USING BIODIESEL: FLEET BEST PRACTICES

MAY 2020
INTRODUCING OUR PRESENTERS:

Jennifer Weaver
OEM Market Development Manager, National Biodiesel Board

Ryan Lamberg
Sustainability Consultant, National Biodiesel Board

Steve Larsen
Director of Procurement and Fuel, Ruan Transport Corporation

Michael Dimitroff
Manager of Cultural & Natural Resources, Chicago Park District
ROADMAP FOR THIS SESSION:

- Overview of U.S. Biodiesel Industry Vision and Market Drivers
- Sustainability Benefits of Biodiesel
- Best Practices from Biodiesel Powered Fleets
- OEM & Fleet Support for Biodiesel
- Q&A
NBB VISION 2020
Biodiesel, renewable diesel, and renewable jet fuel will be recognized as mainstream low-carbon fuel options with superior performance and emission characteristics. In on road, off road, air transportation, electricity generation, and home heating applications, use will exceed six billion gallons by 2030, eliminating over 35 million metric tons of CO2 equivalent greenhouse gas emissions annually. With advancements in feedstock, use will reach 15 billion gallons by 2050.
U.S. Biodiesel & Renewable Diesel Market
(millions of gallons)
Source: EPA EMTS*

*Bolumes reported under the RFS in the D4, D5, and D6 categories.
Source: National Biodiesel Board
# Biomass-based diesel review

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<tr>
<th>Feedstock</th>
<th>Process</th>
<th>Product</th>
<th>Specification</th>
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| Animal fat | **Renewable Hydrocarbon Diesel**  
- React with hydrogen (hydrotreat & isomerize)  
- Convert 3-carbon backbone to renewable propane  
- Convert oxygen to H₂O  
- Meets the diesel spec, ASTM D975  
- Molecules are familiar constituents of ULSD (petroleum diesel)  
- Paraffinic fuel  
| Paraffin | | |
| Vegetable Oil | **Biodiesel**  
- React with methanol (transesterification)  
- Convert 3-carbon backbone to glycerol  
- Oxygen remains in fuel molecule  
- Meets the biodiesel spec, ASTM D6751  
- Different molecules than those in petroleum diesel  
- Oxygenated fuel | FAME | |
BIODIESEL AND RENEWABLE DIESEL TODAY

**Production**

Today's market has reached 2.8 billion gallons with more than 3 billion gallons of domestic production capacity online today. Capacity of planned US expansions will grow to 5.5 billion gallons by 2023.

**Feedstocks**

Soybean oil makes up the largest supply of biodiesel/renewable diesel today at 46%. The rest make up the balance almost equally.

**Markets**

Today's markets are made of fleets, on-road and off-road diesel, as well as the expanding heating oil market. Renewable jet fuel is also an emerging market.

**Policy**

Combination of legislation that drives biodiesel success:
- Renewable Fuel Standard
- Federal Tax Incentive
- Carbon Policies
- State Mandates and Incentives
STATES WITH NOTABLE BIODIESEL POLICIES

Legend:
- Low Carb Fuels Std
- Mandate - Fuel Use or Bioheat
- Tax Incentive – Sales/Income
- Tax Incentive - Production
- Fleet Requirement
- Bioheat Mandate passed – Awaiting Surrounding States
- Policy not enforced
- No major policy

Current as of 01/08/2016
Data from DOE Alternative Fuels Data Center and Individual State Statutes

New York City and surrounding counties
**BIODIESEL INFRASTRUCTURE**

- Biodiesel and biodiesel blends available nationwide at more than 2,000 public locations
- Existing trucks, tanks, dispenser pumps and blending facilities can be used for B20 and lower
• Retailers nationwide sell B10 - B20 blends, especially on main truck routes

• Large retailers often have store-level blending, by-passing terminals
ADVANCED BIOFUEL. BETTER. CLEANER. NOW!

REDUCES CARBON, RECYCLES BYPRODUCTS FROM PROTEIN DEMAND AND SAVES LIVES

Biodiesel, a renewable, clean-burning diesel replacement reduces U.S. dependence on imported petroleum, creates green jobs and improves our environment. Made from an increasingly diverse mix of resources including vegetable oils, recycled cooking oil and animal fats, US biodiesel puts excess oils and fats to good use.

BIO D I E S E L
America’s Advanced Biofuel
The vast majority of medium and heavy-duty truck OEMs support up to B20 all diesel vehicle OEMs support blends up to B5.

“The suite of post-combustion controls for diesel engines, including Diesel Oxidation Catalysts (DOC), Diesel Particulate Filters (DPF) and Selective Catalytic Reduction (SCR), are likely to be among the most important environmental technologies of the 21st Century.”

