



DFW Area On-Road Mobile Source Emission Inventories

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DFW Photochemical Modeling Technical Committee
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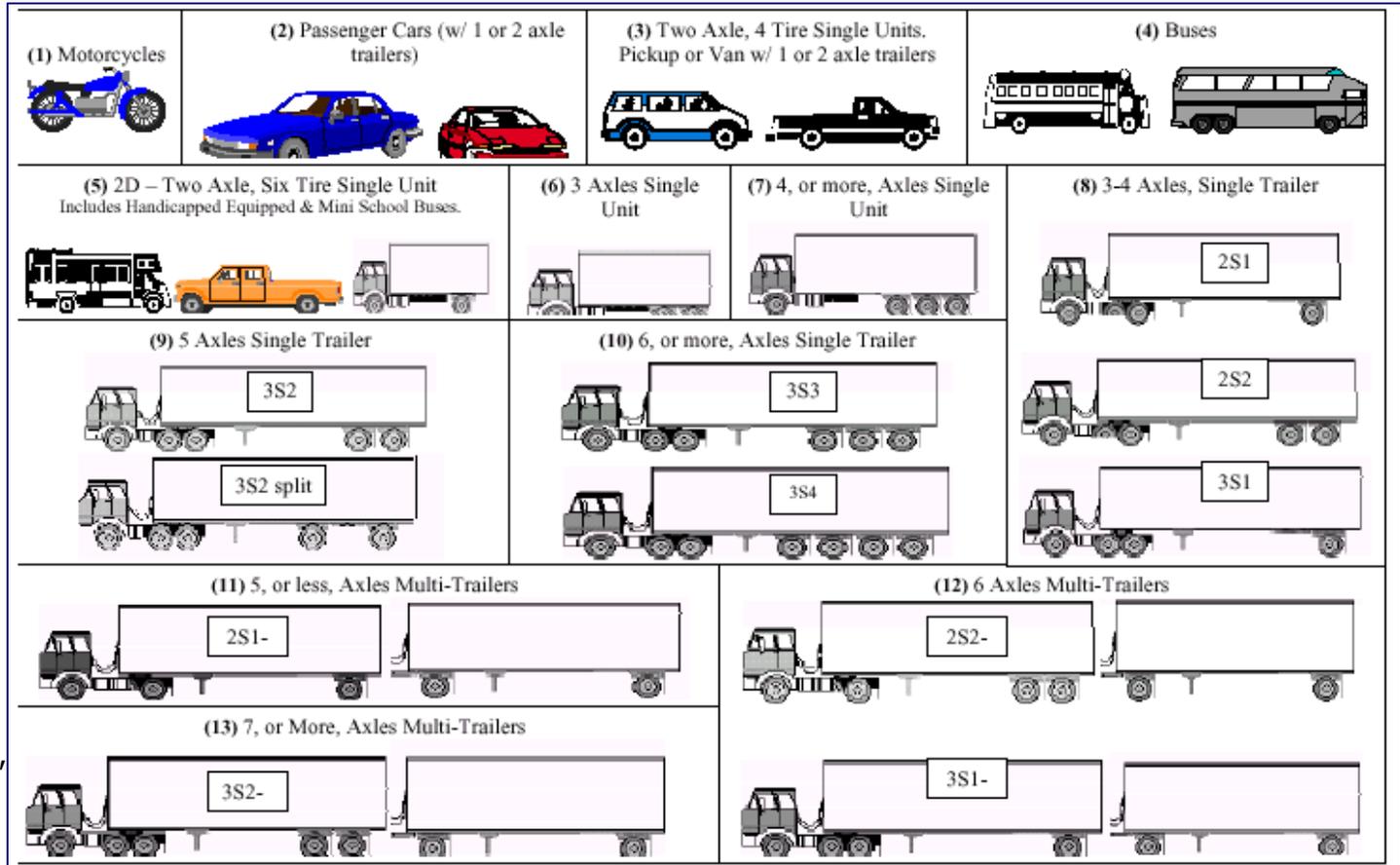
Presentation Overview

- What Are On-Road Mobile Sources?
- MOBILE Model Vehicle Classification
- On-Road Inventory Development Basics
- EPA's On-Road Mobile Emission Rate Models
- Macro-Level versus "SIP Quality" On-Road Inventory Development
- 2006/2012 On-Road Summaries by County and Vehicle Type
- 2012 Nine-County DFW On-Road Control Strategy Estimates
- Vehicle Age Distribution Inputs
- Sample "under the hood" calculations by model year for:
 - Light-duty gasoline vehicles ("passenger cars")
 - Heavy-duty diesel 8b vehicles (most "eighteen wheelers")



What Are On-Road Mobile Sources?

