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Estimation of Fuel Use by Idling Commercial Trucks

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ABSTRACT

This paper uses the recently published 2002 Vehicle Inventory and Use Survey (VIUS) to determine the number of commercial trucks in the categories that are most likely to idle for periods of over 0.5 h at a time. On the basis of estimated numbers of hours for both overnight idling by sleepers and long-duration idling by all size classes during their workdays, the total fuel use by idling trucks is estimated to be over 2 billion gallons per year. Workday idling is determined to be a potentially much larger energy user than overnight idling, but data are required before any definitive conclusions can be reached. Existing technologies can reduce overnight idling, but development may be needed to reduce workday idling.

INTRODUCTION

Idling of heavy vehicles, in particular trucks, has become a subject of great interest in the past few years because of the large quantity of petroleum used and emissions created without any productive movement of goods accomplished. (In 2000, for example, Argonne National Laboratory [Argonne] estimated that over 800 million gallons of diesel are used annually just for overnight idling of sleeper cabs *[1]*.) Recent milestones include a U.S. Department of Energy (DOE) report published in 2000 *(1)*, the inclusion of idling reduction in the 2001 National Energy Policy *(2)*, and the 2004 National Idling Reduction Planning Conference. Of special interest recently was a series of regional workshops held by the U.S. Environmental Protection Agency (USEPA) in an attempt to help states harmonize their inconsistent idling regulations.

Because this topic has aroused such broad interest, published information spreads rapidly and is often quoted (and misquoted) widely. Our previous estimate of the number of trucks that might idle overnight *(1)*, which was based on the 1997 Vehicle Inventory and Use Survey (VIUS) *(3)*, found its way into numerous documents. However, in 2004, long after that work was completed, the 2002 VIUS *(4)* became available, and we use this paper to provide an updated and carefully documented estimate based on the 2002 VIUS. In addition, since many trucks idle for long periods during working hours, we will also estimate the contribution of non-overnight idling to total idling fuel use.

TRUCK CATEGORIES

Trucks are classified in eight gross-vehicle-weight (GVW) classes. Gross vehicle weight means empty vehicle weight plus cargo weight. The classes were formulated over 50 years ago when truck transport was not very prevalent. The eight classes are shown in Figure 1. Note that the USEPA and National Highway Traffic Safety Administration (NHTSA) subdivide class 2 into

2A (6,001–8,500 lb) and 2B (8,501–10,000 lb) for regulatory purposes (emissions and fuel economy).

Data Sources

Two public data sources are often used for trucks:

i. The Federal Highway Administration's (FHWA's) Highway Statistics and
ii. The Bureau of the Census' VIUS.

The FHWA publishes Highway Statistics annually, while the VIUS is conducted every five years in the calendar years ending in 2 and 7. The last VIUS was conducted in 2002. The Highway Statistics provides truck population, vehicle miles, and fuel use data for three types of trucks:

i. Trucks with two axles and four tires,
ii. Single-unit trucks with six tires or more, and
iii. Combination trucks.

