

JAMES MADISON UNIVERSITY.

# **Impacts of Biodiesel Fuel Use: Virginia Biodiesel Experiences**

November 30, 2009

Presented by: Chelsea Jenkins, Virginia Clean Cities

Presented to: Virginia Commission on Energy and Environment



# Agenda

Virginia Biodiesel Users

Impacts and Considerations

Key Points

New Biodiesel Grant Program Announcement

## Clean Cities

A voluntary, locally-based government/industry partnership

*Mission: To advance the energy, economic, and environmental security of the U.S. by supporting local decisions to adopt practices that contribute to the **reduction of petroleum consumption in the transportation sector.***

- Est. 1993 in response to EPAct of 1992
- Companion program to the EPAct mandates requiring certain fleets to acquire AFVs (Federal, State, and Fuel provider fleets)



JAMES MADISON UNIVERSITY.

# Virginia Biodiesel Users

## VA Biodiesel Fleets - Current and Past

- Chesapeake
- James City County
- King & Queen County
- Norfolk
- Virginia Beach
- Newport News
- Norfolk Botanical Gardens
- US Army, Navy
- Virginia International Terminals
- Arlington (county, schools, transit)
- DEQ
- Dominion Power
- Albemarle
- Charlottesville
- Harrisonburg (muni, schools, transit)
- Petroleum distributors statewide
- Universities (JMU, UVA, Hollins, Virginia Tech)
- Staunton
- VDOT/DGS
- Chesterfield
- GRTC
- Ukrops
- Waynesboro
- Gloucester County
- Henrico
- Fish & Wildlife Service
- Shenandoah National Park
- Private companies (construction, long-haul/drays, moving, ad)
- MANY MORE

## VA Biodiesel User Contacts

### Dominion Resources

Diana Anderson  
Manager Supply Chain Services  
(804) 771-4317  
diana.anderson@dom.com

### James Madison University

Dr. Christopher Bachmann ☐  
Director, Alt Fuel Vehicle Lab ☐  
(540) 568-2735 office ☐  
bachmacg@jmu.edu

### Gloucester County Public Schools

Roger D. Kelly  
Fleet Director  
(804) 693-1470  
rkelly@gc.k12.va.us

### James City County

William W. (Buddy) Stewart ☐  
Fleet and Equipment Administrator ☐  
(757) 259-4121 office ☐  
BUDDYS@james-city.va.us

### Ukrops Super Markets

Dell Daughterity  
Director, Product Distribution  
804-219-2107  
ddaughterity@ukrops.com



Biodiesel test engine



Making biodiesel



Testing different fuel additives

---

## ISAT Learn by Doing : Alternative Fuel Vehicles Laboratory

---

JMU has been working with Biodiesel **for over 10 years** – in the lab and in fleet vehicles



Small-scale biodiesel refinery



BioTrike

JAMES MADISON UNIVERSITY

## 2008 Family Weekend Home Football Game



**Biodiesel** Environmentally  
Welcome to the ^ Friendly City

JAMES  
MADISON  
UNIVERSITY



The City of Harrisonburg, James Madison University and Blue Ridge Clean Fuels worked together to increase public awareness of biodiesel.

The City of Harrisonburg Department of Public Transit is a small, rural transit agency, which has transitioned from petrodiesel use to B20 following JMU's lead.

JMU is assessing the technological and economic feasibility of utilizing JMU waste vegetable oil as a source to produce some of the City's B20.

In **President's Bush's address**, he highlighted the implementation of biodiesel as an alternative to fossil fuels, alleviating the dependence on foreign oil, and allowing the economy to keep American dollars in American hands. He commended **JMU and the City of Harrisonburg** for their implementation of biodiesel in all of its fleet vehicles, as a role model for the future of alternative energy.



## What is in it for JMU?

### 1) **EPAct Credits**

- One EPAct AFV credit is earned for each 450 gallons of B100 or 2250 gallons of B20

### 2) **Reliable, Improved Engine Performance**

- High Cetane number – improved performance
- High flash point – increased safety
- Increased lubricity – added fuel economy and reduced maintenance

### 3) **“Green Image”**

- Demonstrates commitment to cleaner, renewable energy

### 4) **More bang for the buck**

- Large performance and social gains for no-capital investment and little cost increase

JAMES MADISON UNIVERSITY.

