NC Transit
Alternative Fuels
Committee Report

September 2008

Purpose of this Report

With a small portion of North Carolina's urban transit bus fleet using some type of alternative fuel, transit systems need incentives to consider alternative fueled vehicles in greater numbers. The Alternative Fuels Committee was created to develop an education process, identify resources, create strategies to use alternative fuels, and consider possible legislative change recommendations.

The Committee is made up of representatives from NC transit systems, the North Carolina Public Transportation Association, the North Carolina Solar Center/NC State University, the Institute for Transportation Research and Education/NC State University, and the Clean Cities Coalition of the Land-of-Sky Regional Council. The NCDOT/Public Transportation Division was an honorary member of the Committee.

This report draws on the research of the committee to summarize the issues regarding alternative fuel transit vehicles, make recommendations for purchasing new vehicles and retrofitting old ones, create baseline qualifications for transit systems before receiving alternative fuel funding, recommend future implementation steps to make alternative fuel vehicles more prevalent, and recommend changes to local and state policies and practices.

Why Alternative Fuel Sources?

There are five primary reasons in North Carolina to study the use of alternative fuel vehicles:

1. **Economics-**With energy prices rising, some alternative fuel vehicles are now becoming less expensive alternatives over the life cycle of the bus than typical diesel buses. Conventional buses running on Ultra Low Sulfur Diesel (ULSD) or biodiesel are the cheapest to purchase. However, with the high price of fuel, some alternative fuel vehicles are anticipated to have cheaper operating costs over 12 years.

2. **Fuel Efficiency-** Achieving a higher mile per gallon rate for transit vehicles decreases energy use and reduces North Carolina's dependence on imported energy sources. Many alternative fuel vehicles achieve better fuel economy than traditional diesel buses.

3. **Ozone Air Quality-** Nitrogen oxides (NO_x) are the primary reason for Code Orange and Code Red ozone air quality days in North Carolina. Thirty-two counties in North Carolina have been designated by the EPA as being in non-attainment for 8-hour ozone emissions.[1] Some alternative fuel vehicles emit less NO_x than diesel buses.

4. **Particulate Matter Air Quality-** Particulate matter (PM) emissions, to a lesser degree than NO_x, have a negative impact on North Carolina air quality. Two counties in North Carolina have been designated non-attainment areas by the EPA for PM 2.5 (particulate

[1]NC Dept. of Natural Resources, Div. of Air Quality website: http://daq.state.nc.us/permits/erc/ercinfo.shtml, accessed July 3, 2008

matter less than 2.5 microns in width).[2] Many alternative fuel vehicles emit less PM than diesel buses.

5. **Greenhouse Gas Emissions-** Carbon dioxide (CO^2) is the primary reason for greenhouse gas related climate change from diesel engines in North Carolina. Some alternative fuel options reduce CO^2 emissions. Most alternative fuel vehicles have fewer CO^2 emissions than diesel buses.

Background Information

The State of North Carolina has been active in creating air quality legislation over the last several years. The legislation has ranged in focus from ozone pollution reduction to warranties to diesel school buses using B20 to retrofitting school buses in non-attainment areas. Discussion of two pieces of legislation follows.

Senate Bill 953

In 1999, the North Carolina Legislature passed Senate Bill 953, with the main purpose to reduce ozone air pollution by reducing emissions of nitrogen oxides (NO_x) from motor vehicles by 25 percent by July 2009. Section 4.4 of the bill requires that the:

> "*Department of Transportation and the Department of Environment and Natural Resources shall jointly develop a draft plan for the purchase of buses under which, beginning 1 January 2004, at least fifty percent (50%) of the new and replacement buses purchased to provide public transportation in counties in which motor vehicle emissions inspections are required to be performed under subsection (c) or (d) of G.S. 143-215.107A will be alternative-fueled or low emission vehicles."*[3]

Forty-eight counties require motor vehicle emissions inspections. The only county with an urban bus fleet that is not required to have motor vehicle emissions inspections is Watauga.[4]

Senate Bill 1277

In July 2007, the North Carolina Legislature passed Senate Bill 1277, which addresses a major concern with the use of biodiesel by requiring that diesel vehicle warranties not be violated by the use of biodiesel. This bill states:

> *"Every new motor vehicle purchased by the State that is designed to operate on diesel fuel shall be covered by an express manufacturer's warranty that allows the use of B-20*

[2] NC Dept. of Natural Resources, Div. of Air Quality website: http://daq.state.nc.us/permits/erc/ercinfo.shtml, accessed July 3, 2008

[3] NC General Assembly website, http://www.ncga.state.nc.us/gascripts/BillLookUp/BillLookUp.pl?Session=1999&BillID=S953, accessed July 3, 2008

[4] NC Dept. of Natural Resources, Div. of Air Quality website: http://daq.state.nc.us/motor/inspect/inspect_faq.shtml, accessed July 3, 2008

fuel, as defined in G.S. 143-58.4. This section does not apply if the intended use, as determined by the agency, of the new motor vehicle requires a type of vehicle for which an express manufacturer's warranty allows the use of B-20 fuel is not available."

