



O₂ DIESEL

**A Low Cost Alternative
Diesel Fuel for California Fleets**
John Browning, West Coast Sales Manager
O2Diesel, Inc.
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Who is O2Diesel, Inc.?



- Seven yrs. in business: >US\$20m invested in R&D
- Public company since 2003 (AMEX: "OTD")
- Recognized international "E diesel®" leader
- Five years of commercial logistics experience
- Commercial sales started Q2 2004
- Substantial independent 3rd party verifications
- Strong industry partnerships (NCGA, fleets, etc.)
- >\$9 million in U.S., state R&D support (DOE, DoD)
- Int'l. partnership with Abengoa Bioenergy (2005)

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What is O₂Diesel™?



- **An Oxygenated Diesel Fuel Containing:**
 - 7.7vol% Biomass-Derived Fuel Grade Ethanol (ASTM D 4806);
 - 0.6vol% of Proprietary, Ag-Based Additive Package (O2D05); and
 - 91.7vol% No.1 & 2 Diesel, CARB, ULSD, TxLED (ASTM D 975).
- **Premium Fuel Properties of O₂Diesel™:**
 - Enhanced Lubricity
 - Corrosion Inhibition
 - Static Electricity Control
 - Excellent Operational Characteristics

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Why Use Ethanol in Diesel?



- U.S. ag-based replacement for imported petroleum (E diesel® represents 500 mgy of new demand potential)
- Outstanding exhaust emissions benefits – verified reduction of both NO_x & PM in new & older diesel engines
- Plentiful supply & excellent infrastructure already exists in key U.S. and global fleet market areas
- No significant environmental side-effects (CARB, EPA)
- Greenhouse gas reduction benefits (Argonne Nat'l. Labs)

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U.S. Fuel Ethanol: A Profile



1. Fuel Ethanol Potential Capacity: 25 - 30 billion gallons (~2025), *about 15% of U.S. transportation fuel demand.*
2. U.S. Fuel Ethanol Capacity: >4 billion gallons (2005).
3. Industry developed in U.S. over 25 yrs. & will overtake Brazil in 2006 as the world's leading producer.
4. Corn is the predominant U.S. ethanol feedstock (~90%) – for now.
5. New capacity to include grain sorghum, straw, “waste” materials, cellulose, MSW, etc. is quickly emerging.
6. *Fuel ethanol & other biofuels are the ONLY commercially available liquid transportation fuels capable of displacing fossil fuels, reducing GHG emissions & cutting petroleum imports NOW.*

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U.S. Fuel Ethanol: A Profile



Federal “Renewable Fuel Standard” (RFS) enacted in 2005
– Requires 7.5 bgy Ethanol & Biofuels by 2012.

RFS Applies to ALL Biofuels Used in Gasoline, Diesel and as Alternative Fuel.

“VEETC” Adopted in 2005 to Extend Federal \$0.51/gal.
Incentive to Fuel Ethanol in ALL Uses.

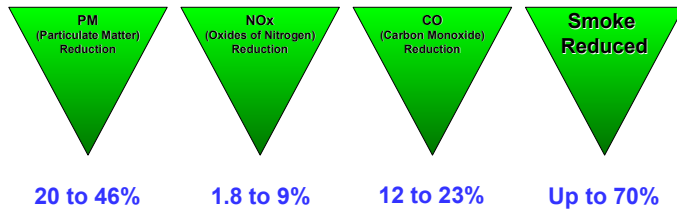
“Renewable Diesel Standard” Legislation Proposed in Nov.
2005 by Sen. Barack Obama (D-IL) Calls for 2.0 bgy
“Non-Diesel” Fuels – including E diesel® -- by 2015.

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O₂Diesel™ Emissions Benefits:



... Compared to EPA or CARB Certified No.2 Diesel



Aggregate data from over 200 laboratory engine, road, and field smoke tests (transient & steady state)
Engine Test Data: Colorado School of Mines, Env. Canada, CE-CERT, Ricardo Engineering & SwRI
(November, 1999 – September, 2005)

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O₂Diesel™ Achievements



- ARB "Alternative Diesel Fuel" Status (Sept. 2003)
- California DMS "Developmental Engine Fuel" (August 2003)
- EPA Tier 1 Health Effects (January 2004)
- Nevada Alternative Fuel status (July 2004)
- Port of L.A. funding for PM reduction (Dec. 2004)
- DOE/NREL emissions testing & durability demonstrations (current)
- DoD/Air Force emissions & durability testing on nontactical engines (current)