- Passenger Cars
- Pickup Trucks
- SUVs
- Vans & Minivans
- Motorcycles
- School Buses
- Transit Buses
- "18-Wheelers"
- Recreational Vehicles





MOBILE Model Vehicle Classification

- Light-duty, heavy-duty, fuel type, and gross vehicle weight rating (GVWR)

MOBILE5	MOBILE6		MOBILE5	MOBILE6		MOBILE5	MOBILE6
LDGV	LDGV		HDGV	HDGV2b		HDDV	HDDV2b
LDGT1	LDGT1			HDGV3			HDDV3
	LDGT2			HDGV4			HDDV4
LDGT2	LDGT3			HDGV5			HDDV5
	LDGT4			HDGV6			HDDV6
LDDV	LDDV			HDGV7			HDDV7
LDDT	LDDT12			HDGV8a			HDDV8a
	LDDT34			HDGV8b			HDDV8b
MC	MC			HDGB			HDDBT



On-Road Inventory Development Basics

- Emissions inventory is multiplication of:
 - Level of activity – vehicle miles traveled (VMT)
 - Emission rate per unit of activity – grams per mile
- Inventories are typically developed by county:
 - 24-hour county totals of NO_x, VOC, and CO are not enough
 - Spatial and temporal distribution of emissions is critical
 - Need “right amount” of emissions in “right place” at “right time”
- Travel demand models (TDMs) provide the best spatial and temporal distribution of VMT estimates
 - Roadway network divided into “links” and “zones”
 - Zone-to-zone travel allocated to links
 - DFW area on-road inventories based on NCTCOG’s TDM



EPA's On-Road Mobile Emission Rate Models

- MOBILE1 – MOBILE6
 - FORTRAN software tool to predict gram-per-mile emission rates (NO_x, VOC, CO, etc.)
 - Periodically updated to include new emission standards, input options, and collected data:
 - MOBILE1 1978
 - MOBILE2 1981
 - MOBILE3 1984
 - MOBILE4 1989
 - MOBILE5 1993
 - MOBILE6 2002 (<http://www.epa.gov/otaq/m6.htm>)
- Motor Vehicle Emission Simulator (MOVES) Model
 - Database driven tool for estimating emission rates
 - MOVES2010a released on September 8, 2010
 - Available at <http://www.epa.gov/otaq/models/moves/>



Macro-Level versus "SIP Quality" On-Road Inventory Development

- Macro-level estimation per county, day type, and year:
 - Vehicle miles traveled for 28 vehicle types
 - 3 pollutants (NO_x, VOC, and CO)
 - 84 total calculations
- NCTCOG "SIP-quality" 2012 analysis:
 - 81,556 total links and zones from travel demand model
 - Vehicle miles traveled for 28 vehicle types
 - 24 hours
 - 11 pollutant categories:
 - NO_x - Exhaust Running & Start
 - CO - Exhaust Running & Start
 - VOC - Exhaust Running, Start, Crankcase, Diurnal, Hot Soak, Resting Loss, & Running Loss
 - 602,861,952 total calculations



2006 Nine-County DFW Summer Weekday On-Road Emission Summary

DFW Area County	Vehicle Miles Traveled	On-Road Emissions (tons per day)		
		NO _x	VOC	CO
Collin	16,068,710	19.17	9.47	116.42
Dallas	64,281,838	83.89	46.05	526.96
Denton	13,408,318	18.80	8.02	98.18
Ellis	5,298,407	14.67	3.57	44.33
Johnson	4,345,589	8.83	3.44	39.39
Kaufman	4,533,347	12.08	3.17	39.67
Parker	3,796,119	10.49	2.70	33.15
Rockwall	1,926,972	5.12	1.22	15.05
Tarrant	40,494,762	52.12	27.11	320.68
Total	154,154,062	225.17	104.77	1,233.83



