

# Diesel Drop-In Alternatives: Ultra-Low Sulfur, Bio-, and Renewable

February 11, 2025

MESSY MIDDLE  
**BOOTCAMP**

## Advanced Clean Tech News For the Commercial Transport Sector

The screenshot displays the ACT News website interface. At the top, the logo for ACT News is accompanied by the tagline "Advanced Clean Tech News FOR THE COMMERCIAL TRANSPORT SECTOR". A navigation bar includes links for News, Webinars, Whitepapers, Videos, Resources, ACT Buyers' Guide, ACT Fleet Forum, Advertise, and Subscribe. A prominent banner for ACT Expo 2025 (April 28 - May 1, 2025, Anaheim, California) offers a 25% discount by March 14, 2025. The main content area features a "TRENDING FEATURES" section with several articles, each with a thumbnail image and a brief summary. The articles include: "Ford: Lower Prices Will Help EV Adoption" (February 6, 2025), "TRC Companies Surpasses \$2 Billion in Funding for Projects Supporting Clean Commercial Transportation, Clean Energy" (February 4, 2025), "Tesla Semi to Enter Mass Production at End of 2025" (January 30, 2025), "Nation's Largest Port-Based Charging Depot Opens in Long Beach" (January 30, 2025), "Norway On Road to Zero-Emission Goal" (January 29, 2025), and "Transportation Secretary Takes First Step to Rescind Biden Fuel Standards" (January 29, 2025). A right-hand sidebar titled "Industry News" lists additional news items such as "Hydrogen Trucks to Get Fuel Station Near Busy East Coast Container Port" and "ZF Range Energy Announce Electric Trailer Partnership". A link for "All Latest Features" is located at the bottom right of the page.

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## The Largest Advanced Commercial Vehicle Technology Show *Driving Economic & Environmental Fleet Sustainability*



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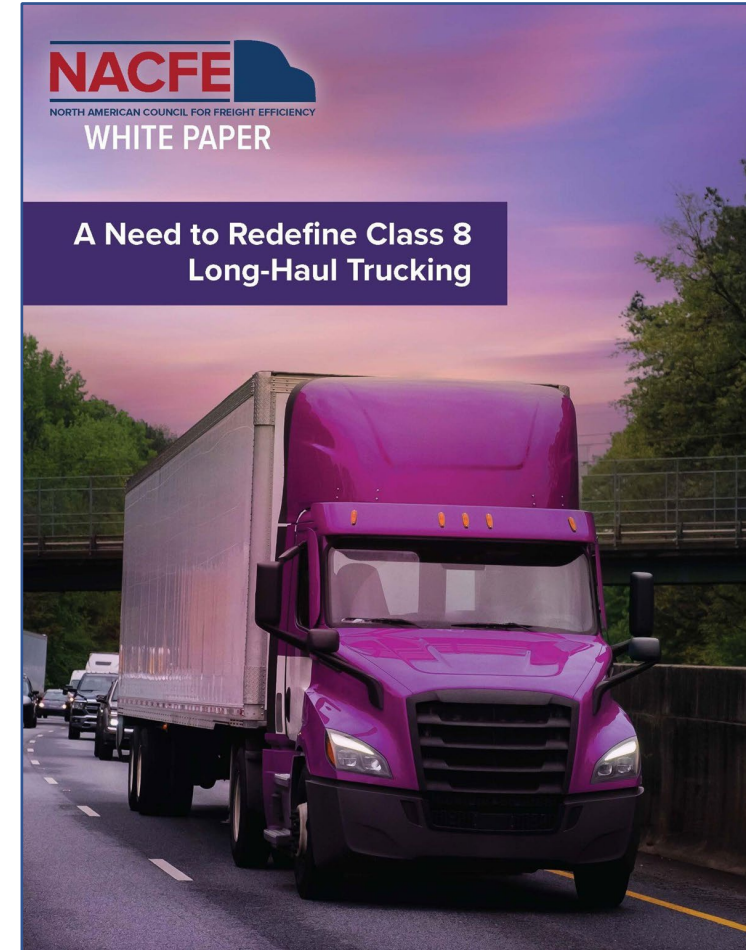
Use Code **25AE-NACFE-50** at  
[www.actexpo.com/register](http://www.actexpo.com/register)  
For \$50 off Full Conference pass

*Conference: April 28-May 1, 2025 | Expo: April 28-30, 2025  
Anaheim, CA | Anaheim Convention Center*



# Run on Less - Messy Middle

- Class 8 truck market is not homogenous
- 65% of heavy-duty truck market is highway tractors *(ACT Research)*
- Important to standardize language and descriptions when discussing long-haul
- This report offers some definitions of long haul we will be using throughout Run on Less - Messy Middle



[Access Report Here](#)



# Messy Middle Bootcamp Series

 **Diesel Drop-In Alternatives: Ultra-Low Sulfur, Bio-, and Renewable** (February 11th)

 **Decarbonizing with Natural Gas** (February 25th)

  **Future Prices & Availability of Existing Infrastructure: What's Next?** (March 11th)

**DIESEL AND NATURAL GAS WORKSHOP (March 25th)**

 **The Current State of HD BEV: Technologies and Capabilities** (April 8th)

 **Strategizing Successful HD BEV Adoption** (April 27th)

 **Charging Depots, Networks & the Economics of Fleet** (May 6th)

**HD BEV WORKSHOP (May 20th)**

 **The Production Processes of Hydrogen Fuel** (June 3rd)

 **Moving Hydrogen from Here to There: The Distribution and Storage of Hydrogen Fuel** (June 17th)

 **The Opportunities and Challenges of Selling Hydrogen to the Industry** (July 1st)

**HYDROGEN FUEL CELL WORKSHOP (July 15th)**

**2023 Bootcamp is still available at: <https://runonless.com/electric-depot/>**

# 2025 Messy Middle Fleets



## Update from The Run Planning...

**Follow the Fleets, Drivers, providers, and more on:**

RunOnLess.com and on Twitter @RunOnLess



Today's Bootcamp Sponsor

ExxonMobil



# Quiz for Today's Session

## Completing Today's Quiz:

- Go to [runonless.com](http://runonless.com) and click back into the session
- Click 'Take Quiz' button
- Create username and password to keep track of your progress
- Provide your name and email to enter a drawing for a Run on Less - Messy Middle swag bag





# What You Should Know

## Q&A

Submit your questions to the host using the Q&A box in the upper right-hand corner

## Recording

A recording of today's webinar will be available on [runonless.com](http://runonless.com)

## Technical Issues

Contact Stephane Babcock at [sbabcock@trccompanies.com](mailto:sbabcock@trccompanies.com)