Environmental Protection Agency

The Clean Air Act of 1990 gave the U.S. EPA broad powers to set national air quality standards. These powers include setting limits on how much of a given pollutant can be in the air anywhere in the United States, and approving State Implementation Plans (SIPs) that explain how each state intends to meet clean air requirements.[5]

The EPA has mandated that all diesel fuel sold after December 2010 must meet strict low emissions standards. This fuel is called Ultra Low Sulfur Diesel (ULSD). Eighty percent of diesel fuel must meet this standard today and is virtually the only type of diesel sold in NC.

The EPA has also mandated that beginning in 2007, new diesel engines must meet strict emission control guidelines. New diesel engines sold from 2004-2006 must meet standards somewhat less stringent. The EPA has developed a diesel retrofit technology program designed to encourage diesel fleet owners to adopt pollution-reducing retrofit strategies for existing engines.[6] Retrofit programs can be used to generate State Implementation Program (SIP) credits. EPA is encouraging states, local agencies, and other organizations to promote the diesel retrofit technology program and to incorporate this program into their SIP.

North Carolina's Urban Transit Fleet

As of October 2007, North Carolina's urban transit bus fleet consists of 818 vehicles with the following fuel types:

- 682 (83%) ultra-low sulfur diesel buses
- 124 (15%) bio-diesel buses
- 5 (<1%) hybrid diesel electric buses
- 4 (<1%) hybrid electric trolleys
- 2 (<1%) kerosene buses
- 1 (<1%) compressed natural gas bus

Vehicles in the urban transit bus fleet are in the following age groups:

- 226 (28%) built before 2000
- 411 (50%) built between 2000 and 2003
- 181 (22%) built after 2003

[5] United States Environmental Protection Agency website, http://www.epa.gov/air/ozonepollution/SIPToolkit, Accessed August 4, 2008

[6] United States Environmental Protection Agency website, http://www.epa.gov/otaq/retrofit/index.htm, Accessed August 1, 2008

Fuel Types Description

Ultra-Low Sulfur Diesel

Ultra-low sulfur diesel (USLD) is a new diesel fuel blend designed to decrease emissions by containing a maximum of 15 parts per million of sulfur.[7] Most diesel fuel currently available is ULSD. Engines designed for previous diesel blends can use ULSD. Most urban transit buses use ULSD, making it the baseline technology for alternative fueled vehicles. To decrease emissions, ULSD powered buses often include other technologies that clean the exhaust. These technologies are discussed later in the report

Compressed Natural Gas

Compressed natural gas (CNG) is derived from methane, a byproduct of petroleum drilling, and also can be captured from other sources, such as landfill gases.[8] CNG and other natural gas fuels, such as liquid natural gas, make up about 12% of the national bus fleet.[9] CNG is used by some of the largest transit fleets in the nation, including New York City and Washington, DC.

There are several CNG refueling stations in North Carolina, with at least one station in many of the larger urban areas.[10] The high infrastructure costs for CNG and the lack of evidence that it is clearly better than other options means that CNG remains an option in areas with fueling stations, but new infrastructure should not be built unless the CNG provider agrees to fund the infrastructure. Therefore, CNG is not a major component of this report.

Biodiesel

Biodiesel is a renewable energy source that diversifies the fuel supply. Biodiesel vehicles are the same as ULSD vehicles. No vehicle modifications are required. Biodiesel is a combination of plant oil or animal fat derived fuel and ULSD.[11] Biodiesel comes in a range of different blends, with B2 indicating 2% biodiesel blended with 98% ULSD and B99 representing 99% biodiesel and 1% ULSD. B5 and B20 are the most popular blends for transit buses. A transit system can purchase pre-blended biodiesel or blend the fuel themselves. The trend over recent years has been for biodiesel to cost slightly more than ULSD.

Transit properties in North Carolina have had varying experiences with implementing biodiesel, but it is believed that most of the setbacks have been overcome.[12] The failures in the past are primarily related to transit systems switching between ULSD and biodiesel, which is not

---

[7] "*Clean Transportation Options for Transit*" Presentation November 5, 2007. NC Solar Center, NCSU.
[8] "*Clean Transportation Options for Transit*" Presentation November 5, 2007. NC Solar Center, NCSU.
[9] "*Clean Transportation Options for Transit*" Presentation November 5, 2007. NC Solar Center, NCSU.
[10] North Carolina DENR Div. of Air Quality website, http://www.ncair.org/motor/cng/refuel.shtml , Accessed August 4, 2008
[11] National Biodiesel Board website, http://www.biodiesel.org/resources/faqs/default.shtm, Accessed July 3, 2008
[12] Based on the experiences of Triangle Transit, Chapel Hill Transit and AppalCART

advisable due to the maintenance work required to prepare the fuel systems for the differences in the fuels. *(note: With 2010 EPA standards, Gillig estimates additional costs of up to $20,000 per vehicle – will this affect cost comparison between diesel and hybrid?)*

