

CleanFlex Power Systems, LLC

Lincoln, Nebraska

... *Imagine* ...



Challenge to go beyond Diesel; to the Future, not for us, for future generations who will benefit by our actions now.



*clean***FLEX**

POWER
SYSTEMS LLC



2008

Invent a better way and innovate with what's widely available now for a clean & efficient diesel engine tomorrow



2008



- CleanFlex™ is a Sophisticated Computerized Emissions Control System for Diesel Engines
- Uses Greener Cleaner BioRenewable Fuel, Less dependence on Foreign Oil
- CleanFlex Optimizes utilization of Ethanol
- CFP licenses competitive clean diesel technologies which can revolutionize the diesel emission protocols sanctioned by the EPA/CARB

- **Pending Verification/Certification-EPA/CARB**
- **Part of Tier IV solution:**
 - **Reduces NOx 42-76% (SMOG)**
 - **With EGR 80% or more!!**
 - **Allows Greater use of EGR by Cooling!!**
 - **Reduces Particulate Matter(PM)**
 - **Potential to avoid Regenerative DPF**
 - **Will not interfere with a DOC for HC and CO emissions (Tier 4)**



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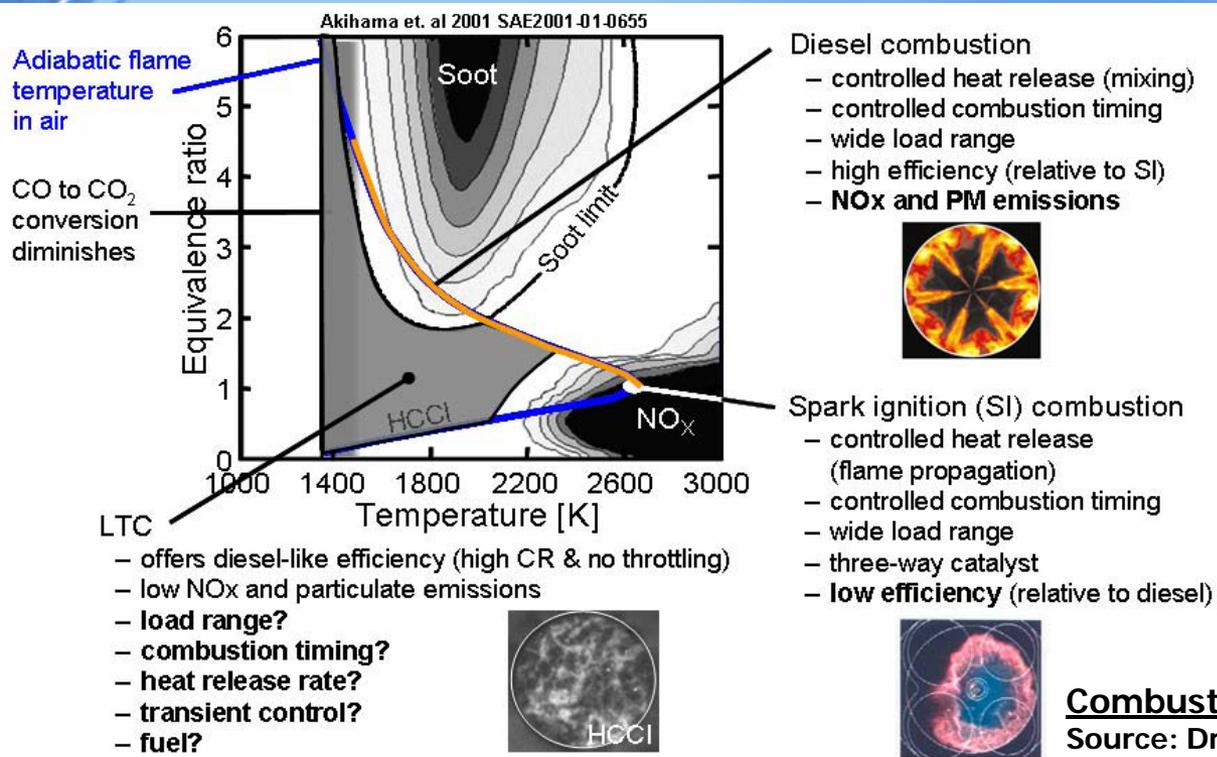
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- Engine runs significantly Cooler
- Increase Horsepower & Energy Efficiency
- Patent Pending Technology

