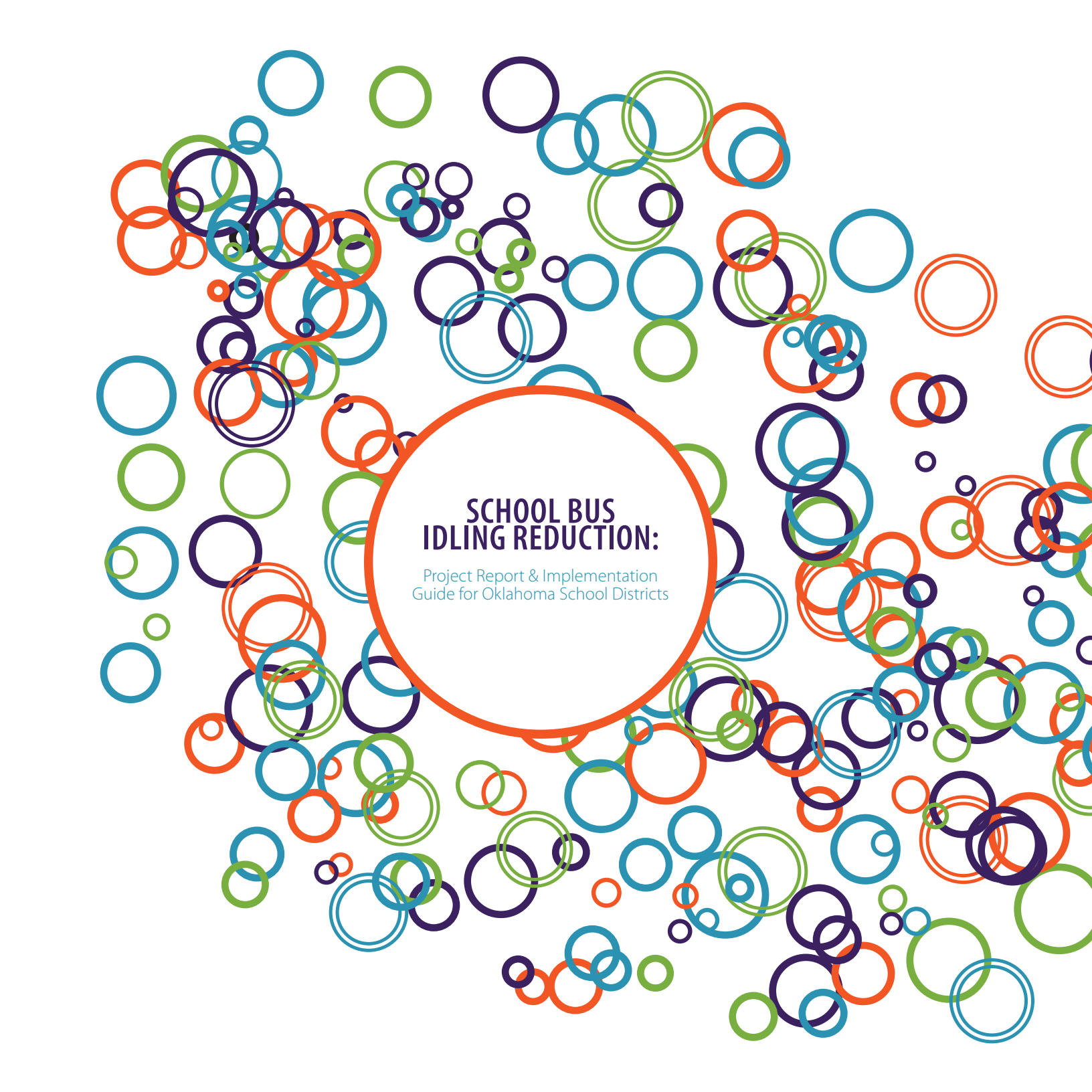




SCHOOL BUS IDLING REDUCTION:

Project Report & Implementation
Guide for Oklahoma School Districts



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SCHOOL BUS IDLING REDUCTION: PROJECT REPORT AND IMPLEMENTATION GUIDE FOR OKLAHOMA SCHOOL DISTRICTS



Introduction

School bus idling wastes fuel and financial resources while producing exhaust emissions that are harmful to human health and the environment. Beginning in late 2006, the Association of Central Oklahoma Governments, Choctaw-Nicoma Park Public Schools, and the Oklahoma Department of Environmental Quality undertook a two-year project to determine the extent of fuel and emissions savings that

Oklahoma school districts might expect by instituting a maximum five-minute school bus idling policy. This report offers the study's findings to public school districts in Oklahoma and elsewhere so that limited resources can be maximized and children, teachers, bus drivers, parents,

school administrators and others can enjoy the benefits of a healthier environment.

Opportunity

A quick Internet search can find numerous scholarly studies, published and cited, about the harmful health effects of diesel exhaust. School-age children from elementary school through high school are a particularly vulnerable population. Two well-known studies substantiating adverse effects on lung development in children with far-reaching effects into adulthood have been published in the *New England Journal of Medicine*¹ and by Environment and Human Health, Inc.,² a Connecticut-based research organization dedicated to education and sound public policy. A list of U.S. government publications and studies about the deleterious health effects of diesel exhaust also can be found on the U.S.

Environmental Protection Agency's website along with online links to many of those studies.³

During the 2007 - 2008 school year, there were 7,750 yellow school buses in Oklahoma transporting approximately 369,000 elementary, middle school, and high school students.⁴ If each of those buses idles for a total of one hour per day as drivers prepare to run routes, transition between elementary, middle school and high school routes, and wait in loading areas while dropping off and picking up students, Oklahoma school districts are literally idling away 3,800 gallons of fuel each school day according to U.S. Environmental Protection Agency assessments.⁵ Additionally, the agency's online Clean School Bus Fuel Savings Calculator indicates that for every five minutes of daily idling time reduced over the course of a school year, 7.5 gallons of fuel per bus can be saved.⁶ Extrapolating these calculations to include all 7,750 yellow school buses in Oklahoma, the opportunity exists for districts to reap substantial fuel savings with relative ease. By reducing idling time by a mere five minutes per bus each school day, a collective savings of more than 58,000 gallons of diesel fuel can be saved annually.

¹ W. James Gauderman, Ph.D., Edward Avol, M.S., Frank Gilliland, M.D., Ph.D., Hita Vora, M.S., et al., "The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age." *The New England Journal of Medicine*. The New England Journal of Medicine. <http://content.nejm.org/cgi/content/full/351/11/1057>.

² John Wargo, Ph.D. "Children's Exposure to Diesel Engine Exhaust on School Buses." *Environment and Human Health*, Inc. www.ehhi.org/reports/diesel/diesel.pdf (17 July 2009).

³ *US EPA Office of Transportation and Air Quality*. United States Environmental Protection Agency. www.epa.gov/otaq/toxics.htm#risk; and *Clean School Bus USA*. United States Environmental Protection Agency. www.epa.gov/otaq/schoolbus/humanhealth.htm.

⁴ STN Media Co., Inc. "2009 edition School Transportation News Buyer's Guide." *School Transportation News*. www.stnonline.com/stn/data_statistics/2007-08_schoolyear.htm.