Diesel Hybrid

Diesel hybrid buses combine a diesel engine using ULSD with an electric drive motor and batteries. Some diesel hybrid manufacturers use the electric motor solely to power the vehicles and the diesel engine to charge the batteries. Other manufacturers use both the electric motor and diesel engine to power the vehicles, with the diesel engine engaging to recharge low batteries or to supplement the electric motor when more power is required.[13] As of 2007, 2-3% of the existing transit bus fleet in the United States are hybrids, but 22% of the new buses on order are hybrids.[14]

Comparison of Alternative Fuel Types for New Transit Buses

1. Economics

Capital Cost Comparison

Diesel hybrid vehicles cost roughly $530,000. They are $210,000 (65%) more expensive to purchase than ULSD and biodiesel vehicles, which cost $320,000.[15] Necessary depot modification costs for diesel hybrids vehicles include battery maintenance equipment, which cost around $1,400 per vehicle in a 100 vehicle fleet. There are no substantial depot modifications required for ULSD or biodiesel buses.

Operating Cost Comparison

Diesel hybrids are more fuel efficient than ULSD buses, which are slightly more fuel efficient than biodiesel buses. It is anticipated that a diesel hybrid bus will require new batteries at least once during its life cycle, at a cost of $67,500 per vehicle.[16] Fuel, however, represents the greatest cost for a transit bus over its life cycle. At the current fuel cost of $4.66/gallon for diesel and $4.86/gallon for biodiesel, 12 year operating costs for buses averaging around 37,000 miles per year are expected to be:[17]

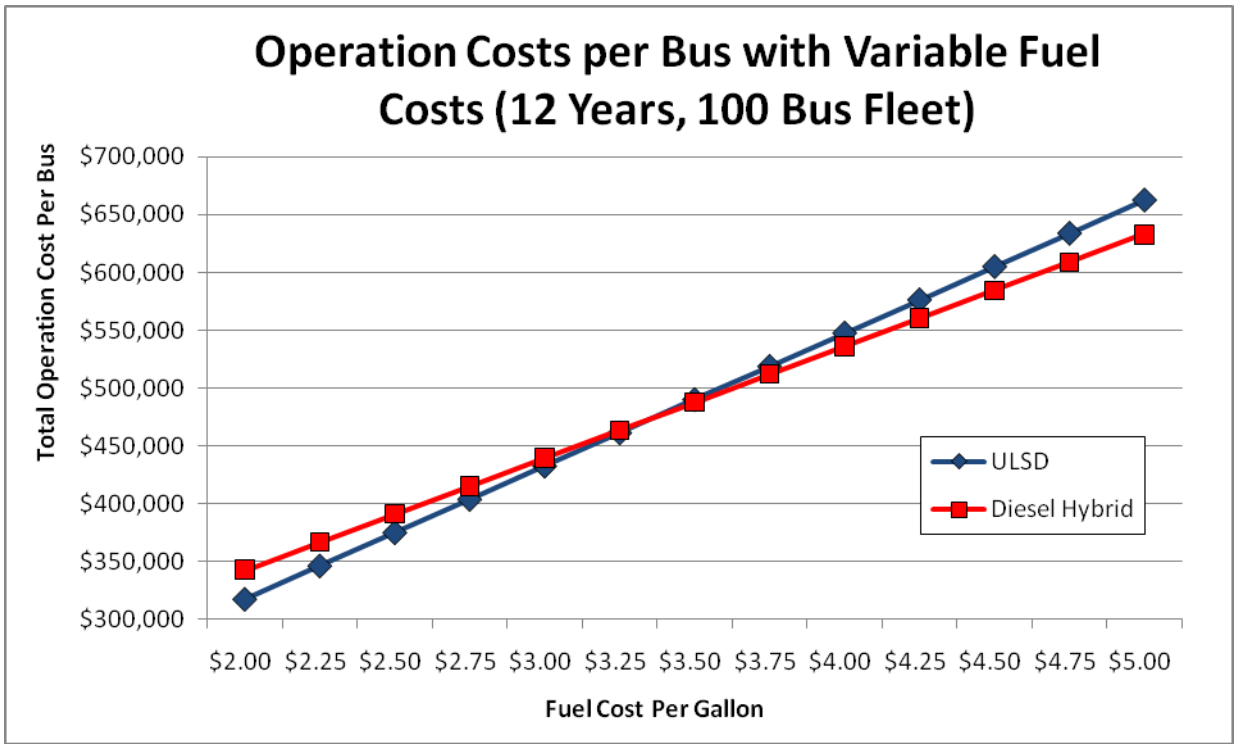
- ULSD- $624,000
- Biodiesel: $653,000
- Diesel Hybrid: $602,000