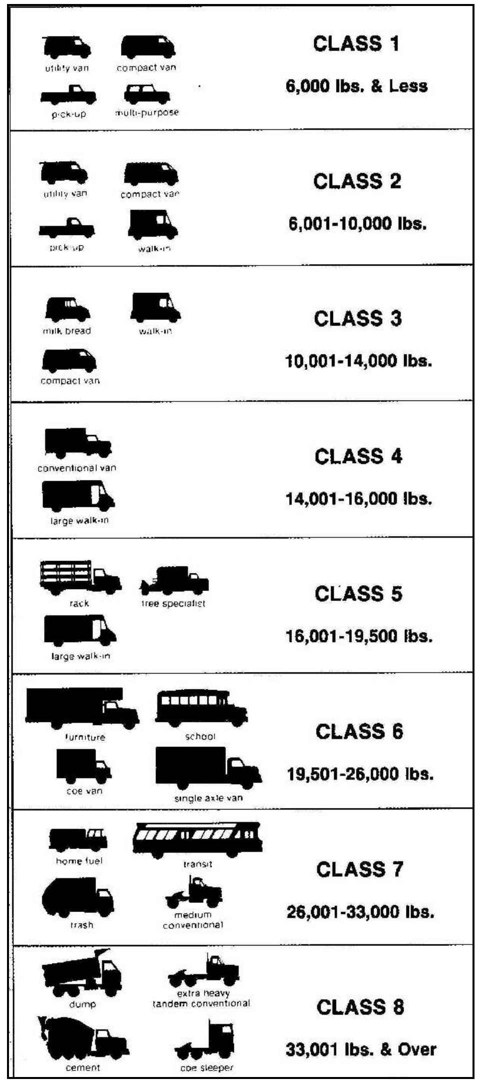

FIGURE 1 Truck Classes *(5).*

The VIUS data provide detailed information related to over 200 attributes of each sampled truck. The 2002 VIUS provides data on 80 million class 1 and 2 trucks and 4 million single-unit trucks, including personal-use vehicles, plus data on 1.4 million combination trucks in GVW class 3–8 *(4)*. The Highway Statistics give data on 85 million two-axle, four-tire trucks; 5.7 million other single-unit trucks; and 2.3 million combination trucks *(6)*. Because the VIUS data give more information than is necessary for our analysis, we will use it VIUS data in this paper. Our analysis also excludes trucks that were not in use while the survey was conducted. Figure 2a shows commercial truck populations, and Figure 2b shows commercial truck fuel use by class. Note that the large numbers of trucks that are personal-use vehicles have now been excluded. Even with those vehicles removed, the smallest and largest classes dominate both fuel use and numbers of vehicles and therefore should be the focus. Classes 1–3 use both gasoline and diesel fuel; higher classes use almost exclusively diesel. The abbreviations SU and C refer to single-unit trucks and combinations (tractor-trailers), respectively.

The 2002 VIUS provides information related to truck type, truck body type, trailer type, and trailer configuration for combination trucks; model year; annual miles; fuel economy in miles per gallon (MPG); average weight; empty weight; percentages of annual miles in trips of different length; and many other attributes. Each sampled truck is assigned to a GVW class on the basis of two different ways: (i) average weight and (ii) the truck's vehicle identification number (VIN). The Census Bureau summaries are by average weight-based GVW class. We

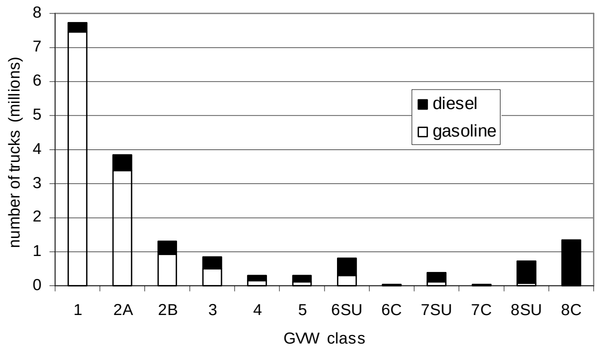

FIGURE 2a Number of commercial trucks (class 1-8).

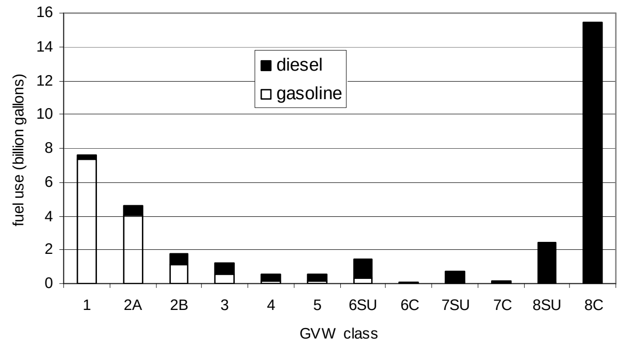

FIGURE 2b Fuel use by commercial trucks (class 1-8).

also use the average weight-based GVW classes in our analysis to be consistent. The sampling frame design measures of sampling variability and coefficients of variation in the 2002 VIUS are described in reference 7. The mircrodata compact disc of the 2002 VIUS was released in early 2005, and so the survey represents the latest data related to the nation's trucks.

A sampled truck's annual miles are assigned to trips of different length, grouped by five distance ranges:

- 50 miles or less,
- 51–100 miles,
- 101–200 miles,
- 201–500 miles, and
- More than 500 miles.

The Census Bureau created a primary trip range field for each sampled truck by selecting the group with the highest percentage. If the highest value occurred in more than one group, the primary trip range was selected randomly. For example, if a truck tractor with sleeper cab has its annual miles distributed as 10% in 101–200-miles group, 45% in the 201–500-miles group, and 45% in the more-than-500-miles group, it could be assigned either to the 201–500-mile group or the more-than-500-mile group. Also, a truck assigned to a group in the less-than-500-miles range could also have some (or substantial) miles in trips of over 500 miles. Aside from analysis by percentage annual miles in various distance groups, we also analyze annual miles to identify trucks that travel long distances.

The 2002 VIUS data file contains 98,682 records, of which 3,250 records are for "Not in Use: trucks that have zero VMT. The number of useful records is therefore 95,432. Out of these useful records, 18,053 records do not have any MPG information. We first summarized the 77,379 records that have MPG information and created a lookup table by two variables: (i) average weight-based GVW and (ii) body type. The average known MPGs from this lookup table were assigned to the 18,053 records that did not have any MPG information. This MPG information is used for computing fuel consumption by various categories of trucks.

