EXPLORING BIODIESEL
regional seminars
“Rearview Mirror Thinking is the tendency to use your experience as a means of framing the future”
Change begins with knowledge..

**Situation**
- State and Federal policies aimed at phasing out carbon-based fuels is underway challenging the entire petroleum supply chain’s sustainability.
- Market consolidation, aging population, reduction in consumer choice.

**Solution**
- Low Carbon Renewable Fuels, Biodiesel, Bioheat®
- Integrate low carbon renewable liquids like biodiesel and renewable diesel throughout distillate pool.

**Strategy**
- Work Together, Win Together
The Supply Chain, How it works, How its challenged

- Each link in the chain has its own purpose.
- Every link in this chain is susceptible to its own challenges.
- Countless challenges associated with legislation to get to Net Zero throughout the supply chain.
- Understanding what you buy/sell and consume is your responsibility, become educated and ask questions.
Market Drivers Influencing Price

- NYMEX
- Spot Market
- Rack Market
- Retail Market
Anticipate Uncertainty
U.S. Distillate Consumption

Sales of Distillate Fuel Oil by End Use

Source: U.S. Energy Information Administration
U.S. Biodiesel & Renewable Diesel Market
(millions of gallons)
Source: EPA EMTS*

*Volumes reported under the RFS in the D4, D5, and D6 categories.
U.S. Biodiesel & Renewable Diesel Market

(millions of gallons)

Source: EPA EMTS*

*Volumes reported under the RFS in the D4, D5, and D6 categories.
U.S. Biodiesel & Renewable Diesel Market
(millions of gallons)
Source: EPA EMTS*

*Biodiesel and Renewable Diesel
Imported fuel

*Volumes reported under the RFS in the D4, D5, and D6 categories.
Low Carbon Liquid Fuels, Mandates/Incentives
Arbitrage Discretionary Blending Driving Markets

Petroleum Administration for Defense Districts

CARB LCFS
800 MGY
B20

Bioheat®
200-800 MGY
B5 – B20
NEFI Resolution
B50 by 2030
Biodiesel
Maximizing Its Potential
What is Biodiesel?

• A domestic, sustainable, renewable fuel for blending into diesel and heating oil made from fats and oils, such as soybean oil and used cooking oil

• EPA designates biodiesel as a high-quality Advanced Biofuel, because it helps reduce GHG emissions between 57% - 86%

• Made through a chemical reaction called transesterification, raw vegetable oil, recycled cooking oil, RHD/Renewable Diesel are not biodiesel
What is Biodiesel?

- Biodiesel is *methyl esters* made from biological oils and fats (triglycerides) by transesterification.
The United States has more than 3 billion gallons of operating biodiesel and renewable diesel capacity. Overall, there is 4.2 billion gallons of registered capacity, according to EPA. There are additional announced plans to build or expand 2.5 billion gallons. In 2018, U.S. biomass-based diesel production increased by more than 300 million gallons, according to EPA.
2019 Biomass Based Diesel Feedstocks

Biomass-based Diesel Feedstocks 2019

- Soy: 41%
- Animal Fat: 14%
- Used Cooking Oil: 21%
- Distillers Corn Oil: 17%
- Canola: 7%
# Emissions Reductions With Biodiesel

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<th>B20</th>
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<tr>
<td>Total Unburned Hydrocarbons</td>
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<td>-20%</td>
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<td>Carbon Monoxide</td>
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<tr>
<td>Particulate Matter</td>
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<td>Polycyclic Aromatic Hydrocarbons</td>
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<td>Ozone Potential</td>
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A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions
http://www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf
Biodiesel offers the Lowest Carbon Intensity of any U.S. Produced Fuel

Based on CARB data, [https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/040115_pathway_ci_comparison.pdf](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/040115_pathway_ci_comparison.pdf)
Green House Gas Benefits: Biodiesel Reduces Carbon Footprint

