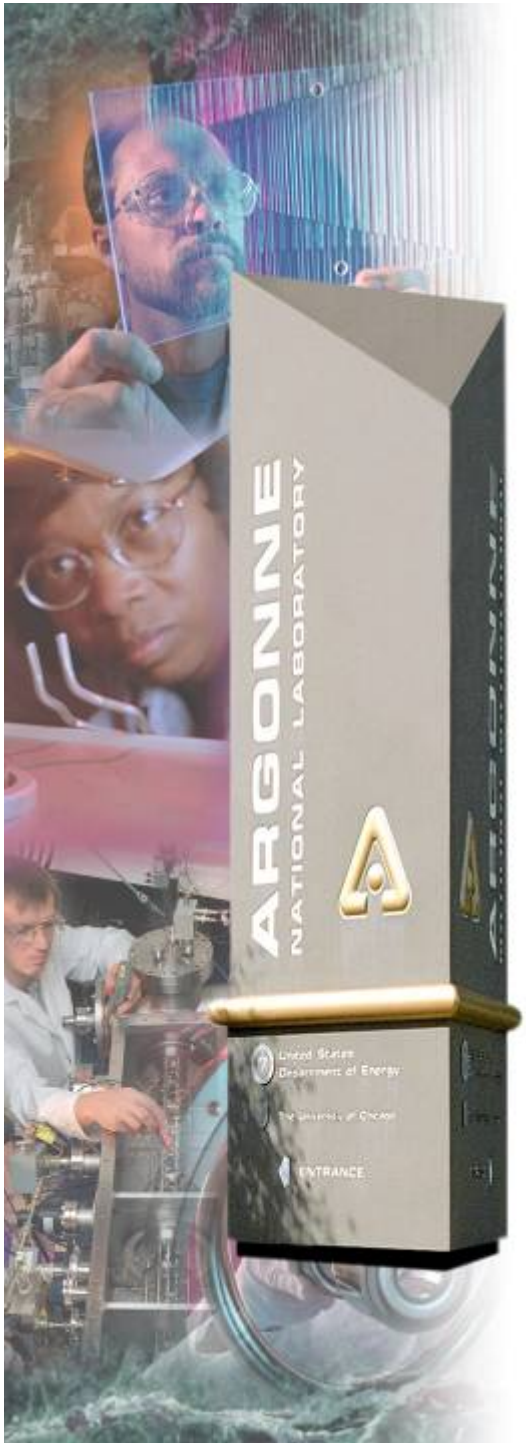

Estimation of Fuel Use by Idling Commercial Trucks

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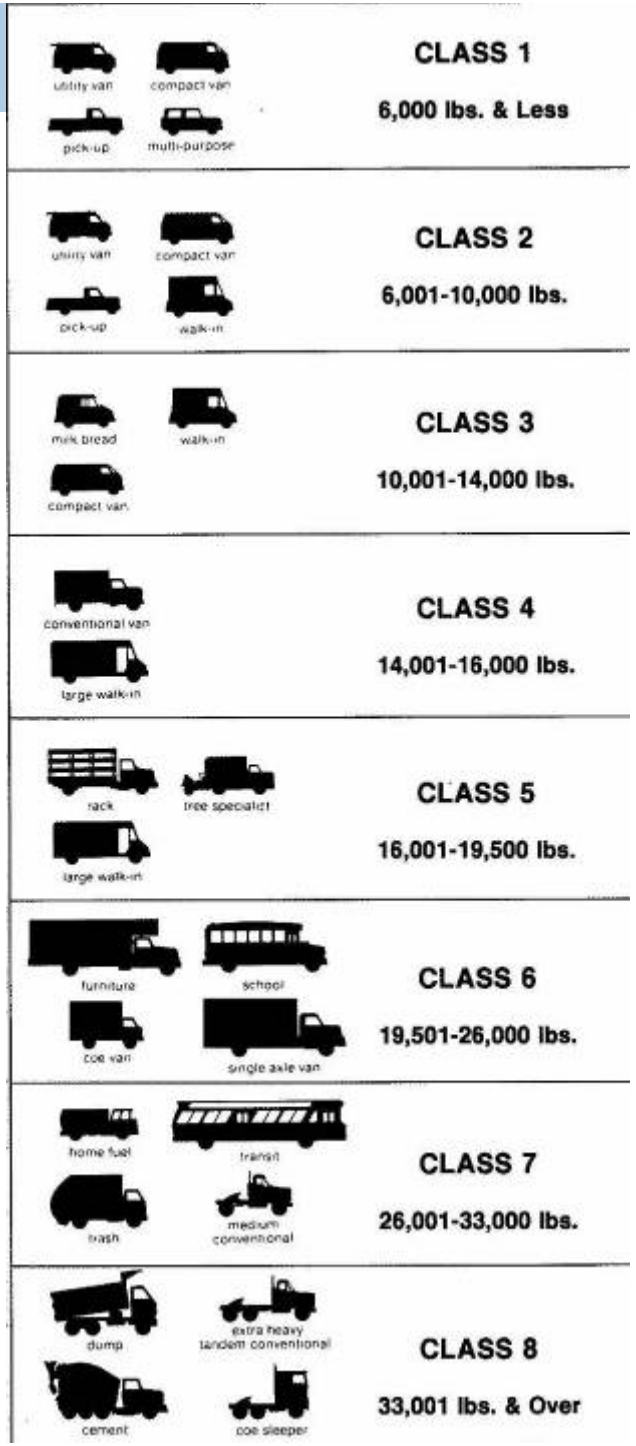
Trucks are classified into 8 classes

