Appendix C:

Emission Inventory Analysis and Results

APPENDIX C: Emission Inventory Development - Analysis and Results

A. Emissions Inventory Data Sources

A variety of data sources were used to establish the tractor and trailer population impacted by the proposed rule. These include the following: ARB Motor Vehicle Emissions Inventory (ARB Inventory), U.S. Bureau of Census 2002 Vehicle Inventory and Use Survey (VIUS)[1], Americas Commercial Transportation Research Company (ACT Research), U.S. Bureau of Census Current Industrial Reports (CIR), and Commercial Carrier Journal. The following sections describe these data sources and the methodology used to estimate the tractor and trailer population impacted by the proposed regulation and the greenhouse gas emission benefits.

1. ARB Heavy-Duty Vehicle Inventory

On-road mobile source emissions in California are currently calculated using the EMFAC2007 (ARB, 2006) model that was released in December of 2006. Since the last EMFAC release, ARB staff members have conducted a re-evaluation of the heavy duty diesel truck emissions inventory to support the Proposed Regulation to Reduce Emissions from In-Use On-Road Diesel Vehicles. In developing this new analysis, staff has integrated new data and assumptions into an expanded methodology that builds upon current modeling in EMFAC2007. The updated inventory categorizes heavy-duty vehicles into separate inventory groups by body type and operational characteristics while keeping the existing weight class based vehicle categories (medium-heavy and heavy-heavy duty vehicle classes). Within the existing weight class groups, the updated inventory categorizes vehicles into California registered and out-of-state registered vehicles. California registered trucks are further split into intrastate and interstate trucks while the out-of-state registered trucks are split into trucks based in neighboring states and trucks based in non-neighboring states. The intrastate trucks are further sub-grouped by body type into single unit trucks and tractors. Also within the intrastate trucks separate inventories are developed for agricultural trucks, port trucks, solid waste collection vehicles, and public and utility fleets. A detailed discussion of the inventory development and data sources used is found in Appendix G, of the "*Staff Report: Initial Statement Of Reasons For Proposed Rulemaking Proposed Regulation For In-Use On-Road Diesel Vehicles*" (ARB, 2008a).

The new baseline inventory for selected calendar years is shown in Table C-1 and C-3. Staff used this updated inventory as the basis for developing inventory for this proposal. Since only a subset of the total heavy-duty vehicle inventory is affected by the proposed regulation, the base inventory must be adjusted to determine the fraction of vehicles affected by this proposal. Furthermore, since the proposed regulation applies only to Class 7 and 8 tractors[2], the medium-heavy duty diesel vehicle inventory shown in Table

[1] http://www.census.gov/svsd/www/vius/products.html

[2] Class 7 tractors are tractors with gross vehicle weight rating between 26,001 and 33,000 pounds while Class 8 tractors' are tractors with gross vehicle weigh rating of 33,001 pounds and greater.

C-2, must be adjusted to include only Class 7 tractors. Table C-3 also shows the baseline population and the fraction of VMT accrued inside California by out-of-state, California interstate, and California intrastate heavy-duty vehicles (ARB, 2008a).

Table C-1 – Baseline Class 8 Tractors (ARB, 2008a)

Class 8 Tractors(Gross Vehicle Weight Rating > 33,000 pounds)				
	Non-neighboring Out-of-state Tractors	Neighboring Out-of-state Tractors	CA Interstate Tractors	CA Intrastate Tractors
CY	Population			
2010	469,323	43,049	62,239	66,037
2015	543,681	51,132	73,924	78,519
2020	626,853	58,008	83,866	89,294
CY	Vehicle Miles Traveled (10^6 miles per Year)			
2010	3,935	1,274	2,673	3,360
2015	4,661	1,509	3,166	3,980
2020	5,316	1,721	3,611	4,540

Table C-2 – Medium-Heavy Duty Diesel Vehicles (ARB, 2008a).

