



Truck Idling: Implications and Solutions

**Alternatives to Truck Engine Idling
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*A U.S. Department of Energy Laboratory
Operated by The University of Chicago*



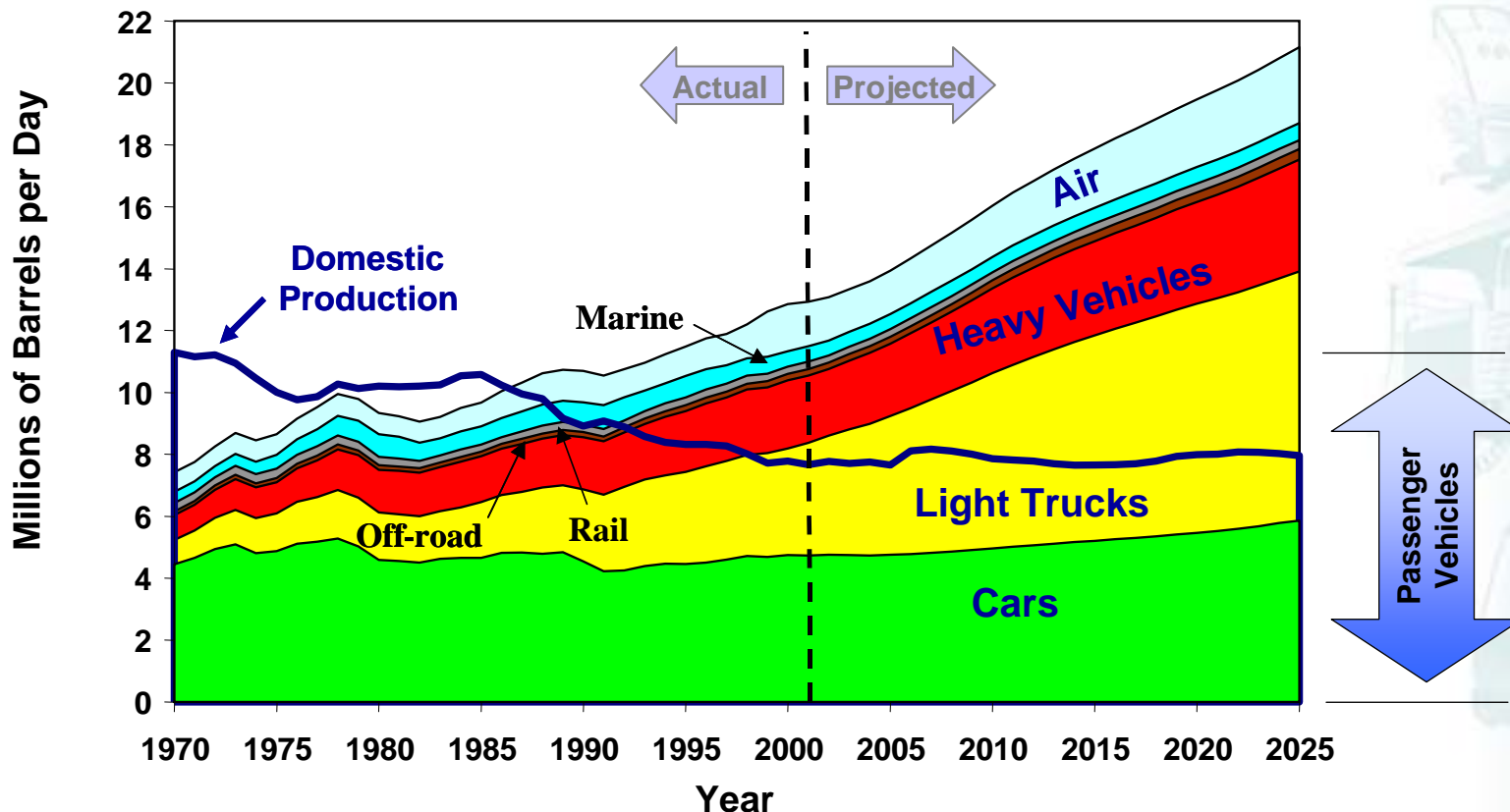
Over 2/3 of our 20 million barrels per day is consumed for transportation.

