		$111,291		$111,291		$144,344		$164,965		$230,951		$269,442

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0 Baseline	EGR+DPF	Tier 1 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF
NOx Emission Std (g/bhp-hr)	9.2	5.82	6.9	4.14	4.56	2.74
PM Emission Std (g/bhp-hr)	0.41	0.00	0.12	0.02	0.09	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	1.00	0.27	0.24	0.06
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	144,364	140,159	144,364	140,159	144,364
Fuel Cost ($/yr)	326,570	336,367	326,570	336,367	326,570	336,367
Incremental Fuel Cost/yr		$ 9,797		$ 9,797		$ 9,797
Incremental Capital Cost		$131,666		$131,666		$131,666
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$15,435		$15,435		$15,435
NOx Emission Factor (g/hr)	7781	4669	5535	3221	3658	2195
PM Emission Factor (g/hr)	329	49	95	16	73	11
HC Emission Factor (g/hr)	0	0	802	217	193	52
NOx (tons/year)	16.89	10.13	12.01	7.21	7.94	4.76
PM (tons/year)	0.72	0.11	0.21	0.03	0.15	0.02
HC (tons/year)	-	-	1.74	0.47	0.42	0.11
NOx Reduction (tons/year)		6.76		4.81		3.18
PM Reduction (tons/year)		0.61		0.18		0.13
HC Reduction (tons/year)		-		1.27		0.31
Cost-Effectiveness ($/ton)		$816		$1,549		$2,593
CE Including Fuel ($/ton)		$1,334		$2,532		$4,097
One-Year Cost-Effectiveness		$19,491		$27,401		$41,461

Measure 51d: SCR Retrofits

Cost of diesel:	2.31
Urea Cost (equivalent to % fuel)	2%
NOx Reduction	80%
PM Reduction	0%
HC Reduction	0%
HC to ROG Conversion	1.26639

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.3	1.86	9.5	1.90	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.42	0.42	0.42	0.41	0.41	0.30	0.30	0.12	0.12	0.12	0.12	0.13	0.13	0.09	0.09	0.09	0.09	0.11	0.11	0.09	0.09	0.09	0.09
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	0.25	0.24	0.24	0.15	0.15	0.15	0.15	0.15	0.15
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	9431	9619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481
Urea Fuel Cost ($/yr)	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351
Incremental Urea Fuel Cost/yr		$439		$ 759		$ 1,438	-	$ 439	-	$ 759	-	$ 1,438	-	$ 439	-	$ 759	-	$ 1,438	-	$ 439	-	$ 759	-	$ 1,438
Incremental Capital Cost		$15,342		$26,500		$50,211		$15,342		$26,500		$50,211		$15,342		$26,500		$50,211		$15,342		$26,500		$50,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,799		$3,107		$5,886		$1,799		$3,107		$5,886		$1,799		$3,107		$5,886		$1,799		$3,107		$5,886
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	560	112	967	193	1832	366	378	76	652	130	1211	242	231	46	399	80	757	151
PM Emission Factor (g/hr)	34	34	60	60	109	109	25	25	17	17	32	32	10	10	12	12	23	23	9	9	12	12	23	23
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	81	140	140	266	266	20	20	34	34	64	64	12	12	21	21	40	40
NOx (tons/year)	1.11	0.22	1.88	0.38	3.64	0.73	0.81	0.16	1.40	0.28	2.65	0.53	0.55	0.11	0.94	0.19	1.75	0.35	0.33	0.07	0.58	0.12	1.09	0.22
PM (tons/year)	0.05	0.05	0.09	0.09	0.16	0.16	0.04	0.04	0.02	0.02	0.05	0.05	0.01	0.01	0.02	0.02	0.03	0.03	0.01	0.01	0.02	0.02	0.03	0.03
HC (tons/year)	-	-	-	-	-	-	0.12	0.12	0.20	0.20	0.38	0.38	0.03	0.03	0.05	0.05	0.09	0.09	0.02	0.02	0.03	0.03	0.06	0.06
NOx Reduction (tons/year)		0.89		1.51		2.91		0.65		1.12		2.12		0.44		0.75		1.40		0.27		0.46		0.87
PM Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$2,020		$2,066		$2,020		$2,781		$2,781		$2,781		$4,123		$4,123		$4,209		$6,734		$6,734		$6,734
CE including Fuel ($/ton)		$2,514		$2,568		$2,514		$3,461		$3,461		$3,461		$5,130		$5,130		$5,237		$8,379		$8,379		$8,379
One-Year Cost-Effectiveness		$17,233		$17,603		$17,233		$23,726		$23,726		$23,726		$35,168		$35,168		$35,991		$57,442		$57,442		$57,442

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.3	1.86	9.5	1.90	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.42	0.42	0.42	0.41	0.41	0.30	0.30	0.12	0.12	0.12	0.12	0.13	0.13	0.09	0.09	0.09	0.09	0.11	0.11	0.09	0.09	0.09	0.09
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	0.25	0.24	0.24	0.15	0.15	0.15	0.15	0.15	0.15
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6573	6704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941
Urea Fuel Cost ($/yr)	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122
Incremental Urea Fuel Cost/yr		$306		$ 529		$ 1,002	-	$ 306	-	$ 529	-	$ 1,002	-	$ 306	-	$ 529	-	$ 1,002	-	$ 306	-	$ 529	-	$ 1,002
Incremental Capital Cost		$15,342		$26,500		$50,211		$15,342		$26,500		$50,211		$15,342		$26,500		$50,211		$15,342		$26,500		$50,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,799		$3,107		$5,886		$1,799		$3,107		$5,886		$1,799		$3,107		$5,886		$1,799		$3,107		$5,886
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	560	112	967	193	1832	366	378	76	652	130	1211	242	231	46	399	80	757	151
PM Emission Factor (g/hr)	34	34	60	60	109	109	25	25	17	17	32	32	10	10	12	12	23	23	9	9	12	12	23	23
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	81	140	140	266	266	20	20	34	34	64	64	12	12	21	21	40	40
NOx (tons/year)	0.78	0.16	1.31	0.26	2.54	0.51	0.56	0.11	0.97	0.19	1.84	0.37	0.38	0.08	0.66	0.13	1.22	0.24	0.23	0.05	0.40	0.08	0.76	0.15
PM (tons/year)	0.03	0.03	0.06	0.06	0.11	0.11	0.02	0.02	0.02	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.14	0.14	0.27	0.27	0.02	0.02	0.03	0.03	0.06	0.06	0.01	0.01	0.01	0.02	0.04	0.04
NOx Reduction (tons/year)		0.62		1.05		2.03		0.45		0.78		1.47		0.30		0.53		0.97		0.19		0.32		0.61
PM Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$2,899		$2,961		$2,899		$3,991		$3,991		$3,991		$5,916		$5,916		$6,039		$9,662		$9,662		$9,662
CE including Fuel ($/ton)		$3,392		$3,465		$3,392		$4,670		$4,670		$4,670		$6,923		$6,923		$7,067		$11,307		$11,307		$11,307
One-Year Cost-Effectiveness		$24,726		$25,257		$24,726		$34,043		$34,043		$34,043		$50,461		$50,461		$51,512		$82,419		$82,419		$82,419

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.5	1.86	9.5	1.90	9.5	1.9	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57	2.855	0.57
PM Emission Std (g/bhp-hr)	0.42	0.42	0.42	0.42	0.41	0.41	0.41	0.41	0.30	0.30	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.09	0.09	0.09	0.09	0.09	0.09	0.11	0.11	0.09	0.09	0.09	0.09	0.09	0.09
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.25	0.25	0.25	0.24	0.24	0.24	0.24	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481
Urea Fuel Cost ($/yr)	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321
Incremental Urea Fuel Cost/yr		$377		$ 651		$ 1,233		$ 1,849		$377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849
Incremental Capital Cost		$15,342		$26,500		$50,211		$75,316		$15,342		$26,500		$50,211		$75,316		$15,342		$26,500		$50,211		$75,316		$15,342		$26,500		$50,211		$75,316
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,799		$3,107		$5,886		$8,829		$1,799		$3,107		$5,886		$8,829		$1,799		$3,107		$5,886		$8,829		$1,799		$3,107		$5,886		$8,829
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	3863	773	360	173	967	193	1832	366	2748	550	378	76	652	130	1211	242	1816	363	231	46	390	80	752	151	1130	227
PM Emission Factor (g/hr)	34	34	60	60	109	109	164	164	25	25	17	17	32	32	48	48	10	10	12	12	22	22	35	35	9	9	12	12	22	22	35	35
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	81	81	140	140	266	266	398	398	20	20	34	34	64	64	96	96	12	12	21	21	40	40	60	60
NOx (tons/year)	0.95	0.19	1.61	0.32	3.12	0.62	4.78	0.96	0.68	0.14	1.20	0.24	2.27	0.45	3.40	0.68	0.47	0.09	0.81	0.16	1.50	0.30	2.25	0.45	0.29	0.06	0.48	0.10	0.94	0.19	1.41	0.28
PM (tons/year)	0.04	0.04	0.07	0.07	0.13	0.13	0.20	0.20	0.03	0.03	0.02	0.02	0.04	0.04	0.06	0.06	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04
HC (tons/year)	-	-	-	-	-	-	-	-	0.10	0.10	0.17	0.17	0.33	0.33	0.49	0.49	0.02	0.02	0.04	0.04	0.08	0.08	0.12	0.12	0.02	0.02	0.03	0.03	0.05	0.05	0.07	0.07
NOx Reduction (tons/year)		0.76		1.29		2.50		3.83		0.55		0.96		1.81		2.72		0.37		0.65		1.20		1.80		0.23		0.40		0.75		1.12
PM Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$2,357		$1,407		$2,357		$2,304		$3,245		$1,245		$2,245		$3,245		$4,899		$4,899		$4,910		$4,910		$7,855		$7,855		$7,855		$7,853
CE Including Fuel ($/ton)		$2,859		$2,911		$2,850		$2,791		$3,924		$3,924		$3,924		$3,924		$5,817		$5,817		$5,938		$5,938		$9,501		$9,501		$9,501		$9,501
One-Year Cost-Effectiveness		$20,102		$20,534		$20,102		$19,688		$27,677		$27,677		$27,677		$27,677		$41,025		$41,025		$41,879		$41,879		$67,007		$67,007		$67,007		$67,007

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	SCR	Tier 0 Baseline	SCR	Tier 1 Baseline	SCR	Tier 1 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR
NOx Emission Std (g/bhp-hr)	8.8	1.76	9.5	1.90	6.9	1.38	6.9	1.38	5.32	1.06	4.655	0.93	3.325	0.67	2.85	0.57
PM Emission Std (g/bhp-hr)	0.55	0.55	0.42	0.42	0.55	0.55	0.30	0.30	0.19	0.19	0.13	0.13	0.19	0.19	0.11	0.11
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	0.28	0.28	0.25	0.25	0.18	0.18	0.15	0.15
Average Horsepower (hp)	88	88	138	138	138	138	138	138	138	138	138	138	138	138	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,052	8,213	13,419	13,688	12,654	12,907	11,419	11,648	12,654	12,907	11,419	11,648	12,654	12,907	11,419	11,648
Urea Fuel Cost ($/yr)	18,762	19,137	26,607	27,139	29,483	30,073	26,607	27,139	29,483	30,073	26,607	27,139	29,483	30,073	26,607	27,139
Incremental Urea Fuel Cost/yr		$ 375		$ 532		$ 590		$ 532		$ 590		$ 532		$ 590		$ 532
Incremental Capital Cost		$9,763		$15,342		$15,342		$15,342		$15,342		$15,342		$15,342		$15,342
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,145		$1,799		$1,799		$1,799		$1,799		$1,799		$1,799		$1,799
NOx Emission Factor (g/hr)	162	32	274	55	199	40	199	40	154	31	134	27	96	19	82	16
PM Emission Factor (g/hr)	10	10	12	12	16	16	9	9	8	8	4	4	6	6	3	3
HC Emission Factor (g/hr)	0	0	0	0	29	29	29	29	8	8	7	7	5	5	2	2
NOx (tons/year)	0.24	0.05	0.41	0.08	0.30	0.06	0.30	0.06	0.23	0.05	0.20	0.04	0.14	0.03	0.12	0.02
PM (tons/year)	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
HC (tons/year)	-	-	-	-	0.04	0.04	0.04	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NOx Reduction (tons/year)		0.19		0.33		0.24		0.24		0.18		0.16		0.12		0.10
PM Reduction (tons/year)		-		-		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$5,893		$5,459		$7,516		$7,516		$9,748		$11,141		$15,597		$18,197
CE Including Fuel ($/ton)		$7,825		$7,074		$9,980		$9,740		$12,944		$14,437		$20,711		$23,581
One-Year Cost-Effectiveness		$50,271		$46,567		$64,114		$64,114		$83,155		$95,034		$133,045		$155,223

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0 Baseline	SCR	Tier 1 Baseline	SCR	Tier 2 Baseline	SCR
NOx Emission Std (g/bhp-hr)	9.7	1.94	6.9	1.38	4.56	0.91
PM Emission Std (g/bhp-hr)	0.41	0.41	0.12	0.12	0.09	0.09
HC Emission Std (g/bhp-hr)	0.00	0.00	1.00	1.00	0.24	0.24
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	142,962	140,159	142,962	140,159	142,962
Urea Fuel Cost ($/yr)	326,570	333,102	326,570	333,102	326,570	333,102
Incremental Urea Fuel Cost/yr		$ 6,531		$ 6,531		$ 6,531
Incremental Capital Cost		$151,702		$151,702		$151,702
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$17,781		$17,781		$17,784
NOx Emission Factor (g/hr)	7783	1556	5535	1107	3655	732
PM Emission Factor (g/hr)	329	329	96	96	71	71
HC Emission Factor (g/hr)	0	0	802	802	193	193
NOx (tons/year)	16.99	3.38	12.01	2.40	7.94	1.59
PM (tons/year)	0.72	0.72	0.21	0.21	0.15	0.15
HC (tons/year)	-	-	1.74	1.74	0.42	0.42
NOx Reduction (tons/year)		13.51		9.61		6.35
PM Reduction (tons/year)		-		-		-
HC Reduction (tons/year)		-		-		-
Cost-Effectiveness ($/ton)		$1,316		$1,851		$2,800
CE Including Fuel ($/ton)		$1,800		$2,530		$3,828
One-Year Cost-Effectiveness		$11,229		$15,785		$23,855

Measure 51c: DOC Retrofits

Cost of diesel:	2.33
Incremental Fuel Consumption	2%
NOx Reduction	0%
PM Reduction	40%
HC Reduction	50%
HC to ROG Conversion	1.26639

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC
NOx Emission Std (g/bhp-hr)	9.3	9.3	9.3	9.30	9.3	9.30	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.25	0.42	0.25	0.41	0.25	0.30	0.18	0.12	0.07	0.12	0.07	0.13	0.08	0.09	0.05	0.09	0.05	0.11	0.07	0.09	0.05	0.09	0.05
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.42	1.00	0.42	1.00	0.42	0.25	0.10	0.25	0.10	0.24	0.10	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	9431	9619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481
Fuel Cost ($/yr)	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351
Incremental Fuel Cost/yr		$439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438
Incremental Capital Cost		$1,158		$3,000		$5,789		$1,158		$2,000		$3,789		$1,158		$2,000		$3,789		$1,158		$2,000		$3,789
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$136		$234		$444		$136		$234		$444		$136		$234		$444		$136		$234		$444
NOx Emission Factor (g/hr)	771	771	1303	1303	2522	2522	560	560	967	967	1832	1832	378	378	652	652	1211	1211	231	231	399	399	757	757
PM Emission Factor (g/hr)	34	21	60	36	109	65	25	15	17	10	32	19	10	6	12	7	23	14	9	5	12	7	23	14
HC Emission Factor (g/hr)	0	0	0	0	0	0	83	34	140	59	266	112	20	8	34	14	64	27	12	5	21	9	40	17
NOx (tons/year)	1.11	1.11	1.88	1.88	3.64	3.64	0.81	0.81	1.40	1.40	2.65	2.65	0.55	0.55	0.94	0.94	1.75	1.75	0.33	0.33	0.58	0.58	1.09	1.09
PM (tons/year)	0.05	0.03	0.09	0.05	0.16	0.09	0.04	0.02	0.02	0.01	0.05	0.03	0.01	0.01	0.02	0.01	0.03	0.02	0.01	0.01	0.02	0.01	0.02	0.01
HC (tons/year)	-	-	-	-	-	-	0.12	0.05	0.20	0.08	0.38	0.16	0.03	0.01	0.05	0.02	0.09	0.04	0.02	0.01	0.03	0.01	0.06	0.02
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.02		0.03		0.06		0.01		0.01		0.02		0.01		0.01		0.03		0.01		0.01		0.01
HC Reduction (tons/year)		-		-		-		0.07		0.12		0.22		0.02		0.03		0.05		0.01		0.02		0.03
Cost-Effectiveness ($/ton)		$341		$341		$353		$366		$684		$684		$952		$1,311		$1,316		$1,152		$1,423		$1,423
CE Including Fuel ($/ton)		$1,445		$1,445		$1,494		$1,351		$2,898		$2,898		$4,078		$5,555		$5,578		$4,880		$6,031		$6,031
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC
NOx Emission Std (g/bhp-hr)	9.3	9.3	9.3	9.30	9.3	9.30	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.25	0.42	0.25	0.41	0.25	0.30	0.18	0.12	0.07	0.12	0.07	0.13	0.08	0.09	0.05	0.09	0.05	0.11	0.07	0.09	0.05	0.09	0.05
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.42	1.00	0.42	1.00	0.42	0.25	0.10	0.25	0.10	0.24	0.10	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6573	6704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941
Fuel Cost ($/yr)	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122
Incremental Fuel Cost/yr		$306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002
Incremental Capital Cost		$1,158		$2,000		$3,789		$1,158		$2,000		$3,789		$1,158		$2,000		$3,789		$1,158		$2,000		$3,789
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$136		$234		$444		$136		$234		$444		$136		$234		$444		$136		$234		$444
NOx Emission Factor (g/hr)	771	771	1303	1303	2522	2522	560	560	967	967	1832	1832	378	378	652	652	1211	1211	231	231	399	399	757	757
PM Emission Factor (g/hr)	34	21	60	36	109	65	25	15	17	10	32	19	10	6	12	7	23	14	9	5	12	7	23	14
HC Emission Factor (g/hr)	0	0	0	0	0	0	83	34	140	59	266	112	20	8	34	14	64	27	12	5	21	9	40	17
NOx (tons/year)	0.78	0.78	1.31	1.31	2.54	2.54	0.56	0.56	0.97	0.97	1.84	1.84	0.38	0.38	0.66	0.66	1.22	1.22	0.23	0.23	0.40	0.40	0.76	0.76
PM (tons/year)	0.03	0.02	0.06	0.04	0.11	0.07	0.02	0.01	0.02	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.03	0.14	0.06	0.27	0.11	0.02	0.01	0.03	0.01	0.06	0.03	0.01	0.01	0.01	0.01	0.04	0.02
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.01		0.02		0.04		0.01		0.01		0.01		0.00		0.00		0.01		0.00		0.00		0.01
HC Reduction (tons/year)		-		-		-		0.05		0.08		0.15		0.01		0.02		0.04		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$489		$489		$506		$525		$981		$981		$1,381		$1,881		$1,889		$1,652		$2,042		$2,042
CE Including Fuel ($/ton)		$1,593		$1,593		$1,648		$1,710		$3,195		$3,195		$4,497		$6,125		$6,150		$5,381		$6,650		$6,650
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC
NOx Emission Std (g/bhp-hr)	9.5	9.5	9.5	9.50	9.5	9.50	9.7	9.70	6.9	6.9	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.25	0.42	0.25	0.41	0.25	0.41	0.25	0.30	0.18	0.12	0.07	0.12	0.07	0.12	0.07	0.13	0.08	0.09	0.05	0.09	0.05	0.09	0.05	0.06	0.04	0.07	0.04	0.05	0.03	0.05	0.03
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.42	1.00	0.42	1.00	0.42	1.00	0.42	0.25	0.10	0.25	0.10	0.24	0.10	0.24	0.10	0.15	0.06	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8884	8246	13,964	14,243	26,458	26,987	39,687	40,481	8884	8246	13,964	14,243	26,458	26,987	39,687	40,481	8,884	8,246	13,964	14,243	26,458	26,987	39,687	40,481	8,884	8,246	13,964	14,243	26,458	26,987	39,687	40,481
Fuel Cost ($/yr)	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321
Incremental Fuel Cost/yr		$377		$ 651		$ 1,233		$ 1,849		$377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849
Incremental Capital Cost		$1,158		$2,000		$3,789		$5,684		$1,158		$2,000		$3,789		$5,680		$1,158		$2,006		$3,789		$5,684		$1,158		$2,000		$3,789		$5,684
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$136		$234		$444		$666		$136		$234		$444		$666		$136		$234		$444		$666		$136		$234		$444		$666
NOx Emission Factor (g/hr)	771	771	1303	1303	2523	2522	3863	3863	560	560	967	967	1832	1832	2742	2748	378	378	652	652	1211	1211	1816	1816	231	231	399	399	757	757	1135	1135
PM Emission Factor (g/hr)	34	21	60	36	109	65	164	98	25	15	17	10	32	19	48	29	10	6	12	7	23	14	35	21	9	5	12	7	23	14	35	21
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	81	34	140	59	266	112	398	167	20	8	34	14	64	27	96	40	12	5	23	9	40	17	60	25
NOx (tons/year)	0.95	0.95	1.61	1.61	3.12	3.12	4.78	4.78	0.69	0.69	1.20	1.20	2.27	2.27	3.40	3.40	0.47	0.47	0.81	0.81	1.50	1.50	2.25	2.25	0.29	0.29	0.49	0.49	0.94	0.94	1.41	1.41
PM (tons/year)	0.04	0.03	0.07	0.04	0.13	0.08	0.20	0.12	0.03	0.02	0.02	0.01	0.04	0.02	0.06	0.04	0.01	0.01	0.02	0.01	0.03	0.02	0.04	0.03	0.01	0.01	0.02	0.01	0.03	0.02	0.04	0.03
HC (tons/year)	-	-	-	-	-	-	-	-	0.10	0.04	0.17	0.07	0.33	0.14	0.49	0.21	0.02	0.01	-	0.01	0.04	0.02	0.08	0.05	0.01	0.01	0.03	0.01	0.05	0.02	0.07	0.03
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.02		0.03		0.05		0.08		0.01		0.01		0.02		0.02		0.01		0.01		0.01		0.02		0.00		0.01		0.01		0.03
HC Reduction (tons/year)		-		-		-		-		0.06		0.10		0.19		0.29		0.01		0.03		0.05		0.07		0.01		0.02		0.03		0.04
Cost-Effectiveness ($/ton)		$398		$398		$411		$427		$798		$798		$798		$798		$1,123		$1,529		$1,536		$1,343		$1,660		$1,660		$1,660		$1,660
CE Including Fuel ($/ton)		$1,502		$1,502		$1,553		$1,553		$1,612		$3,012		$3,012		$3,012		$4,239		$5,773		$5,797		$5,072		$6,268		$6,268		$6,268		$6,268
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC
NOx Emission Std (g/bhp-hr)	8.8	8.80	9.5	9.50	6.9	6.90	6.9	6.90	5.32	5.32	4.655	4.66	3.325	3.33	2.85	2.85
PM Emission Std (g/bhp-hr)	0.55	0.33	0.42	0.25	0.55	0.33	0.30	0.18	0.19	0.12	0.13	0.08	0.19	0.12	0.11	0.07
HC Emission Std (g/bhp-hr)	0.60	0.00	0.00	0.00	1.00	0.42	1.00	0.42	0.28	0.12	0.25	0.10	0.18	0.07	0.15	0.06
Average Horsepower (hp)	88	88	138	138	88	88	138	138	88	88	138	138	88	88	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648
Fuel Cost ($/yr)	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139
Incremental Fuel Cost/yr		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532
Incremental Capital Cost		$737		$1,158		$737		$1,158		$737		$1,158		$737		$1,158
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$86		$136		$86		$136		$86		$136		$86		$136
NOx Emission Factor (g/hr)	162	162	274	274	127	127	199	199	98	98	134	134	61	61	82	82
PM Emission Factor (g/hr)	10	6	12	7	10	6	9	5	4	2	4	2	4	2	3	2
HC Emission Factor (g/hr)	0	0	0	0	18	8	29	12	5	2	7	3	3	1	4	2
NOx (tons/year)	0.24	0.24	0.41	0.41	0.19	0.19	0.30	0.30	0.15	0.15	0.20	0.20	0.09	0.09	0.12	0.12
PM (tons/year)	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
HC (tons/year)	-	-	-	-	0.03	0.01	0.04	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.01		0.01		0.01		0.01		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.03		0.00		0.01		0.00		0.00
Cost-Effectiveness ($/ton)		$712		$921		$608		$589		$1,798		$2,601		$1,881		$3,112
CE Including Fuel ($/ton)		$3,803		$4,534		$3,249		$4,865		$9,608		$12,706		$10,053		$15,312
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-

Off-Highway Trucks	750+ HP		730+ HP		750+ HP	
	Tier 0 Baseline	DOC	Tier 1 Baseline	DOC	Tier 2 Baseline	DOC
NOx Emission Std (g/bhp-hr)	9.2	9.20	6.9	6.90	4.56	4.56
PM Emission Std (g/bhp-hr)	0.41	0.22	0.12	0.07	0.07	0.03
HC Emission Std (g/bhp-hr)	0.000	0.000	1.000	0.420	0.24	0.10
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	142,992	140,159	142,992	140,159	142,992
Fuel Cost ($/yr)	326,570	333,102	326,570	333,102	326,570	333,102
Incremental Fuel Cost/yr		$ 6,531		$ 6,531		$ 6,531
Incremental Capital Cost		$11,449		$11,449		$11,449
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,342		$1,342		$1,342
NOx Emission Factor (g/hr)	7781	7781	5835	5835	3658	3658
PM Emission Factor (g/hr)	329	198	95	58	71	42
HC Emission Factor (g/hr)	0	0	802	337	193	81
NOx (tons/year)	16.89	16.89	12.01	12.01	7.94	7.94
PM (tons/year)	0.72	0.43	0.21	0.13	0.15	0.09
HC (tons/year)	-	-	1.74	0.73	0.42	0.18
NOx Reduction (tons/year)		-		-		-
PM Reduction (tons/year)		0.29		0.08		0.06
HC Reduction (tons/year)		-		1.01		0.24
Cost-Effectiveness ($/ton)		$235		$455		$876
CE Including Fuel ($/ton)		$1,376		$2,669		$5,137
One-Year Cost-Effectiveness		-		-		-

Measure 51f: FTF Retrofits

Cost of diesel	2.33
Incremental Fuel Consumption	2%
NOx Reduction	0%
PM Reduction	50%
HC Reduction	80%
HC to ROG Conversion	1.26639

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF
NOx Emission Std (g/bhp-hr)	9.5	9.5	9.3	9.30	9.5	9.50	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.21	0.42	0.21	0.41	0.21	0.30	0.15	0.12	0.06	0.12	0.06	0.13	0.06	0.09	0.04	0.09	0.04	0.11	0.06	0.09	0.04	0.09	0.04
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.20	1.00	0.20	1.00	0.20	0.25	0.05	0.25	0.05	0.24	0.05	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	94318	96159	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481
Fuel Cost ($/yr)	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351
Incremental Fuel Cost/yr		$439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438
Incremental Capital Cost		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	771	771	1303	1303	2522	2522	560	560	967	967	1832	1832	378	378	652	652	1211	1211	231	231	399	399	757	757
PM Emission Factor (g/hr)	34	17	60	30	109	55	25	12	17	8	32	16	10	5	12	6	23	12	9	5	12	6	23	12
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	16	140	28	266	53	20	4	34	7	64	13	12	2	21	4	40	8
NOx (tons/year)	1.11	1.11	1.88	1.88	3.64	3.64	0.81	0.81	1.40	1.40	2.65	2.65	0.55	0.55	0.94	0.94	1.75	1.75	0.33	0.33	0.58	0.58	1.09	1.09
PM (tons/year)	0.05	0.02	0.09	0.04	0.16	0.08	0.04	0.02	0.02	0.01	0.05	0.02	0.01	0.01	0.02	0.01	0.03	0.02	0.01	0.01	0.02	0.01	0.03	0.02
HC (tons/year)	-	-	-	-	-	-	0.12	0.02	0.20	0.04	0.38	0.08	0.03	0.01	0.05	0.01	0.09	0.02	0.02	0.00	0.03	0.01	0.06	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.02		0.04		0.08		0.02		0.01		0.03		0.01		0.01		0.02		0.01		0.01		0.02
HC Reduction (tons/year)		-		-		-		0.09		0.16		0.31		0.02		0.04		0.07		0.01		0.02		0.05
Cost-Effectiveness ($/ton)		$1,228		$1,228		$1,269		$1,287		$2,356		$2,356		$3,412		$4,622		$4,643		$4,099		$5,053		$5,053
CE including Fuel ($/ton)		$2,111		$2,111		$2,183		$2,212		$4,051		$4,051		$5,867		$7,947		$7,983		$7,049		$8,688		$8,688
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF
NOx Emission Std (g/bhp-hr)	9.5	9.5	9.3	9.30	9.5	9.50	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.21	0.42	0.21	0.41	0.21	0.30	0.15	0.12	0.06	0.12	0.06	0.13	0.06	0.09	0.04	0.09	0.04	0.11	0.06	0.09	0.04	0.09	0.04
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.20	1.00	0.20	1.00	0.20	0.25	0.05	0.25	0.05	0.24	0.05	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6573	6704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,041	6,573	6,704	11,353	11,580	21,510	21,941
Fuel Cost ($/yr)	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122
Incremental Fuel Cost/yr		$306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002
Incremental Capital Cost		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	771	771	1303	1303	2522	2522	560	560	967	967	1832	1832	378	378	652	652	1211	1211	231	231	399	399	757	757
PM Emission Factor (g/hr)	34	17	60	30	109	55	25	12	17	8	32	16	10	5	12	6	23	12	9	5	12	6	23	12
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	16	140	28	266	53	20	4	34	7	64	13	12	2	21	4	40	8
NOx (tons/year)	0.78	0.78	1.31	1.31	2.54	2.54	0.56	0.56	0.97	0.97	1.84	1.84	0.38	0.38	0.66	0.66	1.22	1.22	0.23	0.23	0.40	0.40	0.76	0.76
PM (tons/year)	0.03	0.02	0.06	0.03	0.11	0.05	0.02	0.01	0.02	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.02	0.01
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.02	0.14	0.03	0.27	0.05	0.02	0.00	0.03	0.01	0.06	0.01	0.01	0.00	0.02	0.00	0.04	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.02		0.03		0.05		0.01		0.02		0.01		0.01		0.01		0.01		0.00		0.01		0.01
HC Reduction (tons/year)		-		-		-		0.07		0.11		0.21		0.02		0.03		0.05		0.01		0.02		0.03
Cost-Effectiveness ($/ton)		$1,761		$1,761		$1,821		$1,846		$3,381		$3,381		$4,896		$6,631		$6,661		$5,882		$7,250		$7,250
CE including Fuel ($/ton)		$2,645		$2,645		$2,735		$2,771		$5,078		$5,078		$7,351		$9,957		$10,002		$8,831		$10,885		$10,885
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF
NOx Emission Std (g/bhp-hr)	9.5	9.5	9.3	9.30	9.5	9.50	9.2	9.20	6.9	6.9	6.9	6.90	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	4.56	4.56	4.56	4.56	2.85	2.85	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42	0.21	0.42	0.21	0.41	0.21	0.41	0.21	0.30	0.15	0.13	0.06	0.12	0.06	0.12	0.06	0.13	0.06	0.09	0.04	0.09	0.04	0.09	0.04	0.11	0.06	0.09	0.04	0.09	0.04	0.09	0.04
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.20	1.00	0.20	1.00	0.20	1.00	0.20	0.25	0.05	0.25	0.05	0.24	0.05	0.24	0.05	0.15	0.03	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8084	8246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481	8,084	8,246	13,964	14,243	26,458	26,987	39,687	40,481
Fuel Cost ($/yr)	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321
Incremental Fuel Cost/yr		$377		$ 651		$ 1,233		$ 1,849		$377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849
Incremental Capital Cost		$5,211		$9,000		$17,053		$25,579		$5,211		$9,000		$17,053		$25,579		$5,211		$9,000		$17,053		$25,579		$5,211		$9,000		$17,053		$25,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$611		$1,055		$1,999		$2,999		$611		$1,055		$1,999		$2,999		$611		$1,055		$1,999		$2,999		$611		$1,055		$1,999		$2,999
NOx Emission Factor (g/hr)	771	771	1303	1303	2522	2522	3863	3863	560	560	967	967	1832	1832	2748	2748	378	378	653	653	1211	1211	1816	1816	231	231	399	399	757	757	1135	1135
PM Emission Factor (g/hr)	34	17	60	30	109	55	166	82	25	12	12	5	32	16	48	24	10	5	12	6	23	12	35	18	9	5	12	6	23	12	35	18
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	51	10	140	28	266	53	398	80	20	4	34	7	64	13	96	19	12	2	21	4	68	13	68	12
NOx (tons/year)	0.95	0.95	1.61	1.61	3.12	3.12	4.78	4.78	0.69	0.69	1.20	1.20	2.27	2.27	3.40	3.40	0.47	0.47	0.81	0.81	1.50	1.50	2.25	2.25	0.29	0.29	0.49	0.49	0.94	0.94	1.41	1.41
PM (tons/year)	0.04	0.02	0.07	0.04	0.13	0.07	0.20	0.10	0.03	0.02	0.02	0.01	0.04	0.02	0.06	0.03	0.01	0.01	0.02	0.01	0.03	0.01	0.04	0.02	0.01	0.01	0.02	0.01	0.03	0.01	0.04	0.02
HC (tons/year)	-	-	-	-	-	-	-	-	0.19	0.02	0.17	0.03	0.33	0.07	0.49	0.10	0.02	0.00	0.04	0.01	0.08	0.02	0.12	0.02	0.02	0.00	0.03	0.01	0.05	0.01	0.07	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.02		0.04		0.07		0.10		0.02		0.01		0.02		0.03		0.01		0.01		0.01		0.02		0.01		0.01		0.01		0.02
HC Reduction (tons/year)		-		-		-		-		0.08		0.14		0.26		0.39		0.03		0.03		0.06		0.09		0.01		0.02		0.04		0.06
Cost-Effectiveness ($/ton)		$1,432		$1,432		$1,481		$1,481		$1,501		$2,748		$2,748		$2,748		$3,989		$5,391		$5,416		$5,416		$4,782		$5,894		$5,894		$5,894
CE Including Fuel ($/ton)		$2,315		$2,315		$2,384		$2,394		$2,426		$4,444		$4,444		$4,444		$6,435		$8,717		$8,756		$8,756		$7,731		$9,529		$9,529		$9,529
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-		-

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	FTF	Tier 0 Baseline	FTF	Tier 1 Baseline	FTF	Tier 1 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF
NOx Emission Std (g/bhp-hr)	8.8	8.80	9.5	9.50	6.9	6.90	6.9	6.90	5.32	5.32	4.655	4.66	3.725	3.73	2.85	2.85
PM Emission Std (g/bhp-hr)	0.55	0.28	0.42	0.21	0.55	0.28	0.30	0.15	0.19	0.10	0.13	0.06	0.19	0.10	0.13	0.06
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	1.00	0.20	1.00	0.20	0.28	0.06	0.25	0.05	0.18	0.04	0.15	0.03
Average Horsepower (hp)	88	88	138	138	88	88	138	138	88	88	138	138	88	88	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648	8,052	8,213	11,419	11,648
Fuel Cost ($/yr)	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139	18,762	19,137	26,607	27,139
Incremental Fuel Cost/yr		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532		$ 375		$ 532
Incremental Capital Cost		$3,316		$5,211		$3,316		$5,211		$3,316		$5,211		$3,316		$5,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$389		$611		$389		$611		$389		$611		$389		$611
NOx Emission Factor (g/hr)	162	162	274	274	127	127	199	199	98	98	135	134	68	68	82	82
PM Emission Factor (g/hr)	10	5	12	6	10	5	9	4	4	2	6	2	5	2	3	2
HC Emission Factor (g/hr)	0	0	0	0	18	4	29	6	5	1	7	1	3	1	2	1
NOx (tons/year)	0.24	0.24	0.41	0.41	0.19	0.19	0.30	0.30	0.15	0.15	0.20	0.20	0.09	0.09	0.12	0.12
PM (tons/year)	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
HC (tons/year)	-	-	-	-	0.03	0.01	0.04	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.01		0.01		0.01		0.01		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.03		0.01		0.01		0.00		0.01
Cost-Effectiveness ($/ton)		$2,562		$1,317		$1,157		$1,476		$6,394		$9,220		$6,718		$11,078
CE Including Fuel ($/ton)		$5,035		$6,207		$4,239		$4,505		$12,567		$17,253		$13,204		$20,728
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0 Baseline	FTF	Tier 1 Baseline	FTF	Tier 2 Baseline	FTF
NOx Emission Std (g/bhp-hr)	9.2	9.20	6.9	6.90	4.56	4.56
PM Emission Std (g/bhp-hr)	0.41	0.21	0.12	0.06	0.09	0.04
HC Emission Std (g/bhp-hr)	0.00	0.00	1.00	0.20	0.24	0.05
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	142,962	140,159	142,962	140,159	142,962
Fuel Cost ($/yr)	326,570	333,102	326,570	333,102	326,570	333,102
Incremental Fuel Cost/yr		$ 6,531		$ 6,531		$ 6,531
Incremental Capital Cost		$51,521		$51,521		$51,521
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$6,040		$6,040		$6,040
NOx Emission Factor (g/hr)	7781	7781	5535	5535	3658	3658
PM Emission Factor (g/hr)	329	165	96	48	71	35
HC Emission Factor (g/hr)	0	0	802	160	193	39
NOx (tons/year)	16.89	16.89	12.01	12.01	7.94	7.94
PM (tons/year)	0.72	0.36	0.21	0.10	0.15	0.08
HC (tons/year)	-	-	1.74	0.35	0.42	0.08
NOx Reduction (tons/year)		-		-		-
PM Reduction (tons/year)		0.36		0.10		0.08
HC Reduction (tons/year)		-		1.39		0.33
Cost-Effectiveness ($/ton)		$845		$1,558		$3,089
CE Including Fuel ($/ton)		$1,758		$2,263		$6,429
One-Year Cost-Effectiveness		-		-		-

Measure 51g: DOC+SCR Retrofits

Cost of diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Reduction	90%
PM Reduction	25%
HC Reduction	50%
HC to ROG Conversion	1.26639

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.5	1.86	9.5	1.90	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.32	0.42	0.32	0.41	0.31	0.30	0.23	0.12	0.09	0.12	0.09	0.13	0.10	0.09	0.07	0.09	0.07	0.11	0.08	0.09	0.07	0.09	0.07
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.43	1.00	0.43	1.00	0.43	0.25	0.10	0.25	0.10	0.24	0.10	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	9431	9619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481
Urea Fuel Cost ($/yr)	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,933	22,413	37,954	38,713	71,913	73,351
Incremental Urea Fuel Cost/yr		$439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438
Incremental Capital Cost		$15,921		$27,500		$52,105		$15,921		$27,500		$52,105		$15,921		$27,500		$52,105		$15,921		$27,500		$52,105
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,866		$3,224		$6,108		$1,866		$3,224		$6,108		$1,866		$3,224		$6,108		$1,866		$3,224		$6,108
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	566	113	967	193	1832	366	776	155	653	130	1211	242	231	46	399	80	757	151
PM Emission Factor (g/hr)	34	26	66	45	109	82	25	18	17	13	32	24	10	8	12	9	23	18	9	7	12	9	23	18
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	34	140	60	266	113	20	8	34	15	64	27	12	5	21	9	40	17
NOx (tons/year)	1.11	0.22	1.88	0.38	3.64	0.73	0.81	0.16	1.40	0.28	2.65	0.53	0.55	0.11	0.94	0.19	1.75	0.35	0.33	0.07	0.58	0.12	1.09	0.22
PM (tons/year)	0.05	0.04	0.09	0.06	0.16	0.12	0.04	0.03	0.02	0.02	0.05	0.03	0.01	0.01	0.02	0.01	0.03	0.03	0.01	0.01	0.02	0.01	0.03	0.03
HC (tons/year)	-	-	-	-	-	-	0.12	0.05	0.20	0.09	0.38	0.16	0.03	0.01	0.05	0.02	0.09	0.04	0.02	0.01	0.03	0.01	0.06	0.02
NOx Reduction (tons/year)		0.89		1.51		2.91		0.65		1.12		2.12		0.44		0.75		1.40		0.27		0.46		0.87
PM Reduction (tons/year)		0.01		0.02		0.04		0.01		0.01		0.01		0.00		0.00		0.01		0.00		0.01		0.01
HC Reduction (tons/year)		-		-		-		0.07		0.12		0.23		0.02		0.03		0.05		0.01		0.02		0.01
Cost-Effectiveness ($/ton)		$1,639		$1,666		$1,650		$2,051		$2,327		$2,327		$3,305		$3,669		$3,738		$5,402		$3,631		$5,631
CE including Fuel ($/ton)		$2,024		$2,058		$2,039		$2,534		$2,874		$2,874		$4,333		$4,533		$4,618		$6,674		$4,957		$6,957
One-Year Cost-Effectiveness		$17,883		$18,267		$17,883		$24,621		$24,621		$24,621		$36,495		$37,256		$37,256		$59,609		$59,609		$59,609

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.5	1.86	9.5	1.90	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.32	0.42	0.32	0.41	0.31	0.30	0.23	0.12	0.09	0.12	0.09	0.13	0.10	0.09	0.07	0.09	0.07	0.11	0.08	0.09	0.07	0.09	0.07
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.43	1.00	0.43	1.00	0.43	0.25	0.10	0.25	0.10	0.24	0.10	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6573	6704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941
Urea Fuel Cost ($/yr)	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122	15,314	15,621	26,452	26,981	50,119	51,122
Incremental Urea Fuel Cost/yr		$306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002
Incremental Capital Cost		$15,921		$27,500		$52,105		$15,921		$27,500		$52,105		$15,921		$27,500		$52,105		$15,921		$27,500		$52,105
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,866		$3,224		$6,108		$1,866		$3,224		$6,108		$1,866		$3,224		$6,108		$1,866		$3,224		$6,108
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	566	113	967	193	1832	366	776	155	653	130	1211	242	231	46	399	80	757	151
PM Emission Factor (g/hr)	34	26	66	45	109	82	25	18	17	13	32	24	10	8	12	9	23	18	9	7	12	9	23	18
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	34	140	60	266	113	20	8	34	15	64	27	12	5	21	9	40	17
NOx (tons/year)	0.78	0.16	1.31	0.26	2.54	0.51	0.56	0.11	0.97	0.19	1.84	0.37	0.38	0.08	0.66	0.13	1.22	0.24	0.23	0.05	0.40	0.08	0.76	0.15
PM (tons/year)	0.03	0.03	0.06	0.04	0.11	0.08	0.02	0.02	0.02	0.01	0.03	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.03	0.14	0.06	0.27	0.11	0.02	0.01	0.03	0.01	0.06	0.03	0.01	0.01	0.02	0.01	0.04	0.02
NOx Reduction (tons/year)		0.62		1.05		2.03		0.45		0.78		1.47		0.30		0.53		0.97		0.18		0.32		0.61
PM Reduction (tons/year)		0.01		0.01		0.03		0.01		0.00		0.01		0.00		0.00		0.01		0.00		0.00		0.01
HC Reduction (tons/year)		-		-		-		0.05		0.08		0.15		0.01		0.02		0.04		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$2,351		$2,390		$2,368		$2,943		$3,338		$3,338		$5,033		$5,265		$5,363		$7,751		$8,080		$8,080
CE including Fuel ($/ton)		$2,737		$2,783		$2,757		$3,426		$3,886		$3,886		$5,859		$6,128		$6,243		$9,023		$9,406		$9,406
One-Year Cost-Effectiveness		$25,699		$26,211		$25,699		$33,327		$35,327		$35,327		$52,363		$52,363		$53,456		$85,529		$85,529		$85,529

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR
NOx Emission Std (g/bhp-hr)	9.3	1.9	9.3	1.86	9.3	1.86	9.3	1.86	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.32	0.42	0.32	0.41	0.31	0.41	0.31	0.30	0.23	0.12	0.09	0.12	0.09	0.12	0.09	0.13	0.10	0.09	0.07	0.09	0.07	0.09	0.07	0.11	0.08	0.09	0.07	0.09	0.07	0.09	0.07
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.43	1.00	0.43	1.00	0.43	1.00	0.43	0.25	0.10	0.25	0.10	0.24	0.10	0.24	0.10	0.15	0.06	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8832	8266	13,964	14,243	26,458	26,987	39,687	40,481	8884	8246	13,964	14,243	26,458	26,987	39,687	40,481	8,884	8,246	13,964	14,243	26,458	26,987	39,687	40,481	8,884	8,246	13,964	14,243	26,458	26,987	39,687	40,481
Urea Fuel Cost ($/gal)	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321
Incremental Urea Fuel Cost/yr		$377		$ 651		$ 1,233		$ 1,849		$377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849
Incremental Capital Cost		$15,921		$27,500		$52,105		$78,158		$15,921		$27,500		$52,105		$78,158		$15,921		$27,500		$52,105		$78,158		$15,921		$27,500		$52,105		$78,158
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,866		$3,224		$6,108		$9,162		$1,866		$3,224		$6,108		$9,162		$1,866		$3,224		$6,108		$9,162		$1,866		$3,224		$6,108		$9,162
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	3863	773	568	132	967	193	1832	366	2748	550	378	76	652	130	1211	242	1816	363	231	46	395	80	757	151	1135	227
PM Emission Factor (g/hr)	34	26	60	45	109	82	164	123	25	18	17	13	32	24	48	36	10	8	12	9	22	16	33	25	9	7	12	9	23	18	35	26
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	81	34	140	60	266	133	399	169	20	8	54	15	64	27	96	41	12	5	21	9	40	17	60	25
NOx (tons/year)	0.95	0.19	1.61	0.32	3.12	0.62	4.78	0.96	0.69	0.14	1.20	0.24	2.27	0.45	3.40	0.68	0.47	0.09	0.81	0.16	1.50	0.30	2.25	0.45	0.29	0.06	0.49	0.10	0.94	0.19	1.41	0.28
PM (tons/year)	0.04	0.03	0.07	0.06	0.13	0.10	0.20	0.15	0.03	0.02	0.02	0.02	0.04	0.03	0.06	0.04	0.01	0.01	0.02	0.01	0.03	0.02	0.04	0.03	0.01	0.01	0.02	0.01	0.03	0.02	0.04	0.03
HC (tons/year)	-	-	-	-	-	-	-	-	0.10	0.04	0.17	0.07	0.33	0.14	0.49	0.21	0.02	0.01	0.04	0.02	0.09	0.03	0.12	0.05	0.02	0.01	0.03	0.01	0.05	0.02	0.07	0.03
NOx Reduction (tons/year)		0.76		1.29		2.50		3.83		0.55		0.96		1.81		2.72		0.37		0.65		1.20		1.80		0.23		0.49		0.75		1.12
PM Reduction (tons/year)		0.01		0.02		0.03		0.05		0.01		0.01		0.01		0.01		0.00		0.01		0.01		0.01		0.00		0.00		0.01		0.01
HC Reduction (tons/year)	-	-	-	-	-	-	-	-		0.06		0.10		0.19		0.28		0.03		0.02		0.05		0.07		0.01		0.01		0.03		0.04
Cost-Effectiveness ($/ton)		$1,911		$1,043		$1,925		$1,894		$2,395		$2,714		$2,714		$2,714		$4,092		$4,280		$4,360		$4,360		$6,302		$6,569		$6,569		$6,569
CE Including Fuel ($/ton)		$2,297		$2,336		$2,314		$2,276		$2,875		$3,262		$3,262		$3,262		$4,918		$5,144		$5,240		$5,240		$7,576		$7,895		$7,895		$7,895
One-Year Cost-Effectiveness		$20,861		$21,309		$20,861		$20,430		$28,721		$28,721		$28,721		$28,721		$42,575		$42,575		$43,460		$43,460		$69,535		$69,535		$69,535		$69,535

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	DOC+SCR	Tier 0 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR
NOx Emission Std (g/bhp-hr)	8.5	1.70	8.5	1.90	6.9	1.38	6.9	1.38	5.372	1.06	4.655	0.93	3.3725	0.67	2.85	0.57
PM Emission Std (g/bhp-hr)	0.55	0.41	0.42	0.32	0.55	0.41	0.30	0.23	0.198	0.14	0.13	0.10	0.198	0.14	0.11	0.08
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	1.00	0.43	1.00	0.43	0.388	0.12	0.25	0.10	0.18	0.07	0.15	0.06
Average Horsepower (hp)	88	88	138	138	138	138	138	138	138	138	138	138	138	138	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,053	8,253	11,419	11,648	12,654	12,907	11,419	11,648	12,654	12,907	11,419	11,648	12,654	12,907	11,419	11,648
Urea Fuel Cost ($/yr)	18,762	19,137	26,607	27,139	29,483	30,073	26,607	27,139	29,483	30,073	26,607	27,139	29,483	30,073	26,607	27,139
Incremental Urea Fuel Cost/yr		$ 375		$ 532		$ 590		$ 532		$ 590		$ 532		$ 590		$ 532
Incremental Capital Cost		$10,132		$15,921		$15,921		$15,921		$15,921		$15,921		$15,921		$15,921
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,188		$1,866		$1,866		$1,866		$1,866		$1,866		$1,866		$1,866
NOx Emission Factor (g/hr)	102	32	272	55	199	40	199	40	154	31	134	27	96	19	82	16
PM Emission Factor (g/hr)	10	8	12	9	16	13	9	7	6	4	4	3	6	4	3	2
HC Emission Factor (g/hr)	0	0	0	0	29	12	29	12	22	9	7	3	9	2	6	2
NOx (tons/year)	0.24	0.05	0.41	0.08	0.30	0.06	0.30	0.06	0.23	0.05	0.20	0.04	0.14	0.03	0.12	0.02
PM (tons/year)	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00
HC (tons/year)	-	-	-	-	0.04	0.02	0.04	0.02	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00
NOx Reduction (tons/year)		0.19		0.33		0.24		0.24		0.18		0.16		0.12		0.10
PM Reduction (tons/year)		0.00		0.00		0.01		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)						0.02		0.02		0.01		0.01		0.00		0.00
Cost-Effectiveness ($/ton)		$4,398		$4,428		$4,779		$5,542		$7,944		$9,478		$11,469		$14,509
CE Including Fuel ($/ton)		$5,787		$5,690		$6,289		$7,123		$10,453		$12,181		$15,119		$18,761
One-Year Cost-Effectiveness		$52,168		$48,324		$66,533		$66,533		$86,293		$95,620		$135,668		$161,080

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0 Baseline	DOC+SCR	Tier 1 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR
NOx Emission Std (g/bhp-hr)	9.2	1.84	6.9	1.38	4.56	0.91
PM Emission Std (g/bhp-hr)	0.41	0.21	0.12	0.09	0.09	0.07
HC Emission Std (g/bhp-hr)	0.00	0.00	1.00	0.43	0.24	0.10
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	142,962	140,159	142,962	140,159	142,962
Urea Fuel Cost ($/yr)	326,570	333,102	326,570	333,102	326,570	333,102
Incremental Urea Fuel Cost/yr		$ 6,531		$ 6,531		$ 6,531
Incremental Capital Cost		$157,426		$157,426		$157,426
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$18,455		$18,455		$18,455
NOx Emission Factor (g/hr)	7781	1556	5835	1167	3855	732
PM Emission Factor (g/hr)	329	247	96	72	71	53
HC Emission Factor (g/hr)	0	0	802	341	193	82
NOx (tons/year)	16.89	3.38	12.01	2.40	7.93	1.59
PM (tons/year)	0.72	0.54	0.21	0.16	0.15	0.11
HC (tons/year)	-	-	1.74	0.74	0.42	0.18
NOx Reduction (tons/year)		13.51		9.61		6.35
PM Reduction (tons/year)		0.18		0.05		0.04
HC Reduction (tons/year)		-		1.00		0.24
Cost-Effectiveness ($/ton)		$1,080		$1,548		$2,487
CE Including Fuel ($/ton)		$1,462		$2,096		$3,367
One-Year Cost-Effectiveness		$11,652		$16,381		$24,187

Measure 51b: SCR+DPF Retrofits

Cost of diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Reduction	80%
PM Reduction	85%
HC Reduction	75%
HC to ROG Conversion	1.26639

Excavators	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.3	1.86	9.5	1.90	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.08	0.42	0.08	0.41	0.08	0.30	0.05	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.60	0.00	0.00	0.00	0.00	0.00	1.00	0.28	1.00	0.28	1.00	0.28	0.25	0.07	0.25	0.07	0.24	0.07	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450	137.5	137.5	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1310	1310	1,310	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310	1,310	1,310	1,310.00	1,310	1,310	1,310
Energy Consumption Factor (bhp-hr/gal)	19.10	19.11	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1
Fuel Usage (gal/yr)	9431	9619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481	9,431	9,619	16,289	16,615	30,864	31,481
Urea Fuel Cost ($/yr)	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351	21,973	22,413	37,954	38,713	71,913	73,351
Incremental Urea Fuel Cost/yr		$439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438		$ 439		$ 759		$ 1,438
Incremental Capital Cost		$17,368		$30,000		$56,842		$17,368		$30,000		$56,842		$17,368		$30,000		$56,842		$17,368		$30,000		$56,842
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$2,036		$3,517		$6,664		$2,036		$3,517		$6,664		$2,036		$3,517		$6,664		$2,036		$3,517		$6,664
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	568	112	967	193	1832	366	378	76	652	130	1211	242	231	46	399	80	757	151
PM Emission Factor (g/hr)	34	5	60	9	109	16	25	4	17	3	32	5	10	2	12	2	23	4	9	1	12	2	23	4
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	22	140	39	266	73	20	5	34	9	64	18	12	3	21	6	40	11
NOx (tons/year)	1.11	0.22	1.88	0.38	3.64	0.73	0.81	0.16	1.40	0.28	2.65	0.53	0.55	0.11	0.94	0.19	1.75	0.35	0.33	0.07	0.58	0.12	1.09	0.22
PM (tons/year)	0.05	0.01	0.09	0.01	0.16	0.02	0.04	0.01	0.02	0.00	0.05	0.01	0.01	0.00	0.02	0.00	0.03	0.01	0.01	0.00	0.02	0.00	0.03	0.01
HC (tons/year)	-	-	-	-	-	-	0.12	0.03	0.20	0.06	0.38	0.11	0.03	0.01	0.05	0.01	0.09	0.03	0.02	0.00	0.03	0.01	0.06	0.02
NOx Reduction (tons/year)		0.89		1.51		2.91		0.65		1.12		2.12		0.44		0.75		1.40		0.27		0.46		0.87
PM Reduction (tons/year)		0.04		0.07		0.13		0.03		0.02		0.04		0.01		0.02		0.03		0.01		0.02		0.03
HC Reduction (tons/year)		-		-		-		0.08		0.15		0.28		0.02		0.04		0.07		0.01		0.02		0.04
Cost-Effectiveness ($/ton)		$1,173		$1,186		$1,192		$1,498		$2,050		$2,050		$2,838		$3,192		$3,240		$4,023		$4,441		$4,441
CE Including Fuel ($/ton)		$1,426		$1,441		$1,449		$1,821		$2,493		$2,493		$3,450		$3,881		$3,939		$4,890		$5,400		$5,400
One-Year Cost-Effectiveness		$19,508		$19,028		$19,508		$26,860		$26,860		$26,860		$39,813		$39,813		$40,643		$65,028		$65,028		$65,028

Rubber Tire Loaders	100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.3	1.86	9.5	1.90	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.08	0.42	0.08	0.41	0.08	0.30	0.05	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.60	0.00	0.00	0.00	0.00	0.00	1.00	0.28	1.00	0.28	1.00	0.28	0.25	0.07	0.25	0.07	0.24	0.07	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450	137.5	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	913	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913	913.00	913	913	913	913	913
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	6573	6704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941	6,573	6,704	11,353	11,580	21,510	21,941
Urea Fuel Cost ($/yr)	15,316	15,621	26,452	26,981	50,119	51,122	15,316	15,621	26,452	26,981	50,119	51,122	15,316	15,621	26,452	26,981	50,119	51,122	15,316	15,621	26,452	26,981	50,119	51,122
Incremental Urea Fuel Cost/yr		$306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002		$ 306		$ 529		$ 1,002
Incremental Capital Cost		$17,368		$30,000		$56,842		$17,368		$30,000		$56,842		$17,368		$30,000		$56,842		$17,368		$30,000		$56,842
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$2,036		$3,517		$6,664		$2,036		$3,517		$6,664		$2,036		$3,517		$6,665		$2,036		$3,517		$6,664
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	568	112	967	193	1832	366	378	76	652	130	1211	242	231	46	399	80	757	151
PM Emission Factor (g/hr)	34	5	60	9	109	16	25	4	17	3	32	5	10	2	12	2	23	4	9	1	12	2	23	4
HC Emission Factor (g/hr)	0	0	0	0	0	0	81	22	140	39	266	73	20	5	34	9	64	18	12	3	21	6	40	11
NOx (tons/year)	0.78	0.16	1.31	0.26	2.54	0.51	0.56	0.11	0.97	0.19	1.84	0.37	0.38	0.08	0.66	0.13	1.22	0.24	0.23	0.05	0.40	0.08	0.78	0.15
PM (tons/year)	0.03	0.01	0.06	0.01	0.11	0.02	0.02	0.00	0.02	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.02	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.02	0.14	0.04	0.27	0.07	0.02	0.01	0.03	0.01	0.06	0.02	0.01	0.00	0.02	0.01	0.04	0.01
NOx Reduction (tons/year)		0.62		1.05		2.03		0.45		0.78		1.47		0.30		0.53		0.97		0.19		0.32		0.61
PM Reduction (tons/year)		0.03		0.05		0.09		0.02		0.03		0.07		0.01		0.01		0.02		0.01		0.01		0.02
HC Reduction (tons/year)		-		-		-		0.06		0.10		0.19		0.01		0.03		0.05		0.01		0.02		0.03
Cost-Effectiveness ($/ton)		$1,683		$1,791		$1,710		$2,149		$2,942		$2,942		$4,072		$4,580		$4,649		$5,771		$6,372		$6,372
CE Including Fuel ($/ton)		$1,936		$1,957		$1,967		$2,472		$3,384		$3,384		$4,684		$5,269		$5,348		$6,639		$7,331		$7,331
One-Year Cost-Effectiveness		$27,991		$28,593		$27,991		$38,539		$38,539		$38,539		$57,125		$57,125		$58,315		$93,305		$93,305		$93,305

Crawler Tractors/Dozers	100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP		100-175 HP		175-300 HP		300-600 HP		600-750 HP	
	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	9.5	1.9	9.3	1.86	9.5	1.90	9.7	1.94	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	4.56	0.91	4.56	0.91	2.85	0.57	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42	0.06	0.42	0.06	0.41	0.06	0.41	0.06	0.30	0.05	0.12	0.02	0.12	0.02	0.12	0.02	0.13	0.02	0.09	0.01	0.09	0.01	0.09	0.01	0.11	0.02	0.09	0.01	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	1.000	0.20	1.000	0.20	1.000	0.20	1.000	0.20	0.25	0.05	0.25	0.05	0.24	0.05	0.24	0.05	0.15	0.04	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675	137.5	137.5	238	238	450	450	675	675
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123	1,123	1,123	1,123.00	1,123	1,123	1,123	1,123	1,123
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.10	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	8064	8246	13,964	14,243	26,458	26,987	39,687	40,481	8064	8246	13,964	14,243	26,458	26,987	39,687	40,481	8,064	8,246	13,964	14,243	26,458	26,987	39,687	40,481	8,064	8,246	13,964	14,243	26,458	26,987	39,687	40,481
Urea Fuel Cost ($/yr)	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321	18,837	19,213	32,536	33,187	61,647	62,880	92,471	94,321
Incremental Urea Fuel Cost/yr		$377		$ 651		$ 1,233		$ 1,849		$377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849		$ 377		$ 651		$ 1,233		$ 1,849
Incremental Capital Cost		$17,368		$30,000		$56,842		$85,263		$17,368		$30,000		$56,842		$85,263		$17,368		$30,000		$56,842		$85,263		$17,368		$30,000		$56,842		$85,263
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$2,036		$3,517		$6,664		$9,995		$2,036		$3,517		$6,664		$9,995		$2,036		$3,517		$6,664		$9,995		$2,036		$3,517		$6,664		$9,995
NOx Emission Factor (g/hr)	771	154	1303	261	2522	504	3863	773	540	112	967	193	1828	366	2749	550	378	76	632	126	1211	242	1816	363	231	46	398	80	757	151	1135	227
PM Emission Factor (g/hr)	34	5	56	9	109	16	164	25	25	5	42	7	77	12	116	18	16	3	27	4	51	8	77	12	9	1	17	3	32	5	48	7
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	8	2	14	3	27	7	39	10	2	0	3	1	5	1	8	2	1	0	2	0	4	1	6	1
NOx (tons/year)	0.95	0.19	1.61	0.32	3.12	0.62	4.78	0.96	0.67	0.14	1.20	0.24	2.27	0.45	3.40	0.68	0.47	0.09	0.81	0.16	1.50	0.30	2.25	0.45	0.29	0.06	0.49	0.10	0.94	0.19	1.41	0.28
PM (tons/year)	0.04	0.01	0.07	0.01	0.13	0.02	0.20	0.03	0.03	0.00	0.02	0.00	0.04	0.01	0.06	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01	0.01	0.00	0.02	0.00	0.03	0.00	0.04	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	0.10	0.03	0.17	0.03	0.33	0.09	0.49	0.14	0.02	0.01	0.04	0.01	0.08	0.02	0.12	0.03	0.02	0.00	0.03	0.01	0.05	0.01	0.07	0.02
NOx Reduction (tons/year)		0.76		1.29		2.50		3.83		0.55		0.96		1.81		2.72		0.37		0.65		1.20		1.80		0.23		0.40		0.75		1.12
PM Reduction (tons/year)		0.04		0.06		0.11		0.17		0.03		0.05		0.09		0.13		0.01		0.03		0.05		0.08		0.01		0.01		0.02		0.04
HC Reduction (tons/year)		-		-		-		-		0.07		0.13		0.24		0.36		0.02		0.03		0.06		0.09		0.01		0.02		0.04		0.05
Cost-Effectiveness ($/ton)		$1,368		$1,383		$1,390		$1,375		$1,747		$2,391		$2,391		$2,391		$3,310		$3,724		$3,780		$3,780		$4,692		$5,181		$5,181		$5,181
CE Including Fuel ($/ton)		$1,621		$1,639		$1,648		$1,630		$2,070		$2,834		$2,834		$2,834		$3,923		$4,413		$4,479		$4,479		$5,560		$6,139		$6,139		$6,139
One-Year Cost-Effectiveness		$12,757		$23,146		$22,757		$22,288		$11,332		$11,332		$11,332		$11,332		$46,643		$46,645		$47,410		$47,410		$75,857		$75,857		$75,857		$75,857