Medium-Heavy Duty Diesel Vehicles (Gross Vehicle Weight Rating between 14,001 and 33,000 pounds)			
	Out-of-State	CA Interstate	CA intrastate
CY	Population		
2010	7,631	1,752	209,116
2015	8,282	1,901	227,426
2020	8,898	2,042	244,223
CY	Vehicle Miles Traveled (10^6 miles per Year)		
2010	14	24	4,146
2015	15	27	4,517
2020	16	28	4,846

Table C-3 – Population and CA Share of VMT (ARB, 2008a)

CY	Category	Population	CA Share of VMT
	Heavy-Heavy Duty Vehicles		
2008	Out-of-State Tractors	492,340	12.1%
2008	CA Interstate Tractors	60,263	57.0%
2008	CA Intrastate Tractors	63,684	100%
	Medium-Heavy Duty Vehicles		
2008	Medium-Heavy Intrastate	198,525	100%
2008	Medium-Heavy Interstate	8,896	18.7%

2. 2002 Vehicle Inventory and Use Survey

The VIUS is a stratified statistical data of the nation's trucking fleet collected every 5 years by the Bureau of Census as part of the economic census (Census, 2002). It provides data, at the state and national level, on the physical and operational characteristics of registered private and commercial trucks. Since the state of registration of the truck is provided, a statistical profile of the truck fleet by state can be developed and analyzed to determine the characteristics of the state's trucking fleet. The last survey was conducted in 2002.

3. Bureau of Census, Current Industrial Reports (CIR):

The U.S. Bureau of Census CIR program provides periodic reports on production and shipment of selected products. The CIR provides data on factory shipments of complete truck trailers between 1988 and 2000 (Census, 2000). Staff used these data to determine the fraction of box-type trailers sold each year.

4. ACT Research, LLC.

ACT Research collects commercial vehicle data from manufacturers, analyses it, and disseminates the results to its subscribers. Among other things, it collects and analyzes data related to North American Class 8 trucks and trailers. Among other things, it collects and analyses data related to North American Class 8 trucks and tractors and trailers. ACT provided staff with information on the fraction of 53-foot or longer box-type trailers sold nationwide.

5. Commercial Carrier Magazine (CCJ)

CCJ magazine, published monthly by Randall Reilly Publishing Company, LLC, provides news and business information for professionals responsible for running trucking companies and maintaining equipment. The CCJ publishes once a year, information on the nation's top freight carriers, including the number of tractors and trailers owned by each company. Carrier performance data from the August 2007 and August 2008 issues of CCJ were used to assess the average ratio of trailers to tractors. Staff used these data to approximate the trailer to tractor ratio which was used to determine the total number of trailers affected by this rule.

B. Fraction of Long Haul Tractors

The VIUS data (Census, 2000) were used to determine the fraction of long haul tractors by base state of registration for California intrastate, California interstate, and neighboring out-of-state tractors. Since ARB inventory does not provide a separate inventory for Class 7 trucks, staff also used the VIUS data to determine the fraction of medium-heavy duty vehicles that are long haul Class 7 tractors.

Specifically, the VIUS data provided staff with information on (1) the primary range of operation (to determine the percentage of vehicles with a primary range of operation greater than 100 miles), and (2) jurisdiction in which the vehicle was most driven (to determine whether fleets operate interstate or exclusively intrastate). As shown in Table C-4, this information was used by staff to conclude that 23 percent of California's intrastate tractors and 71 percent of California's interstate tractors range of operation to be greater than 100 miles. For out-of-state registered tractors, 69 percent of tractors registered in neighboring states are affected, while 100 percent of non-neighboring states that operate in California are affected. In addition, analysis of VIUS data provided that approximately 5 percent of the total medium-heavy duty diesel vehicles are Class 7 tractors with primary range of operation greater than 100 miles (Census, 2002).

The VIUS database was also used to determine the VMT fraction accrued by tractors with primary range of operation greater than 100 miles, shown in Table C-4. This VMT fraction was applied to the baseline vehicle miles traveled provided by ARB inventory (discussed in A.1 above) to determine the total VMT accrued by the long haul tractors.