Christopher Frey, Ph.D., Environmental Engineering, North Carolina State University

“A biofuel blend of 20% or higher when mixed with ULSD burns cleaner than natural gas. A biofuel blend of 20% or higher when mixed with ULSD burns cleaner than natural gas. Higher cetane and lubricity than ULSD. Higher cetane and lubricity than ULSD. All other markets.

When demand for power peaks, biodiesel should displace petroleum. Get blended fuel delivered and use your existing tanks.
Biodiesel Improves Emissions for Legacy Engines Today
(While New Diesel Technology Engines Produce Near Zero Emissions)
ON-ROAD DIESEL ENGINES ARE NOW 99%+ CLEANER

SOUTH COAST OZONE FORMULATION SENSITIVITY PER TRANSPORTATION GALLON TRACKS U.S. ON-HIGHWAY EMISSION STANDARDS OF PM AND NOX IN DIESEL ENGINES

[Graph showing trends in emissions from 1975 to 2020]

HEAVY DUTY VEHICLE EMISSIONS COMPARISON IN 2018 (GRAMS/MILE)

<table>
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<tr>
<th>% OF FLEET</th>
<th>NOX</th>
<th>PM</th>
<th>CO₂</th>
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<tbody>
<tr>
<td>NTDE &lt;9B</td>
<td>1.237/</td>
<td>0.002/</td>
<td>351/</td>
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<tr>
<td></td>
<td>0.371</td>
<td>0.006</td>
<td>1960</td>
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<tr>
<td>NTDE B20/RHD 80 &lt;18*</td>
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<td>946/</td>
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<td>0.159</td>
<td>0.08</td>
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*BBD is ~18% of Diesel Pool in CA in 2018
**Stationary + Mobile Sources in CA
Biodiesel – Your Fleet Sustainability Solution
National Biodiesel Board: Fuel Transitions and Fleet Decision Making Webinar

Ruan Transport Corporation
Steve Larsen 5/14/2020
RUAN INTRODUCTION

- Founded 1932 – Still family owned
- National provider of integrated and stand-alone solutions
  - Dedicated contract transportation
  - Managed transportation
  - Brokerage services
  - Value-added warehousing
- Operate ~ 4,000 tractors and 9,500 trailers
- 2019 Transport Topics Rankings
  - #39 For hire
  - #13 Dedicated
  - #9 Bulk
- Purchase 40 - 45M gallons of diesel per year
  - 12% is Bulk fuel
  - 88% is Over-the-road (truck stop) fuel
Industry outreach / collaboration

- NCFP, B20 Club (Iowa Chapter), ACT Expo, BSR Sustainable Fuel Buyer Principles, REG Customer Advisory Board, B20 Club (Iowa)
- Knowledge sharing – industry calls, webinars, panel discussions, best practices

Awards / Memberships

- National Biodiesel Board ‘Initiative Award’
- EPA Smartway Excellence Award recipient
- Heavy Duty Trucking ‘Top 50 Green Fleets’
- Food Logistics’ ‘Top Green Provider’
- Inbound Logistics’ ‘Green Supply Chain Partner’

Ruan has been a heavy user of alternative fuels

- Natural Gas – Well over 100 million miles on CNG and renewable natural gas
- Electric – 17 class 8 BEV tractors on order
- Biodiesel
- Renewable diesel
- **Biodiesel**
  - Purchased approximately 160M gallons of blends between 2013 – 2019
  - Truck Stops
    - Early adoption was often based on incentives by State (i.e. IL, MN, etc.)
    - Biodiesel gained traction in part due to stable standards, incentives and fleet experiences
    - Nearly B20 levels during most warm weather periods
  - Ruan bulk fuel tanks
    - Ruan operates 14 bulk diesel tanks
    - B20 year-round for warm weather sites, and B20 in Spring-Fall for others

- **Renewable Diesel**
  - Purchased approximately 2.0M gallons in the past 27 months
  - Exclusively used in California – related to Low Carbon Fuel Standard (LCFS) credits
  - Blended at 80% Renewable diesel and 20% Biodiesel
DECISION TO UTILIZE BIODIESEL – FACTORS CONSIDERED

- ASTM standards have resulted in predictable biodiesel quality
- Manufacturers have supported or allowed Biodiesel use in our Class-8 fleet
  - We encourage all manufacturers to positively state full support for blends up to B20
- Works with existing Class-8 tractors – no spec changes, no capital cost
- Competitive or better pricing
- Maintenance considerations
  - Out of caution, Ruan gradually ramped up our biodiesel consumption over years, and have not seen any change in fuel-related maintenance issues
- Cleaner emissions: B20 offers 16% CO₂ reduction vs. #2 Diesel (source: EIA)
- Ready to deploy now – nearly effortless way to improve emissions
  - Best emissions improvement to dollar ratio of any alternate fuel