Strategy

In September 2006, the Association of Central Oklahoma Governments' Clean Cities Program Office, Choctaw-Nicoma Park Public Schools, and the Oklahoma Department of Environmental



Quality's Air Quality Division began a school bus idling reduction study. The study was made possible by the U.S. Department of Energy through a Clean Cities Transportation Sector Petroleum Reduction Technologies Commercial Deployment grant.

The project goal was to provide a report to all public school districts in Oklahoma outlining the benefits of a school bus idling reduction policy. The data collected and analyzed, conclusions drawn, and lessons learned are the substance of this publication. Information contained herein can be used in school districts across Oklahoma by school transportation directors and bus drivers, school superintendents and school boards to establish policies to reduce excessive school bus idling, reduce diesel emissions in and around school buses and school buildings, reduce school bus engine wear, and save fuel and money.

While this project purchased and installed a fleet management system with mobile transmission units to collect data, idling reduction policies can be instituted at no cost to school districts other than time spent to draft and institute a policy, explain its benefits, and follow up periodically to ensure compliance.

The objectives of the School Bus Idling Reduction project were to: (1) develop and demonstrate techniques whereby school districts can reduce fuel usage and harmful emissions in conventional-fuel school bus fleets; (2) demonstrate the benefits of instituting school bus idling policies; (3) produce a report and implementation guide documenting project structure, data collection, and fuel savings realized; and (4) train school transportation directors, school bus drivers and key school communicators in idling reduction best practices.

Tactics

The project instituted an idling reduction policy at Choctaw-Nicoma Park Public Schools in Central Oklahoma that required bus drivers to turn off their engines after a maximum of five minutes idling in school parking lots and while waiting before, after, and between routes.

The project included the purchase of a fleet management system with mobile data transmission units to collect data from 15 school buses running a variety of routes. The system purchased did not use satellite transmission, but instead used the Choctaw-Nicoma Park School District's existing two-way radio system.

Each wireless unit sent real-time data to a base computer in the school district's Transportation Operations Office while buses were in operation. Data capture from installed hardware and software included GPS tracking. As long as bus engines were running, the location of the mobile units could be determined at any given time. The installed software date stamped and time stamped transmissions in five-minute data burst intervals. When buses were turned off, mobile units ceased to transmit. With this information, it was possible to track where a bus was located, what time it stopped, how long it took a driver to complete a route, when a bus arrived in a school parking lot, the exact time it was turned on or off, and how long a bus remained idling while parked prior to, following, and between running its routes. Data capture and analysis also allowed fleet management personnel to maximize the efficiency of running each route.

⁵ "When idling, a typical school bus engine burns approximately half a gallon of fuel per hour." *Clean School Bus USA*. United States Environmental Protection Agency. www.epa.gov/OMS/schoolbus/antiidling.htm

⁶ *Clean School Bus USA*. United States Environmental Protection Agency. www.epa.gov/OMS/schoolbus/idle_fuel_calc.htm

Data Collection

The comparative study used baseline data from 2007 that included the length of each route, the number of miles driven over the course of the school year, the number and location of bus stops on each route, the time it took a driver to complete the route, and the amount of fuel consumed per monitored bus. Identical information was collected throughout 2008 with idling reduction time parameters instituted. Adherence to the idling reduction policy was monitored through the installed fleet management hardware and software system so that accurate data comparison could be demonstrated.

Data collection was not without hiccups. As the study progressed, some problems were encountered with older radios that did not separate voice and data transmissions well. This resulted in some drivers turning off their radios. With radios turned off, idling time data and bus locations were not transmitted to the base unit in the Transportation Operations office. The number or frequency of static transmission bursts also prompted some drivers to turn off their radios. This distraction was addressed and corrected.

Other issues surfaced when some radios continued to send data bursts even after buses were parked for the night. It was discovered that these radios were wired directly from the power source, bypassing bus ignitions.

Perhaps the most notable problem occurred when a lightning strike rendered the district base station inoperable in August 2008. This required

the purchase and installation of a new upgraded base station model and rewiring of the mobile units.

At the time this publication went to press in August 2009, all units were in working order. Older radio units are scheduled to be replaced during the 2009 - 2010 school year to improve the system and eliminate any remaining data-voice issues.

Even with the challenges encountered, overall monitored and transmitted idling time data was reliable and consistent. Additionally, mileage and fuel use data was collected separately through physical readings and computerized refueling records. These disparate data collection systems served a fail-safe function and ensured the fidelity of the comparative data.

District Description

With its 40-percent suburban, 40-percent exurban and 20-percent rural transportation route mix, Choctaw-Nicoma Park Public Schools was an ideal demonstration district for Oklahoma. The district encompasses 60 square miles and runs 45 yellow school buses on routes each school day. The district consists of one high school, two junior high schools, and six elementary and intermediate schools. Ranked 23rd in student population in Oklahoma with

approximately 4,800 students, Choctaw-Nicoma Park Public Schools' total fleet of 53 school buses traveled 468,300 miles during the 2005 - 2006 school year, used 113,676 gallons of fuel, and



averaged just over 4 MPG. Statistics compiled by the Oklahoma Department of Education and the U.S. Census Bureau showed that during the 2005 - 2006 school year, Oklahoma's then 540 school districts served predominantly small towns and cities, as well as rural routes. During the 2005 - 2006 school year, the state's two largest school districts served student populations of approximately 41,000 each, followed by three districts with student populations of 19,000 to 21,000 each. The largest 25 public school districts, ranked



by student population, served nearly half of the state's public school enrollment of 634,467. The remaining 515 Oklahoma public school districts served a total student population of some 300,000 students with 409 of those districts serving student populations of fewer than 1,000 students.

Since 2006, consolidation has reduced the number of public school districts in Oklahoma so that as school begins in August 2009, the state is served by 532 districts.

Fleet Description

From mid-September 2006 to January 2007, four 1990 and 1993 model year Choctaw-Nicoma Park school buses with Chevrolet 366 CID gasoline engines were replaced with model year 2007 buses with International VT365 or VT356 diesel engines. These four new buses along with 11 late-model Choctaw-Nicoma Park school buses were equipped with GPS mobile data transmission units in late 2007. The 15 buses were selected on the basis of year-to-year analogous route representation.

Fourteen transmission units operated reliably throughout the study period with one unit consistently failing to transmit regularly to the base computer. Consequently, Bus Unit 9911, while accounted for in inventory, has been removed from both the historical and monitored data so that faulty data is not included in the study results.