Table C-4 - Percentage of Class 7 and 8 Tractors with Primary Range of Operation Greater than 100 Miles and their VMT fraction

Fleet	Percentage of Tractors with Primary Range of Operation > 100 Miles	Percentage of VMT by Tractors with Primary Range of Operation > 100 Miles
CA Intrastate	23%	34%
CA Interstate	71%	80%
Neighboring Out-of-State	69%	84%
Non-neighboring Out-of-State	100%	100%

C. Fraction of Long Haul Tractors that Pull 53-Foot or Longer Box-Type Trailers

Staff analyzed trailer production data from the 1997 to 2000 CIR reports (Census, 2000), which showed that the percentage of box-type trailers sold each year from 1988 to 2000 varied from 70 to 77 percent with an overall average of 73 percent. As shown in Table C-5, staff assumed that this average was appropriate for California intrastate, interstate, and neighboring out-of-state fleets operating in California. It was also assumed that since essentially all non-neighboring out-of-state tractors pull loads for greater distances, it would be appropriate to assume that more than 73 percent are box-type. Staff assumed that 90 percent of these tractors pull box-type trailers. The fractions shown in Table C-5 include all box-type trailers of all lengths. To determine the fraction that are 53-foot or longer, staff consulted two trailer manufacturers and ACT Research. The two trailer manufacturers indicated that 90 percent or more of the box-type trailers to be 53-foot or longer. According to ACT Research, 85 to 90 percent of refrigerated van and dry van trailers are 53-foot or longer (Vieth, 2008). Based on this information, staff assumes that 85 percent of the box-type trailers pulled by California intrastate, interstate, and neighboring out-of-state tractors, and 90 percent of those pulled by non-neighboring out-of-state tractors are 53-foot or longer.

Table C-5 - Percentage of 53-Foot Box Type Trailers

Fleet	Percent Box-Type Trailers	Percent that are 53-foot or Longer
CA Intrastate	73	85
CA Interstate	73	85
Neighboring Out-of-State	73	85
Non-neighboring Out-of-State	90	90

Based on the above assumptions (Tables C-4 to C-5) and the baseline population and VMT provided by ARB inventory (ARB, 2008a), the tractor population impacted by the proposed regulation and the corresponding VMT are calculated and shown in Table C-6 for calendar years 2010 and 2020.

Table C-6: 2010 and 2020 Impacted Tractor Population and the Corresponding Annual VMT

Fleet	Impacted Tractor Population		Annual VMT (10^6 miles)	
	2010	2020	2010	2020
CA Intrastate	9,547	12,910	705	952
CA Interstate	27,462	37,005	1,320	1,783
Neighboring Out-of-State	18,525	24,962	663	896
Non-neighboring Out-of-State	380,152	507,751	3,187	4,306
Total	**435,686**	**582,628**	**5,875**	**7,937**

D. Impacted Box-Type Trailer Population

Available data were used to estimate the number of tractors that would be impacted by the proposed rule, as discussed above. For trailers, no database exists that provides a complete inventory on the total number of box-type trailers that would be impacted by the proposed rule. The ratio of trailers-to-tractors in many fleets is often not one-to-one (in which case the same numbers provided in Table C-6 for tractors could have been used to estimate trailer inventory). The ratio varies considerably from fleet to fleet. Many fleets typically own more trailers than tractors in order to maximize efficiency and reduce downtime for the tractor while waiting for the trailer to be loaded and unloaded. The ratio varies from zero for some owner-operators that own only tractors and pull trailers owned by other businesses, to “infinity” for some shippers that own only trailers and use the services of carriers to pull their trailers. Since data describing the tractor-trailer composition of all fleets that operate in California were not available, staff determined an approximate trailer-to-tractor ratio using data from annual CCJ publications (Vise, 2007; Vise, 2008). The published data included the number of trailers and tractors owned by the top 250 carriers in the country in calendar years 2006 and 2007. Analysis of the two annual datasets provided an estimated ratio of 2.5-to-1 trailers to tractors for both years.

The number of box-type trailers impacted by the proposed rule was then estimated by multiplying the trailer-to-tractor ratio of 2.5 by the number of tractors impacted by the proposed rule shown in Table C-6. Table C-7 shows the resulting 53-foot box-type trailer population impacted by staff’s proposal for calendar years 2010 and 2020.