- Oil imports and prices keep rising
 - 22% imports from Persian Gulf
- Transport still relies on oil for 97% of its energy



Heavy vehicles use 28% of transport fuel

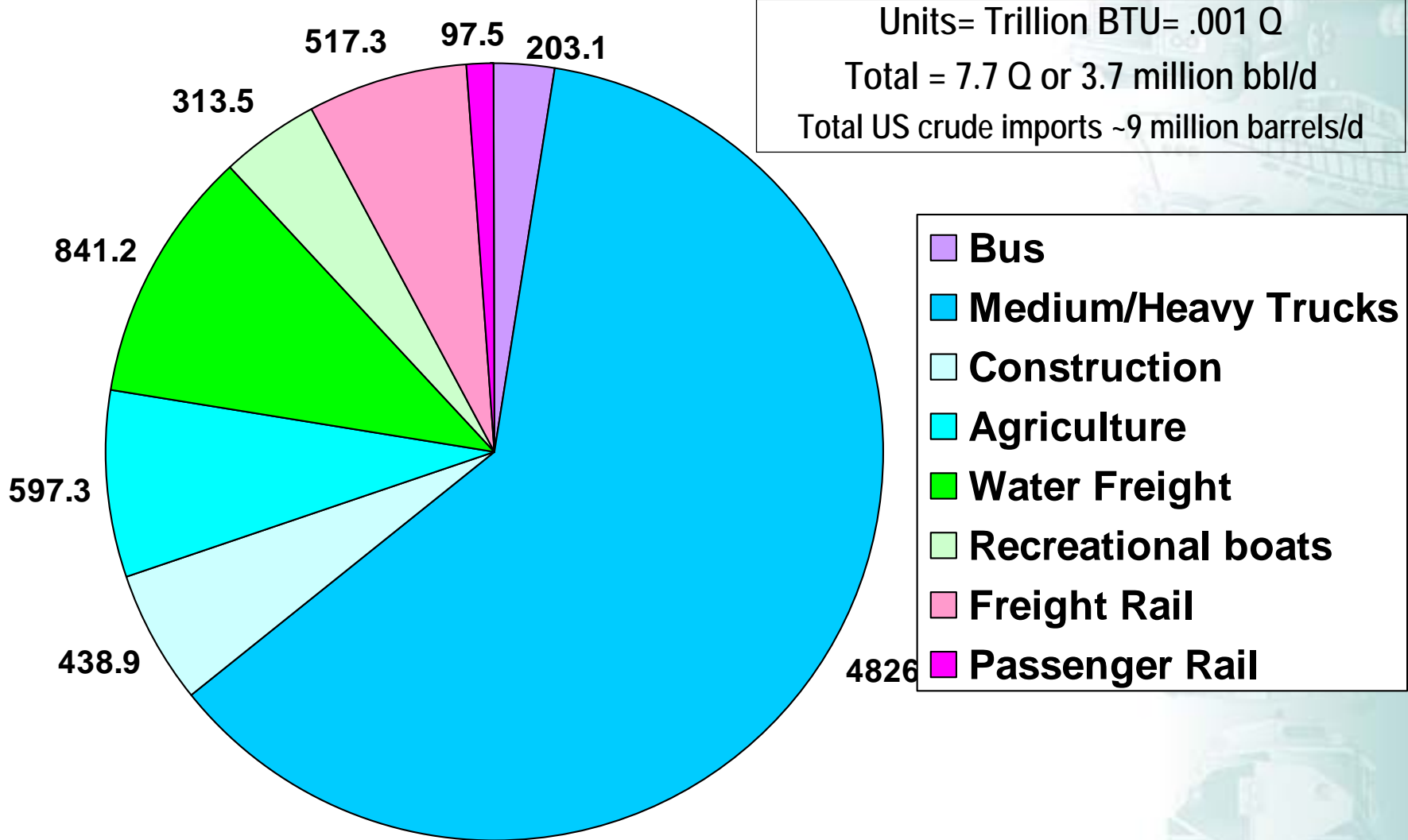
U.S. Transportation Petroleum Use



Source: Transportation Energy Data Book: Edition 22, September 2002,
and EIA Annual Energy Outlook 2003, January 2003