From January 2007 through May 2007, and from August 2007 through December 2007, prior to the institution of a five-minute idling policy, the

Idling Reduction Study Bus Units and Specs

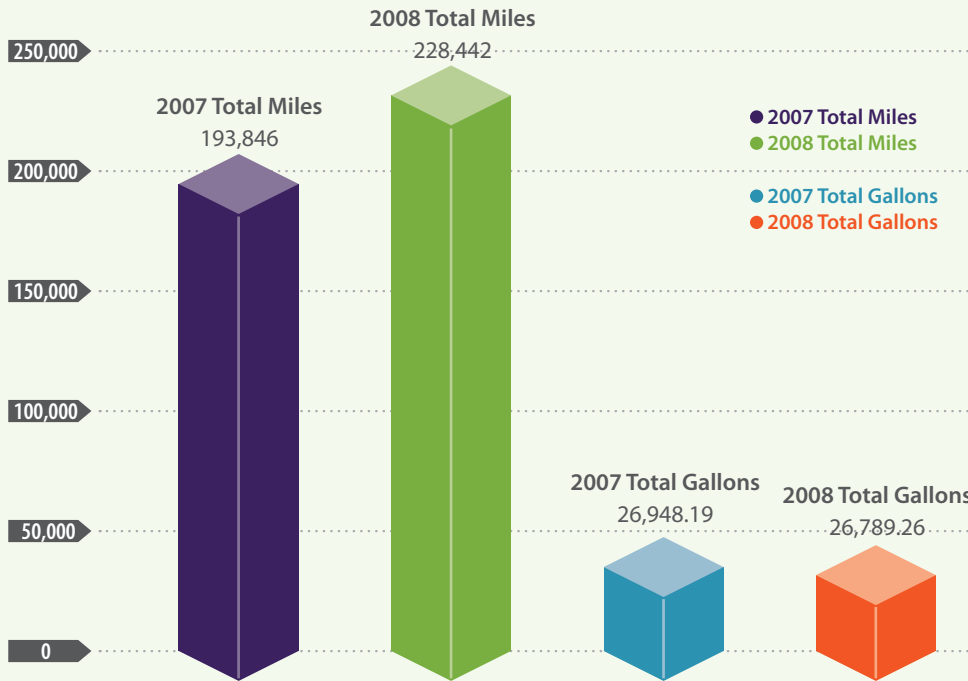
Bus Unit	Year	Manufacturer	Engine	Fuel	Passenger	Equipped
0601L	2006	International	VT365	Diesel	47	Wheelchair lift & A/C
0609L	2006	International	VT365	Diesel	47	Wheelchair lift & A/C
0750L	2007	International	VT365	Diesel	47	Wheelchair lift & A/C
0617	2006	International	VT356	Diesel	71	No Special Equipment
0732	2007	International	VT356	Diesel	71	No Special Equipment
0713	2007	International	VT356	Diesel	71	No Special Equipment
0626	2006	International	VT356	Diesel	71	No Special Equipment
0538	2005	International	VT356	Diesel	71	No Special Equipment
0516	2005	International	VT356	Diesel	71	No Special Equipment
0103	2001	International	T-44E	Diesel	71	No Special Equipment
0215	2002	International	T-44E	Diesel	71	No Special Equipment
0105	2001	International	T-44E	Diesel	71	No Special Equipment
0521	2005	International	VT356	Diesel	71	No Special Equipment
0749	2007	International	VT356	Diesel	71	No Special Equipment
9911	1999	International	T-44E	Diesel	71	No Special Equipment

14 transmitting buses traveled 193,846 miles and used 26,948.19 gallons of diesel fuel. June and July were not included in the study because only four buses operated during those months on limited days and routes.

Throughout 2006 and 2007, bus drivers and school Transportation Operations staff reported that each bus idled at least one hour per day, five days per week. Bus route descriptions including the number of stops and time between stops support these reported average idling

times. Choctaw-Nicoma Park Public Schools fleet management records show that for each regular route stop buses make, it takes two to four minutes to pick up and drop off students. Buses serving handicapped or special needs students take five to eight minutes per pick up and drop off at each route stop. Site loading and unloading takes five to 10 minutes for each regular route bus, depending on the number of passengers, and can take 15 to 20 minutes for buses on routes serving students with physical disabilities and other special needs. Buses

MILES TRAVELED VS. TOTAL FUEL CONSUMED



2007 - 2008 ANNUAL TOTALS

CHART 1

and mobile GPS transmitting units installed on the buses. Each driver was given information about the data that would be collected during the study period. Drivers were directed not to idle buses for more than five minutes in the bus yard, while queued at schools for loading and unloading, or while transitioning between routes. The three air conditioned, handicapped-equipped buses were also directed to turn off engines at five minutes of idling or less, unless weather and temperatures were such that student health and safety could be compromised.

Daily data reports including bus locations and amount of time spent idling were collected and analyzed by the Choctaw-Nicoma Park Public Schools Operations Director and staff.

Methodology

Annual Time Frame: Data collected from January 1 through December 31, excluding the summer break months of June and July, was compared for 2007 and 2008.

Data collected included miles traveled during both the 2007 and 2008 time frames, gallons of fuel consumed during both time frames, and minutes idled during the 2008 time frame.

Data collected during the same time frame in 2006, is included in the Appendix (see Table A) for informational comparison.

involved in the study were also used for activities throughout the school year, increasing the amount of idling time as buses waited in parking lots and/or ran auxiliary equipment.

Bus Driver Training

Upon instituting a monitored five-minute idling policy at Choctaw-Nicoma Park Public Schools, a one-hour training program was put in place to inform drivers about the purpose of the study and to explain the fleet management system

Averages were utilized to compare and/or contrast fuel usage before and after implementing the five-minute idling policy in order to compensate for the variability of miles traveled per bus over the two 10-month time frames included in the project, and to

compensate for the unequal number of school days in each time frame.

Fuel usage: Gallons of fuel consumed per bus were tracked by month, and by bus unit. Daily averages for 2007 were determined by dividing annual totals by 178, the number of days each bus was on route and activity transport during the 2007 time frame.

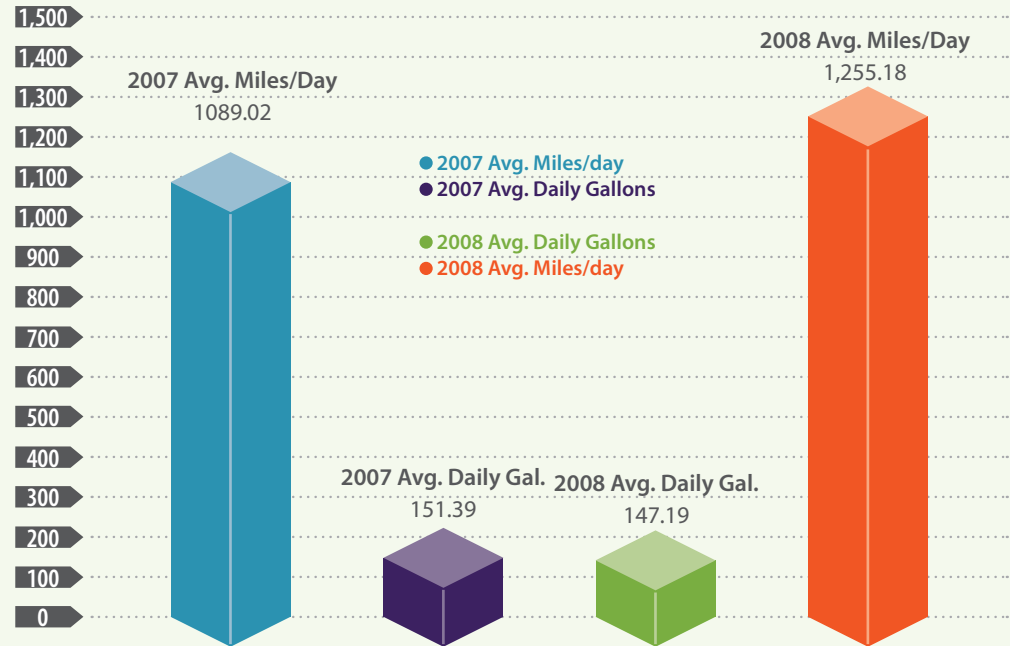
Daily averages for 2008 were determined by dividing annual totals by 182, the number of route/activity days during the 2008 time frame (see Tables B and C).

