

# Eco-Driving 2014



WAUKESHA  
COUNTY TECHNICAL  
COLLEGE





# Welcome

Who am I?

WCTC

Who are you?

Why are we here?

**Clean Cities is on track to meet its goal of saving 2.5 billion gallons of petroleum per year by 2020. To achieve this goal, Clean Cities employs three strategies:**



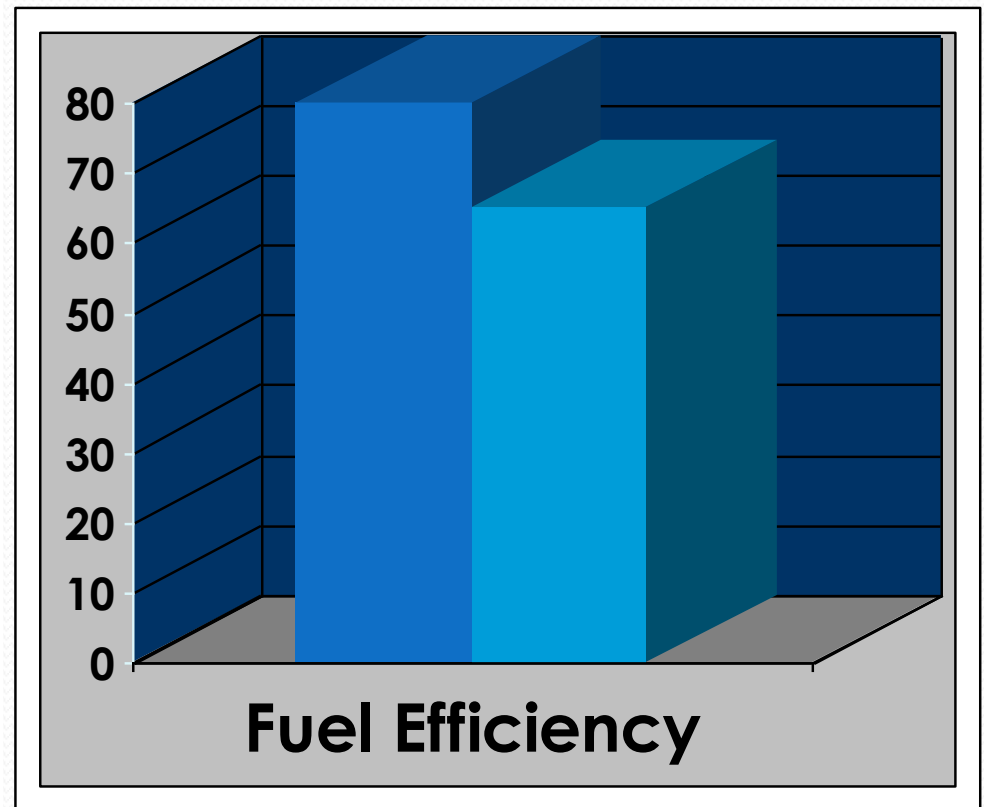
1. Replace petroleum with alternative and renewable fuels, including natural gas, propane, electricity, ethanol, biodiesel, and hydrogen;
2. Reduce petroleum consumption through smarter driving practices and fuel economy improvements; and
3. Eliminate petroleum use through idle reduction and other fuel-saving technologies and practices.

# Today's Agenda

- Welcome
- Simulator
- Class Time
- Over the Road Practice
- Wrap up

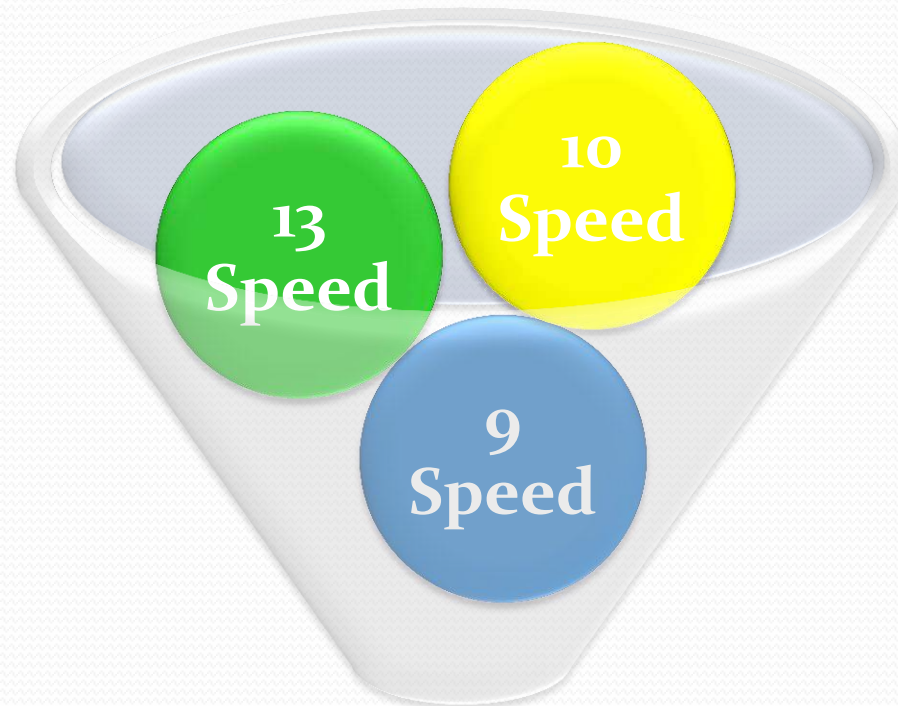
# Skilled Drivers Save Fuel

- Driver's skill level can affect fuel usage.