• U.S. biodiesel on average provides an 80% Reduction in Carbon Emissions compared to petroleum diesel
  • Full life cycle from soil to tailpipe
  • Includes latest indirect land use
Sustainability

• With biodiesel, **food isn’t sacrificed for fuel.** Oils and fats for biodiesel are a minor by-product of producing food for humans and animals.
  – Soybeans are 80% protein, 20% oil
  – No one grows livestock for its fat content
  – No one cooks more fried food to get used oil for biodiesel
Federal Policies

- Renewable Fuel Standard, RFS

- Biodiesel Blenders Tax Credit

- Biodiesel tax credit renewal attached to U.S. spending package

- U.S. lawmakers have amended a government spending bill to extend a tax credit for the biodiesel industry through 2022 and retroactively to when it expired beginning in 2018.
### The RFS, Renewable Fuel Standard

- Bipartisan policy passed in 2005
- Requires increasing volumes of renewable fuels to be blended into the U.S. fuel stream

**Two broad categories:**
- Conventional biofuels—GHG reductions of at least 20%
- Advanced biofuels—GHG reductions of at least 50%

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<td>Biomass-Based Diesel</td>
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<td>19.28B</td>
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<td>N/A</td>
<td>2.43B</td>
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Statewide Requirements

Currently Implemented
CT: B20 (rising)
MA: B5 (V) APS
RI: B5
VT: B7 (rising)

Not yet Implemented
MA: B2
RI: B5
VT: B2

Note: “Downstate” & City of New York has a B5 Bioheat® requirement.
Major Consumption Incentives
Low Carbon Policies

4.5 billion total gallons

LCFS in Place

LCFS Potential
**BMBD GROWTH IN CALIFORNIA**

- **14 MG of BMBD.**
- **.003% of market**
- **507 million gallons of BMBD.**
- **14% of diesel market.**

Source: 2011-1017 CARB quarterly reports.
Projected BMBD Volumes under LCFS

Source: CARB Illustrative Supply Scenario Calculator (https://www.arb.ca.gov/fuels/lcfs/rulemakingdocs.htm)
MINIMUM STATE VOLUMES

2016
- California: 412 MG
- Texas: 1 Billion Gallons
- Illinois: 1 Billion Gallons

2017
- California: 507 MG
- Texas: 1 Billion Gallons
- Illinois: 1 Billion Gallons

2018
- California: 650 MG
- Texas: 1.2 Billion Gallons
- Illinois: 1.4 Billion Gallons

States: CA, TX, IL, MN, OR, NY, IA, PA, RI
NBB Technical Program Overview

- ASTM Standards
- Biodiesel Technical Workshop and Priorities
- BQ-9000 Program Support and Activities
- Baseline Technical Support for Federal and State Programs and Initiatives
- OEM B20, Higher Support Efforts
- Bioheat®
- Pipeline Technical Steering Committee
- Supports New Market Development
BQ-9000 Quality Program

- Quality program designed to ensure only the highest quality fuels enter the marketplace

- Implemented as a means to help instill confidence in biodiesel with users and equipment companies

- Four BQ-9000 designations:
  - Producer
  - Marketer
  - Certified Laboratories
  - Retailer
The ASTM Minimum Standards

- ASTM D6751 (B100)
- ASTM D975 (Petroleum Diesel)
- ASTM D7467 (B6-B20)
- ASTM D396 (Heating Oil)
  - 6-20 Falls Under D396

- B100 Specifications Originally Published in 1999/2002
- Specification Has Been Revised 23 Times
- 23 vs 14 Minimum Properties Evaluated for Biodiesel versus Diesel Fuel
Federal Biomass-Based Diesel Labeling Requirements

• B100 or “neat” biodiesel (100%) has its own label.

• B99 – B100 requires no truck placards.

• Some states requiring BOL and delivery ticket nomenclature, (like MA, APS program).