- Based on gross vehicle weight (GVW)
  - Includes empty vehicle plus cargo
  - Classes formulated >50 years ago
- Classes 1 and 2 include commercial and personal vehicles
  - Our analysis removes personal vehicles
  - Commercial uses include service and retail, construction, agriculture, manufacturing
  - Class 2 is divided into 2A and 2B (>8,500 lbs.)
- Single unit (SU) trucks cover classes 1-8
  - Flatbed, pickup, dump, van dominate
- Combination (C) trucks are in classes 6-8
  - About half have sleepers
    - *Travel long distances*
    - *Driver often sleeps in truck*
  - Trailers include vans, tankers, and flatbeds

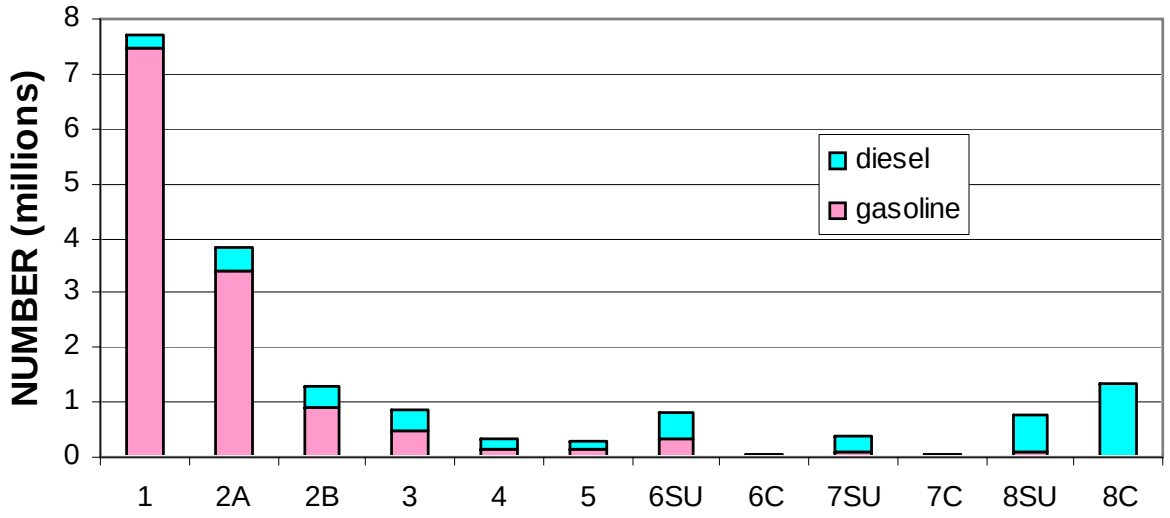


Vehicle Inventory and Use Survey is conducted every 5 years

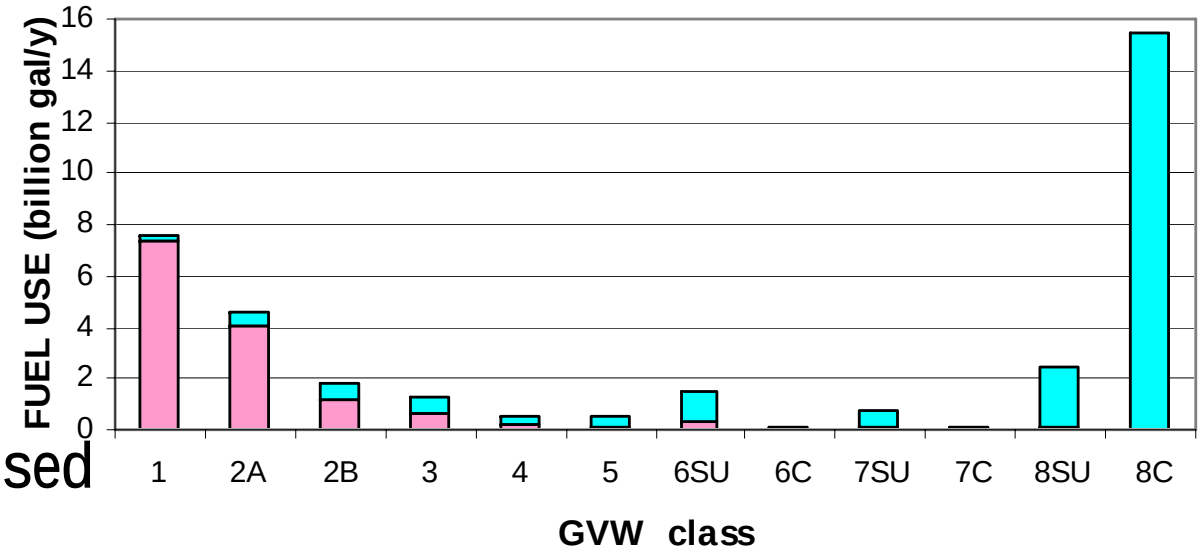
- 2002 data released in 2005
- Sample of 98,682* represents 85.2 million trucks
  - 79.8 million light trucks in use (Classes 1-2)
    - *66.5 million personal use*
    - *13.3 million commercial use*
  - 4 million single-unit heavy trucks
  - 1.4 million combination trucks (about half with sleepers)
- Information includes over 200 attributes of each truck.
  - numbers by class, body type, model year; miles traveled (by trip length), fuel economy
- We analyzed the Census Bureau microdata file with SAS software
- See http://www.census.gov/svsd/www/vius/products.html for survey methodology, questionnaires, and publications

* including 3,250 “not in use”

Classes 1 and 2 dominate commercial vehicle numbers →



but Class 8 uses the most fuel →



- Previous analysis focused on Class 8
- Commercial trucks use 14 billion gallons of gasoline and 23 billion gallons of diesel annually

