# Moving Forward

Planning the journey to lower emission commercial diesel fleets

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## How to use this White Paper

**There's growing pressure on the transport sector to reduce emissions from on- and off-road commercial vehicles as well as rail operations. This is coming from regulators, shareholders, and customers. Operators therefore are evaluating their options and preparing for a lower emissions future.**

That's why ExxonMobil has created this document. It's a detailed resource that aims to help answer questions you may have about how to reduce emissions, efficiently.

The index will guide you to the sections that best meet your needs, with links and references for users wanting to take a deeper dive into the topics covered in this paper. The Definitions section in the Appendix aims to help you with terminology you may not recognise. The journey of reducing emissions to support a net-zero future for the road transport sector will require a portfolio of approaches.

> At ExxonMobil, we have demonstrated capabilities in large-scale solutions, proven technology expertise, and experience working with key industry stakeholders to create meaningful energy product solutions.
>
> **Patrick Rutherford**, ***Global Product Development & Marketing Manager, ExxonMobil***

### ExxonMobil: A history of innovation

ExxonMobil has powered land transport for over one hundred years, enabling personal mobility and commercial transport on road, off-road and by rail. Our brands, Mobil, Esso, and Exxon, serve customers in countries all over the world, supplying in-yard and across our branded network directly and via our distributors.

We are proud of our technology leadership, employing thousands of scientists, and engineers to develop capabilities, technologies, and product solutions for land transport and other sectors.

The transport ecosystem is complex, with many different players that help serve the need to keep people and goods moving more productively, efficiently, and sustainably. 'Sustainability' as that term is used by society spans multiple sustainable development ambitions and impact categories. Sustainability priorities vary from company to company, and country to country, but often reduction in greenhouse gas (GHG) emissions is a common ambition. ExxonMobil has collaborations and strategic relationships with players across the ecosystem, from engine and truck manufacturers to commercial fleets.

ExxonMobil understands that the world of transport is changing as the ecosystem strives to reduce emissions while maintaining the levels of productivity and efficiency that society expects so that people and products arrive where they need to be when they need to be there, affordably, and reliably. We are working with governments at various levels to advance policies that will help enable a resilient and reliable transport future while the sector advances towards meeting societal ambitions to reduce emissions.

Manufacturers are developing commercial electric (EV) and hydrogen-fueled powertrains to meet both consumer demand and varying governmental policies. Yet today, most vehicles used for heavier on-road commercial transport applications are diesel powered. Whilst penetration is growing, Battery Electric Vehicles (BEV) represented in 2025 only around 4% of newly registered medium- and heavy-duty trucks in the EU and there were less than a thousand semi-truck registrations in the US in 2024.[1]

It is essential to consider ways to reduce emissions from existing commercial fleets instead of relying only on a transition in vehicle technology. This white paper aims to dive deeper into the need for solutions that can improve efficiency and reduce emissions from the commercial vehicles on the road today, with an emphasis on the role that fuels technology can play in reducing transportation sector emissions.

It includes insights from research by Frost & Sullivan, commissioned by ExxonMobil, of fleets with 50+ heavy-duty trucks across Europe (EUR- UK, Benelux, Germany, France and Italy), North America (NA – US and Canada) and Asia Pacific (AP – Australia, New Zealand, Indonesia, Singapore, Hong Kong and China). The first wave of research was completed between December 2023 and July 2024. A second wave, updating insights and evaluating change vectors, was completed between December 2025 and January 2026 for the European and North America markets.

We hope it will be of use to a variety of transport ecosystem participants, including commercial fleets, the businesses they serve, fuel supply chain participants, and the policy makers that shape the sector.

# Index

## Section One
### Establishing a platform for productive, efficient and sustainable commercial transport, with a focus on reducing emissions

- Enhancing transport sector productivity and efficiency.
- Commercial transport is growing, with increasing emphasis on sustainability, including reducing emissions.
- Improving fleet efficiency is the foundation of a lower emission fleet.
- Lower emission engine technology as a key enabler of lower emission transport.
- The importance of fuel quality.

## Section Two
### Lowering lifecycle GHG emissions and shifting towards a portfolio of alternative fuels

- The importance of accounting for lifecycle emissions to meet societal climate ambitions.
- The emergence of a portfolio of fueling alternatives.
- The role of duty cycles in shaping pathways.
- The role of policy in enabling choices.

## Section Three
### Biofuels as a portfolio solution for lowering lifecycle GHG emissions from commercial fleets

- Biofuels demand in land transport is expected to grow.
- Biofuels are not all the same. Different kinds of bio-feedstocks and different production pathways.
- Pathways and feedstocks influence the carbon intensity of biofuels.
- The role of certification agencies and voluntary schemes in supporting biofuels.

## Section Four
### Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations

- Introducing biodiesel, its production pathways, standards, and advantages.
- Biodiesel and tailpipe emissions.
- Biodiesel blending, higher biodiesel content blends and the OEM perspective.
- Adapting to the use of biodiesel and the experience of biodiesel users.
- The benefits of additized biodiesel.

## Section Five
### Renewable diesel is a potential solution for reductions in lifecycle GHG emissions from commercial fleets with fewer compromises

- Introducing renewable diesel, its production pathways, feedstocks, standards, and advantages.
- Renewable diesel and tailpipe emissions.
- Use of renewable diesel blends and 100% renewable diesel.
- Adopting renewable diesel to reduce commercial transport emissions and the end-user experience.
- Enablers for scaling renewable diesel adoption.

## Section Six
### Planning your journey to lower emission operations

- Comparing solutions for commercial fleets.
- Looking ahead and connecting with ExxonMobil.

## Definitions

- A helpful decoder of terminology around low emissions and land transport.

Section One

# Establishing a platform for productive, efficient, and sustainable commercial transport, with a focus on reducing emissions

## 01

### Enhancing transportation productivity and efficiency

**Moving people and goods from A to B is fundamental** to society and the economy. And the need to do that more productively and efficiently has shaped the development of the modern transport ecosystem.

**Energy Choices:** Horsepower set the early standard for transport. With the emergence of electric power, electric carriages, powered by batteries, emerged in urban settings, like New York.[2] Similar to horses before them, batteries get exhausted and need re-energizing, so battery swap out stations emerged. Inventors, including Daimler, introduced internal combustion engine (ICE) technology, both spark ignition (gasoline) and compression ignition (diesel). As these technologies matured, they rapidly displaced battery-power, disadvantaged by early battery packs' weight and low energy density. Gasoline and diesel refueling was quick, energy density higher and the new technology prevailed because it enabled users to go further, get on their way faster, and therefore be more productive.

**Engine Technology:** Specialist manufacturers and production line efficiencies emerged making mobility more accessible to society. Light-duty automobiles were followed by bigger trucks. Gasoline widely became the dominant power source globally for lighter vehicles, and diesel for heavier vehicles, going longer distances. As vehicle technology improved performance and range, more progressive fleets adopted these technologies, rapidly reducing costs and improving efficiency.

**Infrastructure Development:** Road infrastructure developments enhanced the driving experience, improved journey times and safety, and lowered vehicle maintenance/repair bills. Just as horses needed feeding, ICE engines required the emergence of convenient refueling infrastructure. ExxonMobil, under brands including Esso and Mobil, has been a leading enabler of land mobility worldwide from the very early days of ICE-powered transport, its participation shaped by the efficiency of its refining, logistics and refueling networks.

**Intermodal:** Waterways, rail, and road competed for journey share, ultimately reaching an equilibrium. As international trade grew, marine ports matured into sophisticated containerized operations to make intermodal transfer more efficient and an essential element of fleet strategy.

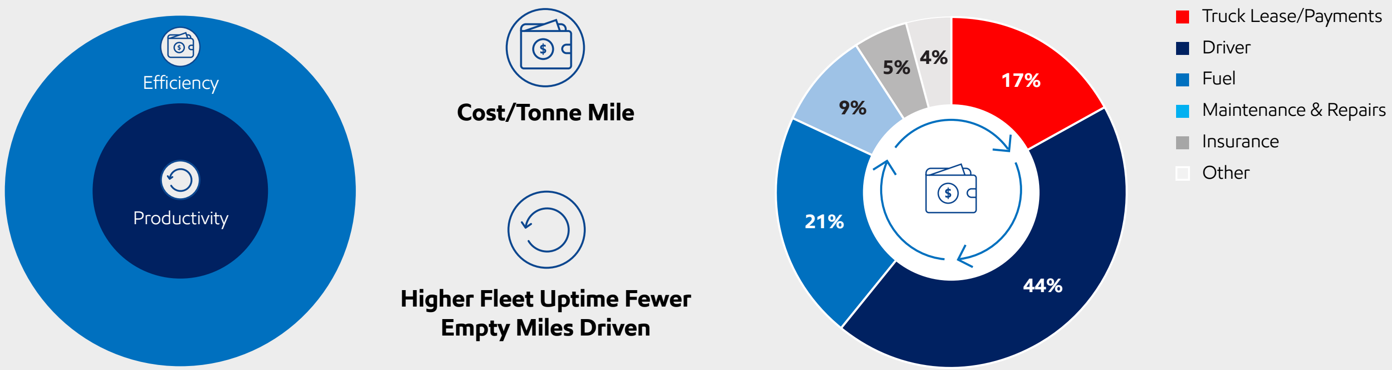
**Fleet Management:** A fleet management ecosystem developed around automated, electronic payments that enable fleets to allow drivers to pay using fuel cards across wider national and, later, international networks. This ecosystem helped optimize fleet running costs, provided better visibility of fuel spend, enhancing productivity and efficiency of operations. With the rise of digital and mobile networks, fleet management has evolved into a data-driven science guided by telematics and fleet planning.