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- Separate Fuel Delivery System
 - > Uses second Fuel Tank
- Combustion Blend:
 - 85% #2 Diesel Fuel
 - 15% 120 proof Ethanol
 - (60%Ethanol/40% Water Ratio)
- **Ready for Market Today !**



<CFP does 2 things for diesel combustion:

- 1) Cools Combustion** which lowers NO_x
- 2) Adds Oxygen** Lower Equivalence Ratio lowers PM

Combustion Processes and Pollutant Formation
 Source: Dr. Dennis Siebers, Sandia National Laboratory

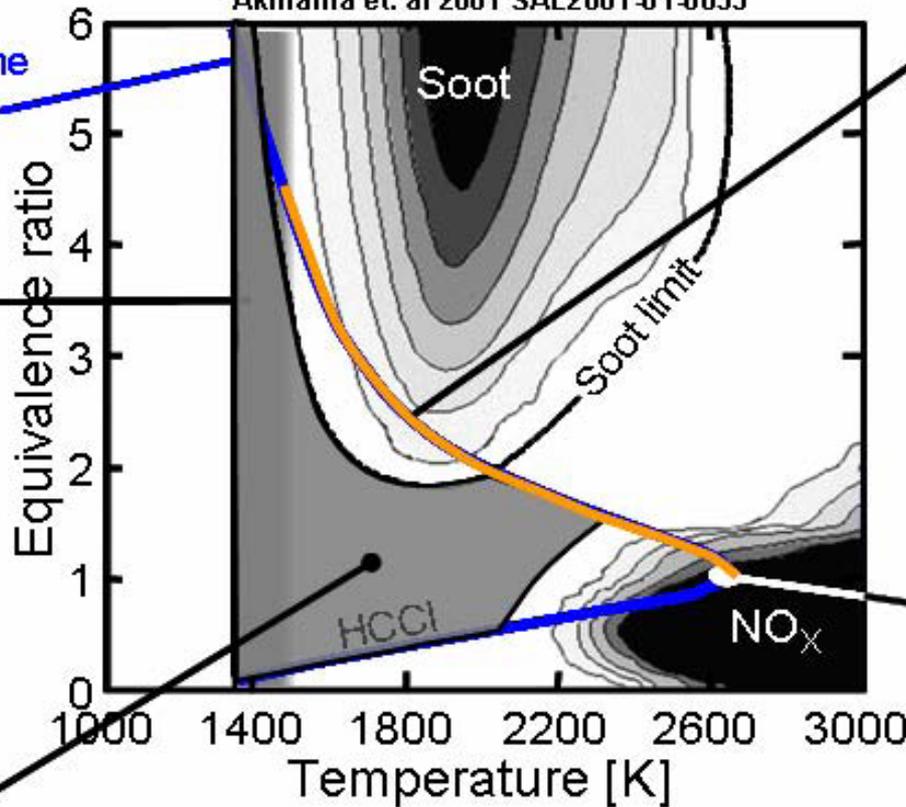
Characteristics of CleanFlex Power System (CFP)

- Utilizes **Ethanol** to adapt Engine to Dual Fuel System
- Displaces Diesel Fuel (Greener Cleaner BioRenewable Fuel) Carbon Neutral
- Sophisticated ECU Controls Dual Fuel System (Data Log Carbon Credits)
- Cools Air Charge(NO_x) & Oxygenates Fuel(PM)
- Prior testing in other diesel engines has shown significant reduction in NO_x and PM & Increased Fuel Efficiency

Combustion Processes and Pollutant Formation

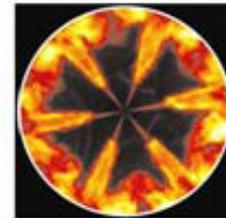
Source: Dr. Dennis Siebers, Sandia National Laboratory

Akihama et. al 2001 SAE2001-01-0655



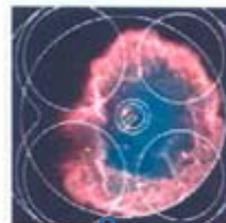
Diesel combustion

- controlled heat release (mixing)
- controlled combustion timing
- wide load range
- high efficiency (relative to SI)
- **NOx and PM emissions**



Spark ignition (SI) combustion

- controlled heat release (flame propagation)
- controlled combustion timing
- wide load range
- three-way catalyst
- **low efficiency** (relative to diesel)