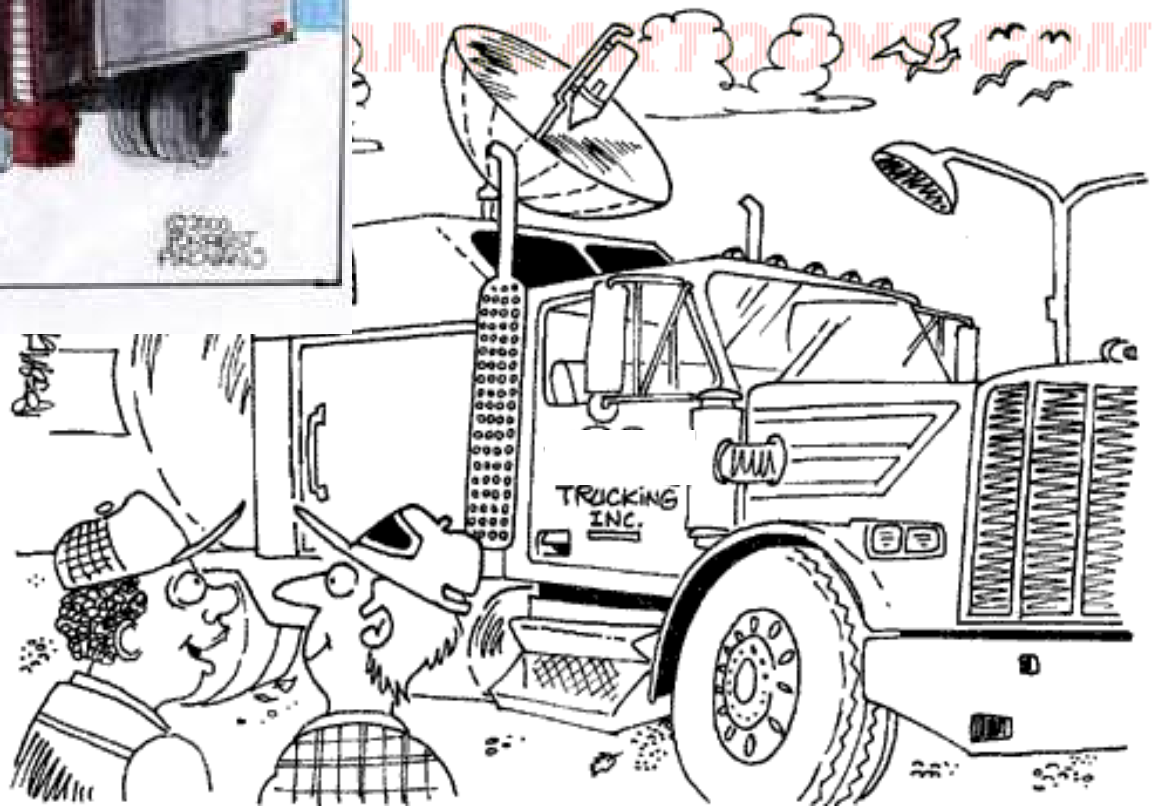
Why do sleepers idle overnight?

- For services to resting driver and friend
  - Heating, ventilation, and air conditioning (HVAC)
  - Power for appliances
    - *TV, microwave, refrigerator, computer, hair drier*
- To keep fuel and engine warm
- To mask out noises and smells
- Because other drivers do it
- For safety

Where?

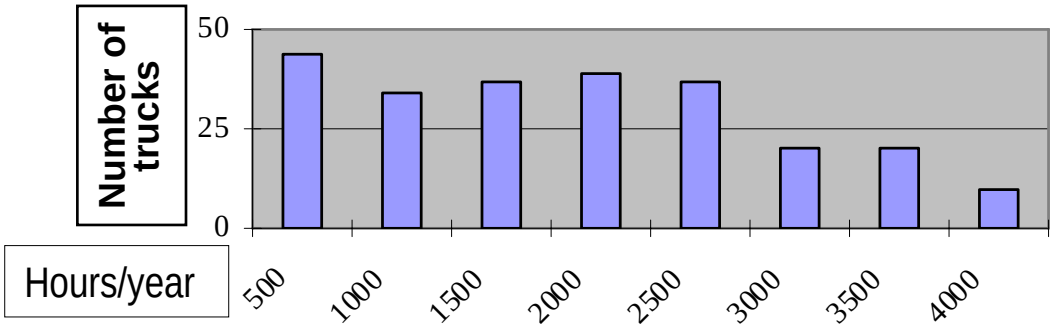
- At truck stops and rest areas
  - Not enough parking spots where needed
- In shopping center parking lots
- On ramps and roadsides
- Near first morning appointment
  - Enables prompt arrival
- At home base

Sleepers have all the comforts of home



How much do these sleeper trucks idle?