Mileage: Monthly mileage was tracked by bus unit. Annual totals were computed and daily averages determined by dividing annual totals by 178 for the 2007 time frame and 182 for the 2008 time frame. Mileage included regular routes, as well as activity transport (see Tables D and E).

MPG: Miles per gallon were calculated for each bus unit per time frame and for the units as a whole per time frame. Miles per gallon were computed by totaling gallons consumed and dividing by miles traveled (see Tables D and E).

Idling Minutes: Data collected included the number of minutes each bus unit idled per school day from January 1, 2008 through December 31, 2008, excluding the summer break months of June and July. Daily idling minutes were totaled by bus unit per month and totaled for the 10-month time frame. An average daily idling time per bus was determined by dividing each unit's 10-month idling minutes by 182 (see Table G).

ANNUAL AVERAGE DAILY COMPARISONS



2007 - 2008 ANNUAL TOTALS

CHART 2

Calculations and Projections

During the 2008 time frame, project bus units traveled a total of 228,442 miles compared to 193,846 miles traveled during 2007. Diesel fuel consumed during 2008 totaled 26,789.26 gallons versus 26,948.19 gallons of diesel fuel consumed

during 2007. A cursory comparison of these totals reveals more miles were traveled in 2008 than in 2007, yet less fuel was used in 2008 than in 2007 (see Charts 1 and 2).

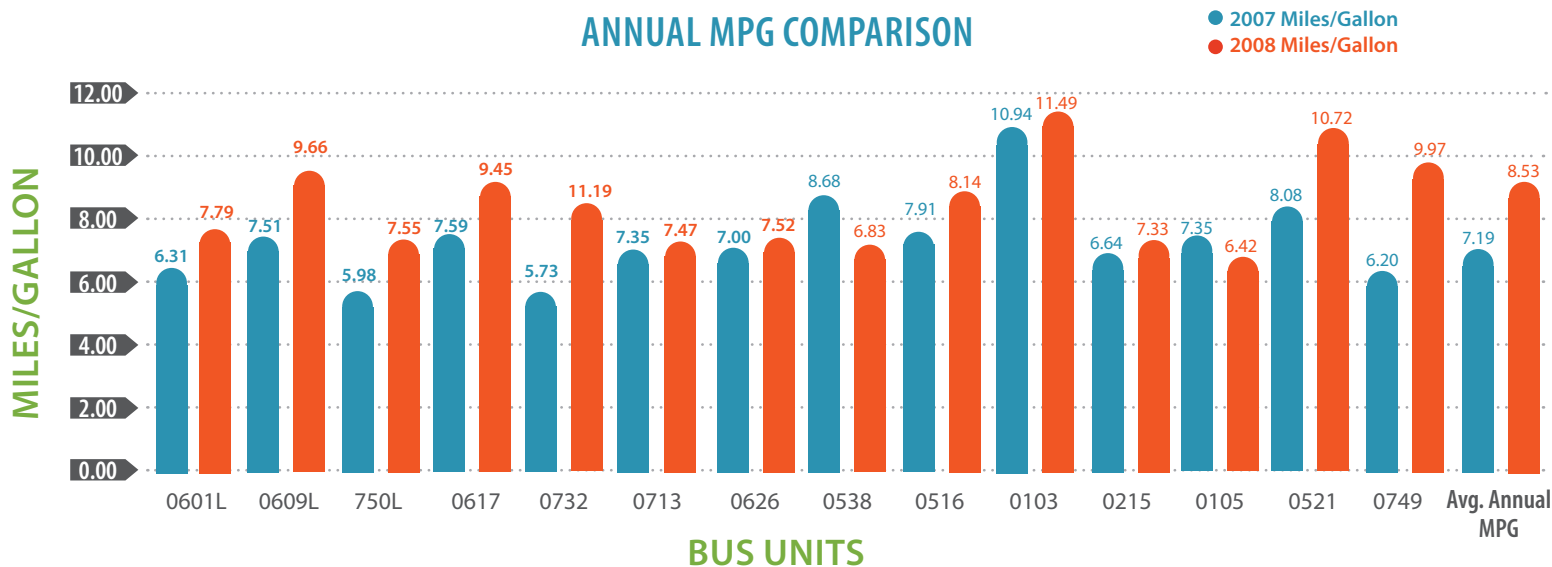


CHART 3

Chart 3 illustrates the individual unit increase or decrease in fuel economy (miles per gallon) from 2007 to 2008. It also illustrates the overall increase in fuel economy across the 14-bus test fleet for 2008. In 2007 overall fuel economy was 7.19 mpg while overall fuel economy was 8.53 mpg in 2008, a gain of 1.34 miles per gallon in 2008.

In Charts 3 and 4, a comparison of the annual fuel economy in MPG/bus for the 2007 and 2008 time frames takes into account the miles traveled, number of route/activity days and the fuel consumed in each time frame. With few exceptions, fuel economy increased in each

project bus, with a total average gain in the 2008 time frame of 1.34 MPG across the 14-bus fleet.

The buses chosen for the study ran a variety of representative routes ranging from assigned route mileage of 24 miles per day to 106 miles

per day (see Table F). All buses were used for transporting students to and from school activities, increasing actual miles traveled to more than that of the assigned route alone, and increasing opportunities for buses to idle outside the range of radio transmission monitoring.