**The Fundamentals Remain Unchanged:** Commercial transport is a competitive business. As with past developments, the readiness and suitability of innovations around truck design, new powertrain options and alternative fueling choices (biofuels, renewable natural gas, electricity and H2), digital capabilities, and intermodal optimization will be carefully assessed by successful fleet managers through the critical lenses of productivity and efficiency. Total cost of ownership (TCO) models will help steer their choices (see **Figure 1**[3]). The Mobil Delvac Guide to TCO[5] provides a good overview of TCO and potential optimization opportunities.

Managing costs and optimizing TCO is one of the key challenges facing the sector and fuel costs is a major dimension. Refueling also brings operational challenges as highlighted by research of heavy-duty commercial truck fleet operators (see **Figure 2**[4]).

**Figure 1**
**Productivity, efficiency and total cost of ownership**

**Fleet Decision Drivers** | **Total Cost of Ownership (TCO) – US Illustration**[3]




**Source:** ExxonMobil.

**Data Source:** ATRI.[3]

**Figure 2**
**Key refueling challenges faced by heavy-duty truck fleets (Europe, 4Q23)[4]**

*What, if any, pain points and challenges does your company face with fueling your trucks today?*

**Reliable Supply & Quality:**
Challenges with fuel availability especially at peak hours leading to queues at peak times. Some face challenges with fuel contamination or poor-quality fuel.

**Infrastructure:**
Need for dedicated truck-friendly stops. Limited availability of alternatives HVO or LNG.

**Time Consumption:**
Queuing/fueling time can be a significant pain point, impacting productivity & delivery schedules.

**Price Fluctuations:**
Frequent fuel price fluctuations. High cost of alternative fuels like biofuels.

**Billing & Quantity Issues:**
Some companies face challenges with billing accuracy & fuel quantity verification, especially when dealing with external fuel suppliers.

**Data Management & Analytics:**
Managing fuel-related data accurately can be challenging, especially when incorrect entries affect overall reporting.

"In the past two years, ***the whole of Europe has faced issues with the higher prices of fuel*** ... Norway is facing the high-cost problem ... increases of 20%–25% for biodiesel and other fuels." – **Norway**

"We sometimes face ***issues in terms of the availability of good and clean diesel***, as we had to face issues in terms of the bad fuel quality." – **Norway**

"***LNG gas refilling network is very thin throughout the nation***, so we have to make sure our vehicles operate only in the areas that are accessible from our fueling station." – **Germany**

"Primary ***challenge is to maintain optimal performance of the fuel system*** so, finding a station that provides diesel with high quality grades without causing any impact on performance is crucial." – **Netherlands**

"***Limited availability of refueling stations & congestion*** ... especially during peak hours are some of the challenges that we face with fueling our HD trucks." – **Germany**

"***Delivery schedule is disrupted during peak hours*** due to the problem of having to spend time at fuel stations." – **UK**

"***Time our driver spends at the fueling station is quite high, leading to losing productive time***, impacting our delivery schedules." – **UK**

"Common challenge we have here is the ***availability and accessibility of infrastructure for refueling trucks***. So, the choice of the reliable network is a challenge." – **Italy**

"Currently, it is ***not possible to use electricity over long distances***, and distribution per 100 km is not feasible. The weak points are the lack of facilities for refueling vehicles (for electric)." – **Italy**

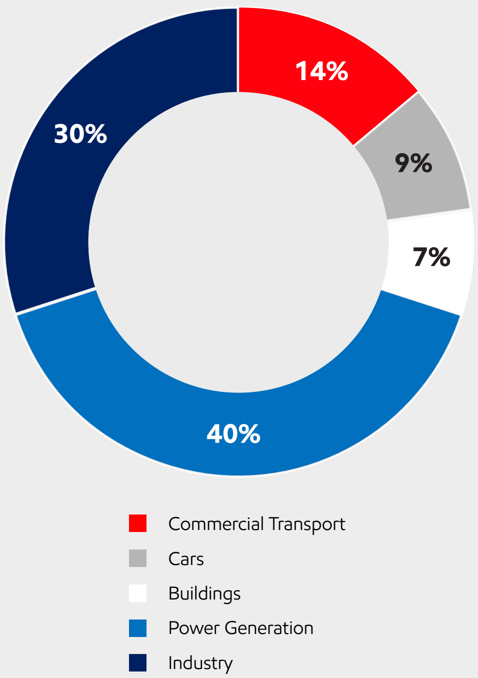
**Source:** ExxonMobil-commissioned research by Frost & Sullivan.[4]

**Establishing a platform for productive, efficient and sustainable commercial transport, with a focus on reducing emissions**

# 02

## Commercial transport is growing, with increasing emphasis on sustainability, including reducing emissions

**Figure 3**
**Sources of global $CO_2$ emissions, 2024**[6]
includes energy-related and process emissions




**Source:** ExxonMobil Global Energy Outlook to 2050.[6]

Road transport continues to be vital to modern life, transporting people and goods to help meet the needs of society and global economic growth.

Reducing transportation-related greenhouse gas (GHG) emissions plays a part in society's efforts to meet its net zero ambitions. Nearly a quarter of worldwide $CO_2$ emissions are estimated to come from transportation (see **Figure 3**).[6] Around three quarters of those emissions come from the road transport sector.[7]

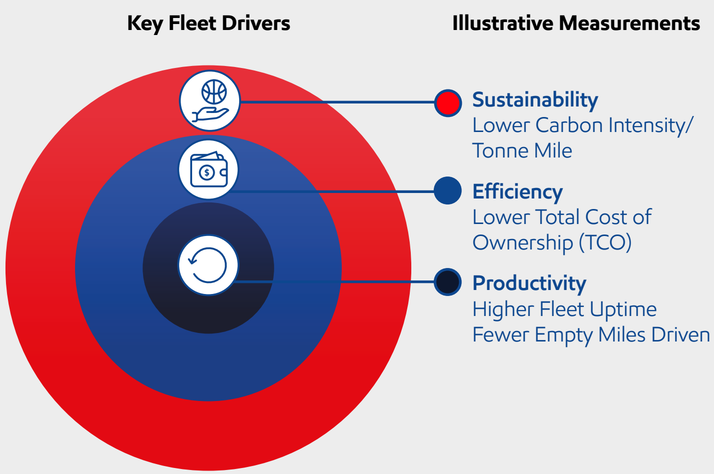
ExxonMobil projects global transportation energy demand will grow 40% by 2050[7] due to global economic growth and the associated increase in vehicles and freight.

Commercial transport is a complex sector with diverse objectives. Light-Duty (LD), Medium-Duty (MD) and Heavy Duty (HD) vans, buses and trucks enable freight haulers, consumer goods companies, bulk shipping, and others to get their shipments where they need to be. Route types and duty cycles vary considerably, including short-haul/long haul, return-to-base/point-to-point, and continuous use/interrupted use. Each case requires efficient fueling solutions, balancing truck downtime and fleet productivity. Each requires affordable and reliable fueling, with an increasing focus on providing potential GHG-emission-reducing benefits while meeting operational performance criteria.

Today, the industry faces many challenges on the path to lower GHG emissions, including a plurality of government policies across regions, technologies, and infrastructure. The sector's complexity requires a higher degree of collaboration than ever before. The energy transition for road transportation will likely require multiple solutions and go through several product evolutions to help achieve societal ambitions to reduce emissions. However, with these challenges come tremendous opportunities for innovation, societal value creation, and transforming government policies.

This has prompted the sector to transition towards lower GHG emission alternatives. In addition to productivity and efficiency, commercial fleets are now assessing their fleet management decisions through a third lens, sustainability (see **Figure 4**), with a particular emphasis on achieving emissions reductions as part of a wider set of sustainability goals without undermining productivity and efficiency objectives. Regarding fleet emissions, in addition to the focus on reducing GHG emissions, focus is also on reducing other tailpipe criteria emissions such as particulate matter (PM), nitrogen oxides ($NO_x$), and sulfur dioxide ($SO_x$).

**Figure 4**
**Sustainability is emerging as a key decision driver for commercial fleets**



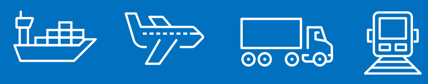

**Source:** ExxonMobil assessment informed by external sources.

Research commissioned by ExxonMobil amongst medium and large commercial heavy duty fleets across the world[4] highlighted that decarbonization/reducing emissions is emerging as one of the key challenges faced by the sector (see **Figure 5)**. This is especially true for the largest heavy-duty fleets. Overall, the biggest challenges facing the sector in North America (NA) and Europe remain relatively unchanged in the last two years.