# Today's Bootcamp Speakers

## Diesel Drop-In Alternatives: Ultra -Low Sulfur, Bio-, and Renewable



**Scott Fenwick**  
*Technical Director*  
Clean Fuels Alliance  
America



**Andrew Gibson**  
*Global Sector Marketing  
Manager Fleet & Global  
Brand Manager Shell  
Rimula  
Shell*



**Colin Huwyler**  
*CEO*  
Optimus Technologies



**Jeff Seger**  
*Clean Energy Consultant*  
NACFE





# EPA27 Low Nox Technologies

**NACFE**

NATIONAL AIR FILTER COUNCIL FOR EFFICIENT ENERGY

What is the EPA27 Low Nox rule

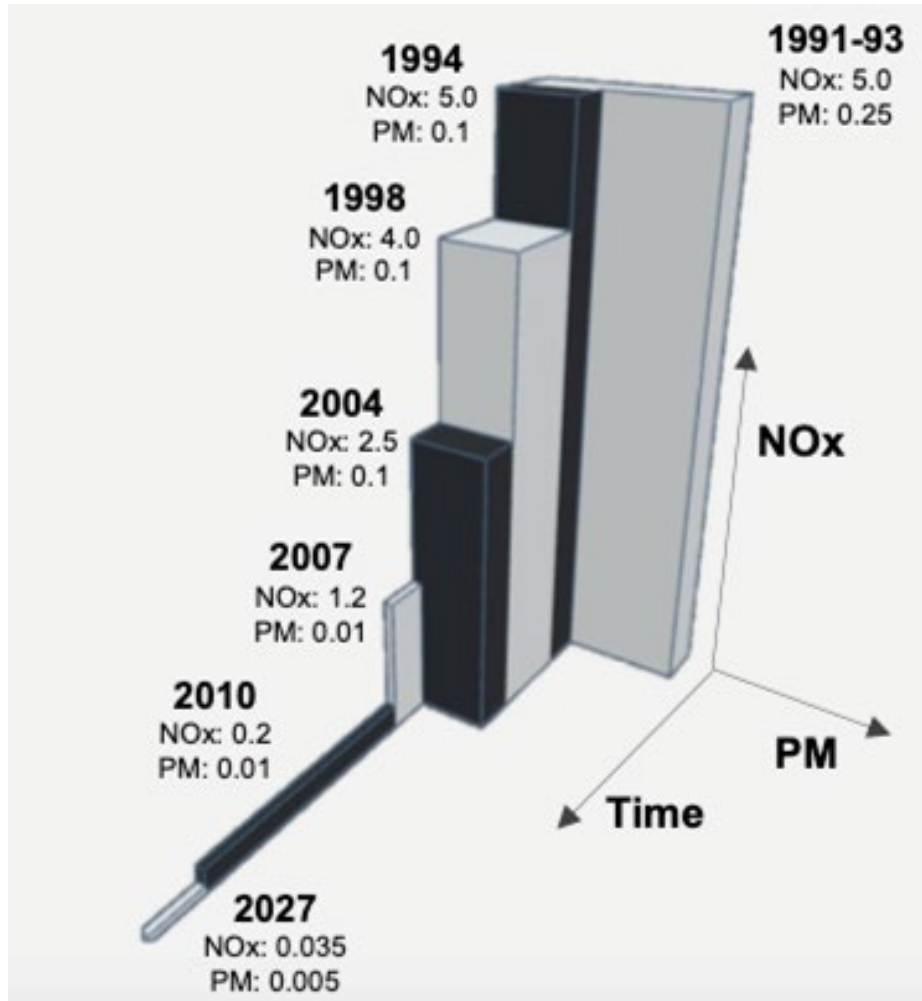
What problem are we trying to solve

What technologies are likely

Other regulation driving technology changes



# What is EPA27



Largest regulatory change since 2010

NOx limits reduced from .2 to .035 g/bhp-hr

Reduction over time

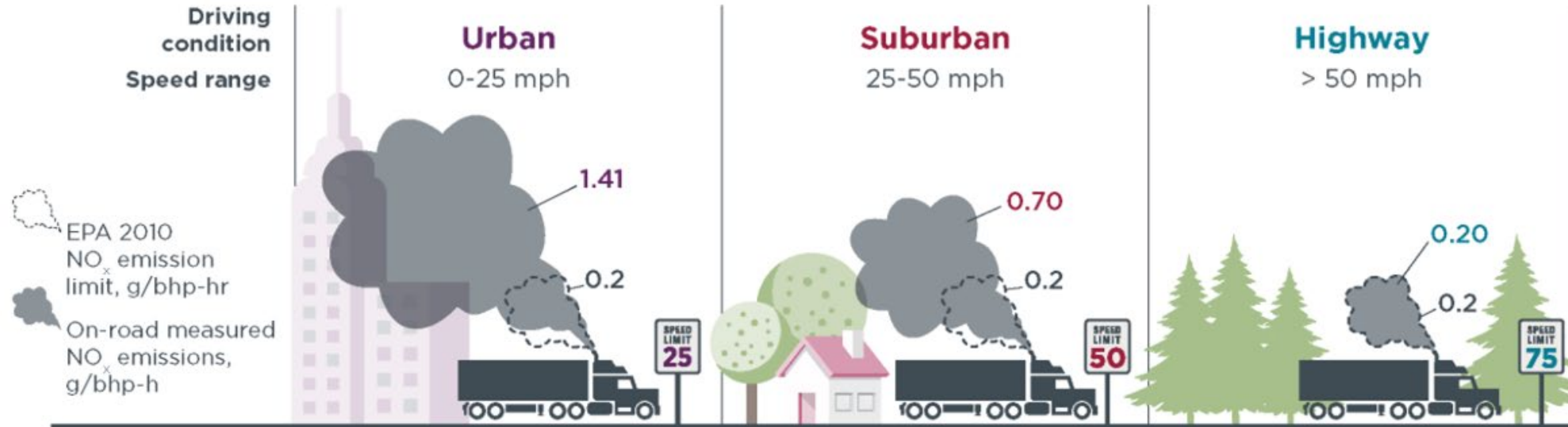
- 80+% reduction since 2010
- 99+% reduction since 1994

Emissions warranty increase

- MHD: 5yr/100k to 10yr/280k miles
- HDD: 5yr/100k to 10yr/450k miles

Courtesy: Cummins, Inc

# What problem are we trying to solve

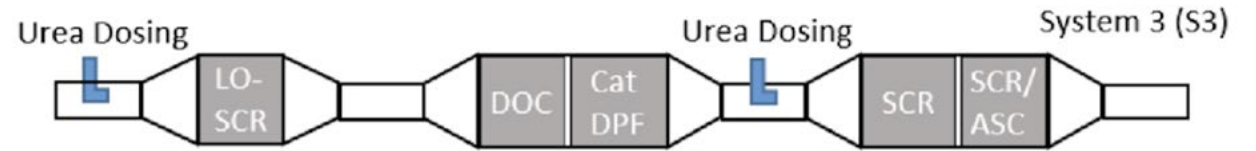
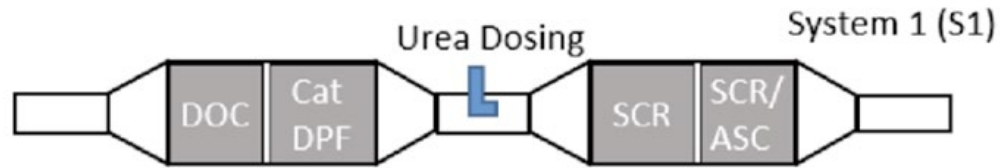


Majority of NO<sub>x</sub> generated under start-up and light load

SCR efficiency is low at low temperatures

Plan of attack is to create heat at light loads

# Two basic approaches



## Heater(s) at the catalyst

1. Add heater(s)
2. Add some catalyst volume

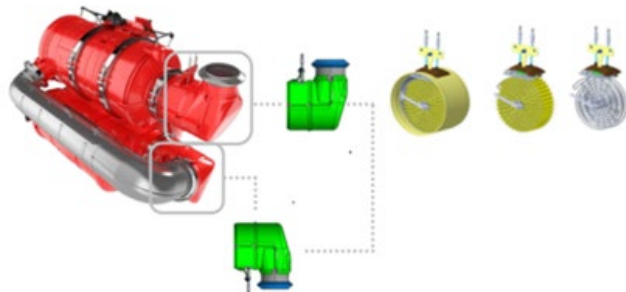
## Dual SCR

1. Add 2<sup>nd</sup> doser near turbo
2. Add 2<sup>nd</sup> catalyst and volume

1. *Cylinder Deactivation and Variable Valve Actuation are additional levers but not believed to be used at this time*
2. *Alternate fuels also provide low Nox (CNG, RNG, LPG, RD, etc)*

# Low NOx Solutions/Architectures

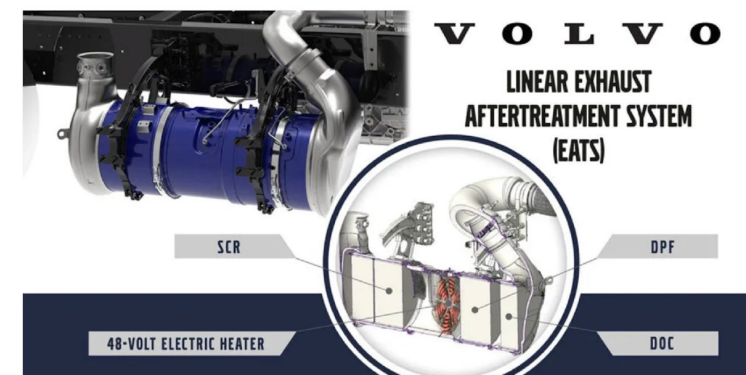
## Cummins



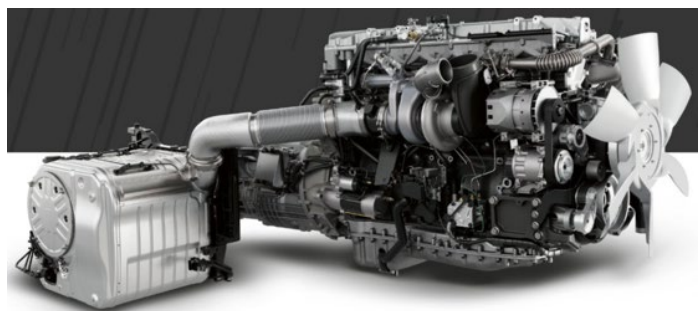
## PACCAR MX



## Volvo



## International S13



Cummins, Volvo, PACCAR announce similar strategies

- 2010-like architecture
- 48V alternator and heater
- Volvo to use a 48 V battery