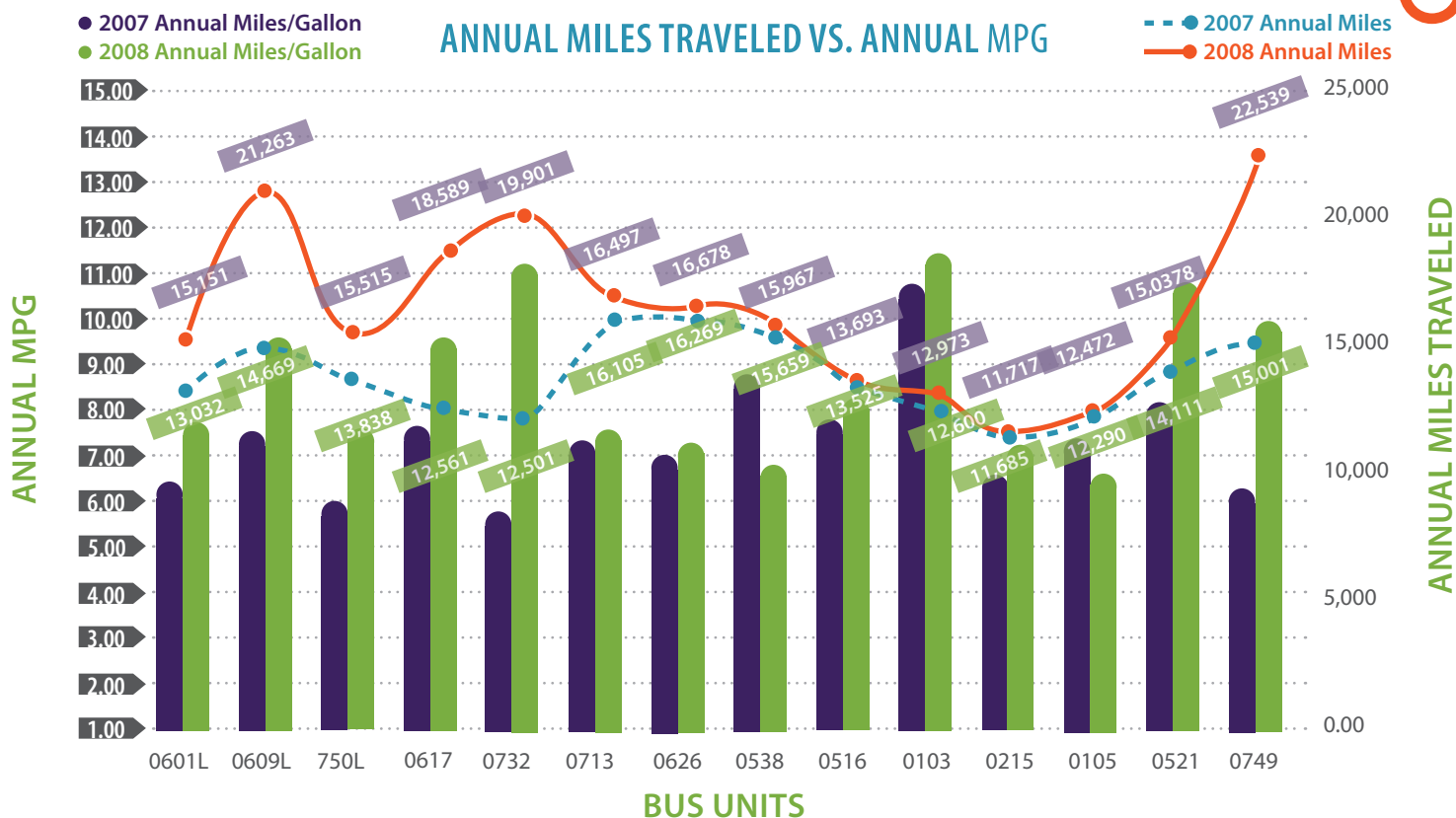


CHART 4

Chart 4 compares miles traveled per unit each year to the MPG achieved. Note that in 2008, the number of miles traveled per unit increased over the previous year. However, the miles traveled per gallon of fuel consumed in 2008 also increased compared to the miles traveled per gallon of fuel consumed in 2007 in all but two units.

Actual minutes spent idling in 2008 (see Table G) averaged 23.745 minutes per bus per day. Compared to the one hour/bus/day (five hours per week/bus) average idling time reported by bus drivers and school transportation operations staff prior to the institution of the five-minute

idling reduction policy, it is evident that bus drivers involved in the study were very mindful in adhering to the policy, even allowing for idling time that might have occurred in out-of-range locales.

Comparing the average minutes each bus idled during the 2008 monitored period to the fuel economy in average MPG achieved (Chart 5), it can be seen that as idling minutes per bus decrease, fuel economy increases. Conversely, as idling minutes increase, fuel economy decreases.

2008 IDLING MINUTES VS. MPG COMPARISON

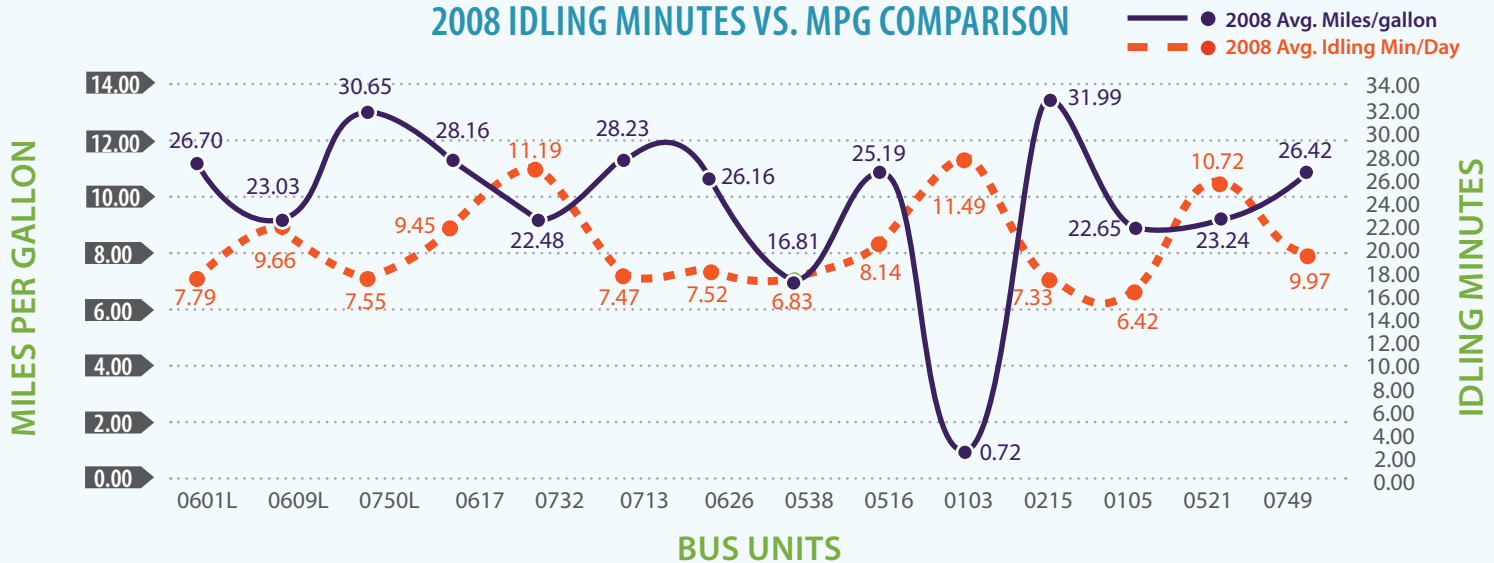


CHART 5

The lowest average idling time (0.72 min.) and associated highest average fuel economy (11.49 MPG) observed in Bus Unit 0103 (see Table G) are credited to the conscientious driving and engine idling habits of the bus unit driver. Monitoring equipment was checked and found to be operating correctly and idling data transmissions were verified. The regular assigned route for Bus Unit 0103 is an elementary school route. The bus is also used for activities and as an auxiliary high school ROTC shuttle in the Choctaw-Nicoma Park School District.

Looking at the 2007 and 2008 data to determine fuel savings attributable to the five-minute idling policy, Tables D and E show that the fleet's fuel economy jumped from 7.19 MPG in 2007 to 8.53 MPG in 2008. From these fuel economy averages, a 2008 calculated fuel savings of nearly 5,000 gallons can be ascribed to the five-minute idling policy within the 14-bus test group.

Dividing the number of miles the test group traveled in 2008 by the lower fuel economy the same group achieved prior to the institution

of the five-minute idling policy produces a projected fuel use of nearly 32,000 gallons absent the idling policy.

$$228,442 \text{ MILES IN 2008} \div 7.19 \text{ MPG} = 31,772.18 \text{ GALLONS}$$

Subtracting the actual 2008 test group fuel use from the projected fuel use yields fuel savings that can be reasonably attributed to the institution of the five minute restriction on idling.