- Conservative estimate 6 hours/day, 300 days/year: 1800 hours/year
  - Caterpillar study consistent with this
- UC Davis survey reveals broad distribution



- Previous work estimated annual impacts
  - Baseline was 458,000 long-haul trucks idling overnight
  - Emission of 140,000 t NO_x, 2400 t CO, and 7.6 million t CO_2
  - Use of over 800 million gallons diesel fuel (5% of all heavy truck fuel)
    - *Value over $2 billion*
  - Noise
  - Engine wear and increased maintenance costs

Several technologies can reduce overnight idling

- All reduce fuel use, emissions, and noise
- All can be retrofit or manufacturer option
- Degree of cab comfort varies
- On-board equipment
  - Automatic engine stop-start controls
  - Heaters and air conditioners
  - Auxiliary power units and similar devices

- Wayside units (electrified parking spaces)
  - Single or dual system
- Simple measures can reduce energy demand
  - Insulation to reduce heat transfer
  - Shades to reduce solar load
  - Waste heat recovery from coolant
  - Load management to reduce peak

Workday idling is important

- Long-duration idling occurs
  - At ports and terminals
  - At busy delivery sites
  - At border crossings
  - At restaurants
- All truck types may idle during the work day
  - We focus on long-duration idling (>30 minutes)
    - *Power take-off excluded*
  - Idling reduction devices do not enable slow movement in queue ("creep mode")
  - Scheduling can reduce workday idling
  - Workday idling has not been studied
  - This work suggests that it could be significant use of fuel

Drivers may need to wait for their next loads

Conservative idling time estimates were assumed

- VIUS data were used to categorize trucks
- Idling time was estimated based on type and annual distance traveled
- Overnight idling →
  - Sleepers only
  - Longer distances imply driver sleeps in tractor more often

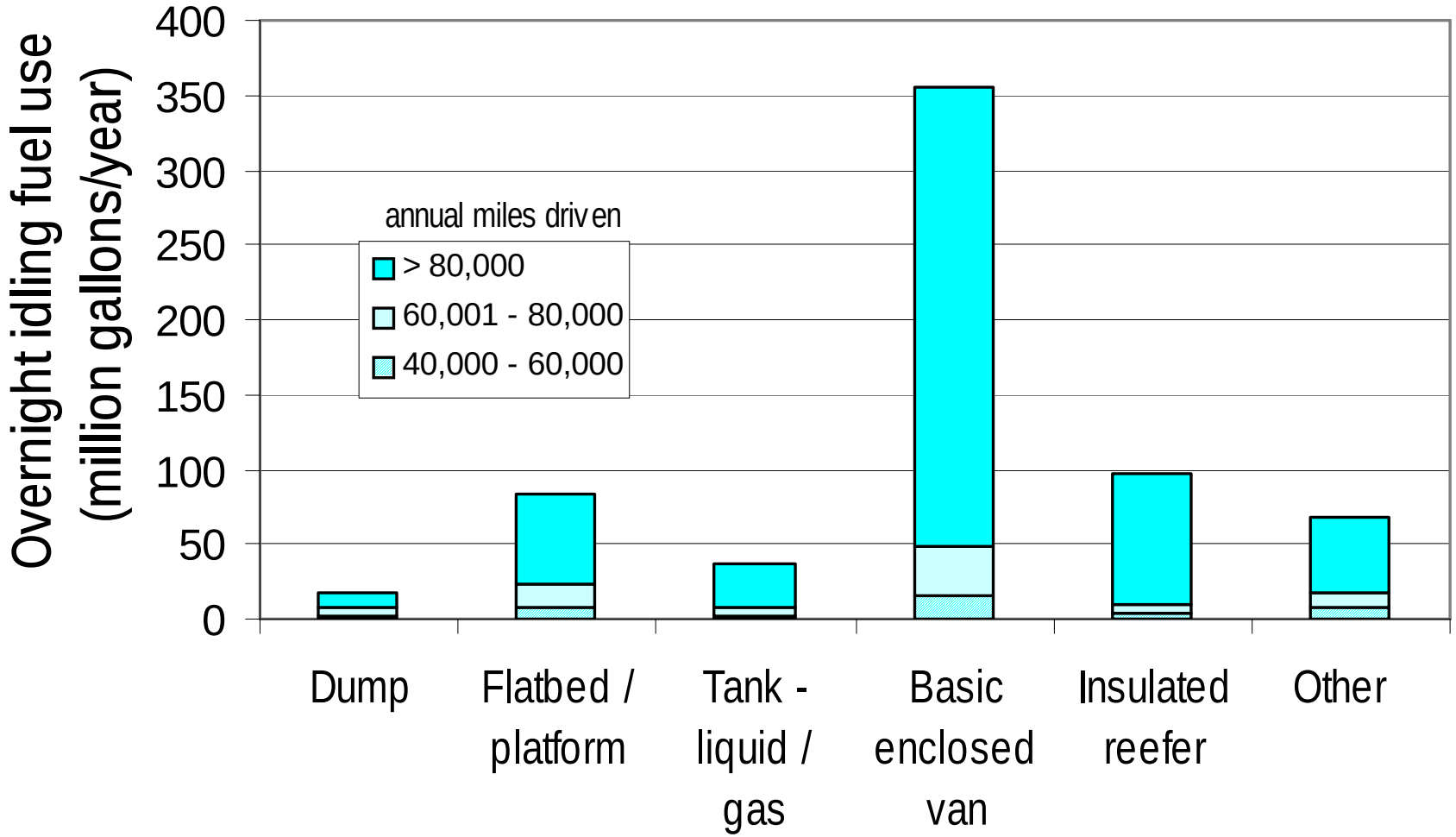
Annual miles (thousands)	Overnight idling hours per year
<40	0
40-60	720
60-80	1260
>80	1800