Light Trucks

Almost all trucks with GVW less than 10,000 lb have two axles and four tires *(8)* and are classified as light trucks. A majority of these light trucks (83%) are used for personal transportation *(4)*. Excluding trucks that are not in use, 13.3 million light trucks are used for commercial purposes. These trucks fall in four categories: (i) pickup, (ii) minivan, (iii) sport utility vehicle, and (iv) full-size van. Nearly 97.5% of personal-use light trucks are gasoline-powered, while 89.3% of commercial light trucks are gasoline-powered. The top five types of businesses using these trucks are (i) construction; (ii) services; (iii) agriculture, forestry, fishing, hunting; (iv) retail trade; and (v) manufacturing. The services category includes information services; waste management, landscaping, or administrative/support services; arts, entertainment, or recreational services; accommodation or food services; and other services. Together, these five business types use 76% of all commercial light trucks.

Single Unit Heavy Trucks

The single unit trucks in GVW class 3–8 have several body types. The top five body types ranked by truck population are (i) flatbed/ platform, (ii) pickup, (iii) dump, (iv) basic enclosed van, and (v) step or multi-stop van. These five body types account for 68% of the single unit trucks in GVW class 3–8. The same five body types rank among the top five by fuel use, but not in the same sequence. The rankings by fuel use are (i) dump, (ii) basic enclosed van, (iii) flatbed/ platform, (iv) pickup, and (v) step or multi-stop van. Together, these five body types account for 62% of the fuel use by single unit trucks in GVW class 3–8. In terms of fuel economy, the five least-fuel-efficient single-unit body types are (i) concrete mixer, (ii) low boy, (iii) trash/ garbage, (iv) open-top van, and (v) pole/logs/pipe. Together, these five least-fuel-efficient trucks account for 23% of the fuel consumption by Class 3–8 single unit trucks with only concrete mixer (no. 9) and garbage trucks (no. 6) ranked among the top 10 fuel consumers.

Combination Trucks

Among truck tractors, 666,300 have cab sleepers and 721,900 do not. Nearly 500,000 of the sleepers have some part of their annual VMT in trips of longer than 200 miles, while nearly 210,000 non-sleepers have some part of their VMT in trips of over 200 miles.

Newer (model year 1997 and later) truck tractors with sleepers total 407,000, average 107,000 miles/year, and have 63% of annual miles in trips over 200 miles. Common carriers and owner operators use their sleepers more intensively, with truck tractors of model year 1995 and newer for common carriers and model year 1991 and newer for owner operators averaging more than 60,000 annual miles per vintage. Such sleepers total 296,300 for common carriers and 128,600 for owner operators. The intensively used older sleepers, not included in the 407,000 mentioned above, total 96,000, average 74,270 miles/year, and have 57% of annual miles in trips over 200 miles. When added to the above 407,000 newer model (1997 and later) sleepers, the sum exceeds 500,000. We also analyzed sleeper trucks by annual miles traveled. Sleepers traveling over 80,000 miles/year total 380,000, average 119,000 miles/year, and have nearly 65% of their annual miles in trips longer than 200 miles. An additional 76,000 sleepers have 60,000–80,000 annual miles, and 46% of these miles involve trips longer than 200 miles. These two groups sum to 456,000 sleepers. Some more sleepers in the 40,000–60,000-annual-mile category would idle overnight because they average over 50,000 miles/year and 34% of miles traveled are for trips longer than 200 miles. Paul Abelson of LandLine magazine *(9)* used his technical judgment of the probability of overnight idling for sleeper trucks by trailer type and estimated that over 490,000 sleepers would idle overnight. Thus, by several different lines of reasoning, nearly half a million sleepers travel long distances, are subjected to the 11 hours/day and 8 days/70 hours-of-service rules, and are likely to idle overnight if an alternative supply of hotel power is not available.

Some 91,000 truck tractors without a sleeper cab have over 40% of their annual miles in trips longer than 200 miles, and another 129,000 tractors have lesser percentages of annual miles in trips longer than 200 miles. In terms of annual miles, 139,000 non-sleeper truck tractors have over 80,000 annual miles, average 113,000 miles/year, and have 29% of their annual miles in trips longer than 200 miles. When on overnight trips, the drivers of these non-sleeper trucks will have to rest somewhere outside and return to the truck after rest. A majority of non-sleeper truck tractors (512,000) are employed in short trips and may idle while waiting for loading/unloading and during stops for meals and other breaks. In terms of average annual miles, 400,000 such trucks travel over 50,000 miles, with 23.4% of annual miles in trips longer than 200 miles. An additional 113,000 truck tractors travel 40,000–50,000 miles annually. The five most often pulled trailers are (i) the basic enclosed van, (ii) the dump, (iii) the flatbed/platform, (iv) the low boy, and (v) the tanker for liquid or gas. They account for 77% of the non-sleepers. The five tractors that have the highest fuel consumption are (i) the basic enclosed van, (ii) the dump, (iii) the tanker for liquid or gas, (iv) the flatbed/platform, and (v) insulated refrigerated van. They account for 82% of the fuel consumption by non-sleepers.