Skilled Drivers 80%    Unskilled Drivers 65%

# Shifting Techniques



**FOR ALL  
TRANSMISSIONS**

# Progressive Shifting

- What is progressive shifting?
  - There are 2 parts to progressive shifting:
    1. As the word implies you will use all the gears, starting with the lowest gear and moving up.
    2. The second part is shifting at lower RPMs and increasing slightly with every shift.
      - This is where you start out in Granny gear: YES the lowest gear possible.
      - Low gear is a momentum gear it is designed to get the 30,000 pound empty weight moving after that you shift every 1000 RPMs.
  - You also must use every single gear.
- When to use it?
  - Stop sign to stop sign driving, stop light, exit ramps any time safety is down to a minimum.
- Why should I use progressive shifting? What are the benefits technique?
  - Every time you follow this process and do it correctly you will save one tenth of a gallon of fuel.
  - Now one tenth of a gallon in a milk jug is not much but do this ten times a day and you save a gallon. (\$4.00 per day X 250 days = \$1000)
  - Less wear and tear on the engine, transmission and the drive train = less down time for your truck.
  - May save time in “getting up to speed.”

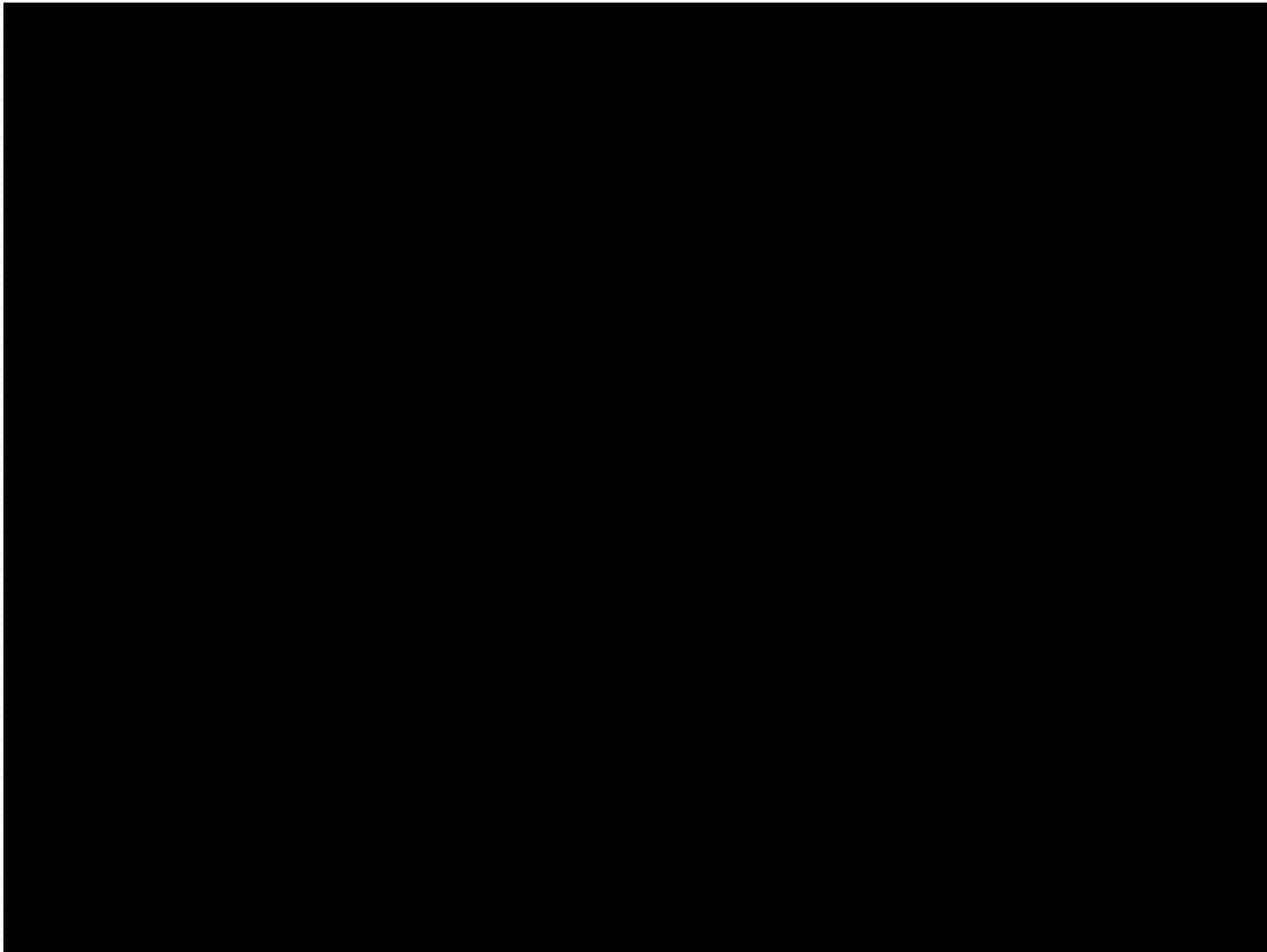
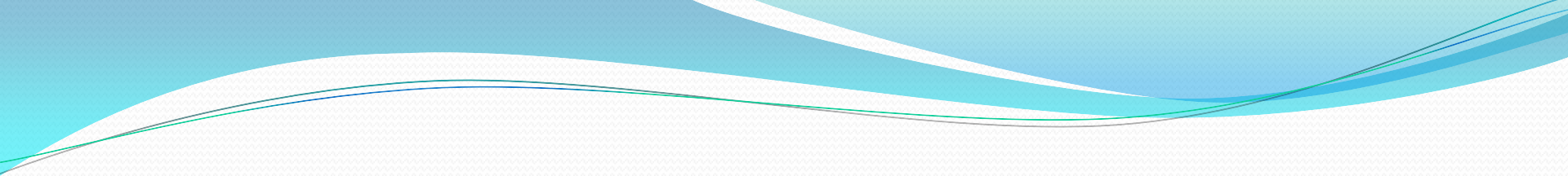
# Shifting for Fuel Economy