The most practical, cost effective and ready-to-use of all alternative fuels is Biodiesel
DECISION TO UTILIZE BIODIESEL – BENEFITS REALIZED

- Cleaner emissions
  - **Biodiesel – B20**
    - Cleaner emissions: 16% CO₂ reduction vs. #2 Diesel *(Source: Energy Information Administration)*
    - Over 700 million pounds of CO₂ reductions vs. #2 diesel since 2013
  - **Renewable diesel**
    - **R80/B20 – 100% renewable content, even larger emissions improvements vs. #2 Diesel**
    - Blending provides benefits of lubricity, low sulfur content and better cloud point
- Reduced costs
  - Ruan has seen competitive or improved fuel costs using biodiesel blends
  - R80/B20 can be cost competitive to B20 or to #2 diesel in CA. Other States likely require some ‘LCFS-like’ programs to reach cost competitiveness for renewable diesel
- Good corporate citizenship / Customer relations / Public relations
  - Provides our customers cleaner transportation with easy implementation and competitive pricing for us
DECISION TO UTILIZE BIODIESEL – OTHER CONSIDERATIONS

- **Performance**
  - We **do not** see ‘foaming’ in fuel getting into oil system (samples at oil changes)
  - **No** phase separation
  - **No** operational issues

- **Blending method options**
  - Purchase pre-blended B20 (or other blends)
    - For bulk fuel blends, ensure ASTM D7467 for B6-B20 blends
  - Maintain separate tanks for neat biodiesel (ASTM D6751) and #2 diesel, along with blending hardware

- **Consider tapering blends in cold weather based on facts**
  - Consistent fuel testing for cloud point
  - Treating with normal ‘Winter treatment’ can help with usage of biodiesel further into Winter season

- **Good bulk diesel tank maintenance is important**
  - We do bottom and nozzle samples monthly

- **Domestic production / energy security**
It is often a challenge to implement incentives that successfully pair maximum environmental benefits with attractiveness of business adoption.

- Biodiesel incentives result in nearly certain 100% effectiveness
  - Truck stop chains will adopt, resulting in ‘indirect adoption’ for nearly every fleet in the nation
- Ongoing support for the ‘Tax Extenders’ package including the Blenders’ Credit
- State initiatives such as reduced IFTA rates on biodiesel
- LCFS-type initiatives – to bring renewable diesel to more markets
- Exploring biodiesel blend levels beyond B20
Steve Larsen
Director of Procurement and Fuel
Ruan Transport Corporation
slarsen@ruan.com
Chicago Park District
Beyond B20
PARK DISTRICT ASSETS

- 8800 + acres
- 1850 acres of natural areas
- 600 + Parks
- 27 Beaches
- 11 Museums
- 10 Lakefront Harbors
- 26 miles of Lakefront
SUSTAINABILITY EFFORTS

The Chicago Park District has a number of different programs implemented to increase sustainability. These are both internal and external partnerships involving:

- Education and Programming
- LEED Silver-Certified new construction
- Energy Usage – 75% renewable sourced
- “Greening” Procurement Specifications
- Water – Clean Marinas Program – 6 of 10 Certified as Clean Marinas
- Real-Time Beach Monitoring
- Waste and Recycle Practices
- DCNR Landscape Operations
- Facilities Upgrades
- Timber Re-Use
CPD HIGH BIODIESEL BLEND FLEET

55 of the 200 diesel vehicles run on B10 to B100

- (5) Refuse trucks
- (19) Heavy duty trucks
- (6) Light duty trucks
- (25) Off-road vehicles
  - (7) Tractors
  - (2) Chippers
  - (12) Lawn mowers
  - (2) Front loaders
  - (1) Back hoe
  - (1) Stump cutter
FLEET FUELING LOCATIONS

- Chicago Fleet and Facilities Management (2FM) supplies B10
- CPD operates a blending dispenser and satellite storage tank
- Maintain fuel quality through proper handling and storage
- Train drivers, supervisors and mechanics to detect changes in vehicle performance and report back to fuel manager
- Collect data to track down any specific fuel related issues
Biodiesel Blends Dispensed

Biodiesel Percentage Yearly Averages

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<tr>
<td></td>
<td>16%</td>
<td>19%</td>
<td>37%</td>
<td>35%</td>
<td>36%</td>
<td>32%</td>
<td>35%</td>
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PROGRAM BENEFITS

- 13th member in the IL B20 Club
- Recently awarded a Chicago Area Clean Cities Award for Biodiesel Use
  - Demonstrate Park District Leadership role in renewable fuels usage
  - Cleaner Air - Reduced emissions for drivers and Chicago residents
  - Fuel security
  - Local economy booster
Cold weather becomes a limiting factor...

