North Carolina 2008
Clean Fuel and Advanced Transportation Technology Options

Biodiesel

Biodiesel is a clean burning alternative fuel, produced from domestic, renewable resources. Pure biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. Biodiesel can be used in any compression-ignition (diesel) engines with little or no modifications. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics. Biodiesel also helps diversify our nation's fuel supply and supports energy security initiatives by being domestically produced.

B20 (20 percent biodiesel and 80 percent petroleum diesel) and higher blends are widely available in North Carolina through a State Purchasing Contract (http://www.doa.state.nc.us/PandC/dynfuels/fuelcost.asp) in all 100 NC Counties and network of local producers and distributors.

Biodiesel fact sheet and NC biofuel retail & distributors: www.cleantransportation.org under Fact Sheets
National Biodiesel Board: www.biodiesel.org

Ethanol

Ethanol is a renewable, domestic, environmentally preferable fuel that enhances the nation's economy and energy independence. There are two ethanol blends used in NC:

- **E10** is a premium blend of 10% ethanol with 90% gasoline and can be used in any gasoline vehicle.
- **E85** is an 85% blend of ethanol with 15% gasoline used in flexible fuel vehicles (FFVs) that operate on E85 and/or gasoline. There is no additional cost to purchase a FFV as compared to the same gasoline model.
- **Both E10 and E85** are available to local government, school systems and state government fleets through a state purchasing contract in all NC counties (http://www.doa.state.nc.us/PandC/dynfuels/fuelcost.asp).

2008 E85 Flexible Fuel Vehicles (highlighted vehicles are on state purchasing contract)

Sedan	Chrysler	2.7L Sebring
Sedan	**Dodge**	**2.7L Avenger**
Sedan	Mercedes	3.0L C300 Series
Sedan	**Ford**	**4.6L Crown Victoria**
Sedan	Lincoln	4.6L Towncar
Sedan	Mercury	4.6L Grand Marquis
Sedan	Chevrolet	3.5L Impala
Sedan	Chevrolet	3.9L Impala (police units)
SUV	Chrysler	4.7L Aspen
SUV	**Dodge**	**4.7L Durango**
SUV	Jeep	4.7L Commander
SUV	**Jeep**	**4.7L Grand Cherokee**
SUV	Buick	3.9L Terrazza
SUV	Chevrolet	5.3L Avalanche
SUV	Chevrolet	3.9L Uplander

SUV	**Chevrolet**	**5.3L Tahoe, Suburban**
SUV	GMC	5.3L Yukon, Yukon XL
SUV	Nissan	5.6L Amada
Minivan	Chrysler	3.3L Town and County
Minivan	Dodge	3.3L Grand Caravan
Minivan	**Chevrolet**	**3.9L Uplander**
Van	**Chevrolet**	**5.3L Express**
Van	GMC	5.3L Savana
Pickup	**Dodge**	**4.7L Dakota**
Pickup	Dodge	4.7L Ram
Pickup	Ford	5.4L F-150 (3-valve)
Pickup	Chevrolet	5.3L Silverado (V8)
Pickup	GMC	5.3L Sierra
Pickup	Nissan	5.6L Titan

NC Ethanol fact sheet and NC biofuel retail & distributors: www.cleantransportation.org under Fact Sheets
American Coalition for Ethanol: www.ethanol.org ***National Ethanol Vehicle Coalition:*** www.e85fuel.com

Compressed Natural Gas (CNG) & Propane (LPG)

CNG and LPG are considered low carbon fuels and are the cleanest fossil fuels. Compared to gasoline and diesel, their use could bring about a significant reduction in tailpipe emissions of carbon monoxide (about 70%), nitrogen oxides (about 85%), and ozone-causing pollutants (about 90%). Honda is the only company that manufactures a light duty dedicated CNG vehicle. Currently most light duty CNG vehicles are up-fitted by companies that have received certification by the U.S. EPA. In addition, many trucks and buses are factory built or available through distributor/OEM relationships.