2008 PROJECTED GALLONS @ 7.19 MPG	31,772.18
2008 ACTUAL GALLONS @ 8.53 MPG	- 26,789.26
2008 CALCULATED FUEL SAVINGS W/POLICY	4,982.92 GALLONS (SAVED)

Dividing the gallons saved in the test fleet by 14, an average savings per bus can be calculated.

$$4,982.92 \text{ GALLONS} \div 14 \text{ (BUSES)} = 355.92 \text{ GALLONS/BUS}$$

Using the test group fuel savings calculations and assuming variable constants from 2007 to 2008, including route miles and number of stops across the entire 53-bus fleet, it can be inferred, all things being equal, the adoption of a fleet-wide five-minute idling policy could produce fuel savings of nearly 19,000 gallons.

$$355.92 \text{ GAL./BUS} \times 53 = 18,863.92 \text{ GALLONS}$$

PROJECTED 2008 SAVINGS ACROSS ENTIRE DISTRICT FLEET

Calculations Summary: The 14-bus test fleet achieved a near-5,000 gallon fuel savings by adhering to the five-minute restricted idling policy. Projecting that savings across the district's entire fleet produced a substantial possible fuel savings with fleet-wide adoption of such a policy.

Emissions Benefits

School buses emit pollutants such as oxides of nitrogen (NO_x), particulate matter (PM), and volatile organic compounds that affect air quality and human health. The U.S. Environmental Protection Agency states both nitrogen oxides and particulate matter, as air pollutants, contribute to premature mortality, aggravation of respiratory and cardiovascular disease, aggravation of existing asthma, acute respiratory

symptoms, chronic bronchitis, and decreased lung function. Numerous studies also link diesel exhaust to increased incidence of lung cancer.⁷ School buses also emit a variety of greenhouse gases (GHG) such as carbon dioxide (CO₂) that affect global climate change.

School transportation personnel including bus drivers, mechanics, office staff and transportation department administrators are concerned about exposure to diesel exhaust and its effects on student passengers, themselves, and others.

Establishing a restricted idling policy reduces that exposure and engages bus drivers in a process in which they are key to ensuring a healthier work environment for themselves, a healthier transportation environment for their passengers, and cleaner air for others in proximity to school buses. Limiting engine idling also reduces GHG emissions and contributes to a healthier planet.

To determine the amount of NO_x, PM, and CO₂ emissions saved by the idling-restricted 14-bus test fleet, fuel usage, miles traveled, and annual pre-and post-study idling hours were entered into the U.S. Environmental Protection Agency's Diesel Emissions Quantifier.⁸

EPA DIESEL EMISSIONS QUANTIFIER RESULTS

	Nitrogen Oxides	Particulate Matter	Carbon Dioxide	
Annual	NO _x (tons/year)	PM (tons/year)	CO ₂ (tons/year)	Diesel-Equivalent (gallons/year)
Baseline of Entire Fleet	1.8084	0.0376	297.3579	26,789.00
Baseline of Vehicles Retrofitted	1.8084	0.0376	297.3579	26,789.00
Percent Reduced (%)	13.5%	17.6%	2.9%	
Amount Reduced Per Year	0.2248	0.0066	8.5602	

⁷ *Federal Register Environmental Documents*. United States Environmental Protection Agency. www.epa.gov/EPA-AIR/2001/January/Day-18/a01a.htm (Federal Register: January 18, 2001; Volume 66, Number 12; Rules and Regulations; page 5001-5050; Federal Register Online via GPO Access at wais.access.gpo.gov).

⁸ *Diesel Emissions Quantifier*. U.S. Environmental Protection Agency. <http://cfpub.epa.gov/quantifier/view/welcome.cfm>

The quantifier calculated a combined annual savings of 0.2514 tons NO_x and PM, and 8.5602 tons CO₂. Other emissions savings calculators include the Environmental Defense Fund's and NAFA Fleet Management Association's Fleet Greenhouse Gas Emissions Calculator.⁹ The EDF-NAFA calculator assesses GHG emissions only; it does not calculate NO_x and PM emissions savings. However, it does provide a reasonable degree of accuracy for the emissions it does assess, tying calculations directly to fuel consumption. In addition to CO₂, the calculator provides emissions assessments for other greenhouse gases including methane (CH₄), nitrous oxide (N₂O), and hydrofluorocarbons. Calculations are based on U.S. Environmental Protection Agency data, and the U.S. Department of Energy's Argonne National Laboratory GREET (Greenhouse Gases, Regulated Emissions, and Energy use in Transportation) modeling.

Conclusions

The Choctaw-Nicoma Park Public Schools fleet study and idling reduction project clearly demonstrates that fuel savings benefits and emissions benefits can be gained by Oklahoma school districts instituting idling reduction policies. The magnitude of benefits will increase or decrease according to fuel use, miles traveled, number of buses in a district's fleet, and the amount of time drivers idle their buses. However, one maxim holds true regardless of a district's

size or the number of buses it runs, "An idling bus is getting zero miles per gallon."



Implementation

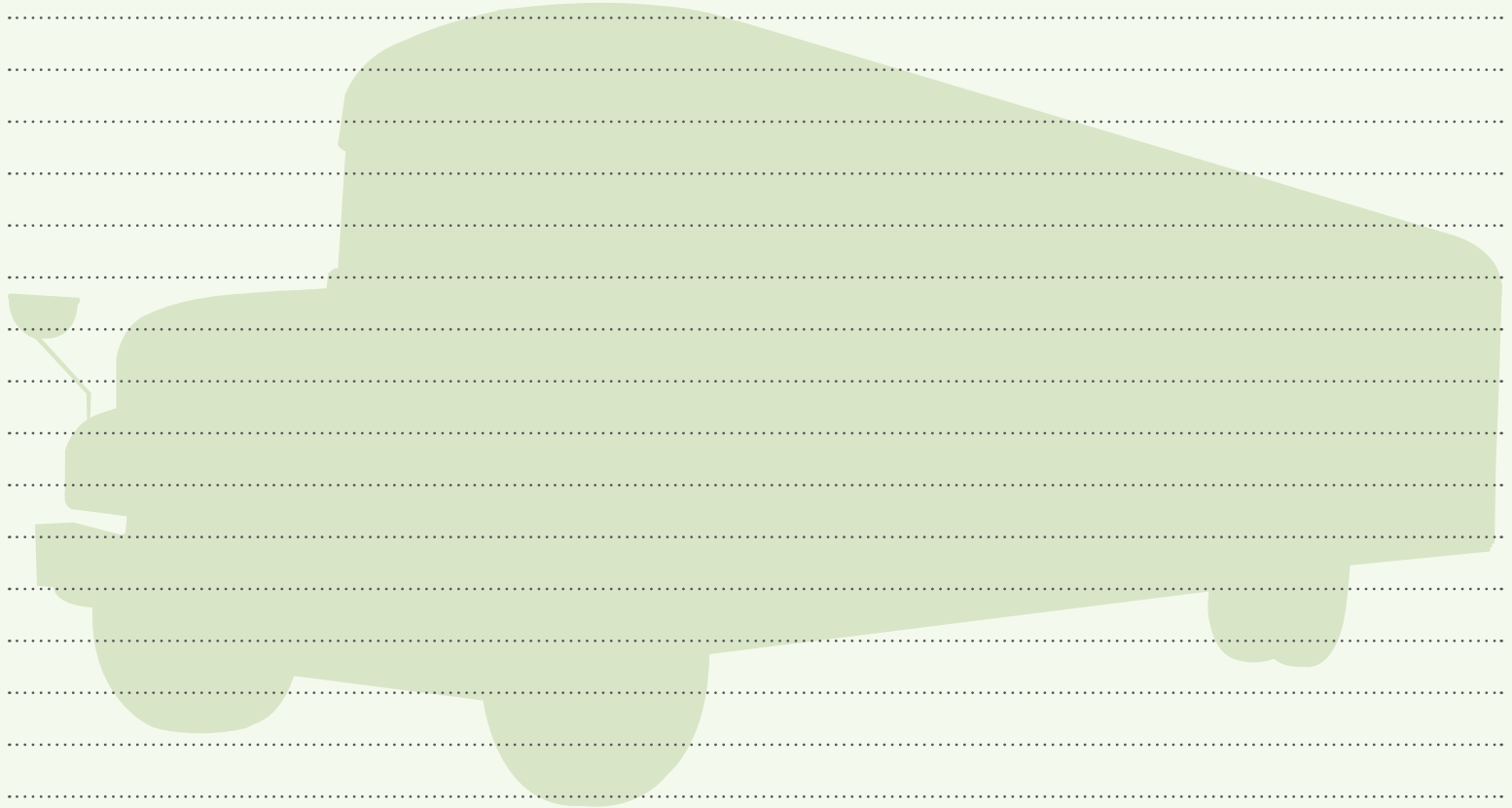
Implementing an idling reduction policy is a low-cost, low-tech solution to saving fuel and reducing vehicular emissions. A few simple guidelines can yield demonstrable results:

