



Harvesting Clean Energy

FOR RURAL DEVELOPMENT

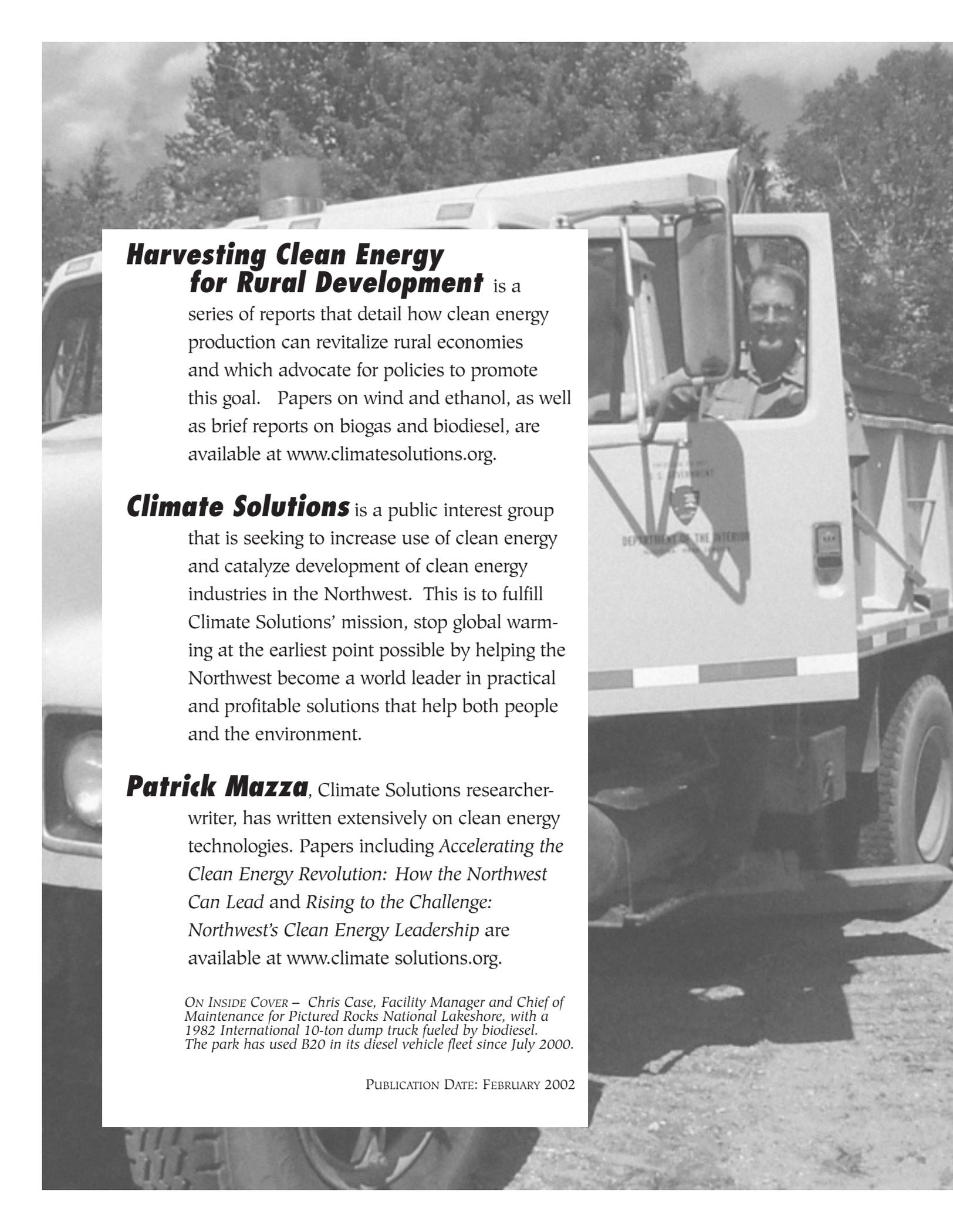


Biodiesel

BY Patrick Mazza



CLIMATE SOLUTIONS
SPECIAL REPORT



Harvesting Clean Energy for Rural Development

is a series of reports that detail how clean energy production can revitalize rural economies and which advocate for policies to promote this goal. Papers on wind and ethanol, as well as brief reports on biogas and biodiesel, are available at www.climatesolutions.org.