Based on the research, reducing emissions is a strong top-down organizational focus for many commercial heavy-duty fleets, with the strongest drivers including investor relations, regulatory pressures and a desire to secure competitive advantage. Strategic focus appears to be stronger amongst commercial operators in AP and Western Europe relative to those in North America. The intensity of strategic focus in Europe and North America has remained relatively unchanged over the last two years. The largest trucking fleets (with 500 or more heavy duty trucks) rated decarbonization/reducing emissions as the most significant challenge facing the sector.

Tackling this challenge means thoughtfully building an integrated plan. Adopting strategies to reduce transportation emissions is a critical element of the activities embraced by many commercial fleets. This involves reducing the emissions from trucking, but many organizations which operate internationally integrate their logistics efforts across land, sea, and air transport, with some shift from road to rail, into their intermodal strategy.

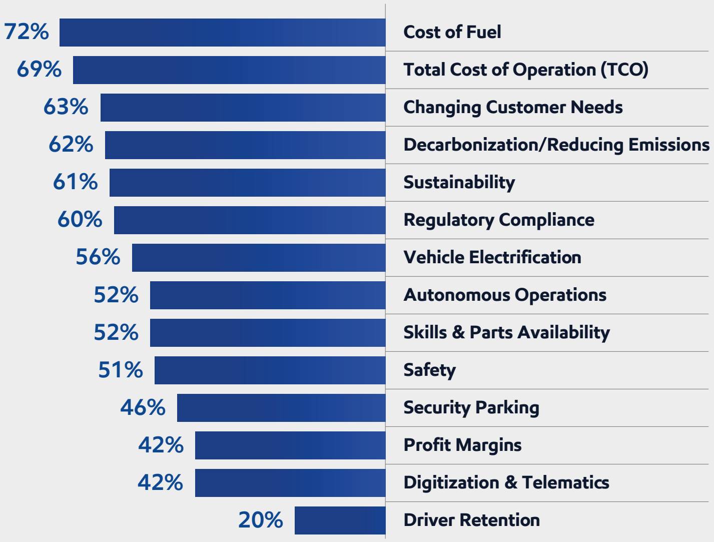
In addition, many are focused in parallel on reducing emissions from their broader infrastructure (for example, lower emission distribution centers and warehousing operations) and programs to reduce the impact of other elements of logistics activities (including waste management, packaging optimization and recycling programs).



Global transportation energy demand is expected to grow 40% from 2024 to 2050[6] due to global economic growth and the associated increase in vehicles and freight.

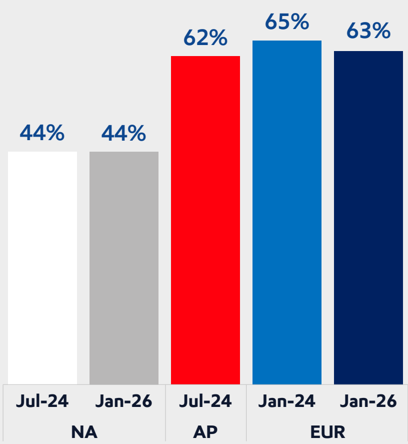
**Figure 5**
**Decarbonization/Reducing emissions as a strategic imperative for medium to large commercial trucking fleets[4]**

**Biggest Sector Challenges** (EUR/NA – Jan-26)
From a fleet operation perspective, which are the major challenges you see in your industry?



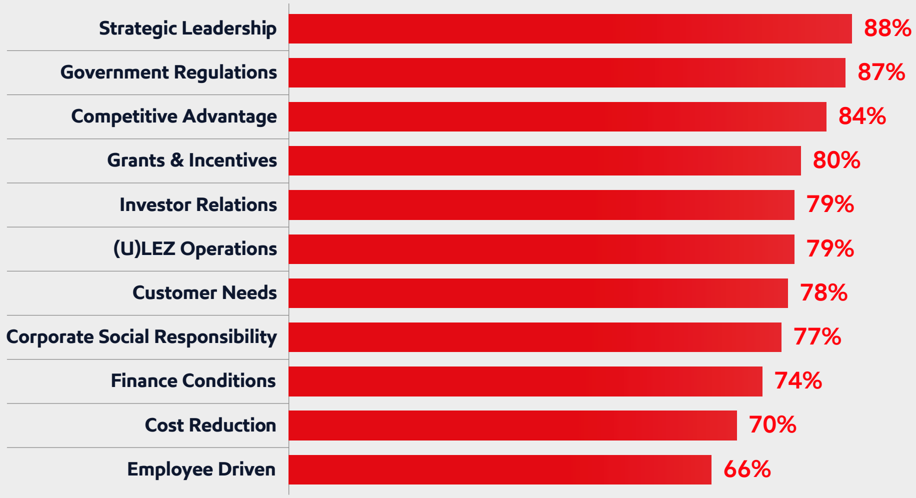

**Source:** ExxonMobil-commissioned research by Frost & Sullivan of heavy duty fleets with 50+ trucks. Average of 1Q26 survey sverage of EUR (N=150) & NA (N=150)

**Strategic Importance of Decarbonization**
How important is decarbonization in your company's strategy? (cornerstone / important part of our strategy)




**Source:** ExxonMobil commissioned research by Frost & Sullivan of heavy duty fleets with 50+ trucks.

**High Decarbonization Drivers** (EUR/NA – Jan-26)
What is driving decarbonization in your company?




**Source:** ExxonMobil-commissioned research by Frost & Sullivan of heavy duty fleets with 50+ trucks. Average of 1Q26 survey sverage of EUR (N=150) & NA (N=150)

# 03

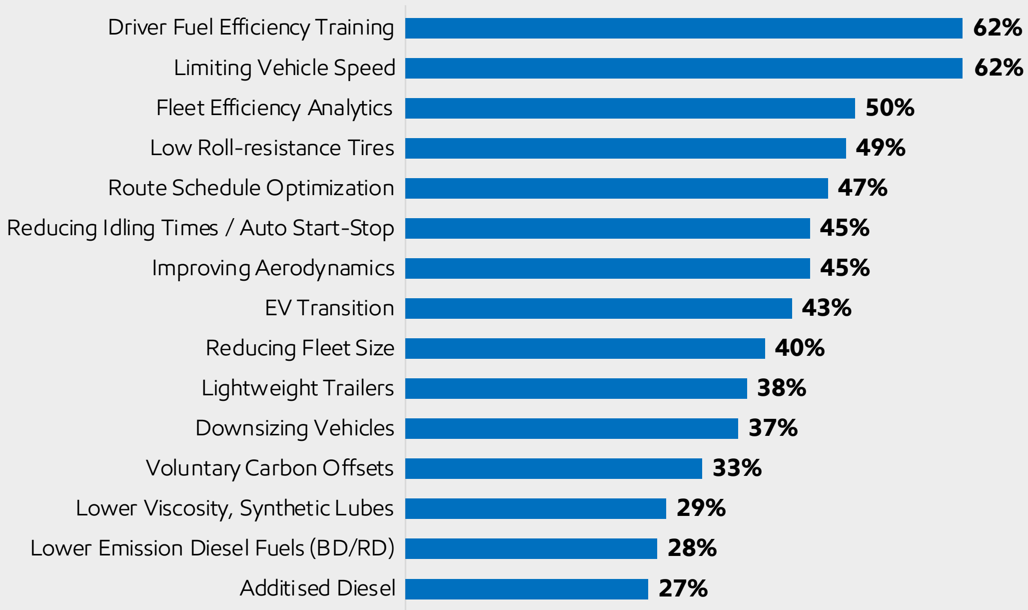
## Improving fleet efficiency is the foundation of a lower emission fleet

Regarding trucking operations, ExxonMobil-commissioned research of medium to large commercial trucking fleets[4] highlighted that improving the fuel efficiency of existing diesel trucks is a foundational priority of their emissions reduction plans (see **Figure 6**). This makes sense because it represents a triple win, reducing fuel consumption per ton-mile, improving TCO, AND reducing the effective $CO_2$ emissions per ton-mile, contributing towards fleet emissions goals, all at the same time. Use of biofuel solutions in their diesel fleet is currently more prevalent in European fleets than in their North American counterparts.