Tractors/Loaders/Backhoes	75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP		75-100 HP		100-175 HP	
	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	8.8	1.76	9.5	1.90	6.9	1.38	6.9	1.38	5.32	1.06	4.655	0.93	3.325	0.67	2.85	0.57
PM Emission Std (g/bhp-hr)	0.55	0.08	0.42	0.06	0.55	0.08	0.30	0.05	0.19	0.03	0.13	0.02	0.19	0.03	0.11	0.02
HC Emission Std (g/bhp-hr)	0.000	0.00	0.000	0.00	1.000	0.20	1.000	0.20	0.28	0.06	0.25	0.05	0.18	0.05	0.15	0.04
Average Horsepower (hp)	88	88	138	138	138	138	138	138	138	138	138	138	138	138	138	138
Load Factor	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Activity (hr/yr)	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362	1,362
Energy Consumption Factor (bhp-hr/gal)	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4	14.8	14.8	16.4	16.4
Fuel Usage (gal/yr)	8,052	8,213	11,419	11,648	12,654	12,907	11,419	11,648	12,654	12,907	11,419	11,648	12,654	12,907	11,419	11,648
Urea Fuel Cost ($/yr)	18,762	19,137	26,607	27,139	29,483	30,073	26,607	27,139	29,483	30,073	26,607	27,139	29,483	30,073	26,607	27,139
Incremental Urea Fuel Cost/yr		$ 375		$ 532		$ 590		$ 532		$ 590		$ 532		$ 590		$ 532
Incremental Capital Cost		$11,053		$17,368		$17,368		$17,368		$17,368		$17,368		$17,368		$17,368
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,296		$2,036		$2,036		$2,036		$2,036		$2,036		$2,036		$2,036
NOx Emission Factor (g/hr)	1628	32	2748	55	1995	40	1995	40	1548	31	1349	27	968	19	829	16
PM Emission Factor (g/hr)	101	2	158	3	160	3	91	1	61	1	40	1	61	1	32	0
HC Emission Factor (g/hr)	0	0	0	0	29	1	29	1	8	2	7	2	5	1	5	1
NOx (tons/year)	0.24	0.05	0.41	0.08	0.30	0.06	0.30	0.06	0.23	0.05	0.20	0.04	0.14	0.03	0.12	0.02
PM (tons/year)	0.02	0.00	0.02	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
HC (tons/year)	-	-	-	-	0.04	0.01	0.04	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
NOx Reduction (tons/year)		0.19		0.33		0.24		0.24		0.18		0.16		0.12		0.10
PM Reduction (tons/year)		0.01		0.02		0.01		0.01		0.01		0.00		0.01		0.00
HC Reduction (tons/year)		-		-		0.03		0.03		0.01		0.01		0.01		0.00
Cost-Effectiveness ($/ton)		$2,866		$3,169		$2,909		$4,047		$6,059		$7,668		$7,719		$10,868
CE Including Fuel ($/ton)		$3,696		$3,997		$3,828		$5,104		$7,788		$9,672		$9,955		$13,708
One-Year Cost-Effectiveness		$56,910		$52,717		$72,581		$72,581		$94,138		$107,585		$150,620		$175,723

Off-Highway Trucks	750+ HP		750+ HP		750+ HP	
	Tier 0 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	9.7	1.94	6.9	1.38	4.56	0.91
PM Emission Std (g/bhp-hr)	0.41	0.06	0.12	0.02	0.099	0.01
HC Emission Std (g/bhp-hr)	0.00	0.00	1.00	0.20	0.24	0.07
Average Horsepower (hp)	1360	1360	1360	1360	1360	1360
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	1,969	1,969	1,969	1,969	1,969	1,969
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	140,159	142,962	140,159	142,962	140,159	142,962
Urea Fuel Cost ($/yr)	326,570	333,102	326,570	333,102	326,570	333,102
Incremental Urea Fuel Cost/yr		$ 6,531		$ 6,531		$ 6,531
Incremental Capital Cost		$171,738		$171,738		$171,738
Useful Life (years)	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$20,133		$20,133		$20,133
NOx Emission Factor (g/hr)	27818	5564	55635	11127	36588	7318
PM Emission Factor (g/hr)	329	49	968	14	711	11
HC Emission Factor (g/hr)	0	0	892	223	193	53
NOx (tons/year)	16.89	3.38	12.01	2.40	7.94	1.59
PM (tons/year)	0.72	0.11	0.21	0.03	0.15	0.02
HC (tons/year)	-	-	1.74	0.48	0.42	0.11
NOx Reduction (tons/year)		13.51		9.61		6.35
PM Reduction (tons/year)		0.61		0.18		0.13
HC Reduction (tons/year)		-		1.26		0.30
Cost-Effectiveness ($/ton)		$784		$1,364		$2,156
CE Including Fuel ($/ton)		$1,039		$1,805		$2,855
One-Year Cost-Effectiveness		$12,712		$17,670		$27,040

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LEFT(K6,3),MID(K6,5,3)
100 175

Measure 51a: DPF Retrofit

Cost of diesel:	2.33
Incremental Fuel Consumption	2%
NOx Emission Reduction	0%
PM Emission Reduction	85%
HC Emission Reduction	80%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0	DPF	Tier 0	DPF	Tier 0	DPF	Tier 0	DPF	Tier 0	DPF	Tier 0	DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	7.2	7.20	8.8	8.80	8.8	8.80	9.5	9.50	9.3	9.30	9.5	9.50
PM Emission Std (g/bhp-hr)	0.55	0.08	0.55	0.08	0.55	0.08	0.42	0.06	0.42	0.06	0.41	0.06
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$1,421		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$167		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	159	159	325	325	454	454	771	771	1303	1303	2522	2522
PM Emission Factor (g/hr)	12	2	20	3	28	4	34	5	60	9	109	16
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.08	0.17	0.17	0.24	0.24	0.40	0.40	0.68	0.68	1.32	1.32
PM (tons/year)	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.00	0.06	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.01		0.01		0.01		0.02		0.03		0.05
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$1,546		$1,535		$1,538		$1,992		$1,992		$2,059
CE Including Fuel ($/ton)		$1,994		$1,980		$1,984		$2,511		$2,511		$2,597
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1	DPF	Tier 1	DPF	Tier 1	DPF	Tier 1	DPF	Tier 1	DPF	Tier 1	DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	6.745	6.75	6.9	6.90	6.9	6.90	6.9	6.90	6.9	6.90	6.9	6.90
PM Emission Std (g/bhp-hr)	0.48	0.07	0.55	0.08	0.55	0.08	0.30	0.05	0.12	0.02	0.12	0.02
HC Emission Std (g/bhp-hr)	0.36	0.07	1.00	0.20	1.00	0.20	1.00	0.20	1.00	0.20	1.00	0.20
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$1,421		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$167		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	149	149	254	254	356	356	560	560	967	967	1832	1832
PM Emission Factor (g/hr)	11	2	20	3	28	4	25	4	17	3	32	5
HC Emission Factor (g/hr)	8	2	37	7	52	10	81	16	140	28	266	53
NOx (tons/year)	0.08	0.08	0.13	0.13	0.19	0.19	0.29	0.29	0.51	0.51	0.96	0.96
PM (tons/year)	0.006	0.001	0.011	0.002	0.015	0.002	0.013	0.002	0.009	0.001	0.017	0.003
HC (tons/year)	0.004	0.001	0.019	0.004	0.027	0.005	0.042	0.008	0.073	0.015	0.139	0.028
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.01		0.01
HC Reduction (tons/year)		0.00		0.02		0.02		0.03		0.06		0.11
Cost-Effectiveness ($/ton)		$1,688		$1,383		$1,383		$2,327		$4,710		$4,710
CE Including Fuel ($/ton)		$2,177		$1,784		$1,784		$2,933		$5,939		$5,939
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF	Tier 2 Baseline	DPF
NOx Emission Std (g/bhp-hr)	5.32	5.32	5.32	5.32	5.32	5.32	4.655	4.66	4.655	4.66	4.56	4.56
PM Emission Std (g/bhp-hr)	0.28	0.04	0.19	0.03	0.19	0.03	0.13	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.28	0.06	0.28	0.06	0.28	0.06	0.25	0.05	0.25	0.05	0.24	0.05
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$1,421		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$167		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	118	118	196	196	275	275	378	378	652	652	1211	1211
PM Emission Factor (g/hr)	6	1	7	1	10	1	10	2	12	2	23	4
HC Emission Factor (g/hr)	6	1	10	2	14	3	20	4	34	7	64	13
NOx (tons/year)	0.06	0.06	0.10	0.10	0.14	0.14	0.20	0.20	0.34	0.34	0.63	0.63
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.01		0.01		0.01		0.03
Cost-Effectiveness ($/ton)		$2,851		$4,054		$4,054		$5,932		$8,245		$8,269
CE Including Fuel ($/ton)		$3,677		$5,228		$5,228		$7,480		$10,396		$10,426
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF	Tier 3 Baseline	DPF
NOx Emission Std (g/bhp-hr)	3.325	3.33	3.325	3.33	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.19	0.03	0.19	0.03	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.18	0.04	0.18	0.04	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	123	123	172	172	231	231	399	399	757	757
PM Emission Factor (g/hr)	7	1	10	1	9	1	12	2	23	4
HC Emission Factor (g/hr)	6	1	9	2	12	2	21	4	40	8
NOx (tons/year)	0.06	0.06	0.09	0.09	0.12	0.12	0.21	0.21	0.40	0.40
PM (tons/year)	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00
NOx Reduction (tons/year)		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$4,179		$4,179		$6,995		$8,726		$8,726
CE Including Fuel ($/ton)		$5,389		$5,389		$8,819		$11,003		$11,003
One-Year Cost-Effectiveness		-		-		-		-		-

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0	DPF	Tier 0	DPF	Tier 1	DPF	Tier 1	DPF	Tier 2	DPF	Tier 2	DPF	Tier 3	DPF	Tier 3	DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	9.30	9.5	9.50	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42475	0.06	0.42475	0.06	0.12	0.02	0.304	0.05	0.088	0.01	0.128	0.02	0.088	0.01	0.112	0.02
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	0.20	1	0.20	0.245	0.05	0.245	0.05	0.15	0.03	0.15	0.03
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101
Fuel Cost ($/yr)	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566
Incremental Fuel Cost/yr		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50
Incremental Capital Cost		$9,000		$5,211		$9,000		$5,211		$9,000		$5,211		$9,000		$5,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,055		$611		$1,055		$611		$1,055		$611		$1,055		$611
NOx Emission Factor (g/hr)	1303	1303	771	771	967	967	560	560	652	652	378	378	399	399	231	231
PM Emission Factor (g/hr)	60	9	34	5	17	3	25	4	12	2	10	2	12	2	9	1
HC Emission Factor (g/hr)	0	0	0	0	140	28	81	16	34	7	20	4	21	4	12	2
NOx (tons/year)	0.22	0.22	0.13	0.13	0.16	0.16	0.09	0.09	0.11	0.11	0.06	0.06	0.07	0.07	0.04	0.04
PM (tons/year)	0.010	0.001	0.006	0.001	0.003	0.000	0.004	0.001	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000
HC (tons/year)	-	-	-	-	0.023	0.005	0.013	0.003	0.006	0.001	0.003	0.001	0.003	0.001	0.002	0.000
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.01		0.00		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.01		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$6,307		$6,307		$14,915		$7,367		$26,108		$18,785		$27,633		$22,149
CE Including Fuel ($/ton)		$6,826		$6,826		$16,144		$7,974		$28,259		$20,332		$29,910		$23,974
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-

Measure 51b: Lean NOx Catalyst + DPF	Cleaire LNC+DPF
Cost of diesel:	2.33
Incremental Fuel Cost	2%
NOx Emission Reduction	25%
PM Emission Reduction	85%
HC Emission Reduction	73%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0	LNC+DPF	Tier 0	LNC+DPF	Tier 0	LNC+DPF	Tier 0	LNC+DPF	Tier 0	LNC+DPF	Tier 0	LNC+DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	7.2	5.40	8.8	6.60	8.8	6.60	9.5	7.13	9.3	6.98	9.5	7.13
PM Emission Std (g/bhp-hr)	0.55	0.08	0.55	0.08	0.55	0.08	0.42	0.06	0.42	0.06	0.41	0.06
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	1,553	1,584	2,589	2,641	3,625	3,697	5,129	5,232	8,860	9,037	16,787	17,122
Incremental Fuel Cost/yr		$ 31		$ 52		$ 72		$ 103		$ 177		$ 336
Incremental Capital Cost		$5,158		$7,263		$9,368		$13,579		$20,000		$37,895
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$605		$851		$1,098		$1,592		$2,345		$4,442
NOx Emission Factor (g/hr)	159	119	325	243	454	341	771	578	1303	977	2522	1892
PM Emission Factor (g/hr)	12	2	20	3	28	4	34	5	60	9	109	16
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.06	0.17	0.13	0.24	0.18	0.40	0.30	0.68	0.51	1.32	0.99
PM (tons/year)	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.00	0.06	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		0.02		0.04		0.06		0.10		0.17		0.33
PM Reduction (tons/year)		0.01		0.01		0.01		0.02		0.03		0.05
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$4,703		$3,813		$3,518		$3,906		$3,348		$3,415
CE Including Fuel ($/ton)		$4,944		$4,044		$3,750		$4,157		$3,601		$3,673
One-Year Cost-Effectiveness		$247,358		$170,994		$157,541		$134,604		$117,247		$114,778

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1	LNC+DPF	Tier 1	LNC+DPF	Tier 1	LNC+DPF	Tier 1	LNC+DPF	Tier 1	LNC+DPF	Tier 1	LNC+DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	6.745	5.06	6.9	5.18	6.9	5.18	6.9	5.18	6.9	5.18	6.9	5.18
PM Emission Std (g/bhp-hr)	0.48	0.07	0.55	0.08	0.55	0.08	0.30	0.05	0.12	0.02	0.12	0.02
HC Emission Std (g/bhp-hr)	0.36	0.10	1.00	0.27	1.00	0.27	1.00	0.27	1.00	0.27	1.00	0.27
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	1,553	1,584	2,589	2,641	3,625	3,697	5,129	5,232	8,860	9,037	16,787	17,122
Incremental Fuel Cost/yr		$ 31		$ 52		$ 72		$ 103		$ 177		$ 336
Incremental Capital Cost		$5,158		$7,263		$9,368		$13,579		$20,000		$37,895
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$605		$851		$1,098		$1,592		$2,345		$4,442
NOx Emission Factor (g/hr)	149	112	254	191	356	267	560	420	967	725	1832	1374
PM Emission Factor (g/hr)	11	2	20	3	28	4	25	4	17	3	32	5
HC Emission Factor (g/hr)	8	2	37	10	52	14	81	22	140	38	266	72
NOx (tons/year)	0.08	0.06	0.13	0.10	0.19	0.14	0.29	0.22	0.51	0.38	0.96	0.72
PM (tons/year)	0.006	0.001	0.011	0.002	0.015	0.002	0.013	0.002	0.009	0.001	0.017	0.003
HC (tons/year)	0.004	0.001	0.019	0.005	0.027	0.007	0.042	0.011	0.073	0.020	0.139	0.038
NOx Reduction (tons/year)		0.02		0.03		0.05		0.07		0.13		0.24
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.01		0.01
HC Reduction (tons/year)		0.00		0.01		0.02		0.03		0.05		0.10
Cost-Effectiveness ($/ton)		$5,130		$3,665		$3,376		$4,794		$6,815		$6,815
CE Including Fuel ($/ton)		$5,394		$3,888		$3,599		$5,103		$7,330		$7,330
One-Year Cost-Effectiveness		$264,044		$218,079		$200,922		$185,324		$158,028		$158,028

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF	Tier 2 Baseline	LNC+DPF
NOx Emission Std (g/bhp-hr)	5.32	3.99	5.32	3.99	5.32	3.99	4.655	3.49	4.655	3.49	4.56	3.42
PM Emission Std (g/bhp-hr)	0.28	0.04	0.19	0.03	0.19	0.03	0.13	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.28	0.08	0.28	0.08	0.28	0.08	0.25	0.07	0.25	0.07	0.24	0.06
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	1,553	1,584	2,589	2,641	3,625	3,697	5,129	5,232	8,860	9,037	16,787	17,122
Incremental Fuel Cost/yr		$ 31		$ 52		$ 72		$ 103		$ 177		$ 336
Incremental Capital Cost		$5,158		$7,263		$9,368		$13,579		$20,000		$37,895
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$605		$851		$1,098		$1,592		$2,345		$4,442
NOx Emission Factor (g/hr)	118	88	196	147	275	206	378	283	652	489	1211	908
PM Emission Factor (g/hr)	6	1	7	1	10	1	10	2	12	2	23	4
HC Emission Factor (g/hr)	6	2	10	3	14	4	20	5	34	9	64	17
NOx (tons/year)	0.06	0.05	0.10	0.08	0.14	0.11	0.20	0.15	0.34	0.26	0.63	0.48
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.01
NOx Reduction (tons/year)		0.02		0.03		0.04		0.05		0.09		0.16
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.01		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$8,221		$9,088		$8,373		$10,509		$11,072		$11,182
CE Including Fuel ($/ton)		$8,644		$9,640		$8,925		$11,186		$11,909		$12,027
One-Year Cost-Effectiveness		$334,770		$282,847		$260,594		$274,702		$234,242		$239,122

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF	Tier 3 Baseline	LNC+DPF
NOx Emission Std (g/bhp-hr)	3.325	2.49	3.325	2.49	2.85	2.14	2.85	2.14	2.85	2.14
PM Emission Std (g/bhp-hr)	0.19	0.03	0.19	0.03	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.18	0.05	0.18	0.05	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,589	2,641	3,625	3,697	5,129	5,232	8,860	9,037	16,787	17,122
Incremental Fuel Cost/yr		$ 52		$ 72		$ 103		$ 177		$ 336
Incremental Capital Cost		$7,263		$9,368		$13,579		$20,000		$37,895
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$851		$1,098		$1,592		$2,345		$4,442
NOx Emission Factor (g/hr)	123	92	172	129	231	173	399	300	757	568
PM Emission Factor (g/hr)	7	1	10	1	9	1	12	2	23	4
HC Emission Factor (g/hr)	6	2	9	2	12	3	21	6	40	11
NOx (tons/year)	0.06	0.05	0.09	0.07	0.12	0.09	0.21	0.16	0.40	0.30
PM (tons/year)	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01
NOx Reduction (tons/year)		0.02		0.02		0.03		0.05		0.10
PM Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.02
Cost-Effectiveness ($/ton)		$10,359		$9,544		$13,602		$13,615		$13,615
CE Including Fuel ($/ton)		$10,989		$10,174		$14,479		$14,644		$14,644
One-Year Cost-Effectiveness		$452,555		$416,950		$448,679		$382,595		$382,595

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0	LNC+DPF	Tier 0	LNC+DPF	Tier 1	LNC+DPF	Tier 1	LNC+DPF	Tier 2	LNC+DPF	Tier 2	LNC+DPF	Tier 3	LNC+DPF	Tier 3	LNC+DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	6.98	9.5	7.13	6.9	5.18	6.9	5.18	4.655	3.49	4.655	3.49	2.85	2.14	2.85	2.14
PM Emission Std (g/bhp-hr)	0.42475	0.06	0.42475	0.06	0.12	0.02	0.304	0.05	0.088	0.01	0.128	0.02	0.088	0.01	0.112	0.02
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	0.27	1	0.27	0.245	0.07	0.245	0.07	0.15	0.04	0.15	0.04
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101
Fuel Cost ($/yr)	2,798	2,854	1,620	1,652	2,798	2,854	1,620	1,652	2,798	2,854	1,620	1,652	2,798	2,854	1,620	1,652
Incremental Fuel Cost/yr		$ 56		$ 32		$ 56		$ 32		$ 56		$ 32		$ 56		$ 32
Incremental Capital Cost		$20,000		$11,579		$20,000		$11,579		$20,000		$11,579		$20,000		$11,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$2,345		$1,357		$2,345		$1,357		$2,345		$1,357		$2,345		$1,357
NOx Emission Factor (g/hr)	1303	977	771	578	967	725	560	420	652	489	378	283	399	300	231	173
PM Emission Factor (g/hr)	60	9	34	5	17	3	25	4	12	2	10	2	12	2	9	1
HC Emission Factor (g/hr)	0	0	0	0	140	38	81	22	34	9	20	5	21	6	12	3
NOx (tons/year)	0.22	0.16	0.13	0.10	0.16	0.12	0.09	0.07	0.11	0.08	0.06	0.05	0.07	0.05	0.04	0.03
PM (tons/year)	0.010	0.001	0.006	0.001	0.003	0.000	0.004	0.001	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000
HC (tons/year)	-	-	-	-	0.023	0.006	0.013	0.004	0.006	0.002	0.003	0.001	0.003	0.001	0.002	0.001
NOx Reduction (tons/year)		0.05		0.03		0.04		0.02		0.03		0.02		0.02		0.01
PM Reduction (tons/year)		0.01		0.00		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.01		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$10,601		$10,546		$21,580		$12,945		$35,062		$28,376		$43,114		$36,730
CE Including Fuel ($/ton)		$10,854		$10,798		$22,095		$13,254		$35,899		$29,054		$44,143		$37,606
One-Year Cost-Effectiveness		$371,281		$363,465		$500,423		$500,423		$741,765		$741,765		$1,211,550		$1,211,550

Measure 51c: EGR+ DPF Retrofit

Cost of diesel:	2.33
Incremental Fuel Cost	3%
NOx Emission Reduction	40%
PM Emission Reduction	85%
HC Emission Reduction	73%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0	EGR+DPF	Tier 0	EGR+DPF	Tier 0	EGR+DPF	Tier 0	EGR+DPF	Tier 0	EGR+DPF	Tier 0	EGR+DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	7.2	4.32	8.8	5.28	8.8	5.28	9.5	5.70	9.3	5.58	9.5	5.70
PM Emission Std (g/bhp-hr)	0.55	0.08	0.55	0.08	0.55	0.08	0.42	0.06	0.42	0.06	0.41	0.06
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,067	1,726	1,778	2,416	2,489	3,420	3,522	5,906	6,084	11,191	11,527
Fuel Cost ($/yr)	2,413	2,485	4,022	4,142	5,630	5,799	7,967	8,206	13,762	14,175	26,075	26,858
Incremental Fuel Cost/yr		$ 72		$ 121		$ 169		$ 239		$ 413		$ 782
Incremental Capital Cost		$3,632		$6,053		$8,474		$13,316		$23,000		$43,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$426		$710		$993		$1,561		$2,696		$5,109
NOx Emission Factor (g/hr)	159	96	325	195	454	273	771	462	1303	782	2522	1513
PM Emission Factor (g/hr)	12	2	20	3	28	4	34	5	60	9	109	16
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.05	0.17	0.10	0.24	0.14	0.40	0.24	0.68	0.41	1.32	0.79
PM (tons/year)	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.00	0.06	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		0.03		0.07		0.10		0.16		0.27		0.53
PM Reduction (tons/year)		0.01		0.01		0.01		0.02		0.03		0.05
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$3,018		$2,852		$2,856		$3,335		$3,359		$3,408
CE Including Fuel ($/ton)		$3,531		$3,337		$3,341		$3,845		$3,873		$3,930
One-Year Cost-Effectiveness		$108,850		$89,059		$89,059		$82,497		$84,271		$82,497

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1	EGR+DPF	Tier 1	EGR+DPF	Tier 1	EGR+DPF	Tier 1	EGR+DPF	Tier 1	EGR+DPF	Tier 1	EGR+DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	6.745	4.05	6.9	4.14	6.9	4.14	6.9	4.14	6.9	4.14	6.9	4.14
PM Emission Std (g/bhp-hr)	0.48	0.07	0.55	0.08	0.55	0.08	0.30	0.05	0.12	0.02	0.12	0.02
HC Emission Std (g/bhp-hr)	0.36	0.10	1.00	0.27	1.00	0.27	1.00	0.27	1.00	0.27	1.00	0.27
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,067	1,726	1,778	2,416	2,489	3,420	3,522	5,906	6,084	11,191	11,527
Fuel Cost ($/yr)	2,413	2,485	4,022	4,142	5,630	5,799	7,967	8,206	13,762	14,175	26,075	26,858
Incremental Fuel Cost/yr		$ 72		$ 121		$ 169		$ 239		$ 413		$ 782
Incremental Capital Cost		$3,632		$6,053		$8,474		$13,316		$23,000		$43,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$426		$710		$993		$1,561		$2,696		$5,109
NOx Emission Factor (g/hr)	149	90	254	153	356	214	560	336	967	580	1832	1099
PM Emission Factor (g/hr)	11	2	20	3	28	4	25	4	17	3	32	5
HC Emission Factor (g/hr)	8	2	37	10	52	14	81	22	140	38	266	72
NOx (tons/year)	0.08	0.05	0.13	0.08	0.19	0.11	0.29	0.18	0.51	0.30	0.96	0.58
PM (tons/year)	0.006	0.001	0.011	0.002	0.015	0.002	0.013	0.002	0.009	0.001	0.017	0.003
HC (tons/year)	0.004	0.001	0.019	0.005	0.027	0.007	0.042	0.011	0.073	0.020	0.139	0.038
NOx Reduction (tons/year)		0.03		0.05		0.07		0.12		0.20		0.38
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.01		0.01
HC Reduction (tons/year)		0.00		0.01		0.02		0.03		0.05		0.10
Cost-Effectiveness ($/ton)		$3,285		$2,812		$2,812		$4,151		$6,420		$6,420
CE Including Fuel ($/ton)		$3,844		$3,290		$3,290		$4,787		$7,403		$7,403
One-Year Cost-Effectiveness		$116,193		$113,583		$113,583		$113,583		$113,583		$113,583

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF	Tier 2 Baseline	EGR+DPF
NOx Emission Std (g/bhp-hr)	5.32	3.19	5.32	3.19	5.32	3.19	4.655	2.79	4.655	2.79	4.56	2.74
PM Emission Std (g/bhp-hr)	0.28	0.04	0.19	0.03	0.19	0.03	0.13	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.28	0.08	0.28	0.08	0.28	0.08	0.25	0.07	0.25	0.07	0.24	0.06
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,067	1,726	1,778	2,416	2,489	3,420	3,522	5,906	6,084	11,191	11,527
Fuel Cost ($/yr)	2,413	2,485	4,022	4,142	5,630	5,799	7,967	8,206	13,762	14,175	26,075	26,858
Incremental Fuel Cost/yr		$ 72		$ 121		$ 169		$ 239		$ 413		$ 782
Incremental Capital Cost		$3,632		$6,053		$8,474		$13,316		$23,000		$43,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$426		$710		$993		$1,561		$2,696		$5,109
NOx Emission Factor (g/hr)	118	71	196	118	275	165	378	227	652	391	1211	726
PM Emission Factor (g/hr)	6	1	7	1	10	1	10	2	12	2	23	4
HC Emission Factor (g/hr)	6	2	10	3	14	4	20	5	34	9	64	17
NOx (tons/year)	0.06	0.04	0.10	0.06	0.14	0.09	0.20	0.12	0.34	0.20	0.63	0.38
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.01
NOx Reduction (tons/year)		0.02		0.04		0.06		0.08		0.14		0.25
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.01		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$5,142		$6,504		$6,504		$8,618		$10,253		$10,376
CE Including Fuel ($/ton)		$6,017		$7,609		$7,609		$9,937		$11,822		$11,965
One-Year Cost-Effectiveness		$147,316		$147,316		$147,316		$168,361		$168,361		$171,869

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF	Tier 3 Baseline	EGR+DPF
NOx Emission Std (g/bhp-hr)	3.325	2.00	3.325	2.00	2.85	1.71	2.85	1.71	2.85	1.71
PM Emission Std (g/bhp-hr)	0.19	0.03	0.19	0.03	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.18	0.05	0.18	0.05	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,778	2,416	2,489	3,420	3,522	5,906	6,084	11,191	11,527
Fuel Cost ($/yr)	4,022	4,142	5,630	5,799	7,967	8,206	13,762	14,175	26,075	26,858
Incremental Fuel Cost/yr		$ 121		$ 169		$ 239		$ 413		$ 782
Incremental Capital Cost		$6,053		$8,474		$13,316		$23,000		$43,579
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$710		$993		$1,561		$2,696		$5,109
NOx Emission Factor (g/hr)	123	74	172	103	231	139	399	240	757	454
PM Emission Factor (g/hr)	7	1	10	1	9	1	12	2	23	4
HC Emission Factor (g/hr)	6	2	9	2	12	3	21	6	40	11
NOx (tons/year)	0.06	0.04	0.09	0.05	0.12	0.07	0.21	0.13	0.40	0.24
PM (tons/year)	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01
NOx Reduction (tons/year)		0.03		0.04		0.05		0.08		0.16
PM Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.02
Cost-Effectiveness ($/ton)		$7,728		$7,728		$11,547		$13,245		$13,245
CE Including Fuel ($/ton)		$9,041		$9,041		$13,315		$15,273		$15,273
One-Year Cost-Effectiveness		$235,706		$235,706		$274,990		$274,990		$274,990

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0	EGR+DPF	Tier 0	EGR+DPF	Tier 1	EGR+DPF	Tier 1	EGR+DPF	Tier 2	EGR+DPF	Tier 2	EGR+DPF	Tier 3	EGR+DPF	Tier 3	EGR+DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	5.58	9.5	5.70	6.9	4.14	6.9	4.14	4.655	2.79	4.655	2.79	2.85	1.71	2.85	1.71
PM Emission Std (g/bhp-hr)	0.42475	0.06	0.42475	0.06	0.12	0.02	0.304	0.05	0.088	0.01	0.128	0.02	0.088	0.01	0.112	0.02
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	0.27	1	0.27	0.245	0.07	0.245	0.07	0.15	0.04	0.15	0.04
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,921	1,080	1,112	1,865	1,921	1,080	1,112	1,865	1,921	1,080	1,112	1,865	1,921	1,080	1,112
Fuel Cost ($/yr)	4,346	4,476	2,516	2,592	4,346	4,476	2,516	2,592	4,346	4,476	2,516	2,592	4,346	4,476	2,516	2,592
Incremental Fuel Cost/yr		$ 130		$ 75		$ 130		$ 75		$ 130		$ 75		$ 130		$ 75
Incremental Capital Cost		$23,000		$13,316		$23,000		$13,316		$23,000		$13,316		$23,000		$13,316
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$2,696		$1,561		$2,696		$1,561		$2,696		$1,561		$2,696		$1,561
NOx Emission Factor (g/hr)	1303	782	771	462	967	580	560	336	652	391	378	227	399	240	231	139
PM Emission Factor (g/hr)	60	9	34	5	17	3	25	4	12	2	10	2	12	2	9	1
HC Emission Factor (g/hr)	0	0	0	0	140	38	81	22	34	9	20	5	21	6	12	3
NOx (tons/year)	0.22	0.13	0.13	0.08	0.16	0.10	0.09	0.06	0.11	0.06	0.06	0.04	0.07	0.04	0.04	0.02
PM (tons/year)	0.010	0.001	0.006	0.001	0.003	0.000	0.004	0.001	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000
HC (tons/year)	-	-	-	-	0.023	0.006	0.013	0.004	0.006	0.002	0.003	0.001	0.003	0.001	0.002	0.001
NOx Reduction (tons/year)		0.09		0.05		0.06		0.04		0.04		0.02		0.03		0.02
PM Reduction (tons/year)		0.01		0.00		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.01		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$10,637		$10,560		$20,330		$13,146		$32,467		$27,290		$41,942		$36,566
CE Including Fuel ($/ton)		$11,151		$11,070		$21,313		$13,782		$34,036		$28,609		$43,970		$38,334
One-Year Cost-Effectiveness		$266,859		$261,240		$359,679		$359,679		$533,144		$533,144		$870,801		$870,801

Measure 51d: SCR Retrofit

Cost of diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Emission Reduction	80%
PM Emission Reduction	0%
HC Emission Reduction	0%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0	SCR	Tier 0	SCR	Tier 0	SCR	Tier 0	SCR	Tier 0	SCR	Tier 0	SCR
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	7.2	1.44	8.8	1.76	8.8	1.76	9.5	1.90	9.3	1.86	9.5	1.90
PM Emission Std (g/bhp-hr)	0.55	0.55	0.55	0.55	0.55	0.55	0.42	0.42	0.42	0.42	0.41	0.41
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,184		$6,974		$9,763		$15,342		$26,500		$50,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$491		$818		$1,145		$1,799		$3,107		$5,886
NOx Emission Factor (g/hr)	159	32	325	65	454	91	771	154	1303	261	2522	504
PM Emission Factor (g/hr)	12	12	20	20	28	28	34	34	60	60	109	109
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.02	0.17	0.03	0.24	0.05	0.40	0.08	0.68	0.14	1.32	0.26
PM (tons/year)	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.06	0.06
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		0.07		0.14		0.19		0.32		0.55		1.06
PM Reduction (tons/year)		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$7,351		$6,015		$6,015		$5,571		$5,691		$5,571
CE Including Fuel ($/ton)		$8,074		$6,606		$6,606		$6,065		$6,195		$6,065
One-Year Cost-Effectiveness		$62,707		$51,306		$51,306		$47,525		$48,547		$47,525

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1	SCR	Tier 1	SCR	Tier 1	SCR	Tier 1	SCR	Tier 1	SCR	Tier 1	SCR
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	6.745	1.35	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38
PM Emission Std (g/bhp-hr)	0.48	0.48	0.55	0.55	0.55	0.55	0.30	0.30	0.12	0.12	0.12	0.12
HC Emission Std (g/bhp-hr)	0.36	0.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,184		$6,974		$9,763		$15,342		$26,500		$50,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$491		$818		$1,145		$1,799		$3,107		$5,886
NOx Emission Factor (g/hr)	149	30	254	51	356	71	560	112	967	193	1832	366
PM Emission Factor (g/hr)	11	11	20	20	28	28	25	25	17	17	32	32
HC Emission Factor (g/hr)	8	8	37	37	52	52	81	81	140	140	266	266
NOx (tons/year)	0.08	0.02	0.13	0.03	0.19	0.04	0.29	0.06	0.51	0.10	0.96	0.19
PM (tons/year)	0.006	0.006	0.011	0.011	0.015	0.015	0.013	0.013	0.009	0.009	0.017	0.017
HC (tons/year)	0.004	0.004	0.019	0.019	0.027	0.027	0.042	0.042	0.073	0.073	0.139	0.139
NOx Reduction (tons/year)		0.06		0.11		0.15		0.23		0.40		0.77
PM Reduction (tons/year)		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$7,847		$7,671		$7,671		$7,671		$7,671		$7,671
CE Including Fuel ($/ton)		$8,619		$8,426		$8,426		$8,350		$8,350		$8,350
One-Year Cost-Effectiveness		$66,937		$65,434		$65,434		$65,434		$65,434		$65,434

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR	Tier 2 Baseline	SCR
NOx Emission Std (g/bhp-hr)	5.32	1.06	5.32	1.06	5.32	1.06	4.655	0.93	4.655	0.93	4.56	0.91
PM Emission Std (g/bhp-hr)	0.28	0.28	0.19	0.19	0.19	0.19	0.13	0.13	0.09	0.09	0.09	0.09
HC Emission Std (g/bhp-hr)	0.28	0.28	0.28	0.28	0.28	0.28	0.25	0.25	0.25	0.25	0.24	0.24
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,184		$6,974		$9,763		$15,342		$26,500		$50,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$491		$818		$1,145		$1,799		$3,107		$5,886
NOx Emission Factor (g/hr)	118	24	196	39	275	55	378	76	652	130	1211	242
PM Emission Factor (g/hr)	6	6	7	7	10	10	10	10	12	12	23	23
HC Emission Factor (g/hr)	6	6	10	10	14	14	20	20	34	34	64	64
NOx (tons/year)	0.06	0.01	0.10	0.02	0.14	0.03	0.20	0.04	0.34	0.07	0.63	0.13
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
HC (tons/year)	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03
NOx Reduction (tons/year)		0.05		0.08		0.12		0.16		0.27		0.51
PM Reduction (tons/year)		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$9,949		$9,949		$9,949		$11,370		$11,370		$11,607
CE Including Fuel ($/ton)		$10,928		$10,928		$10,928		$12,378		$12,378		$12,636
One-Year Cost-Effectiveness		$84,867		$84,867		$84,867		$96,991		$96,991		$99,011

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR	Tier 3 Baseline	SCR
NOx Emission Std (g/bhp-hr)	3.325	0.67	3.325	0.67	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.19	0.19	0.19	0.19	0.11	0.11	0.09	0.09	0.09	0.09
HC Emission Std (g/bhp-hr)	0.18	0.18	0.18	0.18	0.15	0.15	0.15	0.15	0.15	0.15
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$6,974		$9,763		$15,342		$26,500		$50,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$818		$1,145		$1,799		$3,107		$5,886
NOx Emission Factor (g/hr)	123	25	172	34	231	46	399	80	757	151
PM Emission Factor (g/hr)	7	7	10	10	9	9	12	12	23	23
HC Emission Factor (g/hr)	6	6	9	9	12	12	21	21	40	40
NOx (tons/year)	0.06	0.01	0.09	0.02	0.12	0.02	0.21	0.04	0.40	0.08
PM (tons/year)	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02
NOx Reduction (tons/year)		0.05		0.07		0.10		0.17		0.32
PM Reduction (tons/year)		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-
Cost-Effectiveness ($/ton)		$15,918		$15,918		$18,571		$18,571		$18,571
CE Including Fuel ($/ton)		$17,484		$17,484		$20,217		$20,217		$20,217
One-Year Cost-Effectiveness		$135,787		$135,787		$158,418		$158,418		$158,418

	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
Combines	Tier 0	SCR	Tier 0	SCR	Tier 1	SCR	Tier 1	SCR	Tier 2	SCR	Tier 2	SCR	Tier 3	SCR	Tier 3	SCR
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	1.86	9.5	1.90	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42475	0.42	0.42475	0.42	0.12	0.12	0.304	0.30	0.088	0.09	0.128	0.13	0.088	0.09	0.112	0.11
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	1.00	1	1.00	0.245	0.25	0.245	0.25	0.15	0.15	0.15	0.15
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101
Urea Fuel Cost ($/yr)	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566
Incremental Urea Fuel Cost/yr		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50
Incremental Capital Cost		$26,500		$15,342		$26,500		$15,342		$26,500		$15,342		$26,500		$15,342
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$3,107		$1,799		$3,107		$1,799		$3,107		$1,799		$3,107		$1,799
NOx Emission Factor (g/hr)	1303	261	771	154	967	193	560	112	652	130	378	76	399	80	231	46
PM Emission Factor (g/hr)	60	60	34	34	17	17	25	25	12	12	10	10	12	12	9	9
HC Emission Factor (g/hr)	0	0	0	0	140	140	81	81	34	34	20	20	21	21	12	12
NOx (tons/year)	0.22	0.04	0.13	0.03	0.16	0.03	0.09	0.02	0.11	0.02	0.06	0.01	0.07	0.01	0.04	0.01
PM (tons/year)	0.010	0.010	0.006	0.006	0.003	0.003	0.004	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
HC (tons/year)	-	-	-	-	0.023	0.023	0.013	0.013	0.006	0.006	0.003	0.003	0.003	0.003	0.002	0.002
NOx Reduction (tons/year)		0.17		0.10		0.13		0.07		0.09		0.05		0.05		0.03
PM Reduction (tons/year)		-		-		-		-		-		-		-		-
HC Reduction (tons/year)		-		-		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$18,022		$17,643		$24,291		$24,291		$36,006		$36,006		$58,810		$58,810
CE Including Fuel ($/ton)		$18,527		$18,136		$24,971		$24,971		$37,013		$37,013		$60,455		$60,455
One-Year Cost-Effectiveness		$153,734		$150,497		$207,206		$207,206		$307,137		$307,137		$501,657		$501,657

Measure 51c: DOC Retrofit

Cost of diesel:	2.87
Incremental Fuel Consumption	2%
NOx Emission Reduction	0%
PM Emission Reduction	40%
HC Emission Reduction	58%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC	Tier 0 Baseline	DOC
NOx Emission Std (g/bhp-hr)	7.2	7.20	8.8	8.80	8.8	8.80	9.5	9.50	9.3	9.30	9.5	9.50
PM Emission Std (g/bhp-hr)	0.55	0.33	0.55	0.33	0.55	0.33	0.42	0.25	0.42	0.25	0.41	0.25
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,972	3,032	4,954	5,053	6,935	7,074	9,814	10,010	16,951	17,290	32,118	32,761
Incremental Fuel Cost/yr		$ 59		$ 99		$ 139		$ 196		$ 339		$ 642
Incremental Capital Cost		$316		$526		$737		$1,158		$2,000		$3,789
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$37		$62		$86		$136		$234		$444
NOx Emission Factor (g/hr)	159	159	325	325	454	454	771	771	1303	1303	2522	2522
PM Emission Factor (g/hr)	12	7	20	12	28	17	34	21	60	36	109	65
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.08	0.17	0.17	0.24	0.24	0.40	0.40	0.68	0.68	1.32	1.32
PM (tons/year)	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.03	0.02	0.06	0.03
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.01		0.01		0.01		0.02
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$730		$725		$726		$940		$940		$973
CE Including Fuel ($/ton)		$1,903		$1,889		$1,893		$2,300		$2,300		$2,379
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC	Tier 1 Baseline	DOC
NOx Emission Std (g/bhp-hr)	6.745	6.75	6.9	6.90	6.9	6.90	6.9	6.90	6.9	6.90	6.9	6.90
PM Emission Std (g/bhp-hr)	0.48	0.29	0.55	0.33	0.55	0.33	0.30	0.18	0.12	0.07	0.12	0.07
HC Emission Std (g/bhp-hr)	0.36	0.15	1.00	0.42	1.00	0.42	1.00	0.42	1.00	0.42	1.00	0.42
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,972	3,032	4,954	5,053	6,935	7,074	9,814	10,010	16,951	17,290	32,118	32,761
Incremental Fuel Cost/yr		$ 59		$ 99		$ 139		$ 196		$ 339		$ 642
Incremental Capital Cost		$316		$526		$737		$1,158		$2,000		$3,789
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$37		$62		$86		$136		$234		$444
NOx Emission Factor (g/hr)	149	149	254	254	356	356	560	560	967	967	1832	1832
PM Emission Factor (g/hr)	11	6	20	12	28	17	25	15	17	10	32	19
HC Emission Factor (g/hr)	8	3	37	15	52	22	81	34	140	59	266	112
NOx (tons/year)	0.08	0.08	0.13	0.13	0.19	0.19	0.29	0.29	0.51	0.51	0.96	0.96
PM (tons/year)	0.006	0.003	0.011	0.006	0.015	0.009	0.013	0.008	0.009	0.005	0.017	0.010
HC (tons/year)	0.004	0.002	0.019	0.008	0.027	0.011	0.042	0.018	0.073	0.031	0.139	0.058
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.01		0.01		0.00		0.01
HC Reduction (tons/year)		0.00		0.01		0.02		0.02		0.04		0.08
Cost-Effectiveness ($/ton)		$779		$620		$620		$1,009		$1,886		$1,886
CE Including Fuel ($/ton)		$2,031		$1,617		$1,617		$2,469		$4,613		$4,613
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC	Tier 2 Baseline	DOC
NOx Emission Std (g/bhp-hr)	5.32	5.32	5.32	5.32	5.32	5.32	4.655	4.66	4.655	4.66	4.56	4.56
PM Emission Std (g/bhp-hr)	0.28	0.17	0.19	0.12	0.19	0.12	0.13	0.08	0.09	0.05	0.09	0.05
HC Emission Std (g/bhp-hr)	0.28	0.12	0.28	0.12	0.28	0.12	0.25	0.10	0.25	0.10	0.24	0.10
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,972	3,032	4,954	5,053	6,935	7,074	9,814	10,010	16,951	17,290	32,118	32,761
Incremental Fuel Cost/yr		$ 59		$ 99		$ 139		$ 196		$ 339		$ 642
Incremental Capital Cost		$316		$526		$737		$1,158		$2,000		$3,789
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$37		$62		$86		$136		$234		$444
NOx Emission Factor (g/hr)	118	118	196	196	275	275	378	378	652	652	1211	1211
PM Emission Factor (g/hr)	6	4	7	4	10	6	10	6	12	7	23	14
HC Emission Factor (g/hr)	6	3	10	4	14	6	20	8	34	14	64	27
NOx (tons/year)	0.06	0.06	0.10	0.10	0.14	0.14	0.20	0.20	0.34	0.34	0.63	0.63
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01
HC (tons/year)	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.01	0.03	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$1,307		$1,835		$1,835		$2,654		$3,615		$3,630
CE Including Fuel ($/ton)		$3,405		$4,781		$4,781		$6,492		$8,843		$8,880
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC	Tier 3 Baseline	DOC
NOx Emission Std (g/bhp-hr)	3.325	3.33	3.325	3.33	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.19	0.12	0.19	0.12	0.11	0.07	0.09	0.05	0.09	0.05
HC Emission Std (g/bhp-hr)	0.18	0.07	0.18	0.07	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	4,954	5,053	6,935	7,074	9,814	10,010	16,951	17,290	32,118	32,761
Incremental Fuel Cost/yr		$ 99		$ 139		$ 196		$ 339		$ 642
Incremental Capital Cost		$526		$737		$1,158		$2,000		$3,789
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$62		$86		$136		$234		$444
NOx Emission Factor (g/hr)	123	123	172	172	231	231	399	399	757	757
PM Emission Factor (g/hr)	7	4	10	6	9	5	12	7	23	14
HC Emission Factor (g/hr)	6	3	9	4	12	5	21	9	40	17
NOx (tons/year)	0.06	0.06	0.09	0.09	0.12	0.12	0.21	0.21	0.40	0.40
PM (tons/year)	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01
NOx Reduction (tons/year)		-		-		-		-		-
PM Reduction (tons/year)		0.001		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01
Cost-Effectiveness ($/ton)		$1,920		$1,920		$3,176		$3,925		$3,925
CE Including Fuel ($/ton)		$5,003		$5,003		$7,769		$9,601		$9,601
One-Year Cost-Effectiveness		-		-		-		-		-

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0	DOC	Tier 0	DOC	Tier 1	DOC	Tier 1	DOC	Tier 2	DOC	Tier 2	DOC	Tier 3	DOC	Tier 3	DOC
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	9.30	9.5	9.50	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42475	0.25	0.42475	0.25	0.12	0.07	0.304	0.18	0.088	0.05	0.128	0.08	0.088	0.05	0.112	0.07
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	0.42	1	0.42	0.245	0.10	0.245	0.10	0.15	0.06	0.15	0.06
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101
Fuel Cost ($/yr)	5,353	5,460	3,099	3,161	5,353	5,460	3,099	3,161	5,353	5,460	3,099	3,161	5,353	5,460	3,099	3,161
Incremental Fuel Cost/yr		$ 107		$ 62		$ 107		$ 62		$ 107		$ 62		$ 107		$ 62
Incremental Capital Cost		$2,000		$1,158		$2,000		$1,158		$2,000		$1,158		$2,000		$1,158
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$234		$136		$234		$136		$234		$136		$234		$136
NOx Emission Factor (g/hr)	1303	1303	771	771	967	967	560	560	652	652	378	378	399	399	231	231
PM Emission Factor (g/hr)	60	36	34	21	17	10	25	15	12	7	10	6	12	7	9	5
HC Emission Factor (g/hr)	0	0	0	0	140	59	81	34	34	14	20	8	21	9	12	5
NOx (tons/year)	0.22	0.22	0.13	0.13	0.16	0.16	0.09	0.09	0.11	0.11	0.06	0.06	0.07	0.07	0.04	0.04
PM (tons/year)	0.010	0.006	0.006	0.003	0.003	0.002	0.004	0.002	0.002	0.001	0.002	0.001	0.002	0.001	0.002	0.001
HC (tons/year)	-	-	-	-	0.023	0.010	0.013	0.006	0.006	0.002	0.003	0.001	0.003	0.001	0.002	0.001
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.004		0.002		0.001		0.002		0.001		0.001		0.001		0.001
HC Reduction (tons/year)		-		-		0.01		0.01		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$2,978		$2,978		$5,972		$3,196		$11,448		$8,405		$12,429		$10,058
CE Including Fuel ($/ton)		$4,338		$4,338		$8,699		$4,655		$16,676		$12,244		$18,105		$14,650
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-

Measure 51f: Flow Through Filter (FTF) Retrofit

Cost of diesel:	2.33
Incremental Fuel Consumption	2%
NOx Emission Reduction	0%
PM Emission Reduction	50%
HC Emission Reduction	80%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0	FTF	Tier 0	FTF	Tier 0	FTF	Tier 0	FTF	Tier 0	FTF	Tier 0	FTF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	7.2	7.20	8.8	8.80	8.8	8.80	9.5	9.50	9.3	9.30	9.5	9.50
PM Emission Std (g/bhp-hr)	0.55	0.27	0.55	0.28	0.55	0.28	0.42	0.21	0.42	0.21	0.41	0.21
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$1,421		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$167		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	159	159	325	325	454	454	771	771	1303	1303	2522	2522
PM Emission Factor (g/hr)	12	6	20	10	28	14	34	17	60	30	109	55
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.08	0.17	0.17	0.24	0.24	0.40	0.40	0.68	0.68	1.32	1.32
PM (tons/year)	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.03	0.02	0.06	0.03
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.02		0.03
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$2,629		$2,610		$2,615		$3,386		$3,386		$3,501
CE Including Fuel ($/ton)		$3,391		$3,366		$3,372		$4,269		$4,269		$4,414
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1	FTF	Tier 1	FTF	Tier 1	FTF	Tier 1	FTF	Tier 1	FTF	Tier 1	FTF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	6.745	6.75	6.9	6.90	6.9	6.90	6.9	6.90	6.9	6.90	6.9	6.90
PM Emission Std (g/bhp-hr)	0.48	0.24	0.55	0.28	0.55	0.28	0.30	0.15	0.12	0.06	0.12	0.06
HC Emission Std (g/bhp-hr)	0.36	0.07	1.00	0.20	1.00	0.20	1.00	0.20	1.00	0.20	1.00	0.20
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$1,421		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$167		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	149	149	254	254	356	356	560	560	967	967	1832	1832
PM Emission Factor (g/hr)	11	5	20	10	28	14	25	12	17	8	32	16
HC Emission Factor (g/hr)	8	2	37	7	52	10	81	16	140	28	266	53
NOx (tons/year)	0.08	0.08	0.13	0.13	0.19	0.19	0.29	0.29	0.51	0.51	0.96	0.96
PM (tons/year)	0.006	0.003	0.011	0.005	0.015	0.007	0.013	0.006	0.009	0.004	0.017	0.008
HC (tons/year)	0.004	0.001	0.019	0.004	0.027	0.005	0.042	0.008	0.073	0.015	0.139	0.028
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.00		0.01
HC Reduction (tons/year)		0.00		0.02		0.02		0.03		0.06		0.11
Cost-Effectiveness ($/ton)		$2,787		$2,201		$2,201		$3,548		$6,498		$6,498
CE Including Fuel ($/ton)		$3,595		$2,839		$2,839		$4,474		$8,193		$8,193
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF	Tier 2 Baseline	FTF
NOx Emission Std (g/bhp-hr)	5.32	5.32	5.32	5.32	5.32	5.32	4.655	4.66	4.655	4.66	4.56	4.56
PM Emission Std (g/bhp-hr)	0.28	0.14	0.19	0.10	0.19	0.10	0.13	0.06	0.09	0.04	0.09	0.04
HC Emission Std (g/bhp-hr)	0.28	0.06	0.28	0.06	0.28	0.06	0.25	0.05	0.25	0.05	0.24	0.05
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$1,421		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$167		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	118	118	196	196	275	275	378	378	652	652	1211	1211
PM Emission Factor (g/hr)	6	3	7	4	10	5	10	5	12	6	23	12
HC Emission Factor (g/hr)	6	1	10	2	14	3	20	4	34	7	64	13
NOx (tons/year)	0.06	0.06	0.10	0.10	0.14	0.14	0.20	0.20	0.34	0.34	0.63	0.63
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01
HC (tons/year)	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.01
NOx Reduction (tons/year)		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.00		0.01
HC Reduction (tons/year)		0.00		0.00		0.01		0.01		0.01		0.03
Cost-Effectiveness ($/ton)		$4,663		$6,526		$6,526		$9,410		$12,746		$12,804
CE Including Fuel ($/ton)		$6,014		$8,416		$8,416		$11,865		$16,072		$16,144
One-Year Cost-Effectiveness		-		-		-		-		-		-

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF	Tier 3 Baseline	FTF
NOx Emission Std (g/bhp-hr)	3.325	3.33	3.325	3.33	2.85	2.85	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.19	0.10	0.19	0.10	0.11	0.06	0.09	0.04	0.09	0.04
HC Emission Std (g/bhp-hr)	0.18	0.04	0.18	0.04	0.15	0.03	0.15	0.03	0.15	0.03
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Fuel Cost ($/yr)	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Fuel Cost/yr		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$2,368		$3,316		$5,211		$9,000		$17,053
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$278		$389		$611		$1,055		$1,999
NOx Emission Factor (g/hr)	123	123	172	172	231	231	399	399	757	757
PM Emission Factor (g/hr)	7	4	10	5	9	5	12	6	23	12
HC Emission Factor (g/hr)	6	1	9	2	12	2	21	4	40	8
NOx (tons/year)	0.06	0.06	0.09	0.09	0.12	0.12	0.21	0.21	0.40	0.40
PM (tons/year)	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00
NOx Reduction (tons/year)		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.01
HC Reduction (tons/year)		0.00		0.00		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$6,857		$6,857		$11,306		$13,935		$13,935
CE Including Fuel ($/ton)		$8,843		$8,843		$14,255		$17,570		$17,570
One-Year Cost-Effectiveness		-		-		-		-		-

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0	FTF	Tier 0	FTF	Tier 1	FTF	Tier 1	FTF	Tier 2	FTF	Tier 2	FTF	Tier 3	FTF	Tier 3	FTF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	9.30	9.5	9.50	6.9	6.90	6.9	6.90	4.655	4.66	4.655	4.66	2.85	2.85	2.85	2.85
PM Emission Std (g/bhp-hr)	0.42475	0.21	0.42475	0.21	0.12	0.06	0.304	0.15	0.088	0.04	0.128	0.06	0.088	0.04	0.112	0.06
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	0.20	1	0.20	0.245	0.05	0.245	0.05	0.15	0.03	0.15	0.03
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101
Fuel Cost ($/yr)	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566
Incremental Fuel Cost/yr		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50
Incremental Capital Cost		$9,000		$5,211		$9,000		$5,211		$9,000		$5,211		$9,000		$5,211
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$1,055		$611		$1,055		$611		$1,055		$611		$1,055		$611
NOx Emission Factor (g/hr)	1303	1303	771	771	967	967	560	560	652	652	378	378	399	399	231	231
PM Emission Factor (g/hr)	60	30	34	17	17	8	25	12	12	6	10	5	12	6	9	5
HC Emission Factor (g/hr)	0	0	0	0	140	28	81	16	34	7	20	4	21	4	12	2
NOx (tons/year)	0.22	0.22	0.13	0.13	0.16	0.16	0.09	0.09	0.11	0.11	0.06	0.06	0.07	0.07	0.04	0.04
PM (tons/year)	0.010	0.005	0.006	0.003	0.003	0.001	0.004	0.002	0.002	0.001	0.002	0.001	0.002	0.001	0.002	0.001
HC (tons/year)	-	-	-	-	0.023	0.005	0.013	0.003	0.006	0.001	0.003	0.001	0.003	0.001	0.002	0.000
NOx Reduction (tons/year)		-		-		-		-		-		-		-		-
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.01		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$10,721		$10,721		$20,577		$11,235		$40,363		$29,799		$44,128		$35,802
CE Including Fuel ($/ton)		$11,604		$11,604		$22,272		$12,161		$43,689		$32,253		$47,763		$38,751
One-Year Cost-Effectiveness		-		-		-		-		-		-		-		-

Measure 51g: DOC+SCR Retrofit

Cost of diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Emission Reduction	80%
PM Emission Reduction	25%
HC Emission Reduction	58%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0	DOC+SCR	Tier 0	DOC+SCR	Tier 0	DOC+SCR	Tier 0	DOC+SCR	Tier 0	DOC+SCR	Tier 0	DOC+SCR
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	7.2	1.44	8.8	1.76	8.8	1.76	9.5	1.90	9.3	1.86	9.5	1.90
PM Emission Std (g/bhp-hr)	0.55	0.41	0.55	0.41	0.55	0.41	0.42	0.32	0.42	0.32	0.41	0.31
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,342		$7,237		$10,132		$15,921		$27,500		$52,105
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$509		$848		$1,188		$1,866		$3,224		$6,108
NOx Emission Factor (g/hr)	159	32	325	65	454	91	771	154	1303	261	2522	504
PM Emission Factor (g/hr)	12	9	20	15	28	21	34	26	60	45	109	82
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.02	0.17	0.03	0.24	0.05	0.40	0.08	0.68	0.14	1.32	0.26
PM (tons/year)	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.03	0.02	0.06	0.04
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		0.07		0.14		0.19		0.32		0.55		1.06
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$5,173		$4,486		$4,488		$4,519		$4,595		$4,552
CE Including Fuel ($/ton)		$5,663		$4,911		$4,914		$4,905		$4,987		$4,940
One-Year Cost-Effectiveness		$65,073		$53,242		$53,242		$49,319		$50,379		$49,319

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1	DOC+SCR	Tier 1	DOC+SCR	Tier 1	DOC+SCR	Tier 1	DOC+SCR	Tier 1	DOC+SCR	Tier 1	DOC+SCR
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	6.745	1.35	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38
PM Emission Std (g/bhp-hr)	0.48	0.36	0.55	0.41	0.55	0.41	0.30	0.23	0.12	0.09	0.12	0.09
HC Emission Std (g/bhp-hr)	0.36	0.15	1.00	0.43	1.00	0.43	1.00	0.43	1.00	0.43	1.00	0.43
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,342		$7,237		$10,132		$15,921		$27,500		$52,105
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$509		$848		$1,188		$1,866		$3,224		$6,108
NOx Emission Factor (g/hr)	149	30	254	51	356	71	560	112	967	193	1832	366
PM Emission Factor (g/hr)	11	8	20	15	28	21	25	18	17	13	32	24
HC Emission Factor (g/hr)	8	3	37	16	52	22	81	34	140	60	266	113
NOx (tons/year)	0.08	0.02	0.13	0.03	0.19	0.04	0.29	0.06	0.51	0.10	0.96	0.19
PM (tons/year)	0.006	0.004	0.011	0.008	0.015	0.011	0.013	0.010	0.009	0.007	0.017	0.013
HC (tons/year)	0.004	0.002	0.019	0.008	0.027	0.011	0.042	0.018	0.073	0.031	0.139	0.059
NOx Reduction (tons/year)		0.06		0.11		0.15		0.23		0.40		0.77
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		0.00		0.01		0.02		0.02		0.04		0.08
Cost-Effectiveness ($/ton)		$5,455		$4,878		$4,878		$5,657		$6,416		$6,416
CE Including Fuel ($/ton)		$5,973		$5,340		$5,340		$6,139		$6,964		$6,964
One-Year Cost-Effectiveness		$69,463		$67,903		$67,903		$67,903		$67,903		$67,903

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR	Tier 2 Baseline	DOC+SCR
NOx Emission Std (g/bhp-hr)	5.32	1.06	5.32	1.06	5.32	1.06	4.655	0.93	4.655	0.93	4.56	0.91
PM Emission Std (g/bhp-hr)	0.28	0.21	0.19	0.14	0.19	0.14	0.13	0.10	0.09	0.07	0.09	0.07
HC Emission Std (g/bhp-hr)	0.28	0.12	0.28	0.12	0.28	0.12	0.25	0.10	0.25	0.10	0.24	0.10
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,342		$7,237		$10,132		$15,921		$27,500		$52,105
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$509		$848		$1,188		$1,866		$3,224		$6,108
NOx Emission Factor (g/hr)	118	24	196	39	275	55	378	76	652	130	1211	242
PM Emission Factor (g/hr)	6	5	7	5	10	7	10	8	12	9	23	18
HC Emission Factor (g/hr)	6	3	10	4	14	6	20	8	34	15	64	27
NOx (tons/year)	0.06	0.01	0.10	0.02	0.14	0.03	0.20	0.04	0.34	0.07	0.63	0.13
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.01
HC (tons/year)	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.01	0.03	0.01
NOx Reduction (tons/year)		0.05		0.08		0.12		0.16		0.27		0.51
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$7,499		$8,107		$8,107		$9,673		$10,119		$10,308
CE Including Fuel ($/ton)		$8,209		$8,876		$8,876		$10,499		$10,983		$11,188
One-Year Cost-Effectiveness		$88,069		$88,069		$88,069		$100,651		$100,651		$102,748

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR	Tier 3 Baseline	DOC+SCR
NOx Emission Std (g/bhp-hr)	3.325	0.67	3.325	0.67	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.19	0.14	0.19	0.14	0.11	0.08	0.09	0.07	0.09	0.07
HC Emission Std (g/bhp-hr)	0.18	0.07	0.18	0.07	0.15	0.06	0.15	0.06	0.15	0.06
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$7,237		$10,132		$15,921		$27,500		$52,105
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$848		$1,188		$1,866		$3,224		$6,108
NOx Emission Factor (g/hr)	123	25	172	34	231	46	399	80	757	151
PM Emission Factor (g/hr)	7	5	10	7	9	7	12	9	23	18
HC Emission Factor (g/hr)	6	3	9	4	12	5	21	9	40	17
NOx (tons/year)	0.06	0.01	0.09	0.02	0.12	0.02	0.21	0.04	0.40	0.08
PM (tons/year)	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01
NOx Reduction (tons/year)		0.05		0.07		0.10		0.17		0.32
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01
Cost-Effectiveness ($/ton)		$11,726		$11,726		$14,899		$15,531		$15,531
CE Including Fuel ($/ton)		$12,837		$12,837		$16,171		$16,857		$16,857
One-Year Cost-Effectiveness		$140,911		$140,911		$164,396		$164,396		$164,396

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0	DOC+SCR	Tier 0	DOC+SCR	Tier 1	DOC+SCR	Tier 1	DOC+SCR	Tier 2	DOC+SCR	Tier 2	DOC+SCR	Tier 3	DOC+SCR	Tier 3	DOC+SCR
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	1.86	9.5	1.90	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42475	0.32	0.42475	0.32	0.12	0.09	0.304	0.23	0.088	0.07	0.128	0.10	0.088	0.07	0.112	0.08
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	0.43	1	0.43	0.245	0.10	0.245	0.10	0.15	0.06	0.15	0.06
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101
Urea Fuel Cost ($/yr)	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566
Incremental Urea Fuel Cost/yr		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50
Incremental Capital Cost		$27,500		$15,921		$27,500		$15,921		$27,500		$15,921		$27,500		$15,921
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$3,224		$1,866		$3,224		$1,866		$3,224		$1,866		$3,224		$1,866
NOx Emission Factor (g/hr)	1303	261	771	154	967	193	560	112	652	130	378	76	399	80	231	46
PM Emission Factor (g/hr)	60	45	34	26	17	13	25	18	12	9	10	8	12	9	9	7
HC Emission Factor (g/hr)	0	0	0	0	140	60	81	34	34	15	20	8	21	9	12	5
NOx (tons/year)	0.22	0.04	0.13	0.03	0.16	0.03	0.09	0.02	0.11	0.02	0.06	0.01	0.07	0.01	0.04	0.01
PM (tons/year)	0.010	0.007	0.006	0.004	0.003	0.002	0.004	0.003	0.002	0.002	0.002	0.001	0.002	0.002	0.002	0.001
HC (tons/year)	-	-	-	-	0.023	0.010	0.013	0.006	0.006	0.002	0.003	0.001	0.003	0.001	0.002	0.001
NOx Reduction (tons/year)		0.17		0.10		0.13		0.07		0.09		0.05		0.05		0.03
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.01		0.01		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$14,549		$14,310		$20,319		$17,912		$32,043		$30,633		$49,182		$47,180
CE Including Fuel ($/ton)		$14,942		$14,696		$20,866		$18,395		$32,907		$31,458		$50,507		$48,452
One-Year Cost-Effectiveness		$159,535		$156,176		$215,025		$215,025		$318,727		$318,727		$520,588		$520,588

Measure 51h: SCR+DPF Retrofit

Cost of diesel:	2.33
Urea Cost (equivalent to % fuel)	2%
NOx Emission Reduction	80%
PM Emission Reduction	85%
HC Emission Reduction	73%
HC to ROG Conversion	1.26639

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF	Tier 0 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	7.2	1.44	8.8	1.76	8.8	1.76	9.5	1.90	9.3	1.86	9.5	1.90
PM Emission Std (g/bhp-hr)	0.55	0.08	0.55	0.08	0.55	0.08	0.42	0.06	0.42	0.06	0.41	0.06
HC Emission Std (g/bhp-hr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,737		$7,895		$11,053		$17,368		$30,000		$56,842
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$555		$926		$1,296		$2,036		$3,517		$6,664
NOx Emission Factor (g/hr)	159	32	325	65	454	91	771	154	1303	261	2522	504
PM Emission Factor (g/hr)	12	2	20	3	28	4	34	5	60	9	109	16
HC Emission Factor (g/hr)	0	0	0	0	0	0	0	0	0	0	0	0
NOx (tons/year)	0.08	0.02	0.17	0.03	0.24	0.05	0.40	0.08	0.68	0.14	1.32	0.26
PM (tons/year)	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.00	0.06	0.01
HC (tons/year)	-	-	-	-	-	-	-	-	-	-	-	-
NOx Reduction (tons/year)		0.07		0.14		0.19		0.32		0.55		1.06
PM Reduction (tons/year)		0.01		0.01		0.01		0.02		0.03		0.05
HC Reduction (tons/year)		-		-		-		-		-		-
Cost-Effectiveness ($/ton)		$3,183		$2,922		$2,925		$3,234		$3,270		$3,287
CE Including Fuel ($/ton)		$3,460		$3,176		$3,179		$3,487		$3,526		$3,544
One-Year Cost-Effectiveness		$70,989		$58,082		$58,082		$53,802		$54,959		$53,802