- Use tachometer and speedometer as shifting cues.
  - Experienced drivers have learned when to shift via listening to the engine sound.
  - You need to use the tachometer and speedometer to retrain your ears to the proper shifting points.
- Avoid lugging or over-revving engine.
  - It is more difficult to lug the engine these days because of the high torque and low RPM set up. However you must be cautious in any event of over revving.
- Don't force transmission into gear.
  - Knowing when to shift is critical, you need to make sure you are in the right gear for the right speed for the peak Torque and HP range.
  - Keep in mind that if the transmission is “fighting” you that you are probably trying to go into the wrong gear.



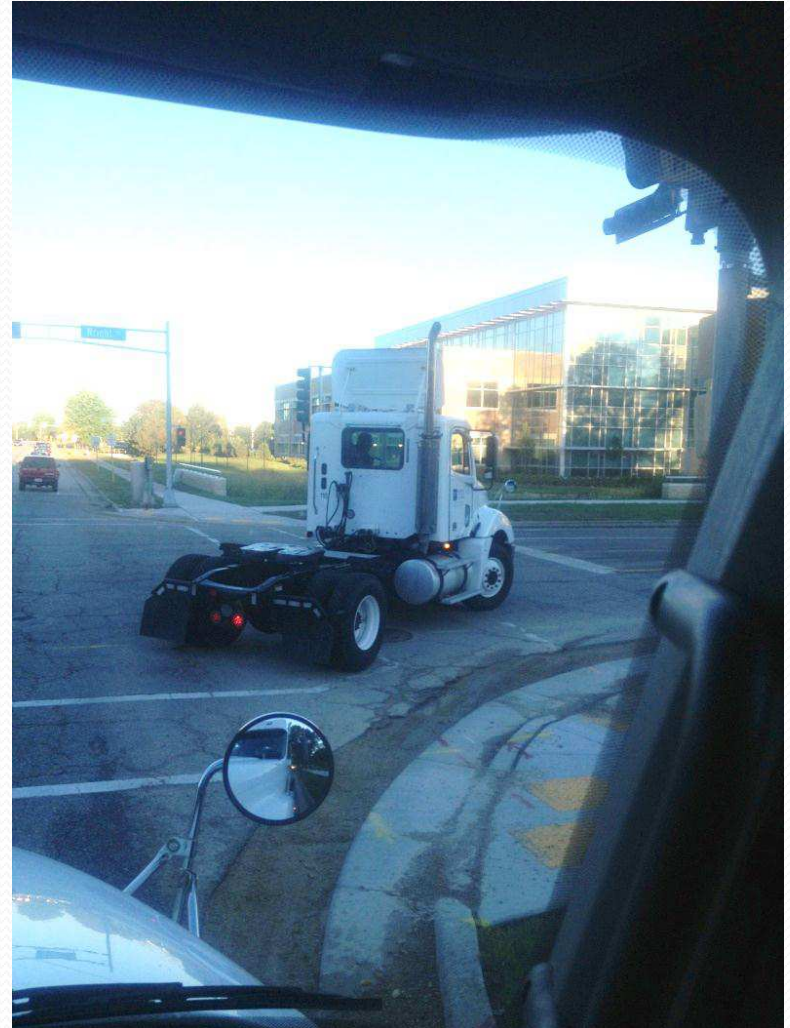
# Progressive Shifting Described

- Starting in (1<sup>st</sup>, low, Granny gear)
- Upshift between 900 - 1300 rpm in lower gears  
(varies per truck)
- Upshift between 1400 – 1600 rpm in upper gears  
(varies per truck)
- Downshift around 1100-1200 rpm (varies per truck)



# Avoid Rapid Starts

- Rapid starts burn excessive fuel because the engine is winding too high of rpm's.