- Workday idling (see next slide)
  - All truck classes
  - Shorter trips assumed to include more idling during day
    - *We estimated up to 900 h/y or 3 h/d (utility vehicles)*
      - Workers use truck as base when they go underground or up poles
- Fuel use is very sensitive to assumptions
    - *Real idling data are needed!*

Workday idling times were estimated based on truck type

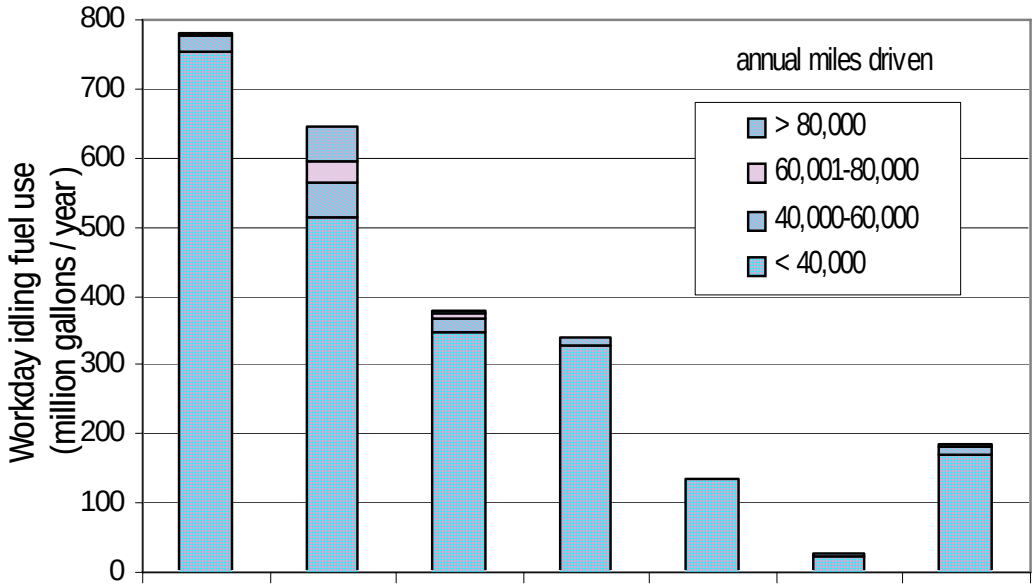
Aggregated category	Body types included	Annual mileage category (1000s)	Assumed annual idling hours
Utility	Service-- utility	<40 40-60 60-80 >80	900 675 450 225
Small van	Minivan, full-size van, multi-stop van, other van	<40 40-60 60-80 >80	600 450 300 150
Dump truck	Dump (all classes)		
Heavy truck (high idle)	Basic enclosed van, reefer, drop frame		
Heavy truck (lower idle)	Flatbed, tanker	<40 40-60 60-80 >80	300 225 150 75
Trash hauler	Trash/garbage		
Pickup	Pickup (classes 1-2)	<40 40-60 60-80 >80	150 112 75 37
Other	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, unknown.		