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF	Tier 1 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	6.745	1.35	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38	6.9	1.38
PM Emission Std (g/bhp-hr)	0.48	0.07	0.55	0.08	0.55	0.08	0.30	0.05	0.12	0.02	0.12	0.02
HC Emission Std (g/bhp-hr)	0.36	0.10	1.00	0.28	1.00	0.28	1.00	0.28	1.00	0.28	1.00	0.28
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,737		$7,895		$11,053		$17,368		$30,000		$56,842
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$555		$926		$1,296		$2,036		$3,517		$6,664
NOx Emission Factor (g/hr)	149	30	254	51	356	71	560	112	967	193	1832	366
PM Emission Factor (g/hr)	11	2	20	3	28	4	25	4	17	3	32	5
HC Emission Factor (g/hr)	8	2	37	10	52	14	81	22	140	39	266	73
NOx (tons/year)	0.08	0.02	0.13	0.03	0.19	0.04	0.29	0.06	0.51	0.10	0.96	0.19
PM (tons/year)	0.006	0.001	0.011	0.002	0.015	0.002	0.013	0.002	0.009	0.001	0.017	0.003
HC (tons/year)	0.004	0.001	0.019	0.005	0.027	0.007	0.042	0.012	0.073	0.020	0.139	0.038
NOx Reduction (tons/year)		0.06		0.11		0.15		0.23		0.40		0.77
PM Reduction (tons/year)		0.00		0.01		0.01		0.01		0.01		0.01
HC Reduction (tons/year)		0.00		0.01		0.02		0.03		0.05		0.10
Cost-Effectiveness ($/ton)		$3,453		$3,030		$3,030		$4,130		$5,654		$5,654
CE Including Fuel ($/ton)		$3,753		$3,293		$3,293		$4,453		$6,096		$6,096
One-Year Cost-Effectiveness		$75,778		$74,076		$74,076		$74,076		$74,076		$74,076

Agricultural Tractors	25-50 HP		50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF	Tier 2 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	5.32	1.06	5.32	1.06	5.32	1.06	4.655	0.93	4.655	0.93	4.56	0.91
PM Emission Std (g/bhp-hr)	0.28	0.04	0.19	0.03	0.19	0.03	0.13	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.28	0.08	0.28	0.08	0.28	0.08	0.25	0.07	0.25	0.07	0.24	0.07
Average Horsepower (hp)	38	38	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,036	1,056	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	2,413	2,461	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 48		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$4,737		$7,895		$11,053		$17,368		$30,000		$56,842
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$555		$926		$1,296		$2,036		$3,517		$6,664
NOx Emission Factor (g/hr)	118	24	196	39	275	55	378	76	652	130	1211	242
PM Emission Factor (g/hr)	6	1	7	1	10	1	10	2	12	2	23	4
HC Emission Factor (g/hr)	6	2	10	3	14	4	20	5	34	9	64	18
NOx (tons/year)	0.06	0.01	0.10	0.02	0.14	0.03	0.20	0.04	0.34	0.07	0.63	0.13
PM (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03	0.01
NOx Reduction (tons/year)		0.05		0.08		0.12		0.16		0.27		0.51
PM Reduction (tons/year)		0.00		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.01		0.01		0.01		0.02
Cost-Effectiveness ($/ton)		$5,169		$6,164		$6,164		$7,826		$8,804		$8,936
CE Including Fuel ($/ton)		$5,619		$6,699		$6,699		$8,439		$9,493		$9,635
One-Year Cost-Effectiveness		$96,076		$96,076		$96,076		$109,801		$109,801		$112,088

Agricultural Tractors	50-75 HP		75-100 HP		100-175 HP		175-300 HP		300-600 HP	
	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF	Tier 3 Baseline	SCR+DPF
NOx Emission Std (g/bhp-hr)	3.325	0.67	3.325	0.67	2.85	0.57	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.19	0.03	0.19	0.03	0.11	0.02	0.09	0.01	0.09	0.01
HC Emission Std (g/bhp-hr)	0.18	0.05	0.18	0.05	0.15	0.04	0.15	0.04	0.15	0.04
Average Horsepower (hp)	63	63	88	88	138	138	238	238	450	450
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	475	475	475	475	475	475	475	475	475	475
Energy Consumption Factor (bhp-hr/gal)	17.2	17.2	17.2	17.2	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,726	1,761	2,416	2,465	3,420	3,488	5,906	6,025	11,191	11,415
Urea Fuel Cost ($/yr)	4,022	4,102	5,630	5,743	7,967	8,127	13,762	14,037	26,075	26,597
Incremental Urea Fuel Cost/yr		$ 80		$ 113		$ 159		$ 275		$ 522
Incremental Capital Cost		$7,895		$11,053		$17,368		$30,000		$56,842
Useful Life (years)	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$926		$1,296		$2,036		$3,517		$6,664
NOx Emission Factor (g/hr)	123	25	172	34	231	46	399	80	757	151
PM Emission Factor (g/hr)	7	1	10	1	9	1	12	2	23	4
HC Emission Factor (g/hr)	6	2	9	2	12	3	21	6	40	11
NOx (tons/year)	0.06	0.01	0.09	0.02	0.12	0.02	0.21	0.04	0.40	0.08
PM (tons/year)	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00
HC (tons/year)	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01
NOx Reduction (tons/year)		0.05		0.07		0.10		0.17		0.32
PM Reduction (tons/year)		0.00		0.00		0.00		0.01		0.01
HC Reduction (tons/year)		0.00		0.00		0.00		0.01		0.02
Cost-Effectiveness ($/ton)		$7,878		$7,878		$11,092		$12,248		$12,248
CE Including Fuel ($/ton)		$8,563		$8,563		$11,960		$13,207		$13,207
One-Year Cost-Effectiveness		$153,721		$153,721		$179,341		$179,341		$179,341

Combines	175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP		175-300 HP		100-175 HP	
	Tier 0	SCR+DPF	Tier 0	SCR+DPF	Tier 1	SCR+DPF	Tier 1	SCR+DPF	Tier 2	SCR+DPF	Tier 2	SCR+DPF	Tier 3	SCR+DPF	Tier 3	SCR+DPF
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
NOx Emission Std (g/bhp-hr)	9.3	1.86	9.5	1.90	6.9	1.38	6.9	1.38	4.655	0.93	4.655	0.93	2.85	0.57	2.85	0.57
PM Emission Std (g/bhp-hr)	0.42475	0.06	0.42475	0.06	0.12	0.02	0.304	0.05	0.088	0.01	0.128	0.02	0.088	0.01	0.112	0.02
HC Emission Std (g/bhp-hr)	0	0.00	0	0.00	1	0.28	1	0.28	0.245	0.07	0.245	0.07	0.15	0.04	0.15	0.04
Average Horsepower (hp)	238	238	138	138	238	238	138	138	238	238	138	138	238	238	138	138
Load Factor	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Activity (hr/yr)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1
Fuel Usage (gal/yr)	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101	1,865	1,902	1,080	1,101
Urea Fuel Cost ($/yr)	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566	4,346	4,433	2,516	2,566
Incremental Urea Fuel Cost/yr		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50		$ 87		$ 50
Incremental Capital Cost		$30,000		$17,368		$30,000		$17,368		$30,000		$17,368		$30,000		$17,368
Useful Life (years)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Annualized Capital Cost ($/yr)		$3,517		$2,036		$3,517		$2,036		$3,517		$2,036		$3,517		$2,036
NOx Emission Factor (g/hr)	1303	261	771	154	967	193	560	112	652	130	378	76	399	80	231	46
PM Emission Factor (g/hr)	60	9	34	5	17	3	25	4	12	2	10	2	12	2	9	1
HC Emission Factor (g/hr)	0	0	0	0	140	39	81	22	34	9	20	5	21	6	12	3
NOx (tons/year)	0.22	0.04	0.13	0.03	0.16	0.03	0.09	0.02	0.11	0.02	0.06	0.01	0.07	0.01	0.04	0.01
PM (tons/year)	0.010	0.001	0.006	0.001	0.003	0.000	0.004	0.001	0.002	0.000	0.002	0.000	0.002	0.000	0.002	0.000
HC (tons/year)	-	-	-	-	0.023	0.006	0.013	0.004	0.006	0.002	0.003	0.001	0.003	0.001	0.002	0.001
NOx Reduction (tons/year)		0.17		0.10		0.13		0.07		0.09		0.05		0.05		0.03
PM Reduction (tons/year)		0.01		0.00		0.00		0.00		0.00		0.00		0.00		0.00
HC Reduction (tons/year)		-		-		0.02		0.01		0.00		0.00		0.00		0.00
Cost-Effectiveness ($/ton)		$10,354		$10,242		$17,904		$13,079		$27,878		$24,783		$38,785		$35,124
CE Including Fuel ($/ton)		$10,610		$10,495		$18,347		$13,402		$28,567		$25,396		$39,744		$35,992
One-Year Cost-Effectiveness		$174,038		$170,374		$234,573		$234,573		$347,702		$347,702		$567,914		$567,914

APPENDIX B

State by State Emissions Inventories, Vehicle Population Estimates, and Emissions Reduction Scenarios

2009 On-Road Emissions Inventories

LADCO States						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	654	631	8,573	594	17.5	9.4
LDGT1	335	453	6,334	477	12.2	6.8
LDGT2	161	208	2,610	193	4.2	2.4
HDGV	57	23	198	53	1.2	0.9
Motorcycle	10	5	53	4	0.2	0.1
LDDV	1	1	1	1	0.4	0.1
LDDT	2	2	2	3	0.4	0.2
Class 2b diesel	4	3	8	39	1.1	0.9
Class 3, 4, 5 diesel	3	3	8	39	0.9	0.7
Class 6, 7 diesel	15	13	28	165	3.6	3.1
Class 8 diesel	64	51	147	1,004	15.9	13.6
Buses	4	2	5	26	0.9	0.8
All State Total	1,310	1,396	17,968	2,598	58.4	38.9
IL						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	132.8	142.4	1614.9	135.3	3.5	1.8
LDGT1	86.4	98.8	1162.7	104.9	2.4	1.3
LDGT2	43.5	48.0	494.8	43.9	0.9	0.4
HDGV	13.1	5.2	36.8	13.8	0.3	0.2
Motorcycle	2.8	1.6	12.6	1.1	0.1	0.0
LDDV	0.2	0.2	0.3	0.3	0.3	0.0
LDDT	0.4	0.5	0.4	0.6	0.2	0.0
Class 2b diesel	0.7	0.7	1.6	8.6	0.3	0.2
Class 3, 4, 5 diesel	0.6	0.7	1.6	8.7	0.2	0.2
Class 6, 7 diesel	2.8	3.0	5.5	37.1	0.8	0.7
Class 8 diesel	12.7	12.6	32.5	218.5	3.7	3.0
Buses	1.4	0.4	1.1	6.2	0.2	0.2
IL Total	297.6	314.2	3364.9	579.0	12.9	7.9
IN						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	113.1	99.4	1413.2	94.9	3.0	1.6
LDGT1	52.3	79.7	1119.5	78.5	2.1	1.2
LDGT2	28.1	41.2	504.4	33.0	0.7	0.4
HDGV	9.3	4.1	36.9	8.3	0.2	0.1
Motorcycle	1.0	0.9	10.4	0.7	0.0	0.0
LDDV	0.1	0.1	0.3	0.2	0.0	0.0
LDDT	0.3	0.4	0.4	0.6	0.0	0.0
Class 2b diesel	0.5	0.6	1.7	6.4	0.2	0.2
Class 3, 4, 5 diesel	0.5	0.5	1.7	6.3	0.2	0.1
Class 6, 7 diesel	2.3	2.2	5.6	26.8	0.6	0.6
Class 8 diesel	8.7	7.8	27.2	165.5	2.9	2.5
Buses	0.4	0.3	1.0	4.1	0.2	0.2
IN Total	216.6	237.2	3122.4	425.5	10.1	7.0
MI						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	132.1	147.3	2231.7	145.6	4.2	2.3
LDGT1	89.1	108.6	1654.3	115.6	2.9	1.7

LDGT2	44.1	51.4	657.1	47.0	1.0	0.6
HDGV	13.5	4.2	43.2	12.6	0.2	0.2
Motorcycle	3.6	0.7	7.7	0.4	0.0	0.0
LDDV	0.2	0.1	0.3	0.3	0.0	0.0
LDDT	0.5	0.4	0.2	0.8	0.0	0.0
Class 2b diesel	1.6	0.9	1.3	10.7	0.2	0.2
Class 3, 4, 5 diesel	1.3	0.9	1.4	10.8	0.1	0.1
Class 6, 7 diesel	6.0	3.8	4.6	46.3	0.6	0.5
Class 8 diesel	26.3	15.9	27.1	283.6	2.7	2.4
Buses	1.2	0.5	0.9	7.1	0.2	0.1
MI Total	319.6	334.8	4629.8	680.8	12.2	8.1
OH						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	197.7	171.5	2135.2	148.9	4.5	2.4
LDGT1	77.9	120.2	1600.8	122.5	3.1	1.8
LDGT2	33.3	49.9	656.6	48.0	1.1	0.6
HDGV	14.0	6.4	51.4	12.2	0.3	0.2
Motorcycle	1.5	1.5	14.9	1.0	0.0	0.0
LDDV	0.2	0.2	0.4	0.3	0.0	0.0
LDDT	0.3	0.5	0.6	0.7	0.1	0.0
Class 2b diesel	0.6	0.7	2.5	8.4	0.3	0.3
Class 3, 4, 5 diesel	0.7	0.7	2.5	8.3	0.2	0.2
Class 6, 7 diesel	3.0	3.0	8.2	35.2	1.0	0.9
Class 8 diesel	11.4	10.5	40.0	218.6	4.3	3.8
Buses	0.5	0.4	1.5	5.4	0.2	0.2
OH Total	341.2	365.3	4514.7	609.4	15.1	10.4
WI						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	78.7	70.4	1177.7	69.6	2.4	1.3
LDGT1	29.5	46.0	796.2	55.4	1.7	0.9
LDGT2	11.8	17.9	297.4	21.6	0.6	0.3
HDGV	6.8	3.1	29.6	6.5	0.2	0.1
Motorcycle	0.7	0.6	7.1	0.4	0.0	0.0
LDDV	0.1	0.1	0.2	0.2	0.0	0.0
LDDT	0.1	0.2	0.3	0.4	0.0	0.0
Class 2b diesel	0.3	0.3	1.3	4.6	0.2	0.1
Class 3, 4, 5 diesel	0.3	0.3	1.2	4.6	0.1	0.1
Class 6, 7 diesel	1.3	1.2	4.1	19.2	0.5	0.4
Class 8 diesel	5.2	4.3	20.3	117.6	2.2	1.9
Buses	0.2	0.2	0.8	3.0	0.1	0.1
WI Total	135.0	144.5	2336.1	303.0	8.0	5.5

2012 On-Road Emissions Inventories

LADCO States						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	568.5	518	7,621	485	17.4	9.3
LDGT1	291.0	371	5,354	389	12.1	6.8
LDGT2	139.5	171	2,187	158	4.1	2.3
HDGV	49.1	19	170	43	0.9	0.6
Motorcycle	8.4	4	53	3	0.2	0.1
LDDV	0.8	1	1	1	0.2	0.1
LDDT	1.6	2	2	2	0.2	0.1
Class 2b diesel	3.6	3	5	31	0.7	0.6
Class 3, 4, 5 diesel	3.3	3	5	31	0.6	0.5
Class 6, 7 diesel	14.9	12	18	130	2.3	2.0
Class 8 diesel	62.3	47	95	793	10.8	9.2
Buses	3.8	2	4	20	0.6	0.5
All State Total	1,146.8	1,152	15,513	2,086	50.2	32.2
IL						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	115.5	117.2	1445.6	105.9	3.5	1.7
LDGT1	75.2	81.1	994.4	82.1	2.4	1.3
LDGT2	37.9	39.4	419.3	34.3	0.8	0.4
HDGV	11.4	4.2	31.6	10.8	0.2	0.1
Motorcycle	2.5	1.3	12.6	0.9	0.1	0.0
LDDV	0.2	0.2	0.1	0.2	0.2	0.0
LDDT	0.4	0.4	0.3	0.5	0.1	0.0
Class 2b diesel	0.7	0.7	1.0	7.4	0.2	0.1
Class 3, 4, 5 diesel	0.6	0.7	1.1	7.5	0.1	0.1
Class 6, 7 diesel	2.8	2.8	3.4	31.8	0.5	0.4
Class 8 diesel	12.6	11.7	20.9	187.6	2.5	2.0
Buses	1.4	0.4	0.8	5.3	0.1	0.1
IL Total	261.1	260.1	2931.1	474.3	10.9	6.5
IN						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	97.1	80.6	1254.8	74.6	3.0	1.6
LDGT1	44.9	64.5	945.3	61.7	2.0	1.2
LDGT2	24.1	33.4	422.8	25.9	0.7	0.4
HDGV	7.9	3.3	31.7	6.5	0.2	0.1
Motorcycle	0.8	0.8	10.4	0.5	0.0	0.0
LDDV	0.1	0.1	0.1	0.2	0.0	0.0
LDDT	0.2	0.3	0.4	0.4	0.0	0.0
Class 2b diesel	0.4	0.5	1.0	4.4	0.1	0.1
Class 3, 4, 5 diesel	0.5	0.4	1.1	4.3	0.1	0.1
Class 6, 7 diesel	2.1	1.9	3.5	18.3	0.4	0.4
Class 8 diesel	7.8	6.6	17.5	113.3	2.0	1.7
Buses	0.4	0.2	0.7	2.8	0.1	0.1
IN Total	186.5	192.6	2689.2	313.0	8.7	5.7
MI						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	114.0	120.2	1986.2	114.8	4.1	2.3
LDGT1	76.9	88.4	1393.7	91.2	2.9	1.7

LDGT2	38.1	41.8	547.8	37.1	1.0	0.6
HDGV	11.6	3.4	36.9	10.0	0.2	0.1
Motorcycle	3.1	0.6	7.7	0.3	0.0	0.0
LDDV	0.2	0.1	0.1	0.3	0.0	0.0
LDDT	0.5	0.4	0.2	0.7	0.0	0.0
Class 2b diesel	1.6	0.8	0.8	9.2	0.1	0.1
Class 3, 4, 5 diesel	1.3	0.8	0.9	9.2	0.1	0.1
Class 6, 7 diesel	5.8	3.5	2.9	39.6	0.4	0.4
Class 8 diesel	25.5	14.6	17.4	242.9	1.8	1.6
Buses	1.2	0.5	0.6	6.1	0.1	0.1
MI Total	279.7	275.1	3995.1	561.4	10.8	6.9
OH						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	175.1	143.7	1884.1	135.0	4.4	2.4
LDGT1	69.0	100.4	1340.4	111.1	3.1	1.8
LDGT2	29.5	41.6	547.4	43.5	1.1	0.6
HDGV	12.4	5.2	44.2	11.1	0.2	0.2
Motorcycle	1.3	1.2	14.9	0.9	0.0	0.0
LDDV	0.2	0.2	0.2	0.2	0.0	0.0
LDDT	0.3	0.4	0.5	0.5	0.0	0.0
Class 2b diesel	0.7	0.7	1.5	6.4	0.2	0.2
Class 3, 4, 5 diesel	0.7	0.7	1.6	6.3	0.2	0.1
Class 6, 7 diesel	3.0	2.8	5.1	26.7	0.6	0.6
Class 8 diesel	11.5	10.0	25.7	166.2	2.9	2.5
Buses	0.5	0.4	1.1	4.1	0.2	0.2
OH Total	304.1	307.3	3866.7	512.0	13.0	8.6
WI						
Vehicle Class	**VOC**	**TOG**	**CO**	**NOx**	**PM10**	**PM25**
LDGV	66.9	56.8	1049.9	54.5	2.4	1.3
LDGT1	25.1	37.0	680.6	43.4	1.7	0.9
LDGT2	10.0	14.4	249.8	16.9	0.6	0.3
HDGV	5.8	2.4	25.2	5.1	0.1	0.1
Motorcycle	0.6	0.5	7.1	0.3	0.0	0.0
LDDV	0.1	0.1	0.1	0.1	0.0	0.0
LDDT	0.1	0.2	0.3	0.3	0.0	0.0
Class 2b diesel	0.3	0.3	0.8	3.3	0.1	0.1
Class 3, 4, 5 diesel	0.3	0.2	0.8	3.2	0.1	0.1
Class 6, 7 diesel	1.2	1.0	2.6	13.6	0.3	0.3
Class 8 diesel	4.8	3.8	13.0	83.0	1.5	1.3
Buses	0.2	0.1	0.5	2.1	0.1	0.1
WI Total	115.4	116.7	2030.7	225.8	6.9	4.5

2009 Vehicle Population Estimates – Illinois

2002 Vehicle VMT by Vehicle Types: ILLINOIS

	Illinois
HDDV	7639894534
HDGV	1233736908
LDDT	181548844
LDDV	81488516
LDGT1	34359192410
LDGT2	11340244982
LDGV	49859207528
MC	326766001
Total	105023881723

Growth Rates: 2%

2009 Vehicle VMT by Vehicle Types

	Illinois		
HDDV	8776907617	8776907617	100%
HDGV	1417178201	1417178201	100%
LDDT	208542555	208542555	100%
LDDV	93604690	93604690	100%
LDGT1	39467911873	39467911873	100%
LDGT2	13026376879	13026376879	100%
LDGV	57272557088	57272557088	100%
MC	377648793	377648793	100%
Total	120639427686	120639427686	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	7323516	4304288360	3575384690	1353121075	111362716	7034810	22936030	84667402	30641317	28847199	128460473	57976315	319583618	3935732	4030736
2008	7986716	5450606322	4491403774	1565611234	190538010	8908324	27534442	141083459	49382000	54030332	232885198	174612734	579381676	7871464	7804485
2007	5973367	5181808039	4201209645	1359249445	162978263	8469004	24851654	117397503	39741774	47333564	197437695	145652361	491208087	7358107	7555704
2006	4462725	4919104994	3902313771	1177480801	139416505	8039850	21954881	97753204	32003009	41484014	167390018	121321846	418562766	6886141	7314775
2005	3313054	4663147365	3588491800	1022883050	119300727	7621320	19393425	81421171	25781054	36331782	141952884	101151772	353286922	6416854	7081899
2004	2404053	4401485763	3260928385	867202019	101910934	7193867	16960072	67698319	20733152	31798007	120246644	84236843	299295012	5999952	6855939
2003	1738178	4130442454	2920657858	769754024	87246388	6750681	14649810	56413594	16709464	27854191	101942920	70212676	253786695	5604140	6637319
2002	1248516	3852572025	2578156046	667048675	74549963	6296538	12496190	46920468	13440489	24383443	86367451	58482485	215019776	5228818	6426659
2001	879842	3548797667	2230434692	578656239	63734334	5800058	10471021	39043973	10816901	21381669	73288205	48797574	182502268	4887580	6220780
2000	612925	3229407503	1890364611	502898907	54584231	5278055	8816171	32547788	8721058	18706868	62067767	40621772	154548094	4566732	6012696
1999	410104	2878966108	1564846471	436897457	46660927	4705309	6942093	27080757	7018090	16409009	52689142	33903936	131212184	4267275	5801998
1998	14100436	2508993286	1265296945	377847531	39935386	4100630	5476713	22661076	5654872	14386783	44644710	28243273	111190219	3989206	5588339
1997	0	2026670931	994199699	327640842	34169687	3312336	4210940	18786894	4554171	12588061	37860438	23548620	94306269	3721833	5295520
1996	0	1527005163	758339088	284354706	29148606	2495695	3152029	15601047	3557282	11011208	32056466	19600698	79850835	3475850	4894086
1995	0	1151740698	559446368	247156145	24975875	1882373	2288965	13012838	2950516	9647848	27181514	16341332	67719721	3251257	4262595
1994	0	866838347	399835872	214512587	21376936	1416737	1615327	10841046	2377225	8443205	23023129	13606613	57360331	3037368	3278742
1993	0	654233529	274177904	185912710	18265222	1069261	1097181	9024971	1913883	7407314	19549255	11359347	48711648	2834155	1986821
1992	0	494768478	180894546	160919201	15639451	808636	715640	7514011	1541210	6495521	16591206	9477547	41344256	2652341	915861
1991	0	372380341	129830185	139741800	13393452	608608	515253	6263518	1242337	5693904	14073871	7904922	35079155	2470527	726457
1990	0	279473990	111397054	121303402	11426801	456765	442437	5201075	998027	4990458	11938694	6592731	29759212	2310103	574627
1989	0	212559064	96241282	105288436	9777156	347401	383946	4332270	803777	4353477	10080374	5472160	25126203	2160375	453290
1988	0	169955271	82786214	91411661	8344398	261426	332633	3598656	646810	3817025	8554842	4565565	21326228	2021341	359039
1987	0	120054693	70906854	79433863	7162173	196214	287815	3006624	521922	3350242	7265786	3812933	18117542	1882307	283227
1986	0	91298432	60481994	68660892	6092193	149216	248542	2489052	417933	2927315	6144142	3169851	15321146	1764662	230575
1985 & Earlier	0	245956067	279893317	302390178	25066470	401984	1165346	9969599	1618683	13116724	26544445	13612939	66446524	6374125	687790
Total	377648793	57272557088	39467911873	13026376879	1417178201	93604690	208542555	924232014	263865964	456748161	1650326271	1144078837	4108118386	106949236	101268749

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	15,302	288,685	183,391	63,434	5,575	472	848	3,120	936	944	3,158	1,116	2,573	396	69
2008	17,852	384,550	244,310	76,813	10,152	628	1,129	5,682	1,704	1,888	6,316	2,231	5,148	792	178
2007	14,345	384,550	242,732	73,473	9,232	628	1,122	5,167	1,549	1,766	5,906	2,087	4,814	740	178
2006	11,582	384,005	239,891	68,347	8,401	628	1,109	4,702	1,410	1,652	5,526	1,952	4,503	691	178
2005	9,361	382,916	235,157	63,755	7,647	626	1,087	4,280	1,283	1,545	5,170	1,827	4,213	646	178
2004	7,438	380,192	228,212	59,376	6,949	621	1,055	3,889	1,166	1,444	4,832	1,707	3,937	604	178
2003	5,951	376,290	218,743	55,318	6,328	613	1,011	3,542	1,062	1,351	4,520	1,597	3,683	564	178
2002	4,782	368,209	207,064	51,474	5,752	602	957	3,219	965	1,263	4,225	1,493	3,442	526	176
2001	3,825	356,771	192,544	47,950	5,231	583	890	2,928	878	1,182	3,956	1,398	3,223	492	176
2000	3,082	341,519	175,815	44,746	4,766	558	813	2,667	800	1,105	3,696	1,306	3,011	459	176
1999	2,444	320,277	157,192	41,849	4,333	523	737	2,425	727	1,035	3,461	1,223	2,820	428	176
1998	10,307	293,587	137,622	38,766	3,945	480	636	2,208	662	967	3,236	1,143	2,637	401	176
1997	0	249,467	117,421	36,096	3,591	408	543	2,010	609	905	3,028	1,070	2,467	374	173
1996	0	197,722	97,535	33,640	3,268	323	451	1,824	547	845	2,828	999	2,304	350	165
1995	0	156,870	78,596	31,397	2,970	256	363	1,662	498	791	2,646	935	2,156	327	149
1994	0	124,189	61,551	29,261	2,704	203	284	1,513	454	739	2,472	874	2,016	306	118
1993	0	98,589	46,400	27,232	2,460	161	214	1,377	413	692	2,316	818	1,887	285	74
1992	0	78,435	33,774	25,310	2,239	128	166	1,253	376	648	2,169	766	1,767	267	35
1991	0	62,094	26,830	23,601	2,039	101	124	1,141	342	607	2,030	717	1,654	249	29
1990	0	49,022	25,567	21,999	1,851	80	118	1,036	311	568	1,900	671	1,548	232	24
1989	0	39,218	24,620	20,504	1,685	64	114	943	283	529	1,770	625	1,442	217	19
1988	0	31,047	23,673	19,116	1,529	51	109	856	257	495	1,657	585	1,350	203	16
1987	0	24,511	22,727	17,834	1,396	40	105	782	234	464	1,553	549	1,265	189	13
1986	0	19,609	21,780	16,553	1,263	32	101	707	212	433	1,449	512	1,180	178	11
1985 & Earlier	0	55,556	113,317	78,279	5,530	91	524	3,095	928	2,072	6,931	2,449	5,648	843	39
Total	106,261	5,446,880	3,156,466	1,067,921	110,826	8,902	14,589	62,028	18,800	25,930	86,751	30,649	70,686	10,761	2,907

2012 Vehicle Population Estimates – Illinois

2002 Vehicle VMT by Vehicle Types: ILLINOIS

	Illinois
HDDV	7539694534
HDGV	1233738808
LDDT	181548844
LDDV	81488516
LDGT1	34959192410
LDGT2	11340244982
LDGV	49859207528
MC	328766001
Total	105023881723

Growth Rates: 2%

2012 Vehicle VMT by Vehicle Types

	Illinois		
HDDV	9312745008	9312745008	100%
HDGV	1503920844	1503920844	100%
LDDT	221307027	221307027	100%
LDDV	99334046	99334046	100%
LDGT1	41883663823	41883663823	100%
LDGT2	13823695355	13823695355	100%
LDGV	60778095762	60778095762	100%
MC	400763921	400763921	100%
Total	128023525787	128023525787	100%

2012 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	77715995	4567746242	3794226836	1436942910	116179005	7466397	24339898	89849725	32516811	30612878	136323282	103973249	339144693	4176630	4277451
2011	84776903	5784229157	4766313615	1661439166	202506582	9453585	29219770	149718695	52404573	57337421	247118411	185300431	614844470	6353280	8282182
2010	63389849	5488976146	4458957285	1442446385	172953936	8987375	26160532	124583169	42174269	50230757	209522461	154461330	521358848	7808482	9018173
2009	47358805	5220193572	4141166692	1249552046	147949911	8531741	23296695	103736482	33961849	44001943	177639527	126747713	442059740	7286404	7762498
2008	35158396	4948569289	3808135993	1085491876	126902885	8087805	20580458	86404799	27359061	38555578	150641537	107343070	374921520	6809723	7515165
2007	25512007	4670891804	3480523289	941505880	108148699	7633977	17998164	71841938	22002186	33744299	127605640	89392812	317614261	6367091	7275578
2006	18446686	4383258576	3099425495	816669129	92588552	7163977	16546495	59866557	17732217	29559090	108182642	74510254	269295247	5947158	7043576
2005	13249351	4088380254	2736959822	707877390	79113017	6691936	13261056	49792576	14263154	25875805	91653830	62062081	226180706	5549924	6818960
2004	9336961	3766012687	2366955138	614074630	67635385	6155067	11111932	41433776	11478981	22690399	77784641	51784375	193672886	5186739	6601541
2003	6504411	3427073077	2006070048	533680343	57925222	5601114	9143650	34539973	9254857	19851678	65866811	43108150	164007673	4846253	6390721
2002	4352061	3055181864	1660627593	462577888	49516949	4993305	7367004	28736316	7447664	17413372	55914139	35979129	139243420	4528466	6157116
2001	14963496	2662563747	1342742179	400974823	42379752	4351621	5811932	23841994	6000995	15245084	47377324	29971988	117995950	4233378	5921901
2000	0	2150719405	1055052674	347695083	36261146	3515077	4468683	19938712	4832922	13356551	40177800	24889984	100078567	3945639	5619648
1999	0	1620470095	804749138	301759489	30932734	2648452	3344959	16555955	3881137	11685162	34018578	20800417	84736345	3688600	5193643
1998	0	1222236443	593688861	262284079	26604598	1997590	2429068	13809328	3131111	10236371	28845240	17341652	71864710	3450280	4529500
1997	0	919895788	424309026	227642473	22884738	1503452	1714198	11504605	2522730	8959997	24432328	14439446	60871242	3223269	3479427
1996	0	694277855	290959765	197292055	19404424	1134709	1164337	9577372	2031030	7860700	20746626	12054830	51693191	3007628	2107369
1995	0	526052267	191866740	170788743	16696711	858131	763687	7973929	1635545	6893089	17606721	10057648	43874855	2814686	971919
1994	0	395172997	137776831	148295116	14213238	645860	546790	6646896	1318378	6042416	14935305	8388767	37226280	2621743	769861
1993	0	296580034	118215446	128728140	12126212	484722	469617	5519422	1059114	5295914	12869457	6996259	31680714	2451500	609799
1992	0	225569379	102132019	111732931	10975596	368664	407446	4597440	852974	4619945	10897374	5807100	26666250	2292607	481005
1991	0	169746913	87853393	97006786	8855142	277428	352993	3818615	685308	4050668	9078467	4845004	22631564	2145063	381015
1990	0	127403000	75246921	84295850	7600555	208224	305432	3190654	553688	3555304	7710510	4046315	19226481	1997519	300563
1989	0	98886626	64183975	72863486	6465083	158349	263755	2641402	443514	3106490	6520213	3363972	16258923	1872674	244688
1988 & Earlier	0	261010546	297026027	320696876	26802881	426586	1236574	10579618	1717760	13919572	28275288	14340039	70513583	6886889	729688
Total	400763921	60778095762	41883663823	13823695355	1503920844	99334046	221307027	980802407	301262056	484704803	1751339441	1214105614	4959568097	113495384	107467207

2012 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	16,298	906,354	194,616	67,317	5,916	501	900	3,311	993	1,002	3,351	1,184	2,730	420	95
2011	18,945	408,087	259,264	83,637	10,773	667	1,199	6,030	1,809	2,003	6,702	2,368	5,461	840	189
2010	15,223	408,087	257,589	77,970	9,797	667	1,191	5,483	1,644	1,874	6,269	2,215	6,109	786	189
2009	12,291	407,609	254,576	72,630	8,916	666	1,177	4,869	1,496	1,753	5,864	2,072	4,778	733	189
2008	8,923	406,353	249,550	67,557	8,115	664	1,153	4,542	1,362	1,640	5,487	1,939	4,471	685	189
2007	7,884	409,463	242,181	63,011	7,374	659	1,119	4,127	1,238	1,533	5,128	1,812	4,178	641	189
2006	6,315	398,261	232,132	58,704	6,715	651	1,073	3,759	1,127	1,434	4,796	1,695	3,909	598	189
2005	5,074	390,746	219,736	54,624	6,104	639	1,016	3,416	1,024	1,340	4,483	1,584	3,663	558	189
2004	4,060	378,608	204,330	50,885	5,651	619	944	3,107	932	1,255	4,198	1,483	3,421	522	189
2003	3,270	362,423	186,576	47,485	5,057	592	862	2,830	849	1,172	3,922	1,386	3,196	488	189
2002	2,594	339,880	166,813	44,198	4,599	555	771	2,574	772	1,098	3,673	1,298	2,993	456	189
2001	10,938	311,557	148,045	41,138	4,187	509	675	2,343	703	1,026	3,434	1,213	2,798	426	187
2000	0	264,737	124,608	38,305	3,811	439	576	2,133	640	960	3,213	1,135	2,618	397	184
1999	0	209,824	103,605	35,699	3,458	343	476	1,935	580	897	3,001	1,060	2,445	371	175
1998	0	166,472	83,407	33,319	3,152	272	388	1,764	529	839	2,808	992	2,288	347	159
1997	0	131,790	65,319	31,052	2,870	215	302	1,606	482	784	2,624	927	2,138	324	125
1996	0	104,623	49,240	28,899	2,611	171	228	1,461	438	735	2,458	868	2,009	303	78
1995	0	83,236	35,841	26,859	2,376	136	186	1,330	399	688	2,302	813	1,875	283	37
1994	0	66,895	26,472	25,046	2,164	108	132	1,211	363	644	2,154	761	1,755	264	31
1993	0	52,022	27,132	23,346	1,964	85	125	1,099	330	603	2,016	712	1,643	247	25
1992	0	41,818	26,127	21,759	1,788	68	121	1,001	300	561	1,878	664	1,530	231	20
1991	0	32,948	25,123	20,286	1,623	54	116	908	272	526	1,758	621	1,433	216	17
1990	0	26,011	24,116	18,926	1,482	43	111	828	249	493	1,648	582	1,343	201	14
1989	0	20,809	23,113	17,566	1,341	34	107	750	225	460	1,537	543	1,253	188	11
1988 & Earlier	0	58,959	120,253	83,070	5,869	96	556	3,285	986	2,199	7,356	2,599	5,994	894	35
Total	112,765	5,780,273	3,349,667	1,133,286	117,609	9,447	15,482	65,824	19,739	27,517	92,061	32,625	75,013	11,419	3,085

2009 Vehicle Population Estimates – Indiana

2002 Vehicle VMT by Vehicle Types: INDIANA

	Indiana
HDDV	5275575664
HDGV	851955916
LDDT	125368188
LDDV	56271730
LDGT1	23726671073
LDGT2	7830983318
LDGV	34430175275
MC	227026899
Total	72524029886

Growth Rates: 2% per year

2009 Vehicle VMT by Vehicle Types

	Indiana		
HDDV	6059978154	6059978154	100%
HDGV	978629551	978629551	100%
LDDT	144008641	144008641	100%
LDDV	64638530	64638530	100%
LDGT1	27254487003	27254487003	100%
LDGT2	8995338301	8995338301	100%
LDGV	39549448873	39549448873	100%
MC	260784613	260784613	100%
Total	83307313667	83307313667	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	50571258	2972317652	2468974692	934395031	78901299	4857874	15838429	58466904	21159300	19920375	88708121	67657347	220687824	2717812	2783418
2008	55165924	3763986592	3101529824	1081129882	131644694	6151625	19013853	97424898	34100641	37310537	160804593	120578472	400090849	5435623	5389371
2007	41248986	3678287098	2901136854	938526965	112544311	5848254	17023150	81068609	27443602	32686097	136340202	100510890	339257998	5081126	5217576
2006	30817264	3396876040	2694734910	813106994	96273787	5651764	15160899	67503278	22099813	28632891	116590840	83778556	287656579	4741400	5051203
2005	22878229	3220127015	2476025642	706349829	82382876	5252887	13392091	56225225	17603055	25068839	98025278	69850152	243958477	4431215	4890253
2004	16801142	3039437123	2251827524	612655566	70374390	4967572	11711744	46748938	14317236	21958049	83035387	58169582	208677567	4143166	4734355
2003	12002954	2852268713	2016854405	531552090	60247816	4661669	10116397	38956294	11538687	19234656	70396478	48486222	175236080	3869928	4583387
2002	8621602	2660385848	1780340462	460629118	51480326	4348061	8629219	32400835	9281302	16837937	59640869	40384962	148481473	3611440	4437226
2001	6075736	2450615215	1540222181	399589900	44011816	4005218	7230743	26961737	7469589	14765069	50615928	33697086	126026573	3375109	4295747
2000	4232543	2230060643	1305387473	347275627	37693031	3644750	5949890	22475810	6022309	12917990	42860771	28051283	106722875	3153548	4152055
1999	2831988	1988064243	1060601577	301008110	32221609	3249237	4793848	18700562	4846328	11331208	36384381	23412295	90608309	2946798	4006551
1998	9737028	1732580257	873747566	260921851	27677301	2831681	3781933	15579505	3904960	9920262	30829315	19503335	76782182	2754739	3853492
1997	0	1399513527	688542598	226251723	23956809	2287326	2907856	12974495	3144873	8692680	26144449	16261452	65123044	2570105	3656811
1996	0	1054470338	523665384	196360569	20128611	1723397	2176628	10773272	2525529	7603767	22136528	13536222	55140833	2400241	3379601
1995	0	795332218	396324562	170673178	17247040	1299869	1580640	8965989	2037473	6662300	18770140	11284474	46763717	2245149	2943527
1994	0	598593473	276105856	148131234	14761386	976925	1115481	7486263	1641588	5830438	15898575	9396019	39610061	2097442	2264129
1993	0	451779645	189332999	128381647	12626823	738376	757656	6232176	1321635	5115105	13499699	7844174	33637730	1957120	1371305
1992	0	341661375	124916364	111122430	10799792	558402	496946	5188785	1064280	4485469	11457024	6544701	28550192	1831569	632446
1991	0	257146494	83653972	96498418	9248821	420273	355807	4325260	857893	3931914	9718683	5459728	24223840	1706018	500963
1990	0	192990201	76925011	83765820	7890764	316418	305624	3591592	689185	3446151	8244241	4552597	20590164	1595237	396807
1989	0	146782233	66459224	72706717	6751595	239897	265133	2991640	555046	3006285	6960882	3778789	17352230	1491842	313018
1988	0	110456790	57167853	63124138	5762207	180526	229699	2484975	445963	2635939	6307529	3152735	14726784	1395833	247933
1987	0	82903526	48964585	54852694	4945824	135495	196750	2076218	360412	2313503	5017374	2633013	12511032	1299823	195582
1986	0	63045948	41785719	47413641	4206951	103041	171630	1718810	288603	2021451	4242825	2188934	10579987	1218584	159223
1985 & Earlier	0	169844468	193279766	208814928	17310981	277589	804727	6884468	1117779	9057727	18399268	9331333	45884513	5782735	474952
Total	260784613	39549448873	27254487003	8995338301	978629551	64638530	144008641	638226554	196036880	315406522	1139629480	790041335	2836852872	73853579	69930931

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	10,686	199,351	126,640	43,805	3,849	326	585	2,155	646	652	2,181	770	1,777	273	62
2008	12,326	265,550	168,708	54,424	7,010	434	760	3,924	1,177	1,304	4,361	1,541	3,554	547	123
2007	9,906	265,550	167,618	50,737	6,375	434	775	3,568	1,070	1,219	4,080	1,441	3,324	511	123
2006	7,998	265,174	165,657	47,197	5,801	433	766	3,247	974	1,141	3,816	1,348	3,109	477	123
2005	6,457	264,422	162,387	44,026	5,281	432	751	2,956	886	1,067	3,570	1,261	2,909	446	123
2004	5,136	262,641	157,692	41,002	4,798	429	728	2,686	805	997	3,337	1,179	2,719	417	123
2003	4,109	259,156	151,053	38,200	4,370	424	698	2,446	733	933	3,121	1,103	2,543	389	123
2002	3,302	254,266	142,988	35,545	3,972	416	661	2,223	667	872	2,917	1,031	2,377	363	123
2001	2,642	246,367	132,961	33,112	3,612	403	615	2,022	606	817	2,732	966	2,226	340	123
2000	2,128	235,836	121,409	30,899	3,291	385	561	1,842	552	763	2,552	902	2,079	317	123
1999	1,688	221,168	108,549	28,761	2,992	361	502	1,675	502	714	2,390	844	1,948	296	123
1998	7,118	202,736	95,095	26,769	2,724	331	439	1,525	457	668	2,234	789	1,821	277	122
1997	0	172,269	81,085	24,926	2,480	282	375	1,388	416	625	2,091	739	1,704	259	119
1996	0	136,536	67,352	23,230	2,250	223	311	1,259	378	584	1,953	690	1,591	241	114
1995	0	108,326	54,274	21,681	2,051	177	261	1,148	344	546	1,827	646	1,489	226	109
1994	0	85,758	42,504	20,206	1,867	140	196	1,045	313	510	1,707	603	1,391	211	81
1993	0	68,080	32,041	18,805	1,699	111	148	951	286	478	1,599	565	1,303	197	61
1992	0	54,163	23,323	17,478	1,546	89	108	865	259	448	1,498	529	1,220	184	24
1991	0	42,879	18,527	16,298	1,408	70	86	788	236	419	1,402	495	1,142	172	20
1990	0	33,852	17,655	15,191	1,278	55	82	715	214	392	1,312	464	1,069	161	16
1989	0	27,082	17,002	14,159	1,163	44	79	651	195	365	1,222	432	996	150	13
1988	0	21,440	16,348	13,200	1,056	35	76	591	177	342	1,144	404	932	140	11
1987	0	16,926	15,694	12,315	964	28	73	540	162	321	1,072	379	874	131	9
1986	0	13,541	15,040	11,430	872	22	70	488	148	299	1,000	353	815	123	7
1985 & Earlier	0	38,366	78,251	54,055	3,819	63	362	2,137	641	1,431	4,786	1,691	3,900	582	23
Total	73,378	3,761,332	2,179,691	737,460	76,531	6,147	10,075	42,833	12,844	17,906	59,906	21,165	48,812	7,431	2,007

2012 Vehicle Population Estimates – Indiana

2002 Vehicle VMT by Vehicle Types: INDIANA

	Indiana
HDDV	5275575664
HDGV	6519559161
LDDT	1263681889
LDDV	56271730
LDGT1	23726671073
LDGT2	7630983318
LDGV	34430176275
MC	227026899
Total	72524028866

Growth Rates: 2% per year

2012 Vehicle VMT by Vehicle Types

	Indiana		
HDDV	6430897297	6430897297	100%
HDGV	1038529508	1038529508	100%
LDDT	152823122	152823122	100%
LDDV	68594925	68594925	100%
LDGT1	28922679643	28922679643	100%
LDGT2	9545924968	9545924968	100%
LDGV	41970191540	41970191540	100%
MC	276746718	276746718	100%
Total	88406387722	88406387722	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	53698624	3154247271	2620095695	991587483	61608274	5155215	16807888	62045546	22454418	21139881	9413768	71788518	234195684	2884164	2953785
2011	58542520	3994267787	3291366252	1147303468	139702402	6528154	20177653	103388081	36187873	39594241	17064712	127956839	424579609	5768327	5719244
2010	43773732	3797306895	3078709638	996078444	119432923	6206214	18065103	86030656	29123370	34686748	14468531	108662980	360023302	5392132	5536933
2009	32703527	3604794151	2869674244	862675647	102166513	5891576	16088867	71635018	23452286	30385453	12266592	88906474	305263462	5031611	5360377
2008	24278559	3417224549	2629700636	749584039	87425367	5586018	14211794	59866659	18892744	26624476	10402520	74125540	258901300	4702441	5189575
2007	17617265	3225474991	2389657383	650154998	74681886	5271628	12428596	49610347	15193565	23302058	8811781	61730026	219327888	4396782	5024136
2006	12737631	3026850376	2140302029	564087330	63935464	4947001	10735601	41340731	12244947	20411970	7470530	51452806	185964052	4106798	4863927
2005	9149313	2823222745	1889311541	488823305	54631334	4614198	9157396	34384025	9849392	17868554	6329136	42856845	157559727	3832489	4708819
2004	6447620	2600612471	1634496101	424047998	46705479	4250369	7673322	28612011	7926787	15668809	5371402	35759598	133740408	3591692	4556681
2003	4491606	2366558407	1385287629	368531886	40000146	3867838	6314060	23851509	6390923	13708674	4648419	29766246	113255168	3346570	4406194
2002	3005307	2109748679	1145743039	319432215	34193930	3448117	5087270	19845186	5142962	12024769	3861139	24845315	96154263	3127123	4251784
2001	1933012	1838628030	927227906	276892356	29265252	3056003	4013418	16533096	4143975	10527462	3271631	20697086	81481886	2923351	4089357
2000	0	1485174951	728564488	240100139	25040061	2427329	3085840	13768637	3337365	9224721	2774699	17256783	68109053	2727416	3880637
1999	0	1119012958	555717895	208979407	21360537	1828883	2309855	11452682	2680111	8089179	2349146	14363686	56515893	2547155	3686460
1998	0	844012912	409970715	181119742	18302697	1379431	1677388	9539004	2162183	7070087	1991902	11975174	47826030	2382570	3123694
1997	0	636232183	293005743	157198051	15664900	1038206	1183736	7944482	1742066	6187308	1687169	9971130	42034513	2226822	2402712
1996	0	479432174	200921693	136239631	13399686	783571	804031	6613635	1402529	5428191	1432598	8324300	35596629	2076911	1455240
1995	0	362573784	132562245	117924012	11460825	592581	527363	5505380	1129422	4760016	1215828	6945209	30297693	1943675	671157
1994	0	272886917	85141513	102404893	9814923	445997	377585	4590000	910403	4172579	1031354	5792846	25706533	1810440	531626
1993	0	204802745	51633437	88892058	8373732	334724	324224	3811426	731389	3657083	874864	4831253	21807998	1692879	421095
1992	0	156766480	70527060	77156950	7164847	264680	281361	3174753	589020	3190294	738705	4010081	18414325	1583155	332177
1991	0	117217629	60966983	66987841	6114900	191577	243758	2637076	473259	2797173	626811	3345708	15628161	1481269	263109
1990	0	87977885	51961510	58210330	5246548	143789	210915	2203299	382472	2455108	532447	2784175	13276807	1379383	207553
1989	0	66904864	44322115	50315735	4464450	109347	182136	1824015	306267	2145180	450252	2322915	11227567	1293171	169969
1988 & Earlier	0	180240306	205110034	221596072	18370552	294580	853983	7305872	1186196	9812133	1952545	9902485	48693013	6136685	504023
Total	276746718	41970191540	28922679643	9545924968	1038529508	68594925	152823122	677291125	208035905	334711925	120938392	838398186	3010490963	78374009	74211263

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	11,213	211,552	134,391	46,486	4,085	346	621	2,286	686	692	2,314	818	1,886	290	65
2011	13,082	261,804	179,034	57,755	7,439	461	827	4,164	1,249	1,363	4,628	1,635	3,771	580	131
2010	10,512	261,804	177,876	53,842	6,765	461	822	3,786	1,135	1,294	4,329	1,530	3,528	543	131
2009	8,488	261,405	175,796	50,086	6,156	460	813	3,445	1,033	1,210	4,050	1,431	3,300	506	131
2008	6,853	260,606	172,326	46,721	5,604	459	796	3,136	940	1,133	3,789	1,339	3,087	473	131
2007	5,451	276,611	167,238	43,512	5,092	455	773	2,850	855	1,058	3,541	1,251	2,885	442	131
2006	4,361	275,016	160,238	40,538	4,637	449	741	2,595	778	930	3,312	1,170	2,699	413	131
2005	3,504	269,829	151,740	37,721	4,215	441	701	2,359	707	925	3,096	1,094	2,523	386	131
2004	2,803	261,447	141,099	35,136	3,833	427	652	2,145	643	866	2,899	1,024	2,362	360	131
2003	2,258	250,271	128,840	32,790	3,492	409	595	1,955	586	809	2,708	957	2,207	337	131
2002	1,791	234,703	115,193	30,521	3,176	384	532	1,777	533	758	2,537	896	2,067	315	130
2001	7,553	215,145	100,851	28,408	2,891	352	466	1,618	485	709	2,371	838	1,932	294	129
2000	0	182,813	86,048	26,451	2,631	299	398	1,473	442	663	2,219	784	1,806	274	127
1999	0	144,893	71,475	24,652	2,388	237	330	1,336	401	619	2,072	732	1,689	256	121
1998	0	114,957	57,596	23,039	2,177	188	266	1,218	365	580	1,939	685	1,580	240	109
1997	0	91,007	45,105	21,443	1,982	149	208	1,109	333	542	1,812	640	1,476	224	86
1996	0	72,247	34,003	19,956	1,803	118	157	1,009	303	507	1,697	600	1,383	209	54
1995	0	57,478	24,750	18,547	1,641	94	114	918	275	475	1,589	562	1,295	196	26
1994	0	45,504	19,661	17,295	1,494	74	91	836	251	445	1,488	526	1,212	182	21
1993	0	35,924	18,736	16,121	1,356	59	87	759	228	416	1,392	492	1,134	170	17
1992	0	29,739	18,042	15,026	1,234	47	69	691	207	388	1,297	458	1,057	159	14
1991	0	22,752	17,348	14,009	1,121	37	60	627	188	363	1,214	429	989	149	12
1990	0	17,962	16,654	13,069	1,023	29	77	573	172	340	1,138	402	927	139	9
1989	0	14,370	15,960	12,130	926	23	74	518	155	317	1,062	375	865	130	8
1988 & Earlier	0	40,714	63,040	57,364	4,053	67	384	2,268	680	1,518	5,079	1,795	4,139	617	24
Total	77,870	3,991,556	2,313,106	782,598	81,215	6,524	10,691	45,455	13,630	19,002	63,573	22,460	51,800	7,886	2,130

2009 Vehicle Population Estimates – Michigan

2002 Vehicle VMT by Vehicle Types: **MICHIGAN**

	Michigan
HDDV	4934216540
HDGV	1055625780
LDDT	176081861
LDDV	78652252
LDGT1	33124408375
LDGT2	11008947458
LDGV	48123829555
MC	132737310
Total	98633895130

Growth Rates: 2% per year

2009 Vehicle VMT by Vehicle Types

	Michigan		
HDDV	5667666118	5667666118	100%
HDGV	1212582204	1212582204	100%
LDDT	202262710	202262710	100%
LDDV	90346715	90346715	100%
LDGT1	38049533149	38049533149	100%
LDGT2	12645130949	12645130949	100%
LDGV	55279146390	55279146390	100%
MC	152473445	152473445	100%
Total	113299341680	113299341680	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	29567596	4154474648	3446894245	1313516973	95285440	6789959	22245357	54683792	19790183	18631423	82968245	63279565	206408176	2541955	2603316
2008	32253968	5260886165	4329993878	1519790134	163115872	8596264	26705297	91121002	31894152	34896352	150399702	112776419	374202894	5083910	5040651
2007	24117113	5001451650	4050228605	1319467983	139449323	8174235	23909318	75823049	25667859	30571137	127516283	94007314	317306245	4752351	4879972
2006	18017990	4747892165	3762074306	1143019203	119269143	7759824	21293763	63135465	20689654	26780195	108111513	78357649	269043705	4434607	4724364
2005	13376258	4500843317	3459530125	992946100	102077451	7356054	18809430	52587162	16851105	23465461	91682534	65330486	228182451	4144492	4573628
2004	9706222	4248289027	3143738718	861236076	87198198	6943287	16449353	43724039	13990837	20537260	77662567	54405709	193304466	3875100	4428019
2003	7017791	3988679567	2815898679	747225458	74650749	6515719	14208660	36435619	10792074	17990073	65841480	45347977	163699266	3619523	4286818
2002	5040809	3718480609	2485503521	647526010	63787291	6077382	12119692	30304333	8680754	15749435	55781796	37771845	136873951	3377761	4150114
2001	3552312	3425279519	2150278409	561720576	54530099	5598183	10155707	25217172	6986268	13809692	47340814	31516691	117872000	3156722	4017790
2000	2474649	3117005756	1822429602	488180451	46703983	5094348	8356712	21021508	5632634	12082129	40087457	26236219	99817351	2949497	3883395
1999	1655772	2778761713	1508609775	423139947	39924556	4541532	6733045	17490539	4532746	10598020	34030123	21897398	84745462	2756087	3747306
1998	5692967	2421666051	1219824351	368788982	34169972	3957904	5311793	14571431	3652289	9276370	28834498	18241368	71813976	2576493	3604151
1997	0	1955131255	958470631	318051703	29236658	3197047	4084136	12134977	2941384	8130200	24452768	15209252	60909207	2403805	3420196
1996	0	1473856699	731080478	276032432	24940463	2408831	3057112	10076185	2362114	7111764	20704180	12659423	51572935	2244933	3160923
1995	0	1111653572	539341255	239922570	21370143	1816856	2220038	8404549	1905639	6231215	17555614	10554310	43737862	2099876	2753065
1994	0	838667443	385466764	206234398	18290265	1367426	1666684	7001863	1536368	5453179	14869855	8788046	37047084	1961726	2117628
1993	0	631462482	264324631	180471560	15645411	1032045	1084141	5826922	1236118	4784132	12626198	7336815	31481195	1830484	1282574
1992	0	477547721	174399648	156209542	13381606	780491	697969	4853044	995415	4195236	10715695	6121225	26702847	1713057	591523
1991	0	359419388	125164410	136661945	11459858	587426	499737	4045393	802383	3677499	9089834	5105520	22656432	1596629	468548
1990	0	269746706	107393721	117753187	9777130	440867	429114	3359197	644591	3223167	7710796	4258021	19220462	1492017	371132
1989	0	205160800	92782610	102206935	8366642	395309	372384	2798066	519132	2811763	6510571	3534282	16229451	1395312	292764
1988	0	154387918	79811093	88736295	7139729	252327	322616	2324184	417107	2465286	5525281	2948737	13773884	1305515	231891
1987	0	115876107	68358638	77109054	6126180	189385	279148	1941876	337092	2163807	4692724	2462644	11701503	1215718	182927
1986	0	86120727	58308421	66651378	5212671	144022	241056	1607594	269929	1890653	3988292	2047299	9895407	1139735	148921
1985 & Earlier	0	237395397	269834647	293540056	21449371	367993	1130254	6439024	1045452	8471645	17208739	8727547	42915547	5408562	444220
Total	152473445	55279146390	38049533149	12645130949	1212582204	90346715	202262710	596929984	183952276	294996083	1065889539	738921560	2653293769	69074869	65408036

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	6,178	278,637	176,800	61,578	4,770	455	622	2,015	604	610	2,039	721	1,662	256	58
2008	7,208	371,165	235,531	76,506	8,686	607	1,095	3,870	1,100	1,219	4,079	1,441	3,324	512	115
2007	5,792	371,165	234,009	71,323	7,899	607	1,088	3,337	1,001	1,141	3,816	1,348	3,109	476	115
2006	4,676	370,640	231,270	66,347	7,188	606	1,075	3,037	911	1,067	3,569	1,261	2,908	446	115
2005	3,775	369,588	226,706	61,899	6,543	604	1,054	2,764	829	998	3,339	1,180	2,721	417	115
2004	3,003	366,959	220,011	57,639	5,946	600	1,029	2,512	753	933	3,121	1,103	2,543	390	115
2003	2,403	362,228	210,882	53,699	5,415	592	981	2,288	686	873	2,919	1,031	2,379	364	115
2002	1,931	355,393	199,623	49,967	4,921	581	928	2,079	623	816	2,729	964	2,223	340	115
2001	1,544	344,353	185,625	46,546	4,476	563	863	1,891	567	764	2,555	903	2,082	318	115
2000	1,244	329,633	169,497	43,436	4,078	539	788	1,723	517	713	2,387	843	1,945	297	115
1999	987	309,129	151,543	40,430	3,708	505	705	1,566	470	668	2,236	790	1,822	277	115
1998	4,162	283,368	132,676	37,631	3,376	463	617	1,426	428	625	2,090	738	1,703	259	114
1997	0	240,784	113,201	35,039	3,072	394	526	1,298	389	584	1,955	691	1,593	242	112
1996	0	180,840	84,030	32,655	2,788	312	437	1,178	353	546	1,827	645	1,488	226	107
1995	0	151,410	75,771	30,476	2,541	247	352	1,074	322	511	1,709	604	1,392	211	96
1994	0	119,866	59,339	28,405	2,314	198	276	978	293	477	1,597	564	1,301	197	76
1993	0	95,157	44,739	26,435	2,105	166	208	889	267	447	1,496	529	1,219	184	48
1992	0	75,705	32,560	24,569	1,915	124	151	809	243	419	1,401	495	1,141	172	23
1991	0	59,933	25,866	22,910	1,745	98	120	737	221	392	1,311	463	1,068	161	19
1990	0	47,316	24,649	21,355	1,584	77	115	669	201	367	1,227	434	1,000	150	15
1989	0	37,853	23,736	19,904	1,441	62	110	609	183	342	1,143	404	931	140	12
1988	0	29,967	22,823	18,556	1,309	49	106	553	166	320	1,070	378	872	131	10
1987	0	23,659	21,910	17,312	1,195	39	102	505	151	300	1,003	354	817	122	8
1986	0	18,926	20,997	16,068	1,081	31	98	457	137	280	936	331	762	115	7
1985 & Earlier	0	53,624	109,245	75,988	4,732	88	508	1,999	599	1,398	4,477	1,582	3,648	544	21
Total	42,902	5,257,288	3,043,031	1,036,866	94,826	8,592	14,150	40,062	12,013	16,747	56,030	19,795	45,654	6,950	1,877

2012 Vehicle Population Estimates – Michigan

2002 Vehicle VMT by Vehicle Types: **MICHIGAN**

	Michigan
HDDV	4934218540
HDGV	1055625780
LDDT	176031861
LDDV	78852252
LDGT1	33124408375
LDGT2	11008347458
LDGV	48123823555
MC	152737310
Total	98533895130

Growth Rates: 2% per year

2012 Vehicle VMT by Vehicle Types

	Michigan		
HDDV	6014784867	6014784867	100%
HDGV	1286801935	1286801935	100%
LDDT	214642806	214642806	100%
LDDV	95676657	95676657	100%
LDGT1	40378468974	40378468974	100%
LDGT2	13419114125	13419114125	100%
LDGV	58662672382	58662672382	100%
MC	16180604O	16180604O	100%
Total	120234167786	120234167786	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	31377369	4408761730	3857871747	1383916843	101117671	7205558	2360695O	58030877	21001501	19771816	88046565	67152781	219042008	2697543	2762660
2011	34228168	5582905087	4595024143	1612813449	173099869	9124546	28339875	96898336	33846329	37032288	159605367	119679238	397107105	5395086	5349179
2010	25593273	6307580503	4298134998	1400226979	147884738	8674563	26372760	80464026	27238937	32442335	135323423	99761313	336727928	5043233	5178666
2009	19120835	5038901148	3992343351	1212981123	126590593	8234788	22597101	66999861	21934802	28419357	114728802	83153764	285511332	4706040	5013533
2008	14194992	4776330935	3671281044	1059722344	108325407	7806304	19960718	55805916	17670286	24901735	97284239	69329233	242149042	4398168	4853783
2007	10300320	4508318302	3336180677	913950613	92535425	7368271	17466185	46400300	14210463	21794294	82416137	57735773	205136235	4112287	4699048
2006	7447336	4230696260	2988039841	792961634	79219972	6914633	15078344	38665771	11452635	19091210	69871485	48123636	173931213	3841057	4548206
2005	5349346	3946081370	2637636221	687159762	67691583	6449367	12861726	32159200	9212086	16712386	59196088	40083784	147374148	3584507	4404134
2004	3769742	3634934028	2281892650	596102369	57870961	5940836	10977316	26760665	7413883	14654956	50238451	33445765	125086709	3349938	4263711
2003	2626117	3307791444	1933976873	518061000	49552641	5406163	8868210	22308193	5977397	12821652	42641130	27842086	106926971	3130030	4121090
2002	1757119	2946844160	1600948762	449039497	42368258	4819510	7145161	18561099	4810186	11246704	36113086	23237694	89932563	2924782	3976671
2001	6041422	2569891387	1294487360	389239402	36261447	4200160	5633917	15463319	3875838	9946280	30699400	19357886	76209566	2734195	3824754
2000	0	2075862138	1017136701	337519012	31026176	3592732	4334118	12877735	3121420	8627833	25949473	16140179	64637338	2550938	3629539
1999	0	1564069520	775828452	292927826	26467019	2956271	3244232	10892928	2506694	7547061	21971441	13454281	54729611	2382341	3354397
1998	0	1179695664	572353264	254607751	22678167	1928062	2395922	8918975	2022278	6612615	18630158	11200318	46414969	2228405	2921575
1997	0	887878183	409060414	220980009	19409775	1451124	1662578	7430433	1629345	5786957	15780009	9325947	39314662	2081800	2247244
1996	0	670113037	280503413	191517864	16803035	1095214	1129275	6185698	1311778	5076959	13399023	7765675	33386871	1942524	1361078
1995	0	506770462	185067932	165770816	14200667	828263	740690	5150089	1056343	4452018	11371681	6495893	28337275	1817910	627729
1994	0	381416730	132825474	143954929	12161294	623380	530325	4293003	851495	3902591	9946205	5418019	24043187	1693295	497227
1993	0	286257363	113867076	124960625	10375568	467851	455379	3564807	684045	3420451	8182768	4618646	20396908	1583341	393848
1992	0	217718262	98461648	108462817	8877686	355833	395177	2969330	550907	2983965	6939070	3750608	17222823	1480717	310684
1991	0	163837693	84696160	94167666	7576738	267772	342363	2466443	442637	2616182	6853473	3129223	14616956	1386423	246084
1990	0	122969651	72542739	81828745	6503274	200977	296234	2060735	357724	2296250	4979956	2613377	12417729	1290129	194123
1989	0	93514421	61877363	70730976	5531729	152837	255813	1705991	286450	2006376	4211183	2172610	10501065	1209496	158036
1988 & Earlier	0	251925694	286350686	311507056	22762244	411741	1199434	6833144	1109443	8890178	18262052	9261743	45542322	5739610	471410
Total	161806040	58662672382	40378468974	13419114125	1286801935	95676657	214642806	633466875	194574903	313054326	1131130505	784149471	2815686574	73302804	69409409