Honda Civic GX (OEM CNG vehicle) NC dealers:

- Apple Tree Honda, Asheville NC: contact Jason Locke (828) 651-8639
- Flow Auto, Winston Salem: contact Joe Busek (336) 785-3380
- Hendrick Honda, Charlotte: contact Terry Moore (704) 552-3351

Clean Fuel Advanced Technology (CFAT) is a project of the NC Solar Center at NC State University
and is sponsored by the NC Department of Transportation, NC Division of Air Quality, and State Energy Office
with support from the Triangle Clean Cities, Centralina Clean Fuels Coalition, and Land-of-Sky's Clean Vehicle Coalition

EPA Certified conversions to CNG and LPG

BAF Technologies www.BAFtechnologies.com
Bill Calvert (214) 231-1450 ext 458
bcalvert@baftechnologies.com
MY 2006-08 Ford Crown Vic, Mercury Marquis, Lincoln Town Car
2007-2008 Ford E350 van 5.4L engine
2008 Ford F150, F250, F350 5.4L engine up to 13,000 GVW
2005-2008 E450 6.8L engine

Cummins Westport www.cumminswestport.com
Bill Boyce (330) 534-8352
5.9L "B Gas Plus" – 195-230hp
8.9L "ISL-G" – 250-320hp
(replaces 8.3L "C Gas Plus" and 8.9L "L Gas Plus")
NC Distributor: Cummins Atlantic
Greg Campbell (864)-208-2657

Baytech Corporation www.baytechcorp.com
Rebecca Royer (650) 949-1976
6.0L L/M/HD (GM, Isuzu, Workhorse – pick-ups, vans/stepvans, Cab forward, Cutaways)
8.1L (Topkick, cutaways)

Westport Innovations
Jonathan Harris (614) 718-2043
jharris@westport.com
15L "ISX-Gas" – 450hp (LNG only)

Emission Solutions
Ira Dorfman (202) 255-6050
idorfman@emissionsolutionsinc.com
CNG replacement of 7.6L International DT466 engine with Phoenix NG – 175-265hp

Conversion engine & station installer

Transeco Energy www.transecoenergy.com
Installs vehicle conversion units & builds refueling stations.
Planned 2008 EPA approved CNG systems; Ford Focus, F-150 5.4 L V-8, GM 6.0 L V-8 pick-up, & Yale Fork-lift
Larry Abbott (828) 654-8300 Mobile: (828) 318-5651

Refueling Infrastructure

FuelMaker www.fuelmaker.com
Paula Herbert 800-898-3835, usinfo@fuelmaker.com

Clean Energy
Mark Riley (603) 318-6817
mriley@cleanenergyfuels.com

List of CNG businesses and services: www.ngvc.org/buz_dir/index.html
More about CNG vehicles: www.eere.energy.gov/afdc/fuels/natural_gas.html
CNG vehicle manufacturers and up fitters: www.ngvc.org/mktplace/factsheets.html
Propane vehicles and equip: www.propanecouncil.org/trade/fleet/index.cfm
Information about NC CNG filling stations: www.daq.state.nc.us/motor/cng/

Hybrid Electric Vehicles

Hybrid-electric vehicles (HEVs) combine the benefits of gasoline engines and electric motors that are configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools. Eco Vehicles (www.ecovehicle.com) will complete hybrid electric retrofits.

2008 Hybrid Electric Vehicles (^available on the state purchasing contract)

Compact	Mid-size (con't)	SUV (con't)
1.3L Honda Civic (43 mpg)	1.5L Toyota Prius^ (47 mpg)	3.3L Lexus RX 400h (25 mpg)
3.5L Lexus GS 450h (24 mpg)	2.4L Toyota Camry^ (34 mpg)	2.3L Mazda Tribute (32 mpg)
Mid-size	**SUV**	2.3L Mercury Mariner (32mpg)
2.4L Chevy Malibu (28 mpg)	6.0L Chevy Tahoe (21 mpg)	3.3L Toyota Highlander (29 mpg)
5.0L Lexus LS 600h (21 mpg)	2.3L Ford Escape (32 mpg)	2.4L Saturn Vue (29 mpg)
2.4L Saturn Aura (28 mpg)	6.0L GMC Yukon (21 mpg)	**Combined MPG reflects city & hwy driving* www.fueleconomy.gov/feg/hybrid_sbs.shtml

Heavy Duty Hybrids such as hybrid trucks and hybrid buses are showing improved fuel efficiency, while simultaneously reducing vehicle emissions. Heavy-duty trucks can easily be hybridized and can positively impact fuel economy and emissions. There are several different hybrid buses available that can be used in shuttle, transit, school and trolley applications. Vendors include;