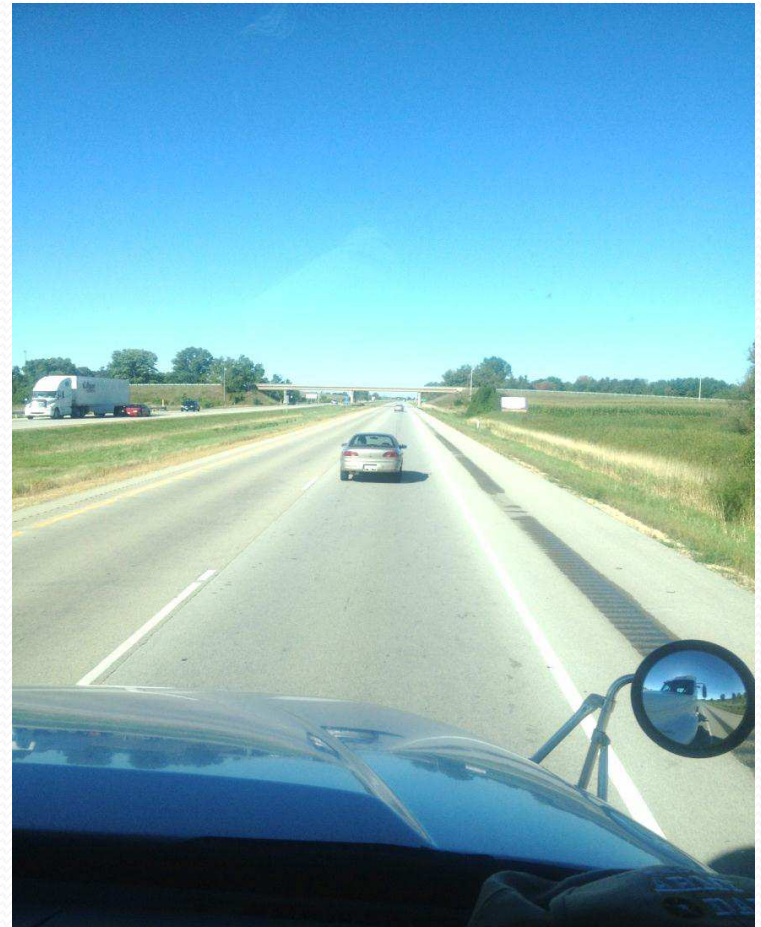


# Shifting for Grades

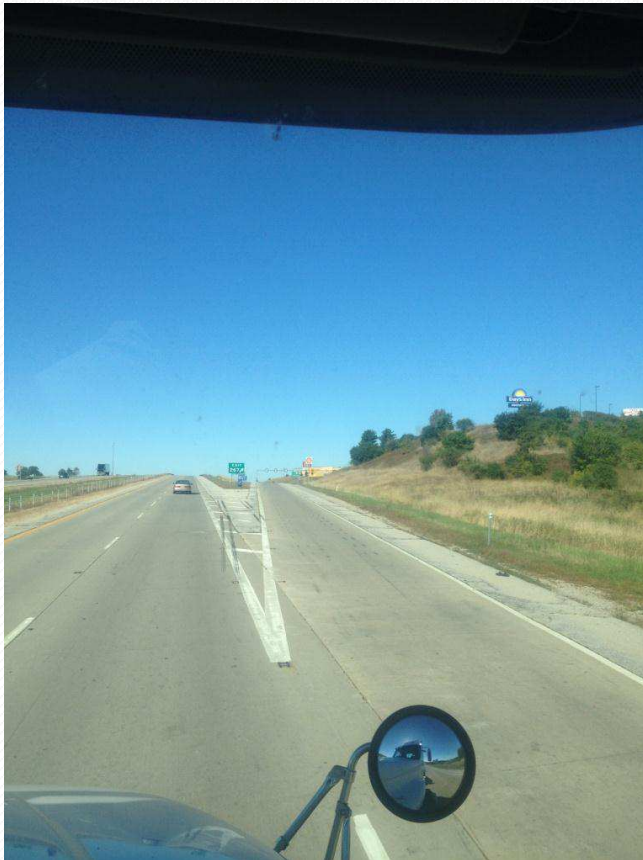
- Avoid downshifting too early.
  - The steepness and length of the grade, as well as the weight of the load and road conditions must all be taken into consideration when approaching an upgrade.
- Slight “lugging” is OK as long as road speed is maintained.
- Keep rpm as low as possible on the way up the grade – high rpm consumes more fuel that cannot be recovered on the downgrade.
  - Use appropriate upgrade and downgrade techniques if driving in mountains or large hills.

# Cruise in Top Gear

- Operate in the highest gear possible – do not run one gear down.
- Keep engine below 1500 rpm (varies per truck).