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	6,556	295,692	187,622	66,347	5,062	483	872	2,139	641	647	2,164	765	1,764	271	61
2011	7,649	393,884	249,947	81,189	9,218	644	1,162	3,894	1,168	1,294	4,329	1,529	3,527	543	122
2010	6,146	393,884	248,332	75,588	8,383	644	1,155	3,641	1,062	1,210	4,049	1,431	3,299	507	122
2009	4,963	393,326	245,426	70,408	7,628	643	1,141	3,223	966	1,132	3,786	1,336	3,086	473	122
2008	4,006	392,210	240,582	65,677	6,943	641	1,119	2,933	880	1,059	3,544	1,252	2,888	443	122
2007	3,187	389,420	233,478	61,167	6,310	636	1,086	2,666	799	990	3,312	1,170	2,699	414	122
2006	2,560	384,399	223,790	56,966	5,746	628	1,041	2,428	728	926	3,098	1,094	2,524	386	122
2005	2,049	377,146	211,841	53,026	5,223	616	985	2,206	662	866	2,896	1,023	2,359	361	122
2004	1,639	365,430	196,987	49,395	4,750	597	916	2,007	602	810	2,711	958	2,209	337	122
2003	1,320	349,809	179,871	46,095	4,327	572	838	1,826	548	757	2,533	895	2,064	315	122
2002	1,047	326,050	160,819	42,805	3,935	536	748	1,662	498	709	2,372	838	1,933	294	122
2001	4,416	300,713	140,797	39,934	3,582	491	655	1,513	454	663	2,218	784	1,807	276	121
2000	0	255,522	120,130	37,184	3,260	418	559	1,377	413	620	2,075	733	1,691	257	119
1999	0	202,521	99,785	34,654	2,959	331	464	1,260	375	579	1,938	685	1,579	240	113
1998	0	160,678	80,409	32,343	2,697	263	374	1,139	342	542	1,814	641	1,478	224	102
1997	0	127,209	62,971	30,143	2,456	208	293	1,037	311	507	1,695	599	1,381	209	81
1996	0	100,981	47,471	28,053	2,234	165	221	944	283	475	1,588	561	1,294	195	51
1995	0	80,339	34,553	26,073	2,033	131	161	859	258	444	1,486	525	1,211	183	24
1994	0	63,802	27,449	24,313	1,852	104	128	782	235	416	1,391	492	1,134	170	20
1993	0	50,212	26,157	22,662	1,681	82	122	710	213	389	1,302	460	1,061	159	16
1992	0	40,169	25,188	21,122	1,530	66	117	646	194	363	1,213	429	988	149	13
1991	0	31,801	24,220	19,692	1,389	52	113	587	176	339	1,136	401	925	139	11
1990	0	25,106	23,251	18,372	1,268	41	108	536	161	318	1,064	376	867	130	9
1989	0	20,085	22,282	17,052	1,147	33	104	485	145	297	993	351	809	122	7
1988 & Earlier	0	58,907	115,931	80,639	5,021	93	539	2,121	636	1,420	4,751	1,678	3,871	577	23
Total	45,528	5,579,087	3,229,288	1,100,118	100,630	9,118	15,016	42,514	12,748	17,773	59,469	21,007	48,448	7,375	1,992

2009 Vehicle Population Estimates – Ohio

2002 Vehicle VMT by Vehicle Types: OHIO

	Ohio
HDDV	7845958943
HDGV	1267048672
LDDT	188450488
LDDV	83688628
LDGT1	35286857575
LDGT2	11648420696
LDGV	51205358201
MC	337642367
Total	107859425570

Growth Rates: 2% per year

2009 Vehicle VMT by Vehicle Types

	Ohio		
HDDV	9012540597	9012540597	100%
HDGV	1455440650	1455440650	100%
LDDT	214173003	214173003	100%
LDDV	96131927	96131927	100%
LDGT1	40533507553	40533507553	100%
LDGT2	13378076532	13378076532	100%
LDGV	58818861073	58818861073	100%
MC	387844948	387844948	100%
Total	123896576273	123896576273	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	75210753	4420500008	3671918639	1389854043	114369403	7224743	23555280	86953341	31468603	29626045	131928782	100521581	32621206	4041993	4139564
2008	82044046	5897769508	4612667358	1607881232	195785053	9148840	28277845	144892577	50715266	55489100	239152335	179327110	59502442	6083986	8015198
2007	61346422	5321711875	4314638267	1395947873	167378519	8697859	25317225	120567122	40814764	48611525	202768329	149482135	50455239	7556769	7759700
2006	45832153	5051916100	4007672491	1209271651	143180617	8256713	22547641	100392446	32867059	42583502	171909388	124597419	42780956	7051520	7512267
2005	34025034	4789047861	3685377423	1050499909	122521731	7827688	19917029	83619464	26477118	37312705	145785476	103882773	36283599	6690206	7272898
2004	24889605	4520321648	3348970316	911155620	104682431	7387889	17417978	69526109	21292927	32656522	123492161	86511157	30737589	6161842	7041043
2003	17851073	4241960430	2999512823	790536843	89601954	6932943	15045341	57936707	17160804	28806227	104695281	72108351	26061815	5755446	6816520
2002	12822247	3956697767	2647763781	685568348	76562740	6466538	12833575	48187276	13809369	25041772	88699289	60061456	22082510	5371018	6599145
2001	9036976	3644611998	2290654284	594279401	65456099	5956653	10753729	40098122	11108946	21958954	75277186	50115061	18742965	5019540	6368795
2000	6294736	3316698401	1941402639	518476694	56057953	5420567	8848800	33426547	8956518	19211936	63743537	41718521	15872044	4690030	6175033
1999	4211769	2956695424	1607095821	447666269	47920727	4832342	7129522	27811911	7207572	16852037	54111698	34819310	13475487	4382487	5958636
1998	14491134	2576733693	1299457719	388049051	41013604	4211343	5624579	23170203	5807548	14763645	45850075	28005815	11419224	4096911	5731003
1997	0	2081389097	1021042135	336486830	35092236	3401765	4324631	19295970	4577129	12927927	38882634	24184410	9685244	3822319	5438494
1996	0	1668232634	778807350	292032010	29935590	2663077	3237131	16022261	3756025	11308500	32921959	20129898	8200673	3569695	5026222
1995	0	1182836590	574550882	253829124	25690199	1933196	2350765	13364172	3030177	9908328	27915389	16782532	6954808	3339038	4377681
1994	0	880242149	410631056	220304220	21953476	1454987	1698939	11133744	2441407	8671164	23644731	13973978	5809004	3119384	3367265
1993	0	671897206	281580444	190932174	18778905	1098130	1126804	9269837	1965566	7697304	20077067	11666038	4902681	2910674	2939437
1992	0	508126751	185778525	165263865	16081701	830468	739069	7716882	1582822	6870894	17039153	9733431	4240511	2723952	940586
1991	0	382434253	133335476	143514694	13756062	625040	529164	6432627	1275879	5947634	14453852	8118348	3802629	2537229	745044
1990	0	287019520	114404668	124578477	11735313	469097	454382	5341499	1024972	5125196	12261027	6770729	3056268	2372474	590141
1989	0	218297954	98839704	108131122	10041130	356780	394312	4449237	825478	4471017	10352535	5619803	2580864	2218703	465528
1988	0	164273909	85021362	93679688	8569689	268485	341614	3695713	663246	3920081	8765815	4688821	2190201	2075915	368732
1987	0	123286054	72821271	81576501	7355545	201512	295586	3087800	536013	3440695	7461955	3915879	1860698	1933127	290874
1986	0	93763402	62114949	70514670	6256676	153244	255253	2656254	429216	3006360	6310029	3256494	1573480	1812307	236801
1985 & Earlier	0	252996644	267450168	310554422	25745294	412837	1196809	10238768	1662386	13470863	27363819	13877775	6824051	6600218	705360
Total	387844948	58818861073	40533507553	13378076532	1455440650	96131927	214173003	949185390	291550612	469079923	1694883494	1174967865	421903634	109936762	104002808

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	15,715	296,479	188,342	65,147	5,726	486	671	3,204	961	989	3,243	1,146	2,642	407	92
2008	16,334	394,932	250,907	80,940	10,426	645	1,160	5,835	1,760	1,939	6,486	2,292	5,285	813	183
2007	14,733	394,932	249,266	75,457	9,481	645	1,152	5,306	1,591	1,814	6,067	2,144	4,944	760	183
2006	11,895	394,373	246,388	70,192	8,627	645	1,139	4,829	1,448	1,696	5,675	2,005	4,624	709	183
2005	9,803	393,254	241,506	65,476	7,853	643	1,116	4,395	1,318	1,587	5,310	1,876	4,327	663	183
2004	7,639	390,457	234,374	60,979	7,136	638	1,083	3,994	1,198	1,483	4,963	1,753	4,044	620	183
2003	6,111	385,423	224,649	56,812	6,499	630	1,038	3,637	1,091	1,387	4,642	1,640	3,782	579	183
2002	4,911	376,150	212,655	52,864	5,907	618	983	3,306	991	1,297	4,339	1,533	3,535	540	183
2001	3,929	366,403	197,743	49,244	5,372	599	914	3,007	902	1,214	4,063	1,435	3,310	505	183
2000	3,165	350,740	180,562	45,954	4,894	573	835	2,739	821	1,134	3,795	1,341	3,093	472	183
1999	2,510	328,924	161,436	42,773	4,460	538	746	2,491	747	1,063	3,555	1,256	2,897	441	182
1998	10,586	301,513	141,338	39,812	4,052	493	653	2,268	680	993	3,323	1,174	2,708	412	181
1997	0	256,202	120,591	37,070	3,688	419	557	2,064	619	929	3,109	1,099	2,534	386	178
1996	0	203,060	100,168	34,548	3,346	332	463	1,873	562	868	2,904	1,026	2,367	359	170
1995	0	161,106	80,718	32,245	3,050	263	373	1,707	512	812	2,717	960	2,214	336	153
1994	0	127,542	63,213	30,051	2,777	208	292	1,554	466	759	2,539	897	2,069	314	121
1993	0	101,250	47,663	27,967	2,527	165	220	1,414	424	711	2,379	840	1,938	293	76
1992	0	80,553	34,886	25,993	2,299	132	180	1,287	388	666	2,227	787	1,815	274	36
1991	0	63,771	27,554	24,238	2,094	104	127	1,172	351	623	2,085	737	1,699	255	30
1990	0	50,345	26,258	22,593	1,901	82	121	1,064	319	583	1,951	689	1,590	239	24
1989	0	40,276	25,285	21,058	1,730	66	117	968	290	543	1,818	642	1,481	223	20
1988	0	31,885	24,313	19,632	1,571	52	112	879	264	509	1,702	601	1,387	209	16
1987	0	25,173	23,340	18,316	1,434	41	108	803	241	477	1,595	563	1,299	194	13
1986	0	20,138	22,368	17,000	1,298	33	103	726	218	445	1,488	526	1,212	182	11
1985 & Earlier	0	57,058	116,377	80,392	5,680	93	538	3,179	953	2,128	7,119	2,515	5,800	865	34
Total	109,130	5,593,941	3,241,688	1,096,754	113,818	9,143	14,983	69,702	19,102	26,630	89,094	31,477	72,594	11,051	2,966

2012 Vehicle Population Estimates – Ohio

2002 Vehicle VMT by Vehicle Types: OHIO

	Ohio
HDDV	7845958943
HDGV	1267048872
LDDT	166450488
LDDV	83688628
LDGT1	35286857575
LDGT2	11646420696
LDGV	51205356201
MC	337642367
Total	107859425570

Growth Rates: 2% per year

2012 Vehicle VMT by Vehicle Types

	Ohio		
HDDV	9564180171	9564180171	100%
HDGV	1544525262	1544525262	100%
LDDT	227282104	227282104	100%
LDDV	102015970	102015970	100%
LDGT1	43014482484	43014482484	100%
LDGT2	14196921841	14196921841	100%
LDGV	62419045921	62419045921	100%
MC	411584161	411584161	100%
Total	131480037914	131480037914	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	79814252	4691069972	3996667313	1474711998	121369725	7666956	24997052	92275581	33394733	31439396	140003679	106780427	348301273	4289395	4392939
2011	87065798	6940397784	4894999502	1706286426	207768665	9708823	30008678	153761161	63819446	58885476	253790371	190303364	631444679	6578790	6905793
2010	65101314	5647443215	4578728646	1481391051	177623424	9230026	28868842	127946795	43312954	51586939	215179366	158631638	535435036	6019304	6234656
2009	48637447	5381133780	4252974109	1283288750	151944416	8762089	23927737	106537267	34878788	45189953	182431618	132223778	453994928	7483130	7972077
2008	36107639	5082175903	3910952005	1114798808	130021042	8306166	21136110	88737844	26097729	39598541	164708713	110241229	385044041	6993579	7718057
2007	26200806	4797001495	3563954091	986926533	111068609	7840087	18484098	73781663	22598224	34665863	131050869	91806332	326189541	6538996	7472011
2006	18943702	4501602344	3183107004	838923810	95085311	7357295	16966236	61482897	18210970	30357157	111103469	76521959	276570067	6107726	7233746
2005	13607071	4198762591	2809928107	726988398	81248992	6862342	13619092	51136722	14648246	26574529	94128386	63737697	234341366	5699767	7009066
2004	9589050	3867691409	2430860652	630654055	69461475	6321248	11411943	42562448	11788903	23303017	79884752	53182504	198901848	5326776	6779777
2003	6680024	3519600756	2060232011	548089200	59489148	5762339	9390417	35472519	9504729	20387860	67645161	44272028	168435723	4977097	6552994
2002	4689563	3137688837	1705462942	475067026	50853859	5128120	7565906	29514223	7648733	17863516	57423767	36950530	143002858	4650730	6323352
2001	15367495	2734450409	1378994927	411800757	43523964	4469110	5966849	24588405	6163016	15556686	48656466	30781202	121181727	4347675	6081789
2000	0	2208786761	1083538082	357082516	37240162	3609980	4589333	20477038	4963407	13719219	41262582	25664689	102780592	4056276	5771373
1999	0	1864221230	826476591	309906705	31767888	2719957	3435270	17002951	3965924	12000670	34937047	21362008	87026199	3788189	5333867
1998	0	1295235652	609717992	269385497	27220197	2051523	2494851	14182166	3216648	10514797	29624034	17609757	73804988	3543413	4645631
1997	0	944732090	435764962	233786601	23297205	1544044	1760479	11816218	2590841	9201908	25091978	14829297	62514707	3310294	3573369
1996	0	713022690	298815420	202618751	19928325	1165345	1195773	9835952	2085874	8072932	21368944	12360093	53088857	3089831	2164266
1995	0	539226173	197149557	175379335	17044806	881300	784306	8189217	1679703	7079206	18062085	10329195	45059434	2890679	998160
1994	0	405842288	141496673	152298941	14596962	663297	561553	6826355	1352973	6206566	15338544	8615265	38231354	2692528	790646
1993	0	304587410	121407148	132203676	12453609	497809	482194	5669441	1087709	5438899	13011500	7185152	32433363	2517688	626263
1992	0	231659535	104889485	114749612	10855727	378618	418447	4721566	876004	4744679	10986193	5963886	27386213	2364505	494022
1991	0	174328787	90225350	99625876	9094222	284918	362523	3921920	703842	4160021	9323577	4975814	23242594	2202977	391302
1990	0	130842759	77276515	86571757	7805763	213846	313678	3276798	568822	3651294	7918686	4155562	19746577	2051450	309678
1989	0	99502472	65916881	74830732	6839634	162624	270876	2712717	455488	3190362	6696252	3454693	16697898	1923234	251295
1988 & Earlier	0	268057579	305044418	329562837	27321112	438106	1270063	10865463	1764138	14295387	29038704	14727206	72417382	9126621	749595
Total	411584161	62419045921	43014482484	14196921841	1544525262	102015970	227282104	1007263129	309395841	497791367	1798623923	1246885298	4477272244	116559651	110368718

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	16,677	314,626	199,870	69,135	6,075	514	924	3,400	1,020	1,029	3,442	1,216	2,804	432	97
2011	19,456	419,105	266,264	85,895	11,064	685	1,231	6,192	1,857	2,057	6,883	2,432	5,608	863	195
2010	15,634	419,105	264,544	80,075	10,061	685	1,223	5,631	1,689	1,925	6,499	2,275	5,246	807	195
2009	12,623	418,512	261,448	74,489	9,155	684	1,208	5,124	1,537	1,800	6,023	2,128	4,907	753	195
2008	10,191	417,324	256,288	69,484	8,334	682	1,185	4,665	1,399	1,684	5,635	1,991	4,591	704	195
2007	8,107	414,356	246,720	64,712	7,573	677	1,150	4,239	1,271	1,574	5,266	1,861	4,291	658	195
2006	6,485	409,013	238,399	60,269	6,897	668	1,102	3,860	1,158	1,472	4,926	1,740	4,014	615	195
2005	5,211	401,296	225,671	56,099	6,269	656	1,043	3,509	1,052	1,376	4,604	1,627	3,752	573	195
2004	4,169	388,830	209,846	52,258	5,701	635	970	3,191	957	1,289	4,311	1,523	3,513	536	195
2003	3,358	372,208	191,614	48,767	5,194	608	886	2,907	872	1,204	4,028	1,423	3,262	501	194
2002	2,664	349,056	171,317	45,391	4,723	570	792	2,643	793	1,128	3,772	1,333	3,074	468	194
2001	11,234	319,968	149,989	42,249	4,300	523	699	2,407	722	1,054	3,527	1,246	2,874	437	192
2000	0	271,884	127,972	39,339	3,913	444	591	2,190	657	986	3,300	1,166	2,689	408	188
1999	0	215,489	106,299	36,662	3,551	352	491	1,987	596	921	3,082	1,089	2,511	381	180
1998	0	170,966	85,659	34,218	3,237	279	396	1,812	543	862	2,884	1,019	2,360	357	162
1997	0	135,348	67,062	31,890	2,947	221	310	1,649	495	805	2,695	952	2,196	333	129
1996	0	107,448	60,570	29,679	2,681	176	234	1,501	450	755	2,524	892	2,057	311	80
1995	0	85,483	36,909	27,594	2,440	140	170	1,366	409	707	2,364	835	1,926	291	39
1994	0	67,674	29,241	25,722	2,222	111	135	1,244	373	661	2,212	782	1,803	271	31
1993	0	53,427	27,865	23,976	2,017	87	129	1,129	339	619	2,071	732	1,697	263	25
1992	0	42,742	26,833	22,347	1,836	70	124	1,026	308	577	1,929	681	1,572	237	21
1991	0	33,837	25,801	20,834	1,667	56	119	933	280	540	1,806	638	1,471	222	17
1990	0	26,714	24,769	19,437	1,522	44	114	852	255	506	1,692	598	1,379	206	14
1989	0	21,371	23,737	18,040	1,377	35	110	771	231	472	1,579	558	1,287	194	12
1988 & Earlier	0	60,551	123,500	85,313	6,027	99	571	3,373	1,012	2,258	7,554	2,669	6,165	918	36
Total	115,810	5,936,335	3,440,105	1,163,884	120,765	9,702	15,900	67,802	20,271	28,260	94,547	33,403	77,038	11,726	3,168

2009 Vehicle Population Estimates – Wisconsin

2002 Vehicle VMT by Vehicle Types: **WISCONSIN**

	Wisconsin
HDDV	4049673094
HDGV	700250490
LDDT	102541587
LDDV	45730919
LDGT1	19308957242
LDGT2	6409920987
LDGV	27980720368
MC	148676334
Total	58744471000

Growth Rates: 2% per year

2009 Vehicle VMT by Vehicle Types

	Wisconsin		
HDDV	4651801441	4651801441	100%
HDGV	804367702	804367702	100%
LDDT	117788051	117788051	100%
LDDV	52530451	52530451	100%
LDGT1	22177625070	22177625070	100%
LDGT2	7362984345	7362984345	100%
LDGV	32141052457	32141052457	100%
MC	170782373	170782373	100%
Total	67478931891	67478931891	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	331116056	2415543587	2009063499	764833490	63207698	3947698	12954623	44880760	16242445	15291413	68094728	51936590	169405881	2096265	2136626
2008	361270006	3058852213	2523788673	884940695	108203088	4999304	15951877	74785960	26176584	26840567	123437910	92559263	307120445	4172530	4137026
2007	270113082	2908002933	2360724141	768297469	92503858	4752760	13923634	62230434	21066443	25090723	104658389	77154849	260423521	3900409	4005151
2006	201181680	2760575390	2192769964	655555188	79130581	4511808	12400455	51817323	16964265	21979374	88730623	64310862	220812890	3639626	3877439
2005	149824724	2616933339	2016428473	578170888	67713186	4277044	10953706	43159988	13666102	19256864	75246827	53618847	187276734	3401519	3753889
2004	108717404	2470090249	1832366878	501479009	57843018	4037047	9579310	35885736	10990294	16855586	63740186	44652529	158651239	3180420	3634218
2003	78604834	2317982195	1641162455	435093110	49619654	3788446	8274439	29803894	8857405	14765036	54036221	37218554	134517441	2970660	3518331
2002	56461064	2162042793	1448705428	377040293	42313367	3533583	7056041	24871748	7124576	12925251	45781928	31000578	113978353	2772236	3406133
2001	39788724	1991586366	1253315465	327077657	36174589	3254961	5914194	20698551	5733856	11334062	38854141	25866770	96741371	2590824	3297530
2000	27718034	1812326203	1062224871	284256844	30981137	2962016	4866546	17253033	4622886	9916195	32801075	21532916	81923335	2420748	3187229
1999	18545974	1615660368	879311235	246385175	26483997	2640591	3921001	14355052	3720171	8698139	27929625	17971904	69563364	2262010	3075636
1998	63765754	1408033602	710989200	213573235	22668687	2301251	3093332	11959245	2997552	7615059	23665407	14971282	59940059	2114611	2958044
1997	0	1137356877	558656061	185194580	19394169	1859885	2378404	9959569	2414089	6872719	20069179	12482726	49990161	1972881	2807066
1996	0	856947123	426118993	160727674	16544283	1400571	1780315	8269952	1936664	5836855	16992591	10389999	42327580	1842469	2594272
1995	0	646350715	314361495	139701687	14175907	1056378	1292843	6897886	1564019	5114160	14408462	8862264	35897081	1723436	2259530
1994	0	486466040	224873910	121250356	12132867	795066	912361	5746656	1260127	4475601	12204172	7212636	30405743	1610062	1738006
1993	0	367152354	154084770	105084659	10378400	600064	619705	4783985	1014522	3926492	10362730	6021398	25821222	1502338	1052660
1992	0	277681421	101647420	90957414	8876703	453802	406464	3983050	816970	3443166	8794718	5023888	21915892	1405961	485482
1991	0	208977854	72953572	78887173	7601909	341548	291029	3320185	658542	3018242	7463322	4190266	18594868	1309586	384563
1990	0	156839307	52595713	68565116	6488670	266334	249895	2757002	529037	2645358	6328600	3494696	15774856	1224547	304800
1989	0	119287009	54079453	59512872	5549358	194959	216859	2296463	426068	2307705	5343436	2900700	13320036	1145176	240281
1988	0	89766042	46516844	51669212	4739147	146711	187676	1907534	342333	2023941	4534777	2420124	11304673	1071479	190320
1987	0	67374051	39843649	44699323	4066135	110114	162562	1593761	276662	1775907	3851470	2021171	9603803	997779	150134
1986	0	51236191	33985760	38809646	3457831	83739	140381	1319404	221539	1561720	3256906	1690286	8121481	935416	122224
1985 & Earlier	0	138029228	157276348	170921981	14228463	225591	656205	5284716	858037	6952954	14123770	7162981	35222181	4438982	384586
Total	170782373	32141052457	22177625070	7362984345	804367702	52530451	117788051	489919787	150483156	242114489	874810094	606456876	2177644200	56891984	53680854

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	6,920	162,008	103,050	35,855	3,164	265	479	1,654	496	500	1,674	591	1,364	210	47
2008	8,073	215,807	137,282	44,548	5,762	353	638	3,012	903	1,001	3,348	1,183	2,728	420	95
2007	6,487	215,807	136,395	41,530	5,240	353	634	2,739	821	936	3,132	1,106	2,552	392	95
2006	5,236	215,502	134,799	38,632	4,768	352	626	2,492	747	876	2,929	1,035	2,387	366	95
2005	4,229	214,890	132,138	36,037	4,340	351	614	2,269	680	819	2,741	968	2,233	342	95
2004	3,364	213,362	126,236	33,562	3,944	349	596	2,062	618	766	2,561	905	2,087	320	95
2003	2,691	210,611	122,915	31,268	3,592	344	571	1,877	563	716	2,396	848	1,952	299	95
2002	2,162	206,637	116,353	29,095	3,265	338	541	1,706	512	669	2,239	791	1,825	279	95
2001	1,730	200,216	106,194	27,103	2,969	327	503	1,552	465	627	2,097	741	1,709	261	95
2000	1,394	191,659	98,793	25,282	2,705	313	459	1,414	424	586	1,959	692	1,596	244	94
1999	1,105	179,737	88,329	23,541	2,460	294	410	1,286	386	548	1,835	648	1,495	228	94
1998	4,661	164,759	77,332	21,912	2,239	269	359	1,171	351	513	1,715	606	1,398	213	94
1997	0	140,000	65,980	20,403	2,038	229	307	1,065	319	480	1,605	567	1,309	198	92
1996	0	110,960	54,606	19,014	1,849	181	265	967	290	448	1,499	530	1,222	185	88
1995	0	88,035	44,164	17,747	1,686	144	205	881	264	419	1,403	496	1,143	173	79
1994	0	69,694	34,587	15,539	1,535	114	161	802	241	392	1,311	463	1,069	162	63
1993	0	55,327	26,073	15,393	1,396	90	121	730	219	367	1,226	434	1,000	151	39
1992	0	44,017	18,978	14,306	1,271	72	88	664	199	344	1,150	406	937	141	19
1991	0	34,847	15,076	13,349	1,157	57	70	605	181	322	1,076	380	877	132	15
1990	0	27,511	14,367	12,436	1,050	45	67	549	165	301	1,007	366	821	123	12
1989	0	22,009	13,835	11,580	956	36	64	500	150	280	936	331	764	115	10
1988	0	17,424	13,303	10,805	868	28	62	454	136	263	876	310	716	106	8
1987	0	13,755	12,770	10,081	793	22	59	414	124	246	823	291	671	100	7
1986	0	11,004	12,238	9,356	717	18	57	375	112	230	768	271	626	94	6
1985 & Earlier	0	31,179	63,675	44,246	3,139	51	296	1,841	492	1,098	3,674	1,298	2,994	447	18
Total	48,054	3,056,760	1,773,687	603,628	62,903	4,996	8,240	32,880	9,880	13,745	45,985	16,247	37,469	5,704	1,541

2012 Vehicle Population Estimates – Wisconsin

2002 Vehicle VMT by Vehicle Types: WISCONSIN

	Wisconsin
HDDV	4049673094
HDGV	700250490
LDDT	1025415971
LDDV	45730919
LDGT1	19306957242
LDGT2	6409920967
LDGV	27980720368
MC	148676394
Total	58744471000

Growth Rates: 2% per year

2012 Vehicle VMT by Vehicle Types

	Wisconsin		
HDDV	4936528904	4936528904	100%
HDGV	853601440	853601440	100%
LDDT	124997623	124997623	100%
LDDV	55745735	55745735	100%
LDGT1	23535073145	23535073145	100%
LDGT2	7813657891	7813657891	100%
LDGV	34108341996	34108341996	100%
MC	181236621	181236621	100%
Total	71609182354	71609182354	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	35145146	2563394178	2132034259	811647419	67076515	4189541	13747550	47627822	17238612	16227370	72262670	55114464	179774876	2213961	2267405
2011	38338268	3246078440	2678264730	939106145	114826983	5306301	16503777	79363459	27778780	30393599	130993298	98224530	325918673	4427922	4390245
2010	28666499	3085999977	2505219344	815329420	98165834	5043667	14775872	66039434	22355878	26526476	111064319	81877344	276363523	4139145	4250288
2009	21416854	2929544689	2326985028	706292489	83974005	4787967	13159462	54988958	18002803	23324687	94161647	68246989	234328405	3862400	4114769
2008	15899519	2777110595	2139850027	613559571	71857775	4538833	11624180	45801725	14502576	20437661	79852535	56900749	196739568	3609719	3983557
2007	11537177	2621279533	1944521116	532173537	61363473	4284147	10165641	38092230	11662987	17887283	67641595	47385621	168381957	3376087	3856881
2006	8341608	2459661249	1741614727	461724289	52550653	4020329	8760800	31734251	9399549	15668774	57345792	39496628	142750984	3152468	3733681
2005	5991693	2294377113	1537377790	400118175	44903284	3749867	7490049	26394098	7560667	13716380	48594148	32896061	120954740	2941921	3614616
2004	4222411	2113466160	1330028309	347097426	38388764	3454191	6276190	21963345	6084814	12027797	41232325	27450023	102852717	2749409	3499366
2003	2941460	1923255066	1127241531	301655637	32877431	3143315	5164418	18309057	4905843	10523145	34914884	22850902	86937699	2568917	3382312
2002	1968113	1714551709	933132117	261466919	28105029	2802216	4160898	15233696	3947875	9230534	29698141	19071929	73810596	2400463	3263783
2001	6766873	1494216522	754507426	226645626	24054070	2442106	3282669	12691247	3181026	8081161	25113919	15887645	62547661	2244042	3139100
2000	0	1206972217	592850281	196529969	20581247	1972642	2523881	10669175	2561851	7081142	21297573	13246768	53049959	2093637	2978881
1999	0	909399143	452200684	170565493	17566925	1486297	1889284	8776033	2057325	6194118	18032674	11025960	44916386	1955265	2753063
1998	0	685912549	333602934	148252548	15043586	1121037	1371976	7320092	1659749	5427188	15290375	9192464	38094269	1828924	2397831
1997	0	516240592	238425750	126671847	12875495	843729	968205	6088397	1337296	4749543	12951165	7654107	32266818	1708600	1844386
1996	0	389625016	163494766	111516681	11013641	636792	657636	5076803	1076619	4166825	10997012	6389956	27401686	1594293	1117081
1995	0	294656521	107869056	96524736	9420028	481579	431342	4226845	866975	3653916	9333025	5331390	23257320	1492017	515198
1994	0	221768971	77418915	83821620	8067207	362453	308836	3523407	698850	3202983	7916953	4446744	19733023	1389742	408090
1993	0	166439128	56427072	72761850	6882644	272024	265191	2925753	561418	2807275	6715856	3709599	16740403	1299499	323244
1992	0	126668328	57389548	63155636	5889023	206992	230132	2437025	452147	2448955	5670497	3078246	14136329	1215272	254988
1991	0	95260442	49386169	54831781	5026037	155591	199376	2024290	363286	2147185	4812342	2568255	11998610	1137062	201970
1990	0	71497882	42282399	47647096	4313964	116854	172512	1691312	293596	1884606	4087211	2144883	10191633	1058851	159323
1989	0	54372256	36085960	41185107	3669478	88865	148873	1400162	235099	1646698	3456255	1783132	8618581	992673	129705
1988 & Earlier	0	145477721	166902919	181383774	15099359	239399	698493	5808183	910555	7378530	14998258	7601413	37378060	4710684	386901
Total	181236621	34108341996	23535073145	7813657891	853601440	55745735	124997623	519906797	159693930	256933833	928355470	643576889	2310933446	60161987	58966552

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	7,343	171,824	109,356	38,050	3,358	281	508	1,755	526	531	1,776	628	1,447	223	50
2011	6,567	229,016	145,685	47,274	6,115	374	677	3,196	958	1,062	3,553	1,255	2,895	446	100
2010	6,884	229,016	144,743	44,072	5,561	374	672	2,907	872	993	3,323	1,174	2,708	416	100
2009	5,558	228,692	143,049	40,997	5,060	374	666	2,645	793	929	3,109	1,098	2,533	389	100
2008	4,488	228,043	140,226	38,242	4,606	373	651	2,408	722	869	2,908	1,028	2,370	363	100
2007	3,570	226,421	136,095	35,616	4,185	370	632	2,188	658	812	2,718	960	2,215	340	100
2006	2,856	223,502	130,438	33,182	3,812	365	606	1,992	597	760	2,542	899	2,072	317	100
2005	2,295	219,285	123,474	30,876	3,464	358	574	1,811	543	710	2,377	840	1,936	296	100
2004	1,836	212,473	114,816	28,762	3,151	347	533	1,647	494	665	2,225	786	1,813	277	100
2003	1,479	203,390	104,840	26,840	2,870	332	487	1,500	450	621	2,079	734	1,694	258	100
2002	1,173	190,739	93,735	24,982	2,610	312	435	1,364	409	582	1,947	688	1,587	242	100
2001	4,947	174,844	82,065	23,253	2,376	286	381	1,242	372	544	1,820	643	1,483	226	99
2000	0	148,569	70,019	21,651	2,163	243	326	1,131	339	509	1,703	602	1,388	211	97
1999	0	117,762	58,161	20,178	1,863	192	270	1,026	308	476	1,591	562	1,296	197	93
1998	0	93,423	46,866	18,833	1,789	153	218	935	280	445	1,489	526	1,213	184	84
1997	0	73,960	36,703	17,552	1,629	121	171	851	255	416	1,391	491	1,133	172	66
1996	0	58,714	27,669	16,335	1,482	96	129	776	232	389	1,303	460	1,062	160	42
1995	0	46,712	20,140	15,182	1,348	76	94	705	211	365	1,220	431	994	150	20
1994	0	36,980	15,999	14,157	1,228	60	74	642	193	341	1,142	403	930	140	16
1993	0	29,195	15,246	13,196	1,115	48	71	583	175	319	1,069	376	871	131	13
1992	0	23,356	14,681	12,299	1,015	38	68	530	159	298	996	352	811	122	11
1991	0	18,490	14,117	11,466	921	30	66	482	144	279	932	329	759	114	9
1990	0	14,697	13,552	10,696	841	24	63	440	132	261	874	309	712	107	7
1989	0	11,678	12,987	9,929	761	19	60	398	119	244	815	288	664	100	6
1988 & Earlier	0	33,087	67,572	46,954	3,331	54	314	1,741	522	1,165	3,899	1,376	3,177	474	19
Total	50,995	3,243,858	1,882,229	640,575	66,753	5,302	8,745	34,892	10,463	14,586	48,800	17,241	39,763	6,053	1,635

2009 Non-Road Emissions Inventories

LADCO All State 2009 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	29.55	280.69	260.50	26.04
Airport Ground Support Equipment	0.31	3.66	3.59	0.24
Commercial Equipment	48.15	2,157.75	57.39	4.90
Construction and Mining Equipment	40.39	664.85	291.17	22.41
Industrial Equipment	28.07	646.27	137.78	5.85
Lawn and Garden Equipment	188.60	4,908.24	49.85	10.46
Logging Equipment	1.30	15.00	2.10	0.26
Pleasure Craft	252.40	1,003.42	65.78	15.05
Railroad Equipment	0.30	4.08	1.39	0.18
Recreational Equipment	456.48	1,662.90	12.39	13.40
Underground Mining Equipment	0.13	0.56	0.65	0.08
Grand Total	**1,045.70**	**11,347.41**	**882.59**	**98.89**

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	24.97	4.58	0.00
	Airport Ground Support Equipment	0.00	0.25	0.05	0.01
	Commercial Equipment	0.02	5.16	41.79	1.18
	Construction and Mining Equipment	0.00	23.68	16.49	0.22
	Industrial Equipment	0.08	5.41	3.36	19.21
	Lawn and Garden Equipment	0.00	1.58	186.93	0.10
	Logging Equipment	0.00	0.15	1.15	0.00
	Pleasure Craft	0.00	0.83	251.58	0.00
	Railroad Equipment	0.00	0.25	0.05	0.00
	Recreational Equipment	0.00	0.23	456.23	0.01
	Underground Mining Equipment	0.00	0.13	0.00	0.00
VOC Total		**0.10**	**62.65**	**962.19**	**20.75**
CO	Agricultural Equipment	0.08	128.37	152.17	0.07
	Airport Ground Support Equipment	0.00	1.53	1.82	0.31
	Commercial Equipment	5.11	21.32	2,111.04	20.28
	Construction and Mining Equipment	0.01	134.44	524.58	5.82
	Industrial Equipment	32.95	31.38	132.57	449.36
	Lawn and Garden Equipment	0.00	6.51	4,899.31	2.43
	Logging Equipment	0.00	0.79	14.21	0.00
	Pleasure Craft	0.00	3.79	999.63	0.00
	Railroad Equipment	0.00	1.06	3.00	0.01
	Recreational Equipment	0.00	0.95	1,661.72	0.24
	Underground Mining Equipment	0.00	0.56	0.00	0.00
CO Total		**38.16**	**330.69**	**10,500.05**	**478.52**

NOX	Agricultural Equipment	0.01	257.76	2.72	0.01
	Airport Ground Support Equipment	0.00	3.50	0.05	0.04
	Commercial Equipment	1.43	34.10	16.45	5.41
	Construction and Mining Equipment	0.00	284.96	5.36	0.84
	Industrial Equipment	5.13	60.08	3.45	69.12
	Lawn and Garden Equipment	0.00	13.69	35.81	0.35
	Logging Equipment	0.00	2.00	0.09	0.00
	Pleasure Craft	0.00	22.53	43.26	0.00
	Railroad Equipment	0.00	1.37	0.02	0.00
	Recreational Equipment	0.00	0.73	11.60	0.05
	Underground Mining Equipment	0.00	0.65	0.00	0.00
NOX Total		**6.57**	**681.36**	**118.82**	**75.84**
PM10	Agricultural Equipment	0.00	25.98	0.07	0.00
	Airport Ground Support Equipment	0.00	0.24	0.00	0.00
	Commercial Equipment	0.02	3.83	1.00	0.04
	Construction and Mining Equipment	0.00	20.91	1.49	0.02
	Industrial Equipment	0.06	4.88	0.05	0.86
	Lawn and Garden Equipment	0.00	1.20	9.26	0.00
	Logging Equipment	0.00	0.14	0.12	0.00
	Pleasure Craft	0.00	0.43	14.62	0.00
	Railroad Equipment	0.00	0.18	0.00	0.00
	Recreational Equipment	0.00	0.15	13.26	0.00
	Underground Mining Equipment	0.00	0.08	0.00	0.00
PM10 Total		**0.09**	**58.01**	**39.86**	**0.92**

LADCO All States 2012 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	25.0	262.3	234.2	21.8
Airport Ground Support Equipment	0.3	3.1	3.1	0.2
Commercial Equipment	49.0	2,319.6	55.7	4.6
Construction and Mining Equipment	36.2	628.1	240.7	19.5
Industrial Equipment	14.7	388.2	88.2	5.3
Lawn and Garden Equipment	180.8	5,093.5	48.9	10.6
Logging Equipment	1.3	16.2	1.5	0.2
Pleasure Craft	225.9	980.6	68.7	14.6
Railroad Equipment	0.3	4.1	1.3	0.2
Recreational Equipment	406.5	1,662.7	14.9	12.2
Underground Mining Equipment	0.1	0.5	0.6	0.1
Grand Total	**939.9**	**11,358.9**	**757.8**	**89.5**

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	20.80	4.24	0.00
	Airport Ground Support Equipment	0.00	0.22	0.04	0.00
	Commercial Equipment	0.02	4.59	43.41	0.95
	Construction and Mining Equipment	0.00	20.19	15.92	0.11
	Industrial Equipment	0.04	4.42	2.03	8.17
	Lawn and Garden Equipment	0.00	1.42	179.31	0.04
	Logging Equipment	0.00	0.11	1.22	0.00
	Pleasure Craft	0.00	0.80	225.05	0.00
	Railroad Equipment	0.00	0.22	0.05	0.00
	Recreational Equipment	0.00	0.22	406.22	0.01
	Underground Mining Equipment	0.00	0.12	0.00	0.00
VOC Total		**0.05**	**53.12**	**877.49**	**9.29**
CO	Agricultural Equipment	0.00	108.92	153.34	0.05
	Airport Ground Support Equipment	0.00	1.37	1.60	0.15
	Commercial Equipment	5.02	20.23	2,276.78	17.62
	Construction and Mining Equipment	0.01	113.66	511.35	3.08
	Industrial Equipment	18.46	29.41	90.86	249.45
	Lawn and Garden Equipment	0.00	6.28	5,085.95	1.23
	Logging Equipment	0.00	0.61	15.63	0.00
	Pleasure Craft	0.00	3.93	976.69	0.00
	Railroad Equipment	0.00	0.96	3.09	0.01
	Recreational Equipment	0.00	0.91	1,661.58	0.22
	Underground Mining Equipment	0.00	0.50	0.00	0.00
CO Total		**23.49**	**286.78**	**10,776.87**	**271.79**

NOX	Agricultural Equipment	0.00	231.78	2.41	0.01
	Airport Ground Support Equipment	0.00	3.05	0.03	0.02
	Commercial Equipment	1.33	33.26	16.69	4.43
	Construction and Mining Equipment	0.00	235.89	4.27	0.50
	Industrial Equipment	2.46	51.49	1.70	32.59
	Lawn and Garden Equipment	0.00	13.71	34.98	0.17
	Logging Equipment	0.00	1.45	0.09	0.00
	Pleasure Craft	0.00	22.35	46.32	0.00
	Railroad Equipment	0.00	1.29	0.02	0.00
	Recreational Equipment	0.00	0.74	14.09	0.05
	Underground Mining Equipment	0.00	0.60	0.00	0.00
NOX Total		**3.80**	**595.61**	**120.61**	**37.77**
PM10	Agricultural Equipment	0.00	21.71	0.07	0.00
	Airport Ground Support Equipment	0.00	0.21	0.00	0.00
	Commercial Equipment	0.03	3.50	1.08	0.05
	Construction and Mining Equipment	0.00	18.02	1.49	0.02
	Industrial Equipment	0.07	4.32	0.04	0.92
	Lawn and Garden Equipment	0.00	1.09	9.53	0.01
	Logging Equipment	0.00	0.12	0.13	0.00
	Pleasure Craft	0.00	0.38	14.26	0.00
	Railroad Equipment	0.00	0.16	0.00	0.00
	Recreational Equipment	0.00	0.14	12.09	0.00
	Underground Mining Equipment	0.00	0.07	0.00	0.00
PM10 Total		**0.09**	**49.72**	**38.68**	**0.99**

Illinois 2009 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	10.93	100.26	96.76	9.67
Airport Ground Support Equipment	0.15	1.75	1.76	0.12
Commercial Equipment	14.24	622.27	17.97	1.50
Construction and Mining Equipment	11.98	200.98	81.36	6.42
Industrial Equipment	6.53	147.87	32.68	1.41
Lawn and Garden Equipment	48.16	1,199.64	13.87	2.79
Logging Equipment	0.00	0.03	0.00	0.00
Pleasure Craft	31.45	112.99	11.00	2.01
Railroad Equipment	0.08	1.05	0.38	0.05
Recreational Equipment	55.71	197.67	1.96	1.72
Underground Mining Equipment	0.04	0.17	0.20	0.02
Grand Total	179.28	2,584.68	257.95	25.71

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	9.27	1.66	0.00
	Airport Ground Support Equipment	0.00	0.12	0.02	0.01
	Commercial Equipment	0.01	1.58	12.29	0.36
	Construction and Mining Equipment	0.00	6.78	5.14	0.06
	Industrial Equipment	0.02	1.31	0.74	4.46
	Lawn and Garden Equipment	0.00	0.42	47.71	0.03
	Logging Equipment	0.00	0.00	0.00	0.00
	Pleasure Craft	0.00	0.18	31.26	0.00
	Railroad Equipment	0.00	0.07	0.01	0.00
	Recreational Equipment	0.00	0.03	55.68	0.00
	Underground Mining Equipment	0.00	0.04	0.00	0.00
VOC Total		0.02	19.81	154.52	4.91
CO	Agricultural Equipment	0.03	47.65	52.56	0.03
	Airport Ground Support Equipment	0.00	0.75	0.86	0.15
	Commercial Equipment	1.57	6.54	607.95	6.22
	Construction and Mining Equipment	0.00	38.09	161.33	1.55
	Industrial Equipment	7.64	7.62	28.34	104.27
	Lawn and Garden Equipment	0.00	1.74	1,197.26	0.65
	Logging Equipment	0.00	0.00	0.02	0.00
	Pleasure Craft	0.00	0.85	112.15	0.00
	Railroad Equipment	0.00	0.29	0.76	0.00

	Recreational Equipment	0.00	0.13	197.50	0.03
	Underground Mining Equipment	0.00	0.17	0.00	0.00
CO Total		9.24	103.81	2,358.72	112.90
NOX	Agricultural Equipment	0.00	95.67	1.09	0.00
	Airport Ground Support Equipment	0.00	1.71	0.03	0.02
	Commercial Equipment	0.44	10.45	5.42	1.66
	Construction and Mining Equipment	0.00	79.27	1.87	0.22
	Industrial Equipment	1.19	14.59	0.87	16.04
	Lawn and Garden Equipment	0.00	3.65	10.13	0.09
	Logging Equipment	0.00	0.00	0.00	0.00
	Pleasure Craft	0.00	5.05	5.95	0.00
	Railroad Equipment	0.00	0.37	0.01	0.00
	Recreational Equipment	0.00	0.10	1.85	0.01
	Underground Mining Equipment	0.00	0.20	0.00	0.00
NOX Total		1.63	211.07	27.20	18.05
PM10	Agricultural Equipment	0.00	9.64	0.02	0.00
	Airport Ground Support Equipment	0.00	0.12	0.00	0.00
	Commercial Equipment	0.01	1.18	0.31	0.01
	Construction and Mining Equipment	0.00	5.95	0.47	0.00
	Industrial Equipment	0.01	1.18	0.01	0.20
	Lawn and Garden Equipment	0.00	0.32	2.46	0.00
	Logging Equipment	0.00	0.00	0.00	0.00
	Pleasure Craft	0.00	0.10	1.91	0.00
	Railroad Equipment	0.00	0.05	0.00	0.00
	Recreational Equipment	0.00	0.02	1.70	0.00
	Underground Mining Equipment	0.00	0.02	0.00	0.00
PM10 Total		0.02	18.58	6.89	0.22

Illinois 2012 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	9.26	93.41	86.99	8.08
Airport Ground Support Equipment	0.13	1.49	1.52	0.10
Commercial Equipment	14.47	668.82	17.46	1.42
Construction and Mining Equipment	10.77	190.75	67.68	5.63
Industrial Equipment	3.42	88.65	21.10	1.28
Lawn and Garden Equipment	46.60	1,251.78	13.65	2.84
Logging Equipment	0.00	0.03	0.00	0.00
Pleasure Craft	28.29	110.96	11.41	1.97
Railroad Equipment	0.07	1.04	0.36	0.04
Recreational Equipment	49.44	200.90	2.31	1.56
Underground Mining Equipment	0.04	0.15	0.19	0.02
Grand Total	162.49	2,608.00	222.66	22.96

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	7.72	1.54	0.00
	Airport Ground Support Equipment	0.00	0.11	0.02	0.00
	Commercial Equipment	0.00	1.41	12.77	0.29
	Construction and Mining Equipment	0.00	5.77	4.97	0.03
	Industrial Equipment	0.01	1.07	0.45	1.89
	Lawn and Garden Equipment	0.00	0.38	46.22	0.01
	Logging Equipment	0.00	0.00	0.00	0.00
	Pleasure Craft	0.00	0.18	28.11	0.00
	Railroad Equipment	0.00	0.06	0.01	0.00
	Recreational Equipment	0.00	0.03	49.40	0.00
	Underground Mining Equipment	0.00	0.04	0.00	0.00
VOC Total		0.01	16.77	143.48	2.23
CO	Agricultural Equipment	0.00	40.42	52.97	0.02
	Airport Ground Support Equipment	0.00	0.67	0.75	0.08
	Commercial Equipment	1.54	6.20	655.68	5.40
	Construction and Mining Equipment	0.00	32.47	157.48	0.80
	Industrial Equipment	4.28	7.19	19.30	57.88
	Lawn and Garden Equipment	0.00	1.67	1,249.77	0.33
	Logging Equipment	0.00	0.00	0.03	0.00
	Pleasure Craft	0.00	0.88	110.08	0.00
	Railroad Equipment	0.00	0.26	0.78	0.00
	Recreational Equipment	0.00	0.13	200.74	0.03
	Underground Mining Equipment	0.00	0.15	0.00	0.00
CO Total		5.82	90.05	2,447.59	64.54

NOX	Agricultural Equipment	0.00	86.02	0.96	0.00
	Airport Ground Support Equipment	0.00	1.49	0.02	0.01
	Commercial Equipment	0.41	10.20	5.49	1.36
	Construction and Mining Equipment	0.00	66.05	1.50	0.13
	Industrial Equipment	0.57	12.54	0.43	7.56
	Lawn and Garden Equipment	0.00	3.66	9.95	0.05
	Logging Equipment	0.00	0.00	0.00	0.00
	Pleasure Craft	0.00	5.01	6.40	0.00
	Railroad Equipment	0.00	0.35	0.01	0.00
	Recreational Equipment	0.00	0.10	2.20	0.01
	Underground Mining Equipment	0.00	0.19	0.00	0.00
NOX Total		0.98	185.62	26.95	9.12
PM10	Agricultural Equipment	0.00	8.06	0.03	0.00
	Airport Ground Support Equipment	0.00	0.10	0.00	0.00
	Commercial Equipment	0.01	1.07	0.33	0.01
	Construction and Mining Equipment	0.00	5.16	0.47	0.00
	Industrial Equipment	0.02	1.04	0.01	0.21
	Lawn and Garden Equipment	0.00	0.29	2.55	0.00
	Logging Equipment	0.00	0.00	0.00	0.00
	Pleasure Craft	0.00	0.09	1.88	0.00
	Railroad Equipment	0.00	0.04	0.00	0.00
	Recreational Equipment	0.00	0.02	1.54	0.00
	Underground Mining Equipment	0.00	0.02	0.00	0.00
PM10 Total		0.02	15.90	6.80	0.23

Indiana 2009 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	5.90	55.46	52.34	5.23
Airport Ground Support Equipment	0.04	0.44	0.43	0.03
Commercial Equipment	6.10	269.22	7.55	0.64
Construction and Mining Equipment	5.21	76.54	41.90	3.12
Industrial Equipment	4.30	97.72	21.03	0.88
Lawn and Garden Equipment	25.67	650.83	7.14	1.46
Logging Equipment	0.04	0.45	0.07	0.01
Pleasure Craft	22.49	88.32	9.36	1.39
Railroad Equipment	0.04	0.53	0.19	0.02
Recreational Equipment	32.97	150.73	1.39	1.09
Underground Mining Equipment	0.04	0.17	0.19	0.02
Grand Total	102.81	1,390.41	141.61	13.89

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	5.02	0.89	0.00
	Airport Ground Support Equipment		0.03	0.01	0.00
	Commercial Equipment	0.00	0.67	5.27	0.15
	Construction and Mining Equipment	0.00	3.32	1.86	0.03
	Industrial Equipment	0.01	0.81	0.48	3.00
	Lawn and Garden Equipment		0.22	25.44	0.01
	Logging Equipment		0.01	0.04	
	Pleasure Craft		0.16	22.33	
	Railroad Equipment		0.03	0.01	0.00
	Recreational Equipment		0.03	32.95	0.00
	Underground Mining Equipment		0.04		
VOC Total		0.02	10.33	89.26	3.20
CO	Agricultural Equipment	0.02	25.78	29.65	0.01
	Airport Ground Support Equipment		0.18	0.21	0.04
	Commercial Equipment	0.66	2.77	263.15	2.64
	Construction and Mining Equipment	0.00	19.02	56.75	0.78
	Industrial Equipment	5.11	4.68	17.79	70.14
	Lawn and Garden Equipment		0.89	649.60	0.33
	Logging Equipment		0.03	0.43	
	Pleasure Craft		0.76	87.57	
	Railroad Equipment		0.14	0.38	0.00
	Recreational Equipment		0.11	150.59	0.03
	Underground Mining Equipment		0.17		
CO Total		5.80	54.52	1,256.12	73.97

NOX	Agricultural Equipment	0.00	51.77	0.56	0.00
	Airport Ground Support Equipment		0.42	0.01	0.01
	Commercial Equipment	0.19	4.43	2.23	0.70
	Construction and Mining Equipment	0.00	41.16	0.62	0.12
	Industrial Equipment	0.80	8.90	0.55	10.79
	Lawn and Garden Equipment		1.87	5.22	0.05
	Logging Equipment		0.07	0.00	
	Pleasure Craft		4.51	4.85	
	Railroad Equipment		0.18	0.00	0.00
	Recreational Equipment		0.08	1.30	0.01
	Underground Mining Equipment		0.19		
NOX Total		0.98	113.60	15.35	11.67
PM10	Agricultural Equipment	0.00	5.22	0.01	0.00
	Airport Ground Support Equipment		0.03	0.00	0.00
	Commercial Equipment	0.00	0.50	0.13	0.01
	Construction and Mining Equipment	0.00	2.94	0.17	0.00
	Industrial Equipment	0.01	0.73	0.01	0.13
	Lawn and Garden Equipment		0.16	1.29	0.00
	Logging Equipment		0.00	0.00	
	Pleasure Craft		0.09	1.30	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.02	1.08	0.00
	Underground Mining Equipment		0.02		
PM10 Total		0.01	9.74	4.00	0.14

Indiana 2012 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	5.00	51.77	47.06	4.37
Airport Ground Support Equipment	0.03	0.37	0.38	0.03
Commercial Equipment	6.19	289.38	7.33	0.60
Construction and Mining Equipment	4.66	71.86	34.58	2.71
Industrial Equipment	2.22	57.74	13.34	0.81
Lawn and Garden Equipment	24.73	678.23	7.02	1.48
Logging Equipment	0.04	0.49	0.05	0.01
Pleasure Craft	20.18	86.03	9.67	1.35
Railroad Equipment	0.04	0.52	0.18	0.02
Recreational Equipment	28.97	155.30	1.53	0.97
Underground Mining Equipment	0.04	0.15	0.18	0.02
Grand Total	92.11	1,391.84	121.30	12.37

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	4.18	0.82	0.00
	Airport Ground Support Equipment		0.03	0.00	0.00
	Commercial Equipment	0.00	0.60	5.47	0.12
	Construction and Mining Equipment	0.00	2.84	1.80	0.02
	Industrial Equipment	0.01	0.66	0.28	1.27
	Lawn and Garden Equipment		0.19	24.53	0.01
	Logging Equipment		0.00	0.04	
	Pleasure Craft		0.16	20.02	
	Railroad Equipment		0.03	0.01	0.00
	Recreational Equipment		0.03	28.95	0.00
	Underground Mining Equipment		0.04		
VOC Total		0.01	8.75	81.93	1.42
CO	Agricultural Equipment	0.00	21.88	29.88	0.01
	Airport Ground Support Equipment		0.17	0.19	0.02
	Commercial Equipment	0.65	2.63	283.81	2.29
	Construction and Mining Equipment	0.00	16.02	55.42	0.42
	Industrial Equipment	2.86	4.36	11.59	38.94
	Lawn and Garden Equipment		0.86	677.20	0.17
	Logging Equipment		0.02	0.47	
	Pleasure Craft		0.78	85.25	
	Railroad Equipment		0.13	0.39	0.00
	Recreational Equipment		0.10	155.17	0.02
	Underground Mining Equipment		0.15		
CO Total		3.51	47.09	1,299.36	41.87

NOX	Agricultural Equipment	0.00	46.56	0.50	0.00
	Airport Ground Support Equipment		0.37	0.00	0.00
	Commercial Equipment	0.17	4.32	2.26	0.58
	Construction and Mining Equipment	0.00	34.01	0.50	0.07
	Industrial Equipment	0.38	7.61	0.27	5.09
	Lawn and Garden Equipment		1.88	5.12	0.02
	Logging Equipment		0.05	0.00	
	Pleasure Craft		4.48	5.20	
	Railroad Equipment		0.17	0.00	0.00
	Recreational Equipment		0.08	1.44	0.01
	Underground Mining Equipment		0.18		
NOX Total		0.55	99.70	15.29	5.76
PM10	Agricultural Equipment	0.00	4.36	0.01	0.00
	Airport Ground Support Equipment		0.03	0.00	0.00
	Commercial Equipment	0.00	0.45	0.14	0.01
	Construction and Mining Equipment	0.00	2.53	0.18	0.00
	Industrial Equipment	0.01	0.65	0.01	0.14
	Lawn and Garden Equipment		0.15	1.33	0.00
	Logging Equipment		0.00	0.00	
	Pleasure Craft		0.08	1.27	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.02	0.95	0.00
	Underground Mining Equipment		0.02		
PM10 Total		0.01	8.31	3.90	0.15

Michigan 2009 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	3.32	32.39	29.09	2.91
Airport Ground Support Equipment	0.07	0.83	0.78	0.05
Commercial Equipment	9.86	453.98	11.13	0.97
Construction and Mining Equipment	9.01	157.82	61.53	4.81
Industrial Equipment	6.23	142.84	30.44	1.29
Lawn and Garden Equipment	40.67	1,100.43	9.94	2.15
Logging Equipment	0.58	6.61	0.95	0.12
Pleasure Craft	100.08	428.87	20.79	5.61
Railroad Equipment	0.07	0.95	0.31	0.04
Recreational Equipment	189.09	615.59	4.30	5.34
Underground Mining Equipment	0.00	0.00	0.00	0.00
Grand Total	358.99	2,940.29	169.24	23.30

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	2.79	0.53	0.00
	Airport Ground Support Equipment		0.05	0.01	0.00
	Commercial Equipment	0.00	1.02	8.60	0.23
	Construction and Mining Equipment	0.00	5.06	3.90	0.05
	Industrial Equipment	0.02	1.20	0.75	4.27
	Lawn and Garden Equipment		0.33	40.33	0.02
	Logging Equipment		0.07	0.52	
	Pleasure Craft		0.06	100.03	
	Railroad Equipment		0.06	0.01	0.00
	Recreational Equipment		0.06	189.02	0.00
	Underground Mining Equipment		0.00		
VOC Total		0.02	10.69	343.69	4.58
CO	Agricultural Equipment	0.01	14.34	18.03	0.01
	Airport Ground Support Equipment		0.33	0.43	0.07
	Commercial Equipment	1.01	4.22	444.74	4.02
	Construction and Mining Equipment	0.00	28.65	127.75	1.40
	Industrial Equipment	7.29	6.95	28.79	99.81
	Lawn and Garden Equipment		1.34	1,098.59	0.50
	Logging Equipment		0.35	6.25	
	Pleasure Craft		0.25	428.62	
	Railroad Equipment		0.24	0.71	0.00
	Recreational Equipment		0.25	615.27	0.06
	Underground Mining Equipment		0.00		
CO Total		8.31	56.93	2,769.17	105.87

NOX	Agricultural Equipment	0.00	28.80	0.29	0.00
	Airport Ground Support Equipment		0.76	0.01	0.01
	Commercial Equipment	0.28	6.75	3.02	1.07
	Construction and Mining Equipment	0.00	60.14	1.18	0.20
	Industrial Equipment	1.13	13.25	0.70	15.35
	Lawn and Garden Equipment		2.82	7.05	0.07
	Logging Equipment		0.90	0.04	
	Pleasure Craft		1.44	19.35	
	Railroad Equipment		0.30	0.00	0.00
	Recreational Equipment		0.20	4.09	0.01
	Underground Mining Equipment		0.00		
NOX Total		1.42	115.36	35.74	16.72
PM10	Agricultural Equipment	0.00	2.90	0.01	0.00
	Airport Ground Support Equipment		0.05	0.00	0.00
	Commercial Equipment	0.00	0.76	0.20	0.01
	Construction and Mining Equipment	0.00	4.47	0.34	0.00
	Industrial Equipment	0.01	1.08	0.01	0.19
	Lawn and Garden Equipment		0.25	1.91	0.00
	Logging Equipment		0.06	0.05	
	Pleasure Craft		0.03	5.58	
	Railroad Equipment		0.04	0.00	0.00
	Recreational Equipment		0.04	5.30	0.00
	Underground Mining Equipment		0.00		
PM10 Total		0.02	9.68	13.40	0.20

Michigan 2012 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	2.81	30.34	26.15	2.43
Airport Ground Support Equipment	0.06	0.71	0.67	0.05
Commercial Equipment	10.03	488.14	10.79	0.92
Construction and Mining Equipment	8.06	149.11	50.67	4.19
Industrial Equipment	3.24	85.00	19.48	1.18
Lawn and Garden Equipment	38.47	1,132.72	9.68	2.17
Logging Equipment	0.60	7.15	0.70	0.11
Pleasure Craft	90.02	415.17	22.07	5.47
Railroad Equipment	0.06	0.94	0.29	0.04
Recreational Equipment	168.46	605.44	5.44	4.91
Underground Mining Equipment	0.00	0.00	0.00	0.00
Grand Total	321.81	2,914.72	145.95	21.47

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	2.32	0.49	0.00
	Airport Ground Support Equipment		0.05	0.01	0.00
	Commercial Equipment	0.00	0.91	8.93	0.19
	Construction and Mining Equipment	0.00	4.28	3.75	0.03
	Industrial Equipment	0.01	0.98	0.44	1.81
	Lawn and Garden Equipment		0.29	38.17	0.01
	Logging Equipment		0.05	0.55	
	Pleasure Craft		0.05	89.96	
	Railroad Equipment		0.05	0.01	0.00
	Recreational Equipment		0.06	168.39	0.00
	Underground Mining Equipment		0.00		
VOC Total		0.01	9.05	310.71	2.04
CO	Agricultural Equipment	0.00	12.17	18.17	0.01
	Airport Ground Support Equipment		0.30	0.38	0.03
	Commercial Equipment	0.99	4.01	479.65	3.49
	Construction and Mining Equipment	0.00	24.19	124.18	0.74
	Industrial Equipment	4.08	6.52	19.00	55.41
	Lawn and Garden Equipment		1.29	1,131.17	0.25
	Logging Equipment		0.28	6.87	
	Pleasure Craft		0.26	414.92	
	Railroad Equipment		0.21	0.73	0.00
	Recreational Equipment		0.24	605.13	0.06
	Underground Mining Equipment		0.00		
CO Total		5.07	49.46	2,800.20	59.98

NOX	Agricultural Equipment	0.00	25.90	0.25	0.00
	Airport Ground Support Equipment		0.66	0.01	0.00
	Commercial Equipment	0.26	6.59	3.06	0.88
	Construction and Mining Equipment	0.00	49.62	0.93	0.12
	Industrial Equipment	0.54	11.36	0.34	7.24
	Lawn and Garden Equipment		2.82	6.82	0.03
	Logging Equipment		0.65	0.04	
	Pleasure Craft		1.43	20.64	
	Railroad Equipment		0.29	0.00	0.00
	Recreational Equipment		0.20	5.23	0.01
	Underground Mining Equipment		0.00		
NOX Total		0.81	99.52	37.34	8.29
PM10	Agricultural Equipment	0.00	2.43	0.01	0.00
	Airport Ground Support Equipment		0.05	0.00	0.00
	Commercial Equipment	0.01	0.69	0.21	0.01
	Construction and Mining Equipment	0.00	3.84	0.34	0.00
	Industrial Equipment	0.01	0.96	0.01	0.20
	Lawn and Garden Equipment		0.23	1.94	0.00
	Logging Equipment		0.05	0.06	
	Pleasure Craft		0.03	5.45	
	Railroad Equipment		0.04	0.00	0.00
	Recreational Equipment		0.04	4.87	0.00
	Underground Mining Equipment		0.00		
PM10 Total		0.02	8.34	12.89	0.22