Table C-7: 2010 and 2020 Impacted 53-Foot Box-Type Trailers

Fleet	2010	2020
CA Intrastate	23,868	32,275
CA Interstate	68,655	92,513
Neighboring Out-of-State	46,313	62,405
Non-neighboring Out-of-State	950,380	1,269,378
Total	**1,089,215**	**1,456,570**

E. Estimated GHG Benefits

The GHGs associated with diesel exhaust are CO_2, methane, and nitrous oxide, with CO_2 being the major component of the three. Since CO_2 is emitted in direct proportion to the fuel combusted, any reduction in CO_2 emissions requires reduction in the fuel burned to propel the vehicle. The proposed regulation would reduce GHG emissions by reducing the fuel consumption of HDVs achieved through improvements in aerodynamic drag and tire rolling resistance. The GHG reductions would contribute towards attaining AB 32 goals for the year 2020.

The following equation was used to calculate the GHG reductions from the proposed regulation.

$$CO_2e \text{ Reduced} = \text{Fuel Savings} * EF/1000 \qquad \text{(Equation C-1)}$$

Where: CO_2e Reduced = average annual reduction in GHGs in metric tons CO_2e
Fuel Savings = Annual fuel savings in gallons per year
EF = GHG emission factor from diesel fuel combustion (10.4 kilograms CO_2e per gallon of diesel fuel (ARB, 2008c))
1000 = Conversion factor from kilograms (kg) to metric tons (1000 kg = 1 MT)

Annual Fuel Savings: The annual fuel savings is determined from the percent fuel efficiency improvement, annual VMT, and the baseline fuel economy, as follows:

$$\text{Fuel Savings (gallons/year)} = \text{Annual VMT} * \%FS/FE$$

Where: Annual VMT is the vehicle miles traveled per year
%FS is the fuel consumption improvement due to improvements in aerodynamic drag and rolling resistance.
FE is the fuel economy in miles per gallon.

Percent Fuel Efficiency Improvements: The percent fuel efficiency improvements used to quantify the GHG benefits are shown in Table C-8. These were determined based on the minimum aerodynamic and tire rolling resistance performance requirements specified in the proposed regulation. For example, the proposed regulation would require a minimum fuel efficiency improvement of 3 percent from low-rolling resistance tires on the combined tractor and the trailer, a minimum of 4 percent from trailer side skirts, and a minimum of 1 percent from front or rear gap fairings on dry-van trailers. Thus, for this example, an in-use pre-2011 model year tractor pulling a dry-van trailer would achieve an overall fuel efficiency improvement of 8 percent, as shown in Table C-8.

The fuel efficiency improvements of currently certified aerodynamic devices are determined from track tests conducted at speeds of 60 to 62 miles per hour and utilizing the "SAE J1321 Type II" test procedures. These aerodynamic devices also reduce drag at lower speeds, though to a lesser extent, since aerodynamic drag varies with the square of the vehicle speed.

Annual VMT: The annual VMT applicable to tractors pulling 53-foot or longer box-type trailers was determined using the baseline VMT (ARB, 2008a) and the factors shown in Tables C-3 to C-5. However, the resulting total VMT cannot be directly applied to the fuel efficiency improvements shown in Table C-8, since the VMT is accrued at various speeds, while the fuel efficiency improvements are determined at speeds of approximately 60 miles per hour. Thus, the speed-VMT distribution of the impacted tractors and fuel efficiency improvements at different speeds are needed in order to accurately quantify the GHG emission benefits. However, such data were not available and therefore staff estimated the GHG benefits using only the VMT accrued at highway speeds, without taking into account benefits that occur at lower speeds. Accordingly, for non-neighboring out-of-state tractors, staff assumed 85 percent of the VMT to be at highway speeds, since these tractors travel long distances, spending the majority of their VMT at highway speeds. For neighboring out-of-state, California interstate, and California intrastate tractors, staff assumed 75 percent of the VMT to be at highway speeds, benefiting fully for 75 percent of the VMT from the aerodynamic devices and low rolling resistance tires.