# Rolling Under Power

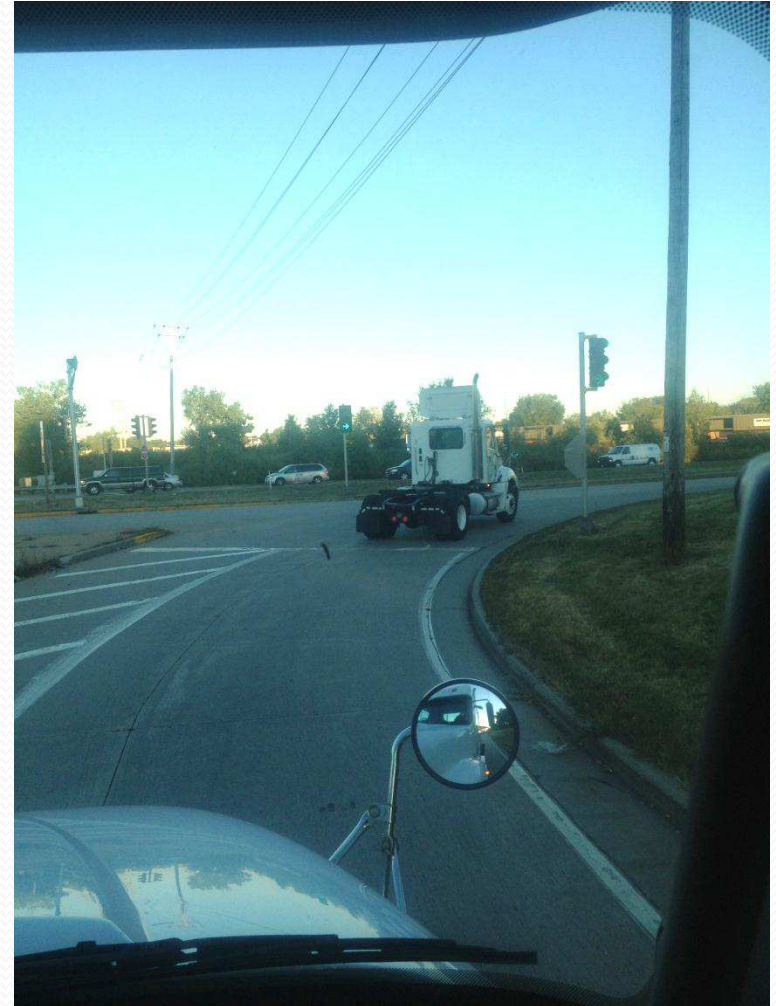


- Anticipate slowdowns and stops.
- Roll in gear as long as possible to improve overall fuel economy.
- By slowing down and keeping under power, you will be able to keep your momentum going forward and be ready to apply power more quickly when needed.
- It takes more fuel to start a vehicle from a complete stop than from a slow roll.
- Do not “coast” with the clutch engaged. You are not in full control of the vehicle.



# Braking

- Use the braking system to slow the momentum of the vehicle – excessive engine braking wastes fuel.
- Try to use your vehicle brakes more. The old habit of hard engine braking to slow the vehicle down wastes fuel.
- Engine braking is still a useful tool when used in appropriate situations.



# Create Efficient Route Plans



# Topography

- Flat Land
- Hills
- Mountains



# Route Location and Stops

- City, Urban, Rural
- Timing of Load Deliveries
- Cargo Restrictions – Hazmat, oversized loads...