BAE Systems	www.hybridrive.com	GM-Allison	www.allisontransmission.com
Ebus	www.ebus.com	DesignLine	www.designlineinternational.com
ISE Corp	www.isecorp.com	National Bus Sales	www.nationalbussales.com
Orion	www.orionbus.com	Trolley Enterprise	www.trolleyenterprises.com

Electric Drive Transportation Association: www.electricdrive.org ***hybridCARS:*** www.hybridcars.com
HEV Cost Calculator Tool: www.eere.energy.gov/afdc/vehicles/hybrid_electric_calculator.html

All-Electric Vehicles

A full-size **all-electric vehicle** is powered entirely by electricity, can be operated on all roads, and can be charged in a wall outlet with either 110 or 220 volts. Two manufacturers offer all-electric vehicles including: Miles Automotive Group, www.milesev.com and Hybrid Technologies, www.hybridtechnologies.com.

Low Speed Vehicles

A **Neighborhood Electric Vehicle (NEV)** is a Low-Speed Vehicle (LSV) with top speeds of 20 to 25 miles per hour that complies with certain U.S. National Highway Traffic Safety Administration (NHTSA) standards. North Carolina allows NEVs to be operated on streets and highways where the posted speed limit is 35 mph or less. NEVs can be titled and licensed as private passenger vehicles.

Low speed vehicles (LSV) that are not NEVs may take the place of conventional vehicles in certain settings. These vehicles are not plated and permitted on public streets. These vehicles help reduce petroleum consumption and emissions by operating on biodiesel, electricity, propane and/or compressed natural gas.

On state contract: a number of low speed utility vehicles with a diesel engine option and NEVs are available on the state contract (Term contract o70N at http://www.gemcar.com/locate/stateDealers.asp)

NEV & LSV Manufacturers:

Columbia Par Car Company www.parcar.com
Cushman, www.cushmanco.com
Dynasty Electric Car, www.itiselectric.com
E-Ride Industries, www.e-ride.com
Global Electric Motorcars, LLC www.gemcar.com
Miles Automotive Group, www.milesev.com
Motrec www.motrec.com (industrial uses)
Vantage www.vantagevehicle.com
Westward Industries www.westwardindustries.com
Zenn Motor Company www.zenncars.com
B.I.G. Man www.bigmanev.com (LSV only)
Eco Vehicles www.ecovehicle.com (LSV only)
Tiger Truck, LLC www.tigertruck.com (LSV only)

NEV & LSV Distributers:

Bleecker Electric Car Co. www.theelectriccarco.com
Contact: Steve Shattuck, (800) 849-3495
Global Electric Motor (GEM) 7 NC distributors:
http://www.gemcar.com/locate/stateDealers.asp
Carolina Industrial Equipment, Inc. Contact: John Yoxtheimer, (800) 476-2434]

NHTSA safety standards for NEVs and LSVs: www.nhtsa.dot.gov/cars/rules/rulings/lsv/lsv.html

Diesel Retrofit Technologies

Diesel retrofit technologies are pollution control devices designed to reduce harmful exhaust emissions on existing diesel engines. The most common retrofits are **diesel particulate filters** (DPFs), **diesel multi-stage filters** (DMFs), and **diesel oxidation catalysts** (DOCs). DPFs are ceramic devices that collect particulate matter in the exhaust stream. DPFs must be used in conjunction with ultra low sulfur diesel (ULSD) and result in a 60 to 90 percent reduction in particulate matter (PM), hydrocarbons (HC), and carbon monoxide (CO). A DMF is a two stage metallic filter consisting of alternating layers of a corrugated metal and a porous sintered metal fleece, which must be used with ULSD. DMFs reduce PM, HC and CO emissions by 50 percent and nitrogen oxide emissions by 20 percent. DOCs are devices that use a chemical process to break down pollutants in the exhaust stream into less harmful components. DOCs can reduce emissions of PM by 20 percent and HC by 50 percent and CO by approximately 40 percent. When possible, a **closed crankcase ventilation system** (CCV) that further reduces emissions of hydrocarbons and particulate matter produced from the engine crankcase or oil pan area should be combined with a DPF or DOC to further reduce emissions.

The U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB) have verification processes for the approved use of diesel retrofit technologies.