Heavy-duty fleet operators across all three regions anticipate diesel powertrains will continue to play a significant role in their energy mix for heavy-duty trucking for some time to come with European fleets anticipating the fastest migration away from diesel technology (see **Figure 7**). Penetration of additized and bio- or renewable diesel solutions into the remaining diesel fleet is expected to grow by 2040 compared with their current penetration.[4]

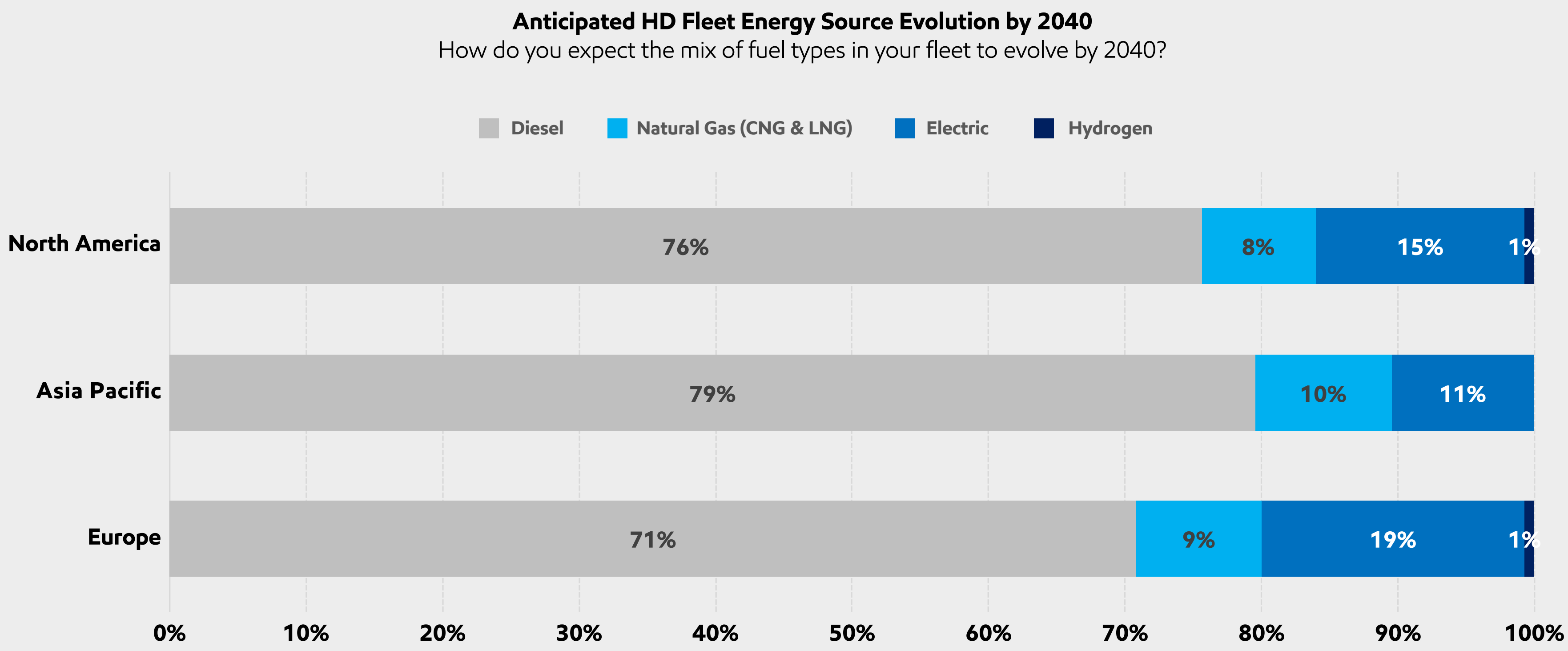
**Figure 6**
**Emissions reduction levers deployed by medium to large HD truck fleets[4]**

**Emissions Reduction Levers (European & North American Fleets, Jan-26)**
Top 5 measures or tools deployed by mid-large sized HD truck fleets to manage their fleet towards lower carbon emissions




**Source:** ExxonMobil commissioned research by Frost & Sullivan of heavy duty fleets with 50+ trucks 1Q26 survey sverage of Europe (N=148) & North America (N=150).

**Figure 7**
**Anticipated powertrain mix by 2040 mid-large sized HE truck fleets**[4]



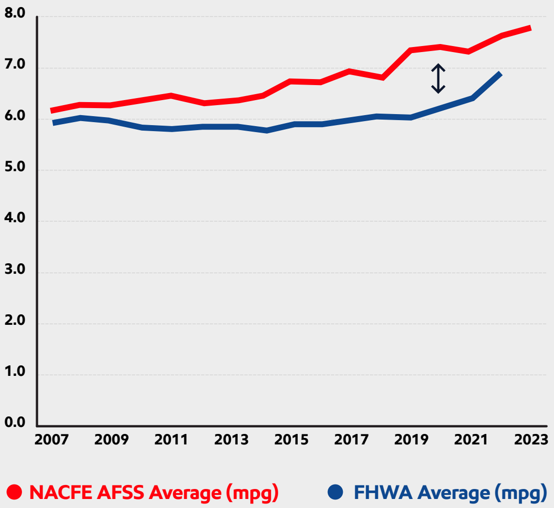

**Source:** ExxonMobil commissioned research by Frost & Sullivan of heavy duty fleets with 50+ trucks – Europe and North America Jan-26 update (N=150 for both). Asia Pacific 2Q24 (N=150).

The most progressive commercial fleets stayed ahead of the curve and adopted technologies to capture fuel efficiency benefits. This makes commercial sense since fuel costs make up **more than 20%**[3] of a North American trucking fleet's cost (greater in Europe where fuel taxes are higher). Efficient fleet operations also form the cornerstone of lower GHG emission fleet operations, and this is growing in importance to commercial fleets and the entities they serve.

Forward-looking fleets have built significant advantages by availing themselves of fuel efficiency enhancements. Organizations like the North American Council for Freight Efficiency (NACFE) have helped drive the development and adoption of vehicle efficiency enhancing and cost-effective technologies, services, and methodologies. Since 2007, fleets participating in the NACFE Annual Fleet Fuel Study (AFFS) delivered an efficiency improvement of 26% (see **Figure 8**). On average over the period 2007-2022, participating fleets secured an 11% advantage over the average US truck fleet. In 2022 alone, NACFE estimate that each truck in AFSS-participating fleets benefited from a nearly $7K/year fuel cost saving vs the average US class 8 truck.[8]

Few, if any fleets, prioritize adopting all the recommended best practices, but the most efficient adopt a higher percentage of the recommended measures. Those fleets adopting more than 50% of the recommended measures reported a five-year fuel economy advantage of ~28% in 2023 over those fleets who had adopted <30% of the available measures. For a 100K mile / year fleet, at the five-year average diesel prices, this was worth $12K per truck in annual fuel savings, on average.[8] **Figure 9** highlights areas where fleets deploy solutions to improve efficiency and reduce tailpipe emissions.[8] NACFE[8] offers tools to guide fleets through potential efficiency optimizations.

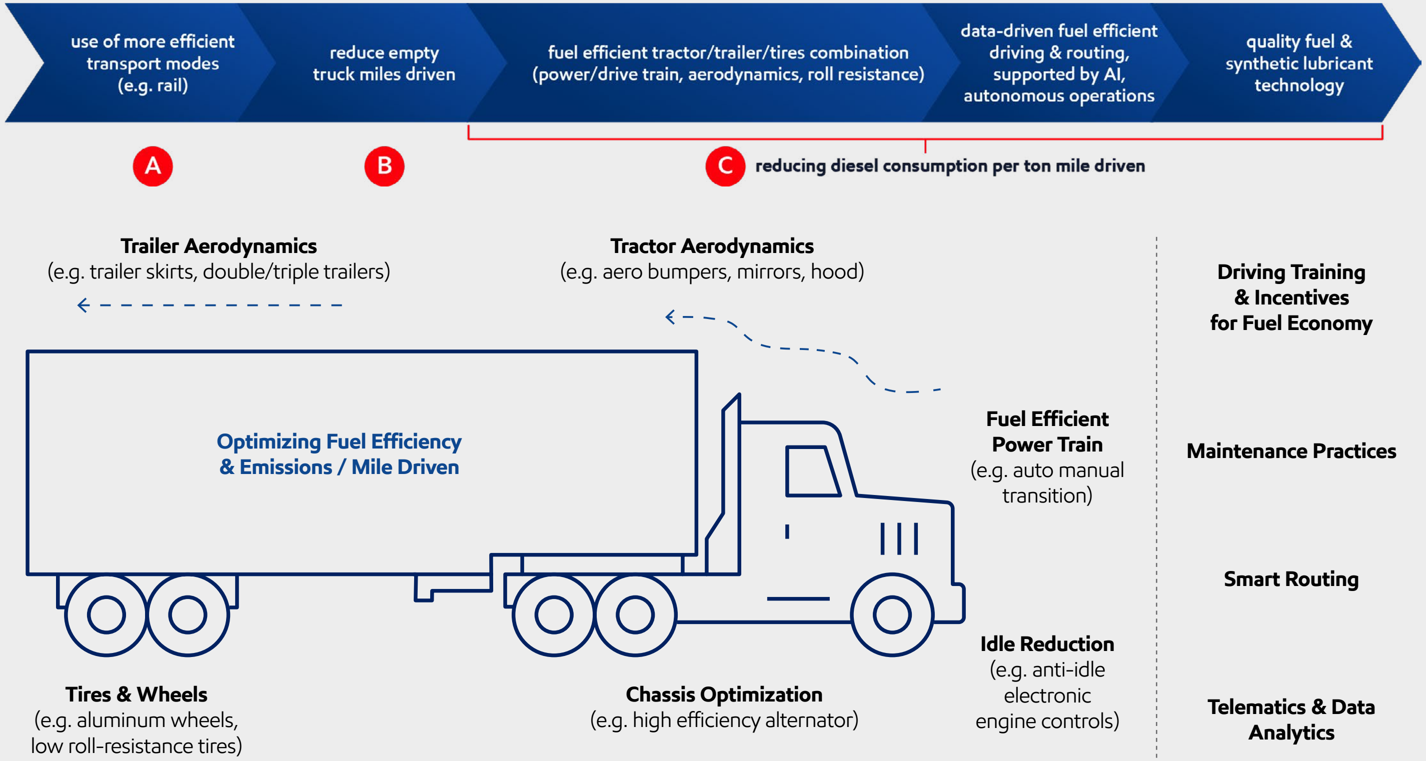
**Figure 8**
**Fleet efficiency improvements in NA 2007-2023**[8]




- Since 2007, Class 8 Fleets participating in the **NACFE** (North American Council for Freight Efficiency) Annual Fleet Fuel Study (**AFSS**) have achieved a fuel efficiency improvement of **26%.**
- Those who have adopted more measures to improve fuel efficiency on average outperform those with lesser adoption.
- On average, over the period 2007-22, fleets participating in have out-performed the average US **fleet by 11%.**
- **NACFE AFSS Average** is the North America Council for Freight Efficiency Annual Fleet Fuel Study average Class 8 truck fuel consumption.
- **FHWA Average** is the class 8 trucks mpg according to the US Federal Highway Administration (the FHWA).