---

[13] "*Clean Transportation Options for Transit*" Presentation November 5, 2007. NC Solar Center, NCSU.
[14] "*More Cities Get Onboard with Hybrids*". USA Today. January 22, 2008.
[15] Transit Bus Lifecycle Costs and Year 2007 Emissions Estimation. U.S. DOT Federal Transit Administration, FTA-WV-26-7004.2007.1. July 2, 2007.
[16] Transit Bus Lifecycle Costs and Year 2007 Emissions Estimation. U.S. DOT Federal Transit Administration, FTA-WV-26-7004.2007.1. July 2, 2007.
[17] U.S. Energy Information Administration website, http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp, Accessed July 3, 2008

Fuel prices are difficult to predict over time, so Figure 1 shows the difference in operating costs for a ULSD bus and a diesel hybrid bus with variable fuel costs. When the fuel price surpasses $3.39/gallon, it is estimated that the life cycle operating cost of a diesel hybrid bus will become increasingly less expensive than the ULSD bus. [18]

Figure 1. Life Cycle Operation Costs per Bus (100 Bus Fleet)

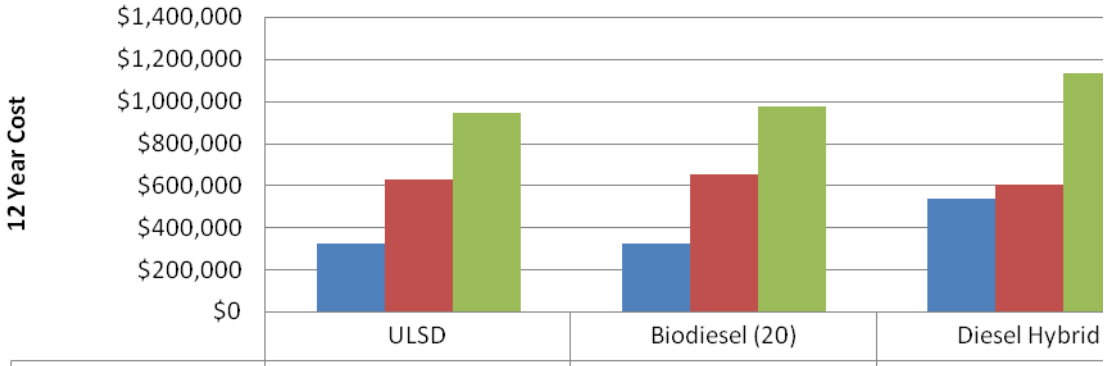


Total Cost Comparison

The total operating and capital costs for one bus in a 100 bus fleet are displayed in Figure 2. ULSD vehicles are estimated to cost roughly $28,000 less than biodiesel vehicles and roughly $189,000 less than diesel hybrid vehicles over the life cycle.[19] However, it is important to note that there are different subsidies in place for capital costs than there are for operating costs. The federal government pays 80% of the capital costs for new vehicles and will pay for 90% of the difference in the purchase price between the diesel hybrid and ULSD/biodiesel vehicles in air quality non-attainment areas.[20] For instance, if a new diesel hybrid costs $530,000 and a ULSD bus costs $320,000, the federal government will pay 90% of this $210,000 difference. With this subsidy, the federal government is encouraging states and municipalities to purchase alternative fuel vehicles by shouldering a greater portion of the financial burden.

[18] Modified from FTA-WV-26-7004.2007.1 by adjusting fuel price.
[19] Modified from FTA-WV-26-7004.2007.1 by adjusting fuel price.
[20] United States Environmental Protection Agency website, http://www.epa.gov/EPA-AIR/2007/March/Day-30/a5879.htm, Accessed August 4, 2008

Figure 2. Life Cycle Cost per Bus (100 Bus Fleet)



	ULSD	Biodiesel (20)	Diesel Hybrid
Capital Costs	$321,143	$321,143	$533,005
Operations Costs	$624,777	$653,381	$601,817
Total Life Cycle Cost	$945,920	$974,524	$1,134,822

2. *Energy Efficiency*

Figure 3 shows the fuel economy of each fuel type, averaged by different types of transit vehicles. Diesel hybrids use less fuel than traditional diesel powered buses because the propulsion is supplemented with an electric motor. In this estimation, diesel hybrid buses are 19% more fuel efficient than ULSD, which is at the low end of other studies that showed a 20-40% increase in efficiency. Diesel hybrids are 21% more fuel efficient than Biodiesel 20.[21]

3. *Ozone Air Quality Comparison*

Nitrogen oxide (NO_x) is a primary contributor to ozone air quality alert days in North Carolina. Diesel hybrids were shown to emit 5% less NO_x than ULSD and 8% less NO_x than Biodiesel 20, when the different service types (express, high-density urban, low density urban) were averaged.[22] (Figure 4)