International

- Dual Dosing w/ 1<sup>st</sup> doser after turbo
- No active DPF, no EGR cooler, high Compression Ratio

*Design iterations likely between now and EPA 27*



# Some of the key attributes

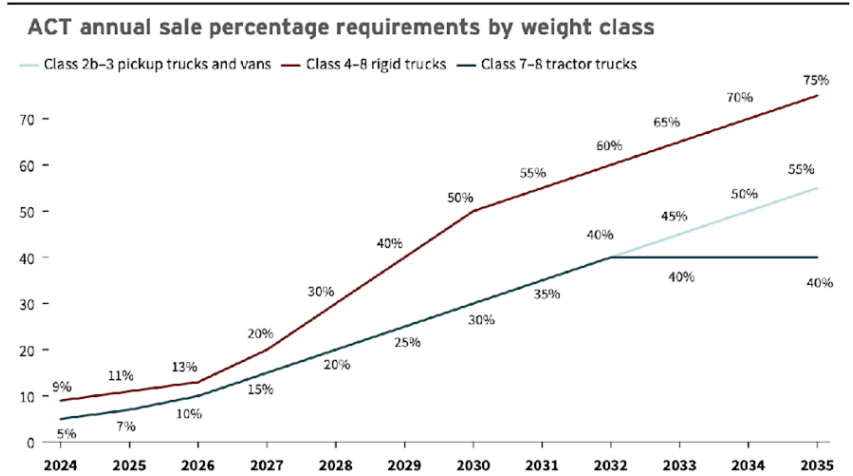
Heater System	Dual SCR and Dual DEF Dosing
<p>Positives</p> <ol style="list-style-type: none"><li>1. More traditional SCR architecture</li><li>2. Only slight increase in DEF consumption (&lt; 1%)</li><li>3. Claimed fuel economy improvement</li></ol>	<p>Positives</p> <ol style="list-style-type: none"><li>1. Removal of EGR cooler and simpler turbo</li><li>2. Passive regen</li><li>3. Claimed fuel economy improvement</li></ol>
<p>Keep an eye on these potential impacts</p> <ol style="list-style-type: none"><li>1. Higher idle fuel consumption?</li><li>2. Alternator and heater reliability?</li><li>3. Expansion of 48 v system to other functions?</li><li>4. Other?</li></ol>	<p>Keep an eye on these potential impacts</p> <ol style="list-style-type: none"><li>1. Possible change in catalyst config to meet .035?</li><li>2. 2<sup>nd</sup> doser reliability/complexity?</li><li>3. Increased DEF consumption?</li><li>4. Other?</li></ol>

# Other regulation driving technology changes

## EPA Greenhouse Gas Phase 3 (CO2 Percent Reduction from Phase2)

Regulatory group	MY 2027	MY 2028	MY 2029	MY 2030	MY 2031	MY 2032
Light heavy-duty vocational	17%	22%	27%	32%	46%	60%
Medium heavy-duty vocational	13%	16%	19%	22%	31%	40%
Heavy heavy-duty vocational	—	—	13%	15%	23%	30%
Medium heavy-duty all cab and heavy heavy-duty day cab tractors	—	8%	12%	16%	28%	40%
Sleeper cab tractors	—	—	—	6%	12%	25%

## CARB ACT



We also have EPA Greenhouse Gas Phase 3 and CARB ACT

These are intended to reduce CO2

Other likely changes

- 1. Aerodynamics, Tires, APUs, electronic parameters, etc
- 1. Powertrain efficiency
- 1. Battery Electric Vehicles
- 1. Fuel Cell Vehicles
- 1. CNG, RNG, LPG, Renewable Diesel, etc
- 1. Hybrids?
- 1. Other?

Stay tuned for all Bootcamp sessions

We will cover all of these future  
technologies



# References

ICCT NOx at light loads graph: <https://theicct.org/publication/current-state-of-nox-emissions-from-in-use-heavy-duty-diesel-vehicles-in-the-united-states/>

SCR architecture diagrams: [https://www.meca.org/wp-content/uploads/resources/MECA\\_2027\\_Low\\_NOx\\_White\\_Paper\\_FINAL.pdf](https://www.meca.org/wp-content/uploads/resources/MECA_2027_Low_NOx_White_Paper_FINAL.pdf)

PACCAR MX: <https://www.ttnews.com/articles/peterbilt-carb-mx-13-engine>

Volvo: <https://www.aftermarketnews.com/volvo-heavy-duty-carb-omnibus-compliant-engine/>

International S13: <https://www.robertstruck.com/--S13-Integrated-Powertrain?t>

Greenhouse Gas Phase 3: [https://theicct.org/wp-content/uploads/2024/09/ID-214---EPA-Phase-3\\_final.pdf?t](https://theicct.org/wp-content/uploads/2024/09/ID-214---EPA-Phase-3_final.pdf?t)

CARB ACT Mandate: <https://rmi.org/understanding-californias-advanced-clean-truck-regulation/?t>





Clean Fuels  
ALLIANCE AMERICA

North American Council for  
Freight Efficiency

Run On Less – Messy Middle Bootcamp webinar

**THE BENEFITS OF RENEWABLE BIOMASS-BASED DISTILLATE  
FUELS AND THE CHALLENGES THAT REMAIN TOWARDS  
DECARBONIZATION**

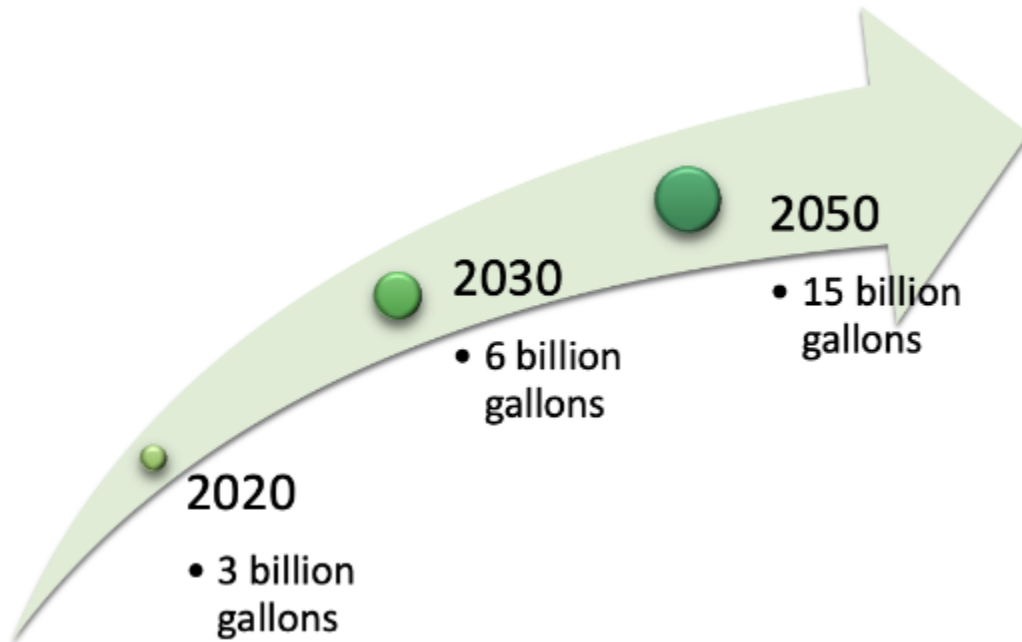
# CLEAN FUELS APPRECIATES THE SUPPORT OF OUR FARMERS AND THEIR CHECKOFFS



Clean Fuels  
ALLIANCE AMERICA



# Clean Fuels Alliance America INDUSTRY vision



***Biodiesel, renewable diesel and sustainable aviation 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 6 billion gallons by 2030, avoiding over 50 million metric tons of CO<sub>2</sub>*** equivalent greenhouse gas emissions annually. With advancements in feedstock, use will reach ***15 billion gallons by 2050.***



# Biodiesel & Renewable Diesel Today

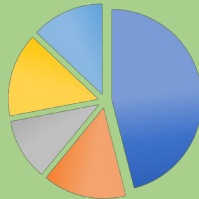


## Production

Today's domestic producers have reached over 4.6 billion gallons with more than 5.9 billion gallons of domestic production capacity online today or in development.