- 1. Educate bus drivers** – Bus drivers are concerned about their work environment and the environment in which they are transporting students. Many bus drivers have children and/or grandchildren of their own and are concerned as parents about the health effects of exposure to vehicle exhaust, as well as the effects of climate change on the environment. Driver buy-in is a key element to implementing a successful idling reduction policy.
- 2. Establish a baseline** – Collect and review fuel consumption data and miles traveled/year prior to implementing an idling reduction policy.
- 3. Analyze data** – Compare route lengths, number of stops, and fuel use on each route. Determine when and where unnecessary idling may be most likely to occur.
- 4. Use the free stuff** – Use free online calculators to determine the amount of vehicular emissions your fleet has produced and is producing.¹⁰
- 5. Make a plan** – Set realistic goals to achieve for the fleet as a whole, and for individual contributors to those goals.
- 6. Establish a written policy** – Include a specific limit on idling time, such as a maximum of five minutes in the summer and 10 minutes in temperatures of 32°F or below.
- 7. Measure and report success** – Meticulously track annual fuel consumption and determine the resulting fuel savings, cost savings and emissions savings. Report successes to school boards, PTAs, school newsletter editors, and others.

⁹ *Environmental Defense Fund Innovation Exchange*. Fleet Greenhouse Gas Emissions Calculator. Environmental Defense Fund. <http://innovation.edf.org/page.cfm?tagID=37020>.

¹⁰ Numerous emissions calculators are available online and include the EPA's Diesel Emissions Quantifier at <http://cfpub.epa.gov/quantifier/view/welcome.cfm>, the previously referenced EDF-NAFA calculator, and the GREET Fleet Footprint Calculator developed by Argonne National Laboratory for the U.S. Department of Energy's Clean Cities Program at www.transportation.anl.gov/modeling_simulation/GREET/footprint_calculator.html

NOTES



APPENDIX

TABLE A: 2006 FUEL USAGE

YEAR 2006 FUEL													
Route & Activity Day/Mo.		17	20	18	20	20	23	20	19	20	13	Total: 190	
Bus Unit #	Route #	Jan. 06	Feb. 06	Mar. 06	Apr. 06	May 06	Aug. 06	Sept. 06	Oct. 06	Nov. 06	Dec. 06	2006 Total Gallons	Avg. gal./day
0601L	MB3	268.29	199.55	205.98	265.98	200.54	198.36	290.85	230.14	185.99	180.37	2,226.05	11.72
0609L	MB4	180.05	200.41	187.66	245.90	260.05	145.93	159.07	257.82	135.96	213.57	1,986.42	10.45
0750L*	MB1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0617	1	162.15	175.89	158.69	185.32	180.65	163.15	205.00	275.08	169.91	69.36	1,745.20	9.19
0732*	5	0.00	0.00	0.00	0.00	0.00	0.00	390.21	195.99	135.85	95.26	817.31	4.30
0713*	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0626	9	227.83	280.24	225.65	300.01	261.25	174.42	316.20	286.25	324.16	182.01	2,578.02	13.57
0538	13	150.20	169.72	151.69	171.08	170.65	160.85	158.32	131.89	108.98	137.97	1,511.35	7.95
0516	16	169.25	201.15	180.89	210.69	187.64	114.20	194.90	206.04	250.16	119.10	1,834.02	9.65
0103	18	110.99	121.45	101.55	127.96	123.72	66.43	126.08	156.72	140.69	132.12	1,207.71	6.36
0215	19	193.34	235.60	205.41	200.55	200.29	201.23	286.58	221.27	203.33	165.99	2,113.59	11.12
0105	23	179.65	225.36	191.25	202.89	223.30	187.34	224.16	203.28	211.45	178.64	2,027.32	10.67
0521	30	151.45	184.07	168.15	190.34	185.69	141.12	154.91	264.08	67.03	80.43	1,587.27	8.35
0749*	33	0.00	0.00	0.00	0.00	0.00	0.00	292.52	228.17	311.29	143.26	975.24	5.13
Total Gallons		1,793.20	1,993.44	1,776.92	2,100.72	1,993.78	1,553.03	2,798.80	2,656.73	2,244.80	1,698.08	20,609.50	108.47
0713*	Put in Service	01/02/2007											
0732*	Put in Service	09/19/2006											
0749*	Put in Service	09/17/2006											
0750L*	Put in Service	12/20/2006											