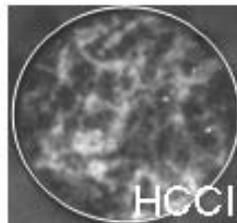


Adiabatic flame temperature in air

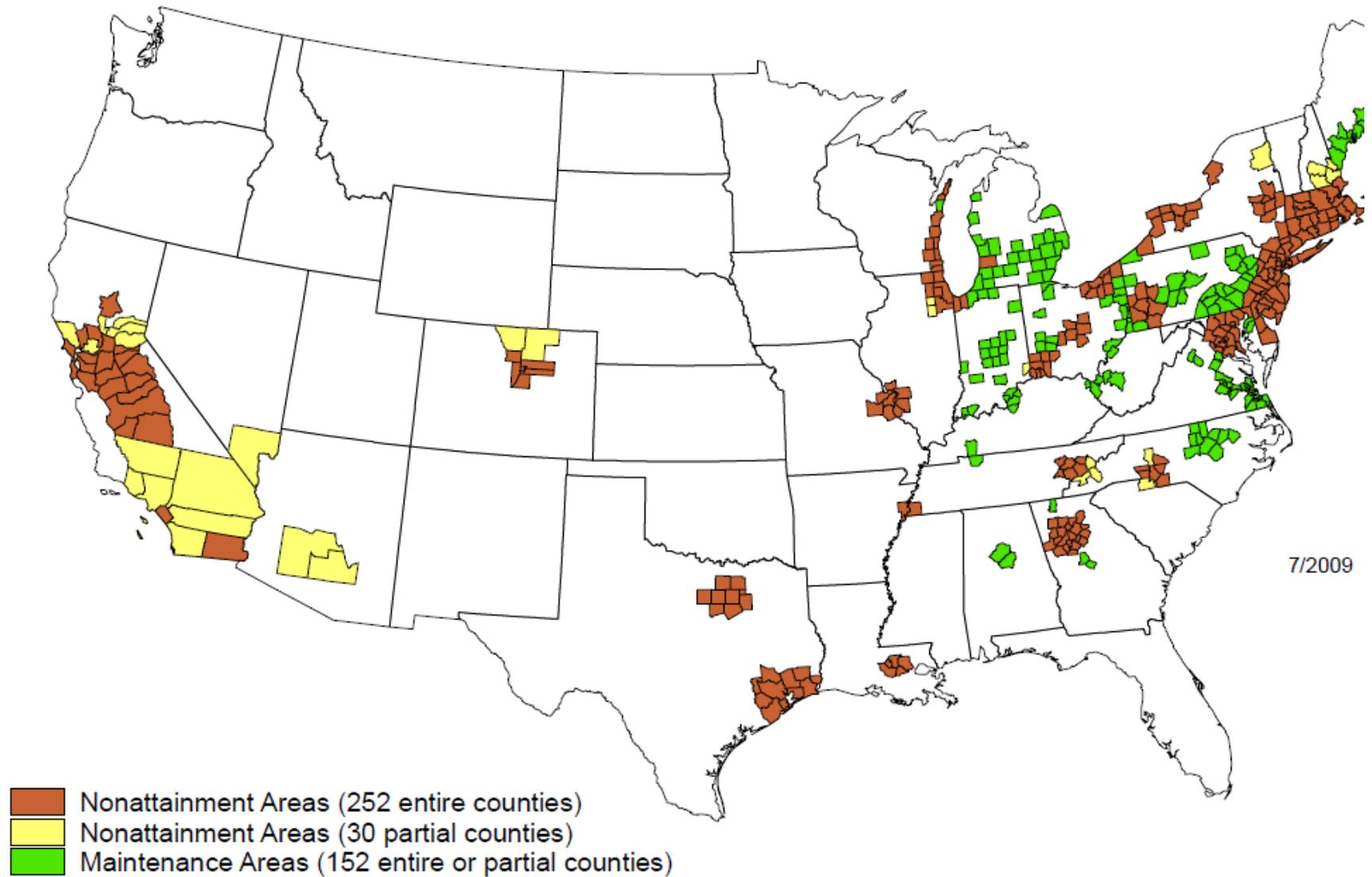
CO to CO₂ conversion diminishes

LTC

- offers diesel-like efficiency (high CR & no throttling)
- low NOx and particulate emissions
- **load range?**
- **combustion timing?**
- **heat release rate?**
- **transient control?**
- **fuel?**



Nonattainment and Maintenance Areas in the U.S. 8-hour Ozone (1997 Standard)



Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on this map.