TRUCK IDLING

The type of truck idling that has received the most attention has been that of sleeper cabs, parked overnight at truck stops, rest areas, or by the side of the road, with the engine left on to keep the sleeping driver comfortable and to keep the engine fluids warm and the batteries charged. Of course, only drivers of sleepers, generally class 8C trucks (see below), are likely to engage in this type of behavior. Several technical options that can be installed on trucks, such as small heaters and auxiliary power units (APUs), are available to provide the services needed when the main engine is shut off. In addition, electrical plug-in options are available at some truck stops and depots. These are described in Stodolsky *et al*. *(1)* and listed on the EPA Smartway web site *(10)*.

Another type of idling is done by various vocational trucks during their workdays. These trucks are using their main engines to accomplish work other than moving the vehicle down the road. Examples include cement mixers that rotate and asphalt trucks that heat their loads to keep it from getting too viscous. The industry term for this kind of application is “power take-off” (or PTO). We do not include PTO in the accounting of truck idling because useful work is being accomplished.

The third type of idling is important but has not as yet been evaluated to see how much energy is being used. It is most succinctly described as “waiting” and can be divided into two categories, depending on whether the truck is simply parked or waiting in a queue, needing to move forward every few minutes to maintain its place in the line. The term for waiting in a line is “creep mode.” Note that these categories exclude time during travel from place to place when the truck is stuck in traffic and must idle. The trucks that are simply parked could utilize the same devices as the overnight idlers if no comfortable waiting place were available for the drivers. Trucks in a line would require some alternative to restarting the engine frequently if this idling were to be avoided. Possibilities include scheduling, delicatessen-style numbers, and engineering to use APUs to power creep mode.

Overnight Idling

Although there may be cases of trucks idling overnight for other reasons, by far the most common reason is that the driver is sleeping in the vehicle and requires heat or air conditioning and electricity to stay comfortable. Drivers remain in their sleeper compartments to sleep and relax during the off-duty periods required by the federal hours-of-service regulations. It is not yet known how recent changes in these regulations will affect total idling time. By definition, and by law, this type of idling is limited to those trucks that have sleeper compartments; almost all of these are class 8C (combinations), but there are some in classes 6 and 7 as well.

Even if the air temperature is moderate, the driver may leave the engine idling because open windows invite intrusions and let in polluted air and noises from other trucks. The number of hours varies greatly, from those drivers who get the truck warm, turn it off, and then curl up under heavy blankets for the night, to those who claim they never turn their trucks off for fear they will not start again. A survey conducted at truck stops by the University of California at Davis showed a broad distribution from about 500 hours/year, up to over 3,500 (see Figure 3, in which the horizontal axis is hours/yr idled, and the vertical axis is number of trucks).

Truckers report idling from 1 to 10 hours per day. This is consistent with the typical 6 hours per day estimated by the American Trucking Associations and the 1,800 hours/year estimated by Caterpillar as the result of an informal survey it performed *(11)*. However, although overnight idling has been discussed often, no good statistical data exist, and this work will perform a sensitivity analysis on this important parameter, around a baseline estimate of 6 hours per day, 300 days per year. Use of auxiliary power units and other idling-reduction devices could eliminate most of this overnight idling.