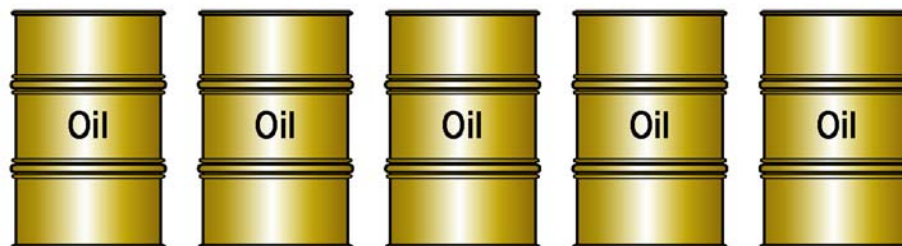
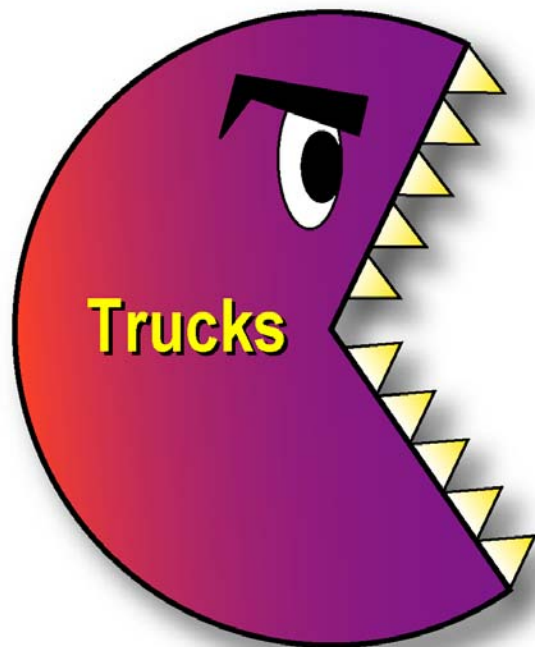


Trucks dominate heavy vehicle energy use



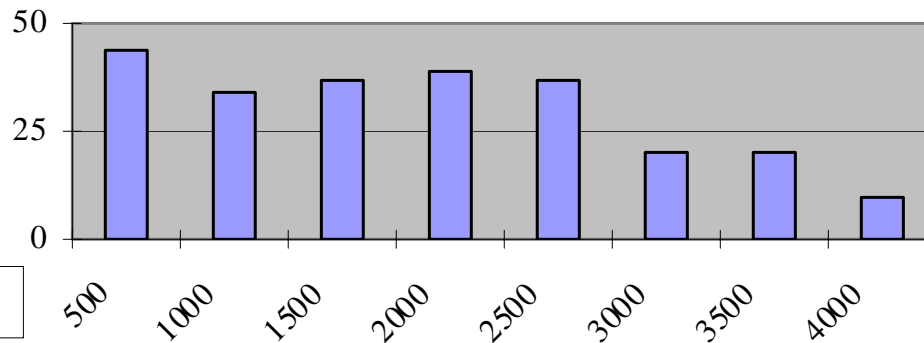
Data from Transportation Energy Data Book

We need to keep trucks from consuming more and more fuel.



How much do long-haul trucks idle?

- Conservative estimate 6 hours/day, 310 days/year: 1860 hours/year
 - Caterpillar study consistent with this
- UC Davis survey reveals broad distribution



- Annual national impacts from 458,000 long-haul trucks
 - Emission of 140,000 t NO_x, 2400 t CO, and 7.6 million t CO₂
 - Waste of 838 million gallons diesel fuel (5% of heavy truck fuel)
 - Value about \$1.4 billion
 - Noise
 - Engine wear and increased maintenance costs



Why do trucks idle?