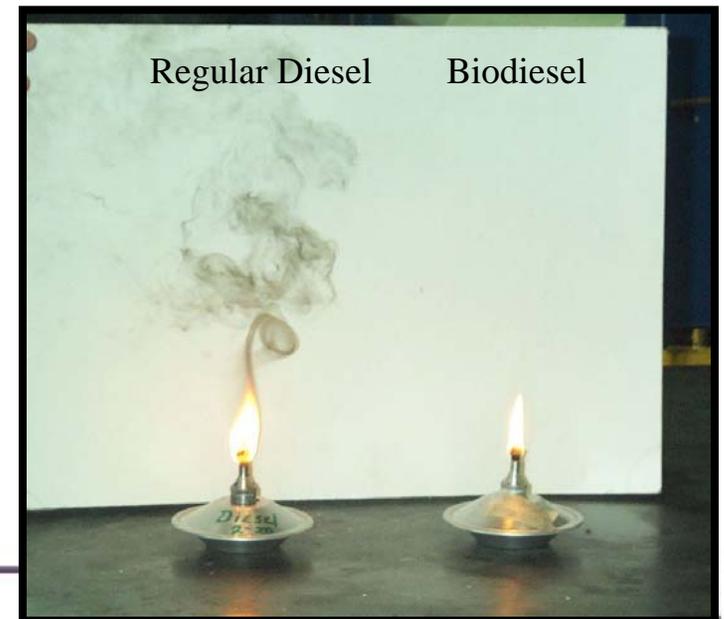
# **Biodiesel Impacts and Considerations**

## Why use biodiesel?

- Reduce dependency on foreign oil. Life cycle energy balance studies indicate each gallon of domestic biodiesel reduces import dependence by 4 gallons
- Support agriculture. The growth of biodiesel demand could add millions to the gross farm income over long-term
- Reduce emissions (unburned hydrocarbons, carbon monoxide, sulfates, PAH's, and particulate matter)
- Improve health- biodiesel is the first alternative fuel to successfully complete Tier I and Tier II health effects testing requirements of the Clean Air Act
- Increase vehicle performance-- smoothes engine combustion

## What are the environmental benefits?

- Yields 3.2 units of fuel product energy for every unit of fossil energy consumed in its lifecycle (NREL)
  - Some producers calculated 10-15:1 energy balance
- Reduces greenhouse gas emissions – B100 reduces life cycle CO<sub>2</sub> by 78% , B20 reduced life cycle emissions by 15%
- Reduces emissions of pollutants
- Reduces odor
- Reduces toxic emissions of diesel – B100 reduces aromatics by 75-95%, B20 reduces by 25%



## Disadvantages of biodiesel

- Soybean oil-based biodiesel will start to crystallize at around 0°C. This can be mitigated by blending with diesel fuel or with additives.
  - New ASTM revision addresses cold weather/quality issues
- Biodiesel is less oxidatively stable than petroleum diesel fuel. Old fuel can become acidic and form sediments and varnish. Additives can prevent this.
- There is limited supply. Soybean oil is widely available but expensive. Inedible animal fats are less expensive but have limited supply.
- Biodiesel is more expensive; Cost very feedstock dependent (75%)
- NOx increase/decrease still debated

JvG, 2004

## Alternative Fuels

Fuel	Capital investment	New infrastructure required	Operating cost
Methanol	+	+	+
Ethanol	+	+	+
Electricity	++	+	++
Propane	+	+	+
CNG/LNG	++	+	++
Hydrogen	++	+	++
<b>Biodiesel</b>	<b>0</b>	<b>0</b>	<b>+</b>

## **How difficult is biodiesel to implement?**

1) *It's a DROP-IN SOLUTION, by far simplest alternative fuel available*

- Can be used in existing diesel engines with little or no mod
- Compatible with diesel at any blend concentration
- Can be use in the existing fuel infrastructure

2) *Flexible and reversible*

- Due to its compatibility with existing systems, the fleet manager can phase biodiesel in and out of the mix
- No new capital equipment is needed
- Can remove or abort at any time by simple cleaning the tank

## How difficult is biodiesel to implement?

### 3) It does require some adjustments

- Solvency => need to phase in at low concentration, monitor fuel filters, promptly clean spills on painted areas
- Higher cloud point => monitor for gelling and engine performance decrease in extreme cold
- Reasonable, but limited shelf-life (4-6 mo)
- Less energy density => slight loss of power on steep hills
- Higher cost