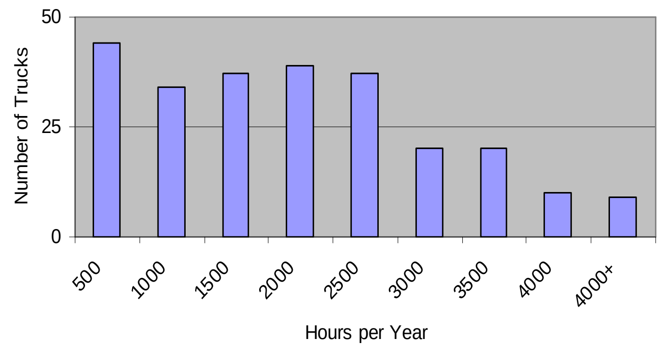

FIGURE 3 Range of idling times reported *(12).*

The 2002 VIUS reports over 665,000 sleepers in use, and almost 60% of these travel over 80,000 miles per year (or 270 miles/day for 300 days). Note that we are using miles per year here rather than distance traveled because the distance-from-home field in VIUS is actually defined as trips that are a given distance from the home base and may not actually reflect trip lengths. The trucks that travel the longest distances in a year travel the farthest each day and are most likely to be idling overnight, but if a truck's route is short and includes several stops each day, the driver can run out of hours far enough from home to have to rest in the truck. We therefore estimated overnight idling hours for a conservative case by assuming that trucks going over 80,000 miles annually idled 6 hours/day, 300 days/year, and those traveling 60,000–80,000 miles idled 70% of that time; 40,000–60,000 miles, 40% of that time; and under 40,000 miles, 10% of that time. Trucks without sleepers are assumed not to idle overnight, and idling fuel use was assumed to be 0.8 gal/h. On the basis of these estimates, total fuel use for idling overnight is about 685 million gallons. Table 1 shows fuel use by distance classes and trailer type. The fuel use of Class 6 and 7 sleepers is shown to be negligible.

Note that team drivers can drive through the night, so a more detailed analysis should include information on teams and exclude overnight idling for them. Because no comprehensive data exist on idling hours, we performed a simple sensitivity analysis to several parameters. To get an upper bound on the fuel used by overnight idling, we considered all sleepers idling 10 hours/day at 1 gallon/hour. This value triples the conservative estimated fuel use to almost 2 billion gallons and is clearly unrealistic. However, the high degree of uncertainty associated with assumptions highlights the need to get better data on actual overnight idling practice. Onboard computers could be used to collect these data.

Idling as Part of the Working Day

Although it is well known that trucks often idle in the course of the workday, no detailed analysis exists. We will give some examples of situations in which trucks generally idle for extended periods, either at rest or in creep mode, and provide rough estimates of the time and energy use for these examples. Again, we will perform sensitivity analysis to gain some insight into whether this workday idling is a significant contributor to total energy use by idling trucks.

TABLE 1 Fuel Used while Idling for Sleeper Trucks, by Selected Body Types and Miles Driven Category

Class 8C w/Sleeper (Body Type)	Miles Driven Category (mi/yr)	Number of Trucks	Total Fuel Used (gal/yr)	Idle Time per Truck (h/yr)	Fuel Used to Idle (gal/yr)/trk	Fuel Used to Idle (gal/yr)	iIdle % of Total Fuel Used
Dump	< 40,000	20,535	46,014,662	0	0	0	0.0
	40,000–60,000	3,797	35,481,756	720	576	2,187,072	6.2
	60,001–80,000	4,872	65,079,191	1,260	1,008	4,910,976	7.5
	> 80,000	7,233	145,494,922	1,800	1,440	10,415,520	7.2
Flatbed/platform	< 40,000	31,666	91,204,132	0	0	0	0.0
	40,000–60,000	14,840	142,730,487	720	576	8,547,840	6.0
	60,001–80,000	15,105	205,347,095	1,260	1,008	15,225,840	7.4
	> 80,000	41,132	852,593,119	1,800	1,440	59,230,080	6.9
Tank — liguid/gas	< 40,000	6,724	24,066,861	0	0	0	0.0
	40,000–60,000	4,055	36,194,736	720	576	2,335,680	6.5
	60,001–80,000	4,523	53,669,123	1,260	1,008	4,559,184	8.5
	> 80,000	20,916	392,994,386	1,800	1,440	30,119,040	7.7
Basic enclosed van	< 40,000	34,239	129,082,598	0	0	0	0.0
	40,000–60,000	25,541	235,177,541	720	576	14,711,616	6.3
	60,001–80,000	33,500	400,281,941	1,260	1,008	33,768,000	8.4
	> 80,000	213,425	4,225,423,766	1,800	1,440	307,332,000	7.3
Insulated reefer	< 40,000	5,914	21,147,647	0	0	0	0.0
	40,000–60,000	5,458	53,092,054	720	576	3,143,808	5.9
	60,001–80,000	7,293	93,097,435	1,260	1,008	7,351,344	7.9
	> 80,000	59,659	1,350,114,617	1,800	1,440	85,908,960	6.4
Other *	< 40,000	42,166	101,965,371	0	0	0	0.0
	40,000–60,000	11,839	116,466,377	720	576	6,819,264	5.9
	60,001– 80,000	10,257	145,308,684	1,260	1,008	10,339,056	7.1
	> 80,000	34,917	747,101,232	1,800	1,440	50,280,480	6.7
Class 8C w/sleeper totals		659,606	9,709,129,733			657,185,760	6.8
Class 7C w/sleeper totals		4,802	45,830,198	1,800	1,440	6,914,880	15.1
Class 6C w/sleeper totals		1,652	23,364,721	1,800	1,440	2,378,880	10.2

* Other includes beverage, curtainside, low boy, pole, dry bulk tank, insulated non-reefer, open top, car carrier, livestock, mobile home toter, drop frame, unknown.