Ohio 2009 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	4.93	47.88	43.26	4.33
Airport Ground Support Equipment	0.04	0.49	0.48	0.03
Commercial Equipment	12.19	551.06	13.93	1.21
Construction and Mining Equipment	10.04	163.47	75.15	5.69
Industrial Equipment	7.19	170.47	35.07	1.49
Lawn and Garden Equipment	53.79	1,421.88	13.70	3.01
Logging Equipment	0.12	1.41	0.20	0.03
Pleasure Craft	33.38	147.82	12.47	1.84
Railroad Equipment	0.08	1.06	0.35	0.05
Recreational Equipment	54.26	282.79	2.22	1.82
Underground Mining Equipment	0.05	0.22	0.25	0.03
Grand Total	176.09	2,788.56	197.08	19.51

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	4.15	0.78	0.00
	Airport Ground Support Equipment		0.03	0.01	0.00
	Commercial Equipment	0.00	1.27	10.62	0.29
	Construction and Mining Equipment	0.00	6.02	3.97	0.06
	Industrial Equipment	0.02	1.39	0.95	4.84
	Lawn and Garden Equipment		0.47	53.29	0.03
	Logging Equipment		0.01	0.11	
	Pleasure Craft		0.22	33.16	
	Railroad Equipment		0.06	0.01	0.00
	Recreational Equipment		0.06	54.20	0.00
	Underground Mining Equipment		0.05		
VOC Total		0.03	13.74	157.10	5.22
CO	Agricultural Equipment	0.01	21.33	26.52	0.01
	Airport Ground Support Equipment		0.20	0.25	0.04
	Commercial Equipment	1.26	5.26	539.54	5.00
	Construction and Mining Equipment	0.00	34.36	127.58	1.52
	Industrial Equipment	8.39	8.01	40.93	113.14
	Lawn and Garden Equipment		1.95	1,419.20	0.73
	Logging Equipment		0.08	1.33	
	Pleasure Craft		1.02	146.80	
	Railroad Equipment		0.27	0.79	0.00
	Recreational Equipment		0.23	282.50	0.06
	Underground Mining Equipment		0.22		
CO Total		9.67	72.94	2,585.45	120.50

NOX	Agricultural Equipment	0.00	42.83	0.42	0.00
	Airport Ground Support Equipment		0.46	0.01	0.01
	Commercial Equipment	0.35	8.41	3.83	1.33
	Construction and Mining Equipment	0.00	73.71	1.21	0.22
	Industrial Equipment	1.31	15.50	0.87	17.40
	Lawn and Garden Equipment		4.10	9.49	0.11
	Logging Equipment		0.19	0.01	
	Pleasure Craft		6.12	6.35	
	Railroad Equipment		0.35	0.01	0.00
	Recreational Equipment		0.18	2.03	0.01
	Underground Mining Equipment		0.25		
NOX Total		1.66	152.11	24.23	19.09
PM10	Agricultural Equipment	0.00	4.32	0.01	0.00
	Airport Ground Support Equipment		0.03	0.00	0.00
	Commercial Equipment	0.01	0.95	0.25	0.01
	Construction and Mining Equipment	0.00	5.33	0.35	0.00
	Industrial Equipment	0.02	1.25	0.01	0.22
	Lawn and Garden Equipment		0.36	2.65	0.00
	Logging Equipment		0.01	0.01	
	Pleasure Craft		0.12	1.72	
	Railroad Equipment		0.05	0.00	0.00
	Recreational Equipment		0.04	1.78	0.00
	Underground Mining Equipment		0.03		
PM10 Total		0.02	12.47	6.79	0.23

Ohio 2012 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	4.18	44.83	38.89	3.62
Airport Ground Support Equipment	0.03	0.42	0.41	0.03
Commercial Equipment	12.41	592.47	13.51	1.15
Construction and Mining Equipment	9.00	153.94	61.92	4.94
Industrial Equipment	3.80	105.15	22.55	1.36
Lawn and Garden Equipment	51.54	1,469.43	13.40	3.04
Logging Equipment	0.13	1.53	0.15	0.02
Pleasure Craft	29.10	144.26	12.86	1.71
Railroad Equipment	0.07	1.06	0.33	0.04
Recreational Equipment	47.59	291.87	2.38	1.60
Underground Mining Equipment	0.05	0.20	0.24	0.03
Grand Total	157.91	2,805.16	166.65	17.53

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	3.46	0.72	0.00
	Airport Ground Support Equipment		0.03	0.01	0.00
	Commercial Equipment	0.00	1.13	11.04	0.23
	Construction and Mining Equipment	0.00	5.14	3.82	0.03
	Industrial Equipment	0.01	1.13	0.60	2.06
	Lawn and Garden Equipment		0.43	51.10	0.01
	Logging Equipment		0.01	0.12	
	Pleasure Craft		0.22	28.89	
	Railroad Equipment		0.06	0.01	0.00
	Recreational Equipment		0.05	47.54	0.00
	Underground Mining Equipment		0.05		
VOC Total		0.01	11.70	143.86	2.34
CO	Agricultural Equipment	0.00	18.10	26.72	0.01
	Airport Ground Support Equipment		0.18	0.22	0.02
	Commercial Equipment	1.24	4.99	581.90	4.34
	Construction and Mining Equipment	0.00	28.91	124.22	0.80
	Industrial Equipment	4.71	7.50	30.12	62.81
	Lawn and Garden Equipment		1.88	1,467.19	0.37
	Logging Equipment		0.06	1.47	
	Pleasure Craft		1.06	143.20	
	Railroad Equipment		0.24	0.81	0.00
	Recreational Equipment		0.22	291.60	0.05
	Underground Mining Equipment		0.20		
CO Total		5.96	63.34	2,667.45	68.41

NOX	Agricultural Equipment	0.00	38.51	0.37	0.00
	Airport Ground Support Equipment		0.40	0.00	0.00
	Commercial Equipment	0.33	8.20	3.88	1.09
	Construction and Mining Equipment	0.00	60.83	0.96	0.13
	Industrial Equipment	0.63	13.27	0.44	8.21
	Lawn and Garden Equipment		4.11	9.24	0.05
	Logging Equipment		0.14	0.01	
	Pleasure Craft		6.07	6.79	
	Railroad Equipment		0.33	0.01	0.00
	Recreational Equipment		0.18	2.19	0.01
	Underground Mining Equipment		0.24		
NOX Total		0.96	132.28	23.91	9.49
PM10	Agricultural Equipment	0.00	3.61	0.01	0.00
	Airport Ground Support Equipment		0.03	0.00	0.00
	Commercial Equipment	0.01	0.86	0.27	0.01
	Construction and Mining Equipment	0.00	4.58	0.36	0.00
	Industrial Equipment	0.02	1.10	0.01	0.23
	Lawn and Garden Equipment		0.33	2.72	0.00
	Logging Equipment		0.01	0.01	
	Pleasure Craft		0.10	1.60	
	Railroad Equipment		0.04	0.00	0.00
	Recreational Equipment		0.03	1.56	0.00
	Underground Mining Equipment		0.03		
PM10 Total		0.02	10.72	6.54	0.25

Wisconsin 2009 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	4.47	44.70	39.06	3.91
Airport Ground Support Equipment	0.01	0.15	0.15	0.01
Commercial Equipment	5.76	261.22	6.82	0.58
Construction and Mining Equipment	4.15	66.05	31.24	2.37
Industrial Equipment	3.82	87.36	18.55	0.78
Lawn and Garden Equipment	20.30	535.47	5.19	1.06
Logging Equipment	0.55	6.51	0.87	0.11
Pleasure Craft	65.01	225.41	12.16	4.21
Railroad Equipment	0.03	0.49	0.16	0.02
Recreational Equipment	124.44	416.13	2.51	3.43
Underground Mining Equipment	0.00	0.00	0.00	0.00
Grand Total	228.54	1,643.48	116.71	16.48

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	3.75	0.72	0.00
	Airport Ground Support Equipment		0.01	0.00	0.00
	Commercial Equipment	0.00	0.61	5.00	0.14
	Construction and Mining Equipment	0.00	2.50	1.62	0.02
	Industrial Equipment	0.01	0.71	0.45	2.65
	Lawn and Garden Equipment		0.14	20.15	0.01
	Logging Equipment		0.06	0.48	
	Pleasure Craft		0.20	64.81	
	Railroad Equipment		0.03	0.01	0.00
	Recreational Equipment		0.06	124.38	0.00
	Underground Mining Equipment		0.00		
VOC Total		0.01	8.08	217.62	2.83
CO	Agricultural Equipment	0.01	19.27	25.41	0.01
	Airport Ground Support Equipment		0.06	0.07	0.01
	Commercial Equipment	0.61	2.53	255.67	2.41
	Construction and Mining Equipment	0.00	14.31	51.16	0.58
	Industrial Equipment	4.52	4.13	16.72	61.99
	Lawn and Garden Equipment		0.59	534.65	0.22
	Logging Equipment		0.33	6.18	
	Pleasure Craft		0.91	224.50	
	Railroad Equipment		0.13	0.36	0.00
	Recreational Equipment		0.22	415.85	0.06
	Underground Mining Equipment		0.00		
CO Total		5.14	42.48	1,530.57	65.28

NOX	Agricultural Equipment	0.00	38.69	0.36	0.00
	Airport Ground Support Equipment		0.14	0.00	0.00
	Commercial Equipment	0.17	4.05	1.96	0.64
	Construction and Mining Equipment	0.00	30.67	0.48	0.08
	Industrial Equipment	0.70	7.85	0.46	9.54
	Lawn and Garden Equipment		1.25	3.92	0.03
	Logging Equipment		0.84	0.04	
	Pleasure Craft		5.40	6.75	
	Railroad Equipment		0.16	0.00	0.00
	Recreational Equipment		0.17	2.33	0.01
	Underground Mining Equipment		0.00		
NOX Total		0.87	89.23	16.30	10.31
PM10	Agricultural Equipment	0.00	3.90	0.01	0.00
	Airport Ground Support Equipment		0.01	0.00	0.00
	Commercial Equipment	0.00	0.46	0.12	0.00
	Construction and Mining Equipment	0.00	2.22	0.15	0.00
	Industrial Equipment	0.01	0.64	0.01	0.12
	Lawn and Garden Equipment		0.11	0.95	0.00
	Logging Equipment		0.06	0.05	
	Pleasure Craft		0.10	4.11	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.03	3.40	0.00
	Underground Mining Equipment		0.00		
PM10 Total		0.01	7.55	8.79	0.13

Wisconsin 2012 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol			
Equipment Type	VOC	CO	NOX	PM10
Agricultural Equipment	3.79	41.96	35.11	3.27
Airport Ground Support Equipment	0.01	0.12	0.13	0.01
Commercial Equipment	5.85	280.83	6.62	0.55
Construction and Mining Equipment	3.73	62.44	25.81	2.07
Industrial Equipment	1.97	51.63	11.77	0.71
Lawn and Garden Equipment	19.43	561.30	5.11	1.08
Logging Equipment	0.56	7.05	0.64	0.10
Pleasure Craft	58.27	224.19	12.65	4.14
Railroad Equipment	0.03	0.49	0.15	0.02
Recreational Equipment	111.99	409.21	3.22	3.20
Underground Mining Equipment	0.00	0.00	0.00	0.00
Grand Total	205.63	1,639.22	101.21	15.16

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	3.12	0.67	0.00
	Airport Ground Support Equipment		0.01	0.00	0.00
	Commercial Equipment	0.00	0.55	5.19	0.11
	Construction and Mining Equipment	0.00	2.14	1.57	0.01
	Industrial Equipment	0.01	0.58	0.26	1.13
	Lawn and Garden Equipment		0.13	19.29	0.00
	Logging Equipment		0.05	0.51	
	Pleasure Craft		0.19	58.07	
	Railroad Equipment		0.03	0.01	0.00
	Recreational Equipment		0.05	111.94	0.00
	Underground Mining Equipment		0.00		
VOC Total		0.01	6.85	197.52	1.26
CO	Agricultural Equipment	0.00	16.35	25.61	0.01
	Airport Ground Support Equipment		0.06	0.06	0.01
	Commercial Equipment	0.60	2.40	275.74	2.09
	Construction and Mining Equipment	0.00	12.08	50.05	0.31
	Industrial Equipment	2.53	3.85	10.84	34.41
	Lawn and Garden Equipment		0.57	560.61	0.11
	Logging Equipment		0.26	6.79	
	Pleasure Craft		0.94	223.24	
	Railroad Equipment		0.11	0.37	0.00
	Recreational Equipment		0.21	408.94	0.05
	Underground Mining Equipment		0.00		
CO Total		3.12	36.83	1,562.26	36.99

NOX	Agricultural Equipment	0.00	34.79	0.32	0.00
	Airport Ground Support Equipment		0.12	0.00	0.00
	Commercial Equipment	0.16	3.95	1.98	0.53
	Construction and Mining Equipment	0.00	25.38	0.39	0.05
	Industrial Equipment	0.34	6.71	0.22	4.50
	Lawn and Garden Equipment		1.25	3.85	0.02
	Logging Equipment		0.60	0.04	
	Pleasure Craft		5.36	7.29	
	Railroad Equipment		0.15	0.00	0.00
	Recreational Equipment		0.17	3.03	0.01
	Underground Mining Equipment		0.00		
NOX Total		0.49	78.49	17.12	5.10
PM10	Agricultural Equipment	0.00	3.26	0.01	0.00
	Airport Ground Support Equipment		0.01	0.00	0.00
	Commercial Equipment	0.00	0.42	0.13	0.01
	Construction and Mining Equipment	0.00	1.91	0.15	0.00
	Industrial Equipment	0.01	0.57	0.01	0.13
	Lawn and Garden Equipment		0.10	0.98	0.00
	Logging Equipment		0.05	0.05	
	Pleasure Craft		0.09	4.05	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.03	3.17	0.00
	Underground Mining Equipment		0.00		
PM10 Total		0.01	6.46	8.55	0.13

2009 Locomotive Emissions for LADCO States

2009 Annual Locomotive Emissions (TPD)

			LADCO		
Type	**SCC**	**NOX**	**PM10-PRI**	**PM25-PRI**	**ROG**
Line Haul Locomotives: Class I Operations	2285002006	240.5	8.3	7.5	15.6
Line Haul Locomotives: Class II / III Operations	2285002007	16.6	0.4	0.3	0.7
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	5.3	0.2	0.1	0.3
Line Haul Locomotives: Commuter Lines	2285002009	13.3	0.4	0.3	0.7
Yard Locomotives	2285002010	59.0	1.4	1.3	4.0
	Totals	334.7	10.6	9.6	21.2
			IL		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	93.0	3.2	2.9	6.0
Line Haul Locomotives: Class II / III Operations	2285002007	5.0	0.1	0.1	0.2
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	1.9	0.1	0.1	0.1
Line Haul Locomotives: Commuter Lines	2285002009	13.2	0.4	0.3	0.7
Yard Locomotives	2285002010	18.9	0.5	0.4	1.3
	Totals	132.0	4.2	3.8	8.2
			IN		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	45.2	1.6	1.4	2.9
Line Haul Locomotives: Class II / III Operations	2285002007	1.9	0.0	0.0	0.1
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.9	0.0	0.0	0.1
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	15.2	0.4	0.3	1.0
	Totals	63.2	2.0	1.8	4.0
			MI		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	8.4	0.3	0.3	0.5
Line Haul Locomotives: Class II / III Operations	2285002007	3.6	0.1	0.1	0.1
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	1.1	0.0	0.0	0.1
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	4.4	0.1	0.1	0.3
	Totals	17.5	0.5	0.5	1.0
			OH		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	64.5	2.2	2.0	4.2
Line Haul Locomotives: Class II / III Operations	2285002007	5.1	0.1	0.1	0.2
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.8	0.0	0.0	0.0
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	15.0	0.4	0.3	1.0
	Totals	85.4	2.7	2.5	5.4
			WI		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	29.4	1.0	0.9	2.0
Line Haul Locomotives: Class II / III Operations	2285002007	1.0	0.0	0.0	0.1
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.6	0.0	0.0	0.0
Line Haul Locomotives: Commuter Lines	2285002009	0.1	0.0	0.0	0.0
Yard Locomotives	2285002010	5.5	0.1	0.1	0.4
	Totals	36.6	1.2	1.1	2.5

2012 Locomotive Emissions for LADCO States

2012 Annual Locomotive Emissions (TPD)

			LADCO		
Vessel Type	**SCC**	**NOX**	**PM10-PRI**	**PM25-PRI**	**ROG**
Line Haul Locomotives: Class I Operations	2285002006	238.3	7.9	7.1	15.2
Line Haul Locomotives: Class II / III Operations	2285002007	16.5	0.4	0.3	0.7
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	4.5	0.1	0.1	0.3
Line Haul Locomotives: Commuter Lines	2285002009	11.3	0.4	0.3	0.7
Yard Locomotives	2285002010	56.1	1.4	1.3	4.0
	Totals	326.7	10.1	9.1	20.8
			IL		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	92.1	3.1	2.7	5.9
Line Haul Locomotives: Class II / III Operations	2285002007	5.0	0.1	0.1	0.2
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	1.6	0.1	0.1	0.1
Line Haul Locomotives: Commuter Lines	2285002009	11.3	0.4	0.3	0.7
Yard Locomotives	2285002010	18.0	0.4	0.4	1.3
	Totals	128.0	4.0	3.6	8.1
			IN		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	44.8	1.5	1.3	2.8
Line Haul Locomotives: Class II / III Operations	2285002007	1.9	0.0	0.0	0.1
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.8	0.0	0.0	0.1
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	14.4	0.4	0.3	1.0
	Totals	61.9	1.9	1.7	4.0
			MI		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	8.3	0.3	0.3	0.5
Line Haul Locomotives: Class II / III Operations	2285002007	3.5	0.1	0.1	0.2
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	1.0	0.0	0.0	0.1
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	4.2	0.1	0.1	0.3
	Totals	16.9	0.5	0.4	1.0
			OH		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	63.7	2.1	1.9	4.0
Line Haul Locomotives: Class II / III Operations	2285002007	5.1	0.1	0.1	0.2
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.6	0.0	0.0	0.0
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	14.2	0.4	0.3	1.0
	Totals	83.7	2.6	2.3	5.3
			WI		
Vessel Type	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	29.3	1.0	0.9	2.0
Line Haul Locomotives: Class II / III Operations	2285002007	1.0	0.0	0.0	0.1
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.5	0.0	0.0	0.0
Line Haul Locomotives: Commuter Lines	2285002009	0.1	0.0	0.0	0.0
Yard Locomotives	2285002010	5.3	0.1	0.1	0.4
	Totals	36.2	1.1	1.0	2.4

2009 Commercial Marine Vessel Emissions for LADCO States

2009 Annual Commercial Marine Emissions (TPD)

LADCO

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	28.0	0.6	0.6	0.6
Ferries	Diesel	2280002022	2.9	0.1	0.1	0.1
Push Boats	Diesel	2280002023	91.7	2.2	1.9	2.2
Excursion	Diesel	2280002024	0.9	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.1	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.1	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.4	0.0	0.0	0.0
Port emissions	Residual	2280003100	22.4	1.4	1.3	0.7
Underway emissions	Residual	2280003200	94.9	7.7	7.0	2.2
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.5
		Totals	241.4	12.1	10.9	6.3

IL

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	10.5	0.2	0.2	0.2
Ferries	Diesel	2280002022	0.1	0.0	0.0	0.0
Push Boats	Diesel	2280002023	54.6	1.3	1.2	1.3
Excursion	Diesel	2280002024	0.3	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	0.8	0.1	0.1	0.0
Underway emissions	Residual	2280003200	2.6	0.2	0.2	0.1
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
		Totals	68.9	1.8	1.6	1.6

IN

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	7.2	0.2	0.2	0.2
Ferries	Diesel	2280002022	0.0	0.0	0.0	0.0
Push Boats	Diesel	2280002023	14.4	0.3	0.3	0.3
Excursion	Diesel	2280002024	0.2	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	2.0	0.1	0.1	0.1
Underway emissions	Residual	2280003200	0.0	0.0	0.0	0.0
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
		Totals	23.8	0.6	0.6	0.6

MI

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	5.3	0.1	0.1	0.1
Ferries	Diesel	2280002022	1.7	0.1	0.1	0.0
Push Boats	Diesel	2280002023	2.5	0.1	0.1	0.1
Excursion	Diesel	2280002024	0.2	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.1	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.3	0.0	0.0	0.0
Port emissions	Residual	2280003100	8.5	0.6	0.5	0.2
Underway emissions	Residual	2280003200	69.5	5.7	5.1	1.6
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.4
		Totals	88.2	6.5	5.9	2.5

OH

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	3.8	0.1	0.1	0.1
Ferries	Diesel	2280002022	0.6	0.0	0.0	0.0
Push Boats	Diesel	2280002023	16.4	0.4	0.4	0.4
Excursion	Diesel	2280002024	0.0	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	8.3	0.5	0.5	0.3
Underway emissions	Residual	2280003200	10.8	0.9	0.8	0.3
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
		Totals	40.0	1.9	1.7	1.1

WI

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	1.1	0.0	0.0	0.0
Ferries	Diesel	2280002022	0.5	0.0	0.0	0.0
Push Boats	Diesel	2280002023	3.8	0.1	0.1	0.1
Excursion	Diesel	2280002024	0.3	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.1	0.0	0.0	0.0
Port emissions	Residual	2280003100	2.8	0.2	0.2	0.1
Underway emissions	Residual	2280003200	12.0	1.0	0.9	0.3
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.1
		Totals	20.5	1.3	1.1	0.6

2012 Commercial Marine Vessel Emissions for LADCO States

2012 Annual Commercial Marine Emissions (TPD)

LADCO

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	27.2	0.6	0.6	0.7
Ferries	Diesel	2280002022	2.7	0.1	0.1	0.1
Push Boats	Diesel	2280002023	88.9	2.2	2.0	2.2
Excursion	Diesel	2280002024	0.9	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.1	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.1	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.4	0.0	0.0	0.0
Port emissions	Residual	2280003100	22.4	1.4	1.3	0.7
Underway emissions	Residual	2280003200	94.9	7.7	7.0	2.2
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.1
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.5
		Totals	237.7	12.1	10.9	6.4

IL

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	10.2	0.2	0.2	0.2
Ferries	Diesel	2280002022	0.1	0.0	0.0	0.0
Push Boats	Diesel	2280002023	52.9	1.3	1.2	1.3
Excursion	Diesel	2280002024	0.3	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	0.8	0.1	0.1	0.0
Underway emissions	Residual	2280003200	2.6	0.2	0.2	0.1
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
		Totals	66.9	1.8	1.6	1.6

IN

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	7.0	0.2	0.2	0.2
Ferries	Diesel	2280002022	0.0	0.0	0.0	0.0
Push Boats	Diesel	2280002023	14.0	0.3	0.3	0.4
Excursion	Diesel	2280002024	0.1	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	2.0	0.1	0.1	0.1
Underway emissions	Residual	2280003200	0.0	0.0	0.0	0.0
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
		Totals	23.2	0.6	0.6	0.6

MI

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	5.2	0.1	0.1	0.1
Ferries	Diesel	2280002022	1.6	0.1	0.1	0.0
Push Boats	Diesel	2280002023	2.4	0.1	0.1	0.1
Excursion	Diesel	2280002024	0.2	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.1	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.3	0.0	0.0	0.0
Port emissions	Residual	2280003100	8.5	0.6	0.5	0.2
Underway emissions	Residual	2280003200	69.5	5.7	5.1	1.6
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.1
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.4
		Totals	87.9	6.5	5.8	2.5

OH

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	3.7	0.1	0.1	0.1
Ferries	Diesel	2280002022	0.6	0.0	0.0	0.0
Push Boats	Diesel	2280002023	15.9	0.4	0.4	0.4
Excursion	Diesel	2280002024	0.0	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	8.3	0.5	0.5	0.3
Underway emissions	Residual	2280003200	10.8	0.9	0.8	0.3
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
		Totals	39.4	1.9	1.7	1.1

WI

Vessel Type	Fuel	SCC	NOX	PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	1.1	0.0	0.0	0.0
Ferries	Diesel	2280002022	0.5	0.0	0.0	0.0
Push Boats	Diesel	2280002023	3.7	0.1	0.1	0.1
Excursion	Diesel	2280002024	0.3	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.1	0.0	0.0	0.0
Port emissions	Residual	2280003100	2.8	0.2	0.2	0.1
Underway emissions	Residual	2280003200	12.0	1.0	0.9	0.3
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.1
		Totals	20.3	1.3	1.1	0.6

2009 and 2012 Emissions Reductions Scenarios

One Preliminary Scenario for On Road HDDV Strategies for ILLINOIS (2009 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	15,606	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	15,606	468	$18,726,778	0.34	0.02	0.00
MY 1990	$8,551	0.12	0.03	0.00	$40,000	2,219	67	$2,663,094	0.02	0.00	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	20,429	-	$0	0.00	0.00	0.00
Sub Total							535	21,389,872	0.36	0.03	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	15,606	468	$21,067,625	0.41	0.02	0.04
MY 1990	$8,015	0.20	0.03	0.04	$45,000	2,219	67	$2,995,980	0.04	0.00	0.01
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	20,429	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.22	0.00	0.11	$45,000	16,761	-	$0	0.00	0.00	0.00
Sub Total							535	24,063,606	0.45	0.03	0.05
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	16,761	503	30,169,569	0.74	0.02	0.22
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	28,354	851	51,036,551	1.15	0.05	0.19
Sub Total							1,353	81,206,120	1.88	0.06	0.41
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	15,606	780	$7,022,542	0.00	0.04	0.08
MY 1990	$2,069	0.00	0.03	0.06	$9,000	2,219	111	$998,660	0.00	0.01	0.02
MY 1991 - 1997	$3,534	0.00	0.01	0.09	$9,000	20,429	1,021	$9,193,146	0.00	0.04	0.25
MY 1998 - 2001	$3,026	0.00	0.01	0.15	$9,000	16,761	838	$7,542,392	0.00	0.03	0.34
MY 2002 - 2006	$2,601	0.00	0.02	0.09	$9,000	28,354	1,418	$12,759,138	0.00	0.07	0.35
Sub Total							4,168	$37,515,878	0.00	0.19	1.03
Cleaire LNC+DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	15,606	624	$12,484,519	0.17	0.03	0.06
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	2,219	89	$1,775,396	0.02	0.01	0.01
MY 1991 - 1997	$6,645	0.11	0.01	0.08	$ 20,000	20,429	817	$16,343,370	0.24	0.03	0.18
MY 1998 - 2001	$5,816	0.14	0.01	0.13	$ 20,000	16,761	670	$13,408,697	0.26	0.02	0.24
MY 2002 - 2006	$5,487	0.13	0.02	0.08	$ 20,000	28,354	1,134	$22,682,911	0.42	0.06	0.25
Sub Total							3,335	66,694,893	1.10	0.15	0.75
EGR+DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	15,606	624	$14,357,197	0.28	0.03	0.06
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	2,219	89	$2,041,705	0.03	0.01	0.01
MY 1991 - 1997	$6,281	0.17	0.01	0.08	$ 23,000	20,429	817	$18,794,876	0.38	0.03	0.18
MY 1998 - 2001	$5,192	0.22	0.01	0.13	$ 23,000	16,761	670	$15,420,002	0.41	0.02	0.24
MY 2002 - 2006	$4,710	0.21	0.02	0.08	$ 23,000	28,354	1,134	$26,085,348	0.67	0.06	0.25
Sub Total							3,335	76,699,127	1.76	0.15	0.75
SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	15,606	312	$8,270,994	0.25	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	2,219	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$11,810	0.34	0.00	0.00	$ 26,500	20,429	409	$10,827,483	0.38	0.00	0.00
MY 1998 - 2001	$9,224	0.45	0.00	0.00	$ 26,500	16,761	503	$13,324,893	0.62	0.00	0.00
MY 2002 - 2006	$10,173	0.43	0.00	0.00	$ 26,500	28,354	567	$15,027,439	0.67	0.00	0.00
Sub Total							1,791	47,450,798	1.94	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	15,606	780	$1,560,565	0.00	0.02	0.06
MY 1990	$920	0.00	0.01	0.04	$2,000	2,219	111	$221,924	0.00	0.00	0.01
MY 1991 - 1997	$1,431	0.00	0.01	0.06	$2,000	20,429	1,021	$2,042,921	0.00	0.02	0.18
MY 1998 - 2001	$1,156	0.00	0.01	0.11	$2,000	16,761	838	$1,676,087	0.00	0.01	0.24
MY 2002 - 2006	$1,093	0.00	0.01	0.06	$2,000	28,354	1,418	$2,835,364	0.00	0.03	0.25
Sub Total							4,168	8,336,862	0.00	0.09	0.75
FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	15,606	624	$5,618,033	0.00	0.02	0.07
MY 1990	$3,257	0.00	0.02	0.06	$9,000	2,219	111	$998,660	0.00	0.00	0.02
MY 1991 - 1997	$4,945	0.00	0.01	0.09	$9,000	20,429	817	$7,354,517	0.00	0.02	0.20
MY 1998 - 2001	$3,941	0.00	0.01	0.15	$9,000	16,761	838	$7,542,392	0.00	0.02	0.34
MY 2002 - 2006	$3,809	0.00	0.01	0.09	$9,000	28,354	1,418	$12,759,138	0.00	0.04	0.35
Sub Total							3,808	$34,272,740	0.00	0.10	0.96
DOC+SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	15,606	468	$12,874,660	0.41	0.01	0.04
MY 1990	$8,611	0.26	0.01	0.04	$27,500	2,219	67	$1,830,877	0.05	0.00	0.01
MY 1991 - 1997	$8,404	0.34	0.00	0.06	$27,500	20,429	613	$16,854,100	0.57	0.01	0.11
MY 1998 - 2001	$6,571	0.45	0.004	0.10	$27,500	16,761	670	$18,436,959	0.83	0.01	0.19
MY 2002 - 2006	$7,245	0.43	0.006	0.06	$27,500	28,354	851	$23,391,752	1.00	0.01	0.15
Sub Total							2,669	73,388,349	2.85	0.03	0.49
SCR+DPF											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	15,606	624	$18,726,778	0.55	0.03	0.06
MY 1990	$5,060	0.26	0.03	0.05	$30,000	2,219	89	$2,663,094	0.06	0.01	0.01
MY 1991 - 1997	$6,505	0.34	0.01	0.08	$30,000	20,429	817	$24,515,055	0.76	0.03	0.18
MY 1998 - 2001	$5,427	0.45	0.01	0.13	$30,000	16,761	670	$20,113,046	0.83	0.02	0.24
MY 2002 - 2006	$5,335	0.43	0.02	0.08	$30,000	28,354	1,134	$34,024,367	1.33	0.06	0.25
Sub Total							3,335	100,042,340	3.53	0.15	0.75
Overall Projects											
MY 1989 and Earlier						15,606	5,774	120,709,691	2.44	0.23	0.48
MY 1990						2,219	799	16,189,391	0.22	0.05	0.10
MY 1991 - 1997						20,429	6,333	105,925,467	2.32	0.16	1.26
MY 1998 - 2001						16,761	6,202	127,634,039	3.68	0.15	2.06
MY 2002 - 2006						28,354	9,924	200,601,997	5.23	0.39	2.04
MY 2007+						17,967	0	0	0	0	0
Total						101,335	29,031	571,060,584	13.88	0.98	5.94
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$11,585,921	4.67	0.79	0.66

One Emission Reduction Scenario Example for On-road HDDVs - 2012 ILLINOIS

Sub Total								$23,171,841	9.34	1.59	1.31
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.02	0.0002	0.001	$7,500	107,538	32,261	$241,960,310	1.44	0.02	0.08
Sub Total						107,538	32,261	$241,960,310	1.44	0.02	0.08
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	18,654	11,193	$1,119,256	1.18	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	16,776	13,421	$1,342,073	4.76	0.00	0.00
Sub Total						35,430	24,613	2,461,329	5.94	0.00	0.00
Grand Total						107,538	98,011	$1,029,784,793	30.6	2.7	7.7

One Example Emission Reduction Scenario for Construction Equipment - 2009 ILLINOIS

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2009 ILLINOIS**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	202	$4,784,500	0.38	0.01	0.03
Rubber Tire Loaders	214	$7,633,250	0.36	0.01	0.04
Crawler Tractor/Dozer	142	$5,789,250	0.23	0.01	0.04
Tractors/Loaders/Backhoes	172	$1,822,500	0.05	0.00	0.00
Off-Highway Trucks	11	$1,821,853	0.12	0.00	0.00
Sub Total	**741**	**$21,851,353**	**1.15**	**0.03**	**0.11**
Measure 51a: DPF Retrofit					
Excavators	354	$2,647,421	0.00	0.02	0.05
Rubber Tire Loaders	381	$3,736,421	0.00	0.02	0.07
Crawler Tractor/Dozer	236	$2,432,842	0.00	0.01	0.05
Tractors/Loaders/Backhoes	464	$1,786,737	0.00	0.02	0.02
Off-Highway Trucks	13	$669,778	0.00	0.01	0.04
Sub Total	**1,448**	**$11,273,199**	**0.00**	**0.07**	**0.21**
Measure 51b: Lean NOx Catalyst					
Excavators	304	$5,304,211	0.16	0.02	0.04
Rubber Tire Loaders	246	$4,921,053	0.13	0.01	0.04
Crawler Tractor/Dozer	207	$4,590,526	0.10	0.01	0.04
Tractors/Loaders/Backhoes	421	$3,506,316	0.07	0.01	0.02
Off-Highway Trucks	13	$1,488,395	0.09	0.01	0.03
Sub Total	**1,191**	**$19,810,500**	**0.55**	**0.06**	**0.16**
Measure 51c: EGR+DPF Retrofit					
Excavators	304	$6,099,842	0.25	0.02	0.04
Rubber Tire Loaders	272	$6,504,158	0.24	0.01	0.04
Crawler Tractor/Dozer	207	$5,279,105	0.16	0.01	0.04
Tractors/Loaders/Backhoes	276	$2,803,579	0.07	0.01	0.01
Off-Highway Trucks	13	$1,711,654	0.15	0.01	0.03
Sub Total	**1,072**	**$22,398,339**	**0.87**	**0.05**	**0.16**
Measure 51d: SCR Retrofit					
Excavators	228	$5,249,789	0.42	0.00	0.00
Rubber Tire Loaders	203	$5,673,789	0.38	0.00	0.00
Crawler Tractor/Dozer	190	$5,821,632	0.30	0.00	0.00
Tractors/Loaders/Backhoes	130	$1,843,842	0.08	0.00	0.00
Off-Highway Trucks	18	$2,730,632	0.38	0.00	0.00
Sub Total	**769**	**$21,319,685**	**1.56**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	304	$530,421	0.00	0.01	0.03
Rubber Tire Loaders	381	$830,316	0.00	0.01	0.05
Crawler Tractor/Dozer	236	$540,632	0.00	0.01	0.03
Tractors/Loaders/Backhoes	421	$350,632	0.00	0.01	0.01
Off-Highway Trucks	13	$148,840	0.00	0.00	0.03
Sub Total	**1,355**	**$2,400,840**	**0.00**	**0.03**	**0.15**
Measure 51f: FTF Retrofit					
Excavators	196	$1,430,526	0.00	0.01	0.03
Rubber Tire Loaders	201	$1,780,579	0.00	0.01	0.04
Crawler Tractor/Dozer	149	$1,404,000	0.00	0.01	0.03
Tractors/Loaders/Backhoes	255	$1,012,263	0.00	0.00	0.01
Off-Highway Trucks	13	$669,778	0.00	0.00	0.04
Sub Total	**814**	**$6,297,146**	**0.00**	**0.03**	**0.14**
Measure 51g: DOC+SCR Retrofit					
Excavators	304	$7,293,289	0.50	0.00	0.03
Rubber Tire Loaders	322	$9,717,632	0.62	0.00	0.05
Crawler Tractor/Dozer	190	$6,041,316	0.30	0.00	0.03
Tractors/Loaders/Backhoes	226	$3,285,526	0.14	0.00	0.01
Off-Highway Trucks	18	$2,833,675	0.38	0.00	0.03
Sub Total	**1,060**	**$29,171,438**	**1.95**	**0.02**	**0.15**
Measure 51h: SCR+DPF Retrofit					
Excavators	388	$10,140,000	0.65	0.02	0.05
Rubber Tire Loaders	343	$10,965,789	0.63	0.02	0.06
Crawler Tractor/Dozer	267	$8,647,895	0.39	0.01	0.04
Tractors/Loaders/Backhoes	473	$7,539,474	0.30	0.02	0.02
Off-Highway Trucks	18	$3,091,282	0.38	0.01	0.04
Sub Total	**1,489**	**$40,384,440**	**2.35**	**0.08**	**0.21**
Grand Total	**9,939**	**$174,906,940**	**8.43**	**0.37**	**1.29**

One Example Emission Reduction Scenario for Agricultural Equipment - 2009 ILLINOIS

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2009 ILLINOIS**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	5,186	$68,616,500	2.05	0.12	0.15
Combines	45	$848,750	0.01	0.00	0.00
Sub Total	**5,231**	**$69,465,250**	**2.06**	**0.12**	**0.15**
Measure 51a: DPF Retrofit					
Agricultural Tractors	6,148	$27,364,737	0.00	0.18	0.24
Combines	216	$1,477,895	0.00	0.00	0.00
Sub Total	**6,364**	**$28,842,632**	**0.00**	**0.18**	**0.24**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	3,752	$47,790,737	0.83	0.13	0.13
Combines	62	$911,579	0.01	0.00	0.00
Sub Total	**3,814**	**$48,702,316**	**0.84**	**0.13**	**0.13**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	4,837	$41,432,684	1.09	0.11	0.13
Combines	62	$1,048,316	0.01	0.00	0.00
Sub Total	**4,899**	**$42,481,000**	**1.10**	**0.11**	**0.13**
Measure 51d: SCR Retrofit					
Agricultural Tractors	1,976	$25,115,026	1.14	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,976**	**$25,115,026**	**1.14**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	6,564	$5,326,947	0.00	0.07	0.18
Combines	308	$475,368	0.00	0.00	0.00
Sub Total	**6,872**	**$5,802,316**	**0.00**	**0.07**	**0.18**
Measure 51f: FTF Retrofit					
Agricultural Tractors	4,275	$13,422,316	0.00	0.06	0.14
Combines	62	$410,211	0.00	0.00	0.00
Sub Total	**4,337**	**$13,832,526**	**0.00**	**0.06**	**0.14**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	3,075	$40,938,816	1.73	0.02	0.12
Combines	0	$0	0.00	0.00	0.00
Sub Total	**3,075**	**$40,938,816**	**1.73**	**0.02**	**0.12**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	5,388	$66,729,474	2.59	0.12	0.18
Combines	62	$1,367,368	0.02	0.00	0.00
Sub Total	**5,450**	**$68,096,842**	**2.61**	**0.12**	**0.18**
Grand Total	**42,018**	**$343,276,724**	**9.49**	**0.81**	**1.28**

One Emission Reduction Scenario Example for On-road HDDVs - 2012 ILLINOIS

One Preliminary Scenario for On Road HDDV Strategies for ILLINOIS (2012 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	10,388	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	10,388	623	$24,931,590	0.41	0.03	0.01
MY 1990	$11,401	0.09	0.02	0.00	$40,000	1,925	77	$3,079,886	0.02	0.00	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	17,744	-	$0	0.00	0.00	0.00
Sub Total							700	28,011,476	0.43	0.03	0.01
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,523	0.29	0.02	0.03	$45,000	10,388	623	$28,048,039	0.49	0.03	0.05
MY 1990	$10,687	0.15	0.02	0.03	$45,000	1,925	77	$3,464,872	0.03	0.00	0.01
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	17,744	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	14,550	-	$0	0.00	0.00	0.00
Sub Total							700	31,512,911	0.53	0.03	0.06
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	14,550	582	34,919,712	0.62	0.01	0.19
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	24,615	985	59,077,029	0.97	0.04	0.16
Sub Total							1,567	93,996,741	1.58	0.05	0.35
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	10,388	1,039	$9,349,346	0.00	0.05	0.10
MY 1990	$2,759	0.00	0.02	0.04	$9,000	1,925	192	$1,732,436	0.00	0.01	0.02
MY 1991 - 1997	$4,835	0.00	0.01	0.08	$9,000	17,744	1,420	$12,775,504	0.00	0.04	0.25
MY 1998 - 2001	$4,161	0.00	0.01	0.11	$9,000	14,550	1,164	$10,475,914	0.00	0.03	0.34
MY 2002 - 2006	$3,570	0.00	0.01	0.07	$9,000	24,615	2,462	$22,153,886	0.00	0.09	0.44
Sub Total							6,276	$56,487,086	0.00	0.22	1.15
Cleaire LNC+DPF											
MY 1989 and Earlier	$6,074	0.09	0.02	0.03	$ 20,000	10,388	831	$16,621,060	0.21	0.04	0.07
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	1,925	154	$3,079,886	0.03	0.01	0.02
MY 1991 - 1997	$8,933	0.08	0.01	0.06	$ 20,000	17,744	1,065	$21,292,507	0.23	0.03	0.17
MY 1998 - 2001	$7,766	0.10	0.01	0.10	$ 20,000	14,550	873	$17,459,856	0.24	0.02	0.23
MY 2002 - 2006	$7,207	0.10	0.01	0.06	$ 20,000	24,615	1,477	$29,538,515	0.40	0.06	0.24
Sub Total							4,400	87,991,824	1.10	0.15	0.73
EGR+DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.03	0.03	$ 23,000	10,388	831	$19,114,219	0.33	0.04	0.07
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	1,925	154	$3,541,869	0.04	0.01	0.02
MY 1991 - 1997	$8,593	0.12	0.01	0.06	$ 23,000	17,744	1,065	$24,486,383	0.36	0.03	0.17
MY 1998 - 2001	$7,136	0.16	0.01	0.10	$ 23,000	14,550	873	$20,078,834	0.39	0.02	0.23
MY 2002 - 2006	$6,461	0.16	0.01	0.06	$ 23,000	24,615	1,969	$45,292,389	0.84	0.07	0.32
Sub Total							4,892	112,513,695	1.97	0.17	0.81
SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	10,388	416	$11,011,452	0.33	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	1,925	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$15,979	0.25	0.00	0.00	$ 26,500	17,744	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$12,445	0.33	0.00	0.00	$ 26,500	14,550	582	$15,422,873	0.52	0.00	0.00
MY 2002 - 2006	$13,569	0.31	0.00	0.00	$ 26,500	24,615	985	$26,092,355	0.84	0.00	0.00
Sub Total							1,982	52,526,680	1.70	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	10,388	1,039	$2,077,633	0.00	0.02	0.07
MY 1990	$1,227	0.00	0.01	0.03	$2,000	1,925	192	$384,986	0.00	0.01	0.02
MY 1991 - 1997	$1,959	0.00	0.00	0.05	$2,000	17,744	1,774	$3,548,751	0.00	0.02	0.23
MY 1998 - 2001	$1,590	0.00	0.00	0.08	$2,000	14,550	1,455	$2,909,976	0.00	0.02	0.31
MY 2002 - 2006	$1,500	0.00	0.01	0.05	$2,000	24,615	2,462	$4,923,086	0.00	0.04	0.32
Sub Total							6,922	13,844,431	0.00	0.11	0.94
FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	10,388	831	$7,479,477	0.00	0.02	0.08
MY 1990	$4,343	0.00	0.01	0.04	$9,000	1,925	154	$1,385,949	0.00	0.01	0.02
MY 1991 - 1997	$6,767	0.00	0.01	0.06	$9,000	17,744	1,420	$12,775,504	0.00	0.02	0.25
MY 1998 - 2001	$5,418	0.00	0.01	0.11	$9,000	14,550	1,164	$10,475,914	0.00	0.02	0.34
MY 2002 - 2006	$5,228	0.00	0.01	0.07	$9,000	24,615	1,969	$17,723,109	0.00	0.04	0.35
Sub Total							5,538	49,839,952	0.00	0.11	1.04
DOC+SCR Retrofit											
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	10,388	623	$17,140,468	0.50	0.01	0.04
MY 1990	$11,411	0.19	0.01	0.03	$27,500	1,925	77	$2,117,422	0.04	0.00	0.01
MY 1991 - 1997	$11,375	0.25	0.00	0.05	$27,500	17,744	710	$19,518,132	0.48	0.01	0.09
MY 1998 - 2001	$8,871	0.33	0.003	0.08	$27,500	14,550	873	$24,007,302	0.78	0.01	0.18
MY 2002 - 2006	$9,672	0.31	0.004	0.05	$27,500	24,615	1,477	$40,615,458	1.26	0.02	0.19
Sub Total							3,760	103,398,781	3.07	0.04	0.51
SCR+DPF											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	10,388	831	$24,931,590	0.67	0.04	0.07
MY 1990	$6,708	0.19	0.02	0.04	$30,000	1,925	154	$4,619,829	0.08	0.01	0.02
MY 1991 - 1997	$8,812	0.25	0.01	0.06	$30,000	17,744	1,065	$31,938,761	0.72	0.03	0.17
MY 1998 - 2001	$7,336	0.33	0.01	0.10	$30,000	14,550	873	$26,189,784	0.78	0.02	0.23
MY 2002 - 2006	$7,138	0.31	0.01	0.06	$30,000	24,615	1,477	$44,307,772	1.26	0.06	0.24
Sub Total							4,400	131,987,736	3.52	0.15	0.73
Overall Projects											
MY 1989 and Earlier						10,388	7,687	160,704,876	2.95	0.28	0.58
MY 1990						1,925	1,232	23,407,133	0.24	0.06	0.12
MY 1991 - 1997						17,744	8,517	126,335,543	1.79	0.16	1.33
MY 1998 - 2001						14,550	8,439	161,940,164	3.34	0.14	2.05
MY 2002 - 2006						24,615	15,262	289,723,597	5.58	0.42	2.26
MY 2007+						38,316	0	0	0	0	0
Total						107,538	41,137	762,111,313	13.89	1.07	6.33
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$3,492	N/A	N/A	N/A	N/A	N/A	N/A	$23,171,841	9.34	1.59	1.31

Sub Total								**$23,171,843**	**9.34**	**1.59**	**1.31**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.02	0.0002	0.001	$7,500	107,538	32,261	$241,960,310	1.44	0.02	0.08
Sub Total						**107,538**	**32,261**	**$241,960,310**	**1.44**	**0.02**	**0.08**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	18,654	11,193	$1,119,256	1.18	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	16,776	13,421	$1,342,073	4.76	0.00	0.00
Sub Total						**35,430**	**24,613**	**2,461,329**	**5.94**	**0.00**	**0.00**
Grand Total						**107,538**	**98,011**	**$1,029,704,793**	**30.6**	**2.7**	**7.7**

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2012 ILLINOIS**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	120	$3,565,750	0.26	0.01	0.03
Rubber Tire Loaders	314	$13,303,500	0.60	0.01	0.05
Crawler Tractor/Dozer	146	$6,979,500	0.29	0.01	0.04
Tractors/Loaders/Backhoes	266	$2,988,250	0.09	0.01	0.01
Off-Highway Trucks	11	$2,148,155	0.11	0.00	0.00
Sub Total	**857**	**$28,985,155**	**1.35**	**0.03**	**0.12**
Measure 51a: DPF Retrofit					
Excavators	1,056	$8,085,316	0.00	0.04	0.08
Rubber Tire Loaders	1,028	$9,177,632	0.00	0.04	0.10
Crawler Tractor/Dozer	821	$8,202,789	0.00	0.04	0.09
Tractors/Loaders/Backhoes	1,615	$6,476,684	0.00	0.04	0.06
Off-Highway Trucks	30	$1,545,641	0.00	0.01	0.04
Sub Total	**4,550**	**$33,488,062**	**0.00**	**0.17**	**0.38**
Measure 51b: Lean NOx Catalyst					
Excavators	656	$11,205,263	0.26	0.03	0.05
Rubber Tire Loaders	452	$9,304,211	0.21	0.02	0.05
Crawler Tractor/Dozer	403	$8,314,737	0.17	0.02	0.05
Tractors/Loaders/Backhoes	896	$7,528,421	0.13	0.03	0.04
Off-Highway Trucks	20	$2,289,839	0.12	0.01	0.03
Sub Total	**2,427**	**$38,642,470**	**0.90**	**0.10**	**0.23**
Measure 51c: EGR+DPF Retrofit					
Excavators	522	$9,248,421	0.32	0.02	0.04
Rubber Tire Loaders	452	$10,699,842	0.34	0.02	0.05
Crawler Tractor/Dozer	403	$9,561,947	0.27	0.02	0.05
Tractors/Loaders/Backhoes	635	$6,446,053	0.16	0.02	0.03
Off-Highway Trucks	20	$2,633,314	0.20	0.01	0.03
Sub Total	**2,032**	**$38,589,578**	**1.28**	**0.09**	**0.21**
Measure 51d: SCR Retrofit					
Excavators	334	$7,771,474	0.50	0.00	0.00
Rubber Tire Loaders	287	$8,675,263	0.53	0.00	0.00
Crawler Tractor/Dozer	303	$9,482,816	0.46	0.00	0.00
Tractors/Loaders/Backhoes	203	$2,935,921	0.13	0.00	0.00
Off-Highway Trucks	30	$4,551,054	0.57	0.00	0.00
Sub Total	**1,157**	**$33,416,528**	**2.18**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	242	$371,368	0.00	0.00	0.02
Rubber Tire Loaders	329	$657,158	0.00	0.01	0.04
Crawler Tractor/Dozer	188	$377,579	0.00	0.00	0.02
Tractors/Loaders/Backhoes	379	$314,211	0.00	0.01	0.02
Off-Highway Trucks	6	$68,695	0.00	0.00	0.01
Sub Total	**1,144**	**$1,789,011**	**0.00**	**0.02**	**0.10**
Measure 51f: FTF Retrofit					
Excavators	672	$5,125,737	0.00	0.02	0.06
Rubber Tire Loaders	680	$6,279,632	0.00	0.02	0.09
Crawler Tractor/Dozer	541	$5,360,211	0.00	0.02	0.07
Tractors/Loaders/Backhoes	1,326	$5,167,895	0.00	0.02	0.06
Off-Highway Trucks	30	$1,545,641	0.00	0.01	0.04
Sub Total	**3,249**	**$23,479,115**	**0.00**	**0.08**	**0.31**
Measure 51g: DOC+SCR Retrofit					
Excavators	522	$11,057,895	0.64	0.01	0.03
Rubber Tire Loaders	559	$17,261,316	0.95	0.01	0.06
Crawler Tractor/Dozer	303	$9,840,658	0.46	0.00	0.04
Tractors/Loaders/Backhoes	499	$7,493,026	0.32	0.01	0.02
Off-Highway Trucks	30	$4,722,792	0.57	0.00	0.03
Sub Total	**1,913**	**$50,375,687**	**2.94**	**0.03**	**0.19**
Measure 51h: SCR+DPF Retrofit					
Excavators	687	$17,777,368	0.91	0.03	0.06
Rubber Tire Loaders	680	$20,932,105	1.01	0.03	0.08
Crawler Tractor/Dozer	541	$17,867,368	0.73	0.03	0.06
Tractors/Loaders/Backhoes	950	$15,678,947	0.57	0.04	0.06
Off-Highway Trucks	30	$5,152,137	0.57	0.01	0.04
Sub Total	**2,888**	**$77,407,926**	**3.79**	**0.13**	**0.29**
Grand Total	**20,217**	**$326,173,531**	**12.44**	**0.65**	**1.82**

One Example Emission Reduction Scenario for Agricultural Equipment - 2012 ILLINOIS

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2012 ILLINOIS**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	10,352	$142,855,750	4.20	0.22	0.37
Combines	116	$3,945,000	0.05	0.00	0.00
Sub Total	**10,468**	**$146,800,750**	**4.25**	**0.23**	**0.37**
Measure 51a: DPF Retrofit					
Agricultural Tractors	13,216	$72,243,947	0.00	0.36	0.64
Combines	647	$4,455,000	0.00	0.01	0.00
Sub Total	**13,863**	**$76,698,947**	**0.00**	**0.37**	**0.64**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	7,231	$96,236,105	1.63	0.26	0.32
Combines	116	$1,848,421	0.01	0.00	0.00
Sub Total	**7,347**	**$98,084,526**	**1.65**	**0.26**	**0.32**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	8,478	$76,128,789	1.91	0.20	0.32
Combines	116	$2,125,684	0.02	0.00	0.00
Sub Total	**8,594**	**$78,254,474**	**1.93**	**0.20**	**0.32**
Measure 51d: SCR Retrofit					
Agricultural Tractors	3,666	$48,693,053	2.12	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**3,666**	**$48,693,053**	**2.12**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	10,200	$9,584,000	0.00	0.11	0.41
Combines	834	$1,257,895	0.00	0.01	0.01
Sub Total	**11,034**	**$10,841,895**	**0.00**	**0.12**	**0.42**
Measure 51f: FTF Retrofit					
Agricultural Tractors	10,705	$44,548,579	0.00	0.14	0.58
Combines	161	$1,066,263	0.00	0.00	0.00
Sub Total	**10,866**	**$45,614,842**	**0.00**	**0.15**	**0.58**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	5,768	$70,870,395	2.92	0.04	0.21
Combines	0	$0	0.00	0.00	0.00
Sub Total	**5,768**	**$70,870,395**	**2.92**	**0.04**	**0.21**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	10,119	$138,440,526	5.13	0.23	0.47
Combines	116	$2,772,632	0.04	0.00	0.00
Sub Total	**10,235**	**$141,213,158**	**5.17**	**0.23**	**0.47**
Grand Total	**81,841**	**$717,072,039**	**18.04**	**1.59**	**3.34**

One Emission Reduction Scenario Example for On-road HDDVs - 2009 INDIANA

One Preliminary Scenario for On Road HDDV Strategies for INDIANA (2009 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	10,776	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	10,776	323	$12,931,739	0.23	0.02	0.00
MY 1990	$8,551	0.12	0.03	0.00	$40,000	1,532	46	$1,838,994	0.01	0.00	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	14,107	-	$0	0.00	0.00	0.00
Sub Total							369	14,770,733	0.25	0.02	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	10,776	323	$14,548,206	0.28	0.02	0.03
MY 1990	$8,015	0.20	0.03	0.04	$45,000	1,532	46	$2,068,868	0.03	0.00	0.01
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	14,107	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.22	0.00	0.11	$45,000	11,574	-	$0	0.00	0.00	0.00
Sub Total							369	16,617,075	0.31	0.02	0.03
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	11,574	347	20,833,535	0.51	0.01	0.15
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	19,580	587	35,243,187	0.79	0.03	0.13
Sub Total							935	56,076,722	1.30	0.04	0.28
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	10,776	539	$4,849,402	0.00	0.03	0.06
MY 1990	$2,089	0.00	0.03	0.06	$9,000	1,532	77	$689,623	0.00	0.01	0.01
MY 1991 - 1997	$3,534	0.00	0.01	0.09	$9,000	14,107	705	$6,348,308	0.00	0.02	0.17
MY 1998 - 2001	$3,028	0.00	0.01	0.15	$9,000	11,574	579	$5,208,384	0.00	0.02	0.23
MY 2002 - 2006	$2,601	0.00	0.02	0.09	$9,000	19,580	979	$8,810,797	0.00	0.05	0.24
Sub Total							2,879	$25,906,514	0.00	0.13	0.71
Cleaire LNC+DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	10,776	431	$8,621,159	0.12	0.02	0.04
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	1,532	61	$1,225,996	0.01	0.00	0.01
MY 1991 - 1997	$6,645	0.11	0.01	0.08	$ 20,000	14,107	564	$11,285,881	0.16	0.02	0.12
MY 1998 - 2001	$5,816	0.14	0.01	0.13	$ 20,000	11,574	463	$9,259,349	0.18	0.02	0.17
MY 2002 - 2006	$5,487	0.13	0.02	0.08	$ 20,000	19,580	783	$15,663,639	0.29	0.04	0.17
Sub Total							2,303	46,056,024	0.76	0.10	0.52
EGR+DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	10,776	431	$9,914,333	0.19	0.02	0.04
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	1,532	61	$1,409,895	0.02	0.00	0.01
MY 1991 - 1997	$6,281	0.17	0.01	0.08	$ 23,000	14,107	564	$12,978,763	0.26	0.02	0.12
MY 1998 - 2001	$5,192	0.22	0.01	0.13	$ 23,000	11,574	463	$10,648,351	0.29	0.02	0.17
MY 2002 - 2006	$4,710	0.21	0.02	0.08	$ 23,000	19,580	783	$18,013,185	0.46	0.04	0.17
Sub Total							2,303	$52,964,428	1.22	0.10	0.52
SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	10,776	216	$5,711,518	0.19	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	1,532	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$11,810	0.34	0.00	0.00	$ 26,500	14,107	282	$7,476,896	0.26	0.00	0.00
MY 1998 - 2001	$9,224	0.45	0.00	0.00	$ 26,500	11,574	347	$9,201,478	0.43	0.00	0.00
MY 2002 - 2006	$10,173	0.43	0.00	0.00	$ 26,500	19,580	392	$10,377,161	0.46	0.00	0.00
Sub Total							1,236	32,767,053	1.34	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	10,776	539	$1,077,645	0.00	0.01	0.04
MY 1990	$920	0.00	0.01	0.04	$2,000	1,532	77	$153,250	0.00	0.00	0.01
MY 1991 - 1997	$1,431	0.00	0.01	0.06	$2,000	14,107	705	$1,410,735	0.00	0.01	0.12
MY 1998 - 2001	$1,156	0.00	0.01	0.11	$2,000	11,574	579	$1,157,419	0.00	0.01	0.17
MY 2002 - 2006	$1,093	0.00	0.01	0.06	$2,000	19,580	979	$1,957,955	0.00	0.02	0.17
Sub Total							2,879	5,757,003	0.00	0.06	0.52
FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	10,776	431	$3,879,522	0.00	0.01	0.05
MY 1990	$3,257	0.00	0.02	0.06	$9,000	1,532	77	$689,623	0.00	0.00	0.01
MY 1991 - 1997	$4,945	0.00	0.01	0.09	$9,000	14,107	564	$5,078,647	0.00	0.01	0.14
MY 1998 - 2001	$3,941	0.00	0.01	0.15	$9,000	11,574	579	$5,208,384	0.00	0.01	0.23
MY 2002 - 2006	$3,809	0.00	0.01	0.09	$9,000	19,580	979	$8,810,797	0.00	0.03	0.24
Sub Total							2,630	23,666,972	0.00	0.07	0.67
DOC+SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	10,776	323	$8,890,570	0.29	0.01	0.02
MY 1990	$8,611	0.26	0.01	0.04	$27,500	1,532	46	$1,264,308	0.03	0.00	0.01
MY 1991 - 1997	$8,404	0.34	0.00	0.06	$27,500	14,107	423	$11,638,565	0.39	0.00	0.07
MY 1998 - 2001	$6,571	0.45	0.004	0.10	$27,500	11,574	463	$12,731,685	0.57	0.00	0.13
MY 2002 - 2006	$7,245	0.43	0.006	0.06	$27,500	19,580	587	$16,153,127	0.69	0.01	0.10
Sub Total							1,843	50,678,176	1.97	0.02	0.34
SCR+DPF											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	10,776	431	$12,931,739	0.38	0.02	0.04
MY 1990	$5,060	0.26	0.03	0.05	$30,000	1,532	61	$1,838,994	0.04	0.00	0.01
MY 1991 - 1997	$6,505	0.34	0.01	0.08	$30,000	14,107	564	$16,928,822	0.52	0.02	0.12
MY 1998 - 2001	$5,427	0.45	0.01	0.13	$30,000	11,574	463	$13,889,023	0.57	0.02	0.17
MY 2002 - 2006	$5,335	0.43	0.02	0.08	$30,000	19,580	783	$23,495,458	0.92	0.04	0.17
Sub Total							2,303	69,084,036	2.44	0.10	0.52
Overall Projects											
MY 1989 and Earlier						10,776	3,987	83,355,834	1.68	0.16	0.33
MY 1990						1,532	552	11,179,551	0.15	0.03	0.07
MY 1991 - 1997						14,107	4,373	73,146,618	1.60	0.11	0.87
MY 1998 - 2001						11,574	4,282	88,137,438	2.54	0.10	1.42
MY 2002 - 2006						19,580	6,853	138,526,305	3.61	0.27	1.41
MY 2007+						12,407	0	0	0	0	0
Total						69,977	20,048	394,344,736	9.58	0.67	4.70
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$2,295,344	0.92	0.16	0.13

Sub Total								$2,295,344	0.92	0.16	0.13
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.02	0.000	0.001	$7,500	69,977	10,497	$78,724,060	0.63	0.01	0.03
Sub Total						69,977	10,497	$78,724,060	0.63	0.01	0.03
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
Diesel Engine Reflash (MY 1993-1998 Engines)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	14,823	8,894	$889,392	0.94	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	13,331	10,664	$1,066,449	3.78	0.00	0.00
Sub Total							19,558	1,955,841	4.72	-	-
Grand Total						69,977	50,103	$477,319,980	15.9	0.8	4.3

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2009 INDIANA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 2B: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	97	$2,301,500	0.18	0.00	0.02
Rubber Tire Loaders	98	$3,474,000	0.17	0.00	0.02
Crawler Tractor/Dozer	80	$3,225,750	0.13	0.01	0.02
Tractors/Loaders/Backhoes	74	$783,500	0.02	0.00	0.00
Off-Highway Trucks	7	$1,169,249	0.07	0.00	0.00
Sub Total	**356**	**$10,953,999**	**0.57**	**0.02**	**0.06**
Measure 51a: DPF Retrofit					
Excavators	170	$1,263,789	0.00	0.01	0.02
Rubber Tire Loaders	173	$1,692,947	0.00	0.01	0.03
Crawler Tractor/Dozer	134	$1,355,684	0.00	0.01	0.03
Tractors/Loaders/Backhoes	198	$762,632	0.00	0.01	0.01
Off-Highway Trucks	8	$412,171	0.00	0.00	0.02
Sub Total	**683**	**$5,487,224**	**0.00**	**0.03**	**0.11**
Measure 51b: Lean NOx Catalyst					
Excavators	146	$2,530,526	0.07	0.01	0.02
Rubber Tire Loaders	112	$2,242,105	0.06	0.01	0.02
Crawler Tractor/Dozer	117	$2,564,211	0.05	0.01	0.02
Tractors/Loaders/Backhoes	180	$1,498,947	0.03	0.01	0.01
Off-Highway Trucks	8	$915,935	0.06	0.00	0.02
Sub Total	**563**	**$9,751,725**	**0.27**	**0.03**	**0.08**
Measure 51c: EGR+DPF Retrofit					
Excavators	146	$2,910,105	0.12	0.01	0.02
Rubber Tire Loaders	124	$2,957,316	0.11	0.01	0.02
Crawler Tractor/Dozer	117	$2,948,842	0.09	0.01	0.02
Tractors/Loaders/Backhoes	118	$1,198,421	0.03	0.00	0.00
Off-Highway Trucks	8	$1,053,326	0.09	0.00	0.02
Sub Total	**513**	**$11,068,010**	**0.43**	**0.03**	**0.08**
Measure 51d: SCR Retrofit					
Excavators	109	$2,502,158	0.20	0.00	0.00
Rubber Tire Loaders	94	$2,612,342	0.17	0.00	0.00
Crawler Tractor/Dozer	107	$3,244,158	0.16	0.00	0.00
Tractors/Loaders/Backhoes	56	$797,789	0.04	0.00	0.00
Off-Highway Trucks	12	$1,820,422	0.25	0.00	0.00
Sub Total	**378**	**$10,976,869**	**0.82**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	146	$253,053	0.00	0.00	0.01
Rubber Tire Loaders	173	$376,211	0.00	0.00	0.02
Crawler Tractor/Dozer	134	$301,263	0.00	0.00	0.02
Tractors/Loaders/Backhoes	180	$149,895	0.00	0.00	0.01
Off-Highway Trucks	8	$91,594	0.00	0.00	0.02
Sub Total	**641**	**$1,172,015**	**0.00**	**0.02**	**0.08**
Measure 51f: FTF Retrofit					
Excavators	92	$664,579	0.00	0.00	0.01
Rubber Tire Loaders	91	$809,526	0.00	0.00	0.02
Crawler Tractor/Dozer	84	$780,632	0.00	0.00	0.02
Tractors/Loaders/Backhoes	109	$431,526	0.00	0.00	0.00
Off-Highway Trucks	8	$412,171	0.00	0.00	0.02
Sub Total	**384**	**$3,098,434**	**0.00**	**0.01**	**0.07**
Measure 51g: DOC+SCR Retrofit					
Excavators	146	$3,479,474	0.24	0.00	0.01
Rubber Tire Loaders	146	$4,386,974	0.28	0.00	0.02
Crawler Tractor/Dozer	107	$3,366,579	0.16	0.00	0.02
Tractors/Loaders/Backhoes	98	$1,427,105	0.06	0.00	0.00
Off-Highway Trucks	12	$1,889,117	0.25	0.00	0.02
Sub Total	**509**	**$14,549,248**	**1.00**	**0.01**	**0.07**
Measure 51h: SCR+DPF Retrofit					
Excavators	185	$4,796,842	0.31	0.01	0.02
Rubber Tire Loaders	155	$4,942,105	0.29	0.01	0.03
Crawler Tractor/Dozer	153	$4,848,947	0.21	0.01	0.02
Tractors/Loaders/Backhoes	201	$3,200,526	0.13	0.01	0.01
Off-Highway Trucks	12	$2,060,855	0.25	0.00	0.02
Sub Total	**706**	**$19,849,276**	**1.18**	**0.04**	**0.10**
Grand Total	**4,733**	**$86,906,799**	**4.28**	**0.18**	**0.66**