For a list of **EPA verified technologies** see: www.epa.gov/otaq/retrofit/verif-list.htm
For a list of **CARB verified technologies** see: www.arb.ca.gov/diesel/verdev/vt/cvt.htm

EPA or CARB Verified Technologies available to the North Carolina market

Caterpillar Emissions Solutions www.cat.com/emissionssolutions Brett Alkins, 704-752-1314, alkins_brett_d@cat.com *Particulate Filters*	**Clean Diesel Technologies** www.cdti.com Glen Reid, 203-327-7050, greid@cdti.com *Multi-stage Filters, Oxidation Catalysts*
Cummins Emission Solutions www.cummins.com Mike Brand, 812-377-3752, michael.s.brand@cummins.com *Oxidation Catalysts with Closed Crankcase Ventilation*	**Cleaire** www.cleaire.com Tom Swenson, 916-689-0248, Tom.swenson@cleaire.com *Particulate Filters*
Donaldson Company, Inc. www.donaldson.com/en/exhaust/emission John Garrett, 952-887-3898 john.garrett@donaldson.com *DPFs, DMFs, DOCs, DOCs with CCV*	**DCL International Inc.** www.dcl-inc.com Tony Almeida, 800-872-1968 x268 talmeida@dcl-inc.com *Particulate Filters*
Engine Control Systems, Inc. www.enginecontrolsystems.com Dana Brewster, 440-840-2511, dabr@enginecontrolsystems.com *DPFs, DOCs, DOCs with CCV*	**Extengine Transport Systems** www.extengine.com Richard Carlson, 714-774-3569, rcarlson@extengine.com *Oxidation Catalysts*
International Truck Engine Corp. www.greendieseltechnology.com John Macaluso, 386-334-4863, john.macaluso@navistar.com *Particulate Filters, Oxidation Catalysts*	**PUREM North America, LLC** Larry Dimitrievski, larry.dimitrievski@purem-na.com 313-592-5883, *Particulate Filters*

EPA's Clean School Bus Program www.epa.gov/otaq/schoolbus/index.htm
Environmental Defense's Cleaner Diesel Handbook www.cleanerdieselhandbook.org
Manufacturers of Emission Controls Association www.meca.org
Southeast Diesel Collaborative www.southeastdiesel.org ***Diesel Technology Forum*** www.dieselforum.org

Motor Oils

Three options are available for replacing conventional petroleum based motor oils. **Synthetic** lubricants flow at lower temperatures providing better cold-temperature starts and has more stable viscosity to reduce engine wear at high temperatures. The increased cost of synthetics is worth the investment for severe driving conditions. Producers can **re-refine oil** to remove contaminants and replace the additive packages that confer its specific properties, such as viscosity. American Petroleum Institute (API) approved re-refined oil is subject to the same stringent refining and performance standards as virgin oil, and is available at a similar cost **Bio-based motor oils**, created primarily from canola or soy oils, offer another alternative to petroleum motor oils and high-end performance characteristics similar to that of synthetics. They are also the most "environmentally friendly" of the motor oils available, maintaining properties of non-toxicity and biodegradability, but their limited availability increases its cost.

State agencies can be procure synthetic and re-refined motor oil from:
North Carolina Correction Enterprise www.doc.state.nc.us/EPRISE/products/oillubes.htm#motor

American Petroleum Institute Oil Recycling www.recycleoil.org

Conservation

Reducing fuel consumption, or conservation, is an important strategy for meeting petroleum reduction goals.

1. Establish a fuel-efficient vehicle procurement policy
2. Keep fleet vehicle tires properly inflated, aligned, and use low rolling resistance (LRR) tires
3. Utilize teleconferencing, videoconferencing, and webinars for meetings and workshops
4. Provide transit incentives for employees to ride public transit and offer ride sharing incentives.
5. Get regular tune-ups, filter changes and engine lubes.
6. Offer employees a telecommuting option.
7. Offer safe bicycle storage; arrange safe bicycling instruction.
8. Require fleet vehicles cars be driven at posted speed limit.
9. Encourage combining multiple out-of-office errands/trips.
10. Establish idle reduction policies; eliminate unnecessary idling
11. Educate Employees and the Public

Fuel Economy Tips: www.fueleconomy.gov/feg/drive.shtml
Fuel Saving Tips: oee.nrcan.gc.ca/english/saving-fuel.cfm

Contact for more information
Anne Tazewell
Clean Transportation
(919) 513-7831
CleanTransportation@ncsu.edu
NORTH CAROLINA SOLAR CENTER NC State University