2012 Nine-County DFW Summer Weekday On-Road Emission Summary

DFW Area County	Vehicle Miles Traveled	On-Road Emissions (tons per day)		
		NO _x	VOC	CO
Collin	20,189,452	10.57	7.29	97.53
Dallas	75,484,002	47.21	33.80	409.86
Denton	18,516,332	10.34	6.80	89.26
Ellis	7,237,704	7.49	3.10	38.40
Johnson	5,343,688	4.63	2.65	30.52
Kaufman	5,632,724	5.77	2.52	31.41
Parker	4,663,328	5.00	2.05	25.22
Rockwall	2,321,347	2.22	0.93	11.45
Tarrant	48,745,787	29.18	20.45	251.50
Total	188,134,364	122.40	79.57	985.15



2006 Nine-County DFW On-Road Emissions by Aggregate Vehicle Category

DFW Area County	Vehicle Miles Traveled	On-Road Emissions (tons per day)		
		NO _x	VOC	CO
Light-Duty Gasoline	142,343,372	103.59	98.97	1,195.15
Heavy-Duty Gasoline	1,772,607	7.44	1.69	18.62
Light-Duty Diesel	909,449	0.96	0.53	0.98
Diesel "18-Wheelers" Running	5,960,030	92.82	2.37	13.34
Diesel "18-Wheelers" Extended Idling		3.20	0.08	0.47
Diesel Buses	355,017	4.65	0.20	1.00
Other Heavy-Duty Diesel	2,703,319	12.36	0.61	2.77
Motorcycles	110,268	0.14	0.30	1.49
Total	154,154,062	225.17	104.77	1,233.83



2012 Nine-County DFW On-Road Emissions by Aggregate Vehicle Category

DFW Area County	Vehicle Miles Traveled	On-Road Emissions (tons per day)		
		NO _x	VOC	CO
Light-Duty Gasoline	173,563,411	71.19	75.21	963.41
Heavy-Duty Gasoline	1,905,024	2.94	0.80	9.98
Light-Duty Diesel	819,922	0.27	0.16	0.37
Diesel "18-Wheelers" Running	7,437,638	34.35	2.22	6.86
Diesel "18-Wheelers" Extended Idling		1.18	0.08	0.24
Diesel Buses	527,522	4.48	0.22	0.84
Other Heavy-Duty Diesel	3,748,584	7.86	0.59	1.56
Motorcycles	132,265	0.13	0.30	1.89
Total	188,134,364	122.40	79.57	985.15



2012 Nine-County DFW On-Road Control Strategy Estimates

On-Road Control Strategy Scenario	On-Road Emissions (tons per day)		
	NO _x	VOC	CO
Federal Standards Only No State Controls	150.02	113.15	1,396.86
Reformulated Gasoline (RFG) Collin, Dallas, Denton, Tarrant	-1.12	-15.02	-85.82
Low Reid Vapor Pressure (RVP) Gasoline Ellis, Johnson, Kaufman, Parker, Rockwall	-0.13	-0.86	-2.98
Texas Low Emission Diesel (TxLED)	-2.65		
Inspection/Maintenance (I/M) Program	-23.72	-17.70	-322.91
Final On-Road Inventory State & Federal Controls	122.40	79.57	985.15