One Example Emission Reduction Scenario for Agricultural Equipment - 2009 INDIANA

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2009 INDIANA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	2,806	$37,137,400	1.11	0.06	0.08
Combines	25	$473,750	0.01	0.00	0.00
Sub Total	**2,831**	**$37,611,150**	**1.12**	**0.06**	**0.08**
Measure 51a: DPF Retrofit					
Agricultural Tractors	3,323	$14,783,684	0.00	0.10	0.13
Combines	116	$793,895	0.00	0.00	0.00
Sub Total	**3,439**	**$15,577,579**	**0.00**	**0.10**	**0.13**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	2,028	$25,823,789	0.45	0.07	0.07
Combines	34	$503,158	0.00	0.00	0.00
Sub Total	**2,062**	**$26,326,947**	**0.45**	**0.07**	**0.07**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	2,615	$22,406,842	0.59	0.06	0.07
Combines	34	$578,632	0.01	0.00	0.00
Sub Total	**2,649**	**$22,985,474**	**0.59**	**0.06**	**0.07**
Measure 51d: SCR Retrofit					
Agricultural Tractors	1,069	$13,591,711	0.62	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,069**	**$13,591,711**	**0.62**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	3,549	$2,879,684	0.00	0.04	0.09
Combines	166	$256,211	0.00	0.00	0.00
Sub Total	**3,715**	**$3,135,895**	**0.00**	**0.04**	**0.10**
Measure 51f: FTF Retrofit					
Agricultural Tractors	2,311	$7,256,842	0.00	0.03	0.08
Combines	34	$226,421	0.00	0.00	0.00
Sub Total	**2,345**	**$7,483,263**	**0.00**	**0.03**	**0.08**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	1,662	$22,127,368	0.94	0.01	0.06
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,662**	**$22,127,368**	**0.94**	**0.01**	**0.06**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	2,913	$36,055,263	1.40	0.07	0.10
Combines	34	$754,737	0.01	0.00	0.00
Sub Total	**2,947**	**$36,810,000**	**1.41**	**0.07**	**0.10**
Grand Total	**22,719**	**$185,649,387**	**5.13**	**0.44**	**0.69**

One Emission Reduction Scenario Example for On-road HDDVs -2012 INDIANA

One Preliminary Scenario for On Road HDDV Strategies for INDIANA (2012 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	7,174	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	7,174	430	$17,216,459	0.28	0.02	0.00
MY 1990	$11,401	0.09	0.02	0.00	$40,000	1,329	53	$2,126,809	0.01	0.00	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	12,253	-	$0	0.00	0.00	0.00
Sub Total							484	19,343,268	0.29	0.02	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,522	0.29	0.02	0.03	$45,000	7,174	430	$19,368,517	0.34	0.02	0.03
MY 1990	$10,687	0.15	0.02	0.03	$45,000	1,329	53	$2,392,660	0.02	0.00	0.00
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	12,253	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	10,047	-	$0	0.00	0.00	0.00
Sub Total							484	21,761,177	0.36	0.02	0.04
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	10,047	402	24,113,737	0.43	0.01	0.13
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	16,998	680	40,795,523	0.67	0.03	0.11
Sub Total							1,082	64,909,260	1.09	0.04	0.24
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	7,174	717	$6,456,172	0.00	0.03	0.07
MY 1990	$2,759	0.00	0.02	0.04	$9,000	1,329	133	$1,196,330	0.00	0.01	0.02
MY 1991 - 1997	$4,835	0.00	0.01	0.06	$9,000	12,253	980	$8,822,099	0.00	0.02	0.17
MY 1998 - 2001	$4,161	0.00	0.01	0.11	$9,000	10,047	804	$7,234,121	0.00	0.02	0.23
MY 2002 - 2006	$3,570	0.00	0.01	0.07	$9,000	16,998	1,700	$15,298,321	0.00	0.06	0.30
Sub Total							4,334	$39,007,043	0.00	0.15	0.79
Cleaire LNC+DPF											
MY 1989 and Earlier	$6,074	0.09	0.02	0.03	$ 20,000	7,174	574	$11,477,640	0.14	0.03	0.05
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	1,329	106	$2,126,809	0.02	0.01	0.01
MY 1991 - 1997	$8,933	0.08	0.01	0.06	$ 20,000	12,253	735	$14,703,498	0.16	0.02	0.12
MY 1998 - 2001	$7,766	0.10	0.01	0.10	$ 20,000	10,047	603	$12,056,868	0.17	0.01	0.16
MY 2002 - 2006	$7,207	0.10	0.01	0.06	$ 20,000	16,998	1,020	$20,397,762	0.27	0.04	0.17
Sub Total							3,038	60,762,577	0.76	0.10	0.51
EGR+DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.02	0.03	$ 23,000	7,174	574	$13,199,286	0.23	0.03	0.05
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	1,329	106	$2,445,830	0.03	0.01	0.01
MY 1991 - 1997	$8,593	0.12	0.01	0.06	$ 23,000	12,253	735	$16,909,023	0.25	0.02	0.12
MY 1998 - 2001	$7,136	0.16	0.01	0.10	$ 23,000	10,047	603	$13,865,399	0.27	0.01	0.16
MY 2002 - 2006	$6,461	0.16	0.01	0.06	$ 23,000	16,998	1,360	$31,276,568	0.58	0.05	0.22
Sub Total							3,378	77,696,105	1.36	0.12	0.56
SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	7,174	287	$7,603,936	0.23	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	1,329	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$15,979	0.25	0.00	0.00	$ 26,500	12,253	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$12,445	0.33	0.00	0.00	$ 26,500	10,047	402	$10,650,234	0.36	0.00	0.00
MY 2002 - 2006	$13,569	0.31	0.00	0.00	$ 26,500	16,998	680	$18,018,023	0.58	0.00	0.00
Sub Total							1,369	36,272,193	1.17	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	7,174	717	$1,434,705	0.00	0.02	0.05
MY 1990	$1,227	0.00	0.01	0.03	$2,000	1,329	133	$265,851	0.00	0.00	0.01
MY 1991 - 1997	$1,959	0.00	0.00	0.05	$2,000	12,253	1,225	$2,450,583	0.00	0.01	0.16
MY 1998 - 2001	$1,590	0.00	0.00	0.08	$2,000	10,047	1,005	$2,009,478	0.00	0.01	0.21
MY 2002 - 2006	$1,500	0.00	0.01	0.05	$2,000	16,998	1,700	$3,399,627	0.00	0.03	0.22
Sub Total							4,780	9,560,244	0.00	0.08	0.65
FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	7,174	574	$5,164,938	0.00	0.02	0.06
MY 1990	$4,343	0.00	0.01	0.04	$9,000	1,329	106	$957,064	0.00	0.00	0.01
MY 1991 - 1997	$6,767	0.00	0.01	0.06	$9,000	12,253	980	$8,822,099	0.00	0.01	0.17
MY 1998 - 2001	$5,418	0.00	0.01	0.11	$9,000	10,047	804	$7,234,121	0.00	0.01	0.23
MY 2002 - 2006	$5,228	0.00	0.01	0.07	$9,000	16,998	1,360	$12,238,657	0.00	0.03	0.24
Sub Total							3,824	34,416,879	0.00	0.08	0.72
DOC+SCR Retrofit											
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	7,174	430	$11,836,316	0.35	0.01	0.03
MY 1990	$11,411	0.19	0.01	0.03	$27,500	1,329	53	$1,462,181	0.03	0.00	0.00
MY 1991 - 1997	$11,375	0.25	0.00	0.05	$27,500	12,253	490	$13,478,206	0.33	0.00	0.06
MY 1998 - 2001	$8,871	0.33	0.003	0.08	$27,500	10,047	603	$16,578,194	0.54	0.00	0.13
MY 2002 - 2006	$9,672	0.31	0.004	0.05	$27,500	16,998	1,020	$28,046,922	0.87	0.01	0.13
Sub Total							2,596	71,401,820	2.12	0.03	0.35
SCR+DPF											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	7,174	574	$17,216,459	0.46	0.03	0.05
MY 1990	$6,708	0.19	0.02	0.04	$30,000	1,329	106	$3,190,213	0.06	0.01	0.01
MY 1991 - 1997	$8,812	0.25	0.01	0.06	$30,000	12,253	735	$22,055,247	0.50	0.02	0.12
MY 1998 - 2001	$7,336	0.33	0.01	0.10	$30,000	10,047	603	$18,085,303	0.54	0.01	0.16
MY 2002 - 2006	$7,138	0.31	0.01	0.06	$30,000	16,998	1,020	$30,596,643	0.87	0.04	0.16
Sub Total							3,038	91,143,865	2.43	0.10	0.50
Overall Projects											
MY 1989 and Earlier						7,174	5,308	110,974,428	2.04	0.20	0.40
MY 1990						1,329	851	16,163,748	0.17	0.04	0.08
MY 1991 - 1997						12,253	5,881	87,240,755	1.23	0.11	0.92
MY 1998 - 2001						10,047	5,827	111,827,454	2.31	0.10	1.42
MY 2002 - 2006						16,998	10,539	200,068,046	3.85	0.29	1.56
MY 2007+						26,459	0	0	0	0	0
Total						74,260	28,407	526,274,431	9.59	0.74	4.37
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$4,590,688	1.85	0.31	0.26

One Emission Reduction Scenario Example for On-road HDDVs -2012 INDIANA

Sub Total								$4,590,688	1.85	0.31	0.26
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.01	0.0002	0.001	$7,500	74,260	22,278	$167,085,204	0.87	0.02	0.05
Sub Total						74,260	22,278	$167,085,204	0.87	0.02	0.05
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	100	12,882	7,729	$772,900	0.81	-	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	100	11,585	9,268	$926,766	3.29	-	0.00
Sub Total						24,466	16,997	$1,699,666	4.10	-	-
Grand Total						74,260	67,682	$699,649,989	16.4	1.1	4.7

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2012 INDIANA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	57	$1,693,250	0.12	0.00	0.01
Rubber Tire Loaders	140	$5,919,000	0.27	0.01	0.02
Crawler Tractor/Dozer	84	$4,008,750	0.16	0.00	0.02
Tractors/Loaders/Backhoes	113	$1,273,250	0.04	0.00	0.00
Off-Highway Trucks	7	$1,386,783	0.07	0.00	0.00
Sub Total	**401**	**$14,281,033**	**0.66**	**0.01**	**0.06**
Measure 51a: DPF Retrofit					
Excavators	506	$3,881,842	0.00	0.02	0.04
Rubber Tire Loaders	463	$4,125,789	0.00	0.02	0.05
Crawler Tractor/Dozer	473	$4,728,789	0.00	0.02	0.05
Tractors/Loaders/Backhoes	688	$2,758,737	0.00	0.02	0.03
Off-Highway Trucks	20	$1,030,427	0.00	0.01	0.03
Sub Total	**2,150**	**$16,525,585**	**0.00**	**0.08**	**0.19**
Measure 51b: Lean NOx Catalyst					
Excavators	314	$5,363,158	0.13	0.01	0.03
Rubber Tire Loaders	203	$4,182,105	0.09	0.01	0.02
Crawler Tractor/Dozer	232	$4,777,895	0.10	0.01	0.03
Tractors/Loaders/Backhoes	381	$3,198,947	0.06	0.01	0.02
Off-Highway Trucks	13	$1,488,395	0.08	0.01	0.02
Sub Total	**1,143**	**$19,010,500**	**0.45**	**0.05**	**0.11**
Measure 51c: EGR+DPF Retrofit					
Excavators	250	$4,428,105	0.15	0.01	0.02
Rubber Tire Loaders	203	$4,809,421	0.15	0.01	0.02
Crawler Tractor/Dozer	232	$5,494,579	0.15	0.01	0.03
Tractors/Loaders/Backhoes	270	$2,738,211	0.07	0.01	0.01
Off-Highway Trucks	13	$1,711,654	0.13	0.01	0.02
Sub Total	**968**	**$19,181,970**	**0.65**	**0.04**	**0.11**
Measure 51d: SCR Retrofit					
Excavators	159	$3,705,816	0.24	0.00	0.00
Rubber Tire Loaders	128	$3,852,263	0.23	0.00	0.00
Crawler Tractor/Dozer	174	$5,440,868	0.26	0.00	0.00
Tractors/Loaders/Backhoes	86	$1,241,316	0.05	0.00	0.00
Off-Highway Trucks	20	$3,034,036	0.37	0.00	0.00
Sub Total	**567**	**$17,274,299**	**1.16**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	115	$175,263	0.00	0.00	0.01
Rubber Tire Loaders	149	$296,737	0.00	0.00	0.02
Crawler Tractor/Dozer	107	$210,737	0.00	0.00	0.01
Tractors/Loaders/Backhoes	162	$134,105	0.00	0.00	0.01
Off-Highway Trucks	4	$45,797	0.00	0.00	0.01
Sub Total	**537**	**$862,639**	**0.00**	**0.01**	**0.05**
Measure 51f: FTF Retrofit					
Excavators	322	$2,455,105	0.00	0.01	0.03
Rubber Tire Loaders	305	$2,812,737	0.00	0.01	0.04
Crawler Tractor/Dozer	312	$3,089,368	0.00	0.01	0.04
Tractors/Loaders/Backhoes	565	$2,201,211	0.00	0.01	0.03
Off-Highway Trucks	20	$1,030,427	0.00	0.00	0.03
Sub Total	**1,524**	**$11,588,848**	**0.00**	**0.04**	**0.16**
Measure 51g: DOC+SCR Retrofit					
Excavators	250	$5,294,474	0.31	0.00	0.02
Rubber Tire Loaders	251	$7,734,737	0.42	0.00	0.03
Crawler Tractor/Dozer	174	$5,646,184	0.26	0.00	0.02
Tractors/Loaders/Backhoes	212	$3,184,211	0.13	0.00	0.01
Off-Highway Trucks	20	$3,148,528	0.37	0.00	0.02
Sub Total	**907**	**$25,008,133**	**1.50**	**0.01**	**0.09**
Measure 51h: SCR+DPF Retrofit					
Excavators	330	$8,557,895	0.44	0.01	0.03
Rubber Tire Loaders	305	$9,375,789	0.45	0.01	0.04
Crawler Tractor/Dozer	312	$10,297,895	0.42	0.01	0.03
Tractors/Loaders/Backhoes	404	$6,669,474	0.24	0.02	0.02
Off-Highway Trucks	20	$3,434,758	0.37	0.01	0.02
Sub Total	**1,371**	**$38,335,810**	**1.92**	**0.07**	**0.15**
Grand Total	**9,568**	**$162,068,819**	**6.36**	**0.32**	**0.92**

One Example Emission Reduction Scenario for Agricultural Equipment - 2012 INDIANA

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2012 INDIANA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	5,604	$77,336,700	2.27	0.12	0.20
Combines	63	$2,155,000	0.03	0.00	0.00
Sub Total	**5,667**	**$79,491,700**	**2.30**	**0.12**	**0.20**
Measure 51a: DPF Retrofit					
Agricultural Tractors	7,155	$39,117,316	0.00	0.20	0.35
Combines	351	$2,416,263	0.00	0.01	0.00
Sub Total	**7,506**	**$41,533,579**	**0.00**	**0.20**	**0.35**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	3,913	$52,090,211	0.88	0.14	0.17
Combines	63	$998,947	0.01	0.00	0.00
Sub Total	**3,976**	**$53,089,158**	**0.89**	**0.14**	**0.17**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	4,590	$41,211,158	1.03	0.11	0.17
Combines	63	$1,148,789	0.01	0.00	0.00
Sub Total	**4,653**	**$42,359,947**	**1.05**	**0.11**	**0.17**
Measure 51d: SCR Retrofit					
Agricultural Tractors	1,984	$26,347,974	1.15	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,984**	**$26,347,974**	**1.15**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	5,521	$5,189,263	0.00	0.06	0.22
Combines	452	$681,684	0.00	0.00	0.00
Sub Total	**5,973**	**$5,870,947**	**0.00**	**0.06**	**0.23**
Measure 51f: FTF Retrofit					
Agricultural Tractors	5,795	$24,122,842	0.00	0.08	0.31
Combines	87	$574,579	0.00	0.00	0.00
Sub Total	**5,882**	**$24,697,421**	**0.00**	**0.08**	**0.31**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	3,121	$38,343,684	1.58	0.02	0.12
Combines	0	$0	0.00	0.00	0.00
Sub Total	**3,121**	**$38,343,684**	**1.58**	**0.02**	**0.12**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	5,479	$74,998,421	2.78	0.12	0.25
Combines	63	$1,498,421	0.02	0.00	0.00
Sub Total	**5,542**	**$76,496,842**	**2.80**	**0.12**	**0.25**
Grand Total	**44,304**	**$388,231,253**	**9.77**	**0.86**	**1.81**

One Emission Reduction Scenario Example for On-road HDDVs -2009 MICHIGAN

One Preliminary Scenario for On Road HDDV Strategies for MICHIGAN (2009 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	10,079	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	10,079	302	$12,094,988	0.22	0.02	0.00
MY 1990	$8,551	0.12	0.03	0.00	$40,000	1,433	43	$1,720,002	0.01	0.00	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	13,195	-	$0	0.00	0.00	0.00
Sub Total							345	13,814,990	0.23	0.02	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	10,079	302	$13,606,862	0.26	0.02	0.03
MY 1990	$8,015	0.20	0.03	0.04	$45,000	1,433	43	$1,935,002	0.02	0.00	0.01
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	13,195	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.22	0.00	0.11	$45,000	10,825	-	$0	0.00	0.00	0.00
Sub Total							345	15,541,864	0.29	0.02	0.03
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	10,825	325	19,485,497	0.47	0.01	0.14
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	18,313	549	32,962,770	0.74	0.03	0.12
Sub Total							874	$52,448,267	1.21	0.04	0.27
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	10,079	504	$4,535,621	0.00	0.03	0.05
MY 1990	$2,069	0.00	0.03	0.06	$9,000	1,433	72	$645,001	0.00	0.01	0.01
MY 1991 - 1997	$3,534	0.00	0.01	0.09	$9,000	13,195	660	$5,937,540	0.00	0.02	0.16
MY 1998 - 2001	$3,026	0.00	0.01	0.15	$9,000	10,825	541	$4,871,374	0.00	0.02	0.22
MY 2002 - 2006	$2,601	0.00	0.02	0.09	$9,000	18,313	916	$8,240,693	0.00	0.05	0.22
Sub Total							2,692	$24,230,228	0.00	0.12	0.86
Cleaire LNC+DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	10,079	403	$8,063,326	0.11	0.02	0.04
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	1,433	57	$1,146,668	0.01	0.00	0.01
MY 1991 - 1997	$6,645	0.11	0.01	0.08	$ 20,000	13,195	528	$10,555,626	0.15	0.02	0.12
MY 1998 - 2001	$5,816	0.14	0.01	0.13	$ 20,000	10,825	433	$8,660,221	0.17	0.01	0.16
MY 2002 - 2006	$5,487	0.13	0.02	0.08	$ 20,000	18,313	733	$14,650,120	0.27	0.04	0.16
Sub Total							2,154	43,075,960	0.71	0.10	0.49
EGR+DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	10,079	403	$9,272,824	0.18	0.02	0.04
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	1,433	57	$1,318,668	0.02	0.00	0.01
MY 1991 - 1997	$6,281	0.17	0.01	0.08	$ 23,000	13,195	528	$12,138,970	0.24	0.02	0.12
MY 1998 - 2001	$5,192	0.22	0.01	0.13	$ 23,000	10,825	433	$9,959,254	0.27	0.01	0.16
MY 2002 - 2006	$4,710	0.21	0.02	0.08	$ 23,000	18,313	733	$16,847,638	0.43	0.04	0.16
Sub Total							2,154	49,537,354	1.14	0.10	0.49
SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	10,079	202	$5,341,953	0.18	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	1,433	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$11,810	0.34	0.00	0.00	$ 26,500	13,195	264	$6,993,102	0.24	0.00	0.00
MY 1998 - 2001	$9,224	0.45	0.00	0.00	$ 26,500	10,825	325	$8,606,095	0.40	0.00	0.00
MY 2002 - 2006	$10,173	0.43	0.00	0.00	$ 26,500	18,313	366	$9,705,705	0.43	0.00	0.00
Sub Total							1,156	30,646,855	1.25	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	10,079	504	$1,007,916	0.00	0.01	0.04
MY 1990	$928	0.00	0.01	0.04	$2,000	1,433	72	$143,333	0.00	0.00	0.01
MY 1991 - 1997	$1,431	0.00	0.01	0.06	$2,000	13,195	660	$1,319,453	0.00	0.01	0.12
MY 1998 - 2001	$1,156	0.00	0.01	0.11	$2,000	10,825	541	$1,082,528	0.00	0.01	0.16
MY 2002 - 2006	$1,093	0.00	0.01	0.06	$2,000	18,313	916	$1,831,265	0.00	0.02	0.16
Sub Total							2,692	5,384,495	0.00	0.06	0.48
FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	10,079	403	$3,628,496	0.00	0.01	0.04
MY 1990	$3,257	0.00	0.02	0.06	$9,000	1,433	72	$645,001	0.00	0.00	0.01
MY 1991 - 1997	$4,945	0.00	0.01	0.09	$9,000	13,195	528	$4,750,032	0.00	0.01	0.13
MY 1998 - 2001	$3,941	0.00	0.01	0.15	$9,000	10,825	541	$4,871,374	0.00	0.01	0.22
MY 2002 - 2006	$3,809	0.00	0.01	0.09	$9,000	18,313	916	$8,240,693	0.00	0.03	0.22
Sub Total							2,460	22,135,596	0.00	0.06	0.62
DOC+SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	10,079	302	$8,315,304	0.27	0.00	0.02
MY 1990	$8,611	0.26	0.01	0.04	$27,500	1,433	43	$1,182,501	0.03	0.00	0.00
MY 1991 - 1997	$8,404	0.34	0.00	0.06	$27,500	13,195	396	$10,885,489	0.37	0.00	0.07
MY 1998 - 2001	$6,571	0.45	0.004	0.10	$27,500	10,825	433	$11,907,804	0.53	0.00	0.12
MY 2002 - 2006	$7,245	0.43	0.006	0.06	$27,500	18,313	549	$15,107,936	0.65	0.01	0.10
Sub Total							1,724	47,399,035	1.84	0.02	0.32
SCR+DPF											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	10,079	403	$12,094,988	0.36	0.02	0.04
MY 1990	$5,060	0.26	0.03	0.05	$30,000	1,433	57	$1,720,002	0.04	0.00	0.01
MY 1991 - 1997	$6,505	0.34	0.01	0.08	$30,000	13,195	528	$15,833,439	0.49	0.02	0.12
MY 1998 - 2001	$5,427	0.45	0.01	0.13	$30,000	10,825	433	$12,990,332	0.53	0.01	0.16
MY 2002 - 2006	$5,335	0.43	0.02	0.08	$30,000	18,313	733	$21,975,180	0.86	0.04	0.16
Sub Total							2,154	64,613,941	2.28	0.10	0.48
Overall Projects											
MY 1989 and Earlier						10,079	3,729	77,962,279	1.57	0.15	0.31
MY 1990						1,433	516	10,456,176	0.14	0.03	0.06
MY 1991 - 1997						13,195	4,090	68,413,652	1.50	0.10	0.82
MY 1998 - 2001						10,825	4,005	82,434,479	2.37	0.09	1.33
MY 2002 - 2006						18,313	6,409	129,561,999	3.38	0.25	1.32
MY 2007+						11,604	0	0	0	0	0
Total						65,449	18,750	368,828,585	8.96	0.63	3.84
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$4,830,102	1.95	0.33	0.27

One Emission Reduction Scenario Example for On-road HDDVs -2009 MICHIGAN

Sub Total								$4,830,102	1.95	0.33	0.27
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.04	0.000	0.002	$7,500	65,449	9,817	$73,630,205	1.08	0.01	0.06
Sub Total						65,449	9,817	$73,630,205	1.08	0.01	0.06
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
Diesel Engine Reflash (MY 1993-1998 Engines)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	13,864	8,318	$831,844	0.88	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	12,468	9,974	$997,444	3.54	0.00	0.00
Sub Total							18,293	1,829,288	4.41	-	-
Grand Total						65,449	46,861	$449,118,179	16.4	1.0	4.2

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2009 MICHIGAN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	97	$2,301,500	0.18	0.00	0.02
Rubber Tire Loaders	108	$3,860,250	0.18	0.00	0.02
Crawler Tractor/Dozer	74	$2,978,250	0.12	0.01	0.02
Tractors/Loaders/Backhoes	171	$1,813,750	0.05	0.00	0.00
Off-Highway Trucks	8	$1,305,208	0.09	0.00	0.00
Sub Total	**458**	**$12,258,958**	**0.62**	**0.02**	**0.06**
Measure 51a: DPF Retrofit					
Excavators	169	$1,258,579	0.00	0.01	0.02
Rubber Tire Loaders	192	$1,873,895	0.00	0.01	0.03
Crawler Tractor/Dozer	125	$1,269,947	0.00	0.01	0.02
Tractors/Loaders/Backhoes	455	$1,751,211	0.00	0.02	0.02
Off-Highway Trucks	10	$515,214	0.00	0.00	0.03
Sub Total	**951**	**$6,668,845**	**0.00**	**0.04**	**0.12**
Measure 51b: Lean NOx Catalyst					
Excavators	145	$2,518,947	0.07	0.01	0.02
Rubber Tire Loaders	124	$2,467,368	0.07	0.01	0.02
Crawler Tractor/Dozer	110	$2,413,684	0.05	0.01	0.02
Tractors/Loaders/Backhoes	413	$3,434,737	0.06	0.01	0.02
Off-Highway Trucks	10	$1,144,919	0.07	0.00	0.02
Sub Total	**802**	**$11,979,656**	**0.33**	**0.04**	**0.10**
Measure 51c: EGR+DPF Retrofit					
Excavators	145	$2,896,789	0.12	0.01	0.02
Rubber Tire Loaders	138	$3,303,526	0.12	0.01	0.02
Crawler Tractor/Dozer	110	$2,775,737	0.08	0.01	0.02
Tractors/Loaders/Backhoes	269	$2,729,737	0.07	0.01	0.01
Off-Highway Trucks	10	$1,316,657	0.11	0.00	0.02
Sub Total	**672**	**$13,022,447**	**0.50**	**0.03**	**0.09**
Measure 51d: SCR Retrofit					
Excavators	109	$2,502,158	0.20	0.00	0.00
Rubber Tire Loaders	100	$2,761,579	0.18	0.00	0.00
Crawler Tractor/Dozer	101	$3,060,053	0.15	0.00	0.00
Tractors/Loaders/Backhoes	127	$1,803,395	0.08	0.00	0.00
Off-Highway Trucks	14	$2,123,825	0.30	0.00	0.00
Sub Total	**451**	**$12,251,009**	**0.91**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	145	$251,895	0.00	0.00	0.01
Rubber Tire Loaders	192	$416,421	0.00	0.00	0.02
Crawler Tractor/Dozer	125	$282,211	0.00	0.00	0.02
Tractors/Loaders/Backhoes	413	$343,474	0.00	0.01	0.01
Off-Highway Trucks	10	$114,492	0.00	0.00	0.02
Sub Total	**885**	**$1,408,492**	**0.00**	**0.02**	**0.09**
Measure 51f: FTF Retrofit					
Excavators	92	$664,579	0.00	0.00	0.01
Rubber Tire Loaders	99	$870,632	0.00	0.00	0.02
Crawler Tractor/Dozer	81	$761,211	0.00	0.00	0.01
Tractors/Loaders/Backhoes	249	$986,684	0.00	0.00	0.01
Off-Highway Trucks	10	$515,214	0.00	0.00	0.03
Sub Total	**531**	**$3,798,319**	**0.00**	**0.02**	**0.08**
Measure 51g: DOC+SCR Retrofit					
Excavators	145	$3,463,553	0.24	0.00	0.01
Rubber Tire Loaders	163	$4,908,026	0.31	0.00	0.02
Crawler Tractor/Dozer	101	$3,175,526	0.15	0.00	0.02
Tractors/Loaders/Backhoes	221	$3,211,711	0.14	0.00	0.01
Off-Highway Trucks	14	$2,203,970	0.30	0.00	0.02
Sub Total	**644**	**$16,962,785**	**1.14**	**0.01**	**0.08**
Measure 51h: SCR+DPF Retrofit					
Excavators	184	$4,779,474	0.31	0.01	0.02
Rubber Tire Loaders	174	$5,545,263	0.32	0.01	0.03
Crawler Tractor/Dozer	142	$4,528,421	0.20	0.01	0.02
Tractors/Loaders/Backhoes	464	$7,389,474	0.29	0.02	0.02
Off-Highway Trucks	14	$2,404,330	0.30	0.01	0.03
Sub Total	**978**	**$24,646,962**	**1.41**	**0.05**	**0.12**
Grand Total	**6,372**	**$102,997,474**	**4.92**	**0.23**	**0.75**

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2009 MICHIGAN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	1,561	$20,671,200	0.62	0.04	0.05
Combines	14	$262,500	0.00	0.00	0.00
Sub Total	**1,575**	**$20,933,700**	**0.62**	**0.04**	**0.05**
Measure 51a: DPF Retrofit					
Agricultural Tractors	1,850	$8,237,842	0.00	0.05	0.07
Combines	64	$439,579	0.00	0.00	0.00
Sub Total	**1,914**	**$8,677,421**	**0.00**	**0.05**	**0.07**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	1,130	$14,391,789	0.25	0.04	0.04
Combines	19	$278,947	0.00	0.00	0.00
Sub Total	**1,149**	**$14,670,737**	**0.25**	**0.04**	**0.04**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	1,455	$12,469,632	0.33	0.03	0.04
Combines	19	$320,789	0.00	0.00	0.00
Sub Total	**1,474**	**$12,790,421**	**0.33**	**0.03**	**0.04**
Measure 51d: SCR Retrofit					
Agricultural Tractors	596	$7,585,974	0.35	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**596**	**$7,585,974**	**0.35**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	1,974	$1,601,053	0.00	0.02	0.05
Combines	92	$141,895	0.00	0.00	0.00
Sub Total	**2,066**	**$1,742,947**	**0.00**	**0.02**	**0.05**
Measure 51f: FTF Retrofit					
Agricultural Tractors	1,286	$4,042,421	0.00	0.02	0.04
Combines	19	$125,526	0.00	0.00	0.00
Sub Total	**1,305**	**$4,167,947**	**0.00**	**0.02**	**0.04**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	925	$12,331,579	0.52	0.01	0.04
Combines	0	$0	0.00	0.00	0.00
Sub Total	**925**	**$12,331,579**	**0.52**	**0.01**	**0.04**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	1,622	$20,074,737	0.78	0.04	0.05
Combines	19	$418,421	0.01	0.00	0.00
Sub Total	**1,641**	**$20,493,158**	**0.79**	**0.04**	**0.05**
Grand Total	**12,645**	**$103,393,884**	**2.86**	**0.25**	**0.39**

One Emission Reduction Scenario Example for On-road HDDVs - 2012 MICHIGAN

One Preliminary Scenario for On Road HDDV Strategies for MICHIGAN (2012 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	6,709	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	6,709	403	$16,102,465	0.26	0.02	0.00
MY 1990	$11,401	0.09	0.02	0.00	$40,000	1,243	50	$1,989,193	0.01	0.00	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	11,460	-	$0	0.00	0.00	0.00
Sub Total							452	18,091,659	0.28	0.02	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,522	0.29	0.02	0.03	$45,000	6,709	403	$18,115,273	0.32	0.02	0.03
MY 1990	$10,687	0.15	0.02	0.03	$45,000	1,243	50	$2,237,843	0.02	0.00	0.00
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	11,460	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	9,397	-	$0	0.00	0.00	0.00
Sub Total							452	20,353,116	0.34	0.02	0.04
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	9,397	376	22,553,453	0.40	0.01	0.12
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	15,898	636	38,155,841	0.62	0.03	0.10
Sub Total							1,012	60,709,294	1.02	0.03	0.22
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	6,709	671	$6,038,424	0.00	0.03	0.07
MY 1990	$2,769	0.00	0.02	0.04	$9,000	1,243	124	$1,118,921	0.00	0.01	0.01
MY 1991 - 1997	$4,835	0.00	0.01	0.06	$9,000	11,460	917	$8,251,263	0.00	0.02	0.16
MY 1998 - 2001	$4,161	0.00	0.01	0.11	$9,000	9,397	752	$6,766,036	0.00	0.02	0.22
MY 2002 - 2006	$3,570	0.00	0.01	0.07	$9,000	15,898	1,590	$14,308,441	0.00	0.06	0.28
Sub Total							4,054	$36,483,085	0.00	0.14	0.74
Cleaire LNC+DPF											
MY 1989 and Earlier	$6,074	0.09	0.02	0.03	$ 20,000	6,709	537	$10,734,977	0.13	0.03	0.05
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	1,243	99	$1,989,193	0.02	0.01	0.01
MY 1991 - 1997	$8,933	0.08	0.01	0.06	$ 20,000	11,460	688	$13,752,105	0.15	0.02	0.11
MY 1998 - 2001	$7,766	0.10	0.01	0.10	$ 20,000	9,397	564	$11,276,726	0.16	0.01	0.15
MY 2002 - 2006	$7,207	0.10	0.01	0.06	$ 20,000	15,898	954	$19,077,921	0.26	0.04	0.16
Sub Total							2,842	$56,830,923	0.71	0.10	0.47
EGR+DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.02	0.03	$ 23,000	6,709	537	$12,345,223	0.22	0.03	0.05
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	1,243	99	$2,287,572	0.03	0.01	0.01
MY 1991 - 1997	$8,593	0.12	0.01	0.06	$ 23,000	11,460	688	$15,814,921	0.23	0.02	0.11
MY 1998 - 2001	$7,136	0.16	0.01	0.10	$ 23,000	9,397	564	$12,968,236	0.25	0.01	0.15
MY 2002 - 2006	$6,461	0.16	0.01	0.06	$ 23,000	15,898	1,272	$29,252,812	0.54	0.05	0.21
Sub Total							3,160	72,668,764	1.27	0.11	0.53
SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	6,709	268	$7,111,922	0.22	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	1,243	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$15,979	0.25	0.00	0.00	$ 26,500	11,460	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$12,445	0.33	0.00	0.00	$ 26,500	9,397	376	$9,961,108	0.34	0.00	0.00
MY 2002 - 2006	$13,569	0.31	0.00	0.00	$ 26,500	15,898	636	$16,852,163	0.54	0.00	0.00
Sub Total							1,280	33,925,194	1.10	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	6,709	671	$1,341,872	0.00	0.02	0.05
MY 1990	$1,227	0.00	0.01	0.03	$2,000	1,243	124	$248,649	0.00	0.00	0.01
MY 1991 - 1997	$1,959	0.00	0.00	0.05	$2,000	11,460	1,146	$2,292,018	0.00	0.01	0.15
MY 1998 - 2001	$1,590	0.00	0.00	0.08	$2,000	9,397	940	$1,879,454	0.00	0.01	0.20
MY 2002 - 2006	$1,500	0.00	0.01	0.05	$2,000	15,898	1,590	$3,179,653	0.00	0.03	0.21
Sub Total							4,471	8,941,647	0.00	0.07	0.61
FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	6,709	537	$4,830,740	0.00	0.02	0.05
MY 1990	$4,343	0.00	0.01	0.04	$9,000	1,243	99	$895,137	0.00	0.00	0.01
MY 1991 - 1997	$6,767	0.00	0.01	0.06	$9,000	11,460	917	$8,251,263	0.00	0.01	0.16
MY 1998 - 2001	$5,418	0.00	0.01	0.11	$9,000	9,397	752	$6,766,036	0.00	0.01	0.22
MY 2002 - 2006	$5,228	0.00	0.01	0.07	$9,000	15,898	1,272	$11,446,752	0.00	0.03	0.23
Sub Total							3,577	32,189,928	0.00	0.07	0.67
DOC+SCR Retrofit											
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	6,709	403	$11,070,445	0.32	0.01	0.03
MY 1990	$11,411	0.19	0.01	0.03	$27,500	1,243	50	$1,367,570	0.03	0.00	0.00
MY 1991 - 1997	$11,375	0.25	0.00	0.05	$27,500	11,460	458	$12,606,097	0.31	0.00	0.06
MY 1998 - 2001	$8,871	0.33	0.003	0.08	$27,500	9,397	564	$15,505,499	0.50	0.00	0.12
MY 2002 - 2006	$9,672	0.31	0.004	0.05	$27,500	15,898	954	$26,232,141	0.82	0.01	0.12
Sub Total							2,428	66,781,752	1.98	0.02	0.33
SCR+DPF											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	6,709	537	$16,102,465	0.43	0.03	0.05
MY 1990	$6,708	0.19	0.02	0.04	$30,000	1,243	99	$2,983,790	0.05	0.01	0.01
MY 1991 - 1997	$8,812	0.25	0.01	0.06	$30,000	11,460	688	$20,628,158	0.47	0.02	0.11
MY 1998 - 2001	$7,336	0.33	0.01	0.10	$30,000	9,397	564	$16,915,090	0.50	0.01	0.15
MY 2002 - 2006	$7,138	0.31	0.01	0.06	$30,000	15,898	954	$28,616,881	0.82	0.04	0.15
Sub Total							2,842	85,246,384	2.27	0.10	0.47
Overall Projects											
MY 1989 and Earlier						6,709	4,965	103,793,807	1.90	0.18	0.37
MY 1990						1,243	796	15,117,876	0.15	0.04	0.08
MY 1991 - 1997						11,460	5,501	81,595,825	1.15	0.11	0.86
MY 1998 - 2001						9,397	5,450	104,591,637	2.16	0.09	1.32
MY 2002 - 2006						15,898	9,857	187,122,695	3.69	0.27	1.46
MY 2007+						24,747	0	0	0	0	0
Total						69,455	26,569	492,221,744	8.97	0.69	4.09
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$9,660,204	3.89	0.66	0.55

One Emission Reduction Scenario Example for On-road HDDVs - 2012 MICHIGAN

Sub Total								$9,660,204	3.89	0.66	0.55
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.03	0.0002	0.002	$7,500	69,455	20,837	$156,273,924	1.86	0.01	0.10
Sub Total						69,455	20,837	$156,273,924	1.86	0.01	0.10
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	12,048	7,229	$722,889	0.76	-	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	10,835	8,668	$866,799	3.08	-	0.00
Sub Total						22,883	15,897	$1,589,689	3.84	-	-
Grand Total						69,455	63,302	$659,745,562	18.6	1.4	4.7

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2012 MICHIGAN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	57	$1,693,250	0.12	0.00	0.01
Rubber Tire Loaders	157	$6,633,000	0.30	0.01	0.02
Crawler Tractor/Dozer	77	$3,680,250	0.15	0.00	0.02
Tractors/Loaders/Backhoes	261	$2,935,750	0.08	0.01	0.01
Off-Highway Trucks	9	$1,767,469	0.09	0.00	0.00
Sub Total	**561**	**$16,709,719**	**0.75**	**0.02**	**0.07**
Measure 51a: DPF Retrofit					
Excavators	500	$3,831,158	0.00	0.02	0.04
Rubber Tire Loaders	515	$4,591,895	0.00	0.02	0.05
Crawler Tractor/Dozer	443	$4,406,211	0.00	0.02	0.05
Tractors/Loaders/Backhoes	1,575	$6,315,632	0.00	0.04	0.06
Off-Highway Trucks	22	$1,133,470	0.00	0.01	0.03
Sub Total	**3,055**	**$20,278,365**	**0.00**	**0.11**	**0.23**
Measure 51b: Lean NOx Catalyst					
Excavators	311	$5,320,000	0.12	0.01	0.03
Rubber Tire Loaders	226	$4,638,947	0.11	0.01	0.03
Crawler Tractor/Dozer	216	$4,434,737	0.09	0.01	0.03
Tractors/Loaders/Backhoes	874	$7,345,263	0.13	0.03	0.04
Off-Highway Trucks	15	$1,717,379	0.09	0.01	0.02
Sub Total	**1,642**	**$23,456,326**	**0.54**	**0.07**	**0.14**
Measure 51c: EGR+DPF Retrofit					
Excavators	247	$4,378,474	0.15	0.01	0.02
Rubber Tire Loaders	226	$5,334,789	0.17	0.01	0.03
Crawler Tractor/Dozer	216	$5,099,947	0.14	0.01	0.03
Tractors/Loaders/Backhoes	620	$6,294,737	0.16	0.02	0.03
Off-Highway Trucks	15	$1,974,986	0.15	0.01	0.02
Sub Total	**1,324**	**$23,082,933**	**0.76**	**0.06**	**0.13**
Measure 51d: SCR Retrofit					
Excavators	158	$3,679,316	0.24	0.00	0.00
Rubber Tire Loaders	143	$4,277,658	0.26	0.00	0.00
Crawler Tractor/Dozer	162	$5,047,553	0.24	0.00	0.00
Tractors/Loaders/Backhoes	199	$2,874,553	0.13	0.00	0.00
Off-Highway Trucks	22	$3,337,440	0.42	0.00	0.00
Sub Total	**684**	**$19,216,519**	**1.28**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	115	$175,263	0.00	0.00	0.01
Rubber Tire Loaders	164	$325,368	0.00	0.00	0.02
Crawler Tractor/Dozer	103	$205,263	0.00	0.00	0.01
Tractors/Loaders/Backhoes	371	$307,474	0.00	0.01	0.02
Off-Highway Trucks	4	$45,797	0.00	0.00	0.01
Sub Total	**757**	**$1,059,165**	**0.00**	**0.02**	**0.06**
Measure 51f: FTF Retrofit					
Excavators	319	$2,435,684	0.00	0.01	0.03
Rubber Tire Loaders	341	$3,152,842	0.00	0.01	0.04
Crawler Tractor/Dozer	291	$2,865,316	0.00	0.01	0.03
Tractors/Loaders/Backhoes	1,292	$5,034,316	0.00	0.02	0.06
Off-Highway Trucks	22	$1,133,470	0.00	0.00	0.03
Sub Total	**2,265**	**$14,621,628**	**0.00**	**0.05**	**0.20**
Measure 51g: DOC+SCR Retrofit					
Excavators	247	$5,235,132	0.30	0.00	0.02
Rubber Tire Loaders	281	$8,678,421	0.48	0.00	0.03
Crawler Tractor/Dozer	162	$5,238,026	0.24	0.00	0.02
Tractors/Loaders/Backhoes	487	$7,313,553	0.31	0.01	0.02
Off-Highway Trucks	22	$3,463,381	0.42	0.00	0.02
Sub Total	**1,199**	**$29,928,512**	**1.75**	**0.02**	**0.11**
Measure 51h: SCR+DPF Retrofit					
Excavators	327	$8,493,158	0.43	0.01	0.03
Rubber Tire Loaders	341	$10,509,474	0.51	0.01	0.04
Crawler Tractor/Dozer	291	$9,551,053	0.39	0.01	0.03
Tractors/Loaders/Backhoes	926	$15,281,053	0.56	0.04	0.05
Off-Highway Trucks	22	$3,778,234	0.42	0.01	0.03
Sub Total	**1,907**	**$47,612,970**	**2.30**	**0.09**	**0.18**
Grand Total	**13,394**	**$195,966,138**	**7.39**	**0.42**	**1.11**

One Example Emission Reduction Scenario for Agricultural Equipment - 2012 MICHIGAN

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2012 MICHIGAN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	3,116	$42,996,350	1.26	0.07	0.11
Combines	35	$1,192,500	0.02	0.00	0.00
Sub Total	**3,151**	**$44,188,850**	**1.28**	**0.07**	**0.11**
Measure 51a: DPF Retrofit					
Agricultural Tractors	3,978	$21,736,421	0.00	0.11	0.19
Combines	195	$1,341,947	0.00	0.00	0.00
Sub Total	**4,173**	**$23,078,368**	**0.00**	**0.11**	**0.19**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	2,177	$28,969,263	0.49	0.08	0.10
Combines	35	$556,842	0.00	0.00	0.00
Sub Total	**2,212**	**$29,526,105**	**0.50**	**0.08**	**0.10**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	2,551	$22,897,105	0.57	0.06	0.10
Combines	35	$640,368	0.01	0.00	0.00
Sub Total	**2,586**	**$23,537,474**	**0.58**	**0.06**	**0.10**
Measure 51d: SCR Retrofit					
Agricultural Tractors	1,103	$14,648,921	0.64	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,103**	**$14,648,921**	**0.64**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	3,069	$2,881,263	0.00	0.03	0.12
Combines	251	$378,211	0.00	0.00	0.00
Sub Total	**3,320**	**$3,259,474**	**0.00**	**0.04**	**0.13**
Measure 51f: FTF Retrofit					
Agricultural Tractors	3,221	$13,392,947	0.00	0.04	0.17
Combines	49	$323,526	0.00	0.00	0.00
Sub Total	**3,270**	**$13,716,474**	**0.00**	**0.04**	**0.17**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	1,738	$21,340,000	0.88	0.01	0.06
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,738**	**$21,340,000**	**0.88**	**0.01**	**0.06**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	3,045	$41,636,842	1.54	0.07	0.14
Combines	35	$835,263	0.01	0.00	0.00
Sub Total	**3,080**	**$42,472,105**	**1.56**	**0.07**	**0.14**
Grand Total	**24,633**	**$215,767,771**	**5.43**	**0.48**	**1.00**

One Emission Reduction Scenario Example for On-road HDDVs - 2009 OHIO

One Preliminary Scenario for On Road HDDV Strategies for OHIO (2009 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	16,027	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	16,027	481	$19,232,383	0.35	0.03	0.00
MY 1990	$8,551	0.12	0.03	0.00	$40,000	2,279	68	$2,734,995	0.02	0.01	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	20,981	-	$0	0.00	0.00	0.00
Sub Total							549	21,967,378	0.37	0.03	0.01
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	16,027	481	$21,636,431	0.42	0.03	0.04
MY 1990	$8,015	0.20	0.03	0.04	$45,000	2,279	68	$3,076,869	0.04	0.01	0.01
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	20,981	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.23	0.00	0.11	$45,000	17,213	-	$0	0.00	0.00	0.00
Sub Total							549	24,713,300	0.46	0.03	0.05
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	17,213	516	30,984,119	0.75	0.02	0.23
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	29,119	874	52,414,488	1.18	0.05	0.19
Sub Total							1,390	83,398,607	1.93	0.07	0.42
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	16,027	801	$7,212,144	0.00	0.04	0.09
MY 1990	$2,069	0.00	0.03	0.06	$9,000	2,279	114	$1,025,623	0.00	0.01	0.02
MY 1991 - 1997	$3,534	0.00	0.01	0.09	$9,000	20,981	1,049	$9,441,352	0.00	0.04	0.25
MY 1998 - 2001	$3,026	0.00	0.01	0.15	$9,000	17,213	861	$7,746,030	0.00	0.03	0.34
MY 2002 - 2006	$2,601	0.00	0.02	0.09	$9,000	29,119	1,456	$13,103,622	0.00	0.08	0.36
Sub Total							4,281	$36,528,770	0.00	0.19	1.06
Cleaire LNC+DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	16,027	641	$12,821,589	0.18	0.03	0.06
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	2,279	91	$1,823,330	0.02	0.01	0.01
MY 1991 - 1997	$6,645	0.11	0.01	0.08	$ 20,000	20,981	839	$16,784,625	0.24	0.03	0.18
MY 1998 - 2001	$5,816	0.14	0.01	0.13	$ 20,000	17,213	689	$13,770,719	0.26	0.02	0.25
MY 2002 - 2006	$5,487	0.13	0.02	0.08	$ 20,000	29,119	1,165	$23,295,328	0.43	0.06	0.26
Sub Total							3,425	68,495,591	1.13	0.15	0.77
EGR+DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	16,027	641	$14,744,827	0.28	0.03	0.06
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	2,279	91	$2,096,829	0.03	0.01	0.01
MY 1991 - 1997	$6,281	0.17	0.01	0.08	$ 23,000	20,981	839	$19,302,319	0.39	0.03	0.18
MY 1998 - 2001	$5,192	0.22	0.01	0.13	$ 23,000	17,213	689	$15,836,327	0.42	0.02	0.25
MY 2002 - 2006	$4,710	0.21	0.02	0.08	$ 23,000	29,119	1,165	$26,789,627	0.68	0.06	0.26
Sub Total							3,425	78,769,930	1.81	0.15	0.77
SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	16,027	321	$8,494,303	0.28	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	2,279	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$11,810	0.34	0.00	0.00	$ 26,500	20,981	420	$11,119,814	0.39	0.00	0.00
MY 1998 - 2001	$9,224	0.45	0.00	0.00	$ 26,500	17,213	516	$13,684,652	0.64	0.00	0.00
MY 2002 - 2006	$10,173	0.43	0.00	0.00	$ 26,500	29,119	582	$15,433,155	0.68	0.00	0.00
Sub Total							1,839	48,731,924	1.99	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	16,027	801	$1,602,699	0.00	0.02	0.06
MY 1990	$920	0.00	0.01	0.04	$2,000	2,279	114	$227,916	0.00	0.00	0.01
MY 1991 - 1997	$1,431	0.00	0.01	0.06	$2,000	20,981	1,049	$2,098,078	0.00	0.02	0.18
MY 1998 - 2001	$1,156	0.00	0.01	0.11	$2,000	17,213	861	$1,721,340	0.00	0.01	0.25
MY 2002 - 2006	$1,093	0.00	0.01	0.06	$2,000	29,119	1,456	$2,911,916	0.00	0.04	0.26
Sub Total							4,281	8,561,949	0.00	0.09	0.77
FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	16,027	641	$5,769,715	0.00	0.02	0.07
MY 1990	$3,257	0.00	0.02	0.06	$9,000	2,279	114	$1,025,623	0.00	0.01	0.02
MY 1991 - 1997	$4,945	0.00	0.01	0.09	$9,000	20,981	839	$7,553,081	0.00	0.02	0.20
MY 1998 - 2001	$3,941	0.00	0.01	0.15	$9,000	17,213	861	$7,746,030	0.00	0.02	0.34
MY 2002 - 2006	$3,809	0.00	0.01	0.09	$9,000	29,119	1,456	$13,103,622	0.00	0.04	0.36
Sub Total							3,911	35,198,071	0.00	0.10	0.99
DOC+SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	16,027	481	$13,222,263	0.42	0.01	0.04
MY 1990	$8,611	0.26	0.01	0.04	$27,500	2,279	68	$1,880,309	0.05	0.00	0.01
MY 1991 - 1997	$8,404	0.34	0.00	0.06	$27,500	20,981	629	$17,309,145	0.58	0.01	0.11
MY 1998 - 2001	$6,571	0.45	0.004	0.10	$27,500	17,213	689	$18,934,739	0.85	0.01	0.20
MY 2002 - 2006	$7,245	0.43	0.006	0.06	$27,500	29,119	874	$24,023,307	1.03	0.01	0.15
Sub Total							2,741	75,369,763	2.93	0.04	0.51
SCR+DPF											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	16,027	641	$19,232,383	0.57	0.03	0.06
MY 1990	$5,060	0.26	0.03	0.05	$30,000	2,279	91	$2,734,995	0.06	0.01	0.01
MY 1991 - 1997	$6,505	0.34	0.01	0.08	$30,000	20,981	839	$25,176,938	0.78	0.03	0.18
MY 1998 - 2001	$5,427	0.45	0.01	0.13	$30,000	17,213	689	$20,656,079	0.85	0.02	0.25
MY 2002 - 2006	$5,335	0.43	0.02	0.08	$30,000	29,119	1,165	$34,942,992	1.37	0.06	0.26
Sub Total							3,425	102,743,387	3.63	0.15	0.77
Overall Projects											
MY 1989 and Earlier						16,027	5,930	123,968,736	2.50	0.24	0.49
MY 1990						2,279	820	16,626,489	0.22	0.05	0.10
MY 1991 - 1997						20,981	6,504	108,785,353	2.38	0.16	1.30
MY 1998 - 2001						17,213	6,369	131,080,035	3.77	0.15	2.12
MY 2002 - 2006						29,119	10,192	206,018,058	5.37	0.40	2.10
MY 2007+						18,452	0	0	0	0	0
Total						104,071	29,815	586,478,671	14.25	1.00	6.30
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$1,794,610	0.72	0.12	0.10

One Emission Reduction Scenario Example for On-road HDDVs - 2009 OHIO

Sub Total								**$1,794,610**	**0.72**	**0.12**	**0.10**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.02	0.000	0.001	$7,500	104,071	15,611	$117,080,254	0.84	0.02	0.04
Sub Total						**104,071**	**15,611**	**$117,080,254**	**0.84**	**0.02**	**0.04**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
Diesel Engine Reflash (MY 1993-1998 Engines)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	22,045	13,227	$1,322,724	1.39	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	19,826	15,860	$1,586,047	5.63	0.00	0.00
Sub Total							**29,088**	**2,908,772**	**7.02**	**-**	**-**
Grand Total						**104,071**	**74,514**	**$708,262,307**	**22.8**	**1.1**	**6.2**

One Example Emission Reduction Scenario for Construction Equipment - 2009 OHIO

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2009 OHIO**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	175	$4,143,250	0.33	0.01	0.03
Rubber Tire Loaders	172	$6,144,250	0.29	0.01	0.03
Crawler Tractor/Dozer	140	$5,654,250	0.23	0.01	0.04
Tractors/Loaders/Backhoes	138	$1,458,750	0.04	0.00	0.00
Off-Highway Trucks	12	$1,957,812	0.13	0.00	0.00
Sub Total	**637**	**$19,358,312**	**1.02**	**0.03**	**0.10**
Measure 51a: DPF Retrofit					
Excavators	308	$2,295,474	0.00	0.01	0.04
Rubber Tire Loaders	308	$3,016,421	0.00	0.01	0.05
Crawler Tractor/Dozer	234	$2,390,211	0.00	0.01	0.04
Tractors/Loaders/Backhoes	374	$1,440,947	0.00	0.01	0.01
Off-Highway Trucks	15	$772,821	0.00	0.01	0.04
Sub Total	**1,239**	**$9,915,873**	**0.00**	**0.06**	**0.19**
Measure 51b: Lean NOx Catalyst					
Excavators	265	$4,603,158	0.14	0.01	0.03
Rubber Tire Loaders	197	$3,946,316	0.10	0.01	0.03
Crawler Tractor/Dozer	205	$4,495,789	0.10	0.01	0.04
Tractors/Loaders/Backhoes	339	$2,822,105	0.05	0.01	0.01
Off-Highway Trucks	15	$1,717,379	0.11	0.01	0.04
Sub Total	**1,021**	**$17,584,747**	**0.50**	**0.05**	**0.15**
Measure 51c: EGR+DPF Retrofit					
Excavators	265	$5,293,632	0.22	0.01	0.03
Rubber Tire Loaders	219	$5,250,053	0.19	0.01	0.03
Crawler Tractor/Dozer	205	$5,170,158	0.15	0.01	0.04
Tractors/Loaders/Backhoes	221	$2,245,526	0.06	0.01	0.01
Off-Highway Trucks	15	$1,974,986	0.17	0.01	0.04
Sub Total	**925**	**$19,934,354**	**0.79**	**0.05**	**0.15**
Measure 51d: SCR Retrofit					
Excavators	199	$4,577,526	0.36	0.00	0.00
Rubber Tire Loaders	162	$4,505,000	0.30	0.00	0.00
Crawler Tractor/Dozer	188	$5,696,105	0.29	0.00	0.00
Tractors/Loaders/Backhoes	104	$1,472,842	0.07	0.00	0.00
Off-Highway Trucks	22	$3,337,440	0.46	0.00	0.00
Sub Total	**675**	**$19,588,913**	**1.48**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	265	$460,316	0.00	0.01	0.03
Rubber Tire Loaders	308	$670,316	0.00	0.01	0.04
Crawler Tractor/Dozer	234	$531,158	0.00	0.01	0.03
Tractors/Loaders/Backhoes	339	$282,211	0.00	0.01	0.01
Off-Highway Trucks	15	$171,738	0.00	0.00	0.03
Sub Total	**1,161**	**$2,115,738**	**0.00**	**0.03**	**0.14**
Measure 51f: FTF Retrofit					
Excavators	171	$1,246,263	0.00	0.01	0.02
Rubber Tire Loaders	160	$1,414,895	0.00	0.01	0.03
Crawler Tractor/Dozer	149	$1,404,000	0.00	0.01	0.03
Tractors/Loaders/Backhoes	203	$805,737	0.00	0.00	0.01
Off-Highway Trucks	15	$772,821	0.00	0.00	0.04
Sub Total	**698**	**$5,643,715**	**0.00**	**0.02**	**0.13**
Measure 51g: DOC+SCR Retrofit					
Excavators	265	$6,329,342	0.43	0.00	0.03
Rubber Tire Loaders	260	$7,847,632	0.50	0.00	0.04
Crawler Tractor/Dozer	188	$5,911,053	0.29	0.00	0.03
Tractors/Loaders/Backhoes	180	$2,616,842	0.12	0.00	0.01
Off-Highway Trucks	22	$3,463,381	0.46	0.00	0.03
Sub Total	**915**	**$26,168,249**	**1.80**	**0.02**	**0.13**
Measure 51h: SCR+DPF Retrofit					
Excavators	337	$8,763,158	0.56	0.02	0.04
Rubber Tire Loaders	277	$8,856,316	0.51	0.01	0.05
Crawler Tractor/Dozer	265	$8,505,789	0.38	0.01	0.04
Tractors/Loaders/Backhoes	381	$6,074,211	0.24	0.02	0.02
Off-Highway Trucks	22	$3,778,234	0.46	0.01	0.04
Sub Total	**1,282**	**$35,977,707**	**2.15**	**0.07**	**0.19**
Grand Total	**8,553**	**$156,287,610**	**7.74**	**0.33**	**1.18**

One Example Emission Reduction Scenario for Agricultural Equipment - 2009 OHIO

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2009 OHIO**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	2,321	$30,744,450	0.92	0.05	0.07
Combines	20	$375,000	0.00	0.00	0.00
Sub Total	**2,341**	**$31,119,450**	**0.92**	**0.05**	**0.07**
Measure 51a: DPF Retrofit					
Agricultural Tractors	2,751	$12,246,158	0.00	0.08	0.11
Combines	96	$655,579	0.00	0.00	0.00
Sub Total	**2,847**	**$12,901,737**	**0.00**	**0.08**	**0.11**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	1,679	$21,390,632	0.37	0.06	0.06
Combines	28	$408,421	0.00	0.00	0.00
Sub Total	**1,707**	**$21,799,053**	**0.37**	**0.06**	**0.06**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	2,165	$18,562,211	0.49	0.05	0.06
Combines	28	$469,684	0.00	0.00	0.00
Sub Total	**2,193**	**$19,031,895**	**0.49**	**0.05**	**0.06**
Measure 51d: SCR Retrofit					
Agricultural Tractors	885	$11,252,737	0.51	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**885**	**$11,252,737**	**0.51**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	2,939	$2,386,737	0.00	0.03	0.08
Combines	136	$209,684	0.00	0.00	0.00
Sub Total	**3,075**	**$2,596,421**	**0.00**	**0.03**	**0.08**
Measure 51f: FTF Retrofit					
Agricultural Tractors	1,914	$6,008,684	0.00	0.02	0.06
Combines	28	$183,789	0.00	0.00	0.00
Sub Total	**1,942**	**$6,192,474**	**0.00**	**0.03**	**0.06**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	1,376	$18,333,816	0.78	0.01	0.05
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,376**	**$18,333,816**	**0.78**	**0.01**	**0.05**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	2,413	$29,903,684	1.16	0.05	0.08
Combines	28	$612,632	0.01	0.00	0.00
Sub Total	**2,441**	**$30,516,316**	**1.17**	**0.05**	**0.08**
Grand Total	**18,807**	**$153,743,897**	**4.25**	**0.36**	**0.57**