4. *Particulate Matter Quality Comparison*

Diesel hybrids emit 57% less particulate matter (PM) than ULSD and 45% less PM than Biodiesel 20, when the different service types were averaged.[23] (Figure 5)

5. *Greenhouse Gas Emissions*

Carbon dioxide (CO^2) is an unavoidable byproduct of burning fossil fuels. Diesel hybrids emit 21% less CO^2 than ULSD vehicles and 23% less CO^2 than Biodiesel 20 vehicles, when averaged by service type.[24] (Figure 6)

[21] Modified from FTA-WV-26-7004.2007.1 by averaging fuel economy by service type.
[22] Modified from FTA-WV-26-7004.2007.1 by averaging emissions by service type.
[23] Modified from FTA-WV-26-7004.2007.1 by averaging emissions by service type.
[24] Modified from FTA-WV-26-7004.2007.1 by averaging emissions by service type.

Figure 3. Average Miles Per Gallon

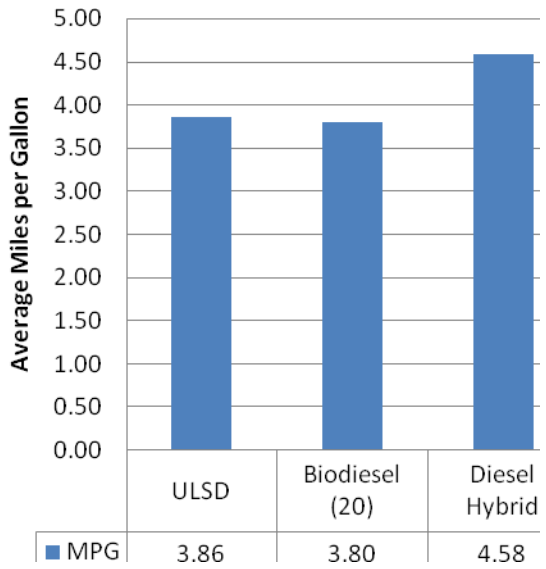


Figure 4. Average NO_x Grams Per Mile

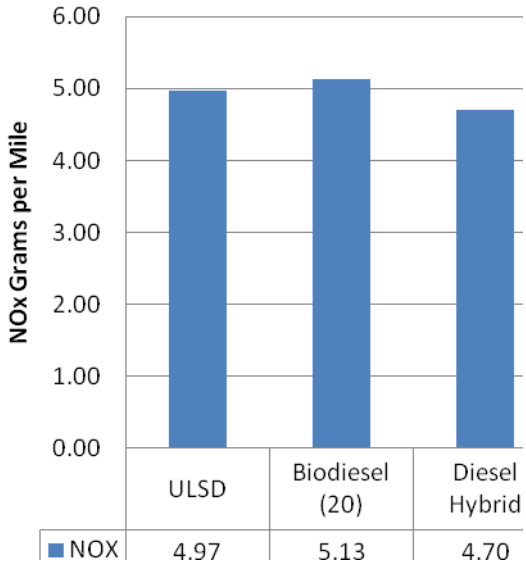


Figure 5. Average PM Grams per Mile

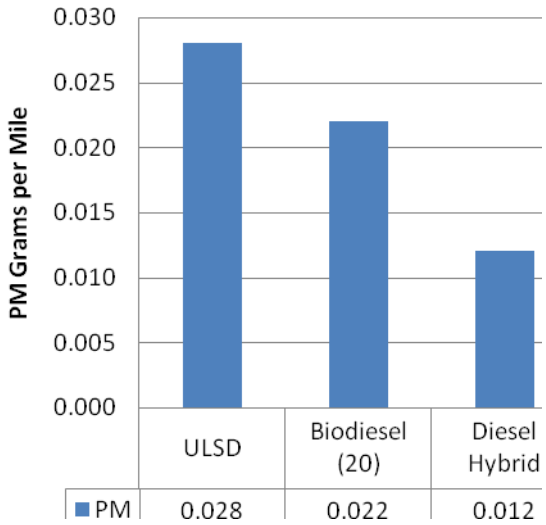
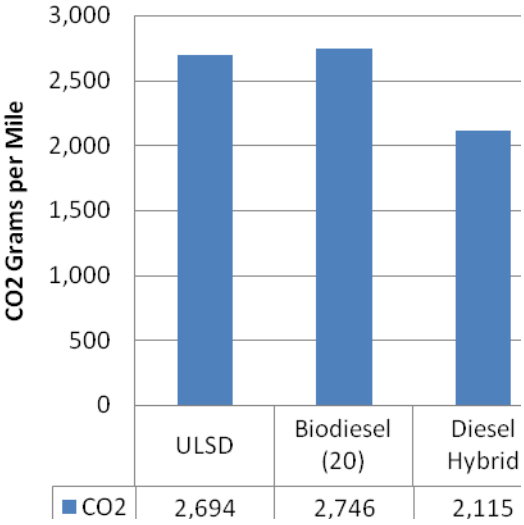