Table C-8: Fuel Efficiency Improvements – Based on Proposed Requirements

	Tractor Improvements	Trailer Improvements[3]	Fuel Savings
1	2011+ model year SmartWay certified sleeper cab tractor (3.5%)	Dry-van trailer – SmartWay certified or retrofitted with side skirts and front gap fairings (6.5%)	10.0%
2	2011+ model year SmartWay certified sleeper cab tractor (3.5%)	Refrigerated-van trailer – SmartWay certified or retrofitted with side skirt (5.5%)	9.0%
3	2011+ model year day cab tractors and all pre-2011 model year in-use tractors - Tire Improvements (1.5%)	Dry-van trailer – SmartWay certified or retrofitted with side skirts and front gap fairings (6.5%)	8.0%
4	2011+ model year day cab tractors and all pre-2011 model year in-use tractors - Tire Improvements (1.5%)	Refrigerated-van trailer – SmartWay certified or retrofitted with a side skirt (5.5%)	7.0%

Fuel Economy of On-Road Heavy-Duty Diesel Vehicles in California

ARB staff has recently reviewed multiple data sources to characterize the variations in the fuel economy values of heavy-duty tractors in California, including data from the United States Department of Energy (U.S. DOE, 2007), Coordinating Research Council E55/59 study by West Virginia University (CRC, 2007), the International Fuel Tax Agreement for trucks operating in California, and Consent Decree, in-use study by West Virginia University. The detailed methodology and results are discussed in Appendix G, of the "*Staff Report: Initial Statement Of Reasons For Proposed Rulemaking Proposed Regulation For In-Use On-Road Diesel Vehicles*" (ARB, 2008a). Results of the analysis, presented in Tables C-9, were used to estimate fuel savings and GHG emission benefits for this proposal.

[3] The trailer aerodynamic technologies specified in the table are meant for illustration purposes. Fleets can meet the requirements using other aerodynamic technologies that meet or exceed the minimum performance requirements.

Table C-9 - Fuel Economy Values by Model Year

Model Year	Fuel Economy (miles per gallon)	Model Year	Fuel Economy (miles per gallon)
Pre-1988	5.20	2003-2006	5.75
1988-1990	5.39	2007	5.61
1991-1993	5.58	2008	5.59
1994-1995	5.76	2009	5.58
1996	5.95	2010	5.78
1997-1998	5.95	2011	5.78
1999-2002	5.48	2012	5.80

For the purposes of quantifying the emission reductions, staff also assumed that all fleets would adopt the large fleet trailer compliance plan which provides a compliance option for in-use pre-2011 trailers based on a phase-in schedule specified in Appendix F of this report. Staff also assumed that in the absence of the proposed regulation, 20 percent of the tractors sold each year from 2010 to 2020 would be SmartWay certified and 25 percent of the in-use pre-2011 model year tractors would use fuel efficient tires.

The GHG emission benefits were calculated for the years 2010 to 2020 based on VMT accrued within California and nationwide. Table C-10 summarizes the 2010, 2015, and 2020 statewide and nationwide GHG emission benefits of the proposed regulation. Staff estimates that from 2010 to 2020, as new fuel efficient tractors and trailers are introduced and in-use ones retrofitted with fuel efficient technologies, GHG emissions will be reduced by a cumulative total of approximately 8 MMT CO_2e statewide and approximately 52 MMT CO_2e nationwide. The 2020 benefits are approximately 1 MMT CO_2e statewide and 7 MMT CO_2e nationwide. Figure C-1 shows the statewide baseline and controlled GHG emissions for calendar years 2010 to 2020. As seen in Figure C-1, GHG emissions from long-haul tractors continue to increase even with implementation of the proposed regulation because the trucking industry will grow substantially between now and 2020 (ARB, 2008a).

Table C-10: 2010, 2015, and 2020 GHG Emission Benefits - Statewide and Nationwide (MMT CO_2e)

	California		Nationwide	
Calendar Year	**Baseline**	**Reductions**	**Baseline**	**Reductions**
2010	8.5	**0.2**	55.6	**0.9**
2015	10.1	**0.8**	65.7	**5.5**
2020	11.4	**1.0**	74.6	**6.7**