Climate Solutions is a public interest group that is seeking to increase use of clean energy and catalyze development of clean energy industries in the Northwest. This is to fulfill Climate Solutions' mission, stop global warming at the earliest point possible by helping the Northwest become a world leader in practical and profitable solutions that help both people and the environment.

Patrick Mazza, Climate Solutions researcher-writer, has written extensively on clean energy technologies. Papers including *Accelerating the Clean Energy Revolution: How the Northwest Can Lead* and *Rising to the Challenge: Northwest's Clean Energy Leadership* are available at www.climate solutions.org.

ON INSIDE COVER – Chris Case, Facility Manager and Chief of Maintenance for Pictured Rocks National Lakeshore, with a 1982 International 10-ton dump truck fueled by biodiesel. The park has used B20 in its diesel vehicle fleet since July 2000.

PUBLICATION DATE: FEBRUARY 2002

Biodiesel

BY Patrick Mazza



Back in 1895 Rudolf Diesel designed the engine that bears his name to run on vegetable oil. Today fuel based on oil crops and animal fats, known as biodiesel, offers new opportunities for farmers to become energy suppliers. Used in Europe for over 20 years, biodiesel is an environmentally superior alternative to petrodiesel -- petroleum-based diesel. Now biodiesel is taking off in the U.S, where fleet users grew from a handful in 1999 to well over 100 by 2002, and production accelerated from around 5 million gallons in 2000 to an estimated 15 million in 2001.

In Widespread Use

Fleet Users – Biodiesel's environmental benefits are attracting new fleet users virtually every week. Among them are school bus operators from New Jersey to Washington state; state governments including Ohio, Kansas, Iowa Michigan, New Jersey, North Carolina, Virginia and Florida; utilities from Florida Power & Light to Pacific Gas & Electric, and federal agencies including the Postal Service and National Parks Service. Most fleets are using B20, a blend of 20% biodiesel with regular diesel. Rockland Materials, an Arizona concrete company, and San Francisco recyclers Green Team are running fleets with B100, pure biodiesel.

Northwest Users – Yellowstone, Grand Teton and Mt. Rainer National Parks are using biodiesel in their fleets. Seattle City Light powers

utility trucks with biodiesel. Garbage is hauled with biodiesel in Tacoma. Hood River County, Oregon runs snowplows on biodiesel. Albertsons in 2001 began testing a biodiesel based on used fryer oil at two Lewiston, Idaho stores, with a goal of using a biodiesel blend to run refrigerator trucks throughout its fleet. In both the Greater Yellowstone and Treasure Valley (Boise) areas, groups of public and private users are partnering to make bulk biodiesel purchases.

Growing & Making Biodiesel

The Recipe – React vegetable oil or animal fat with alcohol, either methanol or ethanol, in the presence of a catalyst, generally sodium or potassium hydroxide.

Biodiesel Sources – Vegetable oils including soy, rapeseed, canola and sunflower, make good biodiesel feedstock, as do animal fats and used cooking oil from restaurants, known as yellow grease. Most biodiesel today derives from soy and yellow grease. Feedstocks sufficient to supply 3.4% of U.S. diesel now exist, the National Renewable Energy Lab (NREL) estimates. But from the tiny mustard seed, a much larger biodiesel supply could grow. NREL researchers estimate mustard oil could supply the equivalent of 18% of current U.S. diesel consumption, as well as an organic soil fumigant that could take 10% of the U.S. pesticide market. A next step is to gain U.S. Food and Drug Administration approval for the mustard-based pesticide.

Northwest Opportunities – University of Idaho researchers, investigating biodiesel since 1979, have been running a 1999 Dodge diesel pick-up and a 2001 Volkswagen diesel beetle on yellow mustard biodiesel. They have identified yellow mustard, canola and rapeseed as biodiesel feedstock crops that are particularly well adapted to the dry, sunny interior Northwest. Idaho and Montana are top growing areas for these oil crops. And mustard rotates with wheat, including dry land varieties. Biodiesel from these crops is not currently cost competitive with petrodiesel, but co-products such as mustard-based pesticide could make it economically viable. And mustard-based biodiesel is already cheaper than the commonly used soy-based biodiesel. The Northwest also has abundant supplies of used cooking oil. Idaho researchers worked with J.R. Simplot in a successful pilot project to convert french fry oil into biodiesel.

