

The Transit Bus Niche Market For Alternative Fuels:

Module 6:
Overview of Biodiesel as a Transit Bus Fuel

Clean Cities Coordinator Toolkit

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What is biodiesel?

- Biodiesel is a diesel replacement fuel produced from vegetable or animal fats
- Referred to as B100 in its pure form
- Can be blended with diesel at varying levels
- The most commonly used and most cost-effective form is B20, which contains 20% biodiesel
- B20 does not typically require any engine modifications
- B20 is mostly composed of petroleum diesel, and has comparable properties to diesel fuel
- B100 properties include:
  - High cetane number (47 to 65), which is conducive to compression ignition
  - Low sulfur
  - High lubricity
  - No aromatics

Examples of Biodiesel Use In Transit Applications

- **Five Seasons Transit**
  - Partnered with Iowa Soybean Board to use B20
  - B5 and B10 are now regularly used in the bus fleet to lower emissions and improve engine lubricity
  - Also has demonstrated a small fleet of hybrid-electric and electric-powered buses, some of which are still in service (?)
  - Using “creative alternatives” has been a key to Five Seasons' clean bus success
- **Central Ohio Transit Authority (COTA)**
  - Total fleet of about 300 buses -- in the process of procuring replacements
  - Has been “cool” to CNG, but Central Ohio CCC has been successful convincing entry into biodiesel (B20).
- **IndyGo (Indianapolis)**
  - Purchased 6 hybrid buses, interested in using **B20 microturbine engines**
  - Decision made in conjunction with Central Indiana CC Alliance

A full-sized transit bus powered by soy-derived biodiesel fuel

Photo: from presentation by John P. Thornton, National Renewable Energy Laboratory, 9th National Clean Cities Conference, Palm Springs, May 2003

Biodiesel, Air Quality, and Energy

- B100 and biodiesel blends have been found to:
  - **Decrease** fuel cycle emissions of CO and PM10
  - **Increase** fuel cycle emissions of NOx
- Biodiesel can provide fuel cycle **CO_2 reductions**
- Biodiesel production is slightly less energy efficient than petroleum diesel production
- Biodiesel use displaces petroleum fuel use
- Emission and energy benefits / disbenefits are essentially proportional to the amount of biodiesel in blends
- Feedstock, base fuel, engine technology **all affect biodiesel emissions**

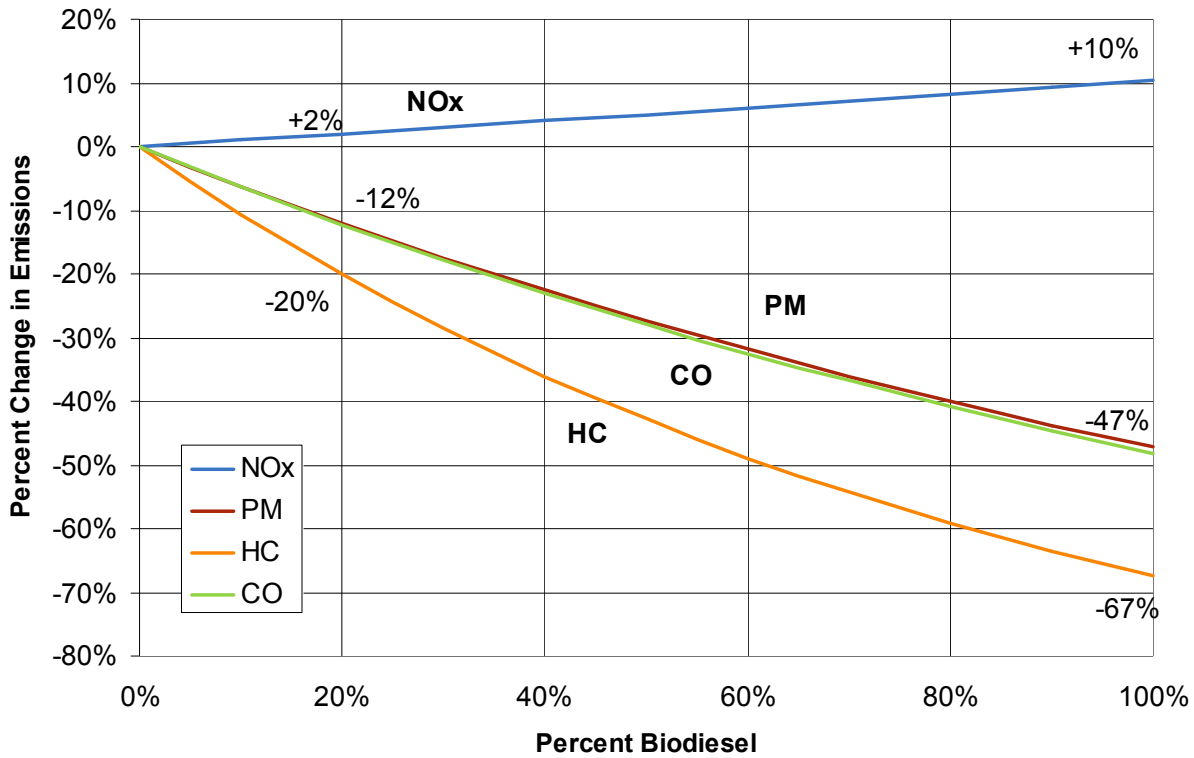
Biodiesel Exhaust Emission Reduction Potential Compared to Federal Diesel (EPA,2002)

Pollutant	B100	B20
CO	-48%	**-12%**
PM10	-47%	**-12%**
HC	-67%	**-20%**
NOx	10%	**+2%**

Exhaust Emissions: Criteria Pollutants

- EPA's report on biodiesel's impact on heavy-duty diesel exhaust emissions analyzed results from about 39 previously published studies
- The results show reductions in PM, CO, and HC, and an increase in NOx emissions

EPA's Primary Correlation using Engine Data (EPA,2002)



Fuel Cost:

- B100 costs about 50% to 150% more than diesel
- B20's incremental cost is about $0.15 to $0.30 per gallon
- This is comparable to the incremental cost of ultra-low sulfur diesel
- Biodiesel fuel cost varies by feedstock
  - Unused cooking oil is the most expensive feedstock
  - Waste grease is the cheapest feedstock

Biodiesel and diesel fuel costs (NREL,2001 and EIA, 2002)

	Cost ($/gal)
B100	~$3 to $2
B20	$1.71-$1.86
Diesel	$1.56
Ultra-low Sulfur Diesel	$1.71

Summary: Current Outlook on Biodiesel Use for Transit Applications

- Biodiesel blends are:
  - A reasonable **petroleum displacement** strategy
  - A good strategy to meet EPAct requirements (in applicable sectors)
  - A relatively costly criteria pollutant **emission reduction** strategy
- The decision to use biodiesel as a **PM control strategy** depends on the region's air quality priorities
- In regions where ozone level are of concern:
  - Biodiesel use would require the mitigation of NOx and HC increases
  - This will increase the cost of implementing biodiesel
- In regions with more flexibility to control NOx and HC emissions, biodiesel must be compared to other PM control strategies
- Additional engine optimization could potentially improve NOx performance of biodiesel
- The use of biodiesel in transit is best determined on a region-specific basis, taking into account all stakeholders and local factors

NOTE: extensive educational info is available on biodiesel: **www.biodiesel.org**