**Data Source:** NACFE.[8]

**Figure 9**
**Opportunity areas for reduced fuel consumption and lower tailpipe emissions/mile driven**




**Source:** ExxonMobil.

**A. Use of more efficient transport modes – adopting intermodal solutions:**
Fleets prioritizing reduced energy consumption and associated emissions per ton mile of freight movement can start by optimizing use of intermodal transport, eliminating truck ton miles in favor of modes like rail. On average, heavy duty fleets in Frost and Sullivan's latest research indicated rail made up around one sixth of their freight movements with a quarter indicating rail is an important part of their freight strategy.[4]

Rail is often well suited for bulk freight movements over longer distance, from ports to central distribution hubs, for instance, with trucks used for onward distribution in a hub and spoke model, where timelines and flexibility are most critical.

Whilst it depends on commodity type, train utilization, locomotive mix, baseline truck duty cycle / efficiency, rail requires less energy per ton mile of freight and typically has lower emissions per ton mile of freight also. Estimates vary, but US EIA baseline numbers from 2019, for example, show an energy intensity (energy/ton mile) ratio of approximately 7 to 1 for class 7/8 road freight versus rail freight.[9] The European Environment Agency reported in 2021 a "well-to-wheels" lifecycle emissions (based on g $CO_2e$ / ton kilometer) factor of more than 5 to 1 for road versus rail freight.[10]

**B. Reducing empty miles driven:**
In addition to intermodal optimization, reducing unproductive truck miles is one of the most immediate opportunities to improve freight efficiency. In the UK, government statistics estimate that 30% of truck miles driven in 2023 were empty miles. Estimates will vary by geography and operating model, and while US or EU fleet figures will differ, the underlying opportunity is comparable across markets.[11] American transportation company, J.B. Hunt, cites reducing empty truck miles driven as an opportunity area, presenting their J.B. Hunt 360°® platform, as an enabler for reducing unproductive truck miles as part of their vision for a more efficient supply chain.[12]

**C. Reducing diesel consumption per ton mile driven:**
For the remaining truck ton miles, there is room for there are vehicle, operational, and human-factor improvement opportunities to improve the efficiency and emissions intensity of the fleet, from the tractor unit at the front to the trailer at the back to the tires underneath and in the driver at the center of the operation.

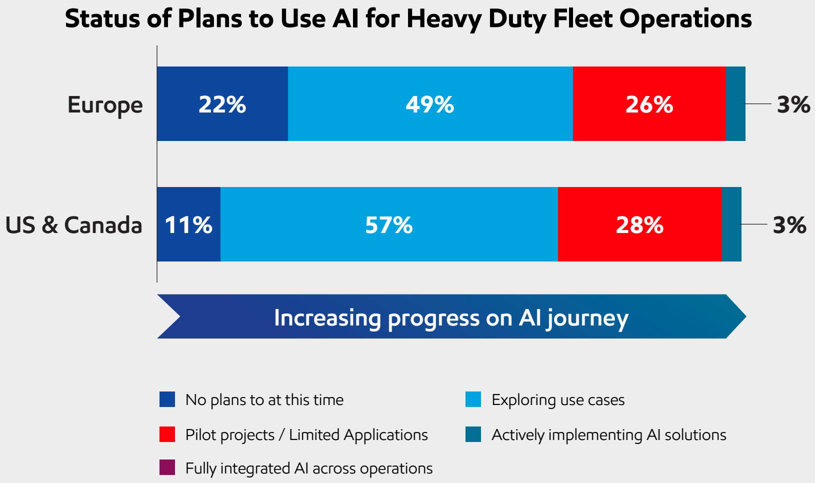
Key vehicle related opportunities include powertrain efficiency, chassis optimization, tractor and trailer aerodynamics, and tire/wheel selection. Operational levers include regular maintenance, intelligent routing, and choice of fuels and lubricants. Driver behavior remains a critical contributor to real world fuel economy.

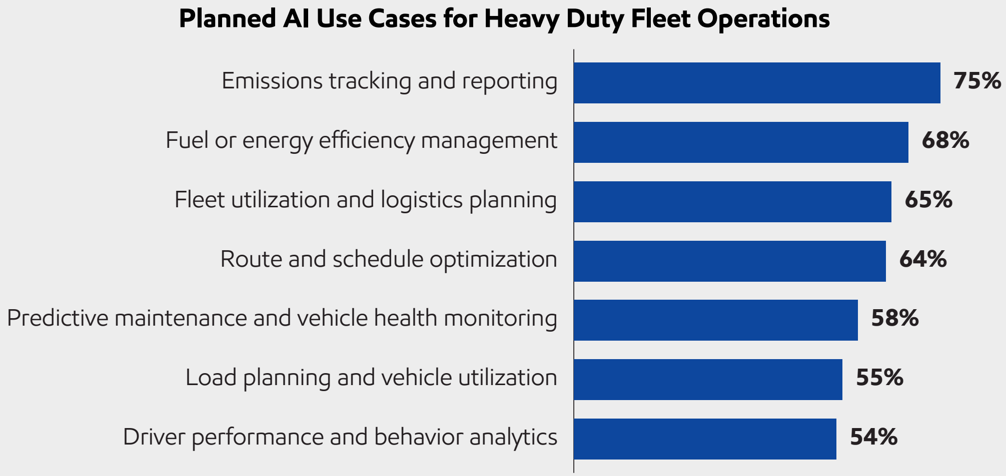
Telematics and integrated fleet data platforms play an increasingly important role in optimized routing and efficiency of day-to-day operations. In addition, these data driven capabilities are a foundational enabler for long term strategic decisions on fleet operations.

Heavy Duty fleets surveyed by Frost & Sullivan highlighted upfront costs, competing budget priorities, and regulatory uncertainty amongst the barriers to optimizing the efficiency and productivity of their fleet operations.[4]

**D. The growing focus on AI**
Advances in artificial intelligence have created an opportunity for AI-enabled autonomous optimization of operations. Use cases under consideration include emissions tracking, fuel efficiency management, fleet utilization planning, and route optimization – see **Figure 10**. Currently, over a quarter of heavy duty fleets are piloting AI-enabled autonomous operations.[4] Fully autonomous heavy duty road fleet operations are being explored but largely remain at the demonstration stage, whereas autonomous mining haul fleets had reached approximately 4% penetration by 2025.[13]

**Figure 10**
**AI is emerging as a Focus Area for HD Fleets**[13]



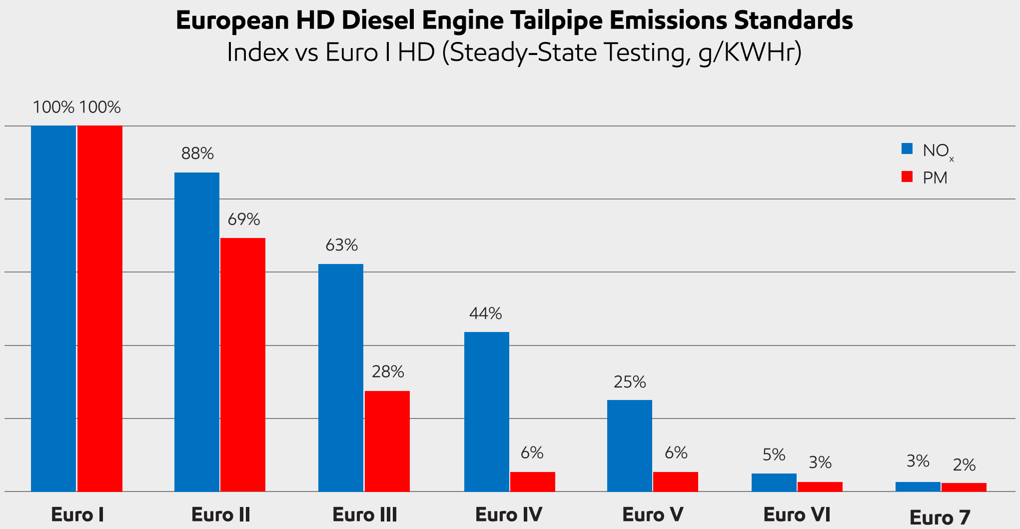

**Source:** ExxonMobil-commissioned research by Frost & Sullivan. Interviews Dec-25 to Jan-26. N=150 Europe, N=150 NA.[4]

# 04
## Lower emission engine technology as a key enabler of lower emission transport

From the 1970s to the early 1980s, diesel engine technology was primarily focused on improving power density and fuel economy. Adopting turbocharging and intercooling was an important technological advancement during this period, as it enabled engines to recycle wasted energy from exhaust gas for more power and better fuel efficiency. More recently, European, US, and Chinese truck standards have guided stepwise emissions control improvements. The Euro standards progression as an example is shown in **Figure 11**.[14]

> Electronic engine control, exhaust gas recirculation, aftertreatment systems, and high pressure, precision fuel injection technology, have resulted in lower tailpipe emissions.