It is necessary to disaggregate trucks into categories based on the type of service they perform and to examine their daily operations. First consider the large trucks that move raw materials, intermediate products, and final consumer goods around the country to and from ports and production plants to distribution centers, retail outlets, and construction sites. Drivers of these trucks may need to park and find the right person to process paperwork, obtain a dock assignment, wait in line for their turn at the loading dock, then wait again while goods are unloaded from or loaded onto their trucks, check the load, and complete more paperwork when they are done. The time involved varies by location, time of day, and type of operation, but it can be from 0.5 hour to as long as 6 hours for a single stop. Similarly, trucks can be delayed in queues at border crossings for as long as 4 hours.

Several measures are being used or could be developed to reduce this wasteful idling time. First, many companies (like Wal-Mart) use a technique known as “drop and hook” to avoid the delay caused by the need to wait while trailers are being loaded or unloaded. If the entire trailer load is going to this site, the truck driver can back the trailer into the loading dock and separate the tractor from the trailer, leaving the tractor free to pick up another trailer and proceed on its way. This type of operation requires more trailers than tractors. If only part of the load is for the site, the driver must wait until that part is unloaded before proceeding to the next stop on his/her route.

Another technique that can be used is scheduled pick-up or delivery times. This technique is being tried at the Port of Long Beach. However, real-time electronic communication is required for this to work well. Otherwise, delays on route can cause drivers to miss their scheduled slots. For locations without scheduling, it would be possible to avoid queues of trucks in creep mode by instituting a take-a-number system, similar to that used in delicatessens. Drivers could then park, turn off their engines, and wait in comfortable areas (such as some shippers already provide) until their numbers were called. Even border crossings could provide this service.

Another situation in which long-duration (>0.5 hour) idling occurs spans a wide class of vehicle service types. Almost all drivers have an hour off for lunch; during this time, the vehicle may be left idling, especially if the weather is warm. One expert writes, “Remember, the cab sits on top of a 500–800 lb heat sink that could be over 200ºF. On a 50–60º day, the cab can be like an oven after sitting for 20–30 minutes.” *(9)* This problem becomes less severe for smaller vehicles.

Another class of vehicles that idles for significant periods during the workday is dump trucks, which idle while being loaded, are then driven to the dump site where they dump their loads, and return to be reloaded, subsequently repeating the process. Depending on the operation, it might be reasonable to shut the engine off during loading. This might require a climate control system independent of the main engine for operation in extreme weather.

Next we consider smaller vehicles. As a general rule, smaller vehicles are easier to start, warm up faster, and are more likely to be stolen, so they are less likely to be left idling when the driver is not in them. However, some types of trucks have been observed to idle for significant periods when making deliveries or performing other jobs. These include leased refrigerated straight trucks, bakery trucks, and linen-supply company trucks (often walk-in vans), which idle from 10 minutes to one hour at a time. Similarly, heavy vocational straight trucks, including refuse haulers, public works crew trucks, and newspaper delivery trucks, may idle for 20–30 minutes at each stop *(13)*. Utility trucks idle as well, sometimes most of the day, but at least in some cases, these are providing a useful service by creating a place for workers to warm up when they come down from utility poles or up out of manholes. For such situations, heaters or APUs could provide the same service with less energy use and emissions. Other than these utility vehicles, we have not identified instances where small trucks are idled for long periods. The owners of the many pickups and vans that perform household and commercial repairs and installations or transport produce from small farms all seem to recognize how much money they save by simply turning their vehicles off when not in use.

Fuel Use for Workday Idling

Given these general observations and essentially no actual data, we did some simple modeling to determine to what extent extended workday idling could be an important problem. The short answer is that, given the large numbers of vehicles potentially involved, the fuel use for this type of idling could be much larger than that for overnight idling, and data should be obtained. This section details the assumptions made in order to scope out the energy use for extended workday idling.

We first had to estimate the per-hour fuel use for extended idling. The only data point we have is that idling large sleeper tractors use approximately 0.8 gal/h (or more depending on idle speed and accessory loads). We assumed that smaller trucks would use proportionately less fuel at idle; thus, if a vehicle class achieved twice the fuel economy as a class 8 tractor, it would burn half as much fuel at idle (0.4 gal/h).