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O₂Diesel™ Fleet Activities



- Nellis Air Force Base (Las Vegas, NV)
- Nevada Air National Guard (Reno, NV)
- Peabody Coal/Rawhide Mine (Gillette, WY)
- City of Lincoln, NE (StarTran)
- Johnson County, KS (JCTransit)
- Springfield, IL (transit agency)
- Des Moines, IA (transit agency)
- Port of Long Beach/Long Beach Container Corp.
- E.J. Harrison Industries (Ventura Co., CA)
- Port of Los Angeles, CA

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O₂Diesel™ USAF Fleet Demos



Nellis Air Force Base & Nevada Air National Guard demonstrations launched mid-2005.
Fleet test involving variety of up to 50 pieces of non-tactical diesel-powered equipment.
Central refueling & fuel supply logistics being demonstrated.
Test designed to continue for one year or more.
Phase-in to other fuels possible (e.g., DoD alternative fuels program).
Expansion to other military fleets?

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O₂Diesel™ USAF Fleet Demo



Nellis AFB O₂Diesel™ Fuel Dispensing Tank



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DoD Project Achievements



O₂Diesel™ enables non-tactical military fleets to reduce NO_x, PM, and visible smoke emissions from any diesel engine & to comply with E.O. 13149.

O₂Diesel™ contributed to Nellis AFB receiving coveted “Drake Award” - API global recognition pending.

O₂Diesel™ is a proven, cost-effective, easy-to-use “drop-in” fuel for bases located in air quality nonattainment areas.

O₂Diesel™ is addressing all technical challenges (DLA/DESC), including development of Mil-spec.

Fleet expansions to other locations & branches underway.

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Emissions & Durability Testing



Project Description:

Testing O₂Diesel™ in a typical 1999 Cummins ISB 6-cyl. engine (5.9 liter) for durability (1000 hours) and regulated emissions.

Project conducted using DoD-earmarked funds.

Project managed under subcontract to Alion/JJMA and conducted at Ricardo Engineering Labs (Romulus, MI).

Testing initiated May, 2005 – Concluded Sept. 2005.

Final draft report submitted & being reviewed.

Emissions & Durability Testing



Preliminary Findings:

- As expected, using O₂Diesel™ results in an engine power reduction due to lower density and heating value of the blend when compared to No.2 diesel.
- O₂Diesel™ had no negative impacts on engine performance or durability.
- O₂Diesel™ reduced NO_x by 8.5% and PM by 11.5% when compared with No.2 diesel as run on the 13-Mode ESC.
- The Final Report will detail percent improvements in all performance, and emissions measured areas.
- Pre- and Post-1000 hour wear measurement data will be included in the Final Report, along with a complete set of conclusions and recommendations.

O₂Diesel™ TxLED & DECS Testing



What is Texas Low Emission Diesel (“TxLED”)?

- Low aromatics & high cetane fuel, similar to CARB diesel.
- Required by TCEQ to be sold (on- & off-road) in E. Texas (incl. DFW, HGA, SAT, & AUS) starting Feb. 1, 2006.
- TxLED is expected to reduce NOx emissions, ozone.

What is a Diesel Emissions Control Strategy (“DECS”)?

- Fuel and/or equipment technology verification required by Calif. to reduce particulate matter (PM) emissions.
- Required for certain Calif. regulated fleets.

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O₂Diesel™ TxLED Emissions Testing



Project Description:

1. Testing O₂Diesel™ in a “representative engine” to achieve TxLED/CARB diesel equivalency using No.2 diesel as base blendstock.
2. Project conducted using DOE and TCEQ funds.
3. Project managed under subcontract to University of California-Riverside (CE-CERT) laboratories.
4. Screening tests initiated June, 2005.
5. Full testing commenced January, 2006.

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DECS Emissions Test Plan



O₂Diesel™ Verification Goals - California:

Levels 1, 2, 3 verification on broadest range of engines & aftertreatment devices.

Three engine families (Phase 1): MY1988 & earlier, pre-1993 & 1994-2002 (initially).

Two or three exhaust aftertreatment devices (DOCs & DPFs).

Up to two possible O₂Diesel™ fuel formulae.

O₂Diesel™ DECS Test Plan



Baseline fuels testing with 7.7 & 10vol% ethanol blends and testing for alternative certification of fuel.