**Figure 11**
**Evolution of Euro tailpipe emissions standards for $NO_x$ and PM (Euro I–7)[14]**




**Source:** ExxonMobil illustration.

This has stimulated significant advances in technology, and helped to reduce tailpipe emissions. The advent of electronic engine control systems represented a significant transformation. Other innovations have included exhaust gas recirculation, aftertreatment systems and high pressure, precision fuel injection technology. **Figure 12** offers a simplified overview of how these features combine in a current typical lower emission diesel engine. Future engine technology and emission control systems are expected to be more sophisticated and complex to meet increasingly stringent emission standards globally.

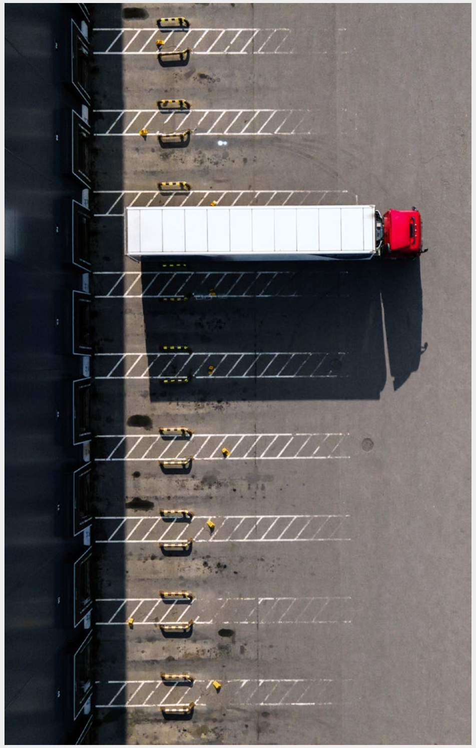
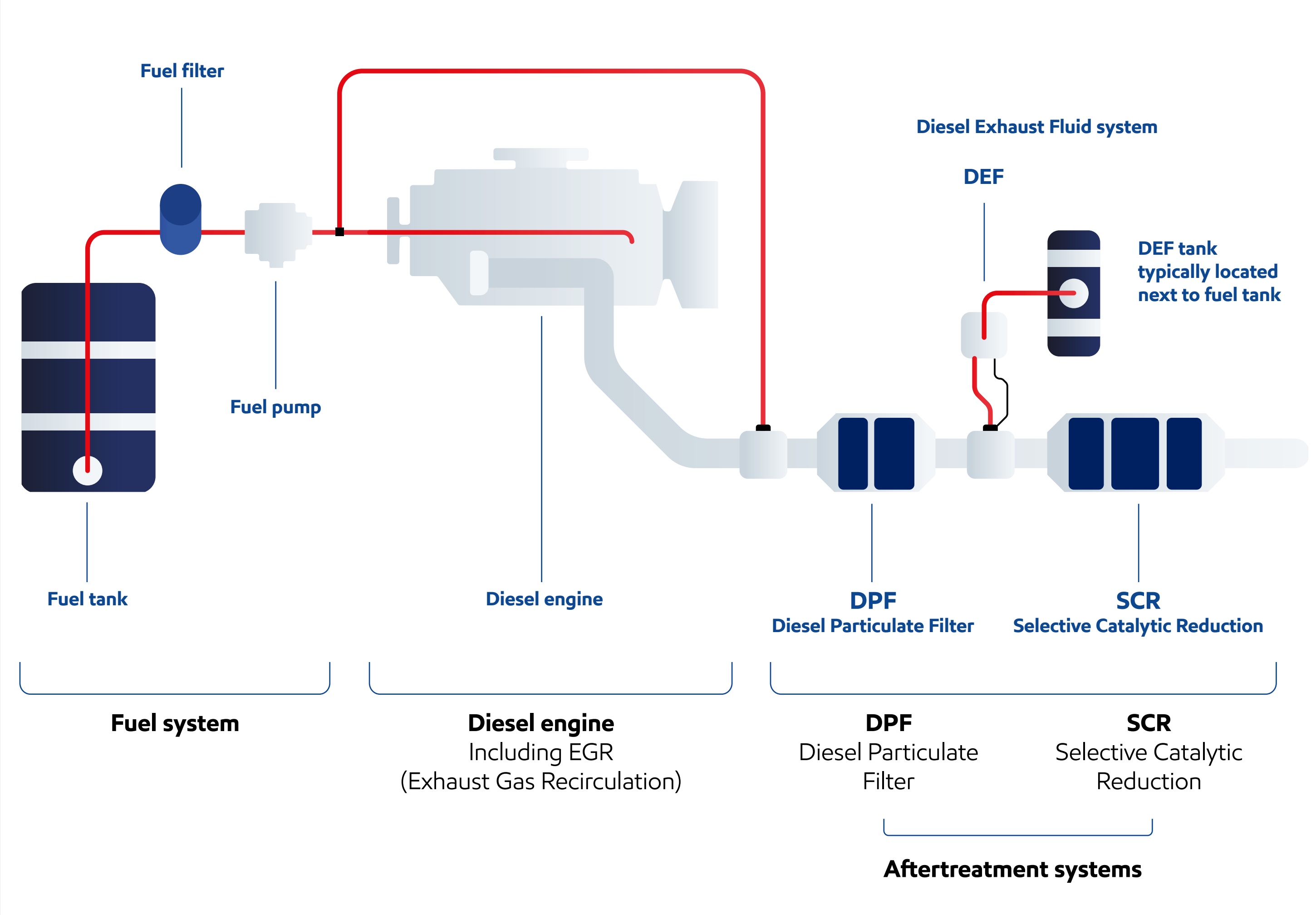


**Figure 12**
**Key elements of a modern lower emission diesel engine**




**Source:** ExxonMobil illustration – not an exact replica but a simplified rendering

# 05
## The importance of fuel quality

Changes to diesel engine technology and meeting emissions standards go hand in hand with the evolution of fuel standards. Many regions and countries have their own diesel fuel standards, with specifications like EN590 in Europe and the ASTM D975 standard in the US. Some key diesel fuel quality measures help enable a shift to lower emission diesel technology – see **Figure 13**. A key focus has been for fuel companies to lower sulfur content, enabling the application of advanced emissions control technologies that substantially reduce emissions from diesel combustion. Sulfur accumulation in the after treatment system over the lifetime of a truck can poison or deactivate the catalysts used to remove criteria pollutants from an engine's exhaust. Major global economies like US, Canada, the UK, EU, China, India, and Australia have all progressed significant sulfur reductions in road fuel. The European Union implemented its ultra-low sulfur diesel (ULSD) specifications in 1999.[15,16] The US Environmental Protection Agency (EPA) phased in more stringent regulations to lower the amount of sulfur in diesel fuel to its current ULSD standard of 15 ppm. Several more countries are taking action to upgrade to the Euro IV 50ppm sulfur standard.[17]

Diesel performance additive technology is complementary to an efficient, lower emission fleet. Fuel performance additive technology also plays a complementary role in strategies for lower emission fleets, going hand-in-hand with fleets fully benefiting from the latest diesel engine technology. Given the complexities of today's heavy-duty vehicle systems, the commercial trucking industry demands more from diesel fuel. Many fleets recognize that high quality diesel fuel is more than just a commodity driven by price and offers significant potential for optimizing modern diesel engine performance. This is an important focus area for fleet managers requiring more product knowledge as the role becomes more strategic.

There is room for further adoption of performance additive technology. In our latest survey of medium to large sized commercial heavy-duty fleets, just above 1 in 4 European and North American fleets have so far adopted this efficiency lever.[4]

As diesel engine technology becomes even more sophisticated and versatile, this significantly impacts what the complete diesel product needs to deliver. Research and innovation at the molecular level, combined with customer feedback, is critical to engineering a fully formulated diesel fuel that helps meet the performance needs of commercial fleet managers.