Figure 6. Average CO^2 Grams per Mile



Existing Bus Fleet Retrofitting Options

Changes in EPA Emission Standards mean that diesel engines built before 2004 have significantly fewer emissions requirements than those built beginning in 2007. The standards will become even more restrictive in 2010. Engines built from 2004-2006 have moderate emissions standards. Since the standards did not come into effect until 2004 model year vehicles, diesel engines built before 2004 are targets for the EPA's diesel retrofit technology program to encourage the reduction of emissions from these existing engines. There are different types of retrofits available, and each accomplishes different reductions in emissions. The potential impacts of diesel retrofit programs vary widely, depending on the engine model year and the

technology manufacturer. The U.S. EPA lists technologies and manufacturers that have qualified for its diesel retrofit technology program on its website, along with the potential emissions reduction ranges.[25] The EPA website also has an in-depth evaluation of the retrofit program and an assessment of the technologies.[26]

The most common diesel emissions are carbon monoxide, nitrogen oxides, particulate matter, and hydrocarbons. Some diesel retrofits reduce one of these pollutants well and some retrofits do a decent job at reducing multiple pollutants. Many studies are available on the anticipated emissions reductions of particular retrofit technologies, but those performed before 2007 and without ULSD as the fuel source are no longer applicable.

Many retrofit technologies are available. Some common retrofit options of diesel buses include:

Diesel Particulate Filter (DPF): A muffler-like device made of high temperature materials installed in the exhaust system that physically traps particulate matter in the engine exhaust. DPFs can reduce particulate matter by up to 90%. These filters cost approximately $7,500.[27]

Diesel Oxidation Catalyst (DOC): Among the most common type of retrofit devices, DOCs are installed in the exhaust system in over 15,000 urban bus engines as part of the U.S. EPA's retrofit program. DOCs can reduce PM emissions by 20-50%, toxic hydrocarbon emissions by more than 70%, and carbon monoxide and hydrocarbon emissions by more than 90%.[28] The cost of purchasing and installing a DOC is approximately $1,500 per vehicle.[29]

Exhaust Gas Recirculation (EGR): These devices recirculate a portion of an engine's exhaust back through the engine to reduce NO_x by about 40%.[30] Low-pressure EGR is most suitable for retrofit applications because it does not require engine modifications.[31]

[25] United States Environmental Protection Agency website, http://www.epa.gov/otaq/retrofit/verif-list.htm, Accessed August 1, 2008

[26] Final Draft, Diesel Retrofit Technology and Program Experience. United States Environmental Protection Agency. July 2005. http://www.epa.gov/cleandiesel/documents/retrofit-tech-prog-exp.07-2005.pdf

[27] *Retrofitting Emission Controls on Diesel Powered Vehicles*, Manufacturers of Emission Controls Association. April 2006. Page 13.

[28] "*Clean Transportation Options for Transit*" Presentation November 5, 2007. NC Solar Center, NCSU..

[29] *"Questions and Answers on Using a Diesel Oxidation Catalyst on Heavy-duty Trucks and Buses"*, Technical Highlights, EPA420-F-03-016, United States Environmental Protection Agency, June 2003.

[30] "Diesel Retrofit FAQ," *Manufacturers of Emission Controls Association*, Washington, DC, http://www.meca.org/jahia/Jahia/engineName/filemanager/pid/229/retrofitFAQ%20%28revised%29.pdf?actionreq=actionFileDownload&fileItem=712.

[31] *Retrofitting Emission Controls on Diesel Powered Vehicles*, Manufacturers of Emission Controls Association. April 2006. Page 16.

EGRs typically work in conjunction with DPFs. The cost of retrofitting an EGR system is about $14,000.[32]

Repowering

Transit buses may require new engines during their duty cycle, a process called repowering. Repowering involves either 1) rebuilding the engine to the initial manufacture date emission standards or 2) purchasing a new engine with current emission standards. FTA allows the use of funds (80-20 match) for midcycle repowering.

Retrofit technologies should only be added when the engine is repowered, according to the schedule shown in Figure 7. The estimated cost for repowering engines that fail 7-10 years from purchase include the addition of DPFs, DOCs, and EGRs as an example. Each transit agency must work with its engine manufacturers to determine the most beneficial and cost effective emissions reducing technologies to apply during repowering.

Figure 7 shows that if an engine fails within 6 years of its original purchase, a new, completely repowered engine that meets current emissions standards should be installed and the life of the vehicle should be extended. If the engine fails 7-10 years from the original purchase, the engine should be rebuilt with the appropriate emissions reducing technologies so the new engine comes as close as possible to the current emissions standards. The life of the vehicle for both of these options will be extended by fifty percent (50%) of the remaining life. Vehicles 10 years and older are not recommended to have emissions reducing retrofits because their expected life span will be too short to justify the expense.