## Feedstocks



Soybean oil makes up the largest supply of biodiesel/renewable diesel today at nearly 40%. The rest make up the balance fairly 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, marine fuel and railroad applications are also emerging markets.



## Policy

Combination of legislation that drives biodiesel success:

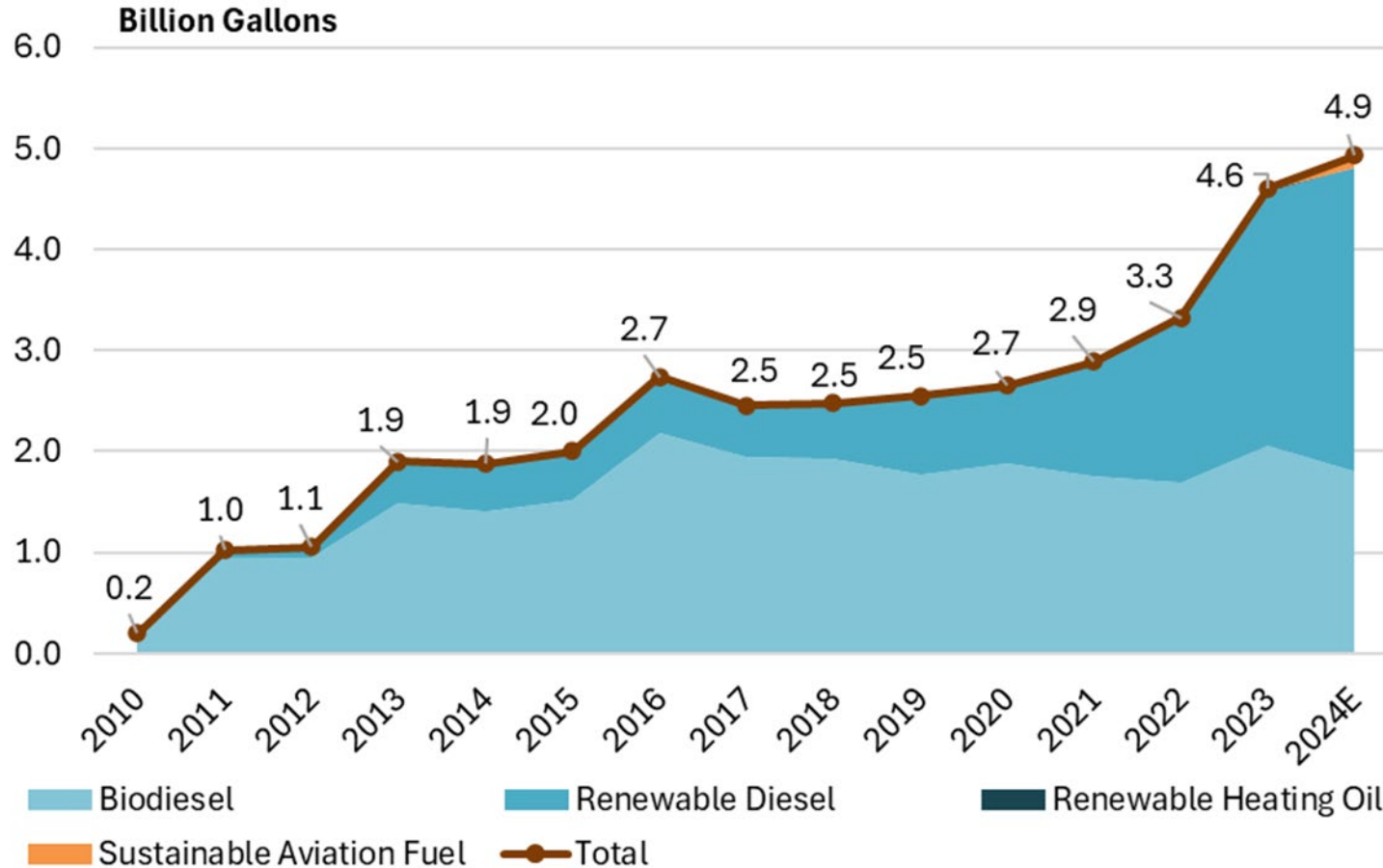
- **Renewable Fuel Standard**
- **Federal Tax Incentive**
- **Carbon Policies**
- **State Mandates and Incentives**
- **USDA Higher Blend Infrastructure Incentive Program**





# BBD CONSUMPTION ON THE RISE

## US Biomass-Based Diesel Consumption



- 2023 set record at 4.6 BG consumed in US
- 2024 on pace to eclipse 2023's record
- SAF starting growth phase
  - Increased volumes expected in 2025

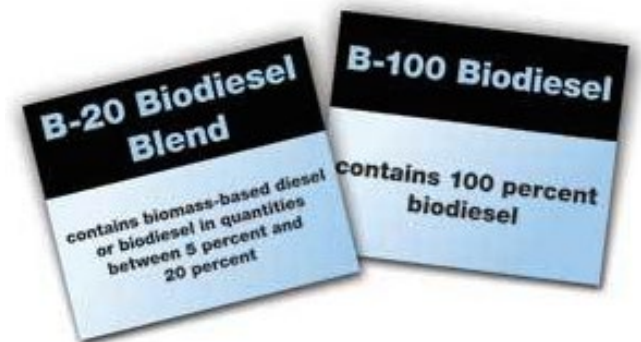




# Biodiesel Infrastructure

- Biodiesel and biodiesel blends available nationwide at more than public locations
- Existing trucks, tanks, dispenser pumps and blending facilities can be used for B20 and lower
- Find retailers offering B20 & higher blends at:  
<https://afdc.energy.gov/stations/#/find/nearest?fuel=BD>
- Blends higher than B20 may require strategic partnerships with fuel suppliers, many already in development through the High Blend Infrastructure Incentive Program (HBIIP) & with major fleets
- 1430 N.A. retail stations offering B20+

- [cleanfuels.org](http://cleanfuels.org) -



# SOME TECHNICAL HIGHLIGHTS

## ➤ Major Positive Changes at ASTM for the transportation market

- New Low Metals (LM) grade has passed in D6751 for B100!
  - Each sulfur grade (S15, S500, S5000) of No. 1-B and No. 2-B of B100 has a LM grade
  - LM grades are 4 ppm max Na+K+Ca+Mg. All other grades remain at 10 ppm max (5 Na/K, 5 Ca/Mg)
  - Use of LM grade for B6-B20 in NTDEs passed in D7467 this past fall, DDC support for B20 in CA!
- Cetane Number in D6751 for B100 has been changed to 45 minimum (previously 47)
  - EPA has updated D6751 references as part of their regulatory streamlining efforts
- Fuel stability re-additization project

## ➤ Major Positive Changes at UL for the heating oil market

- UL 296 listing procedures for heating oil burners now updated to allow up to B100
  - Carlin and Beckett have both released B100 capable and UL listed burners into the market!
  - Covers all blends between B20 and B100, uses current D6751!