• Specifics on label fonts, dimensions, etc. are found in the final rule.
B20 and After-Treatment Systems

- Biodiesel performs well with DPF and NOx SCR systems, and has some distinct advantages:
  - Less engine out particulate matter
  - Particulate burns off faster and at lower temperatures
  - May provide better performance and less maintenance vs. ULSD
  - Potential increase in fuel economy through 50% less regenerations
  - 90% + reduction in NOx using NOx SCR after-treatment
    - With B20 or with petrodiesel
OEM Biodiesel Support

• GVW Class 5-8 vehicles account for 92% of on-road diesel fuel the vast majority of new diesel engines now have full OEM support for B20 and lower blends meeting ASTM standards

• [www.biodiesel.org/using-biodiesel/oem-information](http://www.biodiesel.org/using-biodiesel/oem-information)

*Models equipped with Cummins engines are B20 approved. See NBB website for details.*
Biodiesel Improves Distillate Properties

- Blends with petrodiesel in any percentage

- Higher Cetane
  - Over 50 vs. average petrodiesel around 44

- Higher Lubricity
  - 2% biodiesel, can impart a 65% increase in lubricity value

- Virtually Zero Sulfur
  - Meets ULSD limits of 15 ppm or less
  - Up to 86% life cycle CO$_2$ reduction (per EPA)

- Zero Aromatics Reduces Toxicity and Burns Cleaner

- 11% Oxygen Provides Superior Lubricity and Reduces Black Smoke (Particulates)

- High Flash Point Makes it Safer to Store & Handle
Diesel Fuel
America’s Work Horse
Diesel technology remains a key strategy in the lineup of technologies for the future:

- Undisputed power source for heavy-duty vehicles, rail, marine, industrial, agriculture and construction sectors
  - Diesel moves 90% of all freight nationally
- Manufacturers turn to diesel to meet the NHTSA/EPA fuel economy mandates of 54.5 MPG by 2025.

Low carbon liquid fuels are key differentiators that enable diesel to compete in a low-carbon future.
How Has Your Fuel Changed?

“Do You Know What’s In Your Saddle Tank”?  
“Do You Know What Happens In HPFI Systems”? 

Reducing Sulfur Chemically Changed the Fuel, Impacting.....

- Lubricity
- Stability
- Conductivity
- Winter Operability
- Solvency
- Density
Extreme Temperature & Pressures

600F / 38,000 PSI

Injector Tip, Plunger Barrel and Injector Labyrinth, The “Impact Zone”

Filter Blocking = Shortened PMI
Power Loss = Reduced Performance
Economy Deficits = Increased Fuel Costs
Filtration Challenges

• Primary Fuel Filters
  • New: 7-25 µm
  • Historical: 10-50 µm

• Secondary Fuel Filter
  • New: 2-5 µm
  • Historical: 2-15 µm
Filter Plugging & Mileage Depreciation

Have you ever burnt a burger while grilling?

Particles are masses of smaller, hydrogen rich **carbonaceous** particles.
Diagnosing The Operational Issues, “Critical”
Microbial, Corrosion, Monoglycerides, Water, Paraffin and Thermal Instability
Corrosion Plaguing Diesel

Corrosion in Systems Storing and Dispensing Ultra Low Sulfur Diesel (ULSD), Hypotheses Investigation

Battelle Memorial Institute
505 King Avenue
Columbus, OH 43201

To
Clean Diesel Fuel Alliance
C/O Mr. Prentiss Swezies
American Petroleum Institute
1228 L Street, NW
Washington, DC 20005-4070

September 5, 2012
Establish A Prevent Defense

• Housekeeping vigilance
• Desiccant dryers
• Fuel additives
• Updated fuel specifications
• Switch loading
• Establish tank management
• Know what you are buying
National Conference of Weights & Measures
Premium Diesel Fuel Specifications

Current
- Cetane Number: 47 Minimum
- Lubricity: 520 Micron
- Low Temperature Operability: Requiring the ASTM Guideline Using the Tougher LTFT Method
- Stability: 80% Reflectance, 180-Minute Test