Sleepers hauling basic enclosed vans dominate overnight idling fuel use

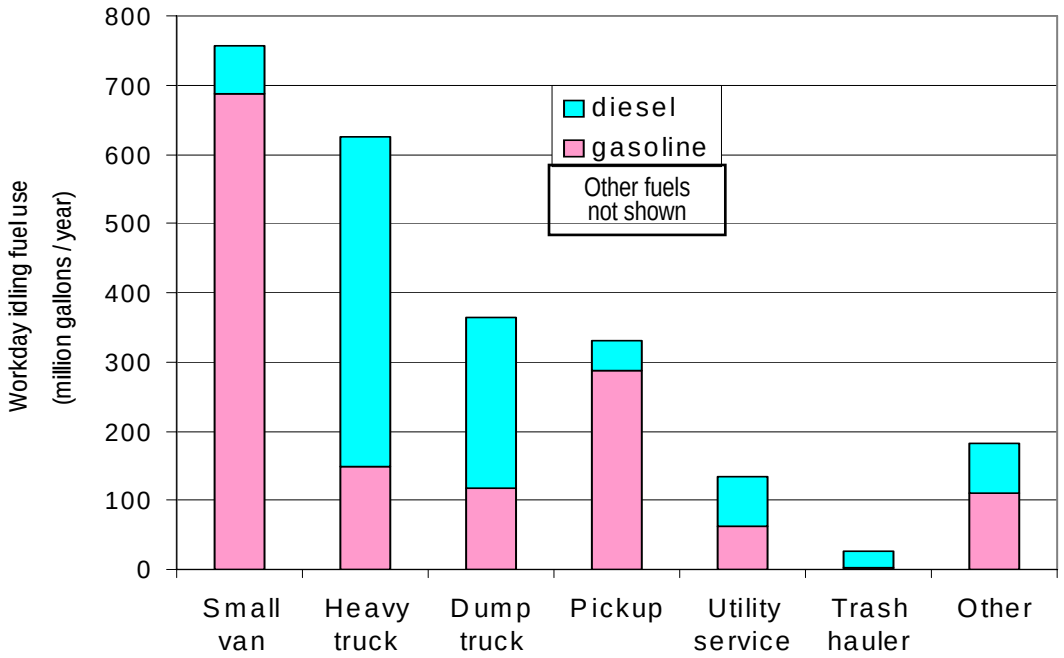


Idling during the work day may be very significant

- Short-range trucks dominate (by assumption)



- Small vans* and pickups use mostly gasoline
- Heavy trucks* and dump trucks use the most diesel



* See category definitions on slide 12

Idling may use over 8% of commercial truck fuel

	Fuel use (million gallons/year)			
	Gasoline	Diesel	Other	Total
Overnight idling	0	666	0	666
Workday idling	1,416	1,002	73	2,491
Total long-duration idling fuel use	1,416	1,668	73	3,157
Total fuel use for commercial trucks	13,922	22,681	378	36,982
Idling % of total use by fuel type	10.2%	7.4%	19%	8.5%

Workday contribution could overshadow overnight idling

- Overnight contribution is at least 666 million gallons per year
  - Based on very conservative assumptions
    - *Average 6 hours/night for longest haul*
    - *Fewer for <80,000 miles per year*
- Workday contribution could be over 2.5 billion gallons per year
  - This is ~7% of fuel use by these vehicles
  - Idling duration estimates were based on vehicle duties
  - No actual data were available
  - Results are very sensitive to assumptions
    - *Example: Removing pickup trucks subtracts 350 million gallons from total!*
    - *Data are needed*
  - Current idling reduction technology does not address “creep mode”
    - *Technology development could provide significant benefits*
    - *Hybrid trucks could turn engines off and use electric motors to move them*

Conclusions

- Total usage of petroleum by long-duration idling of commercial trucks may exceed 3 billion gallons per year
  - 45% is gasoline, 53% diesel fuel
- Actual idling practices by different vehicle classes are not well known
- Data should be gathered to determine the scope of the problem
- Development of technology to allow engines to be off in queues would save energy and reduce emissions

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