# CLEAN FUELS / NREL ANNUAL FUEL QUALITY SURVEY

- Conducted annually since 2018; roughly covering 92% of biodiesel industry production
- 14 fuel quality parameters; over 6,100 independent parameters analyzed in 2022
- Nearly all of them “meet or beat” the ASTM specification limits
- Key findings:
  - Metals (Na + K + Ca + Mg) significantly below 1 ppm
  - Phosphorus below 0.5 ppm
- Request for CY 2024 data coming in early February
- 2022 NREL report <https://www.nrel.gov/docs/fy23osti/86227.pdf>

# SOME TECHNICAL HIGHLIGHTS

- Major Railroads are now seriously looking at biodiesel and renewable diesel
  - Progress Rail at B20 approval
  - Wabtec at B11 approval – working up to B20 later in FY24
- The Ocean-Going marine diesel specification (ISO 8217) now allows up to B100
  - Major marine shipping companies have conducted B45, B100 field trials with success
  - Large ships are designed to work w/ low quality No. 6 Bunker Fuel and heavy fuel oils
    - Systems are heated, running B100 is easy compared to No. 6 oil!
- Major dispenser companies are partnering with Clean Fuels on B100 dispensers





Clean Fuels  
ALLIANCE AMERICA

# Questions?

## LOW-CARBON LIQUID FUELS ARE THE LOWEST COST OPTION TOWARDS DECARBONIZATION

Scott Fenwick

Technical Director

[sfenwick@cleanfuels.org](mailto:sfenwick@cleanfuels.org)

573-418-9677 (cell)





# OPTIMUS

T E C H N O L O G I E S

**RUN  
ON LESS**  
MESSY MIDDLE

February 11<sup>th</sup>, 2025

Colin Huwyler, CEO |

[c.huwyler@optimustec.com](mailto:c.huwyler@optimustec.com)





# Biodiesel Engine Compatibility



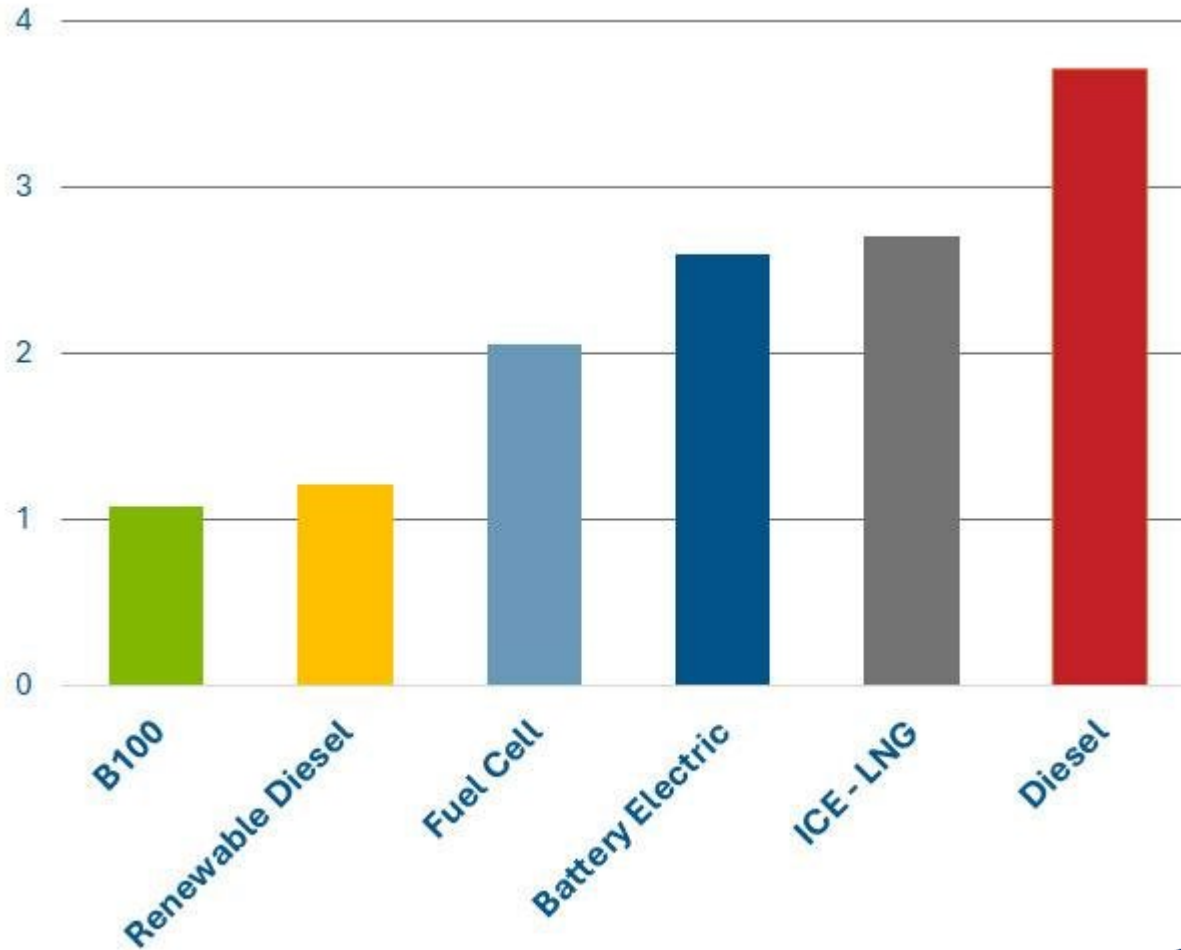
## B20

Today's engines are compatible with biodiesel blends up to 20%

## B100

Optimus upgrades engines to use 100% biodiesel

# Total Lifecycle CO2 Emissions: Production, Operations, and Disposal (MM lbs)



# WHY B100?

- 100% Biogenic Carbon
- Utilizes Existing Infrastructure
- Available Nationwide
- Low Cost
- Improves Operational Performance

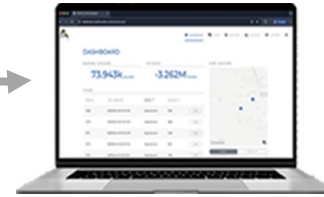
# The Optimus Vector System



**Biodiesel Tank**



**Fuel Selector Valves**



**Customer Dashboard**



**Vector Manifold**



**User Interface**

**1100+**

Class 8 trucks are equipped and operating with the Optimus Vector System

**85+**

**Million Miles**

of validation that heavy-duty fleets can seamlessly decarbonize



# Fully Automated

# Hands Off

100% automated system doesn't require driver engagement

1. Driver turns key—system wakes up
2. Driver starts engine on diesel
3. B100 is preheated with waste heat from engine using coolant
4. After set points are met, B100 pump turns on and circulates fuel through entire Vector System and up to valves
5. When next step points are met, the fuel selector valves automatically switch the fuels from diesel to B100
6. The vehicle runs on B100 until it is turned off except during DPF regenerations or if any fault occurs
7. Driver turns the key off—engine keeps running, switches fuels and purges B100, shuts off engine