Proposed
- Cetane Number, ASTM D613: 47 minimum
- Corrosion, NACE TM0172-2015: B+ rating minimum
- Filter Blocking Tendency, ASTM D2068, procedure B: 1.6 maximum
- Injector Deposit, CEC DW-10 B: 2 % maximum power loss
- Low Temperature Operability, Cloud Point, LTFT, or a restricted CFPP: ASTM D975 Guideline
  - CFPP should be limited to a maximum of 6 C below the cloud point of the fuel.
- Lubricity Wear Scar Diameter, ASTM D6079: 460-micron maximum
Top Tier Diesel Fuel

- A voluntary program, endorsed by an alliance of engine makers.
- Driven by ULSD mandate, HPFI systems, EMA concerns about diesel quality and D975.
- Fuel contamination concerns, particulate matter, water and corrosion.
- Additives, Filtration & Housekeeping.
Gasoline Marketing Trends
Past
Present
Future
Maximum Sulfur Limits in Gasoline, 2020

India implemented 10 ppm since April

Legend:
- 0-10 ppm
- 11-30 ppm
- 31-50 ppm
- 51-150 ppm
- 151-500 ppm
- 501-2,500 ppm
- No information / Not regulated

Countries may apply lower limits for different grades, regions/cities, or based on average content. Detailed information on limits and regulations can be found at www.stratasadvisors.com.

Source: Stratas Advisors, April 2020.
All Gasoline Is Created Equal, “What’s Your $”

Myths About Premium Gas

Premium versus Regular

63% of U.S. drivers believe there is a difference in the quality of gasoline sold by different gas stations...

But only 12% choose a gas station based on fuel quality.*

*gasoline that contains an enhanced detergent additive

NewsRoom.AAA.com
Gasoline Direct Injection (GDI) Systems

Benefits
- More Power
- Significant Efficiency Improvements
- Greenhouse Gas Reductions

Challenges
- Injector Coking

TOP TIER
Detergent Gasoline
Projected Growth Globally

• GDI Market Penetration Grew From 1% to 44% In Last 17 Years

• Now Projected To Go To 62% in the next 5 years

Source: IHS 2014
TOP TIER® Gasoline, An Overview

- Voluntary standard sponsored by equipment manufacturers

- Addresses, combustion chamber deposits and valve sticking performance

- (~2½ times) more deposit control additive required vs LAC

- Participation requires all grades, all marketing areas
Next Generation Gasoline Marketing Increases
Diesel Fuel, LCLF’s & The Future

• Diesel technology remains a key strategy in the lineup of technologies for the future:
  • Undisputed power source for heavy-duty vehicles, rail, marine, industrial, agriculture and construction sectors
    • Diesel moves 90% of all freight nationally
  • Manufacturers turn to diesel to meet the NHTSA/EPA fuel economy mandates of 54.5 MPG by 2025.
  • Low carbon liquid fuels are key differentiators that enable diesel to compete in a low-carbon future.
Heating Oil Market Renaissance
Heating Oil, What People Are Saying

• Hasn’t Evolved In Decades

• It’s Carbon Intensive Even At 15 ppm

• Policymakers Loathe It

• Poor Merchantability

• Market Contraction Will Accelerate

• **Our People Are Our Biggest Asset**
The question is not whether carbon-intensive fuel will spell the end of the planet in your great grandchildren’s lifetime...

but if it will spell the end of your business in yours.

**THE SITUATION**

Your company has survived past threats from supply, price and utility competition, but now faces an unparalleled and organized threat from government. Unlike the other threats, this one has the power to assess harmful carbon taxes, offer financial incentives to convert away from oil and legislate you out of business.

**THE SOLUTION**

Bioheat®, made from America’s advanced biofuel, biodiesel, blended with varying amounts of heating oil will reduce atmospheric carbon emissions. Blending at 20% provide a 16% reduction, increasing the blend to 50% will reduce carbon emissions by 40%.
The Facts are The Facts!