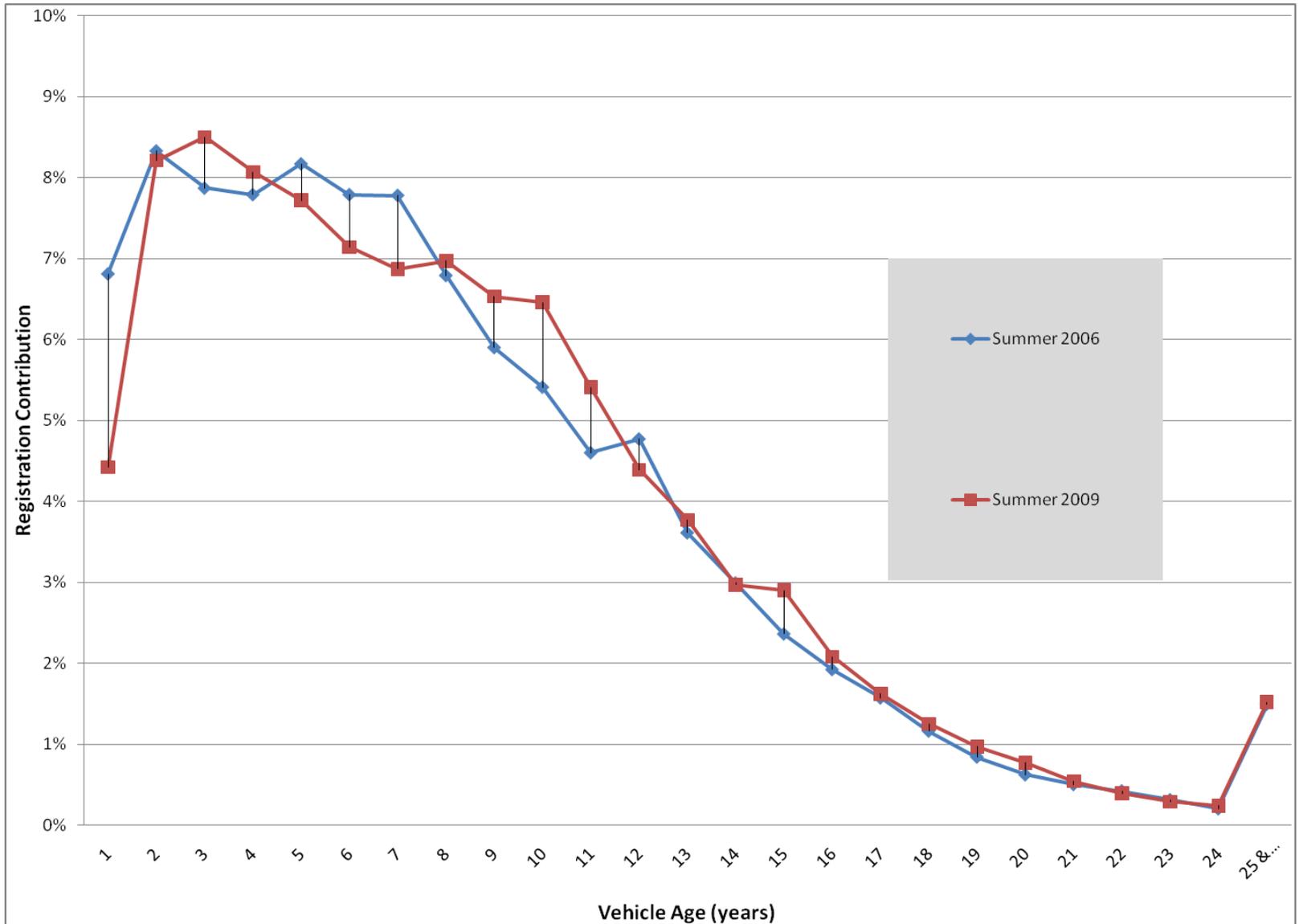


Vehicle Age Distribution Inputs

- “Snapshot” queries are taken of the vehicle registration database in January and July of each year for all 254 Texas counties
 - Prior to 2001, MOBILE5 categorization scheme was used
 - From 2001 to present, MOBILE6 categorization scheme was used
 - MOVES source use type (SUT) categories now queried for future work
- Standard inventory development approach:
 - For historical years, use the age distribution profile for that year:
 - 2006 on-road inventory based on Summer 2006 queries
ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/Mobile_EI/DFW/m62/2006/
 - For future years, use the latest available profile when the work is done:
 - Current 2012 on-road inventory based on Summer 2009 queries
ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/Mobile_EI/DFW/m62/2012/
 - 2009 future case on-road inventory for 5-23-2007 DFW SIP based on Summer 2005 profile:
ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/Mobile_EI/DFW/m62/2009/