TABLE C: 2008 FUEL USAGE

YEAR 2008 FUEL

Route & Activity Days/Mo.		18	21	16	22	17	15	21	19	20	13	Total: 182	
Bus Unit #	Route #	Jan. 08	Feb. 08	Mar. 08	Apr. 08	May 08	Aug. 08	Sept. 08	Oct. 08	Nov. 08	Dec. 08	2008 Total Gallons	Avg. gal./day
0601L	MB3	209.50	217.43	161.41	234.65	148.22	158.50	208.00	277.34	177.63	153.27	1,945.95	10.69
0609L	MB4	228.70	342.00	245.61	117.88	247.32	148.10	278.30	261.42	148.29	184.25	2,201.87	12.10
0750L*	MB1	159.82	280.26	166.53	235.43	158.48	167.80	264.80	239.71	184.61	198.33	2,055.77	11.30
0617	1	133.60	206.24	171.84	134.16	118.56	201.50	329.50	386.61	158.40	125.90	1,966.31	10.80
0732*	5	70.45	187.63	224.03	188.19	138.11	232.30	211.97	289.64	69.41	167.33	1,779.06	9.78
0713*	7	225.14	270.13	224.21	311.76	231.05	171.10	319.40	205.39	120.05	189.14	2,267.37	12.46
0626	9	187.70	237.64	169.60	168.25	137.23	176.50	242.00	358.70	311.91	229.68	2,219.21	12.19
0538	13	237.63	297.24	219.12	193.42	229.44	172.80	303.90	270.34	215.13	199.10	2,338.12	12.85
0516	16	238.71	151.64	195.10	172.10	178.29	60.10	167.60	247.44	102.04	169.08	1,682.10	9.24
0103	18	163.27	106.19	129.99	148.97	74.41	125.00	100.30	135.12	119.12	27.01	1,129.38	6.21
0215	19	163.51	134.35	159.89	196.30	105.13	86.70	213.00	234.22	165.51	139.05	1,597.66	8.78
0105	23	179.16	394.79	274.27	268.91	202.79	136.00	96.60	138.16	143.20	109.89	1,943.77	10.68
0521	30	174.88	252.58	155.27	112.92	125.64	53.80	105.90	202.46	22.34	196.77	1,402.56	7.71
0749*	33	155.57	311.40	246.55	318.19	279.25	243.20	324.60	244.50	84.79	52.08	2,260.13	12.42
Total Gallons		2,527.64	3,389.52	2,743.42	2,801.13	2,373.92	2,133.40	3,165.87	3,491.05	2,022.43	2,140.88	26,789.26	147.19
0713*	Put in Service	01/02/2007											
0732*	Put in Service	09/19/2006											
0749*	Put in Service	09/17/2006											
0750L*	Put in Service	12/20/2006											

TABLE E: 2008 MILES TRAVELED

YEAR 2008 MILES

Route & Activity Days/Mo.		18	21	16	22	17	15	21	19	20	13	Total: 182		
Bus Unit #	Route #	Jan. 08	Feb. 08	Mar. 08	Apr. 08	May 08	Aug. 08	Sept. 08	Oct. 08	Nov. 08	Dec. 08	2008 Total Miles	Avg. mi./day	Mi./gal.
O601L	MB3	1,583	1,733	1,475	2,061	1,375	1,102	1,821	1,607	1,583	811	15,151	83.25	7.79
O609L	MB4	2,207	2,410	2,114	2,328	2,098	1,704	2,298	2,319	2,080	1,705	21,263	116.83	9.66
O750L*	MB1	1,628	1,817	1,520	1,820	1,562	1,074	1,767	1,718	1,551	1,058	15,515	85.25	7.55
O617	1	1,859	1,900	1,625	1,969	1,903	1,711	1,936	2,001	1,907	1,778	18,589	102.14	9.45
O732*	5	1,991	2,045	2,055	2,152	2,146	1,738	1,841	1,944	2,040	1,949	19,901	109.35	11.19
O713*	7	1,807	1,880	1,840	1,709	1,678	1,349	1,864	1,849	1,651	1,320	16,947	93.12	7.47
O626	9	1,679	1,737	1,660	1,687	1,605	1,527	1,716	1,806	1,678	1,583	16,678	91.64	7.52
O538	13	1,600	1,629	1,635	1,639	1,478	1,228	1,828	1,728	1,819	1,383	15,967	87.73	6.83
O516	16	1,422	1,317	1,441	1,321	1,371	1,223	1,361	1,442	1,475	1,320	13,693	75.24	8.14
O103	18	1,306	1,382	1,271	1,472	1,146	1,247	1,233	1,246	1,435	1,235	12,973	71.28	11.49
O215	19	1,190	1,309	1,149	1,201	1,150	1,090	1,187	1,100	1,200	1,141	11,717	64.38	7.33
O105	23	1,253	1,225	1,228	1,246	1,229	1,096	1,285	1,214	1,399	1,297	12,472	68.53	6.42
O521	30	1,493	1,590	1,491	1,491	1,459	1,379	1,548	1,493	1,549	1,544	15,037	82.62	10.72
O749*	33	2,209	2,520	2,458	2,151	1,962	2,209	2,451	2,340	2,140	2,099	22,539	123.84	9.97
Totals		23,227	24,494	22,962	24,247	22,162	19,677	24,136	23,807	23,507	20,223	228,442	1255.18	8.53
O713*	Put in Service	01/02/2007												
O732*	Put in Service	09/19/2006												
O749*	Put in Service	09/17/2006												
O750L*	Put in Service	12/20/2006												

TABLE G: 2008 IDLING MINUTES

YEAR 2008

Route & Activity Days/Mo.		18	21	16	22	17	15	21	19	20	13	Total: 182	
Bus Unit #	Route #	Jan. 08	Feb. 08	Mar. 08	Apr. 08	May. 08	Aug. 08	Sept. 08	Oct. 08	Nov. 08	Dec. 08	2008 Total Min.	Avg. min./day
0601L	MB3	703.00	596.00	555.00	499.00	234.00	400.00	539.00	487.00	514.00	333.00	4,860.00	26.70
0609L	MB4	620.00	470.00	648.00	579.00	162.00	292.00	409.00	370.00	389.00	253.00	4,192.00	23.03
0750L*	MB1	821.00	252.00	893.00	865.00	381.00	199.00	624.00	564.00	594.00	386.00	5,579.00	30.65
0617	1	724.00	408.00	606.00	669.00	261.00	376.00	599.00	542.00	570.00	370.00	5,125.00	28.16
0732*	5	151.00	422.00	877.00	585.00	332.00	294.00	412.00	372.00	392.00	255.00	4,092.00	22.48
0713*	7	945.00	746.00	506.00	424.00	300.00	144.00	596.00	539.00	568.00	369.00	5,137.00	28.23
0626	9	675.00	402.00	435.00	504.00	445.00	392.00	549.00	497.00	523.00	340.00	4,762.00	26.16
0538	13	405.00	166.00	318.00	269.00	399.00	259.00	363.00	328.00	294.00	259.00	3,060.00	16.81
0516	16	540.00	638.00	522.00	659.00	368.00	449.00	139.00	275.00	605.00	389.00	4,584.00	25.19
0103	18	8.00	4.00	0.00	5.00	5.00	30.00	46.00	8.00	10.00	15.00	131.00	0.72
0215	19	630.00	702.00	745.00	661.00	310.00	510.00	714.00	463.00	578.00	510.00	5,823.00	31.99
0105	23	150.00	598.00	698.00	465.00	198.00	347.00	486.00	440.00	394.00	347.00	4,123.00	22.65
0521	30	671.00	718.00	420.00	555.00	398.00	530.00	96.00	208.00	278.00	356.00	4,230.00	23.24
0749*	33	437.00	598.00	500.00	835.00	371.00	123.00	567.00	513.00	459.00	405.00	4,808.00	26.42
Total Minutes		7,480.00	6,720.00	7,723.00	7,574.00	4,164.00	4,345.00	6,139.00	5,606.00	6,168.00	4,587.00	60,506.00	332.43
Average Min./Bus													23.746

0713*	Put in Service	01/02/2007
0732*	Put in Service	09/19/2006
0749*	Put in Service	09/17/2006
0750L*	Put in Service	12/20/2006

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This report, printed in Central Oklahoma, is authorized by the Association of Central Oklahoma Governments Board of Directors and funded through U.S. Department of Energy National Energy Technology Laboratory Clean Cities Transportation Sector Petroleum Reduction Technologies Commercial Deployment cooperative agreement Award #DE-FG26-06NT43021. One thousand copies were printed. Copies have been deposited with the publications Clearinghouse of the Oklahoma Department of Libraries.