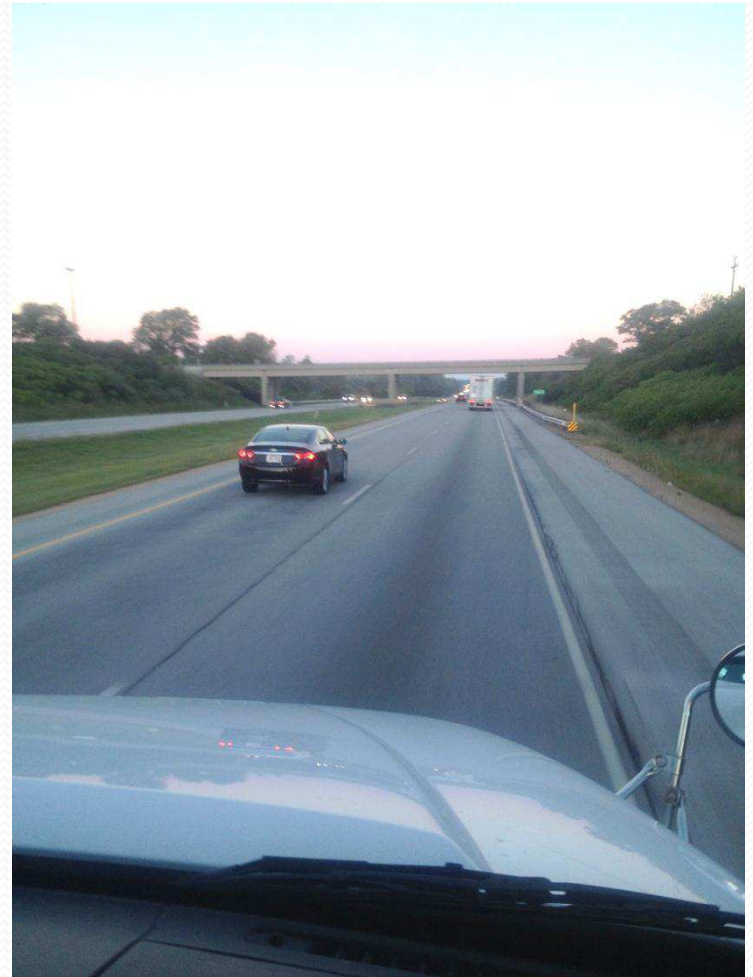
# Road Surfaces

- Rolling resistance to tires.
- Concrete, Asphalt, Gravel

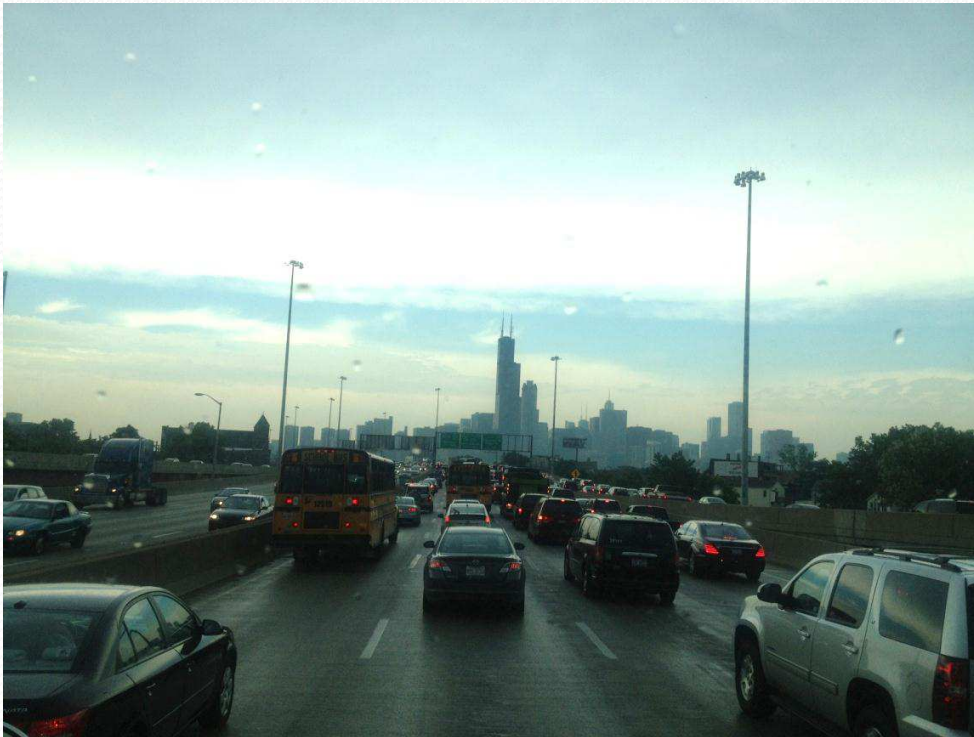


# Road Design

- Interstate system – freeway, toll-way.
- Two lane urban/rural – straight, high or low speed curves.
- Two lane city – stoplights, stop signs, roundabouts...



# Traffic Patterns (Time of Day)



- Speed Changes
- Sudden braking –  
loss of kinetic  
energy.



**Reduce Idle Time**

# What Is Idling?

**When a vehicle is running for nonpropulsion purposes, it is idling.**

- Nearly all vehicle types can idle, and they do so for many reasons and for varying periods of time. The vehicle operator is usually in charge of whether to idle the vehicle.
- While this definition is generally good, it suggests that a good solution is to just turn the key. While that's sometimes true, it's more complicated than that. With the current state of technology, some types of engine idling are easier to remedy than others.
- Educating drivers, fleet managers, and other decision-makers about the consequences of unnecessary idling—and ways to reduce it—is one of Clean Cities' goals.



# What Is Idling?

When a vehicle is running for nonpropulsion purposes, it is idling.



## Examples

- Trucks idling while in queue.
- Vehicles waiting to load/unload passengers or goods, including:
  - Delivery trucks
  - Shuttle buses
  - Taxis



# Some Idling Is Difficult To Avoid

- Sometimes, idling is difficult to avoid, usually when there is a *non-propulsion* need for power (some work vehicles are equipped with “power take-off” or PTO). “Idling for power” does not have a one-size-fits-all solution. The best solution will depend on the particular power needs.
  - Long-haul trucks may idle to provide heating or cooling for drivers during overnight rest periods. Police cars may idle not only to power warning lights and communications equipment, but to be “at the ready.”
  - Knowing the “why” of idling is important for evaluating potential solutions. Optimal solutions for delivery trucks will likely be different from those for work trucks.
- Running emergency lights and other auxiliaries (emergency vehicles, utility vehicles).
  - Powering HVAC (all vehicle types, for operator and passenger comfort in extreme weather).
  - Performing nonpropulsion (PTO) work (bucket trucks, sewer-line maintenance trucks, wood chippers).



# Most Idling Is Wasteful

## Waiting in Queue

- Delivery trucks, transit buses and motor coaches, shuttle buses, taxis, railroad crossings.

## Engine Warming

- Today's vehicles warm up faster by being driven than idling.

## Sitting in Vehicle

- During lunch breaks, to complete paperwork, to make phone calls.

Eliminating unnecessary idling is a very low-hanging fruit. It's money in your pocket or in your fuel budget. Often, no investment is required and savings are immediate.



# Why Care About Idling?

## Idling Pollutes!



# Idling Pollutes

- Each gallon of fuel burned produces about 20 pounds of carbon dioxide, a greenhouse gas.
- Nationally, 27% of greenhouse gas emissions come from transportation.
- Pollution from motor vehicles contributes to the formation of ground-level ozone.
- Each year, U.S. passenger vehicles, light trucks, medium-duty trucks, and heavy-duty vehicles consume more than 6 billion gallons of diesel fuel and gasoline combined—without even moving.
- Roughly half of that fuel is wasted by passenger vehicles (cars and light trucks), and the remaining half by medium- and heavy-duty vehicles.
- Generally, the bigger the vehicle's engine, the more fuel it consumes when idling.
- In addition, idling vehicles emit carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), particulates (PM<sub>10</sub> and PM<sub>2.5</sub>), and nitrogen oxides (NO<sub>x</sub>). These emissions, along with noise from idling vehicles, have led to many local and state restrictions on idling.