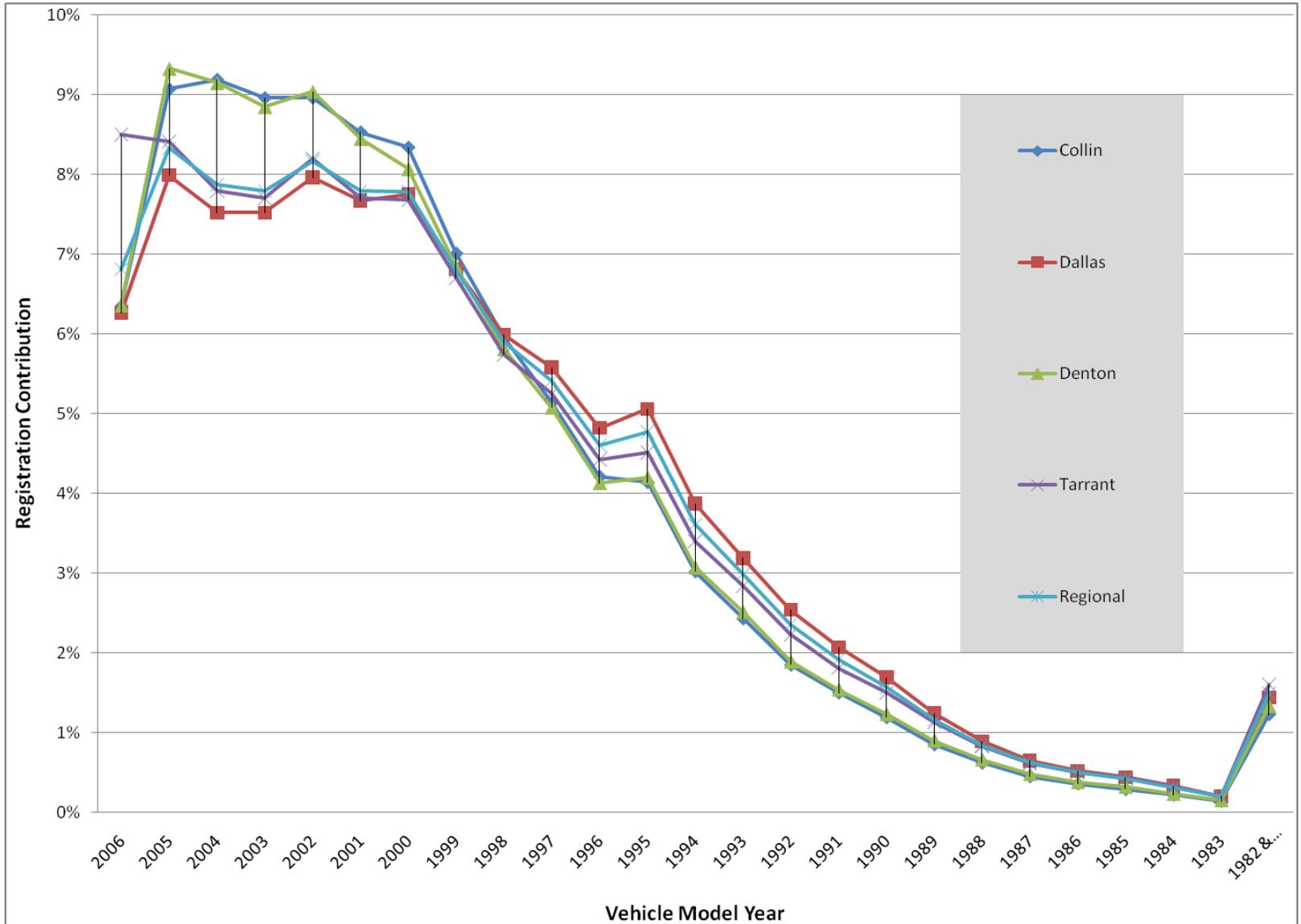


DFW Light-Duty Vehicle Regional Age Distribution Profiles – Summers of 2006 & 2009