- To keep fuel and engine warm
- For services to resting driver
 - Heating, ventilation, and air conditioning (HVAC)
 - Power for appliances
 - TV
 - Microwave
 - Refrigerator
 - Computer
 - Hair drier
- To mask out noises and smells
- Because other drivers do it
- For safety



Trucks don't just idle at truck stops



- Overnight idling occurs
 - 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
- Other long-duration idling occurs
 - At ports and terminals
 - At busy delivery sites
 - At border crossings

Scheduling can reduce idling at these locations.



Several technologies can reduce idling

- All reduce fuel use, emissions, and noise
- On-board equipment
 - Automatic engine stop-start controls
 - Cylinder deactivation
 - Auxiliary power units (APU) and similar devices
 - Cab and block heaters (fuel-fired or electric)
 - Air conditioners
- Wayside units
 - Shore power plug-ins (TSE*)
 - Electricity only
 - All services
 - Fluid circulation systems
 - so far only used for buses



* TSE= Truck Stop Electrification

Engine modifications are inexpensive

- **Automatic start-stop controls sense sleeper temperature**
 - Turn engine on to run HVAC when too warm or cold
 - Engine stays on in extreme weather, so minimal savings
 - Engine turning on and off may disturb sleep
 - Extra starts and stops add to engine wear
 - Start-up emissions may be a problem
 - Cost \$1200+ for factory option or retrofit
- **Cylinder deactivation reduces fuel use and emissions**
 - Smaller percentage reduction would be achieved (vs APU)
 - Little information available



Various on-board designs provide full service

- Devices supply HVAC, electricity, and charge battery
- Auxiliary power unit (APU) or gen set
 - Diesel-fueled engine and generator
 - Fuel cell
 - Reformed methanol or diesel fuel, or H₂
 - Under development
- Inverter/charger with batteries
- Typically weigh up to 400 lb and cost ~\$7000
- Lighter, less expensive units desirable
 - Manufacturers have made improvements



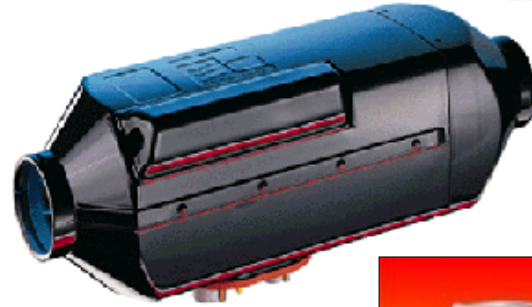
Latest CARB proposal would limit APU use

- Airborne toxic control measure applies to highway trucks >10,000 lb
- Puts 5 minute limit on running main **or auxiliary** diesel engine
 - New auxiliary engines must meet strictest small engine standards
- Exceptions allow idling when APU could be used instead
 - APU use for HVAC only until 1/1/09
 - Idling in traffic or queues
 - Idling because of weather, required repairs, or inspection
 - Provision of power for other work or emergency functions
- Minimum penalty is \$100
- **CARB rationale: APU emissions may exceed main engine's after 2007**
 - But petroleum use would be reduced by APU
 - And cleaner small engines could be mandated
 - New OEM APU routes exhaust through main emission system
- Comments have been forwarded to CARB



Heaters or air conditioners provide one service

- Heaters usually diesel-fuelled
 - Very small and efficient
 - Used widely in Europe
 - Used on trucks, buses, boats
- Most air conditioners rely on batteries
 - One system uses evaporative cooling
 - Thermal storage being developed
 - May just cool localized, enclosed area
- Heaters and air conditioners can be combined
 - Electrical service from battery may be sufficient



TSE eliminates local emissions

- Overall emissions may be reduced (vs APU)
 - Electricity generation plants have good emission controls
 - This applies to S, N, HC, PM, **but not CO₂**
- Energy use is greater than for on-board systems
 - But it's not in the form of petroleum
 - And still way below idling
 - Electricity generation is about 35% efficient
 - Direct heating ~90% efficient
 - There are transmission losses for electricity and conditioned air
- But trucks must park in equipped locations
 - Schneider claims 80% of idling is **not** at truck stops
- There may not be enough spaces where needed



