

Surrounding Denver Metro  
Smart Sign Study  
Summer 2000

Sponsored by the Regional Air Quality Council and the City of Boulder

Over the course of the 2000 summer, the smart sign measured over 200,000 vehicles in locations all around the Denver metro area. The locations for measuring moving vehicles varied from Highlands Ranch to Thornton to out west at 6<sup>th</sup> and Kipling and Boulder. The sign was testing the emissions of Carbon monoxide (CO) and the amount of Hydrocarbons present in the exhaust of cars passing by. Numerous studies of this sort have been done, and these data will conclude as they have in the past, that a small amount of the highest emitting vehicles are responsible for a large portion of the total vehicle emissions (see figure below). The SMART SIGN uses an RSD 3000 detection system so all HC data in this report are given as ppm HEXANE.

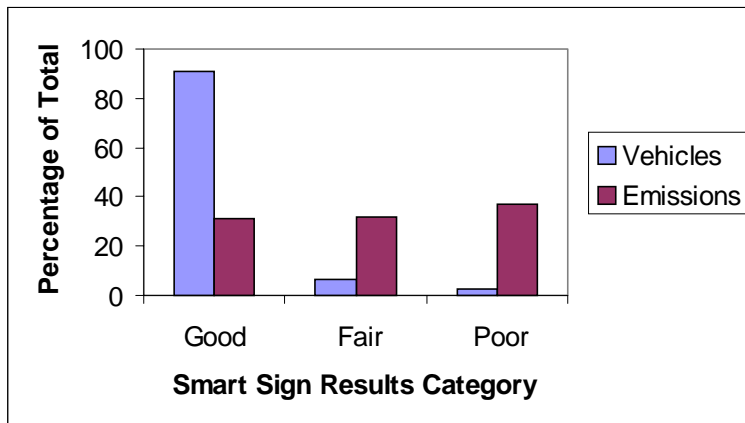
**Data Summary**

	Count	Percentage of Total	Average Emission
Total Vehicles	216,588		
Valid CO Readings	167,344	77 %	0.51 % CO
Valid HC Readings	159,974	74 %	110 ppm HC

**CO Data**

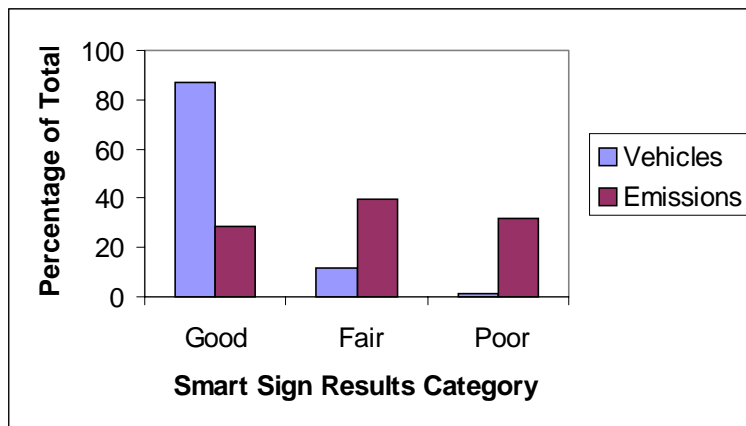
Cars are placed into 3 different categories: good, fair, and poor. These categories correspond to < 1.3 %, > 1.3 % but < 4.5 %, and > 4.5 % respectively. As the following graph will show, less than 10 % of the dirtiest vehicles were responsible for approximately 69 % of the CO emissions. Of this, less than 3 % were again putting out more than 37 %. As these data show, vehicles emissions would be greatly reduced by fixing this small portion of the vehicle fleet, as well as improving the gas mileage on the repaired vehicles.

Smart Sign Results for CO: Percentage of Broken Vehicles and Their Resulting Contribution to Total Emissions



The Hydrocarbon data were divided into the following respectively for good, fair, and poor: < 200 ppm, > 200 ppm but < 1000 ppm, and finally > 1000 ppm. . This data echoes the CO data in showing that again, a small amount of vehicles puts out most of the emissions today. Approximately 13 % of these vehicles were responsible for more than 70% of the Hydrocarbon emissions. The worst vehicles, only 1.2 %, were responsible for 32 % of the HC emissions. Again, fixing this small amount of cars would greatly reduce the amount of HC emissions.

Results for HC: Percentage of Broken Vehicles and Their Resulting Contribution to Total Emissions



Data from the I-25 to 6<sup>th</sup> avenue site in Denver are available on our web site at [www.feet.biochem.du.edu](http://www.feet.biochem.du.edu). Vehicles are identified by make, model year and emission test status. From these data we know that most emissions are from broken vehicles about 5-13 years of age. On average the fraction of these broken vehicles increases with vehicle age, however the number of on-road vehicles decreases with increasing age. The differences between the various sites are believed to arise from the measured fleet having a different average age at each of the sites. In all cases we attempted to avoid locations where there would be a significant fraction of vehicles in a cold-start mode. These are vehicles within about 65 seconds of start which have higher than normal emissions because of the need to “choke” the engine to assure cold starting and operation.

**Individual Totals from Summer**

6<sup>th</sup> and I-225 in Aurora

	Count	Percent of Total	Average Emissions
Total Vehicles	12846	100 %	
Valid CO	11220	87 %	0.66 % CO
Valid HC	10736	84 %	110 ppm

6<sup>th</sup> and Kipling in Lakewood

	Count	Percent of Total	Average Emissions
Total Vehicles	41868	100 %	
Valid CO	33740	81 %	0.56 % CO
Valid HC	31566	75 %	130 ppm HC

Table Mesa/Foothills Area in Boulder

	Count	Percent of Total	Average Emission
Total Vehicles	64678	100 %	
Valid CO	56279	87 %	0.50 % CO
Valid HC	55611	86 %	86 ppm HC

Federal Avenue in Westminster

	Count	Percent of Total	Average Emission
Total Vehicles	21975	100 %	
Valid CO	15457	70 %	0.64 % CO
Valid HC	14010	64 %	194 ppm HC

Lincoln Avenue and I-25 in Douglas County

	Count	Percent of Total	Average Emission
Total Vehicles	33864	100 %	
Valid CO	19848	59 %	0.27 % CO
Valid HC	18508	55 %	65 ppm HC

**Individual Totals from Summer (cont.)**

## Northglenn Town Hall

	Count	Percentage of Total	Average Emission
Total Vehicles	18015	100 %	
Valid CO	15777	88 %	0.43 % CO
Valid HC	15403	86 %	109 ppm HC

Thornton on Westbound 112<sup>th</sup>

	Count	Percentage of Total	Average Emission
Total Vehicles	23342	100 %	
Valid CO	15023	64 %	0.61 % CO
Valid HC	14140	61 %	144 ppm HC

**Past Data from 6<sup>th</sup> and I-25 site**

	2000	1999	1997	1996
Mean CO (%)	0.43	0.45	0.51	0.53
Percent of Total CO from Dirtiest 10 %	65.3	66.3	67.0	63.8
Mean HC (ppm)	88	65	130	125
Percent of Total HC from Dirtiest 10 %	54.6	63.7	48.3	58.0

Prepared by:  
 Michael Duncan  
 miduncan@du.edu  
 303-871-2586

Dr. Donald Stedman  
 Department of Chemistry and Biochemistry  
 University of Denver  
 dstedman@du.edu  
 303-871-2580