1997 Star Tran Bus - 4-Cylinder Series 50 Detroit Diesel

12-Oct-09

Fuel Type	HP	% HP INC	NOx PPM	% CO	% O2	% CO2	HC PPM	% NOx Reduction
Diesel	155		1000	0.02	10.9	7.66	6	
E60 + Diesel	200	23%	737	0.08	10.76	6.92	10	26%
Diesel	160		1001	0.02	10.46	7.15	17	
E60 + Diesel	210	24%	751	0.11	9.39	7.31	21	25%
Diesel	165		993	0.03	9.52	7.35	19	
E60 + Diesel	210	21%	718	0.14	9.22	7.47	25	28%

*Results taken by UNL Industrial Product Ag Center & SE College-Milford, NE

**1996 Peterbilt – Caterpillar 3406E Diesel Engine Retrofitted with CFP Ethanol Fuel system
Test Results – Oct 12th, Omaha Truck Center, Council Bluffs, IA.**



1996 Peterbilt-3406E CAT -Meets EPA Tier 1 Emission Regulations

Fuel Type	HP	Eng RPM	NOx PPM	% CO	% O2	% CO2	HC PPM	% NOx Reduction
120 Proof Ethanol	330	1600	508	0.17	10.05	7.33	34	48%

***Today, Omaha, NE's 3-year '8-hour' Ozone levels are nearing 0.7 ppm**

***The EPA has proposed lower 8-hour ozone standard to 0.6 to 0.7ppm**

"EPA proposes that the level of the 8-hour primary standard, which was set at 0.075 ppm in the 2008 final rule, should instead be set at a lower level within the range of 0.060 to 0.070 parts per million (ppm)"

Source: 40 CFR Parts 50 and 58 [EPA-HQ-OAR-2005-0172; FRL-9102-1] RIN 2060-AP98 National Ambient Air Quality Standards for Ozone

- *"If ozone levels continue to trend upward as they appear to have in recent years, the Omaha-Council Bluffs MSA could become non-attainment in the future".*

source: NDEQ Bulletin-"EPA Tightens Ozone Standards Implications for Nebraska"

weblink:<http://www.deq.state.ne.us/AirWaves.nsf/cf7e4bdd49c643bf8625747f005a1515/06d2d0c4f39618e18625748e006039d7?OpenDocument>

- * 'Fuel-Coolant' Delivery System developed for potential EPA Verified Status for Off-Road and Highway Diesel Engine Applications
- * Promote value of an Agriculturally Driven Biofuel-Based Retrofit Technology
- * Reduced Fuel Consumption and Exhaust Emissions (NOx, Particulates)

An "In-Cylinder" Pre-Treatment for NOx and PM Reductions

- A single gallon of ethanol used in a diesel engine instead of a gasoline engine, is **More Valuable** to the environment and economy of any nation.
- H₂O (water) and C₂H₅-OH (ethanol) are available and should be used in varying volumes/ratios to provide, "**Precise, Predictable and Dependable**" Clean Diesel Exhaust Emissions throughout the world. 60% Ethanol(120 proof)/40% H₂O would be a capable 'All-Weather' Fuel-Coolant Fumigant Mix.
- Today and yesterday's diesel engine **WILL NOT** be the 'Norm' of tomorrow's Tier 4 diesel engine.