**Figure 13**
**Diesel fuel quality basics**

| | |
|---|---|
| **Sulfur** | Occurs naturally in all crude oils. Presence in fuel results in exhaust emissions of sulfur dioxide. Ultra low sulfur diesel fuel is required for exhaust aftertreatment systems because the catalysts can be sensitive to sulfur poisoning. |
| **Lubricity** | Fuel's ability to protect the fuel system from mechanical wear, i.e. metal-to-metal contact. As sulfur contents have been reduced to protect aftertreatment systems & reduce emissions, maintaining lubricity levels is important. |
| **Biodiesel** | FAME (fatty acid methyl ester) is a bio-component of diesel fuel. The EN590 specification caps FAME content at 7% by volume (B7). ASTM D975 limits FAME content to 5% by volume (B5). FAME does offer additional lubricity to low sulfur fuels. |
| **Cetane Number** | Measure of diesel fuel ignition quality. Higher cetane generally benefits cold starts in winter time with lower noise and less white smoke. |
| **Cloud Point** | Temperature at which paraffinic waxes, naturally present in diesel, begin to crystallize to form a haze in the fuel. Wax crystals can result in fuel filter plugging. The risk of filter plugging is an important consideration in colder climates, especially as new renewable diesel fuels are introduced to reduce lifecycle GHG emissions. |

**Source:** ExxonMobil technology assessment.

**Figure 14**
## Diesel fuels additive technology

### Detergent-based additives
Can provide substantial benefits for diesel fuel products by removing injector deposits and preventing them from forming in the first place.

### Cetane improvers
Help when the crude selection or processing does not result in an on-specification cetane number on its own. A cetane number indicates the diesel fuel's auto-ignition quality. Higher cetane may benefit cold starts and reduce noise and white smoke upon starting a vehicle, particularly in winter time.

### Lubricity improvers
Are required because the natural lubricity-enhancing compounds in diesel fuel are reduced in ultra-low sulfur diesel fuel. Fuel lubricity protects the fuel pump and fuel injectors from wear. Lubricity improvers are not necessary if a minimum of 2% fatty acid methyl esters (FAME) are blended into the fuel.

### Cold flow improvers
Cold temperatures encourage wax to drop out of diesel fuel, which can lead to loss of flow from filter plugging or bulk gelling in the fuel tank. Cold flow additives are added at the refinery or the terminal to ensure the diesel fuel flows at the temperatures to which it will be exposed. Blending of cold flow additives depends on geography and season.

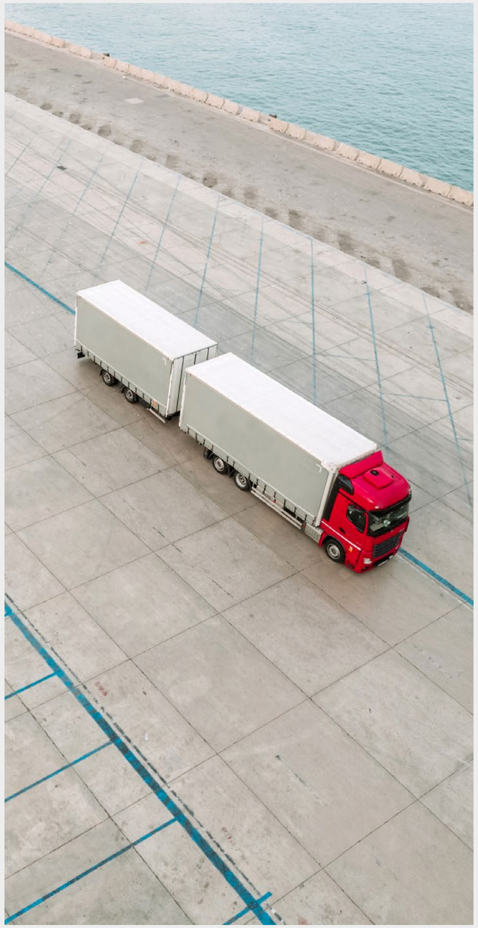
### Corrosion inhibitors
Over time, corrosion can impact the performance of diesel fuel systems. Corrosion inhibitors are typically added at refineries to help prevent the corrosion of steel and copper or its alloys (brass, bronze).

**Source:** ExxonMobil technology assessment.

Diesel additives are blended in small amounts into the fuel for vehicle performance, product quality, safety, and regulatory purposes. They enhance a fuel's specific properties without substantially altering its bulk physical makeup (such as density, energy content). They come in different types (see **Figure 14**) and achieving the right balance for a particular application requires careful work and significant investment in testing and proof of performance.

Performance technology has never been more important, but it is also complex. Finding the right mix can be tricky. It is important to understand the makeup of the fuel you use to power your fleet and what questions you should ask. High quality diesel from reputable providers, like ExxonMobil, contains an optimized blend of additives to meet local fuel specifications, and exceed those standards to achieve better performance from modern truck fleets.

There are many "aftermarket" additives sold that claim to meet specific customer needs. In contrast to the additives described above that are blended at the refineries and terminals, aftermarket additives are added by hand to fuel. However, in ExxonMobil's view, fuel should meet the required specifications without customers needing to purchase additional additives. Fleet managers should always be cautious of adding additives to diesel fuel as in certain circumstances it can cause more harm than good. For example, aftermarket cold flow enhancers can interact poorly with cold flow additives blended into the fuel at the refinery or the terminal, resulting in filter plugging and potentially worsening the fuel's cold flow properties. Aftermarket additives become less soluble in cold temperatures and may not dissolve correctly in the fuel. The growing interest in "all-in-one" differentiated diesel fuels has brought additives to the forefront as managers look to harness the best formulation package for their unique fleet needs. Enhancing diesel fuel is a science best left to the experts and we recommend fully formulated diesel products from reputable suppliers with a long standing commitment to fuels quality.



# 06
## The critical importance of fuel detergency for high pressure, precision injection systems

Just as lower emission engine technology is at the heart of the modern lower emission diesel fleet, the right fuel additive technology is at the heart of the best modern diesel fuels. High pressure, precision diesel injection systems are designed to optimize fuel combustion characteristics (see **Figure 15**).

This elevates the importance of diesel detergency in ensuring the injection system performance stays true over a vehicle's lifetime. Injector cleanliness is critical for the performance of lower emission diesel engine technology, as you can see in **Figure 16**. Fuels designed to help keep precision fuel injection systems clean can also contribute to reduced fuel consumption. ExxonMobil's Diesel Efficient™ fuel, marketed under Esso, Mobil and Exxon brands, and available in many markets globally, incorporates a terminal-additized detergent and many fleets are benefiting from its fully formulated performance benefits, on road and on-rail (see **Figure 17**).[18]

**Figure 15**
**Optimizing fuel combustion in modern lower emission diesel engine technology**

**Optimizing fuel combustion:**
Engine manufacturers seek to optimize the diesel combustion process, balancing trade-offs between engine responsiveness, power, fuel economy, and emissions. Diesel fuel, injected into the combustion cylinder, undergoes atomization, vaporization and fuel vapor-air mixing in order to initiate the combustion process.

**Fuel injectors** are designed to optimize combustion:

**Precise timing with tight shutoff:** delivers the right amount of fuel at the right time, without leakage after injection is complete.

**Spray pattern:** ensures fuel spray is appropriately placed in the combustion zone, promoting vigorous mixing between fuel and air to initiate combustion.

**Fuel droplet size:** ensures proper atomization and vaporization, influencing burn rate. Smaller droplets have a greater surface area to volume ratio, so they evaporate and burn faster.

**Spray penetration (or depth):** prevents liquid fuel from hitting and pooling on the piston crown or cylinder wall, where it won't burn completely and can generate particulate matter (soot).

**Injector deposits** can negatively affect these characteristics, detrimentally impacting engine efficiency, performance, and emissions. Internal deposits can hinder the movement and seating of the injector needle, resulting in non-optimal injection timing or leakage of fuel which can subsequently coke and generate soot. Nozzle deposits (or coking) can alter the spray pattern, fuel droplet size, and spray penetration in undesirable ways which deviate from the original engine design.

**Source:** ExxonMobil.

**Figure 16**
**Function of an effective diesel detergent technology**

**How the fuel injector optimizes combustion**

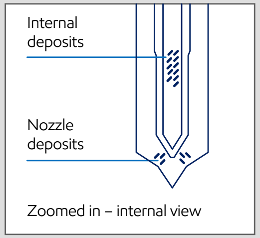
**Dirty**

**Spray pattern:**
Inconsistent

Fuel not supplied efficiently & timely

**Operation:**
Injector motion is hindered

Incomplete combustion



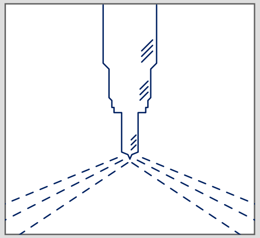

**Cleaner**

**Spray pattern:**
Uniform spray pattern

Small fuel droplets

**Operation:**
Consistent flow

Timely operation



**The 1-2-3 of the right fuel detergent**

1. Finds deposits
2. Interacts with the deposit
3. Releases deposit from the metal surface & carries away with the fuel

**Source:** ExxonMobil.

**Figure 17**
**Case Studies – Leveraging Esso Diesel Efficient™ Fuel Technology**

On-Road

## Esso Diesel Efficient™ fuel helps lower a road transport company's operational cost & improves business efficiency[a,e]

We worked with one of the largest private transport providers in Singapore, with a fleet of more than 1,000 vehicles. This fleet's on-going search for ways to enhance overall business efficiencies resulted in a trial of Esso Diesel Efficient fuel.