Conventional TSE supplies electricity

- Plug-in pedestal similar to set-up for RVs at campground
- Modified equipment required on truck for electric HVAC
 - Cost about \$2500
- Parking spaces equipped with 120V and/or 240V AC
 - Cost per space about \$2600
- Operating cost is nominal
 - \$0.75/h projected charge
- Standardized plugs desirable



Advanced TSE has received good publicity

- Demonstrations funded by several agencies
 - Cost per parking space about \$15,000
 - Maintenance staff required
- IdleAire system supplies additional services
 - Electricity and conditioned air for \$1.25-1.50/hour
 - Internet, phone, movies, cable TV at additional cost
 - This is what makes the whole enterprise pay
 - No vehicle modification necessary
 - Only investment by trucker is \$10 window template



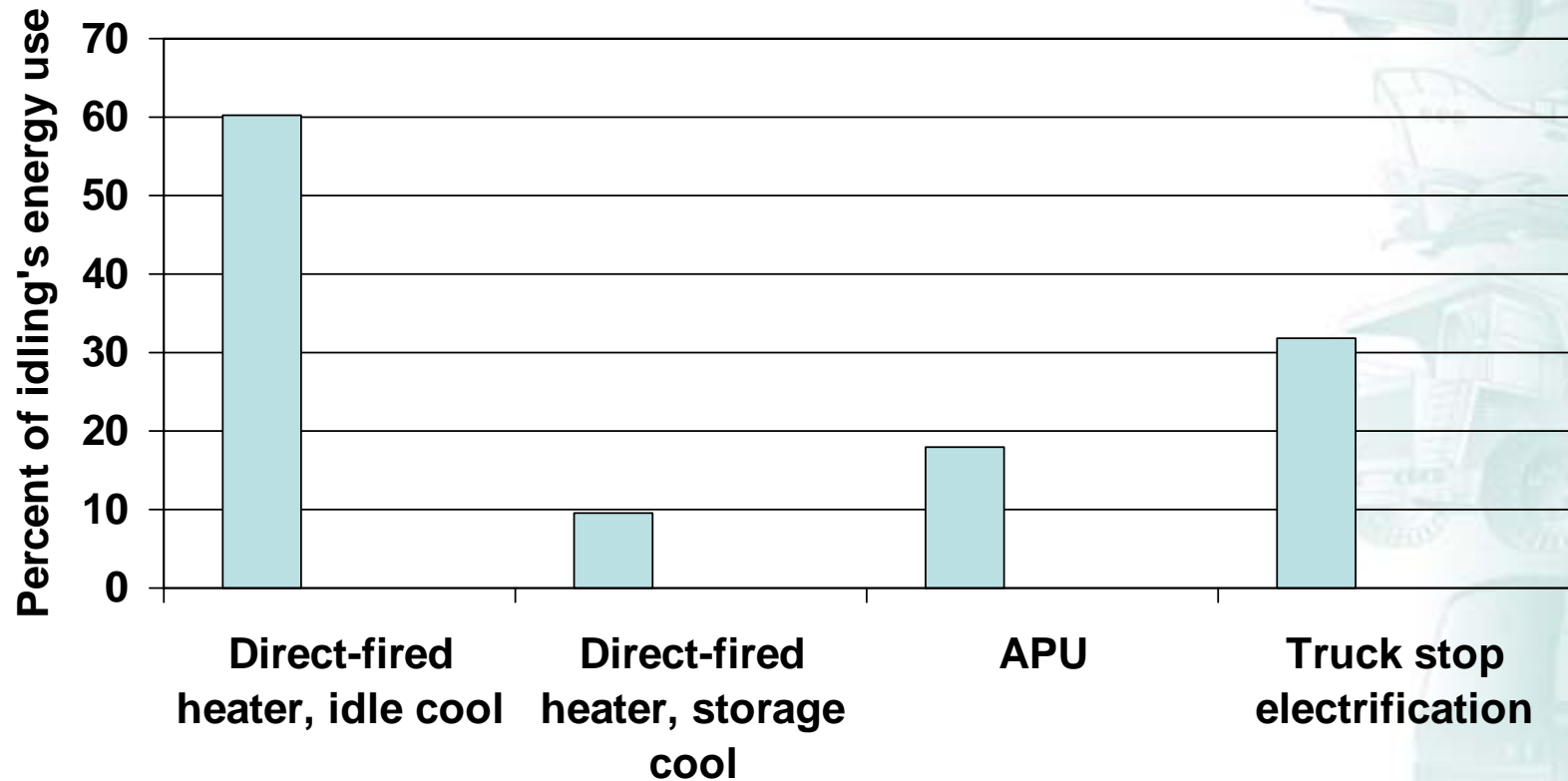
Technologies have pros and cons

System	Services	Advantages	Disadvantages
Idling	All	No investment	High emissions, noise, fuel use
Automatic start-stop	All, intermittently	Low cost	Noisy, minimal benefit in winter
APU or similar device	All	Anywhere, anytime	High cost and weight
Truck stop electrification	All	Quiet, no local emissions	Requires equipped location
Heater	Heating	Low cost and weight	Not full service
Air conditioner	Cooling	Low cost	Not full service, battery may be heavy



NO ENDORSEMENTS IMPLIED!

Alternatives to idling reduce impacts



Similar reductions occur for CO₂ emissions and petroleum consumption except truck-stop electrification uses <1% petroleum.



Payback time depends on operating practices

- Fuel savings are the main financial benefit
 - Payback is faster if more idling hours are displaced
- Savings also accrue from reduced maintenance costs