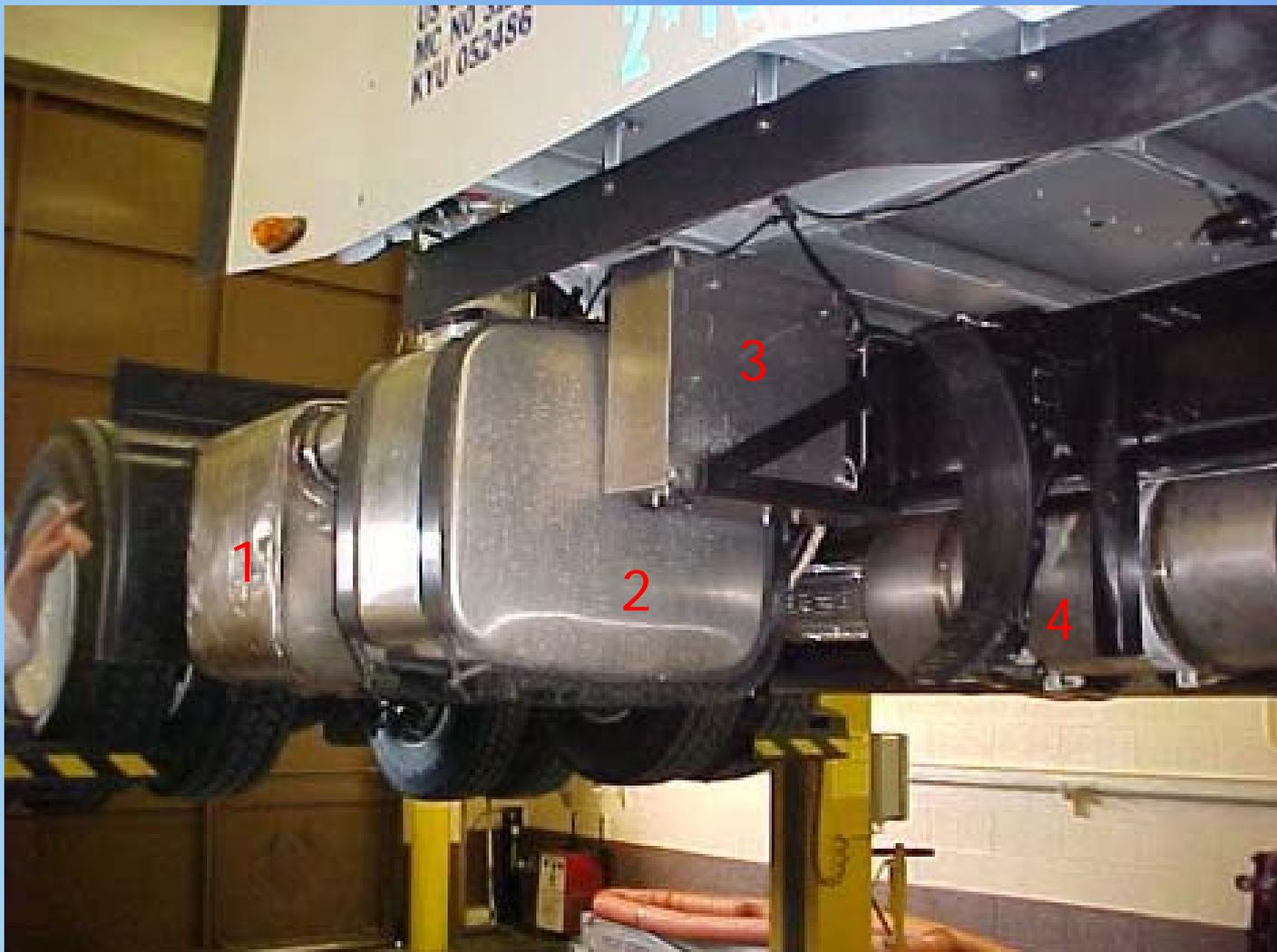
Bullet Points List for Emerging Technology Status via Application to EPA

- CleanFlex Power Systems, LLC, (aka CFP) the manufacturer, has submitted an application and test plan for verification, as well as an explanation of why the technology should be considered an Emerging Technology, to EPA or CARB. These documents were received by Jennifer Went and Greg Orehowsky from the 'OTAQ' (Office of Transportation and Air Quality)-EPA.
- CFP would like the EPA to approve the application and test plan for Emerging Technology Verification process.
- CFP believes they are not violating the Clean Air Act prohibition of 'tampering' with OEM's EPA 'certified' engine fueling and emission systems.
- CFP believes their on-board diagnostics and fuel delivery system is a prudent and viable proposition vs. the Engine Manufacturers' current 'Verified Technologies' options as listed on the EPA's Verified Technologies List.
- The 'Fuel-Coolant' mix can be introduced at a 15%/85% v/v ratio with diesel fuel for clean and predictable precise emission reductions of NOx and PM.
- Current agricultural producers and industrial manufacturers depend on diesel engines for power generation. They say that the engine manufacturers such as John Deere, CASE IH, Caterpillar, Cummins, are universally worried about how and what negative effects will occur should excessive heat buildup issues related to EGR and Regenerative Particulate Filters become the cause of fire or explosion events.