Examine fuel-only O₂Diesel™ verification (Level 1).

Baseline testing for aftertreatment systems after 25 hrs. of operation (1 cold + 3 hot).

1000-hr. durability followed by post-test (also working with Donaldson, Johnson-Matthey, etc.).

O₂Diesel™ DECS Test Plan



Testing fuel & engines at CE-CERT (UC-Riverside), Olson EcoLogic, and Ricardo Engineering Heavy-Duty Engine Dynamometer Facilities.

Emissions Measurements with CE-CERT Mobile Emissions Laboratory (MEL).

Basic Emissions to be Tested: THC, NMHC, CO, NO_x, PM, Toxics (Formaldehyde, Acetaldehyde, 1-3 Butadiene, and Benzene).

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CE-CERT Engine Testing Facility



- 600-hp DC electrical dynamometer
- Exhaust vented to Mobile Emissions Lab



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DECS Multimedia Assessment



Working Assumptions:

The O2D05 additive is not overly toxic -- the toxicity of O₂Diesel™ is expected to be similar as to that of reference fuel.

Releases of fuel ethanol into the environment are well-understood & effects are negligible.

The transport of diesel compounds in non-aqueous phase (as organic liquid or vapor) is negligible.

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O₂Diesel™ DoD Alt. Fuel Plan



Southwest Research Institute (SwRI) selected to conduct fuel testing.

Initial fuel characterization of three fuel blends containing no less than 10vol% biodiesel (ASTM D 6751), no less than 5.0vol% fuel ethanol (ASTM D 4806), no more than 5.0vol% Fischer-Tropsch diesel + additives.

Emissions testing (FTP) in 2 - 3 "representative" diesel engines in non-tactical equipment.

Demonstration of performance in field operations.

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DECS O₂Diesel™ Timetable



Feb., 2006: Launch Level 1 DECS emissions testing at CE-CERT, Olson EcoLogic & Ricardo labs

Dec., 2005: Begin Multimedia Assessment

1st Quarter, 2006: Initial emissions data

December, 2005: Multimedia literature search completed

2nd Quarter, 2006: Begin engine durability testing

1st Quarter, 2006: Submission of initial DECS data?

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O₂Diesel™ DoD Alt. Fuel Plan



Goal: development of alternative fuel that meets E.O. 13149 (April, 2000) objectives for DoD.

20% (min.) petroleum displacement of diesel fuel with biofuels (ethanol + biodiesel) or other non-petroleum products (including additives).

Good emissions performance (lower NOx & PM).

Good operational characteristics (cold temp.).

Accomplish above & keep fuel cost under control.

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O₂Diesel™ DoD Alt. Fuel Plan



Earmarked funds (\$800,000 net) approved by Congress in November, 2004.

Project concept proposed by DoD in Dec. 2004.

Requests for Proposal sent to four leading testing facilities in April, 2005.

Proposals received & evaluated in May/June, 2005.

O₂Diesel, Inc. subcontract approved in Oct. 2005.

Project starts Jan. 2006 & completed by mid-2007.

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E diesel® Consortium



Not-for-Profit membership organization formed to address technical, commercial, & regulatory issues facing E diesel® (e.g., ASTM, NCWM, OEM)

Organized under the Renewable Fuels Foundation.

Consortium began work in early 2002.

Broad industry and government participation.

See www.e-diesel.org for more information.

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E diesel® Consortium Members



Illinois “Core Group” (original E diesel® Task Force)
U.S. ethanol producers (Abengoa, ADM, Aventine)
Additive Mfrs. & Suppliers (incl. O2Diesel, Inc.)
U.S. Dept. of Energy (incl. NREL, Argonne Nat’l. Lab)
Renewable Fuels Association (U.S. and Canada)
National Corn Growers Ass’n. (and state chapters)
State & local, public & private groups

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Conclusions



O₂Diesel™ enables civilian & military fleets to reduce NO_x, PM, and visible smoke emissions from any diesel engine
O₂Diesel™ is a cost-effective, easy-to-use “drop-in” fuel
O₂Diesel™ is meeting all technical & regulatory challenges
Full CARB, TCEQ, & EPA verifications to be completed in ‘06
Product acceptance, fuel spec. issues must be addressed
E diesel® Consortium addressing industry-wide issues
O₂Diesel™ is a fuel “ready for prime time” NOW!

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