 - Routine maintenance can be performed less often without idling
 - Mileage to overhaul can be increased without idling
 - Worksheet for trucks is based on TMC RP 1108
- Low-idling history should increase vehicle resale value
- Device has residual value



Calculate Your Idling Costs

(Based on Maintenance Council Report RP1108, issued March 1995, and Argonne National Laboratory Reports, June 2000)

Instructions: In each row, start at the left and fill in the blanks with information about your equipment and costs. Then multiply or divide as shown. Some answers are used again. Where you see an arrow, copy the answer into the blank at the end of the arrow, so you can use it in the next step.

1	How many hours each year could you use auxiliary devices instead of idling? [] hours/year x [] gallons/hour = [] gallons/year	How much fuel is used for idling? Look up the number in the table below.	What is the price of diesel fuel? \$ [] /gallon	Fuel Costs = \$ [] /year
2	[] hours/year x [] gallons/hour = [] gallons/year	What is your average fuel economy? "Miles of idling" (idling is like putting miles on your engine)	[] gallons/year x [] miles/gallon = [] miles/year	
3	How much does an oil change cost? \$ [] /oil chg. ÷ [] miles/oil chg. = \$ [] /mile	How many miles between oil changes?	[] miles/year x [] miles/year = [] miles/year	Preventive Maintenance Costs = \$ [] /year
4	How much does an engine overhaul cost? \$ [] /overhaul ÷ [] miles/overhaul = \$ [] /mile	How many miles between overhauls?	[] miles/year x [] miles/year = [] miles/year	Overhaul Costs = \$ [] /year
5	Total Costs for Idling (add right-hand column)			Total Costs = \$ [] /year

How much fuel is used for idling (gallons/hour)?