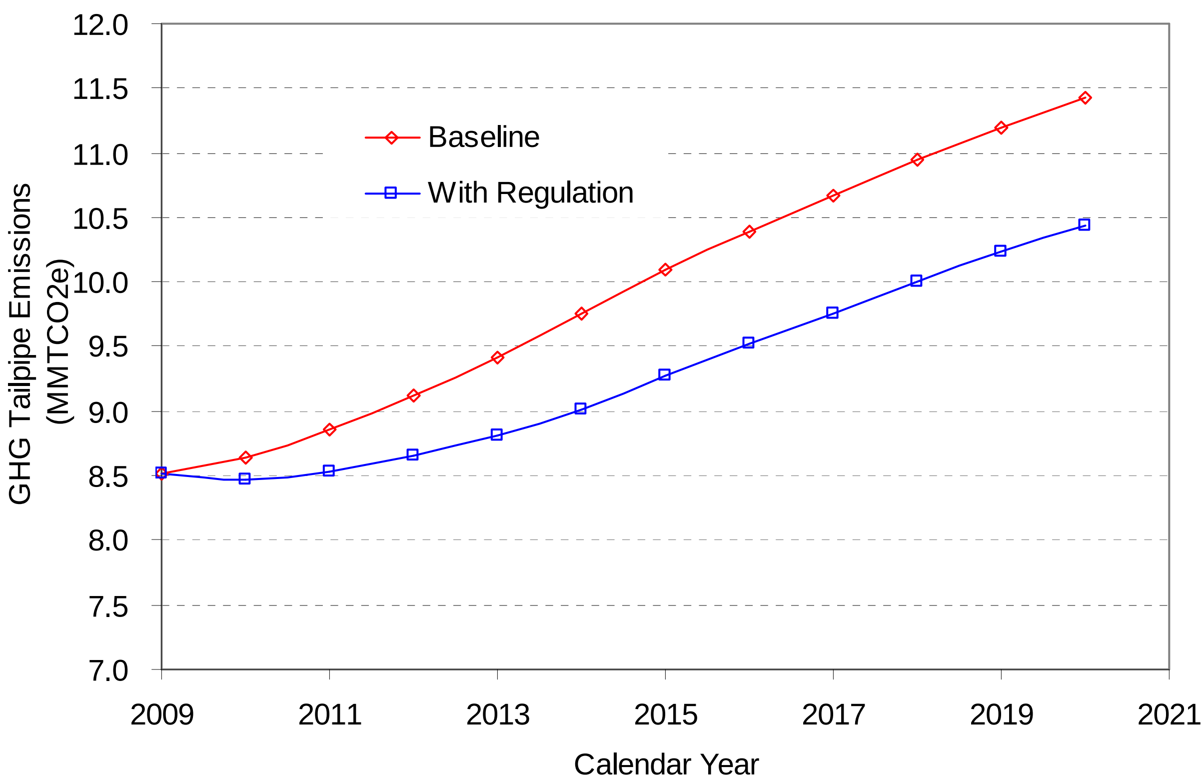

Figure C-1. Statewide GHG Emissions With and Without the Regulation (Long-haul tractor pulling 53-foot box-type trailers)

Estimated Oxides of Nitrogen (NOx) Emission Benefits

In addition to GHG benefits, reducing aerodynamic drag and rolling resistance also reduces NOx emissions (Bachman, 2005; Bachman, 2006). Thus, the proposed regulation is expected to provide NOx emission reduction benefits that would contribute towards attainment of ambient air quality standards for ozone. Staff used the methodology specified in the U.S. EPA SmartWay State Implementation Plan (SIP) and Transportation Conformity guidance document (U.S. EPA, 2007) to quantify the NOx emission benefits from the proposed regulation.

Because the effects of the SmartWay technologies on NOx emissions of trucks with particulate matter and NOx aftertreatment controls is not yet determined, the U.S. EPA recommends that, for SIP and conformity determinations, the NOx reductions not be applied to trucks of model years newer than 2006. Furthermore, the NOx emission reductions associated with SmartWay retrofit applications vary by speed, requiring the VMT to be distributed by speed. Since speed distribution data for the fleet that is impacted by the proposed regulation were not available, staff made the following assumptions on VMT-speed distribution of long-haul tractors. That is, for non-neighboring out-of-state tractors, staff assumed 85 percent of the VMT to be at highway speeds and a corresponding NOx reduction of 9.5 percent. For the remaining 15 percent of the VMT staff assumed an average speed of 35 miles per hour and a NOx reduction of 4.6 percent. For California intrastate, California interstate, and neighboring out-of-state tractors, staff assumed 75 percent of the VMT to be at highway speeds and a corresponding NOx reduction of 9.5 percent. For the remaining 25 percent of the VMT, staff assumed an average speed of 35 miles per hour and a corresponding NOx reduction of 4.6 percent. Based on these assumptions and U.S. EPA guidelines, California specific NOx reductions were estimated to be 4.3 and 1.4 tons per day in 2014 and 2020 respectively. These reductions assume a “business as usual” scenario, where they do not take into account the impact of other proposed regulations that would impact NOx emissions.