We then had to estimate the idling hours for different types of trucks. This estimate was highly uncertain. We identified several classes of trucks that might idle for extended periods and estimated the possible extent of idling. Our first attempt assumed that all vehicles of that type idled for the maximum time; these estimates did not seem reasonable, so we revised our numbers downward on the basis that (i) only a subset of the vehicles were high idlers or (ii) the need was only present part of the year. In each case, we assumed that the vehicles that traveled the longest distances spent most of their time on the road, and those that traveled under 40,000 miles per year were driven less because much of the time, they were stopped waiting for something or someone and were idled most. We assigned the maximum idling hours to the under-40,000-mile trucks, 75% of maximum to those driven 40,000–60,000 miles, 50% to those driven 60,000–80,000 miles, and 25% to those driven more than 80,000 miles. In each case, we assumed that the vehicle operated for 300 days per year and estimated a typical number of hours idled per day for the body type. Vans and dump trucks were assigned 2 hours/day; utility vehicles, 3 hours/day; platform trucks, tankers, and garbage trucks, 1 hour/day; and all other trucks, 0.5 hour/day. As shown in Table 2, even these relatively conservative estimates yield a total fuel use of almost 2.5 billion gallons annually (7% of the fuel used by these trucks), leading us to conclude that idling during the workday consumes a significant amount of fuel and should be examined in detail.

Table 2 was constructed by identifying types of trucks that were likely to idle and specifically adding hours for them over an assumed low baseline. However, the idling hours by some delivery vans could be underestimated, and accounting for increased idling by those numerous large trucks would significantly increase the total. Similarly, it would be appropriate to identify types of trucks, such as pickups, for which we could not identify any reason to idle routinely and subtract these types of trucks. Subtracting pickup trucks reduced the first estimate by almost 500 million gallons per year because of the large number of pickups in commercial service (over 7 million). This modification illustrates the high degree of sensitivity of these results to individual inputs. It is clear that actual data on idling practices of trucks during the workday must be sought.

TABLE 2 Fuel Used by Commercial Trucks Idling on the Job by Selected Body Type and Miles Driven Category