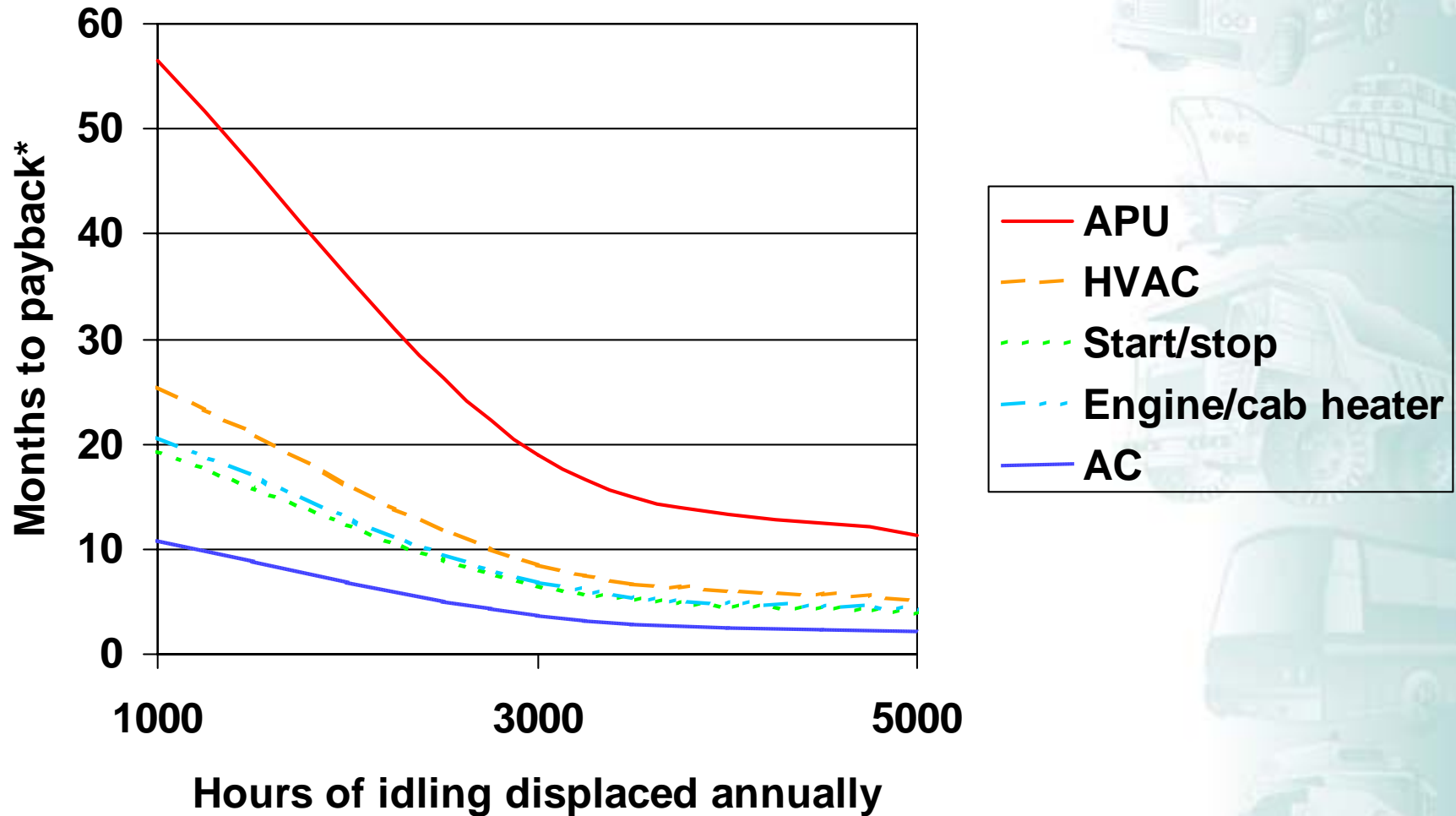
Locate your engine RPM and parasitic brake horsepower (BHP) at idle. The corresponding number is about how much fuel you use to idle. For example, 1000 RPM at a BHP of 10 consumes about 1.2 gallons of fuel an hour. Typical accessories require between 10 and 20 BHP.

RPM	Brake Horsepower of Accessories				
	0	5	10	20	30
800	0.6	0.7	1.0	1.4	1.7
1000	0.75	1.0	1.2	1.55	2.0
1200	1.0	1.2	1.5	1.8	2.25

Download worksheet at:
www.transportation.anl.gov/downloads/idling.xls



On-board devices have good payback times for high idlers



*No resale value assumed



Payback for advanced TSE user is immediate

- With fuel at \$1.75/h and \$1.50/h charge, user repays template in 4 nights
- But parking space requires 10,000 hours' use to repay
 - Staff at facility increases cost considerably
 - Electricity cost increases it more
 - Profits from pay-per-view and other services defray costs
 - Initial installations have received government subsidies
- Conventional TSE equipment pays back in <2 years