Economic Gains – An Iowa study found that converting state government diesels to B20 would cost an added \$500,000 annually, but if that spurred creation of a biodiesel plant capable of producing 5 million gallons per year, added tax revenues would more than make up the cost. A University of Missouri study estimated that a region producing 100 mgly will add \$8.34 million to annual personal income.

Biodiesel Harvesting Clean Energy

A NEW ECONOMIC OPPORTUNITY FOR RURAL COMMUNITIES

Biodiesel Makers – At least 17 companies are making and marketing biodiesel. Plants are on line in California, Nevada, Hawaii, Iowa, Illinois, Minnesota, Florida and Kentucky. Go Green Industries proposes a 17 mgy plant for Richland, Washington.

Homemade Biodiesel – A number of people make biodiesel on a small-scale basis. For example, Eugene Biosource runs a demonstration VW Vanagon on oils from several Eugene, Oregon restaurants. Biodiesel pioneer John Tickle has published a how-to handbook. (See Resources list.) Issues include quality control and handling of toxic materials, particularly methanol. There are diverse opinions on "home-brewing" in the biodiesel community. The National Biodiesel Board does not recommend that individuals make their own biodiesel.

Using Biodiesel

Ready to Use – Biodiesel runs all diesel engines. B20 requires no engine modifications. Engines made before 1993 should have fuel system rubber seals, gaskets and hoses replaced before using blends above 35%. Biodiesel is a mild solvent that will clean petrodiesel crud out of

tanks and engines even at lower blends, so may call for some fuel filter changes during initial use.

Costs – B20 costs range from 10-30 cents per gallon more than petrodiesel depending on the volume purchased. The cost differential is expected to narrow in coming years as the biodiesel industry scales up, technologies improve and petrodiesel prices rise to meet clean air mandates scheduled for mid-decade.

Availability – Biodiesel is commercially available in all states and available at the retail pump in nine. The only Northwest retail pump is Dr. Dan's Alternative Fuels Werks in Seattle, which also does on-site bulk delivery of B100 and B20. Lilyblad Petroleum of Tacoma will also make arrangements for on-site or delivered sales in its service area. World Energy makes bulk deliveries virtually anywhere in the U.S. Pacific Northwest Biodiesel makes the fuel at an Aloha, Oregon plant and sells to a number of local users. (See Resources.) For a complete list of biodiesel fuel suppliers who are members of the National Biodiesel Board, visit www.biodiesel.org.

Performance – Pure biodiesel contains about 10-12% less energy than the equal weight of petrodiesel, but is denser so in the tank there is only a 3-7% reduction in mileage and peak power. Blends of B20 and below have virtually the same fuel economy and power as diesel. Numerous independent studies show biodiesel has excellent lubricating qualities that reduce wear and tear. Some fleet owners report decreased idle vibration and quieter operation.

Safer to Handle – Petrodiesel burns at 125 deg. F. Biodiesel's flash point is around 300 deg. F, making it the safest fuel to use, handle and store. It biodegrades four times faster than petrodiesel, about the same rate as dextrose. This makes it especially attractive for use in boats. With only one-tenth the toxicity of table salt, biodiesel is less irritating to skin than a 4% soap and water solution. Mechanics report it does not cause the cracked skin that petrodiesel does.

Cold Weather Operation – Biodiesel should be treated the same way as the common No. 2 diesel for winter use, typically blending it with No. 1 diesel or using engine heaters. B20 use in temperatures far below 0 deg. F should cause no difficulties. B100 may pose some cold weather problems, and may require fuel additives or heating of the fueling system to prevent gelling. Much depends on the oil source. Rapeseed and canola-based B100 have been used at Yellowstone since 1995 without troubles. They gel at lower temperatures than B100 derived from waste oil.

Restoring Lubrication -- Federal mandates will reduce sulfur in petrodiesel from 500 parts per million to 15 in 2005/6. The cleaning



The "Bean Bus" at USDA Agricultural Research Service (ARS) in Beltsville, Md., gives tours to visitors and runs on soy-based B20 (20% biodiesel). All diesel-powered vehicles and equipment at ARS-Beltsville use B20.