Conclusion:

- A simple BioFuel Driven solution should prevail and be accepted within the EPA's National Clean Diesel Campaign as a 'consumer and environmentally friendly option' for engine retrofits and OEM design configurations in the future. CFP's computerized technology optimizes a 'Fuel Coolant' Emission Reducing 'ethanol and water' fuel mix deserves a test plan within the Emerging Technologies guidelines as set forth by the EPA. Previous research and tests clearly point to large reductions of Greenhouse Gas Emissions of NOx and PM when an alcohol/water mix (ie. CFP's all weather specification 'Fuel Coolant' EM-60) combines with diesel fuel in combustion associated with common diesel engines.

Typical SCR Application in a U.S. Heavy Duty Truck



1-SCR Catalyst 2-Urea Tank 3-Urea Doser 4-Catalyzed DPF

Challenges & possible Solutions for International Emission Reduction Efforts:

- Lack of Uniformity between Countries' Regulations
- Current Emission Reducing technologies have negative cost consequences; causes economic disadvantages vs. India, China and others' lack of 'fair' emission lowering regulations

Solution Process:

- **Use environmentally clean HCCE concept that saves \$**
- **Adapt latest electronics for reliable control system**
- **Use widely available substrates such as: H₂O and C₂H₅OH(ethanol) as chemical catalysts for emission reductions.**
- ***Invent a better way and innovate with what's widely available now for a clean & efficient diesel tomorrow***

120 Proof Ethanol Fuel Spec

- 120 Proof Ethanol
 - Stable formulation
 - Negative 100 F freezing Temperature**
- Power Package Additive
 - Patent Pending Water Soluble Denaturant
 - Lubricity Additive for 'Fuel Coolant' Ethanol/H2O mix

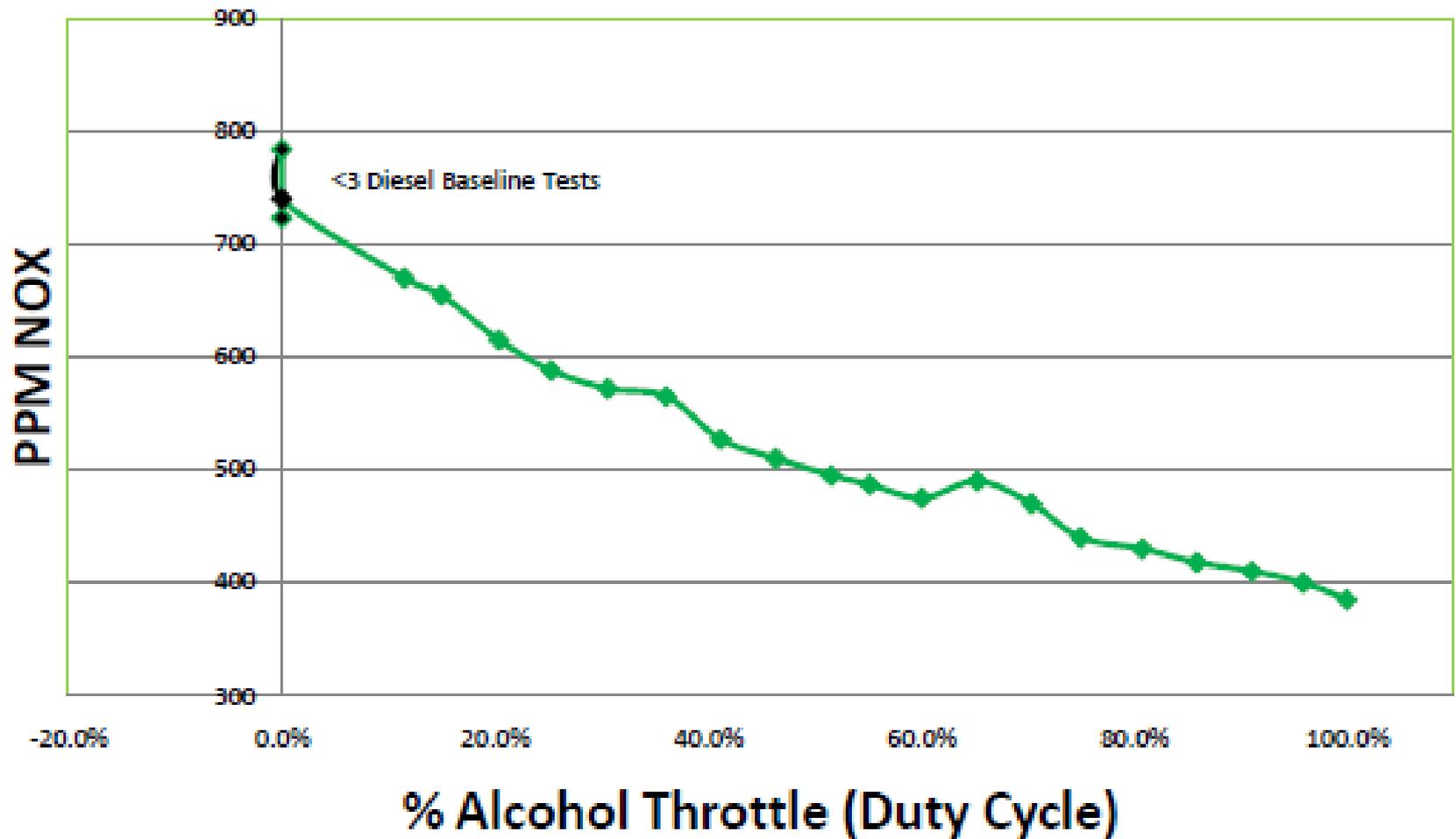
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Don Ellis Engines, Oklahoma City, OK
November, 17th 2009
Caterpillar 379 (Tier 0) Diesel Engine