# Idling Threatens Health

- The most significant health impacts of transportation stem from tailpipe emissions.
- Particulate matter irritates the eyes, nose, throat, and lungs, contributing to respiratory and cardiovascular illnesses and even premature death.
- Ozone can inflame and damage the airways and **aggravate lung diseases such as asthma, emphysema, and chronic bronchitis.**



# What Can YOU Do?

**3** Steps to Idling Reduction



# You Can . . .

## Step 1: Be AWARE

Reducing idling saves money and protects the air.

- Turn off vehicles when not moving.
- Set policy to reduce unnecessary idling.
- Identify nonvehicle solutions when possible.
- Consider alternative power sources to provide necessary services.





**You Can . . .**

## **Step 2: EDUCATE Drivers**

**Inform your drivers about idling reduction.**

- Adopt an idling reduction policy.
- Host an idling reduction workshop for drivers.
- Post signs to remind drivers NOT to idle.
- Ask drivers to make a pledge to idling reduction.
- Offer incentives/rewards for idling reduction efforts.





# You Can . . .

## Step 3: CONSIDER Technology

### Engine Idle Management Systems

- These systems simply shut down a vehicle's engine after a preset amount of time, such as 3 minutes.

### Heaters for Cab and/or Engine Block

- These units use much less fuel than idling an engine. Engine block heaters warm an engine (or keep it warm) to avoid the prolonged idling required for the warm-up of some diesel engines.

### Auxiliary Power Systems

- Auxiliary power systems provide power for HVAC, electronics, and other devices. Some systems provide power for power take-off (PTO) equipment.

### Electrified Parking Spaces

- Electrified parking spaces (EPS) allow truck drivers to shut off their engines and power HVAC, electronics, and more with electricity.

Finally, some fleet management telematics systems enable the monitoring of vehicles' idling times. Identifying "high idlers" or unexpected idling patterns may be a first step in devising a plan to reduce idling.

# Idle Thoughts

- Limit Warm-Up Time
- Use Auxiliary Power Units
- Excessive idling wastes fuel, adds contaminants to the oil, and adds carbons to the combustion chamber. Reduction of idle time from 50% to 25% can improve fuel economy up to 4%.
- The engine will warm up and approach operating temperature while you are driving at low RPM's and low power as you begin your trip.
- Use an APU for heating and cooling the cab when stopped (5 Minutes- overnight). The APU will use about 1 gallon of fuel per night as opposed to 1.5 gallons per hour on the main engine.

# Speed and Space Management Techniques

Proper speed management means operating at the appropriate speed for road conditions.

# Keep Vehicle Speed Down

- Fuel economy drops about one tenth of a mile per gallon for every mile over 55mph.
- Example:
  - 5 mpg at 65 mph
  - 6 mpg at 55 mph
  - 125,000 miles per year
  - \$3.00 per gallon
  - How much would you save by driving at 55 mph instead of 65? **\$12,501!**

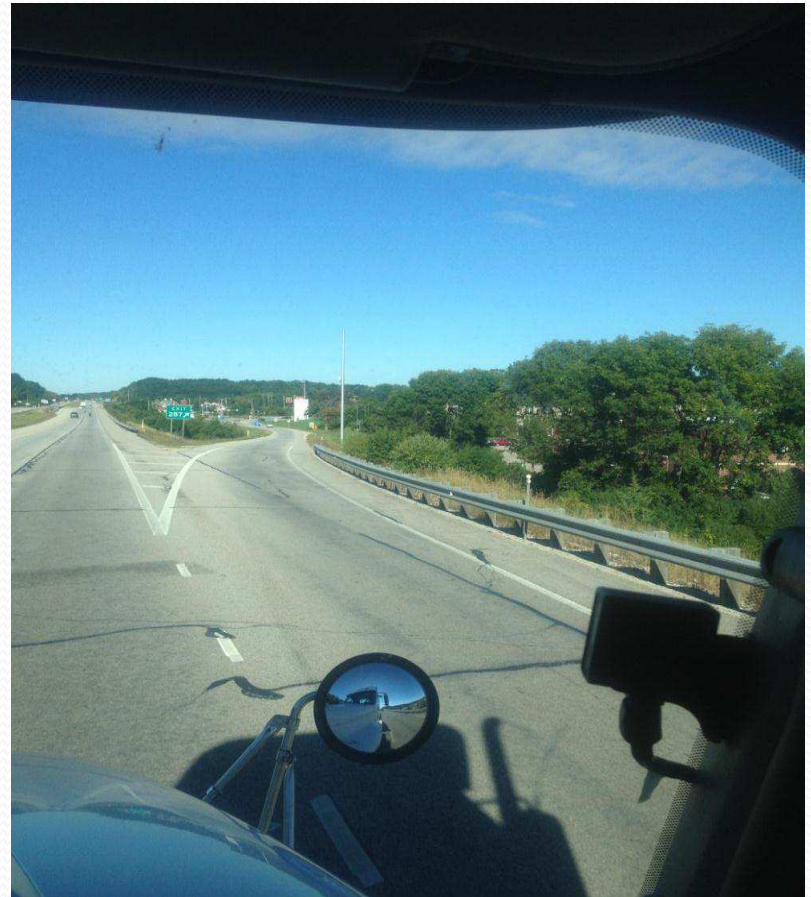
# Cruise Control



- Using cruise control helps maintain average speed and aids in better fuel economy.
- Use as much as traffic patterns and weather permit.