• However, the biggest challenge we as an industry face in 2019 and going forward is the "electrification of everything."

The short synopsis on HB 725 – FN is that this proposal if adopted would drive the cost of fossil fuels so high that the end users would be forced to seek alternative sources of energy as opposed to what they use today. This proposal would cost you jobs, market share and potentially your company.

January 16, 2019

TO: FMA Members
FROM: Eric DeGesero
RE: The Future of Your Business

As 2019 begins there are a number of priorities for FMA. Among the priorities are continuing to try and find a way to resolve the ongoing subrogation suits by homeowner insurers against oil dealers and establishing relationships with new members of Congress from New Jersey (look for an upcoming announcement but mark your calendars for a Washington D.C. trip May 9-10).

However, the biggest challenge we as an industry face in 2019 and going forward is the "electrification of everything."

There is a strong push in the Northeast to eliminate all fossil fuels in:

• the building sector by converting everyone to heat pumps.
• the transportation sector by pushing electric cars.

This is not simply a U.S. matter. The province of Quebec, Canada, has banned new installations of heating oil systems in 2023 that are not operating on bio or renewable fuel and by 2028 all existing non bio or renewable fuel heating systems will need to be either removed or replaced with bio or renewable fuels units. The City of Montreal is considering advancing these deadlines.

NORA is working on developing a fuel and equipment that will allow for liquid fuels to be part of the heating mix in the future. This article is an excellent synopsis. The author Rich Sweetser, along with NORA Chairman Charlie Uglietto, Cubby Oil, Somerville, MA, NORA President John Huber and Dr. Tom Butcher, who heads NORA’s research lab will present an in depth analysis of all that NORA is doing to ensure your company's future as the EEE 2019 keynote in Hershey, PA.
Heat Pumps: Cost

The cost of converting to an electric air-source heat pump system in Massachusetts over the last few years is expensive for homeowners.

Massachusetts Heat Pump Conversion Cost
2014-2019 (n=622)

Averages
Avg. sq. ft. of Conditioned Space = 1,502 sq. ft.
Avg. Total Cost of Conversion = $20,428
Avg. Cost per sq. ft. Conditioned Space = $13.60

Source: Diversified Energy Specialists Research & Analysis; MassCEC; MA DOER
# Pour Point Evaluation, B50, UCO

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<th>Pour Point Evaluation</th>
<th>Managing Higher Percentage Blends of Bio</th>
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<td>Degrees (F)</td>
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<tr>
<td>Neat #2</td>
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## Additive Blends

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*Generic #2 heating oil, Boston Harbor, Biodiesel, UCO, Used Cooking Oil, Compliant APS Biodiesel, Tests Performed at Intertek, Chelsea, Massachusetts, September 2019.
BIOHEAT® TRADEMARKS

- Bioheat®, Min 2% - 5% Max
- Bioheat Plus™, 6-20%
- Bioheat Super Plus™ 21-100%
Biodiesel/ULSHO, A Cleaner Choice

- Renewable
- Biodegradable
- High cetane
- Increased lubricity
- Safer flash point
- No nitrogen or aromatics
- Virtually sulfur free
- Contains 11% oxygen by weight
- Enhances fireside performance
- Helps reduce brush & vacuum intervals
- Creates a positive consumer impression about heating oil
- Our sole pathway forward

Biodiesel blends at 20% (B-20) with ULSHO are lower in Greenhouse Gas emissions than natural gas when evaluated over 100 years, while blends of 2% (B-2) or more are lower in GHG than natural gas when evaluated over twenty years.
Preparing For Increased Demand

Production
Transportation
Storage, Blending,
Delivery

3 BGY Heating Oil
B20, 2023 Time Frame
600 MGY Biodiesel Demand
21K Rail Cars, Nov-March
3500 Cars Monthly

ABUNDANT
KEEPING AMERICA COMFORTABLE FOR YEARS TO COME