CAT 379 Engine 600 Hp-NOx Emissions Data Nov 17th-Don Ellis Engines



Summary:

NOx reduction was very predictable and uniform in measured reduction vs increased 120 Proof Ethanol ~~20~~ Ratios to Diesel Fuel

IRS Tax Credit Possibilities

- Volumetric Ethanol Excise Tax Credit (VEETC) via IRS Form 6478 (\$0.45/G)
- Potential Accreditation as Technology Useable within IRS Form 4136-Lines 14 & 15
“Diesel Water Fuel Emulsion Blending”
*Needs at least a 14% H₂O/86% Diesel Blend into fuel mix.
 - Range of tax credits from \$.046 to \$0.244 per Gallon

Challenges & Opportunities

- Enhancing **Thermal Efficiency** while simultaneously reducing emissions
- Seamless inter-mode transition in '**Fuel-Coolant**' mode combustion concept
- Optimizing **Evaporative Cooling** and fuel oxygenation=a cleaner & more efficient Diesel engine
- Treatment of **HC, CO** with DOC (diesel oxidation catalyst)
- Increase in ECU control unit processing requirements of 'Fuel-Coolant' concept allows for **Greater Efficiencies**.
- Realizing stable, repeatable and controllable response of enabling technologies with **Increasing Degrees of Efficiency Gains**. (Fan air flow, EGR, Turbo Compounding)
- **Data Logging** 'Fuel-Coolant' use vs. NOx reductions to prove compliance. Potential '**Pollution/Carbon Credits**'

July 2009

Friendly stewards

By ANN TONER

PROCES and family members are welcome at Terry and Elaine O'Neil's water irrigation. Neighbors do and better among the 1,600 trees they've planted around their home and the holdings of their 300-acre farm in Dutchess County, N.Y.

At a glance

- The O'Neils' water irrigation is the first of its kind in the Midwest.
- The irrigation was an award-winning project that has inspired other farmers to plant trees on their farms.



Diesel, ethanol and water: A green solution
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November 2009

ethanol today

The Official Magazine for the American Ethanol Industry

studying cellulose:
75 billion gallons feasible by 2030

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AUGUST 2009

BATTLING THE BLEND BARRIER

WHAT IS THE CORN ETHANOL'S FUTURE? BUSINESS ON THE EDGE

INSIDE

- GET PAID TO GROW BIOMASS
- EAR INFECTIONS: HOW TO PREVENT THEM
- NEW ETHANOL-BLENDED FUEL

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CleanFlex Power
Systems, LLC
Founders of Potential
'Emerging Technology'
Status for Ethanol
Based Clean Diesel
Technology.

**Run Cleaner.....
Live Greener!**

CleanFlex Power Test – 2008
Bob Dickey and Kevin Kenney





Thank you for your time reviewing this

“Ethanol Driven”

Clean Diesel Engine Technology

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