Harvesting Clean Energy Biodiesel

A NEW ECONOMIC OPPORTUNITY FOR RURAL COMMUNITIES

process will remove lubricating qualities that can be restored with biodiesel. Tests performed by Stanadyne Automotive Corp. show that 1% biodiesel can improve lubricity of diesel by up to 65%. A 1% blend in all U.S. diesel would expand annual demand 550 million gallons.

Approved Fuel – Biodiesel is registered as a fuel and fuel additive with the U.S. Environmental Protection Administration (EPA) and has completed the rigorous health effects testing requirements of the Clean Air Act.

Environmental Benefits

Toxic Particulates – Petrodiesel trucks and buses constitute 6% of miles driven but emit 20% of particulate pollution from particles. These tiny toxic-laden particles slip right past the lungs into the blood stream. EPA and CARB identify diesel exhaust as a probable cancer causer. Particulates also obscure mountain views so dear to Northwesterners. Biodiesel cuts particulates by 55% and toxics by up to 90%.

Sulfur Dioxide – Biodiesel effectively emits no sulfur dioxide, a pollutant that causes acid rain and burns lungs, throats and eyes. Without the sulfurous bite of petrodiesel, some say burning biodiesel smells more like popcorn.

Global Warming – B100 is the commercially available fuel providing the greatest global warming reductions, reducing global

B100 is a federally-recognized alternative fuel, and meets California Air Resources Board (CARB) clean diesel standards. The American Society of Testing and Materials (ASTM), the U.S. fuel standard-setting body, issued biodiesel specifications in 2001. Most engine manufacturers have stated that B20 that meets their specifications will not void warranties, and some have approved B100. Fuel should conform to the ASTM specification to ensure good quality. Manufacturers should be contacted for specific guidelines.

warming contributor carbon dioxide by 78% over its lifecycle -- Carbon emissions are recaptured in crops that feed biodiesel production.

Energy Balance – Biodiesel yields 3.24 times the energy it takes to make it, better than any other liquid fuel. Petrodiesel yields only 0.83 times as much.

Ozone – Biodiesel from some feedstocks might produce slightly more oxides of nitrogen, an ozone precursor, than petrodiesel. But other pollution reductions diminish overall ozone potential by 50%.

Environmental Impact	B100	B20
Air Toxics	-60%-90%	-12%-20%
Particulates	-55%	-18%
Carbon Monoxide	-43%	-13%
Hydrocarbons	-56%	-11%
Cancer Risk	-94%	-27%
Carbon Dioxide	-78%	-16%
Ozone Potential	-50%	-10%

Sources: U.S. Environmental Protection Administration, U.S. Department of Energy



USDA researcher Robert Dunn studies biodiesel winterized for better cold start-ups.

Public Support

Federal – State and federal agencies are mandated to buy alternative fuel vehicles under a federal law known as EPAct. They can meet up to half their obligation with biodiesel. Buying 450 gallons of B100 to be used in B20 and higher blends will be credited as one alternative vehicle purchase. The Congressional Budget Office found this the least cost way to meet EPAct requirements. In addition, proposed federal legislation would mandate that 5% of U.S. fuel use be from renewable sources by 2016.

State – Over a dozen states have policies to support biodiesel. (See National Biodiesel Board in Resources.) Texas has a biodiesel fuel tax exemption. Hawaii taxes biodiesel at half the rate of petrodiesel. Missouri has a framework for the state to make up the added cost for school districts using biodiesel.

Northwest – Idaho provides a tax break of up to 2.5 cents per gallon on the first 10% of biodiesel blended into petrodiesel. In B20 and higher blends Montana taxes at an 85% rate. Montana provides property tax breaks that could benefit biodiesel plants. Oregon provides energy loans that could potentially be used by biodiesel plants.

Resources

General

National Biodiesel Board

Your questions on biodiesel answered at www.biodiesel.org or at biodiesel@sockets.net site includes factsheets at <http://www.biodiesel.org/fuelfactsheet.htm> and State Biodiesel Initiatives http://www.biodiesel.org/pdf_files/state_initiatives.PDF.