F. References

ARB, 2006. California Air Resources Board. EMFAC2007. Available at: http://www.arb.ca.gov/msei/onroad/latest_version.htm Last Accessed: October 22,2008.

ARB, 2008a. California Air Resources Board. *Staff Report: Initial Statement Of Reasons For Proposed Rulemaking. Proposed Regulation For In-Use On-Road Diesel Vehicles. Appendix G – Emissions Inventory Methodology and Results*. Sacramento: October 2008.

ARB, 2008c. California Air Resources Board. *Climate Change Proposed Scoping Plan. Appendices Volume II: Analysis and Documentation.* (Appendix II, p.I-6). Sacramento: October 2008*.* http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm

Bachman, 2005. Bachman, Leon J., Anthony Erb, Cheryl Bynum. *Effect of Single Wide Tires and Trailer Aerodynamics on Fuel Economy and NOx Emissions of Class 8 Line-Haul Tractor-Trailers.* Society of Automotive Engineer 2005-01-3551 http://www.epa.gov/smartway/transport/documents/tech/effects-on-fuel-economy.pdf

Bachman, 2006. Bachman , L J., A. Erb, C. Bynum, B. Shoffner, H. De La Fuente, C. Ensfield. *Fuel Economy Improvements and NOx Reduction by Reduction of Parasitic Losses: Effect of Engine Design.* Society of Automotive Engineer, 2006-01-3474. http://www.epa.gov/smartway/transport/documents/tech/fuel-economy-improvements.pdf

Census, 2000. Bureau of Census. *Current Industrial Reports, M336L - Truck Trailers.* http://www.census.gov/cir/www/336/m336l.html

Census, 2002. United States Bureau of Census. *2002 Vehicle Inventory and Use Survey Microdata.* http://www.census.gov/svsd/www/vius/products.html

CRC, 2007. Coordinating Research Council, Inc. *Heavy-Duty Vehicle Chassis Dynamometer Testing for Emissions Inventory, Air Quality Modeling, Source Apportionment and Air Toxics Emissions Inventory.* August 2007. Available at: http://www.crcao.com/reports/recentstudies2007/E-55-59/E-55_59_Final_Report_23AUG2007.pdf

U.S. DOE, 2008. Department of Energy, Oak Ridge National Laboratory. *Transportation Energy Data Book: Edition 27.* ORNL 6891. http://www-cta.ornl.gov/data/tedb27/Edition27_Cover.pdf

U.S. EPA, 2007. U.S. Environmental Protection Agency. *SmartWay SIP and Transportation Conformity Guidance: Accounting for NOx Reductions from Trailer*

Aerodynamic Kits and Low Rolling Resistance Tires. EPA420-B-07-004. June 2007. www.epa.gov/otaq/stateresources/transconf/policy/420b07004.pdf

Vieth, 2008. Vieth, Ken. Telephone Communication with Mr. Ken Vieth, Senior Partner and General Manager of Americas Commercial Transportation Research co., LLC (ACT Research). July 2, 2008

Vise, 2007. Vise, Avery. The CCJ Top 250: Mediocre at Best*. Commercial Carrier Journal*. August 2007. pp. 61-110. http://www.rrpub.com/etrucker/ccj/ccj0807_250.pdf

Vise, 2008. Vise, Avery. *The CCJ Top 250: Slower But Solid. Commercial Carrier Journal*. August 2008. pp. 52-103. http://www.rrpub.com/ccj/pdfs/top250_07.pdf