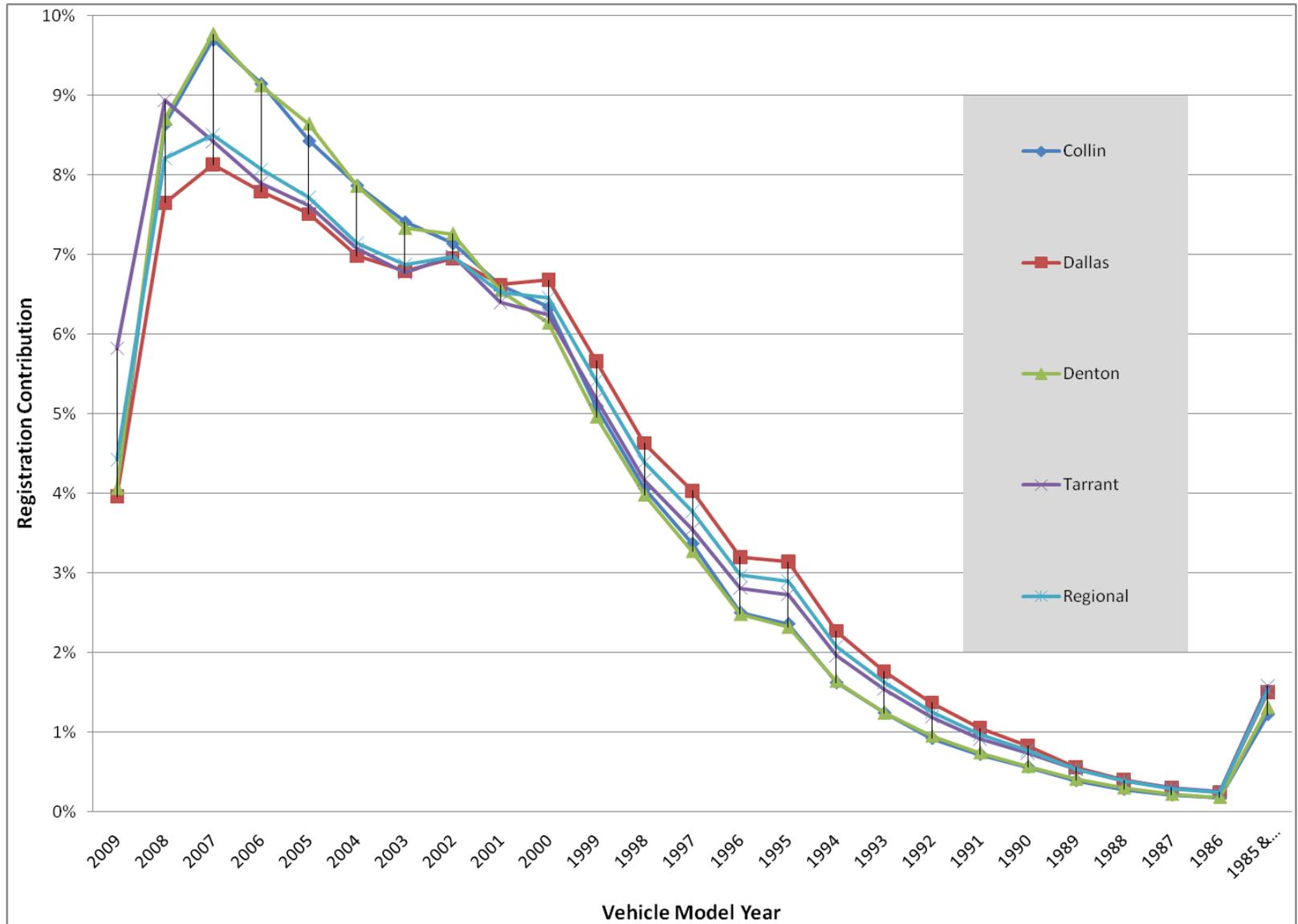


DFW Light-Duty Vehicle Age Distribution Profiles Summer of 2006





DFW Light-Duty Vehicle Age Distribution Profiles Summer of 2009





2006 Light-Duty Gasoline Vehicle (LDGV) NO_x Calculations

Vehicle Model Year	NO _x Emission Rate (grams per mile)	LDGV 2006 Age Distribution	Annual Mileage Accumulation	Combination Age / Mileage Distribution	Vehicle Miles Traveled	NO _x Emissions (tpd)	Weighted NO _x Rates (gpm)
2006	0.0407	6.82%	14,910	9.34%	9,664,236	0.43	0.0038
2005	0.0942	8.34%	14,174	10.86%	11,237,771	1.17	0.0102
2004	0.1861	7.88%	13,475	9.76%	10,093,604	2.07	0.0182
2003	0.2099	7.80%	12,810	9.18%	9,497,938	2.20	0.0193
2002	0.2768	8.18%	12,178	9.15%	9,469,799	2.89	0.0253
2001	0.3403	7.80%	11,577	8.30%	8,583,734	3.22	0.0282
2000	0.7349	7.79%	11,006	7.88%	8,149,892	6.60	0.0579
1999	0.7958	6.80%	10,463	6.54%	6,761,900	5.93	0.0520
1998	0.8529	5.90%	9,947	5.40%	5,585,819	5.25	0.0461
1997	0.9068	5.41%	9,456	4.71%	4,869,086	4.87	0.0427
1996	0.9600	4.60%	8,989	3.80%	3,935,609	4.16	0.0365
1995	1.1195	4.78%	8,546	3.75%	3,881,096	4.79	0.0420
1994	1.3602	3.62%	8,124	2.70%	2,793,621	4.19	0.0367
1993	1.6193	2.99%	7,723	2.13%	2,199,180	3.93	0.0344
1992	1.6935	2.36%	7,342	1.59%	1,649,679	3.08	0.0270
1991	1.7730	1.92%	6,980	1.23%	1,275,045	2.49	0.0219
1990	1.8336	1.57%	6,636	0.96%	992,124	2.01	0.0176
1989	1.8664	1.16%	6,308	0.67%	696,803	1.43	0.0126
1988	1.9634	0.84%	5,997	0.46%	479,848	1.04	0.0091
1987	1.9464	0.62%	5,701	0.32%	335,817	0.72	0.0063
1986	1.9677	0.50%	5,420	0.25%	257,342	0.56	0.0049
1985	2.1800	0.42%	5,152	0.20%	204,139	0.49	0.0043
1984	2.2374	0.31%	4,898	0.14%	142,305	0.35	0.0031
1983	2.2416	0.20%	4,656	0.08%	86,573	0.21	0.0019
1982 & Older	2.5255	1.42%	4,427	0.58%	596,343	1.66	0.0146
Total		100.00%		100.00%	103,439,304	65.74	0.5766