# Rolling Under Power

- Roll in gear and under control!
- By slowing down and keeping under power, you will be able to keep your momentum going forward and be ready to apply power more quickly when needed. It takes more fuel to start a vehicle from a complete stop than from a slow roll.
- Do not “coast” with the clutch engaged. You are not in full control of the vehicle.





# Size and Type of Load

- Empty
- Loaded - Partially or Fully
- Over-Sized
- Type of Trailer
  - Trailers – flat bed, curtain side, van, refrigerated, doubles, triples, tankers...
  - Will the load shift? (liquid in tankers, livestock, sand/gravel, etc.)

# Weather

- Precipitation (rain, snow, fog, sleet...)
  - Traction is necessary to start and stop the vehicle – less friction between the road and the tires, means less traction.
  - Visibility may be helped by slowing down
- Head winds as opposed to trailing winds.
- Cross winds – slow down!
- Temperature and Humidity
  - Air density increases fuel consumption.
  - Humidity increases drag.





# Conduct Proper Inspections to Maintain Vehicle

This can go a long way in ensuring your vehicle's safe and  
efficient operation

It's also required by Law!

# Pre-Trip Inspection

- Complete a full pre-trip inspection each time you get into the vehicle for a new shift.
- Tire Pressure
  - Improperly inflated tires can reduce fuel economy.
  - Tires that are 10 psi too low can decrease fuel economy by 0.05%.
  - Low inflation also diminishes tire life expectancy.
- Proper Lubrication
  - Reduces friction and wear.
- Check Braking System
  - Allows for proper control if adjusted and maintained.
  - No loss of forward momentum by grabbing or sticking brakes.



# En-Route Inspection



- Allows drivers to recheck important areas of the vehicle and take appropriate maintenance steps while in a relatively safe environment.
- Saves breakdowns on the road – saves fuel, time, major repair bills, and aggravation for you, **and** time and fuel for the “gawkers” that slow down and cause the backup to see you alongside the road.

Another good reason for  
Pre-trip and En-route  
inspections...



# Other Fuel Saving Ideas

# Fuel at Night or Early Morning?

- This often considered myth is actually true.
  - Heat creates vapors which take up space in your tank.
  - Fueling in the morning or at night means lower temperatures creating less vapors thereby leaving more room for fuel.





# Alternate Fuel Usage

- Natural Gas Engines (Compressed Natural Gas & Liquefied Natural Gas)
  - Natural gas is a clean-burning alternative fuel that offers a number of advantages to users.
  - It is colorless, non-corrosive and odorless, though an odorant is commonly added to aid in leak detection.
  - A switch from diesel to natural gas has the potential to result in lower levels of emissions, including Nox and PM.
  - Natural gas is also generally less expensive than diesel or gasoline.
- Propane Engines (Liquefied Petroleum Gas)
  - Propane is a low carbon, clean burning fuel, a switch to propane has the potential to result in reductions of hydrocarbon, carbon monoxide (CO), Nox, and GHG emissions.
  - Propane is also nontoxic, so it is not harmful to soil or water when spilled or leaked.
- Engines Certified for Biodiesel
  - Produced from vegetable oils, animal fats, or biomass conversion.
  - B5 – 5% biodiesel, 95% petroleum diesel can be used in any diesel vehicle.
  - B20 – 20% biodiesel, 80% petroleum diesel must be used for engines certified by the manufacturer.
  - Significant reductions of PM, CO, and hydrocarbon emissions can be achieved with B20 blends.
  - Minor impacts to torque and fuel economy are related to the lower energy density of biodiesel fuels.
- Microturbines (Auxiliary Power Unit)
  - It charges batteries which in turn power an electric motor that drives the wheels of the vehicle.
  - The microturbine can be fueled with natural gas, waste methane, biodiesel, diesel, or propane.



# CNG, LNG

Manufacturer: Peterbilt

Manufacturer Website:

*[www.peterbilt.com](http://www.peterbilt.com)*

Model: 365

Application: Tractor

Fuel Type(s): CNG, LNG

Power Source(s): Cummins

Westport ISL G 8.9L



# Reduce Trailer Drag

- Trailer Gap Reduction
  - Minimizing trailer gap enhances the truck aerodynamics, which improves fuel economy.
  - Every 12” increase in trailer gap results in a 1% decrease in fuel economy.
- Trailer Skirts
- Trailer “Boat Tails”



# Air Conditioning vs. Windows Down

- Keep the windows open until 50 mph then close them for less drag.
- Don't run with "fan on" while driving – unless needed. The engine fan draws 60 to 80 hp and reduces fuel economy.
- It depends on your driving speed, but there are times when using the air conditioning system can be more fuel efficient than rolling the windows down.
- Based on a study conducted by the Society of Automotive Engineers (SAE), driving with the windows up and the air conditioning on is typically a more fuel efficient way to drive. The study concluded that the more aerodynamic the vehicle, the more drag open windows will create. So, when traveling at speeds around 50 mph or faster, air conditioning is usually a better bet.

# Wrap Up

- Progressive Shifting
- Efficient Route Plans
- Reduce Idle Time
- Speed and Space
- Inspections

# Thank you!

Time to Practice!