## Price Fluctuations

- Biodiesel Cost Analysis 2008

OPIS Standard Rack Prices Daily 2008

Biodiesel cost at two Virginia refineries 2008

Date (Daily)	DOW	Ultra-Low Diesel Richmond VA Gross OPIS Average(¢/gal)	convert to dollars/gal	B100 cost at Refinery A	federal blend tax credit	state producer credit	net cost	biodiesel premium (above petro cost)	B100 cost at Refinery B	federal blend tax credit	state producer credit	net cost	biodiesel premium (above petro cost)
<b>averages:</b>		<b>301.21</b>	<b>3.01</b>	<b>4.33</b>	<b>-1.00</b>	<b>-0.10</b>	<b>3.23</b>	<b>0.22</b>	<b>4.45</b>	<b>-1.00</b>	<b>-0.10</b>	<b>3.35</b>	<b>0.34</b>

biodiesel blend cost calculator (cost per gallon)					
		B2	B5	B10	B20
petro cost:	3.010	2.950	2.860	2.709	2.408
bio cost:	3.230	0.065	0.162	0.323	0.646
final blend cost:		3.014	3.021	3.032	3.054
If bio is 22 cents more, final B2 cost is + half cent					

biodiesel blend cost calculator (cost per gallon)					
		B2	B5	B10	B20
petro cost:	3.010	2.950	2.860	2.709	2.408
bio cost:	3.350	0.067	0.168	0.335	0.670
final blend cost:		3.017	3.027	3.044	3.078
If bio is 34 cents more, final B2 cost is + three-quarters cent					

## Price Fluctuations

Biodiesel Cost Analysis 2008

### Refinery A

B100 Premium High: \$1.34 more on 12/25/2008

B100 Premium Low: \$0.64 less on 3/15/2008

### Refinery B

B100 Premium High: \$1.33 more on 12/11/2008

B100 Premium Low: \$0.44 less on 5/23/2008

## Price Fluctuations

- Virginia Department of Transportation
  - 60,000 gallons of B20 used annually - mainly to meet EPA requirements
  - 9 years of biodiesel use
  - Price July 16, 2009: \$1.6252/gal diesel & \$1.8538/gal B20
  
- Dominion VA Power
  - Jan 2008 - Dec 2008: Used 507,322 gallons B20 and 7,502 gallons of B5
  - In 2008, price ranged from \$0.09 to \$0.30 higher per gallon
  - Price July 2, 2009: B20 was \$.07 higher

**VDOT Price Fluctuations '07-'08**

Month	Sept 07	Oct 07	Nov 07	Nov 07	Dec 07	Apr 08	May 08	Jun 08	Jun 08	Jul 08	Sep 08	Oct 08
\$/Gal B20	2.57	2.61	2.85	2.89	2.86	3.64	3.49	3.99	3.57	4.16	3.45	3.12
\$/Gal Diesel	2.51	2.44	2.75	2.79	2.68	3.37	3.50	4.22	4.08	4.06	3.42	3.34
Difference	.06	.17	.10	.10	.18	.27	-.01	-.23	-.51	.10	.03	.22

JAMES MADISON UNIVERSITY.

# Key Points

## Key Points:

-B2 good choice for VA to implement a large and relatively easy petroleum displacement initiative; JMU/VCC would strongly support a mandate.

- it may cost more, but not much more at only 2% biodiesel
- it will reduce emissions, but only by a small amount (since only 2% biodiesel)
- it will create a local market for locally grown soybeans/canola/other feedstocks
- it will help our Country get on the path towards energy independence and clean, renewable fuel (a baby step, but a step in the right direction)

### - It will receive some criticism:

- it will cause some inconveniences during the startup phase:
  - expect to replace fuel filters more often as the program starts up- expect a few to get frustrated at beginning phases
  - even if biodiesel isn't the problem, it will likely be blamed for everything to broken taillight
- expect all of these issues to resolve once comfort increases/fuel systems adjusted

## Virginia Clean Cities Projects of Interest

### *Virginia State Clean Diesel Grant Program 2009*

- VA Biodiesel Grant Program
- NOFA January 2010
- Up to \$25,000 available to buy- down cost of biodiesel blends in VA public fleets (phase I) and private fleets (phase II)

## Resources

- Clean Cities:  
<http://www1.eere.energy.gov/cleancities/>
- Alternative Fuels and Advanced Vehicles Data Center:  
<http://www.afdc.energy.gov/afdc/>
- Virginia Clean Cities:  
<http://www.hrccc.org>
- National Biodiesel Board  
<http://www.biodiesel.org>

## Contact Information

Chelsea Jenkins  
Executive Director  
Virginia Clean Cities  
(757) 256-8528 cell  
(757) 233-8982 office  
[www.hrccc.org](http://www.hrccc.org)



## **Defining Characteristic:**

**The university will be an environmentally literate community whose members think critically and act, individually and collectively, as model stewards of the natural world.**