Figure 7. Retrofit Schedule for Repowering Engines

Engine Failure from Year of Purchase	Retrofit	Cost per Vehicle	Guaranteed Future Service Years
0-6 Years	Full repowering to most current emissions standards	Full repowering is $60,000; repower without transmission is $40,000	50% of the remaining useful life
7-10 Years	Rebuild with retrofit technologies to approach most current emissions standards	$23,000	50% of the remaining useful life
> 10 Years	No retrofit		

[32] *Retrofitting Emission Controls on Diesel Powered Vehicles*, Manufacturers of Emission Controls Association. April 2006. Page 14.

Policies and Practices Recommendations

The policies and practices listed in Figure 8 should currently be in place or under development. These baseline policies show a minimum commitment to the concept of alternative fuel vehicles and emissions reductions. This report encourages transit systems to meet the minimum criteria before beginning to seek funding for alternative fuel vehicles and emissions reducing technologies.

Figure 8. Policies and Practices that Should Currently be in Place

Activity	Who
1. Current Maintenance Plan • Document maintenance of emissions equipment • Meet manufacturer requirements to clean DPFs (scrubber and burn)	Systems
2. Include flexible fueled vehicles (FFVs) for sedans, vans, and cutaways on the state contract and in local bids (for use of E85 Ethanol)	Systems, NCDOT/PTD
3. Include alternative fuel vehicles on the state contract and in local bids for sedans, vans, and cutaways (propane, hybrid, electric, CNG, etc.)	Systems, NCDOT/PTD
4. Have no major maintenance or safety findings during FTA or NCDOT / PTD reviews (a major finding is defined as not fixable within the 90 days) *Idea is that have good maintenance and can handle a new equipment type in your fleet mix.*	Systems
5. Implement and document savings related to the following policies (examples in appendix A): • idle reduction policy[33] • engine shut off policy	Systems
6. Select a fuel type and fully commit to it • Preferred diesel fuel is B20 – follow the implementation guidelines to implement • Research the benefits for you to be a B20 remixer • In the areas with CNG stations, determine if working with the provider makes CNG an effective solution – be sure the bus technology is appropriate for your system and size *(APTA 2008 Fact Book, pgs 30-32 shows CNG as 2nd most widely used fuel by public transportation bus operations)*	Systems
7. Look for and apply for grants and other funding to support alternative fuel vehicle and emission reduction activities	Systems, NCDOT/PTD
8. Create a consortium to purchase new hybrid-electric vehicles, as well as CNG and propane vehicles. *Note: develop these procurements as new fuels and technologies become viable.* • Require any bus procurements to include at least one alternative	Systems, NCDOT/PTD

[33] U.S. EPA website. http://www.epa.gov/otaq/diesel/idle-ncdc.htm, accessed July 3, 2008.

fuel option • Make sure the technology matches your service types *(are hybrid electric appropriate for express service – check details from peers)*	
9. Education • Continue to offer Alternative Fuels webinar once per year. Systems are encouraged to participate in these webinars. • Create a working group / mailing list to share fuel and vehicle developments / maintenance findings • Stay on top of new and emerging fuel sources for transit vehicles and share through the mailing list • Develop and participate in biannual teleconferences on maintenance issues when operating B20 and diesel hybrid buses	ITRE, NC Solar Center, Systems
10. All diesel buses that need to be repowered should be retrofitted with pollution savings devices such as DPFs, DOCs, EGRs, etc. to approach current emissions standards. Specific needs depend on the make, model, and year of the vehicle.	Systems
11. Transit systems with multiple vehicle and fuel types should continually analyze and document the performance under different service types	Systems
12. Transit systems should create a plan with projected costs that details how to address engine failures at different stages of the vehicle lifecycles to foster emission reductions (see Figure 7)	Systems

Funding-related policy opportunities for exploration by NCDOT/PTD and the transit systems are shown in Figure 9. Successful implementation of these policy opportunities will encourage the increased use of alternative fuel vehicles and significant emissions reductions.

Figure 9. Future Policy Opportunities and Cost Estimates

Policy Opportunities	Who	Cost
1. Subsidize the difference in vehicle costs to encourage hybrid diesel buses	NCDOT/ PTD	Up to $210,000 per vehicle
2. Purchase regional scrubbers and burners to clean emissions reducing technologies	NCDOT/ PTD	$22,000 per scrubber[34] $50,000 for entire set up[35]
3. Identify a funding source to pay the difference between ULSD and B20 fuel prices (contingent on a minimum of 1 year commitment)	NCDOT/ PTD, Systems	Roughly 5% more per gallon
4. Explore different funding scenarios to pay for repowering of diesel engines to address emissions (matches to Plan specified in Figure 8, #12)	NCDOT/ PTD, Systems	Roughly $23,000 per vehicle
5. Encourage regions to have similar fleets to promote sharing of fueling centers, maintenance capabilities, information, and training	NCDOT/ PTD, Systems	None
6. Be flexible with moving operating and capital budget subsidies to encourage cheaper operating cost vehicles instead of cheaper capital cost vehicles	NCDOT/ PTD	None

[34] *Cummins Approved DPF Cleaning Machine*, Cummins Atlantic Product Fact Sheet.
[35] *Diesel Particulate Filter Cleaning Equipment*, FSX Equipment Company, August 6, 2008.