## Proven in Arctic Conditions

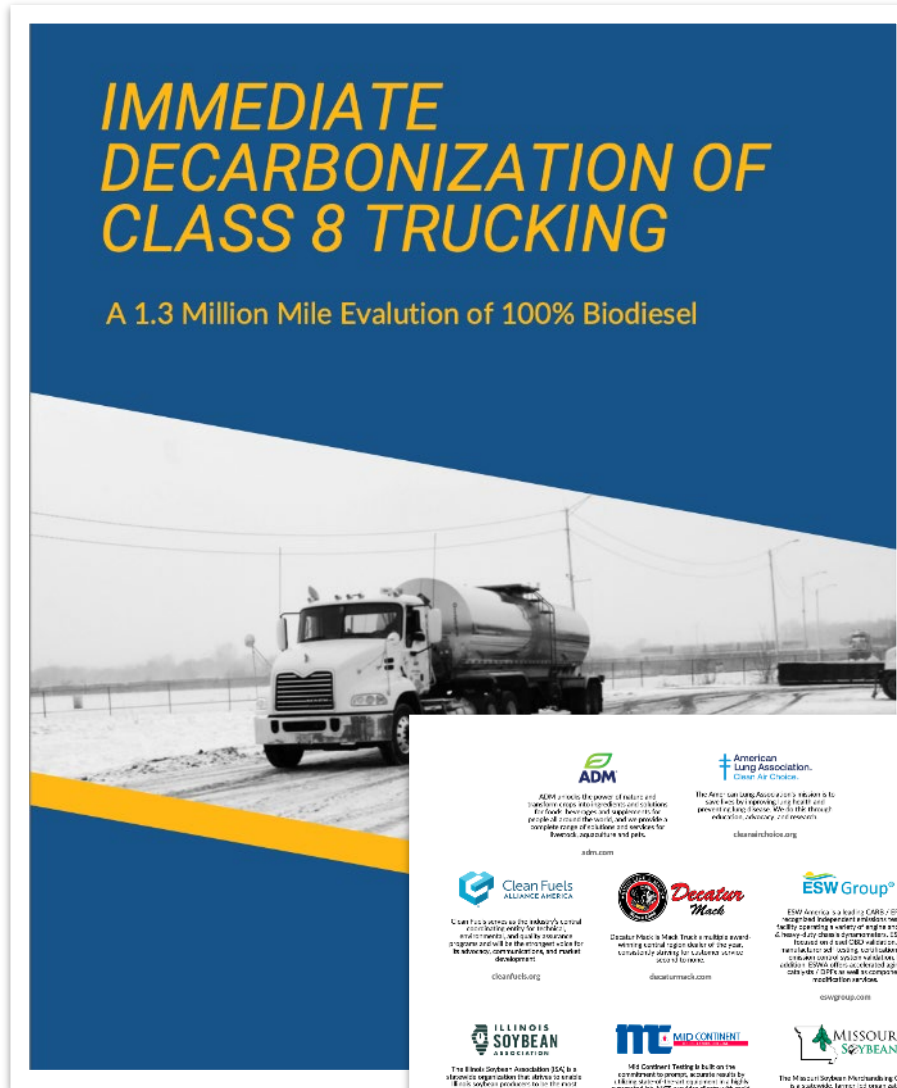


B100 with Optimus Technologies is proven to work in subzero conditions to below

**-30°F**

# Validated Performance

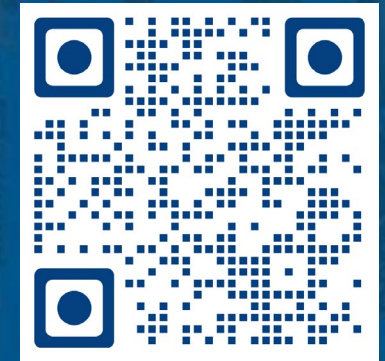
- B100 achieved fuel economy parity
- Improvement in diesel particulate filter (DPF) performance & operation
- Improvement in monitored parameters of engine oil
- No impact on cost of maintenance vs. diesel
- No impact on operations or performance of trucks



# 1.3MM

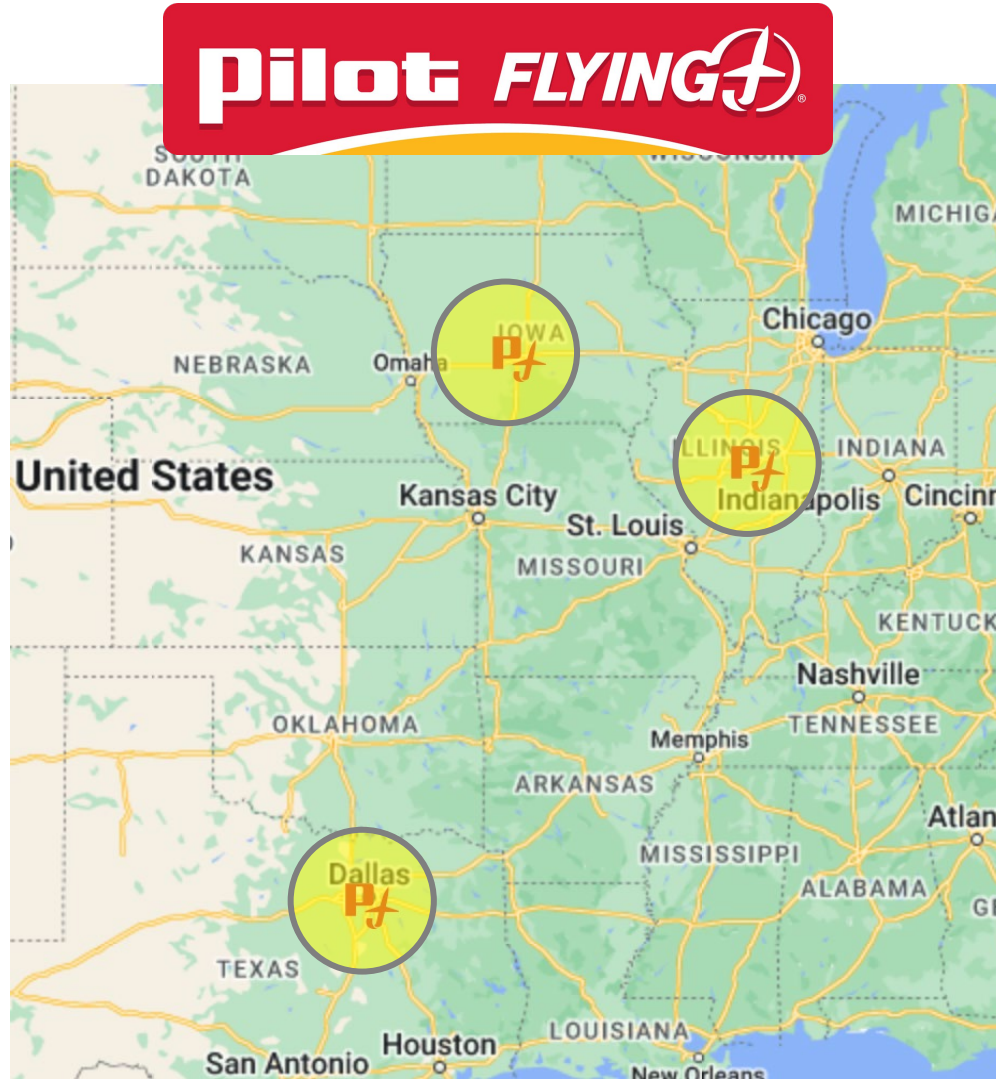
Mile evaluation of 100% biodiesel

Report available at:





# B100 Retail Availability



# Q1 2025

#368 Decatur, IL

#373 Des Moines, IA

#433 Dallas, TX



# Refueling Solutions



# SMART Fuel

The SMARTFuel RFID technology restricts refueling to only customer vehicles upgraded to use 100% biodiesel, preventing misfueling.

# Summary

- *B100 delivers proven carbon reductions*
- *1,100+ Vector Systems on the road with over 85+ million miles driven*
- *No disruption to operations*
- *No charging required*