One Emission Reduction Scenario Example for On-road HDDVs - 2012 OHIO

One Preliminary Scenario for On Road HDDV Strategies for OHIO (2012 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	10,669	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	10,669	640	$25,604,719	0.42	0.03	0.01
MY 1990	$11,401	0.09	0.02	0.00	$40,000	1,977	79	$3,163,040	0.02	0.00	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	18,223	-	$0	0.00	0.00	0.00
Sub Total							719	28,767,759	0.44	0.03	0.01
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,522	0.29	0.02	0.03	$45,000	10,669	640	$28,805,309	0.51	0.03	0.05
MY 1990	$10,687	0.15	0.02	0.03	$45,000	1,977	79	$3,558,420	0.03	0.00	0.01
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	18,223	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	14,943	-	$0	0.00	0.00	0.00
Sub Total							719	32,363,729	0.54	0.03	0.06
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	14,943	598	35,862,511	0.64	0.02	0.19
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	25,280	1,011	60,672,052	0.99	0.04	0.16
Sub Total							1,609	96,534,563	1.63	0.06	0.36
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	10,669	1,067	$9,601,770	0.00	0.05	0.10
MY 1990	$2,759	0.00	0.02	0.04	$9,000	1,977	198	$1,779,210	0.00	0.01	0.02
MY 1991 - 1997	$4,835	0.00	0.01	0.06	$9,000	18,223	1,458	$13,120,431	0.00	0.04	0.26
MY 1998 - 2001	$4,161	0.00	0.01	0.11	$9,000	14,943	1,195	$10,758,753	0.00	0.03	0.35
MY 2002 - 2006	$3,570	0.00	0.01	0.07	$9,000	25,280	2,528	$22,752,020	0.00	0.10	0.45
Sub Total							6,446	$58,012,183	0.00	0.22	1.18
Cleaire LNC+DPF											
MY 1989 and Earlier	$6,074	0.09	0.02	0.03	$ 20,000	10,669	853	$17,069,813	0.21	0.04	0.08
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	1,977	158	$3,163,040	0.03	0.01	0.02
MY 1991 - 1997	$8,933	0.08	0.01	0.06	$ 20,000	18,223	1,093	$21,867,384	0.23	0.03	0.18
MY 1998 - 2001	$7,766	0.10	0.01	0.10	$ 20,000	14,943	897	$17,931,255	0.25	0.02	0.24
MY 2002 - 2006	$7,207	0.10	0.01	0.06	$ 20,000	25,280	1,517	$30,336,026	0.41	0.06	0.25
Sub Total							4,518	90,367,519	1.13	0.16	0.75
EGR+DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.02	0.03	$ 23,000	10,669	853	$19,630,285	0.34	0.04	0.08
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	1,977	158	$3,637,496	0.04	0.01	0.02
MY 1991 - 1997	$8,593	0.12	0.01	0.06	$ 23,000	18,223	1,093	$25,147,492	0.37	0.03	0.18
MY 1998 - 2001	$7,136	0.16	0.01	0.10	$ 23,000	14,943	897	$20,620,944	0.40	0.02	0.24
MY 2002 - 2006	$6,461	0.16	0.01	0.06	$ 23,000	25,280	2,022	$46,515,240	0.87	0.08	0.33
Sub Total							5,024	115,551,456	2.02	0.18	0.84
SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	10,669	427	$11,308,751	0.34	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	1,977	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$15,979	0.25	0.00	0.00	$ 26,500	18,223	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$12,445	0.33	0.00	0.00	$ 26,500	14,943	598	$15,839,275	0.54	0.00	0.00
MY 2002 - 2006	$13,569	0.31	0.00	0.00	$ 26,500	25,280	1,011	$26,796,823	0.87	0.00	0.00
Sub Total							2,036	53,944,850	1.74	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	10,669	1,067	$2,133,727	0.00	0.02	0.08
MY 1990	$1,227	0.00	0.01	0.03	$2,000	1,977	198	$395,380	0.00	0.01	0.02
MY 1991 - 1997	$1,959	0.00	0.00	0.05	$2,000	18,223	1,822	$3,644,564	0.00	0.02	0.23
MY 1998 - 2001	$1,590	0.00	0.00	0.08	$2,000	14,943	1,494	$2,988,543	0.00	0.02	0.32
MY 2002 - 2006	$1,500	0.00	0.01	0.05	$2,000	25,280	2,528	$5,056,004	0.00	0.05	0.33
Sub Total							7,109	14,218,218	0.00	0.11	0.97
FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	10,669	853	$7,681,416	0.00	0.02	0.08
MY 1990	$4,343	0.00	0.01	0.04	$9,000	1,977	158	$1,423,368	0.00	0.01	0.02
MY 1991 - 1997	$6,767	0.00	0.01	0.06	$9,000	18,223	1,458	$13,120,431	0.00	0.02	0.26
MY 1998 - 2001	$5,418	0.00	0.01	0.11	$9,000	14,943	1,195	$10,758,753	0.00	0.02	0.35
MY 2002 - 2006	$5,228	0.00	0.01	0.07	$9,000	25,280	2,022	$18,201,616	0.00	0.05	0.36
Sub Total							5,687	51,185,583	0.00	0.11	1.07
DOC+SCR Retrofit											
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	10,669	640	$17,603,245	0.51	0.01	0.04
MY 1990	$11,411	0.19	0.01	0.03	$27,500	1,977	79	$2,174,590	0.04	0.00	0.01
MY 1991 - 1997	$11,375	0.25	0.00	0.05	$27,500	18,223	729	$20,045,102	0.49	0.01	0.09
MY 1998 - 2001	$8,871	0.33	0.003	0.08	$27,500	14,943	897	$24,655,476	0.80	0.01	0.19
MY 2002 - 2006	$9,672	0.31	0.004	0.05	$27,500	25,280	1,517	$41,712,036	1.30	0.02	0.19
Sub Total							3,861	106,190,449	3.15	0.04	0.53
SCR+DPF											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	10,669	853	$25,604,719	0.69	0.04	0.08
MY 1990	$6,708	0.19	0.02	0.04	$30,000	1,977	158	$4,744,560	0.08	0.01	0.02
MY 1991 - 1997	$8,812	0.25	0.01	0.06	$30,000	18,223	1,093	$32,801,077	0.74	0.03	0.17
MY 1998 - 2001	$7,336	0.33	0.01	0.10	$30,000	14,943	897	$26,896,883	0.80	0.02	0.24
MY 2002 - 2006	$7,138	0.31	0.01	0.06	$30,000	25,280	1,517	$45,504,039	1.30	0.06	0.25
Sub Total							4,518	135,551,278	3.61	0.16	0.75
Overall Projects											
MY 1989 and Earlier						10,669	7,895	165,043,753	3.03	0.29	0.59
MY 1990						1,977	1,265	24,039,103	0.25	0.06	0.12
MY 1991 - 1997						18,223	8,747	129,746,481	1.84	0.17	1.36
MY 1998 - 2001						14,943	8,667	166,312,393	3.43	0.15	2.10
MY 2002 - 2006						25,280	15,674	297,545,856	5.73	0.44	2.32
MY 2007+						39,350	0	0	0	0	0
Total						110,441	42,247	782,687,586	14.26	1.10	6.50
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$3,589,219	1.45	0.25	0.20

One Emission Reduction Scenario Example for On-road HDDVs - 2012 OHIO

Sub Total								$3,589,219	1.45	0.25	0.20
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.01	0.0002	0.001	$7,500	110,441	33,132	$248,493,005	1.27	0.02	0.07
Sub Total						110,441	33,132	$248,493,005	1.27	0.02	0.07
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	19,158	11,495	$1,149,475	1.21	-	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	17,229	13,783	$1,378,308	4.89	-	0.00
Sub Total						36,387	25,278	$2,527,783	6.10	-	-
Grand Total						110,441	100,658	$1,037,297,594	23.1	1.4	6.8

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2012 OHIO**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	103	$3,055,000	0.22	0.00	0.02
Rubber Tire Loaders	252	$10,660,500	0.48	0.01	0.04
Crawler Tractor/Dozer	145	$6,954,750	0.29	0.01	0.04
Tractors/Loaders/Backhoes	213	$2,394,750	0.07	0.01	0.01
Off-Highway Trucks	14	$2,773,567	0.14	0.00	0.00
Sub Total	**727**	**$25,838,567**	**1.20**	**0.03**	**0.11**
Measure 51a: DPF Retrofit					
Excavators	919	$7,038,947	0.00	0.04	0.07
Rubber Tire Loaders	824	$7,353,474	0.00	0.03	0.08
Crawler Tractor/Dozer	814	$8,126,526	0.00	0.04	0.08
Tractors/Loaders/Backhoes	1,293	$5,183,526	0.00	0.03	0.05
Off-Highway Trucks	36	$1,854,769	0.00	0.01	0.05
Sub Total	**3,886**	**$29,557,243**	**0.00**	**0.15**	**0.34**
Measure 51b: Lean NOx Catalyst					
Excavators	571	$9,748,421	0.23	0.02	0.05
Rubber Tire Loaders	363	$7,466,316	0.17	0.02	0.04
Crawler Tractor/Dozer	400	$8,280,000	0.17	0.02	0.05
Tractors/Loaders/Backhoes	717	$6,024,211	0.11	0.02	0.03
Off-Highway Trucks	24	$2,747,806	0.15	0.01	0.04
Sub Total	**2,075**	**$34,266,754**	**0.82**	**0.09**	**0.21**
Measure 51c: EGR+DPF Retrofit					
Excavators	454	$8,046,368	0.28	0.02	0.04
Rubber Tire Loaders	363	$8,586,263	0.27	0.02	0.04
Crawler Tractor/Dozer	400	$9,522,000	0.27	0.02	0.05
Tractors/Loaders/Backhoes	508	$5,156,842	0.13	0.02	0.02
Off-Highway Trucks	24	$3,159,977	0.24	0.01	0.04
Sub Total	**1,749**	**$34,471,451**	**1.18**	**0.08**	**0.19**
Measure 51d: SCR Retrofit					
Excavators	290	$6,754,711	0.44	0.00	0.00
Rubber Tire Loaders	229	$6,898,368	0.42	0.00	0.00
Crawler Tractor/Dozer	301	$9,452,132	0.46	0.00	0.00
Tractors/Loaders/Backhoes	162	$2,340,368	0.10	0.00	0.00
Off-Highway Trucks	36	$5,461,265	0.68	0.00	0.00
Sub Total	**1,018**	**$30,906,844**	**2.10**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	210	$320,526	0.00	0.00	0.02
Rubber Tire Loaders	264	$527,158	0.00	0.01	0.03
Crawler Tractor/Dozer	187	$376,421	0.00	0.00	0.02
Tractors/Loaders/Backhoes	304	$251,789	0.00	0.00	0.01
Off-Highway Trucks	8	$91,594	0.00	0.00	0.01
Sub Total	**973**	**$1,567,488**	**0.00**	**0.02**	**0.09**
Measure 51f: FTF Retrofit					
Excavators	584	$4,454,526	0.00	0.01	0.05
Rubber Tire Loaders	545	$5,036,684	0.00	0.01	0.07
Crawler Tractor/Dozer	537	$5,315,211	0.00	0.01	0.07
Tractors/Loaders/Backhoes	1,062	$4,139,053	0.00	0.02	0.05
Off-Highway Trucks	36	$1,854,769	0.00	0.01	0.05
Sub Total	**2,764**	**$20,800,243**	**0.00**	**0.07**	**0.28**
Measure 51g: DOC+SCR Retrofit					
Excavators	454	$9,620,658	0.56	0.01	0.03
Rubber Tire Loaders	449	$13,861,447	0.76	0.01	0.05
Crawler Tractor/Dozer	301	$9,808,816	0.46	0.00	0.04
Tractors/Loaders/Backhoes	399	$5,993,553	0.25	0.01	0.02
Off-Highway Trucks	36	$5,667,350	0.68	0.00	0.04
Sub Total	**1,639**	**$44,951,824**	**2.72**	**0.03**	**0.17**
Measure 51h: SCR+DPF Retrofit					
Excavators	598	$15,483,158	0.79	0.03	0.05
Rubber Tire Loaders	545	$16,788,947	0.81	0.02	0.06
Crawler Tractor/Dozer	537	$17,717,368	0.73	0.03	0.06
Tractors/Loaders/Backhoes	761	$12,560,526	0.46	0.03	0.04
Off-Highway Trucks	36	$6,182,564	0.68	0.01	0.05
Sub Total	**2,477**	**$68,732,564**	**3.46**	**0.12**	**0.26**
Grand Total	**17,308**	**$291,092,978**	**11.48**	**0.58**	**1.65**

One Example Emission Reduction Scenario for Agricultural Equipment - 2012 OHIO

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2012 OHIO**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	4,636	$63,993,300	1.88	0.10	0.17
Combines	52	$1,766,250	0.02	0.00	0.00
Sub Total	**4,688**	**$65,759,550**	**1.90**	**0.10**	**0.17**
Measure 51a: DPF Retrofit					
Agricultural Tractors	5,918	$32,358,789	0.00	0.16	0.29
Combines	289	$1,990,895	0.00	0.00	0.00
Sub Total	**6,207**	**$34,349,684**	**0.00**	**0.17**	**0.29**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	3,239	$43,120,000	0.73	0.12	0.14
Combines	52	$829,474	0.01	0.00	0.00
Sub Total	**3,291**	**$43,949,474**	**0.74**	**0.12**	**0.14**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	3,797	$34,102,947	0.86	0.09	0.14
Combines	52	$953,895	0.01	0.00	0.00
Sub Total	**3,849**	**$35,056,842**	**0.87**	**0.09**	**0.14**
Measure 51d: SCR Retrofit					
Agricultural Tractors	1,642	$21,806,711	0.95	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,642**	**$21,806,711**	**0.95**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	4,568	$4,293,053	0.00	0.05	0.19
Combines	373	$562,421	0.00	0.00	0.00
Sub Total	**4,941**	**$4,855,474**	**0.00**	**0.05**	**0.19**
Measure 51f: FTF Retrofit					
Agricultural Tractors	4,794	$19,954,421	0.00	0.06	0.26
Combines	72	$477,474	0.00	0.00	0.00
Sub Total	**4,866**	**$20,431,895**	**0.00**	**0.07**	**0.26**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	2,583	$31,729,211	1.31	0.02	0.10
Combines	0	$0	0.00	0.00	0.00
Sub Total	**2,583**	**$31,729,211**	**1.31**	**0.02**	**0.10**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	4,532	$62,027,368	2.30	0.10	0.21
Combines	52	$1,244,211	0.02	0.00	0.00
Sub Total	**4,584**	**$63,271,579**	**2.32**	**0.10**	**0.21**
Grand Total	**36,651**	**$321,210,418**	**8.08**	**0.71**	**1.49**

One Emission Reduction Scenario Example for On-road HDDVs - 2009 WISCONSIN

One Preliminary Scenario for On Road HDDV Strategies for WISCONSIN (2009 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	8,272	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	8,272	248	$9,926,749	0.18	0.01	0.00
MY 1990	$8,551	0.12	0.03	0.00	$40,000	1,176	35	$1,411,661	0.01	0.00	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	10,829	-	$0	0.00	0.00	0.00
Sub Total							283	11,338,410	0.19	0.02	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	8,272	248	$11,167,593	0.22	0.01	0.02
MY 1990	$8,015	0.26	0.03	0.04	$45,000	1,176	35	$1,588,119	0.02	0.00	0.00
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	10,829	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.22	0.00	0.11	$45,000	8,885	-	$0	0.00	0.00	0.00
Sub Total							283	12,755,711	0.24	0.02	0.03
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	8,885	267	15,992,379	0.39	0.01	0.12
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	15,030	451	27,053,614	0.61	0.02	0.10
Sub Total							717	43,045,993	1.00	0.03	0.22
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	8,272	414	$3,722,531	0.00	0.02	0.04
MY 1990	$2,069	0.00	0.03	0.06	$9,000	1,176	59	$529,373	0.00	0.00	0.01
MY 1991 - 1997	$3,534	0.00	0.01	0.09	$9,000	10,829	541	$4,873,131	0.00	0.02	0.13
MY 1998 - 2001	$3,026	0.00	0.01	0.15	$9,000	8,885	444	$3,998,095	0.00	0.01	0.18
MY 2002 - 2006	$2,601	0.00	0.02	0.09	$9,000	15,030	751	$6,763,403	0.00	0.04	0.18
Sub Total							2,210	$19,886,533	0.00	0.10	0.55
Cleaire LNC+DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	8,272	331	$6,617,833	0.09	0.02	0.03
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	1,176	47	$941,107	0.01	0.00	0.01
MY 1991 - 1997	$6,645	0.11	0.01	0.08	$ 20,000	10,829	433	$8,663,345	0.13	0.01	0.10
MY 1998 - 2001	$5,816	0.14	0.01	0.13	$ 20,000	8,885	355	$7,107,724	0.14	0.01	0.13
MY 2002 - 2006	$5,487	0.13	0.02	0.08	$ 20,000	15,030	601	$12,023,828	0.22	0.03	0.13
Sub Total							1,768	35,353,837	0.58	0.08	0.40
EGR+DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	8,272	331	$7,610,508	0.15	0.02	0.03
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	1,176	47	$1,082,273	0.02	0.00	0.01
MY 1991 - 1997	$6,281	0.17	0.01	0.08	$ 23,000	10,829	433	$9,962,846	0.20	0.01	0.10
MY 1998 - 2001	$5,192	0.22	0.01	0.13	$ 23,000	8,885	355	$8,173,883	0.22	0.01	0.13
MY 2002 - 2006	$4,710	0.21	0.02	0.08	$ 23,000	15,030	601	$13,827,403	0.35	0.03	0.13
Sub Total							1,768	40,656,913	0.94	0.08	0.40
SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	8,272	165	$4,384,314	0.15	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	1,176	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$11,810	0.34	0.00	0.00	$ 26,500	10,829	217	$5,739,466	0.20	0.00	0.00
MY 1998 - 2001	$9,224	0.45	0.00	0.00	$ 26,500	8,885	267	$7,063,301	0.33	0.00	0.00
MY 2002 - 2006	$10,173	0.43	0.00	0.00	$ 26,500	15,030	301	$7,965,786	0.35	0.00	0.00
Sub Total							949	25,152,867	1.03	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	8,272	414	$827,229	0.00	0.01	0.03
MY 1990	$920	0.00	0.01	0.04	$2,000	1,176	59	$117,638	0.00	0.00	0.01
MY 1991 - 1997	$1,431	0.00	0.01	0.06	$2,000	10,829	541	$1,082,918	0.00	0.01	0.09
MY 1998 - 2001	$1,156	0.00	0.01	0.11	$2,000	8,885	444	$888,466	0.00	0.01	0.13
MY 2002 - 2006	$1,093	0.00	0.01	0.06	$2,000	15,030	751	$1,502,979	0.00	0.02	0.13
Sub Total							2,210	4,419,230	0.00	0.05	0.40
FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	8,272	331	$2,978,025	0.00	0.01	0.04
MY 1990	$3,257	0.00	0.02	0.06	$9,000	1,176	59	$529,373	0.00	0.00	0.01
MY 1991 - 1997	$4,945	0.00	0.01	0.09	$9,000	10,829	433	$3,898,505	0.00	0.01	0.10
MY 1998 - 2001	$3,941	0.00	0.01	0.15	$9,000	8,885	444	$3,998,095	0.00	0.01	0.18
MY 2002 - 2006	$3,809	0.00	0.01	0.09	$9,000	15,030	751	$6,763,403	0.00	0.02	0.18
Sub Total							2,019	18,167,401	0.00	0.05	0.51
DOC+SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	8,272	248	$6,824,640	0.22	0.00	0.02
MY 1990	$8,611	0.26	0.01	0.04	$27,500	1,176	35	$970,517	0.02	0.00	0.00
MY 1991 - 1997	$8,404	0.34	0.00	0.06	$27,500	10,829	325	$8,934,074	0.30	0.00	0.06
MY 1998 - 2001	$6,571	0.45	0.004	0.10	$27,500	8,885	355	$9,773,121	0.44	0.00	0.10
MY 2002 - 2006	$7,245	0.43	0.006	0.06	$27,500	15,030	451	$12,399,573	0.53	0.01	0.08
Sub Total							1,415	38,901,925	1.51	0.02	0.26
SCR+DPF											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	8,272	331	$9,926,749	0.29	0.02	0.03
MY 1990	$5,060	0.26	0.03	0.05	$30,000	1,176	47	$1,411,661	0.03	0.00	0.01
MY 1991 - 1997	$6,505	0.34	0.01	0.08	$30,000	10,829	433	$12,995,017	0.40	0.01	0.09
MY 1998 - 2001	$5,427	0.45	0.01	0.13	$30,000	8,885	355	$10,661,586	0.44	0.01	0.13
MY 2002 - 2006	$5,335	0.43	0.02	0.08	$30,000	15,030	601	$18,035,743	0.71	0.03	0.13
Sub Total							1,768	53,030,755	1.87	0.08	0.40
Overall Projects											
MY 1989 and Earlier						8,272	3,061	63,986,169	1.29	0.12	0.25
MY 1990						1,176	423	8,581,723	0.12	0.03	0.05
MY 1991 - 1997						10,829	3,357	56,149,302	1.23	0.08	0.67
MY 1998 - 2001						8,885	3,287	67,656,649	1.95	0.08	1.09
MY 2002 - 2006						15,030	5,260	106,335,732	2.77	0.21	1.08
MY 2007+						9,524	0	0	0	0	0
Total						53,716	15,389	302,709,575	7.36	0.52	3.15
Measure 46i: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$2,039,589	0.82	0.14	0.12

One Emission Reduction Scenario Example for On-road HDDVs - 2009 WISCONSIN

Sub Total								$2,039,589	0.82	0.14	0.12
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.02	0.000	0.001	$7,500	53,716	8,057	$60,430,696	0.45	0.01	0.02
Sub Total						53,716	8,057	$60,430,696	0.45	0.01	0.02
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
Diesel Engine Reflash (MY 1993-1998 Engines)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	11,379	6,827	$682,721	0.72	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	10,233	8,186	$818,634	2.90	0.00	0.00
Sub Total							15,014	1,501,356	3.62	-	-
Grand Total						53,716	38,460	$366,681,215	12.2	0.7	3.3

One Example Emission Reduction Scenario for Construction Equipment

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2009 WISCONSIN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	75	$1,800,500	0.14	0.00	0.01
Rubber Tire Loaders	70	$2,476,000	0.12	0.00	0.01
Crawler Tractor/Dozer	61	$2,496,000	0.10	0.00	0.02
Tractors/Loaders/Backhoes	58	$613,250	0.02	0.00	0.00
Off-Highway Trucks	5	$788,563	0.05	0.00	0.00
Sub Total	**269**	**$8,174,313**	**0.43**	**0.01**	**0.04**
Measure 51a: DPF Retrofit					
Excavators	132	$992,842	0.00	0.01	0.02
Rubber Tire Loaders	126	$1,237,737	0.00	0.01	0.02
Crawler Tractor/Dozer	101	$1,026,474	0.00	0.01	0.02
Tractors/Loaders/Backhoes	156	$600,632	0.00	0.01	0.01
Off-Highway Trucks	6	$309,128	0.00	0.00	0.02
Sub Total	**521**	**$4,166,812**	**0.00**	**0.03**	**0.08**
Measure 51b: Lean NOx Catalyst					
Excavators	114	$1,997,895	0.06	0.01	0.02
Rubber Tire Loaders	81	$1,596,842	0.04	0.00	0.01
Crawler Tractor/Dozer	89	$1,950,526	0.04	0.00	0.02
Tractors/Loaders/Backhoes	141	$1,173,684	0.02	0.00	0.01
Off-Highway Trucks	6	$686,952	0.04	0.00	0.02
Sub Total	**431**	**$7,405,899**	**0.21**	**0.02**	**0.06**
Measure 51c: EGR+DPF Retrofit					
Excavators	114	$2,297,579	0.09	0.01	0.02
Rubber Tire Loaders	89	$2,102,684	0.08	0.00	0.01
Crawler Tractor/Dozer	89	$2,243,105	0.06	0.00	0.02
Tractors/Loaders/Backhoes	92	$934,526	0.02	0.00	0.00
Off-Highway Trucks	6	$789,994	0.07	0.00	0.02
Sub Total	**390**	**$8,367,889**	**0.33**	**0.02**	**0.06**
Measure 51d: SCR Retrofit					
Excavators	85	$1,963,789	0.16	0.00	0.00
Rubber Tire Loaders	65	$1,800,605	0.12	0.00	0.00
Crawler Tractor/Dozer	82	$2,477,053	0.12	0.00	0.00
Tractors/Loaders/Backhoes	43	$609,500	0.03	0.00	0.00
Off-Highway Trucks	9	$1,365,316	0.19	0.00	0.00
Sub Total	**284**	**$8,216,264**	**0.62**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	114	$199,789	0.00	0.00	0.01
Rubber Tire Loaders	126	$275,053	0.00	0.00	0.02
Crawler Tractor/Dozer	101	$228,105	0.00	0.00	0.01
Tractors/Loaders/Backhoes	141	$117,368	0.00	0.00	0.00
Off-Highway Trucks	6	$68,695	0.00	0.00	0.01
Sub Total	**488**	**$889,011**	**0.00**	**0.01**	**0.06**
Measure 51f: FTF Retrofit					
Excavators	72	$517,737	0.00	0.00	0.01
Rubber Tire Loaders	66	$577,895	0.00	0.00	0.01
Crawler Tractor/Dozer	65	$606,789	0.00	0.00	0.01
Tractors/Loaders/Backhoes	84	$333,474	0.00	0.00	0.00
Off-Highway Trucks	6	$309,128	0.00	0.00	0.02
Sub Total	**293**	**$2,345,023**	**0.00**	**0.01**	**0.05**
Measure 51g: DOC+SCR Retrofit					
Excavators	114	$2,747,105	0.19	0.00	0.01
Rubber Tire Loaders	106	$3,178,421	0.20	0.00	0.02
Crawler Tractor/Dozer	82	$2,570,526	0.12	0.00	0.01
Tractors/Loaders/Backhoes	75	$1,089,868	0.05	0.00	0.00
Off-Highway Trucks	9	$1,416,838	0.19	0.00	0.01
Sub Total	**386**	**$11,002,759**	**0.76**	**0.01**	**0.06**
Measure 51h: SCR+DPF Retrofit					
Excavators	145	$3,806,842	0.24	0.01	0.02
Rubber Tire Loaders	112	$3,571,579	0.21	0.01	0.02
Crawler Tractor/Dozer	114	$3,647,368	0.16	0.01	0.02
Tractors/Loaders/Backhoes	159	$2,534,211	0.10	0.01	0.01
Off-Highway Trucks	9	$1,545,641	0.19	0.00	0.02
Sub Total	**539**	**$15,105,641**	**0.90**	**0.03**	**0.08**
Grand Total	**3,601**	**$65,673,611**	**3.25**	**0.14**	**0.50**

One Example Emission Reduction Scenario for Agricultural Equipment - 2009 WISCONSIN

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2009 WISCONSIN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	2,095	$27,726,950	0.83	0.05	0.06
Combines	18	$337,500	0.00	0.00	0.00
Sub Total	**2,113**	**$28,064,450**	**0.83**	**0.05**	**0.06**
Measure 51a: DPF Retrofit					
Agricultural Tractors	2,483	$11,048,684	0.00	0.07	0.10
Combines	86	$588,316	0.00	0.00	0.00
Sub Total	**2,569**	**$11,637,000**	**0.00**	**0.07**	**0.10**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	1,516	$19,332,526	0.34	0.05	0.05
Combines	25	$365,263	0.00	0.00	0.00
Sub Total	**1,541**	**$19,697,789**	**0.34**	**0.05**	**0.05**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	1,955	$16,750,053	0.44	0.05	0.05
Combines	25	$420,053	0.00	0.00	0.00
Sub Total	**1,980**	**$17,170,105**	**0.44**	**0.05**	**0.05**
Measure 51d: SCR Retrofit					
Agricultural Tractors	801	$10,189,947	0.46	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**801**	**$10,189,947**	**0.46**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	2,651	$2,149,789	0.00	0.03	0.07
Combines	123	$189,579	0.00	0.00	0.00
Sub Total	**2,774**	**$2,339,368**	**0.00**	**0.03**	**0.07**
Measure 51f: FTF Retrofit					
Agricultural Tractors	1,729	$5,437,895	0.00	0.02	0.06
Combines	25	$164,368	0.00	0.00	0.00
Sub Total	**1,754**	**$5,602,263**	**0.00**	**0.02**	**0.06**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	1,243	$16,539,079	0.70	0.01	0.05
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,243**	**$16,539,079**	**0.70**	**0.01**	**0.05**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	2,176	$26,922,632	1.05	0.05	0.07
Combines	25	$547,895	0.01	0.00	0.00
Sub Total	**2,201**	**$27,470,526**	**1.05**	**0.05**	**0.07**
Grand Total	**16,976**	**$138,710,529**	**3.83**	**0.33**	**0.52**

One Emission Reduction Scenario Example for On-road HDDVs - 2012 WISCONSIN

One Preliminary Scenario for On Road HDDV Strategies for WISCONSIN (2012 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	5,507	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	5,507	330	$13,215,815	0.22	0.02	0.00
MY 1990	$11,401	0.09	0.02	0.00	$40,000	1,020	41	$1,632,596	0.01	0.00	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	9,406	-	$0	0.00	0.00	0.00
Sub Total							371	14,848,411	0.23	0.02	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,522	0.29	0.02	0.03	$45,000	5,507	330	$14,867,792	0.26	0.02	0.03
MY 1990	$10,687	0.15	0.02	0.03	$45,000	1,020	41	$1,836,670	0.02	0.00	0.00
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	9,406	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	7,713	-	$0	0.00	0.00	0.00
Sub Total							371	16,704,462	0.28	0.02	0.03
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	7,713	309	18,510,350	0.33	0.01	0.10
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	13,048	522	31,315,736	0.51	0.02	0.08
Sub Total							830	49,826,086	0.84	0.03	0.18
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	5,507	551	$4,955,931	0.00	0.03	0.05
MY 1990	$2,759	0.00	0.02	0.04	$9,000	1,020	102	$918,335	0.00	0.01	0.01
MY 1991 - 1997	$4,835	0.00	0.01	0.06	$9,000	9,406	752	$6,772,079	0.00	0.02	0.13
MY 1998 - 2001	$4,161	0.00	0.01	0.11	$9,000	7,713	617	$5,553,105	0.00	0.01	0.18
MY 2002 - 2006	$3,570	0.00	0.01	0.07	$9,000	13,048	1,305	$11,743,401	0.00	0.05	0.23
Sub Total							3,327	$29,942,851	0.00	0.12	0.61
Cleaire LNC+DPF											
MY 1989 and Earlier	$6,074	0.09	0.02	0.03	$ 20,000	5,507	441	$8,810,543	0.11	0.02	0.04
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	1,020	82	$1,632,596	0.01	0.00	0.01
MY 1991 - 1997	$8,933	0.08	0.01	0.06	$ 20,000	9,406	564	$11,286,799	0.12	0.01	0.09
MY 1998 - 2001	$7,766	0.10	0.01	0.10	$ 20,000	7,713	463	$9,255,175	0.13	0.01	0.12
MY 2002 - 2006	$7,207	0.10	0.01	0.06	$ 20,000	13,048	783	$15,657,868	0.21	0.03	0.13
Sub Total							2,332	46,642,980	0.58	0.08	0.39
EGR+DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.02	0.03	$ 23,000	5,507	441	$10,132,125	0.18	0.02	0.04
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	1,020	82	$1,877,485	0.02	0.00	0.01
MY 1991 - 1997	$8,593	0.12	0.01	0.06	$ 23,000	9,406	564	$12,979,818	0.19	0.01	0.09
MY 1998 - 2001	$7,136	0.16	0.01	0.10	$ 23,000	7,713	463	$10,643,451	0.21	0.01	0.12
MY 2002 - 2006	$6,461	0.16	0.01	0.06	$ 23,000	13,048	1,044	$24,008,731	0.45	0.04	0.17
Sub Total							2,593	59,641,610	1.04	0.09	0.43
SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	5,507	220	$5,836,985	0.18	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	1,020	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$15,979	0.25	0.00	0.00	$ 26,500	9,406	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$12,445	0.33	0.00	0.00	$ 26,500	7,713	309	$8,175,404	0.28	0.00	0.00
MY 2002 - 2006	$13,569	0.31	0.00	0.00	$ 26,500	13,048	522	$13,831,117	0.45	0.00	0.00
Sub Total							1,051	27,843,506	0.90	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	5,507	551	$1,101,318	0.00	0.01	0.04
MY 1990	$1,227	0.00	0.01	0.03	$2,000	1,020	102	$204,074	0.00	0.00	0.01
MY 1991 - 1997	$1,959	0.00	0.00	0.05	$2,000	9,406	941	$1,881,133	0.00	0.01	0.12
MY 1998 - 2001	$1,590	0.00	0.00	0.08	$2,000	7,713	771	$1,542,529	0.00	0.01	0.16
MY 2002 - 2006	$1,500	0.00	0.01	0.05	$2,000	13,048	1,305	$2,609,645	0.00	0.02	0.17
Sub Total							3,669	7,338,699	0.00	0.06	0.50
FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	5,507	441	$3,964,745	0.00	0.01	0.04
MY 1990	$4,343	0.00	0.01	0.04	$9,000	1,020	82	$734,668	0.00	0.00	0.01
MY 1991 - 1997	$6,767	0.00	0.01	0.06	$9,000	9,406	752	$6,772,079	0.00	0.01	0.13
MY 1998 - 2001	$5,418	0.00	0.01	0.11	$9,000	7,713	617	$5,553,105	0.00	0.01	0.18
MY 2002 - 2006	$5,228	0.00	0.01	0.07	$9,000	13,048	1,044	$9,394,721	0.00	0.02	0.19
Sub Total							2,935	26,419,317	0.00	0.06	0.55
DOC+SCR Retrofit											
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	5,507	330	$9,085,873	0.27	0.00	0.02
MY 1990	$11,411	0.19	0.01	0.03	$27,500	1,020	41	$1,122,409	0.02	0.00	0.00
MY 1991 - 1997	$11,375	0.25	0.00	0.05	$27,500	9,406	376	$10,346,232	0.25	0.00	0.05
MY 1998 - 2001	$6,871	0.33	0.003	0.08	$27,500	7,713	463	$12,725,865	0.41	0.00	0.10
MY 2002 - 2006	$9,672	0.31	0.004	0.05	$27,500	13,048	783	$21,529,568	0.67	0.01	0.10
Sub Total							1,993	54,809,948	1.63	0.02	0.27
SCR+DPF											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	5,507	441	$13,215,815	0.35	0.02	0.04
MY 1990	$6,708	0.19	0.02	0.04	$30,000	1,020	82	$2,448,893	0.04	0.00	0.01
MY 1991 - 1997	$8,812	0.25	0.01	0.06	$30,000	9,406	564	$16,930,198	0.38	0.01	0.09
MY 1998 - 2001	$7,336	0.33	0.01	0.10	$30,000	7,713	463	$13,882,762	0.41	0.01	0.12
MY 2002 - 2006	$7,138	0.31	0.01	0.06	$30,000	13,048	783	$23,486,802	0.67	0.03	0.13
Sub Total							2,332	69,964,470	1.86	0.08	0.39
Overall Projects											
MY 1989 and Earlier						5,507	4,075	85,186,942	1.56	0.15	0.30
MY 1990						1,020	653	12,407,726	0.13	0.03	0.06
MY 1991 - 1997						9,406	4,515	66,968,338	0.95	0.09	0.70
MY 1998 - 2001						7,713	4,473	85,841,747	1.77	0.08	1.09
MY 2002 - 2006						13,048	8,090	155,577,588	2.96	0.22	1.20
MY 2007+						20,311	0	0	0	0	0
Total						57,004	21,806	403,982,340	7.36	0.57	3.35
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$4,079,178	1.64	0.28	0.23

One Emission Reduction Scenario Example for On-road HDDVs - 2012 WISCONSIN

Sub Total								**$4,079,178**	**1.64**	**0.28**	**0.23**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.01	0.0002	0.001	$7,500	57,004	17,101	$128,259,075	0.63	0.01	0.03
Sub Total						**57,004**	**17,101**	**$128,259,075**	**0.63**	**0.01**	**0.03**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	9,888	5,933	$593,299	0.62	-	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	8,893	7,114	$711,410	2.52	-	0.00
Sub Total						**18,781**	**13,047**	**$1,304,709**	**3.15**	**-**	**-**
Grand Total						**57,004**	**51,954**	**$537,625,302**	**12.8**	**0.9**	**3.6**

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment in the LADCO States **2012 WISCONSIN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	44	$1,281,250	0.09	0.00	0.01
Rubber Tire Loaders	103	$4,368,750	0.20	0.00	0.02
Crawler Tractor/Dozer	61	$2,903,250	0.12	0.00	0.02
Tractors/Loaders/Backhoes	88	$988,750	0.03	0.00	0.00
Off-Highway Trucks	5	$1,006,098	0.05	0.00	0.00
Sub Total	**301**	**$10,548,098**	**0.49**	**0.01**	**0.04**
Measure 51a: DPF Retrofit					
Excavators	394	$3,019,737	0.00	0.02	0.03
Rubber Tire Loaders	336	$2,999,842	0.00	0.01	0.03
Crawler Tractor/Dozer	352	$3,514,263	0.00	0.02	0.04
Tractors/Loaders/Backhoes	539	$2,162,368	0.00	0.01	0.02
Off-Highway Trucks	14	$721,299	0.00	0.01	0.02
Sub Total	**1,635**	**$12,417,510**	**0.00**	**0.06**	**0.14**
Measure 51b: Lean NOx Catalyst					
Excavators	243	$4,136,842	0.10	0.01	0.02
Rubber Tire Loaders	147	$3,012,632	0.07	0.01	0.02
Crawler Tractor/Dozer	172	$3,529,474	0.07	0.01	0.02
Tractors/Loaders/Backhoes	298	$2,503,158	0.04	0.01	0.01
Off-Highway Trucks	9	$1,030,427	0.05	0.00	0.01
Sub Total	**869**	**$14,212,533**	**0.33**	**0.04**	**0.08**
Measure 51c: EGR+DPF Retrofit					
Excavators	193	$3,401,579	0.12	0.01	0.02
Rubber Tire Loaders	147	$3,464,526	0.11	0.01	0.02
Crawler Tractor/Dozer	172	$4,058,895	0.11	0.01	0.02
Tractors/Loaders/Backhoes	211	$2,141,421	0.05	0.01	0.01
Off-Highway Trucks	9	$1,184,991	0.09	0.00	0.01
Sub Total	**732**	**$14,251,413**	**0.48**	**0.03**	**0.08**
Measure 51d: SCR Retrofit					
Excavators	123	$2,845,263	0.18	0.00	0.00
Rubber Tire Loaders	93	$2,809,000	0.17	0.00	0.00
Crawler Tractor/Dozer	129	$4,016,842	0.19	0.00	0.00
Tractors/Loaders/Backhoes	68	$981,895	0.04	0.00	0.00
Off-Highway Trucks	14	$2,123,825	0.26	0.00	0.00
Sub Total	**427**	**$12,776,825**	**0.85**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	90	$138,632	0.00	0.00	0.01
Rubber Tire Loaders	108	$217,158	0.00	0.00	0.01
Crawler Tractor/Dozer	81	$163,158	0.00	0.00	0.01
Tractors/Loaders/Backhoes	127	$105,368	0.00	0.00	0.01
Off-Highway Trucks	2	$22,898	0.00	0.00	0.00
Sub Total	**408**	**$647,214**	**0.00**	**0.01**	**0.04**
Measure 51f: FTF Retrofit					
Excavators	249	$1,892,842	0.00	0.01	0.02
Rubber Tire Loaders	223	$2,057,211	0.00	0.01	0.03
Crawler Tractor/Dozer	231	$2,276,526	0.00	0.01	0.03
Tractors/Loaders/Backhoes	442	$1,723,263	0.00	0.01	0.02
Off-Highway Trucks	14	$721,299	0.00	0.00	0.02
Sub Total	**1,159**	**$8,671,141**	**0.00**	**0.03**	**0.12**
Measure 51g: DOC+SCR Retrofit					
Excavators	193	$4,067,105	0.23	0.00	0.01
Rubber Tire Loaders	183	$5,649,079	0.31	0.00	0.02
Crawler Tractor/Dozer	129	$4,168,421	0.19	0.00	0.02
Tractors/Loaders/Backhoes	166	$2,492,368	0.11	0.00	0.01
Off-Highway Trucks	14	$2,203,970	0.26	0.00	0.01
Sub Total	**685**	**$18,580,943**	**1.11**	**0.01**	**0.07**
Measure 51h: SCR+DPF Retrofit					
Excavators	255	$6,596,842	0.34	0.01	0.02
Rubber Tire Loaders	223	$6,857,368	0.33	0.01	0.03
Crawler Tractor/Dozer	231	$7,588,421	0.31	0.01	0.02
Tractors/Loaders/Backhoes	316	$5,216,842	0.19	0.01	0.02
Off-Highway Trucks	14	$2,404,330	0.26	0.01	0.02
Sub Total	**1,039**	**$28,663,804**	**1.42**	**0.05**	**0.11**
Grand Total	**7,255**	**$120,769,481**	**4.68**	**0.24**	**0.67**

One Example Emission Reduction Scenario for Agricultural Equipment - 2012 WISCONSIN

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2012 WISCONSIN**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	4,186	$57,752,500	1.70	0.09	0.15
Combines	47	$1,605,000	0.02	0.00	0.00
Sub Total	**4,233**	**$59,357,500**	**1.72**	**0.09**	**0.15**
Measure 51a: DPF Retrofit					
Agricultural Tractors	5,345	$29,218,737	0.00	0.15	0.26
Combines	262	$1,804,737	0.00	0.00	0.00
Sub Total	**5,607**	**$31,023,474**	**0.00**	**0.15**	**0.26**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	2,925	$38,939,789	0.66	0.10	0.13
Combines	47	$746,316	0.01	0.00	0.00
Sub Total	**2,972**	**$39,686,105**	**0.67**	**0.11**	**0.13**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	3,430	$30,776,421	0.77	0.08	0.13
Combines	47	$858,263	0.01	0.00	0.00
Sub Total	**3,477**	**$31,634,684**	**0.78**	**0.08**	**0.13**
Measure 51d: SCR Retrofit					
Agricultural Tractors	1,482	$19,663,000	0.86	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,482**	**$19,663,000**	**0.86**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	4,126	$3,874,842	0.00	0.05	0.17
Combines	338	$510,105	0.00	0.00	0.00
Sub Total	**4,464**	**$4,384,947**	**0.00**	**0.05**	**0.17**
Measure 51f: FTF Retrofit					
Agricultural Tractors	4,330	$18,010,895	0.00	0.06	0.23
Combines	65	$429,632	0.00	0.00	0.00
Sub Total	**4,395**	**$18,440,526**	**0.00**	**0.06**	**0.23**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	2,332	$28,627,500	1.18	0.02	0.09
Combines	0	$0	0.00	0.00	0.00
Sub Total	**2,332**	**$28,627,500**	**1.18**	**0.02**	**0.09**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	4,092	$55,967,368	2.07	0.09	0.19
Combines	47	$1,119,474	0.02	0.00	0.00
Sub Total	**4,139**	**$57,086,842**	**2.09**	**0.09**	**0.19**
Grand Total	**33,101**	**$289,904,579**	**7.29**	**0.64**	**1.35**

APPENDIX C

Summary of Emission Inventory and Vehicle Population Estimates, and Emission Control Measure and Emission Reduction Scenario Analysis

Summary of Emission Inventory and Vehicle Population Estimates, and Emission Control Measure and Emission Reduction Scenario Analyses

EMISSION INVENTORY ESTIMATES

Onroad TOG and NOx Emissions

2009 and 2012 TOG and NOx emissions for gasoline and diesel vehicles were set equal to 2009 and 2012 BaseK emissions as shown in Table 1.

Table 1. LADCO onroad TOG and NOx emissions by fuel type

Year	Gasoline TOG	Diesel TOG	Total TOG	Gasoline NOx	Diesel NOx	Total NOx
2009	1,321	75	1,396	1,322	1,276	2,598
2012	1,083	67	1,150	1,048	987	2,035

TOG and NOx emissions were distributed according to 2002 NEI emissions fractions by vehicle type corrected to reflect ENVIRON, 2004[1] vehicle miles traveled by vehicle type for all pollutants as shown in Table 2.

Table 2. LADCO onroad TOG and NOx emissions by vehicle class

	2009 Emission		2012 Emissions	
Vehicle Class	TOG	NOx	TOG	NOx
LDGV	631	594	518	471
LDGT1	453	477	371	378
LDGT2	208	193	171	153
HDGV	23	53	19	42
Motorcycle	5	4	4	3
LDDV	1	1	1	1
LDDT	2	3	2	2
Class 2b diesel	3	39	3	30
Class 3, 4, 5 diesel	3	39	3	30
Class 6, 7 diesel	13	165	12	127
Class 8 diesel	51	1,004	46	776
Buses	2	26	2	20
Totals	**1,396**	**2,598**	**1,150**	**2,035**

Onroad PM and CO Emissions

NEI 2002 PM and CO emissions were projected to 2009 and 2012 based on EPA NMIM runs for 2002, 2009 and 2012. In NMIM runs, the EPA default county database file was used. The default county database includes 2002 VMT, but not 2009 or 2012 VMT. The 2009 and 2012 VMT applied in NMIM was developed assuming a uniform yearly VMT

[1] ENVIRON, 2004. LADCO/MPCA Total Volume and Vehicle Classification Temporal Profiles. September 2004.

growth rate of 2% across all vehicle types and counties. Emissions distributions by vehicle type were corrected to reflect ENVIRON, 2004[1] vehicle miles traveled by vehicle type for all pollutants.

Table 3. LADCO onroad CO and NOx emissions by vehicle class

	2009 Emissions (tpd)			2012 Emissions (tpd)		
Vehicle Class	**CO**	**PM10**	**PM25**	**CO**	**PM10**	**PM25**
LDGV	8,573	17.5	9.4	7,621	17.4	9.3
LDGT1	6,334	12.2	6.8	5,354	12.1	6.8
LDGT2	2,610	4.2	2.4	2,187	4.1	2.3
HDGV	198	1.2	0.9	170	0.9	0.6
Motocycle	53	0.2	0.1	53	0.2	0.1
LDDV	1	0.4	0.1	1	0.2	0.1
LDDT	2	0.4	0.2	2	0.2	0.1
Class 2b diesel	8	1.1	0.9	5	0.7	0.6
Class 3, 4, 5 diesel	8	0.9	0.7	5	0.6	0.5
Class 6, 7 diesel	28	3.6	3.1	18	2.3	2.0
Class 8 diesel	147	15.9	13.6	95	10.8	9.2
Buses	5	0.9	0.8	4	0.6	0.5
Totals	**17,968**	**58.4**	**38.9**	**15,513**	**50.2**	**32.2**

HEAVY HEAVY-DUTY VEHICLE POPULATION ESTIMATES

VMT and Population Estimates

VMT Mileage Accumulation used in Scenarios

VMT mileage accumulation by model year range was estimated based on MOBILE6 default mileage accumulation rates and population age distribution. The MOBILE6 default mileage accumulation rates (MARs) by age distribution and vehicle type are shown in Table 4; medium-HDDVs and Class 8 HDDVs were applicable to the Chip Reflashing and Retrofits measures, respectively.

Table 4. MOBILE6 Default Annual Mileage Accumulation Rates by Age Distribution and Vehicle Type.

Age	*HDDV4-5*	*HDDV6-7*	*HDDV8a*	*HDDV8b*
1	30,563	40,681	87,821	124,208
2	28,622	36,872	78,257	112,590
3	26,805	33,420	69,735	102,060
4	25,103	30,291	62,141	92,514
5	23,509	27,455	55,374	83,861
6	22,016	24,885	49,343	76,017
7	20,618	22,555	43,970	68,907
8	19,309	20,443	39,181	62,462
9	18,083	18,529	34,915	56,620

Age	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b
10	16,935	16,795	31,112	51,324
11	15,860	15,222	27,724	46,523
12	14,853	13,797	24,705	42,172
13	13,910	12,505	22,015	38,228
14	13,026	11,335	19,617	34,652
15	12,199	10,273	17,481	31,411
16	11,425	9,312	15,577	28,473
17	10,699	8,440	13,881	25,810
18	10,020	7,650	12,369	23,396
19	9,384	6,933	11,022	21,208
20	8,788	6,284	9,822	19,224
21	8,230	5,696	8,752	17,426
22	7,707	5,163	7,799	15,796
23	7,218	4,679	6,950	14,319
24	6,760	4,241	6,193	12,979
25	6,331	3,844	5,518	11,765

Annual VMT accumulations for M-HDDVs and Class 8 HDDVs by model year group were estimated based summing and averaging of the annual MARs for each applicable model year for a particular model year group. For example, in the 2009 case, Age 1 of the MAR in Table 4 is for MY 2009 vehicles, Age 2 is for MY 2008 vehicles and so on. For the 2012 case, Age 1 of the MAR in Table 4 is for MY 2012 vehicles, Age 2 is for MY 2011 vehicles and so on. The VMT accumulation estimates by model year group for 2009 and 2012 M-HDDVs and Class 8 HDDVs are shown in Table 5 and Table 6, respectively. These estimates were now used in the emission reduction scenarios to estimate average vehicle activity for those vehicles targeted in control measures.

Table 5. 2009 VMT accumulation

MY bin	M-HDDV	HDDV8
MY1989 & Earlier	2000	11000
MY 1990	7000	16000
MY 1991 – 1997	10000	26000
MY 1998 – 2001	16000	44000
MY 2002 – 2006	25000	70000
MY 2007+	34000	101000
*MY 1993 – 1998**	*12000*	*30000*

* Used for reflashing measure

Table 6. 2012 VMT accumulation

MY bin	MDV	HDDV8
MY1989 & Earlier	2000	10000
MY 1990	5000	12000
MY 1991 – 1997	8000	19000
MY 1998 – 2001	12000	32000
MY 2002 – 2006	19000	51000
MY 2007+	31000	88000
*MY 1993 – 1998**	*9000*	*22000*

* Used for reflashing measure

Populations Estimates Used in Emissions Scenarios

The basis of population estimates for 2009 and 2012 are 2009 and 2012 VMT estimates. The basis of VMT estimates for 2009 and 2012 are the 2002, MOBILE6 8 vehicle class VMT estimates from ENVIRON, 2004[1]. These 2002 VMT from ENVIRON, 2004[1] were grown by 2% per year to derive 2009 and 2012 VMT by MOBILE6 8 vehicle classes as shown in Table 7.

Table 7. VMT estimates (millions of miles/year) by the MOBILE6 8 Vehicle Classes

Vehicle Class	2002[1]	2009	2012
HDDV	29,745	34,168	36,259
HDGV	5,109	5,868	6,227
LDDT	772	887	941
LDDV	346	397	422
LDGT1	145,804	167,483	177,734
LDGT2	48,236	55,408	58,799
LDGV	211,599	243,061	257,938
MC	1,175	1,350	1,432
Total	**442,786**	**508,622**	**539,753**

The above 2009 and 2012 VMT by the eight MOBILE6 vehicle classes were distributed to vehicle model year by default MOBILE6 age distribution and VMT mileage accumulation by age. Additionally, HDDV VMT was distributed to detailed HDDV classes such that population fractions by HDDV class were equivalent to MOBILE6 defaults. MOBILE6 default HDDV class fractions vary by model year for pre-1996 model years and are equivalent thereafter. For purposes of calculation simplicity and due to the small variance in HDDV fractions for the HDDV classes of concern, 1996+ HDDV class fractions were applied to all model years. Tables 8 and 9 show vehicle VMT by model year and vehicle class for 2009 and 2012, respectively. Tables 10 and 11 show the vehicle population estimates for 2009 and 2012, respectively, and these population estimates were used in the emission reduction scenario analyses.

HEAVY-DUTY DIESEL VEHICLE CONTROL MEASURES ASSESSMENT

Control Measure Assessment

As discussed in the Retrofits and Fleet Modernization White Papers, emission factors (g/mile) for on-road HDDVs were calculated based on the engine emission standards (g/bhp-hr) and conversion factors (bhp-hr/mile) for HDDVs from EPA's MOBILE6 model by vehicle class and model year.

In the previous analysis, it was assumed that the vehicle with installed retrofit device or replacement vehicle would travel 50,000 mile annually across the model year groups. The vehicle activity is now assumed based on default Mobile6 annual mileage accumulation in which activity is assumed to vary by vehicle age (see Tables 5 and 6).

Note that this would most likely under-estimate the emission reduction potentials for such a program as funded project data in similar programs, such as the Sacramento Emergency Clean Air Transportation (SECAT) program, showed that retrofitted vehicles or replacement vehicles tend to travel at an average of 45,000 to 50,000 miles.

Using this methodology, the emission reduction per vehicle was estimated based on the baseline and control emission factors, as well as the assumed annual VMT. The per-vehicle emission reduction potentials for each technology by model year group were used in the emission reduction scenario analysis.

Emission Reduction Scenario Analysis

The emission reduction scenario analysis was developed based on a series of selected control measures, including the Retrofits and Fleet Modernization Measures. For each control measure, the amount of emission reduction (in tpd) for each model year group was estimated based on the number of recommended vehicles based on a penetration rate and number of vehicle available (as provided in Tables 10 and 11), and the per-vehicle emission reduction estimates. The recommended vehicles were based on a set of criteria related to the cost-effectiveness value of the measure and assigned penetration rate as follows:

Cost-Effectiveness (CE) Value ($/ton of NOx+20*PM+ROG reduced)	Penetration Rate (%)	
	2009	2012
CE < 4,000	5	10
4,000 < CE < 7,000	4	8
7,000 < CE < 10,000	3	6
10,000 < CE < 14,300	2	4
14,300 and over	0	0

These emission reduction potentials by each model group for each control measure were then added up to provide a total emission reduction for the scenario. Again, the emission reduction scenario analysis was just one of infinite possible scenarios to implement the selected control measures. However, it provides a general idea of whether there are available or excess emissions, and potential emission reductions from target sources, as well as available measures to cost effectively reduce these available or excess emissions and associated costs to achieve the potential emission reductions.

Table 8. 2009 Vehicle VMT Estimates By Vehicle Types and Model Years (millions of miles/year)

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	262	18,267	15,172	5,756	461	30	98	330	119	112	500	381	1,244	15	16
2008	285	23,132	19,059	6,659	789	38	117	549	192	210	907	680	2,256	31	30
2007	213	21,991	17,828	5,782	675	36	105	457	155	184	769	567	1,913	29	29
2006	159	20,876	16,560	5,008	577	34	93	381	125	161	652	472	1,622	27	28
2005	118	19,790	15,228	4,351	494	32	82	317	100	141	553	394	1,376	25	28
2004	86	18,680	13,838	3,774	422	31	72	264	81	124	468	328	1,165	23	27
2003	62	17,529	12,394	3,274	361	29	62	220	65	108	397	273	988	22	26
2002	45	16,350	10,940	2,837	309	27	53	183	52	95	336	228	837	20	25
2001	31	15,061	9,465	2,461	264	25	45	152	42	83	285	190	711	19	24
2000	22	13,705	8,022	2,139	226	22	37	127	34	73	242	158	602	18	23
1999	15	12,218	6,640	1,854	193	20	30	105	27	64	205	132	511	17	23
1998	50	10,648	5,369	1,607	165	17	23	88	22	56	174	110	433	16	22
1997	0	8,601	4,219	1,394	141	14	18	73	18	49	147	92	367	14	21
1996	0	6,481	3,218	1,210	121	11	13	61	14	43	125	76	311	14	19
1995	0	4,888	2,374	1,051	103	8	10	51	11	38	106	64	264	13	17
1994	0	3,679	1,697	912	89	6	7	42	9	33	90	53	223	12	13
1993	0	2,777	1,163	791	76	5	5	35	7	29	76	44	190	11	8
1992	0	2,100	768	684	65	3	3	29	6	25	65	37	161	10	4
1991	0	1,580	551	594	55	3	2	24	5	22	55	31	137	10	3
1990	0	1,186	473	516	47	2	2	20	4	19	46	26	116	9	2
1989	0	902	408	448	40	1	2	17	3	17	39	21	98	8	2
1988	0	679	351	389	35	1	1	14	3	15	33	18	83	8	1
1987	0	510	301	338	30	1	1	12	2	13	28	15	71	7	1
1986	0	387	257	292	25	1	1	10	2	11	24	12	60	7	1
1985 & Earlier	0	1,044	1,188	1,286	104	2	5	39	6	51	104	53	259	33	3
Totals	**1,350**	**243,061**	**167,483**	**55,408**	**5,868**	**397**	**887**	**3,598**	**1,105**	**1,778**	**6,426**	**4,454**	**15,995**	**416**	**394**

Table 9. 2012 Vehicle VMT Estimates By Vehicle Types and Model Years (millions of miles/year)

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012	278	19,385	16,101	6,108	489	32	103	350	127	119	531	405	1,320	16	17
2011	303	24,548	20,226	7,067	838	40	124	583	204	223	962	721	2,394	33	32
2010	227	23,337	18,919	6,135	716	38	111	485	164	196	816	601	2,030	30	31
2009	169	22,154	17,573	5,315	613	36	99	404	132	171	692	501	1,721	28	30
2008	126	21,001	16,160	4,617	524	34	88	336	107	150	587	418	1,460	27	29
2007	91	19,823	14,685	4,005	448	32	77	280	86	131	497	348	1,237	25	28
2006	66	18,602	13,152	3,475	383	30	66	233	69	115	421	290	1,049	23	27
2005	47	17,351	11,610	3,011	328	28	56	194	56	101	357	242	888	22	27
2004	33	15,983	10,044	2,612	280	26	47	161	45	88	303	202	754	20	26
2003	23	14,544	8,513	2,270	240	24	39	134	36	77	256	168	639	19	25
2002	16	12,966	7,047	1,968	205	21	31	112	29	68	218	140	542	18	24
2001	53	11,300	5,698	1,706	175	18	25	93	23	59	184	117	459	16	23
2000	0	9,128	4,477	1,479	150	15	19	78	19	52	156	97	390	15	22
1999	0	6,877	3,415	1,284	128	11	14	64	15	45	132	81	330	14	20
1998	0	5,187	2,519	1,116	110	8	10	54	12	40	112	68	280	13	18
1997	0	3,904	1,801	968	94	6	7	45	10	35	95	56	237	13	14
1996	0	2,946	1,235	839	80	5	5	37	8	31	81	47	201	12	8
1995	0	2,228	815	726	69	4	3	31	6	27	69	39	171	11	4
1994	0	1,677	585	631	59	3	2	26	5	24	58	33	145	10	3
1993	0	1,259	502	548	50	2	2	21	4	21	49	27	123	10	2
1992	0	957	433	475	43	2	2	18	3	18	42	23	104	9	2
1991	0	720	373	413	37	1	2	15	3	16	35	19	88	8	1
1990	0	541	319	359	31	1	1	12	2	14	30	16	75	8	1
1989	0	411	272	310	27	1	1	10	2	12	25	13	63	7	1
1988 & Earlier	0	1,108	1,260	1,365	110	2	5	41	7	54	110	56	275	35	3
Totals	**1,432**	**257,938**	**177,734**	**58,799**	**6,227**	**422**	**941**	**3,819**	**1,173**	**1,887**	**6,819**	**4,727**	**16,974**	**442**	**418**

Table 10. 2009 Vehicle Population Estimates By Vehicle Types and Model Years (1000 Vehicles)

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	54.7	1,225.2	778.2	269.8	23.1	2.0	3.6	12.1	3.6	3.7	12.3	4.3	10.0	1.5	0.3
2008	63.8	1,632.0	1,036.7	335.2	42.0	2.7	4.8	22.1	6.6	7.3	24.6	8.7	20.0	3.1	0.7
2007	51.3	1,632.0	1,030.0	312.5	38.2	2.7	4.8	20.1	6.0	6.9	23.0	8.1	18.7	2.9	0.7
2006	41.4	1,629.7	1,018.0	290.7	34.8	2.7	4.7	18.3	5.5	6.4	21.5	7.6	17.5	2.7	0.7
2005	33.4	1,625.1	997.9	271.2	31.7	2.7	4.6	16.7	5.0	6.0	20.1	7.1	16.4	2.5	0.7
2004	26.6	1,613.5	968.4	252.6	28.8	2.6	4.5	15.1	4.5	5.6	18.8	6.6	15.3	2.4	0.7
2003	21.3	1,592.7	928.2	235.3	26.2	2.6	4.3	13.8	4.1	5.3	17.6	6.2	14.3	2.2	0.7
2002	17.1	1,562.7	878.7	218.9	23.8	2.6	4.1	12.5	3.8	4.9	16.4	5.8	13.4	2.0	0.7
2001	13.7	1,514.1	817.1	204.0	21.7	2.5	3.8	11.4	3.4	4.6	15.4	5.4	12.5	1.9	0.7
2000	11.0	1,449.4	746.1	190.3	19.7	2.4	3.5	10.4	3.1	4.3	14.4	5.1	11.7	1.8	0.7
1999	8.7	1,359.2	667.0	177.2	17.9	2.2	3.1	9.4	2.8	4.0	13.5	4.8	11.0	1.7	0.7
1998	36.8	1,246.0	584.0	164.9	16.3	2.0	2.7	8.6	2.6	3.8	12.6	4.5	10.3	1.6	0.7
1997	0.0	1,058.7	498.3	153.5	14.9	1.7	2.3	7.8	2.3	3.5	11.8	4.2	9.6	1.5	0.7
1996	0.0	839.1	413.9	143.1	13.5	1.4	1.9	7.1	2.1	3.3	11.0	3.9	9.0	1.4	0.6
1995	0.0	665.7	333.5	133.5	12.3	1.1	1.5	6.5	1.9	3.1	10.3	3.6	8.4	1.3	0.6
1994	0.0	527.0	261.2	124.5	11.2	0.9	1.2	5.9	1.8	2.9	9.6	3.4	7.8	1.2	0.5
1993	0.0	418.4	196.9	115.8	10.2	0.7	0.9	5.4	1.6	2.7	9.0	3.2	7.3	1.1	0.3
1992	0.0	332.9	143.3	107.7	9.3	0.5	0.7	4.9	1.5	2.5	8.4	3.0	6.9	1.0	0.1
1991	0.0	263.5	113.9	100.4	8.4	0.4	0.5	4.4	1.3	2.4	7.9	2.8	6.4	1.0	0.1
1990	0.0	208.0	108.5	93.6	7.7	0.3	0.5	4.0	1.2	2.2	7.4	2.6	6.0	0.9	0.1
1989	0.0	166.4	104.5	87.2	7.0	0.3	0.5	3.7	1.1	2.1	6.9	2.4	5.6	0.8	0.1
1988	0.0	131.8	100.5	81.3	6.3	0.2	0.5	3.3	1.0	1.9	6.5	2.3	5.3	0.8	0.1
1987	0.0	104.0	96.4	75.9	5.8	0.2	0.4	3.0	0.9	1.8	6.0	2.1	4.9	0.7	0.0
1986	0.0	83.2	92.4	70.4	5.2	0.1	0.4	2.8	0.8	1.7	5.6	2.0	4.6	0.7	0.0
1985 & Earlier	0.0	235.8	480.9	333.0	22.9	0.4	2.2	12.1	3.6	8.1	27.0	9.5	22.0	3.3	0.1
Totals	**379.7**	**23,116.2**	**13,394.5**	**4,542.4**	**458.9**	**37.8**	**62.0**	**241.5**	**72.4**	**101.0**	**337.8**	**119.3**	**275.2**	**41.9**	**11.3**

Table 11. 2012 Vehicle Population Estimates By Vehicle Types and Model Years (1000 Vehicles)

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012	58.0	1,300.1	825.9	286.3	24.5	2.1	3.8	12.9	3.9	3.9	13.0	4.6	10.6	1.6	0.4
2011	67.7	1,731.9	1,100.2	355.7	44.6	2.8	5.1	23.5	7.0	7.8	26.1	9.2	21.3	3.3	0.7
2010	54.4	1,731.9	1,093.1	331.6	40.6	2.8	5.1	21.3	6.4	7.3	24.4	8.6	19.9	3.1	0.7
2009	43.9	1,729.4	1,080.3	308.5	36.9	2.8	5.0	19.4	5.8	6.8	22.8	8.1	18.6	2.9	0.7
2008	35.5	1,724.5	1,059.0	287.8	33.6	2.8	4.9	17.7	5.3	6.4	21.4	7.5	17.4	2.7	0.7
2007	28.2	1,712.3	1,027.7	268.0	30.5	2.8	4.8	16.1	4.8	6.0	20.0	7.1	16.3	2.5	0.7
2006	22.6	1,690.2	985.1	249.7	27.8	2.8	4.6	14.6	4.4	5.6	18.7	6.6	15.2	2.3	0.7
2005	18.1	1,658.3	932.5	232.3	25.3	2.7	4.3	13.3	4.0	5.2	17.5	6.2	14.2	2.2	0.7
2004	14.5	1,606.8	867.1	216.4	23.0	2.6	4.0	12.1	3.6	4.9	16.3	5.8	13.3	2.0	0.7
2003	11.7	1,538.1	791.7	202.0	20.9	2.5	3.7	11.0	3.3	4.6	15.3	5.4	12.4	1.9	0.7
2002	9.3	1,442.4	707.9	188.0	19.0	2.4	3.3	10.0	3.0	4.3	14.3	5.1	11.7	1.8	0.7
2001	39.1	1,322.2	619.7	175.0	17.3	2.2	2.9	9.1	2.7	4.0	13.4	4.7	10.9	1.7	0.7
2000	0.0	1,123.5	528.8	162.9	15.8	1.8	2.4	8.3	2.5	3.7	12.5	4.4	10.2	1.5	0.7
1999	0.0	890.5	439.2	151.8	14.3	1.5	2.0	7.5	2.3	3.5	11.7	4.1	9.5	1.4	0.7
1998	0.0	706.5	353.9	141.7	13.1	1.2	1.6	6.9	2.1	3.3	10.9	3.9	8.9	1.4	0.6
1997	0.0	559.3	277.2	132.1	11.9	0.9	1.3	6.3	1.9	3.1	10.2	3.6	8.3	1.3	0.5
1996	0.0	444.0	209.0	122.9	10.8	0.7	1.0	5.7	1.7	2.9	9.6	3.4	7.8	1.2	0.3
1995	0.0	353.2	152.1	114.2	9.8	0.6	0.7	5.2	1.6	2.7	9.0	3.2	7.3	1.1	0.1
1994	0.0	279.7	120.8	106.5	9.0	0.5	0.6	4.7	1.4	2.5	8.4	3.0	6.8	1.0	0.1
1993	0.0	220.8	115.1	99.3	8.1	0.4	0.5	4.3	1.3	2.3	7.8	2.8	6.4	1.0	0.1
1992	0.0	176.6	110.9	92.6	7.4	0.3	0.5	3.9	1.2	2.2	7.3	2.6	6.0	0.9	0.1
1991	0.0	139.8	106.6	86.3	6.7	0.2	0.5	3.5	1.1	2.0	6.8	2.4	5.6	0.8	0.1
1990	0.0	110.4	102.3	80.5	6.1	0.2	0.5	3.2	1.0	1.9	6.4	2.3	5.2	0.8	0.1
1989	0.0	88.3	98.1	74.7	5.6	0.1	0.5	2.9	0.9	1.8	6.0	2.1	4.9	0.7	0.0
1988 & Earlier	0.0	250.2	510.3	353.3	24.3	0.4	2.4	12.8	3.8	8.6	28.6	10.1	23.3	3.5	0.1
Total	**403.0**	**24,531.1**	**14,214.4**	**4,820.5**	**487.0**	**40.1**	**65.8**	**256.3**	**76.9**	**107.1**	**358.4**	**126.6**	**292.1**	**44.5**	**12.0**