Appendix A
Sample Policies

CHAPEL HILL TRANSPORTATION DEPARTMENT

O P E R A T I N G B U L L E T I N

NUMBER: 08 - 05Revised 6-08 Replaces: 05-57

SUBJECT: Idling Control Policy

Purpose:

To protect public health and improve the environment by reducing emissions while conserving fuel. Less idling time is good for the environment because it reduces air pollution, noise and fuel use. It also reduces wear and tear on engines, lengthens engine life, saves money and contributes to a cleaner atmosphere. Reducing idling makes good business and environmental sense.

Definitions:

"Idle" means the operation of the engine of a vehicle while the vehicle is not in motion and not being used to operate auxiliary equipment that is essential to the basic function of the vehicle and "idling" has a corresponding meaning.

Departments Affected:

This policy applies to all CHT vehicles.

Policies:

CHT employees shall not cause or permit CHT vehicles to idle for more than three (3) consecutive minutes in a sixty (60) minute period, except as allowed under policy exemptions described below.

CHT employees shall drive within the posted speed limit in all areas.

CHT employees shall avoid sudden stops and quick acceleration.

CHT employees shall not utilize drive-through services in CHT vehicles.

The Following are Policy Exceptions:

Any occupied CHT vehicle when the outside air temperature exceeds 85 ˚F or falls below 32˚F.

A CHT vehicle may idle for a maximum of ten (10) minutes for cold warm-ups when the previous evenings' low temperature was below 32 ˚F or twenty (20) minutes when the temperature was below 15 ˚F or if ice and/or snow is on the windshield. *All cold warm-ups shall be done in fast idle.*

A CHT vehicle may idle while forced to remain motionless because of on-highway traffic, when required to yield the right of way to responding emergency vehicles, at an official traffic control device or signal, or at the direction of a law enforcement official.

A CHT vehicle may idle to prevent a safety or health emergency.

A CHT vehicle may idle when being used in an emergency capacity or in an emergency training mode and not for the convenience of the vehicle operator.

A CHT vehicle may idle for maintenance, servicing, repairing, or diagnostic purposes if idling is required for such activity.

A CHT vehicle may idle as part of a state or federal inspection to verify that all equipment is in good working order, provided idling is required as part of the inspection.

A CHT vehicle may idle due to mechanical difficulties over which the driver has no control. The claim of mechanical difficulties should be supported by work order documentation.

PROCEDURES:
None

RESPONSIBILITIES:
Operations and Maintenance shall monitor for compliance.

Operations and Maintenance shall provide and apply technology, where available, to monitor and verify compliance.

Note: Violation of this policy will lead to discipline, up to and including termination

Chapel Hill Bus Shut Down Policy

- This policy is included in the Chapel Hill operating procedures and states that at any layover of over 5 minutes, the bus engine must be shut down. The only exception is if the outside temperature is over 85 degrees, the bus can be left running to keep the interior cool.

Subject/Title:
Anti-Idling Policy

Procedure No:
CATS OP01

Effective Date:
October 11, 2004

Revised Date:
January 18, 2008

Keith Parker
Chief Executive Officer and Director of Public Transit

1.0 Purpose

Eliminate all unnecessary idling by transit vehicles such that idling time is minimized in all aspects of transit vehicle operations. Reducing unnecessary idling will not only improve fuel economy and reduce fuel consumption, but will further reduce the emission of harmful pollutants. These are all values consistent with the City of Charlotte's focus area to Safeguard the Environment.

2.0 Scope

This applies to the operation of all Charlotte Area Transit System (CATS) owned transit and service vehicles.

3.0 Procedure

CATS owned transit and service vehicles will not idle for more than 10 minutes at a CATS Operations Facility and/or while in service (including layover) and not idle for more than 5 minutes in an enclosed area, unless the following conditions exist.

1. When auxiliary power is needed for other equipment (wheel chair) and/or climate control.
2. When vehicle is being repaired and/or serviced.
3. Traffic conditions i.e. traffic detours, accident in roadway.
4. Extreme weather conditions.
5. When engine must idle to perform a certain task.
6. While hybrid diesel-electric vehicles are charging batteries.
7. When a variance is issued.
8. When utilizing older buses that can be adversely impacted by shutting the vehicle down (i.e. buses that exceed the useful life guidelines issued by the Federal Transit Administration).

Changes:
Three year Review
Purpose: Removed estimated annual savings and added reference to City focus area.