All Commercial Body Types	Miles Driven Category (mi/yr)	Number of Trucks	Total Fuel Used (gal/yr)	Ave. mpg	Idle Time (h/yr)	Idle Fuel Flow Rate (gal/h)	Fuel Used to Idle (gal/yr)/trk	Fuel Used to Idle (gal/yr)	Idle as x% of Total Fuel Used
Minivan	< 40,000	1,175,532	1,038,768,478	17.7	600	0.262	157	184,897,237	17.8
	40,000–60,000	65,009	178,620,070	17.7	450	0.262	118	7,668,858	4.3
	60,001–80,000	17,384	86,127,314	13.0	300	0.357	107	1,861,425	2.2
Full-size (LD) van	< 40,000	2,040,986	2,040,445,188	13.2	600	0.352	211	430,462,502	21.1
	40,000–60,000	69,063	240,504,381	13.1	450	0.354	159	11,007,904	4.6
	> 80,000	9,400	51,618,036	17.3	150	0.268	40	378,173	0.7
Dump	< 40,000	724,547	1,019,392,773	5.8	600	0.800	480	347,782,560	34.1
	40,000–60,000	49,005	490,693,938	4.9	450	0.947	426	20,882,131	4.3
	60,00–80,000	23,529	326,154,539	5.1	300	0.910	273	6,422,033	2.0
	> 80,000	23,977	483,093,921	5.3	150	0.875	131	3,148,678	0.7
Flatbed/platform	< 40,000	939,658	1,217,696,747	7.4	300	0.627	188	176,757,289	14.5
	40,000–60,000	49,334	370,892,077	6.4	225	0.725	163	8,047,609	2.2
	60,00–80,000	25,770	321,901,976	5.7	150	0.814	122	3,146,653	1.0
	> 80,000	50,924	1,012,165,598	5.6	75	0.829	62	3,164,563	0.3
Service – utility	< 40,000	248,756	368,030,625	7.7	900	0.603	542	134,909,748	36.7
	40,00–60,000	4,924	28,084,098	8.2	675	0.566	382	1,880,728	6.7
	60,00–80,000	718	4,313,840	11.3	450	0.411	185	132,671	3.1
	> 80,000	913	8,736,854	10.3	225	0.450	101	92,541	1.1
Tank – liquid/gas	< 40,000	177,128	379,586,263	5.5	300	0.844	253	44,829,487	11.8
	40,000–60,000	16,329	143,096,007	5.7	225	0.814	183	2,990,785	2.1
	60,001–80,000	12,016	146,697,628	5.9	150	0.786	118	1,417,481	1.0
	> 80,000	35,401	673,812,671	5.9	75	0.786	59	2,088,059	0.3
Trash/garbage	< 40,000	77,520	305,197,033	4.4	300	1.055	316	24,524,509	8.0
	40,000–60,000	12,016	119,502,504	5.0	225	0.928	209	2,508,941	2.1
	60,001–80,000	2,733	35,901,942	5.2	150	0.892	134	365,802	1.0
	> 80,000	949	18,234,173	5.9	75	0.786	59	55,975	0.3
Basic enclosed van	< 40,000	650,517	1,469,253,265	7.3	600	0.636	381	248,087,579	16.9
	40,000–60,000	107,404	817,171,943	6.5	450	0.714	321	34,501,470	4.2
	60,001–80,000	94,550	1,052,739,306	6.3	300	0.737	221	20,891,048	2.0
	> 80,000	302,672	5,873,032,985	6.1	150	0.761	114	34,534,379	0.6
Insulated reefer	< 40,000	96,268	292,236,464	6.7	600	0.693	416	40,001,509	13.7
	40,000–60,000	20,414	161,964,407	6.2	450	0.748	337	6,874,908	4.2
	60,001–80,000	17,325	202,947,017	6.0	300	0.773	232	4,019,400	2.0
	> 80,000	70,694	1,556,874,982	5.6	150	0.829	124	8,786,254	0.6
Multi-stop van	< 40,000	372,892	662,599,461	8.6	600	0.540	324	120,712,945	18.2
	40,000–60,000	17,268	84,280,278	9.6	450	0.483	218	3,755,790	4.5
	60,001–80,000	3,077	24,132,931	8.5	300	0.546	164	503,904	2.1
	> 80,000	1,265	11,870,995	10.1	150	0.459	69	87,172	0.7
Other van	< 40,000	54,471	77,343,236	8.8	600	0.527	316	17,232,644	22.3
	40,000–60,000	1,193	5,713,537	9.6	450	0.483	218	259,478	4.5
	60,001–80,000	513	3,062,867	11.2	300	0.414	124	63,759	2.1
	> 80,000	377	3,480,504	10.9	150	0.426	64	24,073	0.7
Drop frame	< 40,000	6,304	18,859,832	6.2	600	0.748	449	2,830,699	15.0
	40,000–60,000	1,810	14,755,498	5.9	450	0.786	354	640,556	4.3
	60,00–80,000	1,364	15,423,848	6.3	300	0.737	221	301,379	2.0
	> 80,000	4,502	102,985,261	6.0	150	0.773	116	522,232	0.5
Other	< 40,000	9,829,988	9,827,530,297	13.7	150	0.339	51	499,392,091	5.1
	40,00–60,000	503,006	1,842,295,205	12.5	112	0.371	42	20,912,173	1.1
	60,001–80,000	65,680	579,037,170	7.8	75	0.595	45	2,930,338	0.5
	> 80,000	70,181	1,173,164,852	6.5	37	0.714	26	1,853,642	0.2
All commercial body type totals		18,147,256	36,982,024,815	9.4				2,491,143,761	6.7

Note: "Other" includes pickup, SUV, armored, concrete mixer, concrete pumper, crane, curtainside, low boy, pole, other service, street sweeper, tank (dry/bulk), tow/wrecker, vacuum, insulated non-reefer, open top, car carrier, livestock, mobile home toter, and unknown.

CONCLUSIONS

Extended idling by commercial trucks represents a significant use of our petroleum resources, and much of this oil use could be avoided by installing idle-reduction technologies, by adopting vehicle scheduling policies, or simply by turning the trucks off. Until now, attention has been focused on overnight idling by tractor-trailers with sleepers, which represent a very visible and obvious target for conservation and emission-reduction efforts. However, commercial trucks of all sizes idle for extended periods (0.5 hour or more) during their workdays, for a variety of reasons, such as while drivers wait to pick up or drop off a load or as a means of providing a warm haven for workers fixing utilities or roads in inclement weather. The quantity of petroleum used by such trucks may be far greater than that used by sleepers idling overnight. Although the length of time these vehicles idle is considerably shorter than the 6–10 hours that sleepers idle, the sheer number of vehicles more than makes up for it.

The sum of overnight and workday idling of trucks may consume well over 2 billion gallons of oil (mostly diesel) annually in the United States. To develop an accurate estimate of idling fuel use, data on vehicles and fleets in many industries would have to be collected. Cost-effective technologies exist for reducing overnight idling, but the fewer hours trucks idle per day while working will be somewhat of a barrier to their use in non-sleepers, because the payback period will be longer than the two years that the trucking industry requires. Further, for those vehicles that idle in queues (creep mode), some technology development will be required to enable slow vehicle motion without the use of the main engine. One possibility is use of the auxiliary power unit to supply minimal motive power. It will be a challenge to extend the realm of idle-reduction technologies to solve the problem of workday idling.

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