2012 Light-Duty Gasoline Vehicle (LDGV) NO_x Calculations

Vehicle Model Year	NO _x Emission Rate (grams per mile)	LDGV 2009 Age Distribution	Annual Mileage Accumulation	Combination Age / Mileage Distribution	Vehicle Miles Traveled	NO _x Emissions (tpd)	Weighted NO _x Rates (gpm)
2012	0.0243	4.42%	14,910	6.16%	7,900,107	0.21	0.0015
2011	0.0305	8.21%	14,174	10.88%	13,949,822	0.47	0.0033
2010	0.0409	8.50%	13,475	10.70%	13,730,324	0.62	0.0044
2009	0.0529	8.07%	12,810	9.66%	12,392,409	0.72	0.0051
2008	0.0768	7.72%	12,178	8.79%	11,270,063	0.95	0.0067
2007	0.0914	7.14%	11,577	7.73%	9,908,943	1.00	0.0071
2006	0.1287	6.87%	11,006	7.07%	9,063,988	1.29	0.0091
2005	0.2442	6.97%	10,463	6.82%	8,742,227	2.35	0.0166
2004	0.3964	6.53%	9,947	6.07%	7,786,430	3.40	0.0241
2003	0.3963	6.46%	9,456	5.71%	7,322,731	3.20	0.0226
2002	0.4741	5.41%	8,989	4.54%	5,829,640	3.05	0.0215
2001	0.5427	4.39%	8,546	3.51%	4,497,389	2.69	0.0190
2000	1.0602	3.77%	8,124	2.86%	3,671,507	4.29	0.0303
1999	1.1089	2.97%	7,723	2.14%	2,749,638	3.36	0.0238
1998	1.1546	2.90%	7,342	1.99%	2,552,381	3.25	0.0230
1997	1.1908	2.08%	6,980	1.36%	1,740,411	2.28	0.0162
1996	1.2277	1.62%	6,636	1.00%	1,288,708	1.74	0.0123
1995	1.4658	1.25%	6,308	0.74%	945,508	1.53	0.0108
1994	1.7242	0.97%	5,997	0.54%	697,889	1.33	0.0094
1993	2.0097	0.77%	5,701	0.41%	526,545	1.17	0.0082
1992	2.0752	0.54%	5,420	0.27%	350,959	0.80	0.0057
1991	2.1510	0.39%	5,152	0.19%	240,768	0.57	0.0040
1990	2.2063	0.29%	4,898	0.13%	170,360	0.41	0.0029
1989	2.2195	0.24%	4,656	0.10%	134,022	0.33	0.0023
1988 & Older	2.3792	1.52%	4,427	0.63%	807,298	2.12	0.0150
Total		100.00%		100.00%	128,270,065	43.13	0.3051