Recent developments impact truck idling

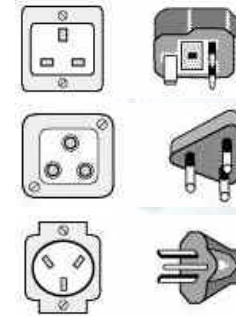
- New technology options are available
 - But choices may be confusing
- Agencies have been busy with programs
 - But capital is still scarce
- Many states and localities are restricting idling
 - Some devices might not meet new regulations
- Hours of service rules have changed
 - May increase need for idle-reduction devices
- EPA guidelines allow emission credits in SIPs
- Trade organizations have been formed

Most long-haul trucks still idle overnight!



How can we speed up idling reduction?

- Encourage a level playing field
 - Encourage uniform regulations
 - Reduce investment risk by standardization
- Create financial incentives
- Demonstrate technology effectiveness
- Develop more attractive technology
- Facilitate coordination among stakeholders
- Continue education



FREE BUMPER STICKER

MY RIG SLEEPS WHEN I DO!

IDLING LESS MEANS...

- More Profits**
- Cleaner Air**
- Using Less Foreign Oil**



What financial tools could be used?

- Excise tax exemption for idle-reduction equipment
- Weight waiver (250 pounds in Energy Bill)
- Grants or tax credits for equipment
 - California's Carl Moyer Program
 - Canada's program
- Tax refund for APU fuel
 - Some states refund tax for all non-road fuel
- Low-interest loans
- Leasing opportunities
- Emission credit trading
 - EPA guidelines allow credits in SIPs
- Regulations to deter idling



DOE idling reduction R&D began in 1986

- “Don’t Idle Your Profits Away” published 1986
- APU research funded (diesel in late 1980’s, fuel cell now)
- More Electric Truck development supported
- Detailed studies (trucks began 1996, locomotives 2001)
- Information published and disseminated
 - Comprehensive updated report in preparation
- Demonstration projects funded
- Clean Cities is embracing idling reduction



Better technologies are being developed

- New technologies will be
 - Cheaper
 - Lighter
 - Smaller
 - More durable
 - Available from OEM
- DOE funds truck electrification program
- DOE funds fuel cell APU
 - UC Davis, Freightliner, *et al.*
- DOE tried to fund lightweight APU
- DOD needs quiet APU (fuel cell)
 - National Automotive Center (TACOM)
 - Ballard Power Systems
 - University of Alabama



Each stakeholder has an important role

- DOE focuses on energy and emissions R&D
- EPA creates environmental policy and deploys innovative environmental strategies
 - States and municipalities set and enforce regulations
 - Need to be consistent
- DOT emphasizes infrastructure and safety
- Industry makes it happen
 - Manufacturers build equipment
 - Owners and operators purchase and use

Collaborative effort is putting the pieces together.



NATIONAL IDLING REDUCTION PLANNING CONFERENCE

*Developing comprehensive, nationwide
solutions for heavy-vehicle idling reduction*

MAY 17-19, 2004
ALBANY, NEW YORK



- 214 people attended from
 - Government at all levels
 - Industry: users, truck stop operators, manufacturers
 - Research institutions
- All relevant topic areas were covered
 - Technology and research
 - Legislation and regulation
 - Energy, environmental impacts, and economics
- Objective was coordinated action
- Major needs identified as education, consistency in regulations, and financing
- Presentations at www.orau.gov/idlingreduction



NIRP participants to generate action plan

- Industry and government agencies are cooperating
 - This was apparent from broad sponsorship of meeting
- Working groups will cover three major topic areas
 - Technology
 - Regulations and standards
 - Financial issues
- Working group volunteers will identify
 - Major issues
 - Appropriate actions and actors
 - Optimum schedule
- Report will be generated
- Progress will be tracked
- Follow-on meeting will address next steps



Thank you

- Sid Diamond – DOE FreedomCAR and Vehicle Technologies
- Frank Stodolsky- ANL

- **Disclaimer: no endorsements are implied!**
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