The Optimus  
Vector Manifold



# Thank You!



**OPTIMUS**  
TECHNOLOGIES

**Colin Huwyler**  
Chief Executive Officer  
412.727.8228  
[c.huwyler@optimustec.com](mailto:c.huwyler@optimustec.com)

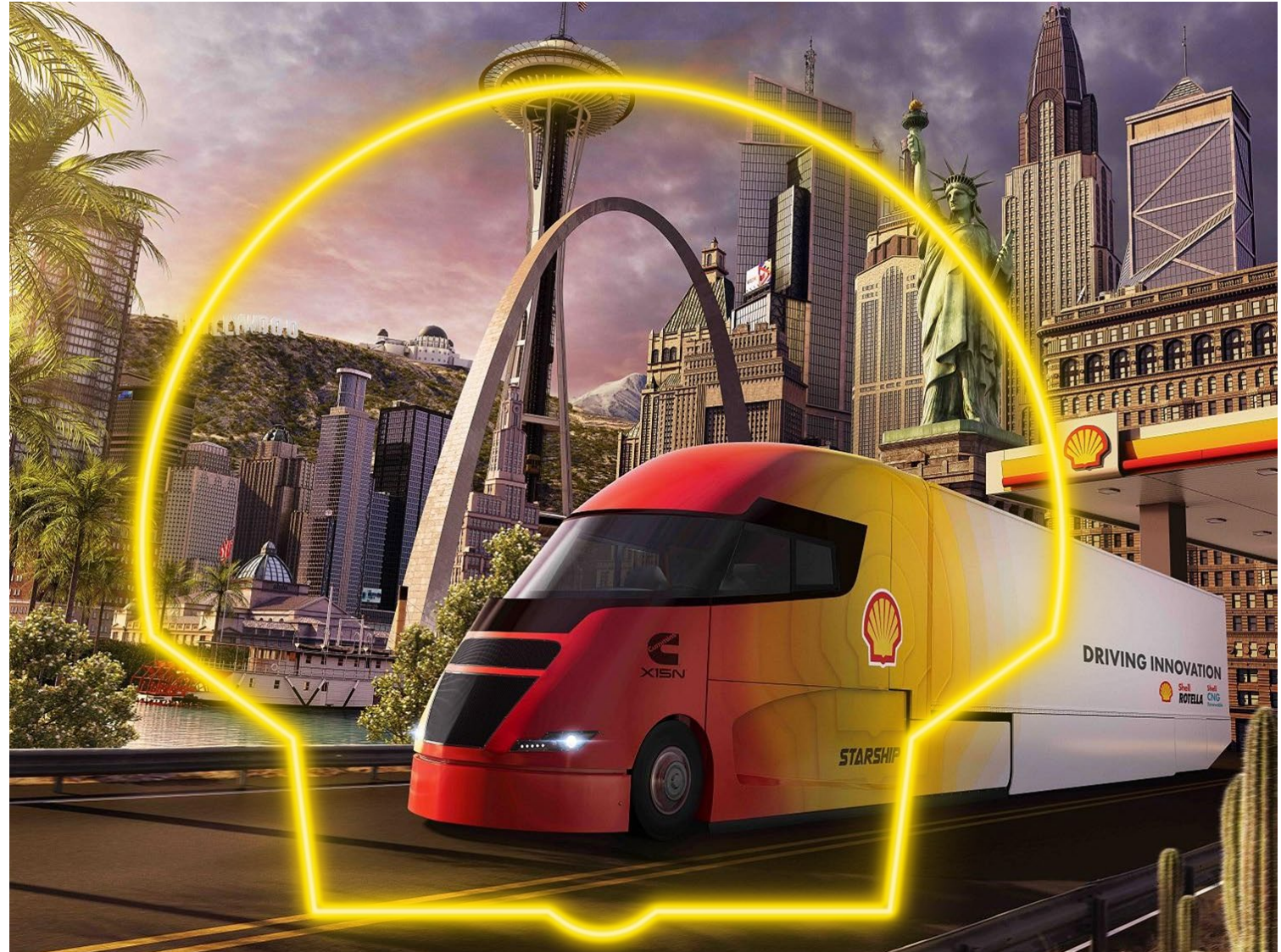
**RUN  
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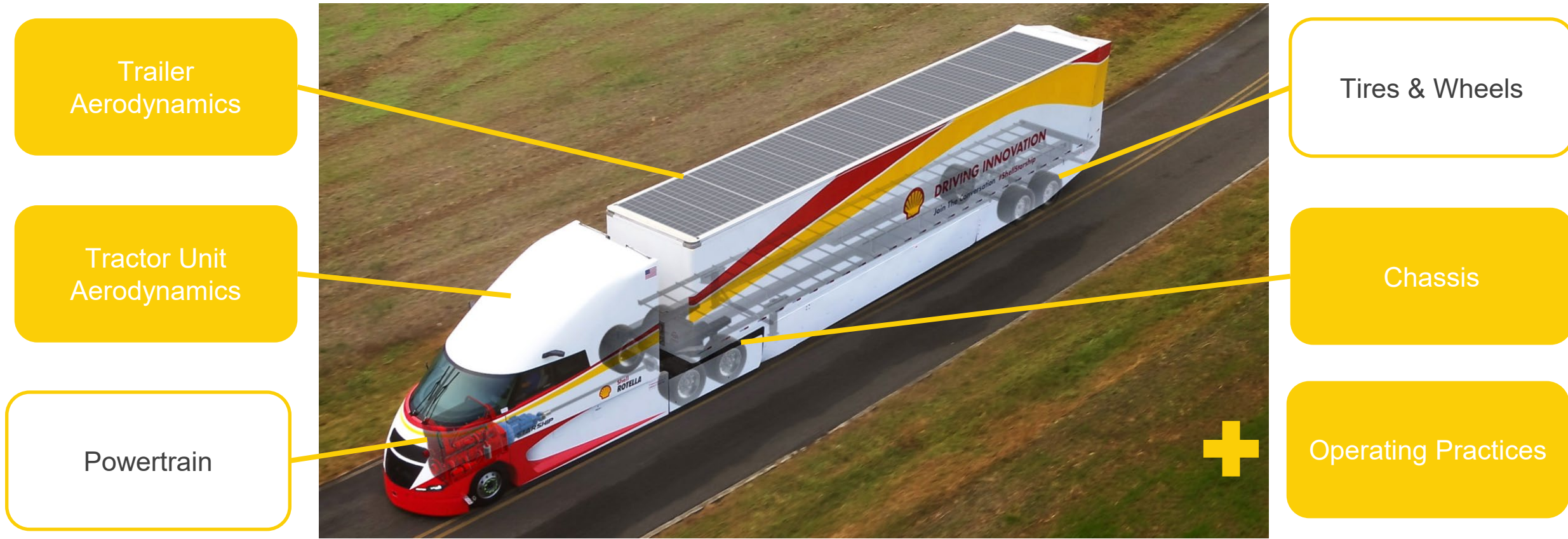
## The Role of Lubricants in Truck Efficiency

Andrew Gibson  
Global Sector Marketing Manager Fleet  
Global Brand Manager Shell Rimula

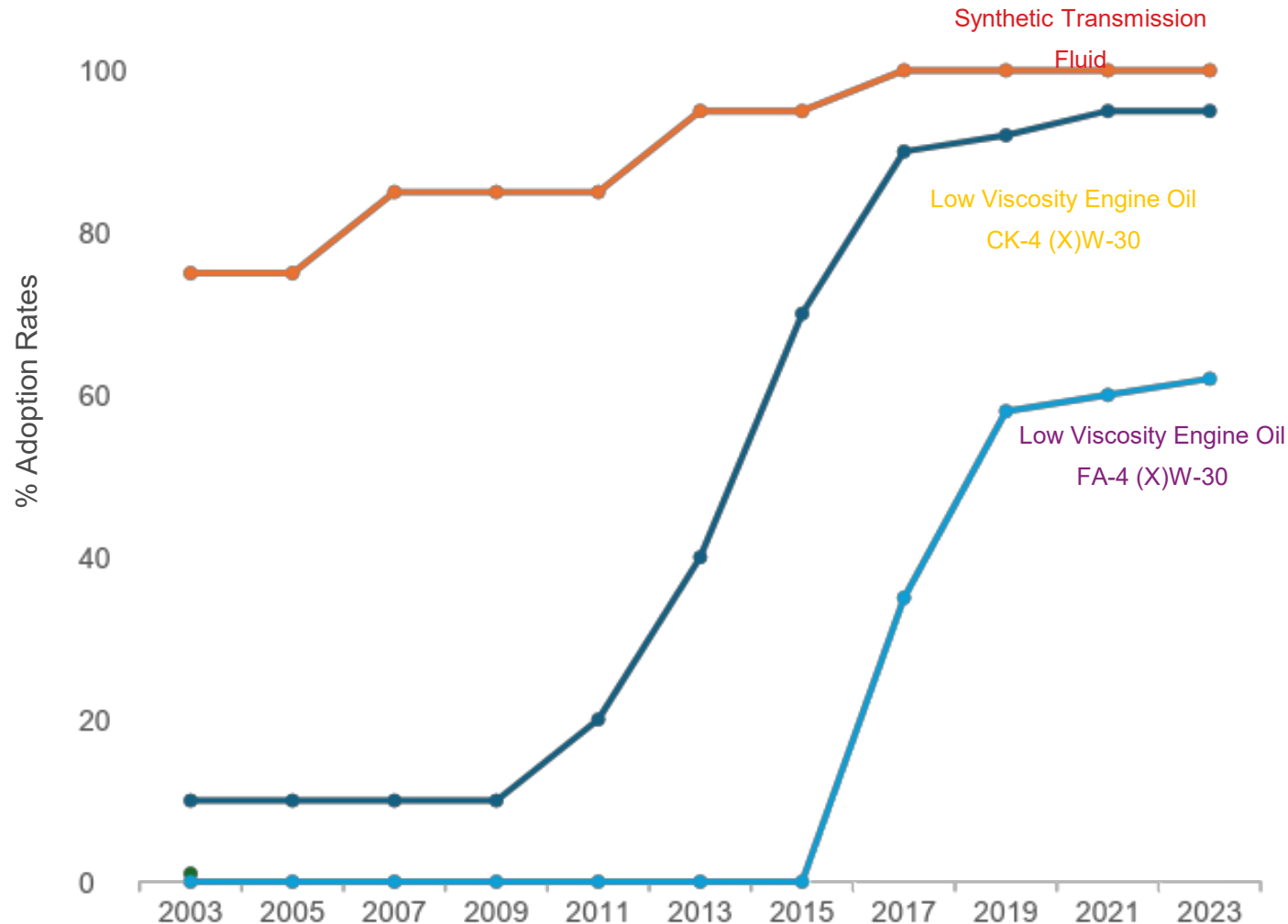




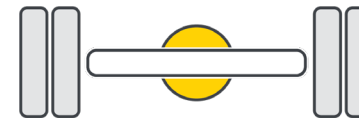
# Where to Start: There are many ways to improve the efficiency of your truck and help reduce emissions



