

Data Methodology for Breathe Better Outcomes

The following example illustrates the methodology used for the Breathe Better project outcomes, using data and results from the 48 participating schools in 2009-2010. Schools submitted data on the occurrence of idling on their campuses, as follows:

- Schools recorded the number of school buses serving their afternoon routes and ensured that all were participating. Among participating schools that provided usable data pertaining to buses, the total was 42 buses.
- For the 2009-2010 school year, 32 schools submitted usable data about cars but only 5 schools submitted usable data about buses. “Usable data” is defined as one baseline data set before starting Breathe Better and one final data set in spring 2010 (at minimum). Only schools that submit at least two data sets are included in calculations. The data is summarized here:

	Car Data - Baseline			Car Data – Final 2010		
	Total # cars	# Idling	% Idling	Total # cars	# Idling	% Idling
TOTAL (n=32)	3469	1097	31.6	3419	661	19.3

	Bus Data - Baseline			Bus Data – Final 2010		
	Total # buses	# Idling	% Idling	Total # buses	# Idling	% Idling
TOTAL (n=5)	42	29	69	49	12	24.5

Outcome #1: Audience Reached:

This outcome will tally the individuals (students, parents, and bus drivers) and entities (schools, school districts, and counties) involved in Breathe Better.

Outcome #2: Behavior Change Observed:

Most of the 48 participating schools reported (at least anecdotally) a decrease in idling over time. The average baseline for schools prior to Breathe Better was about 32% of all cars idling (range 3-81%). As of 2010, the 32 schools that reported car data were averaging about 19% of all cars idling (range 4-90%). Although this data is self-reported and contains some inconsistencies, some of which are related to the warm weather during the fall and spring data collections, the overall trend has been towards positive behavioral change.

Outcome #3: Emissions Reductions Estimated:

Emissions reductions are estimated for the following pollutants: carbon dioxide (CO₂), volatile organic compounds (VOCs), carbon monoxide (CO), oxides of nitrogen (NO_x) and particulate matter (PM). Proportionate quantities of priority and toxic chemicals are also reduced.

Due to the varying circumstances at these schools and several confounding factors (ex. effect of weather on drivers' behavior), the following assumptions are necessary to estimate quantitative emissions reductions:

- All participating drivers avoided idling on all 180 days of the 2009-10 school year (participation started at different times of the year and may have varied at times)
- Each driver reduced daily idling time by 15 minutes on average (based on anecdotal observations from participating schools)
- Both schools buses and personal vehicles consume fuel at 0.5 gallons/hour while idling, based on these sources:
 - EPA idling reduction calculator http://epa.gov/cleanschoolbus/idle_fuel_calc.htm
 - Natural Resources Canada, Office of Energy Efficiency <http://oee.nrcan.gc.ca/transportation/personal/idling.cfm?attr=8>, converted to English units is about 0.5 gallon/hour
 - Estimates on the fuel consumption of personal vehicles while idling are inconsistent, varying by vehicle size and from one source to another, ranging from 0.1 gallon/hour to 1.0 gallon/hour. No U.S. federal agency has an estimate online; estimates on state agency websites vary greatly and lack citations or calculation methods. The Natural Resources Canada, Office of Energy Efficiency cites how their figure was calculated and is therefore the best compromise.

Assuming that all 3,511 vehicles (personal vehicles and school buses) reduced their daily idling time by 15 minutes/day for all 180 days of the 2009-2010 school year, each vehicle:

- avoided 45 hours of idling; and therefore
- saved 22.5 gallons of fuel.

Therefore, the school buses collectively saved **383 gallons of diesel**, and the personal vehicles collectively saved **9810 gallons of gasoline**.

- **2,000 pounds = 1 ton**
- Diesel fuel emits **22.2 lbs CO₂/gallon** consumed, and gasoline emits **19.4 lbs CO₂/gallon** consumed (<http://www.epa.gov/OMS/climate/420f05001.htm>).
 - School buses: **4.25** tons CO₂ reduced
 - Personal vehicles: **95.2** tons CO₂ reduced

The school buses collectively reduced idling time by **765 hours**, and the personal vehicles collectively reduced idling time by **10,350 hours**.

- **453.6 grams = 1 pound**
- Under “summer conditions” (i.e. 75°F), idling school buses (heavy-duty diesel vehicles) emit: **12.5 g/hr VOCs, 55 g/hr NO_x, 94 g/hr CO, and 2.52 g/hr PM** (<http://www.epa.gov/OMS/consumer/f98014.pdf>)
 - **37** pounds VOCs reduced
 - **164** pounds NO_x reduced
 - **280** pounds CO reduced
 - **7.5** pounds PM reduced

- Under “summer conditions” (i.e. 75°F), idling personal vehicles* (cars and light trucks) emit: **20.1 g/hr VOCs**, **5.2 g/hr NO_x**, and **284 g/hr CO**
(<http://www.epa.gov/OMS/consumer/f98014.pdf>)

*NOTE: since most schools did not count cars and light trucks separately, these values are the AVERAGE emissions of the two vehicle classes.

- **869** pounds VOCs reduced
- **225** pounds NO_x reduced
- **12,284** pounds CO reduced

Collectively, all vehicles that participated in Breathe Better by reducing idling time during the 2009-10 school year achieved the following estimated emissions reductions:

- **99** tons CO₂
- **868** pounds VOCs*
- **389** pounds NO_x*
- **12,564** pounds CO
- **7.5** pounds PM**
- proportionate quantities of priority and toxic chemicals (not calculated to date)

*Ground-level ozone precursors **Bus emissions only