APPENDIX D

Emission Inventory, Vehicle Population Estimates, and Emission Reduction Scenario Analysis for Minnesota

2009 and 2012 On-Road Emissions Inventories for MINNESOTA

2009 NEI Scaled Emissions (NMIM revised VMT from NEI02 mix to ENVIRON VMT-mix)						
	VOC	TOG	CO	NOx	PM10	PM25
LDGV	82.3	90.6	1328.5	81.7	2.2	1.0
LDGT1	46.2	61.3	962.1	64.7	1.5	0.7
LDGT2	20.7	25.8	370.0	25.3	0.5	0.2
HDGV	8.7	3.1	23.5	6.2	0.1	0.1
Motocycle	1.1	0.7	6.7	0.6	0.0	0.0
LDDV	0.041	0.057	0.1	0.2	0.0	0.0
LDDT	0.269	0.263	0.3	0.5	0.0	0.0
Class 2b diesel	0.5	0.5	1.2	5.5	0.1	0.1
Class 3, 4, 5 diesel	0.4	0.5	1.2	5.5	0.1	0.1
Class 6, 7 diesel	1.9	1.9	4.0	23.3	0.5	0.4
Class 8 diesel	8.5	8.0	23.9	139.4	2.1	1.7
Buses	0.4	0.3	0.8	3.6	0.1	0.1
MN Total	171.0	192.9	2722.3	356.4	7.4	4.5

2012 NEI Scaled Emissions (NMIM revised VMT from NEI02 mix to ENVIRON VMT-mix)						
	VOC	TOG	CO	NOx	PM10	PM25
LDGV	71.4	75.8	1194.7	65.9	2.2	1.0
LDGT1	40.0	50.7	818.5	52.2	1.5	0.7
LDGT2	17.9	21.2	316.8	20.4	0.5	0.2
HDGV	7.5	2.5	20.6	5.0	0.1	0.1
Motocycle	1.0	0.6	6.7	0.5	0.0	0.0
LDDV	0.040	0.058	0.1	0.1	0.0	0.0
LDDT	0.264	0.332	0.3	0.5	0.0	0.0
Class 2b diesel	0.5	0.4	0.7	4.8	0.1	0.1
Class 3, 4, 5 diesel	0.4	0.4	0.8	4.8	0.1	0.1
Class 6, 7 diesel	1.9	1.8	2.5	20.4	0.3	0.2
Class 8 diesel	8.3	7.4	15.4	122.2	1.4	1.1
Buses	0.4	0.3	0.5	3.2	0.1	0.1
MN Total	149.6	161.4	2377.5	299.9	6.3	3.6

2009 and 2012 On-Road Vehicle Population Estimates MINNESOTA

2002 Vehicle VMT by Vehicle Types: Minnesota

	Minnesota
HDDV	3886350507
HDGV	624379290
LDDT	91879520
LDDV	41240283
LDGT1	17388742496
LDGT2	5739151185
LDGV	25233099498
MC	166384217
Total	53151226997

Growth Rates: 2%

2009 Vehicle VMT by Vehicle Types

	Minnesota		
HDDV	4441221414	4441221414	100%
HDGV	717215542	717215542	100%
LDDT	105540687	105540687	100%
LDDV	47372122	47372122	100%
LDGT1	19974199283	19974199283	100%
LDGT2	6592480711	6592480711	100%
LDGV	26984899744	26984899744	100%
MC	191123166	191123166	100%
Total	61054052669	61054052669	100%

2009 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	37062535	2178344619	1809455908	684797060	56359229	3560226	11607628	42849076	15507174	14599194	65012183	49584645	161737132	1991823	2039904
2008	40429862	2758462313	2273041308	792335576	66479429	4508388	13934825	71400512	24991591	27344052	117850062	88369244	283217566	3983645	3949749
2007	30230437	2622445970	2126177816	687898548	62481189	4286053	12475883	59413356	20112797	23954904	99920661	73662166	248634541	3723843	3823844
2006	22585278	2489495359	1974910484	595907791	70556889	4068763	11111081	49471631	16196308	20984401	84713921	61399416	210817023	3474865	3701913
2005	16786938	2359958517	1816089145	517667870	60376553	3857051	9814761	41206201	13047458	18387046	71840517	51191602	178798999	3247537	3583956
2004	12156603	2227534967	1650313642	449001457	51575805	3640622	8563273	34261243	10482780	16092560	60854764	42631176	151469931	3036447	3469702
2003	8798595	2090363457	1478107139	389562547	44154266	3416432	7414079	28550190	8456444	14096645	51591992	35533727	128428039	2836183	3359061
2002	6318678	1949736830	1304771401	337584699	37728771	3186598	6324160	23745842	6802057	12340145	43709449	29597228	108818725	2646743	3251943
2001	4452770	1796000661	1128794124	292850432	32255121	2935334	5299248	19759649	5474293	10820988	37085273	24695820	92362035	2473541	3148256
2000	3101933	1634361332	956889059	254510627	27624373	2671155	4360533	16472014	4413615	9467304	31411693	20558153	78214790	2311164	3042948
1999	2075486	1457007478	791948542	220602060	23514491	2381293	3513303	13705220	3551765	8304387	26865293	17158343	66404788	2159612	2936311
1998	7136048	1269769023	640349898	191223744	20210782	2075276	2771694	11417868	2861857	7270337	22594110	14293555	56271931	2018886	2824137
1997	0	1025671923	503151598	165814789	17292836	1676330	2131102	9508715	2304807	6370655	19160678	11917652	47727182	1883572	2679994
1996	0	772797546	383782558	143908236	14751732	1263039	1595201	7895488	1850903	5572630	16223362	9919659	40411474	1759083	2476834
1995	0	582681058	283128565	125082526	12639967	952645	1158416	6585629	1493218	4862650	13758212	8270137	34272074	1645419	2157244
1994	0	438695666	202351769	108582043	10818287	716992	817496	5486513	1203083	4272997	11651707	6886130	29029321	1537168	1859329
1993	0	331099120	138757848	94088016	9253914	541139	555269	4567421	988596	3748746	9893625	5748818	24652334	1434329	1604998
1992	0	250395822	91548388	81439124	7914924	409240	384200	3802744	779987	3287298	8396595	4796464	20923793	1342315	1463505
1991	0	188456870	65705376	70721516	6776253	308009	260763	3169885	628731	2861611	7122604	4000579	17763106	1250302	367144
1990	0	141438169	56376607	61390081	5782956	231153	223912	2632197	505688	2525608	6042018	3336496	15060752	1169113	290811
1989	0	107573391	48706467	53285114	4948092	175815	194310	2182506	406781	2203239	5101547	2765390	12717056	1093336	229404
1988	0	80951292	41897031	46262258	4222992	132305	168341	1821182	326836	1931747	4329495	2310569	10782928	1022974	181705
1987	0	60758128	35885041	40200450	3624683	99301	145659	1521614	264138	1695514	3677120	1929676	9169053	952611	143337
1986	0	45204954	30609154	34748389	3083180	75516	125794	1259877	211510	1481478	3109471	1604221	7753834	893073	116691
1985 & Earlier	0	124475181	141850385	153035755	12688828	203439	589766	5045485	819195	6638204	13484409	6838723	33627728	4238036	3480362
Total	191123166	26984899744	19974199283	6592480711	717215542	47372122	105540687	467741858	143671011	231154332	835208762	579003489	2079065535	54125624	51250803

2009 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2009	7,744	146,100	92,812	32,103	2,821	239	429	1,579	473	478	1,596	565	1,302	200	45
2008	9,035	194,616	123,642	39,686	5,136	318	571	2,875	662	955	3,196	1,129	2,604	401	90
2007	7,260	194,616	122,844	37,184	4,672	318	568	2,615	784	894	2,990	1,056	2,436	376	90
2006	5,862	194,340	121,406	34,689	4,251	318	661	2,379	714	836	2,797	988	2,279	350	90
2005	4,732	193,789	119,010	32,266	3,870	317	650	2,166	650	782	2,617	924	2,132	327	90
2004	3,764	192,410	115,495	30,050	3,617	314	534	1,968	590	731	2,445	864	1,993	306	90
2003	3,012	188,929	110,703	27,996	3,203	310	512	1,792	537	684	2,287	808	1,864	285	90
2002	2,420	186,346	104,792	26,050	2,911	305	484	1,629	489	639	2,138	755	1,742	266	90
2001	1,936	180,557	97,444	24,267	2,647	295	450	1,482	444	598	2,002	707	1,631	249	90
2000	1,560	172,839	88,978	22,645	2,412	282	411	1,350	405	559	1,870	661	1,524	233	90
1999	1,237	162,088	79,553	21,078	2,193	265	368	1,227	368	524	1,752	619	1,427	217	90
1998	5,216	148,681	69,649	19,619	1,997	243	322	1,118	335	489	1,638	579	1,334	203	89
1997	0	126,252	59,425	18,268	1,817	206	275	1,017	305	458	1,532	541	1,248	190	88
1996	0	100,064	49,361	17,025	1,649	164	228	923	277	428	1,431	506	1,166	177	84
1995	0	79,390	39,776	15,890	1,503	130	184	841	252	400	1,339	473	1,091	166	75
1994	0	62,850	31,150	14,809	1,369	103	144	766	230	374	1,251	442	1,020	155	60
1993	0	49,894	23,482	13,782	1,245	82	109	697	209	350	1,172	414	955	144	37
1992	0	39,695	17,093	12,809	1,133	65	79	634	190	328	1,098	388	894	135	18
1991	0	31,428	13,576	11,944	1,032	51	63	578	173	307	1,027	363	837	126	15
1990	0	24,809	12,939	11,193	937	41	60	524	157	287	961	340	783	118	12
1989	0	19,847	12,460	10,377	853	32	58	477	143	268	896	316	730	110	10
1988	0	15,719	11,981	9,674	774	26	55	433	130	251	839	296	683	103	8
1987	0	12,405	11,502	9,026	707	20	53	396	119	235	788	278	640	96	6
1986	0	9,924	11,022	8,377	639	16	51	358	107	219	733	269	597	90	5
1985 & Earlier	0	28,117	57,348	39,616	2,799	46	265	1,566	470	1,049	3,508	1,239	2,858	426	17
Total	59,777	2,756,596	1,597,447	540,461	56,088	4,595	7,383	31,391	9,413	13,123	43,904	15,611	35,773	5,446	1,471

2002 Vehicle VMT by Vehicle Types: **Minnesota**

	Minnesota
HDDV	3666350507
HDGV	624379290
LDDT	91879520
LDDV	41240283
LDGT1	17388742496
LDGT2	5739151385
LDGV	25233099498
MC	166384217
Total	53151226997

Growth Rates: 2%

2012 Vehicle VMT by Vehicle Types

	Illinois		
HDDV	4713059694	4713059694	100%
HDGV	761114871	761114871	100%
LDDT	112000622	112000622	100%
LDDV	50271675	50271675	100%
LDGT1	21196780073	21196780073	100%
LDGT2	6995993270	6995993270	100%
LDGV	30759007487	30759007487	100%
MC	202821432	202821432	100%
Total	64791049125	64791049125	100%

2012 Vehicle VMT Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	39331059	2311676737	1920209085	726712118	59808865	3776141	12318107	45471782	16456337	15492781	68891448	82619515	171636739	2113738	2164763
2011	42904493	2827323469	2412169621	840832854	102384742	4784337	14787747	75770795	26521276	25017227	125063429	93778146	311164827	4227477	4191605
2010	32680782	2782950643	2256316938	730003443	87529698	4546394	13239507	63049929	21343862	25421136	108036565	78170880	263852964	3951772	4057894
2009	23987678	2641872391	2095790805	632382115	74875538	4317803	11791168	52499690	17187632	22688814	89899091	65157651	223720712	3687555	3928500
2008	17793209	2504406857	1927248338	549353285	64072081	4093134	10415503	43728350	13846067	19512479	76237732	54324938	189742928	3446313	3803323
2007	12911296	2363677927	1751326040	476483938	54732656	3863457	9106638	36558305	11135022	17077553	64576562	45240545	160740486	3222302	3682076
2006	9335123	2218310424	1568579121	413406892	46856861	3625545	7867880	30297690	8974046	14959473	54749835	37708875	136288863	3009780	3564663
2005	6705325	2069076322	1384633848	358247584	40038074	3381841	6711249	25199277	7218398	13095460	46384817	31408816	115479302	2808745	3450988
2004	4725315	1905930270	1197885355	310776221	34229393	3115000	5823605	20999098	5809364	11483317	39365800	26207402	98015331	2624941	3340955
2003	3291798	1734397320	1015246083	270088713	29315205	2834651	4827432	17480233	4683763	10046778	33334340	21816477	83002160	2452626	3229200
2002	2202522	1546187992	840422128	234104671	25059887	2527047	3728345	14544090	3769161	8812682	28297422	18208571	70469292	2291798	3116037
2001	7572831	1347489045	679544435	202928167	21447844	2202299	2941344	12116733	3037028	7715339	23977050	15168435	59716223	2142458	2996997
2000	0	1088451250	533948501	175963980	18351296	1778935	2261543	10090724	2445879	6760590	20333484	12647107	50648467	1998861	2844031
1999	0	820068938	407273121	152716571	15654656	1340347	1692840	8378755	1964193	5913719	17216362	10526822	42884980	1866753	2626436
1998	0	618558042	300458298	132738577	13413634	1010954	1229320	6988722	1584615	5181507	14598203	8776335	36369799	1746132	2289265
1997	0	465547350	214737305	115206909	11480452	760876	867533	5822332	1276721	4534539	12364885	7307617	30806147	1631255	1760893
1996	0	351365035	147250981	99846956	9820328	574261	589256	4846984	1027862	3978199	10499194	6100692	26161255	1522121	1066512
1995	0	265722155	97151882	86423850	8399380	434289	386492	4035502	827728	3488508	8910533	5090046	22204496	1424476	491876
1994	0	199991838	63727071	75050238	7193136	326861	276724	3363908	667214	3057989	7558564	4245446	18839739	1326830	389617
1993	0	150095316	59827206	65147645	6136919	245312	237617	2793308	536004	2680194	6411838	3540716	15982591	1240673	308611
1992	0	114157743	51687693	56540590	5250955	186576	206203	2326705	431679	2338094	5413802	2938898	13495444	1160259	243445
1991	0	85906159	44461465	49093679	4481473	140403	176845	1932653	346841	2049985	4594495	2451894	11453541	1085588	192827
1990	0	64477009	38081493	42661039	3846543	105379	154578	1614749	280305	1799293	3902169	2047788	9730273	1010918	152111
1989	0	49033067	32482679	36875268	3271895	80138	133483	1336779	224456	1572154	3299795	1702412	8228430	947736	123834
1988 & Earlier	0	132094058	150320521	162402767	13463383	215891	625865	5354309	869336	7044515	14309762	7257308	35586012	4497438	389387
Total	202821432	30759007487	21196780073	6995993270	761114871	50271675	112000622	496371402	152464826	245302826	886330220	614443135	2206320979	57438545	54387762

2012 Vehicle Population Estimates By Vehicle Types and Model Years

Age	MC	LDGV	LDGT1	LDGT2	HDGV2b-3	LDDV	LDDT	HDDV2b	HDDV3	HDDV4-5	HDDV6-7	HDDV8a	HDDV8b	HDDBS	HDDBT
2012+	8,218	155,042	98,452	34,068	2,994	253	453	1,676	502	507	1,696	699	1,382	213	48
2011	9,598	206,528	131,210	42,327	5,452	338	606	3,051	916	1,014	3,392	1,198	2,764	425	96
2010	7,704	206,528	130,363	39,460	4,958	338	603	2,775	832	948	3,173	1,121	2,585	398	96
2009	6,221	206,235	128,837	36,707	4,512	337	595	2,525	757	887	2,968	1,049	2,418	371	96
2008	5,022	205,650	126,294	34,240	4,107	336	584	2,299	689	830	2,777	981	2,253	347	96
2007	3,995	204,187	122,565	31,869	3,732	334	566	2,089	626	776	2,595	917	2,115	324	96
2006	3,196	201,555	117,479	29,703	3,398	329	543	1,902	570	726	2,427	858	1,978	303	96
2005	2,568	197,752	111,207	27,645	3,089	323	514	1,729	518	678	2,269	802	1,849	283	96
2004	2,054	191,009	103,409	25,752	2,809	313	478	1,572	472	635	2,125	751	1,731	264	96
2003	1,655	183,418	94,424	24,031	2,559	300	436	1,432	430	593	1,985	701	1,617	247	96
2002	1,313	172,009	84,422	22,358	2,327	281	390	1,303	391	556	1,859	657	1,515	231	95
2001	5,536	157,675	73,912	20,820	2,119	258	342	1,186	356	519	1,738	614	1,416	216	95
2000	0	133,990	63,062	19,386	1,928	219	291	1,079	324	486	1,626	574	1,325	201	93
1999	0	106,189	52,382	18,067	1,750	174	242	979	294	454	1,519	537	1,236	188	89
1998	0	84,249	42,211	16,862	1,595	138	195	893	268	425	1,421	502	1,158	176	80
1997	0	66,697	33,057	15,715	1,452	109	153	813	244	397	1,328	469	1,082	164	63
1996	0	52,948	24,920	14,625	1,321	87	115	740	222	372	1,244	439	1,014	153	40
1995	0	42,125	18,139	13,593	1,202	69	84	673	202	348	1,165	412	949	143	19
1994	0	33,349	14,409	12,675	1,095	55	67	613	184	326	1,090	385	888	133	15
1993	0	26,328	13,731	11,815	994	43	63	556	167	305	1,020	360	831	125	13
1992	0	21,062	13,223	11,012	905	34	61	506	152	284	950	336	774	117	10
1991	0	16,674	12,714	10,266	821	27	59	460	138	266	890	314	725	109	8
1990	0	13,164	12,206	9,578	750	22	56	420	126	249	834	295	680	102	7
1989	0	10,531	11,697	8,890	679	17	54	380	114	233	778	275	634	95	6
1988 & Earlier	0	29,838	60,859	42,041	2,970	49	281	1,662	498	1,113	3,723	1,315	3,033	453	18
Total	57,069	2,925,321	1,695,223	573,641	59,521	4,781	7,835	33,313	9,989	13,926	46,591	16,461	37,963	5,779	1,561

2009 and 2012 NONROAD Emissions Inventories for MINNESOTA

Minnesota 2009 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol				
Equipment Type	VOC	CO	NOX	PM10	PM25
Agricultural Equipment	8.94	82.90	79.50	7.90	7.27
Airport Ground Support Equipment	0.07	0.82	0.84	0.06	0.05
Commercial Equipment	6.24	259.64	8.00	0.65	0.60
Construction and Mining Equipment	4.30	44.82	31.00	2.70	2.49
Industrial Equipment	2.79	62.40	13.90	0.59	0.55
Lawn and Garden Equipment	16.53	405.95	4.49	0.87	0.80
Logging Equipment	0.23	2.31	0.38	0.05	0.04
Pleasure Craft	48.33	156.71	11.58	2.94	2.71
Railroad Equipment	0.03	0.40	0.15	0.02	0.02
Recreational Equipment	116.34	320.09	2.85	3.18	2.92
Underground Mining Equipment	0.00	0.00	0.00	0.00	0.00
Grand Total	203.81	1,336.05	152.70	18.96	17.46

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	7.59	1.35	0.00
	Airport Ground Support Equipment		0.06	0.01	0.00
	Commercial Equipment	0.00	0.69	5.39	0.16
	Construction and Mining Equipment	0.00	3.18	1.10	0.02
	Industrial Equipment	0.01	0.55	0.31	1.93
	Lawn and Garden Equipment		0.11	16.42	0.01
	Logging Equipment		0.03	0.20	
	Pleasure Craft		0.16	48.17	
	Railroad Equipment		0.03	0.00	0.00
	Recreational Equipment		0.05	116.29	0.00
	Underground Mining Equipment		0.00		
VOC Total		0.01	12.44	189.24	2.12
CO	Agricultural Equipment	0.02	39.03	43.82	0.02
	Airport Ground Support Equipment		0.36	0.39	0.07
	Commercial Equipment	0.68	2.83	253.44	2.69
	Construction and Mining Equipment	0.00	16.52	27.87	0.43
	Industrial Equipment	3.29	3.19	10.88	45.05
	Lawn and Garden Equipment		0.46	405.32	0.17
	Logging Equipment		0.14	2.17	
	Pleasure Craft		0.75	155.96	
	Railroad Equipment		0.11	0.29	0.00
	Recreational Equipment		0.22	319.82	0.05
	Underground Mining Equipment		0.00		
CO Total		3.99	63.61	1,219.96	48.49
NOX	Agricultural Equipment	0.00	78.59	0.90	0.00
	Airport Ground Support Equipment		0.82	0.01	0.01
	Commercial Equipment	0.19	4.53	2.57	0.72
	Construction and Mining Equipment	0.00	30.64	0.29	0.08
	Industrial Equipment	0.51	6.07	0.39	6.93
	Lawn and Garden Equipment		0.96	3.51	0.02

	Logging Equipment		0.36	0.02	
	Pleasure Craft		4.48	7.10	
	Railroad Equipment		0.15	0.00	0.00
	Recreational Equipment		0.17	2.67	0.01
	Underground Mining Equipment		0.00		
NOX Total		0.70	126.77	17.46	7.78
PM10	Agricultural Equipment	0.00	7.88	0.02	0.00
	Airport Ground Support Equipment		0.06	0.00	0.00
	Commercial Equipment	0.00	0.51	0.13	0.01
	Construction and Mining Equipment	0.00	2.60	0.11	0.00
	Industrial Equipment	0.01	0.49	0.01	0.09
	Lawn and Garden Equipment		0.08	0.79	0.00
	Logging Equipment		0.03	0.02	
	Pleasure Craft		0.09	2.86	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.03	3.14	0.00
	Underground Mining Equipment		0.00		
PM10 Total		0.01	11.79	7.08	0.09
PM25	Agricultural Equipment	0.00	7.25	0.02	0.00
	Airport Ground Support Equipment		0.05	0.00	0.00
	Commercial Equipment	0.00	0.47	0.12	0.01
	Construction and Mining Equipment	0.00	2.39	0.10	0.00
	Industrial Equipment	0.01	0.46	0.00	0.09
	Lawn and Garden Equipment		0.08	0.72	0.00
	Logging Equipment		0.02	0.02	
	Pleasure Craft		0.08	2.63	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.03	2.89	0.00
	Underground Mining Equipment		0.00		
PM25 Total		0.01	10.84	6.51	0.09

Minnesota 2012 Emissions (tpd)

Summary by Equipment Type

Sum of Emissions (tpd)	Pol				
Equipment Type	VOC	CO	NOX	PM10	PM25
Agricultural Equipment	7.92	78.15	70.38	6.76	6.22
Airport Ground Support Equipment	0.06	0.72	0.70	0.05	0.04
Commercial Equipment	6.45	278.89	7.73	0.61	0.56
Construction and Mining Equipment	3.89	41.92	25.82	2.24	2.06
Industrial Equipment	2.09	46.45	10.99	0.48	0.45
Lawn and Garden Equipment	16.77	428.22	4.54	0.90	0.83
Logging Equipment	0.24	2.48	0.29	0.04	0.04
Pleasure Craft	44.86	156.29	12.16	2.92	2.68
Railroad Equipment	0.03	0.40	0.14	0.02	0.02
Recreational Equipment	108.20	320.10	3.59	2.98	2.74
Underground Mining Equipment	0.00	0.00	0.00	0.00	0.00
Grand Total	190.53	1,353.61	136.33	16.99	15.64

Summary by Equipment Type and Fuel Type

Sum of Emissions (tpd)		Fuel Type			
Pol	Equipment Type	CNG	Diesel	Gasoline	LPG
VOC	Agricultural Equipment	0.00	6.64	1.28	0.00
	Airport Ground Support Equipment		0.05	0.01	0.00
	Commercial Equipment	0.00	0.61	5.71	0.13
	Construction and Mining Equipment	0.00	2.79	1.09	0.02
	Industrial Equipment	0.01	0.48	0.23	1.38
	Lawn and Garden Equipment		0.10	16.66	0.00
	Logging Equipment		0.02	0.22	
	Pleasure Craft		0.16	44.70	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.05	108.15	0.00
	Underground Mining Equipment		0.00		
VOC Total		0.01	10.92	178.06	1.54
CO	Agricultural Equipment	0.02	33.55	44.57	0.02
	Airport Ground Support Equipment		0.30	0.37	0.05
	Commercial Equipment	0.66	2.57	273.33	2.34
	Construction and Mining Equipment	0.00	13.67	27.91	0.34
	Industrial Equipment	2.42	2.49	8.23	33.30
	Lawn and Garden Equipment		0.42	427.67	0.13
	Logging Equipment		0.10	2.38	
	Pleasure Craft		0.80	155.48	
	Railroad Equipment		0.10	0.30	0.00
	Recreational Equipment		0.20	319.85	0.05
	Underground Mining Equipment		0.00		
CO Total		3.10	54.21	1,260.08	36.22
NOX	Agricultural Equipment	0.00	69.54	0.83	0.00
	Airport Ground Support Equipment		0.68	0.01	0.01

	Commercial Equipment	0.18	4.28	2.66	0.61
	Construction and Mining Equipment	0.00	25.49	0.27	0.06
	Industrial Equipment	0.38	5.11	0.28	5.22
	Lawn and Garden Equipment		0.93	3.59	0.02
	Logging Equipment		0.26	0.02	
	Pleasure Craft		4.55	7.60	
	Railroad Equipment		0.13	0.00	0.00
	Recreational Equipment		0.16	3.41	0.01
	Underground Mining Equipment		0.00		
NOX Total		0.56	111.15	18.69	5.93
PM10	Agricultural Equipment	0.00	6.74	0.02	0.00
	Airport Ground Support Equipment		0.05	0.00	0.00
	Commercial Equipment	0.00	0.45	0.14	0.01
	Construction and Mining Equipment	0.00	2.14	0.11	0.00
	Industrial Equipment	0.01	0.38	0.00	0.09
	Lawn and Garden Equipment		0.08	0.83	0.00
	Logging Equipment		0.02	0.02	
	Pleasure Craft		0.08	2.83	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.03	2.94	0.00
	Underground Mining Equipment		0.00		
PM10 Total		0.01	9.98	6.90	0.10
PM25	Agricultural Equipment	0.00	6.20	0.02	0.00
	Airport Ground Support Equipment		0.04	0.00	0.00
	Commercial Equipment	0.00	0.42	0.13	0.01
	Construction and Mining Equipment	0.00	1.96	0.10	0.00
	Industrial Equipment	0.01	0.35	0.00	0.09
	Lawn and Garden Equipment		0.07	0.76	0.00
	Logging Equipment		0.02	0.02	
	Pleasure Craft		0.08	2.61	
	Railroad Equipment		0.02	0.00	0.00
	Recreational Equipment		0.03	2.71	0.00
	Underground Mining Equipment		0.00		
PM25 Total		0.01	9.18	6.35	0.10

2009 and 2012 Locomotive and Commercial Marine Emissions Inventories for MINNESOTA

2009 Annual Locomotive Emissions (TPD)

Vessel Type	SCC	NOX	MN PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	31.2	1.0	0.9	1.8
Line Haul Locomotives: Class II / III Operations	2285002007	12.2	0.3	0.2	0.5
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.3	0.0	0.0	0.0
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	2.8	0.1	0.1	0.2
	Totals	46.5	1.3	1.2	2.4

2012 Annual Locomotive Emissions (TPD)

Vessel Type	SCC	NOX	MN PM10-PRI	PM25-PRI	ROG
Line Haul Locomotives: Class I Operations	2285002006	28.9	0.9	0.8	1.6
Line Haul Locomotives: Class II / III Operations	2285002007	11.5	0.2	0.2	0.5
Line Haul Locomotives: Passenger Trains (Amtrak)	2285002008	0.3	0.0	0.0	0.0
Line Haul Locomotives: Commuter Lines	2285002009	0.0	0.0	0.0	0.0
Yard Locomotives	2285002010	2.5	0.1	0.1	0.2
	Totals	43.1	1.2	1.0	2.3

2009 Annual Commercial Marine Emissions (TPD)

Vessel Type	Fuel	SCC	NOX	MN PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	0.0	0.0	0.0	0.0
Ferries	Diesel	2280002022	0.0	0.0	0.0	0.0
Push Boats	Diesel	2280002023	0.0	0.0	0.0	0.0
Excursion	Diesel	2280002024	0.0	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	2.6	0.1	0.1	0.1
Underway emissions	Residual	2280003200	1.4	0.1	0.1	0.0
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
Port emissions	Diesel	2280002100	3.1	0.1	0.1	0.1
Underway emissions	Diesel	2280002200	9.0	0.2	0.2	0.2
		Totals	16.1	0.5	0.4	0.5

2012 Annual Commercial Marine Emissions (TPD)

Vessel Type	Fuel	SCC	NOX	MN PM10-PRI	PM25-PRI	ROG
Tugs	Diesel	2280002021	0.0	0.0	0.0	0.0
Ferries	Diesel	2280002022	0.0	0.0	0.0	0.0
Push Boats	Diesel	2280002023	0.0	0.0	0.0	0.0
Excursion	Diesel	2280002024	0.0	0.0	0.0	0.0
Dredge	Diesel	2280002025	0.0	0.0	0.0	0.0
Support Vessels	Diesel	2280002029	0.0	0.0	0.0	0.0
Fishing Vessels	Diesel	2280002030	0.0	0.0	0.0	0.0
Military Vessels	Diesel	2280002040	0.0	0.0	0.0	0.0
Port emissions	Residual	2280003100	2.7	0.1	0.1	0.1
Underway emissions	Residual	2280003200	1.5	0.1	0.1	0.0
Fishing Vessels	Gasoline	2280004030	0.0	0.0	0.0	0.0
Military Vessels	Gasoline	2280004040	0.0	0.0	0.0	0.0
Port emissions	Diesel	2280002100	3.0	0.1	0.1	0.1
Underway emissions	Diesel	2280002200	9.0	0.2	0.2	0.2
		Totals	16.3	0.5	0.4	0.5

2009 and 2012 Emissions Reductions Scenarios for MINNESOTA

One Emission Reduction Scenario Example for On-road HDDVs - 2009 MINNESOTA

One Preliminary Scenario for On Road HDDV Strategies for Minnesota (2009 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$26,154	0.18	0.000	0.001	$35,000	7,898	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$8,783	0.26	0.02	0.00	$40,000	7,898	237	$9,477,380	0.17	0.01	0.00
MY 1990	$8,551	0.12	0.03	0.00	$40,000	1,123	34	$1,347,757	0.01	0.00	0.00
MY 1991 - 1997	$25,529	0.09	0.01	0.00	$40,000	10,339	-	$0	0.00	0.00	0.00
Sub Total							271	10,825,137	0.18	0.01	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$8,657	0.32	0.02	0.03	$45,000	7,898	237	$10,662,052	0.21	0.01	0.02
MY 1990	$8,015	0.20	0.03	0.04	$45,000	1,123	34	$1,516,227	0.02	0.00	0.00
MY 1991 - 1997	$14,569	0.22	0.01	0.07	$45,000	10,339	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$17,472	0.22	0.00	0.11	$45,000	8,482	-	$0	0.00	0.00	0.00
Sub Total							271	12,178,279	0.23	0.01	0.02
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$8,611	0.53	0.01	0.16	$60,000	8,482	254	15,268,428	0.37	0.01	0.11
MY 2002 - 2006	$8,587	0.49	0.02	0.08	$60,000	14,349	430	25,828,938	0.58	0.02	0.09
Sub Total							685	41,097,366	0.95	0.03	0.21
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$2,954	0.00	0.02	0.04	$9,000	7,898	395	$3,554,017	0.00	0.02	0.04
MY 1990	$2,069	0.00	0.03	0.06	$9,000	1,123	56	$505,409	0.00	0.00	0.01
MY 1991 - 1997	$3,534	0.00	0.01	0.09	$9,000	10,339	517	$4,652,532	0.00	0.02	0.12
MY 1998 - 2001	$3,026	0.00	0.01	0.15	$9,000	8,482	424	$3,817,107	0.00	0.01	0.17
MY 2002 - 2006	$2,601	0.00	0.02	0.09	$9,000	14,349	717	$6,457,234	0.00	0.04	0.18
Sub Total							2,110	$18,986,300	0.00	0.09	0.52
Cleaire LNC+DPF											
MY 1989 and Earlier	$5,536	0.10	0.02	0.04	$ 20,000	7,898	316	$6,318,253	0.09	0.02	0.03
MY 1990	$4,281	0.08	0.03	0.05	$ 20,000	1,123	45	$898,505	0.01	0.00	0.01
MY 1991 - 1997	$6,645	0.11	0.01	0.08	$ 20,000	10,339	414	$8,271,168	0.12	0.01	0.09
MY 1998 - 2001	$5,816	0.14	0.01	0.13	$ 20,000	8,482	339	$6,785,968	0.13	0.01	0.12
MY 2002 - 2006	$5,487	0.13	0.02	0.08	$ 20,000	14,349	574	$11,479,528	0.21	0.03	0.13
Sub Total							1,688	33,753,422	0.56	0.08	0.38
EGR+DPF Retrofit											
MY 1989 and Earlier	$5,548	0.16	0.02	0.04	$ 23,000	7,898	316	$7,265,991	0.14	0.02	0.03
MY 1990	$4,415	0.13	0.03	0.05	$ 23,000	1,123	45	$1,033,281	0.02	0.00	0.01
MY 1991 - 1997	$6,281	0.17	0.01	0.08	$ 23,000	10,339	414	$9,511,843	0.19	0.01	0.09
MY 1998 - 2001	$5,192	0.22	0.01	0.13	$ 23,000	8,482	339	$7,803,863	0.21	0.01	0.12
MY 2002 - 2006	$4,710	0.21	0.02	0.08	$ 23,000	14,349	574	$13,201,457	0.34	0.03	0.13
Sub Total							1,688	38,816,435	0.89	0.08	0.38
SCR Retrofit											
MY 1989 and Earlier	$12,002	0.32	0.00	0.00	$ 26,500	7,898	158	$4,185,843	0.14	0.00	0.00
MY 1990	$15,139	0.26	0.00	0.00	$ 26,500	1,123	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$11,810	0.34	0.00	0.00	$ 26,500	10,339	207	$5,479,649	0.19	0.00	0.00
MY 1998 - 2001	$9,224	0.45	0.00	0.00	$ 26,500	8,482	254	$6,743,556	0.31	0.00	0.00
MY 2002 - 2006	$10,173	0.43	0.00	0.00	$ 26,500	14,349	287	$7,605,187	0.34	0.00	0.00
Sub Total							906	24,014,235	0.98	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,314	0.00	0.01	0.03	$2,000	7,898	395	$789,782	0.00	0.01	0.03
MY 1990	$920	0.00	0.01	0.04	$2,000	1,123	56	$112,313	0.00	0.00	0.01
MY 1991 - 1997	$1,431	0.00	0.01	0.06	$2,000	10,339	517	$1,033,896	0.00	0.01	0.09
MY 1998 - 2001	$1,156	0.00	0.01	0.11	$2,000	8,482	424	$848,246	0.00	0.01	0.12
MY 2002 - 2006	$1,093	0.00	0.01	0.06	$2,000	14,349	717	$1,434,941	0.00	0.02	0.13
Sub Total							2,110	4,219,178	0.00	0.04	0.38
FTF Retrofit											
MY 1989 and Earlier	$4,650	0.00	0.01	0.04	$9,000	7,898	316	$2,843,214	0.00	0.01	0.03
MY 1990	$3,257	0.00	0.02	0.06	$9,000	1,123	56	$505,409	0.00	0.00	0.01
MY 1991 - 1997	$4,945	0.00	0.01	0.09	$9,000	10,339	414	$3,722,026	0.00	0.01	0.10
MY 1998 - 2001	$3,941	0.00	0.01	0.15	$9,000	8,482	424	$3,817,107	0.00	0.01	0.17
MY 2002 - 2006	$3,809	0.00	0.01	0.09	$9,000	14,349	717	$6,457,234	0.00	0.02	0.18
Sub Total							1,927	17,344,990	0.00	0.05	0.49
DOC+SCR Retrofit											
MY 1989 and Earlier	$8,517	0.32	0.01	0.03	$27,500	7,898	237	$6,515,699	0.21	0.00	0.02
MY 1990	$8,611	0.26	0.01	0.04	$27,500	1,123	34	$926,583	0.02	0.00	0.00
MY 1991 - 1997	$8,404	0.34	0.00	0.06	$27,500	10,339	310	$8,529,642	0.29	0.00	0.05
MY 1998 - 2001	$6,571	0.45	0.004	0.10	$27,500	8,482	339	$9,330,706	0.42	0.00	0.10
MY 2002 - 2006	$7,245	0.43	0.006	0.06	$27,500	14,349	430	$11,838,263	0.51	0.01	0.08
Sub Total							1,351	37,140,893	1.44	0.02	0.25
SCR+DPF											
MY 1989 and Earlier	$5,812	0.32	0.02	0.04	$30,000	7,898	316	$9,477,380	0.28	0.02	0.03
MY 1990	$5,060	0.26	0.03	0.05	$30,000	1,123	45	$1,347,757	0.03	0.00	0.01
MY 1991 - 1997	$6,505	0.34	0.01	0.08	$30,000	10,339	414	$12,406,752	0.38	0.01	0.09
MY 1998 - 2001	$5,427	0.45	0.01	0.13	$30,000	8,482	339	$10,178,952	0.42	0.01	0.12
MY 2002 - 2006	$5,335	0.43	0.02	0.08	$30,000	14,349	574	$17,219,292	0.67	0.03	0.13
Sub Total							1,688	50,630,133	1.79	0.08	0.38
Overall Projects											
MY 1989 and Earlier						7,898	2,922	61,089,612	1.23	0.12	0.24
MY 1990						1,123	404	8,193,241	0.11	0.02	0.05
MY 1991 - 1997						10,339	3,205	53,607,508	1.17	0.08	0.64
MY 1998 - 2001						8,482	3,139	64,593,935	1.86	0.07	1.04
MY 2002 - 2006						14,349	5,022	101,522,074	2.65	0.20	1.03
MY 2007+						9,093	0	0	0	0	0
Total						51,285	14,692	289,006,369	7.02	0.49	3.01
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$235,010	0.09	0.02	0.01

One Emission Reduction Scenario Example for On-road HDDVs - 2009 MINNESOTA

Sub Total								$235,010	0.09	0.02	0.01
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.04	0.001	0.002	$7,500	51,285	7,693	$57,695,089	0.84	0.01	0.04
Sub Total						51,285	7,693	$57,695,089	0.84	0.01	0.04
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
Diesel Engine Reflash (MY 1993-1998 Engines)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	10,864	6,518	$651,815	0.69	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	9,770	7,816	$781,576	2.77	0.00	0.00
Sub Total							14,334	1,433,391	3.46	-	-
Grand Total						51,285	36,719	$348,369,860	11.4	0.5	3.1

One Example Emission Reduction Scenario for Construction Equipment - 2009 MINNESOTA

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment & in the LADCO States **2009 MINNESOTA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	79	$1,903,500	0.15	0.00	0.01
Rubber Tire Loaders	85	$2,796,250	0.14	0.00	0.02
Crawler Tractor/Dozer	46	$1,186,750	0.05	0.00	0.01
Tractors/Loaders/Backhoes	138	$1,419,000	0.04	0.00	0.00
Off-Highway Trucks	5	$788,563	0.05	0.00	0.00
Sub Total	**353**	**$8,094,063**	**0.44**	**0.02**	**0.04**
Measure 51a: DPF Retrofit					
Excavators	119	$894,316	0.00	0.01	0.02
Rubber Tire Loaders	138	$1,342,895	0.00	0.01	0.03
Crawler Tractor/Dozer	57	$372,789	0.00	0.00	0.01
Tractors/Loaders/Backhoes	323	$1,256,684	0.00	0.01	0.01
Off-Highway Trucks	6	$309,128	0.00	0.00	0.02
Sub Total	**643**	**$4,175,812**	**0.00**	**0.03**	**0.08**
Measure 51b: Lean NOx Catalyst					
Excavators	101	$1,778,947	0.06	0.01	0.02
Rubber Tire Loaders	95	$1,897,895	0.06	0.01	0.01
Crawler Tractor/Dozer	57	$828,421	0.02	0.00	0.01
Tractors/Loaders/Backhoes	288	$2,404,211	0.05	0.01	0.01
Off-Highway Trucks	6	$686,952	0.04	0.00	0.02
Sub Total	**547**	**$7,596,425**	**0.22**	**0.03**	**0.06**
Measure 51c: EGR+DPF Retrofit					
Excavators	101	$2,045,789	0.09	0.01	0.02
Rubber Tire Loaders	102	$2,405,316	0.10	0.01	0.01
Crawler Tractor/Dozer	57	$952,684	0.03	0.00	0.01
Tractors/Loaders/Backhoes	187	$1,909,000	0.05	0.01	0.01
Off-Highway Trucks	6	$789,994	0.07	0.00	0.02
Sub Total	**453**	**$8,102,784**	**0.34**	**0.02**	**0.06**
Measure 51d: SCR Retrofit					
Excavators	82	$1,930,316	0.17	0.00	0.00
Rubber Tire Loaders	78	$2,195,316	0.16	0.00	0.00
Crawler Tractor/Dozer	51	$1,005,605	0.05	0.00	0.00
Tractors/Loaders/Backhoes	89	$1,231,553	0.06	0.00	0.00
Off-Highway Trucks	8	$1,213,614	0.17	0.00	0.00
Sub Total	**308**	**$7,576,404**	**0.61**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	101	$177,895	0.00	0.00	0.01
Rubber Tire Loaders	138	$298,421	0.00	0.00	0.02
Crawler Tractor/Dozer	57	$82,842	0.00	0.00	0.01
Tractors/Loaders/Backhoes	288	$240,421	0.00	0.00	0.01
Off-Highway Trucks	6	$68,695	0.00	0.00	0.01
Sub Total	**590**	**$868,274**	**0.00**	**0.01**	**0.06**
Measure 51f: FTF Retrofit					
Excavators	70	$523,421	0.00	0.00	0.01
Rubber Tire Loaders	82	$727,579	0.00	0.00	0.01
Crawler Tractor/Dozer	40	$242,526	0.00	0.00	0.01
Tractors/Loaders/Backhoes	174	$694,421	0.00	0.00	0.01
Off-Highway Trucks	6	$309,128	0.00	0.00	0.02
Sub Total	**372**	**$2,497,076**	**0.00**	**0.01**	**0.06**
Measure 51g: DOC+SCR Retrofit					
Excavators	101	$2,446,053	0.19	0.00	0.01
Rubber Tire Loaders	123	$3,674,868	0.25	0.00	0.02
Crawler Tractor/Dozer	51	$1,043,553	0.05	0.00	0.01
Tractors/Loaders/Backhoes	157	$2,221,711	0.10	0.00	0.00
Off-Highway Trucks	8	$1,259,411	0.17	0.00	0.01
Sub Total	**440**	**$10,645,595**	**0.77**	**0.01**	**0.06**
Measure 51h: SCR+DPF Retrofit					
Excavators	131	$3,421,579	0.24	0.01	0.02
Rubber Tire Loaders	128	$4,095,789	0.26	0.01	0.02
Crawler Tractor/Dozer	68	$1,433,684	0.07	0.00	0.01
Tractors/Loaders/Backhoes	328	$5,096,842	0.21	0.01	0.01
Off-Highway Trucks	8	$1,373,903	0.17	0.00	0.02
Sub Total	**663**	**$15,421,798**	**0.94**	**0.03**	**0.08**
Grand Total	**4,369**	**$64,978,231**	**3.32**	**0.16**	**0.50**

One Example Emission Reduction Scenario for Agricultural Equipment - 2009 MINNESOTA

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2009 MINNESOTA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	4,275	$56,577,800	1.69	0.10	0.13
Combines	37	$698,750	0.01	0.00	0.00
Sub Total	**4,312**	**$57,276,550**	**1.70**	**0.10**	**0.13**
Measure 51a: DPF Retrofit					
Agricultural Tractors	5,059	$22,521,316	0.00	0.15	0.20
Combines	177	$1,210,263	0.00	0.00	0.00
Sub Total	**5,236**	**$23,731,579**	**0.00**	**0.15**	**0.20**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	3,088	$39,348,737	0.68	0.11	0.11
Combines	51	$750,526	0.01	0.00	0.00
Sub Total	**3,139**	**$40,099,263**	**0.69**	**0.11**	**0.11**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	3,976	$34,076,316	0.89	0.09	0.11
Combines	51	$863,105	0.01	0.00	0.00
Sub Total	**4,027**	**$34,939,421**	**0.90**	**0.09**	**0.11**
Measure 51d: SCR Retrofit					
Agricultural Tractors	1,624	$20,663,026	0.94	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**1,624**	**$20,663,026**	**0.94**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	5,404	$4,384,842	0.00	0.05	0.15
Combines	252	$388,632	0.00	0.00	0.00
Sub Total	**5,656**	**$4,773,474**	**0.00**	**0.06**	**0.15**
Measure 51f: FTF Retrofit					
Agricultural Tractors	3,515	$11,053,421	0.00	0.05	0.12
Combines	51	$337,737	0.00	0.00	0.00
Sub Total	**3,566**	**$11,391,158**	**0.00**	**0.05**	**0.12**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	2,529	$33,687,500	1.42	0.02	0.10
Combines	0	$0	0.00	0.00	0.00
Sub Total	**2,529**	**$33,687,500**	**1.42**	**0.02**	**0.10**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	4,432	$54,893,684	2.13	0.10	0.15
Combines	51	$1,125,789	0.02	0.00	0.00
Sub Total	**4,483**	**$56,019,474**	**2.15**	**0.10**	**0.15**
Grand Total	**34,572**	**$282,581,445**	**7.80**	**0.67**	**1.06**

One Emission Reduction Scenario Example for On-road HDDVs - 2012 MINNESOTA

One Preliminary Scenario for On Road HDDV Strategies for Minnesota (2012 Analysis)

Technology	Project Cost-Effectiveness ($/ton)	Estimated NOx Reductions per Vehicle (tons/year)	Estimated PM Reductions per Vehicle (tons/year)	Estimated THC Reductions per Vehicle (tons/year)	Cost per Unit ($)	Number of Units Available	Units Recommended	Total Cost	Total NOx Reduction (tons/day)	Total PM Reduction (tons/day)	Total THC Reduction (tons/day)
Measure 31: Fleet Modernization (Incentive/Voluntary Program)											
Diesel Engine/Vehicle Upgrades (MY 1990 Engine 6 g NOx)											
MY 1989 and Earlier	$28,769	0.16	0.000	0.001	$35,000	5,257	-	$0	0.00	0.00	0.00
Sub Total							-	-	0.00	0.00	0.00
Diesel Engine/Vehicle Upgrades (MY 2001/2 Engine 4 g NOx)											
MY 1989 and Earlier	$9,661	0.24	0.02	0.00	$40,000	5,257	315	$12,617,555	0.21	0.02	0.00
MY 1990	$11,401	0.09	0.02	0.00	$40,000	974	39	$1,558,690	0.01	0.00	0.00
MY 1991 - 1997	$34,934	0.07	0.00	0.00	$40,000	8,980	-	$0	0.00	0.00	0.00
Sub Total							354	14,176,245	0.22	0.02	0.00
Diesel Engine/Vehicle Upgrades (MY 2002/4 Engine 2.4 g NOx)											
MY 1989 and Earlier	$9,522	0.29	0.02	0.03	$45,000	5,257	315	$14,194,750	0.25	0.02	0.02
MY 1990	$10,687	0.15	0.02	0.03	$45,000	974	39	$1,753,527	0.02	0.00	0.00
MY 1991 - 1997	$19,936	0.16	0.00	0.05	$45,000	8,980	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$24,024	0.16	0.00	0.08	$45,000	7,364	-	$0	0.00	0.00	0.00
Sub Total							354	15,948,276	0.27	0.02	0.03
Diesel Engine/Vehicle Upgrades (MY 2007 Engine 0.2 g NOx)											
MY 1998 - 2001	$11,841	0.39	0.01	0.12	$60,000	7,364	295	17,672,414	0.31	0.01	0.10
MY 2002 - 2006	$11,789	0.36	0.01	0.06	$60,000	12,458	498	29,898,120	0.49	0.02	0.08
Sub Total							793	47,570,534	0.80	0.03	0.18
Measure 46: Aftertreatment Device Retrofits (Incentive/Voluntary Program)											
DPF											
MY 1989 and Earlier	$3,250	0.00	0.02	0.04	$9,000	5,257	526	$4,731,583	0.00	0.03	0.05
MY 1990	$2,759	0.00	0.02	0.04	$9,000	974	97	$876,763	0.00	0.01	0.01
MY 1991 - 1997	$4,835	0.00	0.01	0.06	$9,000	8,980	718	$6,465,517	0.00	0.02	0.13
MY 1998 - 2001	$4,161	0.00	0.01	0.11	$9,000	7,364	589	$5,301,724	0.00	0.01	0.17
MY 2002 - 2006	$3,570	0.00	0.01	0.07	$9,000	12,458	1,246	$11,211,795	0.00	0.05	0.22
Sub Total							3,176	$28,587,383	0.00	0.11	0.58
Cleaire LNC+DPF											
MY 1989 and Earlier	$6,074	0.09	0.02	0.03	$ 20,000	5,257	421	$8,411,703	0.11	0.02	0.04
MY 1990	$5,650	0.06	0.02	0.04	$ 20,000	974	78	$1,558,690	0.01	0.00	0.01
MY 1991 - 1997	$8,933	0.08	0.01	0.06	$ 20,000	8,980	539	$10,775,862	0.11	0.01	0.09
MY 1998 - 2001	$7,766	0.10	0.01	0.10	$ 20,000	7,364	442	$8,836,207	0.12	0.01	0.12
MY 2002 - 2006	$7,207	0.10	0.01	0.06	$ 20,000	12,458	747	$14,949,060	0.20	0.03	0.12
Sub Total							2,227	44,531,523	0.56	0.08	0.37
EGR+DPF Retrofit											
MY 1989 and Earlier	$6,102	0.15	0.02	0.03	$ 23,000	5,257	421	$9,673,459	0.17	0.02	0.04
MY 1990	$5,886	0.10	0.02	0.04	$ 23,000	974	78	$1,792,494	0.02	0.00	0.01
MY 1991 - 1997	$8,593	0.12	0.01	0.06	$ 23,000	8,980	539	$12,392,242	0.18	0.01	0.09
MY 1998 - 2001	$7,136	0.16	0.01	0.10	$ 23,000	7,364	442	$10,161,638	0.20	0.01	0.12
MY 2002 - 2006	$6,461	0.16	0.01	0.06	$ 23,000	12,458	997	$22,921,892	0.43	0.04	0.16
Sub Total							2,476	56,941,724	1.00	0.09	0.41
SCR Retrofit											
MY 1989 and Earlier	$13,197	0.29	0.00	0.00	$ 26,500	5,257	210	$5,572,754	0.17	0.00	0.00
MY 1990	$20,057	0.19	0.00	0.00	$ 26,500	974	-	$0	0.00	0.00	0.00
MY 1991 - 1997	$15,979	0.25	0.00	0.00	$ 26,500	8,980	-	$0	0.00	0.00	0.00
MY 1998 - 2001	$12,445	0.33	0.00	0.00	$ 26,500	7,364	295	$7,805,316	0.26	0.00	0.00
MY 2002 - 2006	$13,569	0.31	0.00	0.00	$ 26,500	12,458	498	$13,205,003	0.43	0.00	0.00
Sub Total							1,003	26,583,073	0.86	0.00	0.00
DOC Retrofit											
MY 1989 and Earlier	$1,445	0.00	0.01	0.03	$2,000	5,257	526	$1,051,463	0.00	0.01	0.04
MY 1990	$1,227	0.00	0.01	0.03	$2,000	974	97	$194,836	0.00	0.00	0.01
MY 1991 - 1997	$1,959	0.00	0.00	0.05	$2,000	8,980	898	$1,795,977	0.00	0.01	0.11
MY 1998 - 2001	$1,590	0.00	0.00	0.08	$2,000	7,364	736	$1,472,701	0.00	0.01	0.16
MY 2002 - 2006	$1,500	0.00	0.01	0.05	$2,000	12,458	1,246	$2,491,510	0.00	0.02	0.16
Sub Total							3,503	7,006,487	0.00	0.06	0.48
FTF Retrofit											
MY 1989 and Earlier	$5,115	0.00	0.01	0.04	$9,000	5,257	421	$3,785,267	0.00	0.01	0.04
MY 1990	$4,343	0.00	0.01	0.04	$9,000	974	78	$701,411	0.00	0.00	0.01
MY 1991 - 1997	$6,767	0.00	0.01	0.06	$9,000	8,980	718	$6,465,517	0.00	0.01	0.13
MY 1998 - 2001	$5,418	0.00	0.01	0.11	$9,000	7,364	589	$5,301,724	0.00	0.01	0.17
MY 2002 - 2006	$5,228	0.00	0.01	0.07	$9,000	12,458	997	$8,969,436	0.00	0.02	0.18
Sub Total							2,803	25,223,355	0.00	0.06	0.53
DOC+SCR Retrofit											
MY 1989 and Earlier	$9,365	0.29	0.01	0.03	$27,500	5,257	315	$8,674,569	0.25	0.00	0.02
MY 1990	$11,411	0.19	0.01	0.03	$27,500	974	39	$1,071,600	0.02	0.00	0.00
MY 1991 - 1997	$11,375	0.25	0.00	0.05	$27,500	8,980	359	$9,877,874	0.24	0.00	0.05
MY 1998 - 2001	$8,871	0.33	0.003	0.08	$27,500	7,364	442	$12,149,785	0.40	0.00	0.09
MY 2002 - 2006	$9,672	0.31	0.004	0.05	$27,500	12,458	747	$20,554,957	0.64	0.01	0.16
Sub Total							1,903	52,328,785	1.55	0.02	0.26
SCR+DPF											
MY 1989 and Earlier	$6,391	0.29	0.02	0.03	$30,000	5,257	421	$12,617,555	0.34	0.02	0.04
MY 1990	$6,708	0.19	0.02	0.04	$30,000	974	78	$2,338,036	0.04	0.00	0.01
MY 1991 - 1997	$8,812	0.25	0.01	0.06	$30,000	8,980	539	$16,163,793	0.36	0.01	0.09
MY 1998 - 2001	$7,336	0.33	0.01	0.10	$30,000	7,364	442	$13,254,311	0.40	0.01	0.12
MY 2002 - 2006	$7,138	0.31	0.01	0.06	$30,000	12,458	747	$22,423,590	0.64	0.03	0.12
Sub Total							2,227	66,797,285	1.78	0.08	0.37
Overall Projects											
MY 1989 and Earlier						5,257	3,890	81,330,657	1.49	0.14	0.29
MY 1990						974	623	11,846,047	0.12	0.03	0.06
MY 1991 - 1997						8,980	4,310	63,936,783	0.90	0.08	0.67
MY 1998 - 2001						7,364	4,271	81,955,821	1.69	0.07	1.04
MY 2002 - 2006						12,458	7,724	146,625,362	2.82	0.21	1.14
MY 2007+						19,391	0	0	0	0	0
Total						54,424	20,819	385,694,670	7.03	0.54	3.20
Measure 46: Midwest Clean Diesel Initiative											
All Diesel Sources	$1,492	N/A	N/A	N/A	N/A	N/A	N/A	$470,020	0.19	0.03	0.03

Sub Total								**$478,020**	**0.19**	**0.03**	**0.03**
Measure 33/34/35/37: Anti-Idling Restriction on Onroad HDDVs											
Anti-Idling Restrictions											
All MY Heavy HDDVs	$1,700	0.03	0.0004	0.002	$7,500	54,424	16,327	$122,452,981	1.44	0.02	0.08
Sub Total						**54,424**	**16,327**	**$122,452,981**	**1.44**	**0.02**	**0.08**
Measure 42: Accelerate Low NOx Calibration/Reflash Program (Mandatory Phase-in)											
MY 1993-1998 Medium-HDDVs	$371	0.04	0.00	0.00	$100	9,441	5,664	$566,441	0.60	0.00	0.00
MY 1993-1998 Heavy-HDDVs	$110	0.13	0.00	0.00	$100	8,490	6,792	$679,206	2.41	0.00	0.00
Sub Total						**17,931**	**12,456**	**1,245,647**	**3.01**	**0.00**	**0.00**
Grand Total						**54,424**	**49,602**	**$589,863,317**	**11.7**	**0.6**	**3.3**

One Example Emission Reduction Scenario for Construction Equipment - 2012 MINNESOTA

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Construction Equipment & in the LADCO States **2012 MINNESOTA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Excavators	72	$1,929,000	0.15	0.00	0.01
Rubber Tire Loaders	146	$5,711,500	0.27	0.01	0.02
Crawler Tractor/Dozer	85	$3,855,750	0.16	0.00	0.02
Tractors/Loaders/Backhoes	258	$2,714,000	0.08	0.01	0.00
Off-Highway Trucks	7	$1,278,016	0.07	0.00	0.00
Sub Total	**568**	**$15,488,266**	**0.73**	**0.02**	**0.07**
Measure 51a: DPF Retrofit					
Excavators	359	$2,755,421	0.00	0.02	0.03
Rubber Tire Loaders	369	$3,339,474	0.00	0.02	0.05
Crawler Tractor/Dozer	315	$3,159,947	0.00	0.02	0.04
Tractors/Loaders/Backhoes	1,080	$4,340,842	0.00	0.03	0.04
Off-Highway Trucks	17	$875,863	0.00	0.01	0.03
Sub Total	**2,140**	**$14,471,547**	**0.00**	**0.08**	**0.18**
Measure 51b: Lean NOx Catalyst					
Excavators	228	$3,920,000	0.10	0.01	0.02
Rubber Tire Loaders	180	$3,698,947	0.09	0.01	0.02
Crawler Tractor/Dozer	168	$3,625,263	0.08	0.01	0.03
Tractors/Loaders/Backhoes	650	$5,484,211	0.10	0.02	0.02
Off-Highway Trucks	12	$1,373,903	0.08	0.00	0.02
Sub Total	**1,238**	**$18,102,324**	**0.45**	**0.05**	**0.12**
Measure 51c: EGR+DPF Retrofit					
Excavators	184	$3,331,368	0.13	0.01	0.02
Rubber Tire Loaders	180	$4,253,789	0.15	0.01	0.02
Crawler Tractor/Dozer	168	$4,169,053	0.12	0.01	0.03
Tractors/Loaders/Backhoes	461	$4,705,316	0.12	0.02	0.02
Off-Highway Trucks	12	$1,579,989	0.12	0.00	0.02
Sub Total	**1,005**	**$18,039,515**	**0.65**	**0.05**	**0.11**
Measure 51d: SCR Retrofit					
Excavators	129	$2,994,500	0.21	0.00	0.00
Rubber Tire Loaders	120	$3,648,632	0.25	0.00	0.00
Crawler Tractor/Dozer	136	$4,312,526	0.22	0.00	0.00
Tractors/Loaders/Backhoes	156	$2,164,632	0.10	0.00	0.00
Off-Highway Trucks	17	$2,578,931	0.33	0.00	0.00
Sub Total	**558**	**$15,699,220**	**1.11**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Excavators	88	$134,526	0.00	0.00	0.01
Rubber Tire Loaders	135	$278,000	0.00	0.00	0.02
Crawler Tractor/Dozer	81	$167,684	0.00	0.00	0.01
Tractors/Loaders/Backhoes	262	$220,000	0.00	0.00	0.01
Off-Highway Trucks	4	$45,797	0.00	0.00	0.01
Sub Total	**570**	**$846,007**	**0.00**	**0.01**	**0.05**
Measure 51f: FTF Retrofit					
Excavators	240	$1,826,526	0.00	0.01	0.03
Rubber Tire Loaders	262	$2,475,000	0.00	0.01	0.04
Crawler Tractor/Dozer	219	$2,175,158	0.00	0.01	0.03
Tractors/Loaders/Backhoes	917	$3,603,316	0.00	0.02	0.04
Off-Highway Trucks	17	$875,863	0.00	0.00	0.03
Sub Total	**1,655**	**$10,955,863**	**0.00**	**0.04**	**0.16**
Measure 51g: DOC+SCR Retrofit					
Excavators	184	$3,983,158	0.25	0.00	0.02
Rubber Tire Loaders	228	$7,021,184	0.43	0.00	0.03
Crawler Tractor/Dozer	136	$4,475,263	0.22	0.00	0.02
Tractors/Loaders/Backhoes	380	$5,476,842	0.24	0.00	0.01
Off-Highway Trucks	17	$2,676,249	0.33	0.00	0.02
Sub Total	**945**	**$23,632,696**	**1.48**	**0.01**	**0.10**
Measure 51h: SCR+DPF Retrofit					
Excavators	247	$6,405,789	0.35	0.01	0.02
Rubber Tire Loaders	262	$8,250,000	0.44	0.01	0.04
Crawler Tractor/Dozer	219	$7,250,526	0.31	0.01	0.03
Tractors/Loaders/Backhoes	680	$10,774,737	0.41	0.03	0.03
Off-Highway Trucks	17	$2,919,544	0.33	0.01	0.02
Sub Total	**1,425**	**$35,600,597**	**1.86**	**0.07**	**0.15**
Grand Total	**10,104**	**$152,836,036**	**6.27**	**0.34**	**0.93**

One Example Emission Reduction Scenario for Agricultural Equipment - 2012 MINNESOTA

Summary Results of an Emission Reduction Scenario for Nonroad Diesel Agricultural Equipment in the LADCO States **2012 MINNESOTA**

Equipment Type	Total Unit Recom.	Total Cost ($)	Total NOx (tpd)	Total PM (tpd)	Total HC (tpd)
Measure 20: Fleet Modernization (Tier 2 or Tier 3 Engines)					
Agricultural Tractors	11,029	$146,272,650	4.37	0.25	0.33
Combines	93	$3,165,000	0.04	0.00	0.00
Sub Total	**11,122**	**$149,437,650**	**4.41**	**0.25**	**0.33**
Measure 51a: DPF Retrofit					
Agricultural Tractors	14,033	$68,659,105	0.00	0.39	0.57
Combines	518	$3,566,842	0.00	0.01	0.00
Sub Total	**14,551**	**$72,225,947**	**0.00**	**0.40**	**0.57**
Measure 51b: Lean NOx Catalyst					
Agricultural Tractors	8,175	$102,903,895	1.78	0.29	0.29
Combines	93	$1,481,053	0.01	0.00	0.00
Sub Total	**8,268**	**$104,384,947**	**1.79**	**0.29**	**0.29**
Measure 51c: EGR+DPF Retrofit					
Agricultural Tractors	10,167	$86,006,684	2.27	0.24	0.29
Combines	93	$1,703,211	0.02	0.00	0.00
Sub Total	**10,260**	**$87,709,895**	**2.29**	**0.24**	**0.29**
Measure 51d: SCR Retrofit					
Agricultural Tractors	4,377	$55,351,526	2.56	0.00	0.00
Combines	0	$0	0.00	0.00	0.00
Sub Total	**4,377**	**$55,351,526**	**2.56**	**0.00**	**0.00**
Measure 51e: DOC Retrofit					
Agricultural Tractors	11,680	$10,103,474	0.00	0.13	0.37
Combines	668	$1,007,579	0.00	0.00	0.01
Sub Total	**12,348**	**$11,111,053**	**0.00**	**0.13**	**0.38**
Measure 51f: FTF Retrofit					
Agricultural Tractors	12,105	$46,660,737	0.00	0.16	0.52
Combines	129	$854,053	0.00	0.00	0.00
Sub Total	**12,234**	**$47,514,789**	**0.00**	**0.17**	**0.52**
Measure 51g: DOC+SCR Retrofit					
Agricultural Tractors	6,657	$76,037,500	3.28	0.05	0.19
Combines	0	$0	0.00	0.00	0.00
Sub Total	**6,657**	**$76,037,500**	**3.28**	**0.05**	**0.19**
Measure 51h: SCR+DPF Retrofit					
Agricultural Tractors	11,571	$146,436,316	5.71	0.26	0.42
Combines	93	$2,221,579	0.04	0.00	0.00
Sub Total	**11,664**	**$148,657,895**	**5.75**	**0.26**	**0.42**
Grand Total	**91,481**	**$752,431,203**	**20.07**	**1.78**	**3.00**