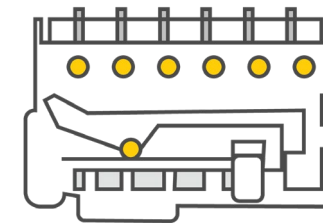
By looking at the adoption rates of different technologies by leading fleets we see some interesting trends appear.



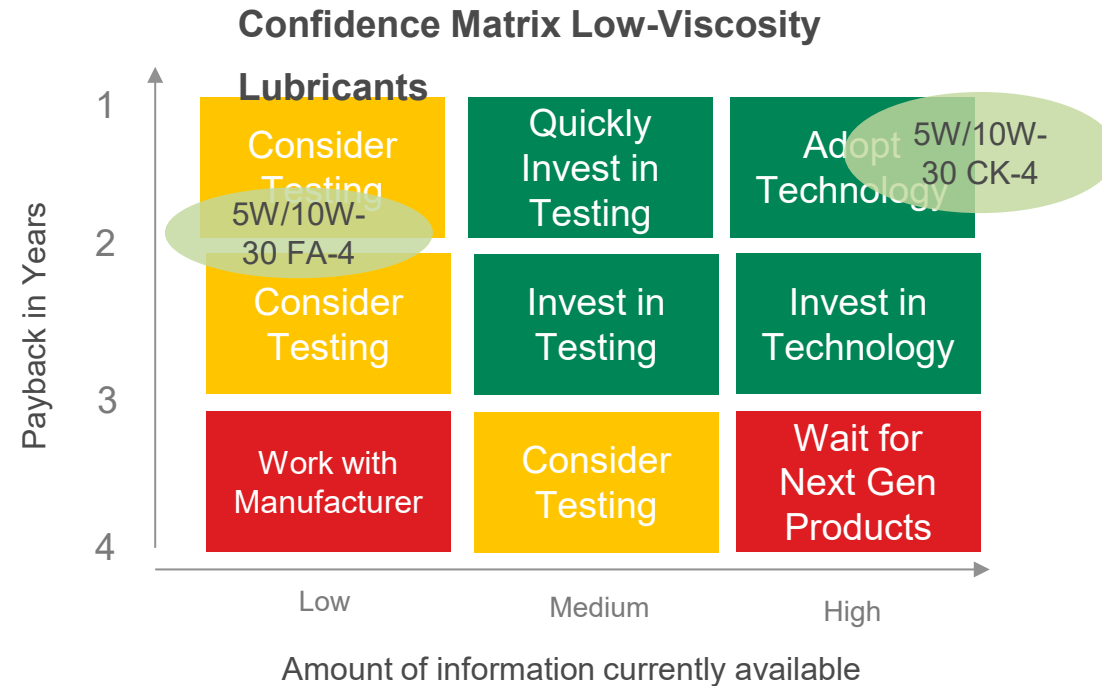
91% Adoption rate of Automated Manual Transmissions which require a synthetic gear oil for fuel economy and long drain reasons (100% adopted) & 100% Adoption rate of synthetic axle oils for fuel economy and long drain reasons



91% Adoption rate of 10W-30 Low Viscosity Engine Oils and 39% are going further adopting FA-4 super High Efficiency 10W-30 / 5W-30 Engine Oils



How mature is the technology? What should you consider doing and does it stack up commercially?



What is PC-12 ?

Content © 2025 NACFE

Source: [Confidence Matrix Low Viscosity Lubricants\\_vB2\\_scrn.jpg \(1400x1050\)](#)



# Starship 2.0 Tech Summary

## Operational Efficiency

- Fuel Saving Driver Behaviours that minimise fuel consumption.
- An integrated fuel-efficient engine and transmission pairing that optimises gear selection, enables smoother gear change and predictive shifting for improved efficiency and performance.
- Camera Driver Vision System

## Aerodynamic improvements

- A hyper-aerodynamic carbon fibre cab designed for low aerodynamic drag.
- An updated Gap Sealer that enables seamless continuity between tractor and trailer.
- Full length Side Skirts that minimise air movement under the truck. A custom modified Boat Tail for improved air flow over the back of the truck.

## Roof-mounted solar panels

A trailer-roof solar array to reduce load on engine by providing power for interior auxiliary systems.

## Tires

Wide-based tire setup that offers reduced rolling resistance and weight for improved fuel economy.

## Axle-ratio

6x2 setup with a revised rear-axle configuration for lower weight, reduced friction and improved fuel economy.

## Transmission upgrade

Light-weight design utilising Eaton's GearLogic™ technology for improved performance, fuel efficiency and driver confidence.

## Engine upgrade

Next-Gen X15 Cummins Engine with refinements to its big-bore design and new EX ratings feature the Endurant™ Transmission from Eaton, this integrated pairing aims to deliver better fuel economy with reduced Greenhouse Gas (GHG) emissions.

## Low viscosity fuel efficient synthetic lubricants

- Shell Rotella FE 5W-30 API FA-4 heavy-duty engine with low HTHS viscosity formulation for improved fuel economy.
- Synthetic Shell Spirax transmission fluid and Shell wheel hub oil offer improved drivetrain efficiency.



# Shell Starship 3.0 NG

## Demonstrating the Art of the Possible

Shell Starship is Shell's technology demonstration vehicle. When we combined many of these technologies together, we achieved Fuel Economy figures of 9mpg\* with 80,000lbs cargo.

\*diesel gallon equivalent for Natural Gas

Predictive/Adaptive Cruise Control



Aerodynamic Features have been enhanced



Roof-mounted solar panels

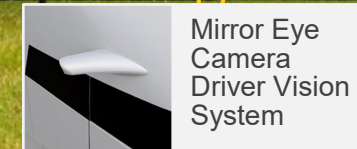


Zeus Door redesign

Automatic Air Gap Closures



Cummins X15N an industry-first large-bore natural gas engine



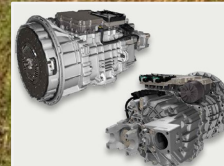
Mirror Eye Camera Driver Vision System



Meritor FUELite Plus Axle with optimized 2.64 axle-ratio



Shell Rotella NG 5W-30 Engine Oil, Rotella ELC Coolant, Spirax synthetic drivetrain lubricants and Gadus chassis grease



Eaton Endurant 12 - Speed Automated Manual Transmission



Bridgestone wide-based, low-rolling resistance fuel economy tires on the truck and trailer





## Diesel Drop-In Alternatives: Ultra -Low Sulfur, Bio-, and Renewable



**Scott Fenwick**  
*Technical Director*  
Clean Fuels Alliance  
America



**Andrew Gibson**  
*Global Sector Marketing  
Manager Fleet & Global  
Brand Manager Shell  
Rimula  
Shell*

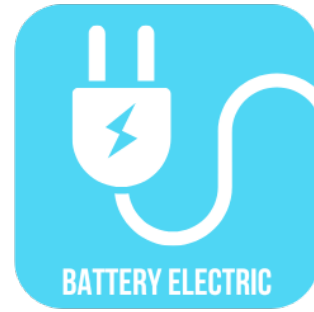


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