- Source high quality fuel supplier
- Keep water out of fuel storage and vehicle fuel lines
- Ensure proper blending from supplier
- Use ASTM spec biodiesel
- Use anti-gel additives
- Chicago Department of Fleet uses Valvtec
- Consider testing biodiesel at a third party laboratory

Positive experience with biodiesel has encouraged the use of higher blends

- Biodiesel tends to clean fuel systems
- Cleaning action releases years of diesel varnish
- Accumulated varnish clogs filters
- Increase fuel filter change intervals initially
OPTIMUS TECHNOLOGIES RETROFIT

The Optimus Technologies System fulfills a number of goals:

- Allows for B100 operation throughout winter
- EPA approval for biodiesel systems for medium and heavy-duty trucks
- Integrates into existing equipment
- Never inhibits the use of petrol diesel
- System runs automatically without driver intervention
- Lowest cost method to achieve ~80% carbon reductions
CHICAGO PARK DISTRICT B100 PROJECT

- Autocar Refuse Haulers with 6.7L Cummins Engine
- (1) 2017 and (1) 2019 has the Optimus System installed
- (2) identical trucks will serve as a diesel only control group
- Telematics continuously monitor engine and aftertreatment performance
- New DPFs were analyzed and installed at start of test
COLD WEATHER OPERATION

- Average 2018/2019 Winter Temp was 26.7°F
- Coldest temp was -23°F on Jan. 30, 2019
- Indoor fueling station was built for B99 dispensing in cold weather

Climate source: Weather.gov/chicago
B100 PROJECT 1ST YEAR SUMMARY

Two Lakefront refuse trucks running on B100 with the Optimus Technologies Retrofit achieved the following emissions reductions by using 2,887 gallons of biodiesel:

- 14.45 lbs particulate matter
- 16 lbs Hydrocarbons
- 159 lbs Carbon Monoxide
- 12 lbs sulfur
- 53,737 lbs Carbon Dioxide
LESSONS LEARNED

- **Education is essential**
- Inform and brief Fleet/Organizational Leadership
- Know the products and organize the program logistics for a successful rollout
  - Source the highest quality parts, fuel products and ASTM fuel producers
    - These are your Successful Program Partners
  - Inform and train Managers and Technicians – and Operators at the appropriate time
    - Implement Team Orientations
    - Highlight trouble-shooting awareness and immediate communication response protocols and contacts
    - Ensure Optimal Winterization practices
  - If applicable, research and contract with the highest-rated and knowledgeable Service Contractor
- **Implement slowly with continuous monitoring and oversight**
- **Maintain Fuel Data and PM reports with an eye for fuel-related incidents and assess and respond accordingly**
- **Maintain optimal UST, AST and dispensing conditions**
CHICAGO PARK DISTRICT CONTACT

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OEM & FLEET SUPPORT FOR BIODIESEL
OEM & FLEET SUPPORT GROWING DUE TO:

- Growing volumes & availability
- Favorable policies – RFS, EPACT, Tax Credits, etc.
- GHG emissions benefits
- Vehicle performance benefits
- ASTM specifications
- BQ-9000 biodiesel quality
- Consumers and fleets want the option
- “Green” competitive advantage - easy way to green your fleet!
In the GVW Class 5-8 vehicles that account for 92% of on-road diesel fuel use, the vast majority of new diesel engines now have full OEM support for B20 and lower blends meeting ASTM standards with no vehicle modifications required.

Biodiesel offers fleets an easy and cost-effective way to significantly lower carbon and reduce GHG emissions in both legacy and new vehicles and equipment.
OEMS SUPPORTING B20
*Models equipped with Cummins engines are B20 approved. See NBB website for details.
FLEETS ARE MOVING BEYOND B20

In the ever-increasing drive to cut carbon and lower CO$_2$ emissions, forward-looking fleets and users are investigating higher biodiesel blends to maximize the reduction in their carbon footprint.
CARBON INTENSITY OF FUELS
grams CO2e/MJ

Electricity from a Coal Fired Power Plant

https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/040115_pathway_ci_comparison.pdf
There is a growing trend amongst states and federal programs to increase the use of low carbon fuels to address climate change and sustainability. The NBB recognizes that in order for fleets and end-users to best comply and take advantage of these programs, all elements of the fuels distribution system must be aligned. We would like to help share your collective voice and power. Please help us to inform the appropriate policymakers, including the OEMs from which you purchase vehicles / engines.

BIODIESEL FLEETS: SHARE YOUR STORY

  - Review the Letter
  - Fill Out the Form, Click Submit and You’re Done!

- **From Phone or Mobile Device:**
  - Send a Text to **52886** with keyword **Fleet Letter**
  - A link to the letter will be sent to you promptly
  - Review the Letter
  - Fill Out the Form, Click Submit and You’re Done!
THANK YOU! QUESTIONS?

www.nbb.org
www.biodiesel.org
www.bettercleanernow.com

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