An Overview of Biodiesel and Petroleum Diesel Life Cycles

National Renewable Energy Lab
http://www.ott.doe.gov/biofuels/docs/life_cycle.html

UNIVERSITY OF IDAHO BODIESEL HOMEPAGE

<http://www.uidaho.edu/bae/biodiesel/>

From the Fryer to the Fuel Tank: The Complete Guide to Using Vegetable Oil as an Alternative Fuel, by Joshua Tickell, available from

<http://www.veggievan.org/book/>

U.S. DEPARTMENT OF ENERGY NORTHWEST REGIONAL BIOMASS PROGRAM,

Jeff James (206) 553-2079
jeffrey.james@hq.doe.gov
<http://www.ott.doe.gov/rbep>

State Contacts

IDAHO

John Crockett
Energy Bureau, 208-327-7962
jbcrocke@idwr.state.id.us

MONTANA

Howard Haines
Department of Environmental Quality
406-444-6773, Hhaines@state.mt.us

OREGON

Office of Energy:
John White, 503 378-3194
John.white@state.or.us
Mark Kendall, 503-378-6043

WASHINGTON

Kim Lyons
Washington State University
Energy Program, 360-956-2083
lyonsk@wsu.edu

Using Biodiesel

BIODIESEL HANDLING AND USE GUIDELINES

K. Shaine Tyson
National Renewable Energy Lab
<http://www.nrel.gov/docs/fy01osti/30004.pdf>

ALTERNATIVE FUELS DATA CENTER

<http://www.afdc.doe.gov/>
hotline – 800-423-1DOE
hotline@afdc.nrel.gov

OFFICE OF TRANSPORTATION TECHNOLOGIES

www.ott.doe.gov
includes EPA information

CLEAN CITIES COALITIONS

promoting use of alternative fuels and
vehicles www.cccities.doe.gov

PUGET SOUND

Linda Graham,
Linda.graham@ci.seattle.wa.us,
206-684-0935
<http://cityofseattle.net/cleancities/>

COLUMBIA WILLAMETTE

Larry Medearis, lmed@portptld.com
503-460-4080

ROGUE VALLEY

Steve Vincent
Steve.Vincent@avistacorp.com
541-858-4773

Northwest Suppliers

WORLD ENERGY,

www.worldenergy.net, Graham Noyes,
director Western U.S. 650-712-9688
grahamn@worldenergy.net; Washington
terminal – Lilyblad Petroleum
2244 Port of Tacoma Road
Tacoma, WA 94802
253-572-4402
www.lilyblad.com.
(Other NW terminals to be announced.)

DR. DAN'S ALTERNATIVE FUELS WERKS

912 NW 50th St
Seattle, Washington 98107
206-783-5728
www.fuelwerks.com

PACIFIC NORTHWEST BODIESEL

Aloha, OR,
www.pacificnwbiodiesel.com
Scott Hartford, 503-844-0290
pacificbiodiesel@hotmail.com



Cincinnati Metro is one of several transit fleets running city buses on biodiesel.



CLIMATE SOLUTIONS

A PROJECT OF EARTH ISLAND INSTITUTE

610 East 4th Avenue • Olympia, WA 98501

360-352-1763 • FAX 360-943-4977

info@climatesolutions.org www.climatesolutions.org

CLIMATE SOLUTIONS programs are made possible by contributions from hundreds of individual members and grants from the W. Alton Jones, Turner, Energy, & Bullitt Foundations.

For membership information, additional copies of this report, or for a list of our publications, please contact us.

Reviewers

We thank our reviewers:

Jenna Higgins
National Biodiesel Board

Howard Haines
Montana Department of
Environmental Quality

Kim Lyons
Washington State University
Energy Program

Photo Credits

Cover:
Bean Bus
Agricultural Research Service, USDA

Cincinnati Metro bus
National Biodiesel Board

USDA Researcher
Agricultural Research Service, USDA

INSIDE COVER:
Pictured Rocks truck
National Biodiesel Board

Page 1 & 2:
Bean Bus
Agricultural Research Service, USDA

Page 3
USDA Researcher
Agricultural Research Service, USDA

Page 4:
Cincinnati Metro bus
National Biodiesel Board

DESIGN BY LINDA GREER



**CLIMATE
SOLUTIONS**
A PROJECT OF EARTH ISLAND INSTITUTE

610 East 4th Avenue
Olympia, WA 98501

NON-PROFIT ORG.
U.S. POSTAGE
PAID
OLYMPIA, WA
PERMIT # 771