2006 Heavy-Duty Diesel Vehicle 8b (HDDV8b) NO_x Calculations

Vehicle Model Year	NO _x Emission Rate (grams per mile)	HDDV8b 2006 Age Distribution	Annual Mileage Accumulation	Combination Age / Mileage Distribution	Vehicle Miles Traveled	NO _x Emissions (tpd)	Weighted NO _x Rates (gpm)
2006	6.4105	10.69%	124,208	17.60%	991,994	7.01	1.1285
2005	6.4979	10.63%	112,590	15.87%	894,047	6.40	1.0310
2004	6.6052	3.22%	102,060	4.36%	245,465	1.79	0.2877
2003	7.2071	4.81%	92,514	5.89%	331,997	2.64	0.4246
2002	10.9835	3.50%	83,861	3.89%	218,983	2.65	0.4268
2001	17.8431	8.46%	76,017	8.52%	480,004	9.44	1.5199
2000	17.9156	17.04%	68,907	15.56%	877,051	17.32	2.7884
1999	17.9813	11.34%	62,462	9.39%	528,902	10.48	1.6877
1998	29.6843	11.12%	56,620	8.35%	470,351	15.39	2.4777
1997	30.1936	4.96%	51,324	3.37%	190,074	6.33	1.0185
1996	29.4031	4.17%	46,523	2.57%	144,928	4.70	0.7562
1995	30.7154	3.74%	42,172	2.09%	117,849	3.99	0.6424
1994	30.3448	2.76%	38,228	1.40%	78,808	2.64	0.4244
1993	34.4193	0.80%	34,652	0.37%	20,637	0.78	0.1261
1992	35.9797	0.34%	31,411	0.14%	7,914	0.31	0.0505
1991	26.9059	0.21%	28,473	0.08%	4,565	0.14	0.0218
1990	24.1785	0.40%	25,810	0.14%	7,686	0.20	0.0330
1989	28.6516	0.37%	23,396	0.11%	6,431	0.20	0.0327
1988	27.4493	0.15%	21,208	0.04%	2,429	0.07	0.0118
1987	25.8678	0.15%	19,224	0.04%	2,202	0.06	0.0101
1986	25.8678	0.37%	17,426	0.09%	4,790	0.14	0.0220
1985	25.9419	0.25%	15,796	0.05%	2,895	0.08	0.0133
1984	25.9669	0.21%	14,319	0.04%	2,296	0.07	0.0106
1983	26.0420	0.03%	12,979	0.00%	264	0.01	0.0012
1982 & Older	26.0577	0.28%	11,765	0.04%	2,425	0.07	0.0112
Total		100.00%		100.00%	5,634,984	92.91	14.9583



2012 Heavy-Duty Diesel Vehicle 8b (HDDV8b) NO_x Calculations

Vehicle Model Year	NO _x Emission Rate (grams per mile)	HDDV8b 2009 Age Distribution	Annual Mileage Accumulation	Combination Age / Mileage Distribution	Vehicle Miles Traveled	NO _x Emissions (tpd)	Weighted NO _x Rates (gpm)
2012	0.5854	6.01%	124,208	9.84%	695,695	0.45	0.0576
2011	0.5854	6.11%	112,590	9.07%	641,133	0.41	0.0531
2010	0.5854	15.85%	102,060	21.31%	1,507,233	0.97	0.1248
2009	3.6720	11.86%	92,514	14.46%	1,022,533	4.14	0.5309
2008	3.7316	10.26%	83,861	11.34%	802,233	3.30	0.4233
2007	3.7856	3.51%	76,017	3.51%	248,355	1.04	0.1329
2006	7.0353	4.50%	68,907	4.08%	288,762	2.24	0.2873
2005	7.1019	3.85%	62,462	3.17%	224,405	1.76	0.2254
2004	7.1622	8.84%	56,620	6.59%	466,314	3.68	0.4723
2003	7.6631	12.99%	51,324	8.79%	621,390	5.25	0.6733
2002	11.4987	4.59%	46,523	2.81%	198,996	2.52	0.3236
2001	18.1345	2.75%	42,172	1.53%	108,229	2.16	0.2775
2000	18.1746	1.93%	38,228	0.97%	68,770	1.38	0.1767
1999	18.2110	1.67%	34,652	0.76%	53,990	1.08	0.1390
1998	21.7973	2.11%	31,411	0.87%	61,638	1.48	0.1900
1997	22.5397	0.96%	28,473	0.36%	25,351	0.63	0.0808
1996	22.3357	0.52%	25,810	0.18%	12,418	0.31	0.0392
1995	22.9341	0.13%	23,396	0.04%	2,729	0.07	0.0088
1994	22.9678	0.21%	21,208	0.06%	4,127	0.10	0.0134
1993	35.0080	0.15%	19,224	0.04%	2,731	0.11	0.0135
1992	36.5990	0.16%	17,426	0.04%	2,630	0.11	0.0136
1991	27.4595	0.09%	15,796	0.02%	1,341	0.04	0.0052
1990	24.6697	0.11%	14,319	0.02%	1,405	0.04	0.0049
1989	29.4253	0.06%	12,979	0.01%	735	0.02	0.0031
1988 & Older	28.1757	0.80%	11,765	0.12%	8,768	0.27	0.0349
Total		100.00%		100.00%	7,071,910	33.56	4.3052



Questions?

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