Their fleet's concern centred around:

- **Ensuring vehicles are able to handle the stress from heavy loads.**
- **Protecting engine life and optimising their performance.**
- **Minimising vehicle downtime and lowering maintenance costs.**

The trial[b], which was carried out in collaboration with Esso, exceeded expectations.

**Cost savings:**

1.8%

average increase in fuel efficiency.

11%

average reduction in DEF consumption.

**Efficient and productive fleet operation:**

- More powerful and responsive engines.
- Enhanced efficiency with fewer engine breakdowns.
- Greater reduction in black smoke and engine cleanliness retained.
- Fewer refuelling trips required.

**Increased product confidence:**

- Greater service reliability and customer confidence.

[a] This Proof of Performance is based on the experience of a single customer who used Esso Diesel Efficient™ fuel over a trial period of 6 months. Actual results can vary depending on factors such as type of operation, vehicle, engine, driving conditions, driving behaviour and diesel fuel previously used.
[b] The comparison during this trial period was against our commercial additized diesel (ADO) with different dosage of additive(s). Data collected was based on telematics reporting on fuel consumption and mileage travelled. DEF (AdBlue) consumption was derived from drivers' manual record keeping. Trial was performed in Singapore by our customer on 4 prime movers.

By Rail

## Esso Diesel Efficient™ fuel helps a rail freight operator improve fuel economy & reduce emissions[c,e]

We worked with one of North America's largest rail freight operators. To support its sustainability goals, the customer trialed Esso Diesel Efficient fuel to test its ability to improve fuel economy and reduce exhaust emissions.

The 19-day test used a US EPA Certified Tier 3 GE ES44AC locomotive, during which 16K litres of non-detergent No. 2 diesel fuel were consumed to establish baseline performance. The engine then ran on 66K litres of Esso Diesel Efficient fuel.

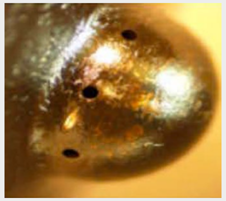
The injectors that ran on Esso Diesel Efficient fuel showed:

- **An average 3.8% higher flow rate than the injectors that ran only on non-detergent diesel.**
- **Smaller diesel fuel droplet size distribution.**
- **Visible reduction in external deposits.**

Post-trial analysis showed that Esso Diesel Efficient delivered an improvement in fuel efficiency.

The finding showed that if the customer's entire fleet switched to Esso Diesel Efficient fuel it could annually achieve a reduction in fuel consumption of 3 ML and lower $CO_2$ exhaust emissions by 8M KG.[d]

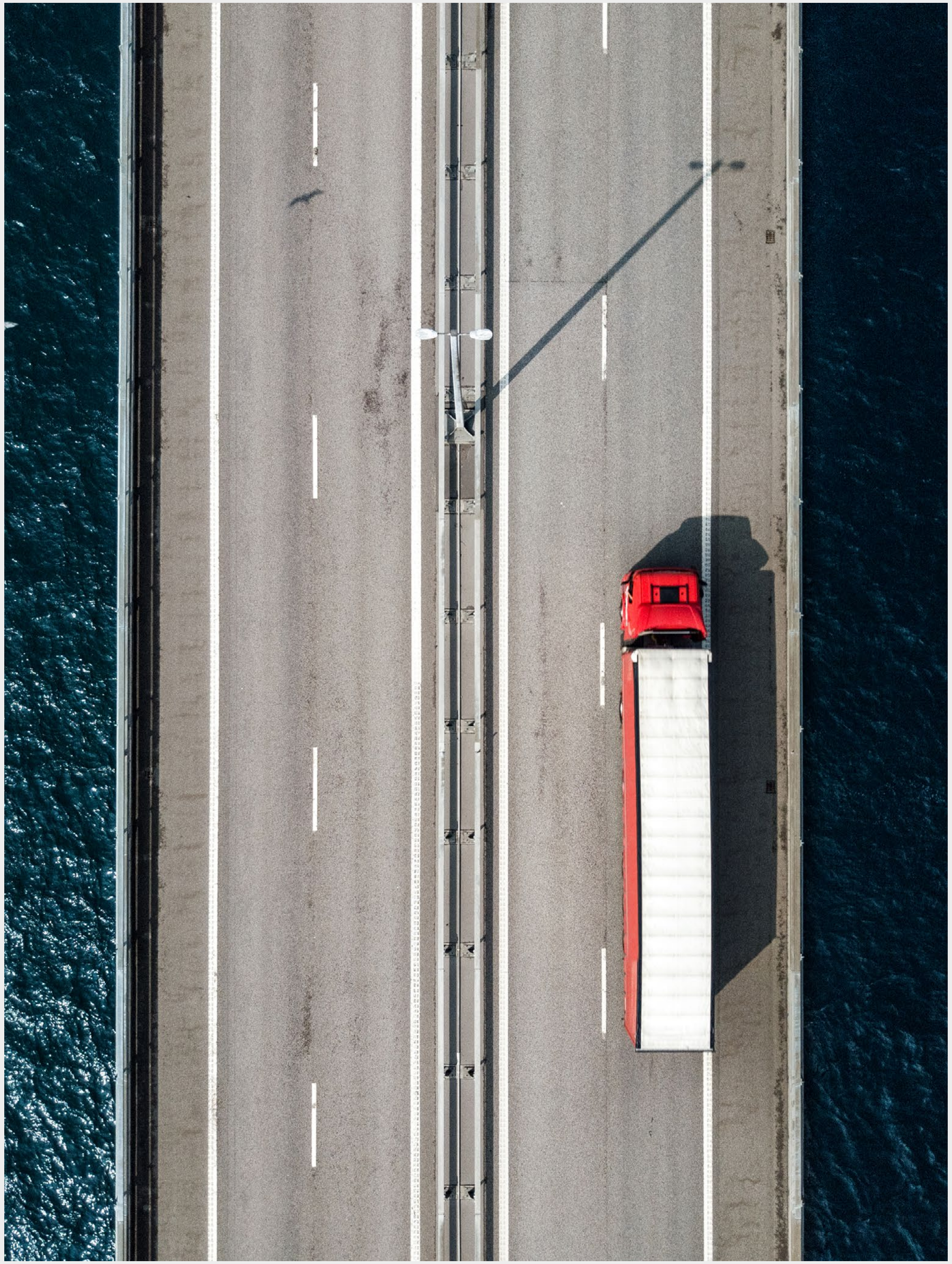
**Non-Detergent Diesel**
This injector accumulated 8,800 MWhrs on non-detergent diesel only.



**Esso Diesel Efficient™**
This injector accumulated 12,000 MWhrs on non-detergent diesel prior to **Esso Diesel Efficient™** fuel cleanup.

[c] Results were measured over a 19-day demonstration on a single locomotive. Actual benefits and fuel economy will vary depending on factors such as vehicle engine type, engine conditions and diesel fuel previously used.
[d] Figures calculated as potential benefits that could be realized over an entire year assuming the rail company's entire fleet realized the same benefits as the locomotive in the 19-day field demonstration. Actual benefits and fuel economy will vary depending on factors such as locomotive / engine type, engine conditions, operating conditions and diesel fuel previously used.
[e] These proofs of performance were demonstrated using first generation additive package. Our upcoming second generation detergent additive package is expected to have similar or better cleaning performance than that of the first generation additive package if compared in the same engine/vehicle type with the same test protocol. Actual results may vary based on factors such as vehicle type, engine type, driving behavior, and other factors.

**Source:** Esso Diesel Efficient™ customer testimonials.



## Section One in Brief

**Establishing a platform for productive, efficient and sustainable commercial transport, with a focus on reducing emissions**

- Productivity and efficiency are fundamental needs of commercial fleets, and this has helped shape the solutions adopted for moving people and goods from A to B today. All future choices are assessed through these two critical lenses.
- Demand for commercial transportation is anticipated to rise globally. This growth in demand, and increasing societal efforts to reduce emissions, mean sustainability, and especially reducing fleet GHG emissions, is a rapidly emerging additional consideration of fleet planning.
- Whilst alternative powertrain technology is beginning to gain penetration in commercial fleets, diesel technology will continue to play a major role, for the fleet on the road today and especially longer haul, heavier-duty applications.
- Commercial fleets can now choose from a range of tools (including driver training, telematics, smart routing, and improved aerodynamics) to enhance efficiency and reduce emissions. Leading fleets have demonstrated significant advances, improving productivity and efficiency, thereby lowering both operating costs (as measured by TCO) and reducing emissions per ton mile. AI appears set to play a future role as part of this toolkit with fleets at early stages in this aspect of their journey.
- Modernizing the existing fleet to benefit from the latest lower emission diesel engine technology is a key component of the strategy used by many advanced commercial fleets.
- Fuel quality is a key enabler of this transition to lower emission vehicle technology. Fuel detergency is especially important in ensuring high pressure precision injection systems function optimally.
- Utilizing the right fully formulated diesel fuel technology helps advanced commercial fleets maximize the benefits of fleet modernization and helps optimize their efficiency in operation.

# Lowering lifecycle GHG emissions and shifting towards a portfolio of alternative fuels

Transportation significantly contributes to global emissions, representing around a quarter of global greenhouse gas (GHG) emissions, around three quarters of which come from which road transport.[6,7] Commercial transport makes up a significant share of road transport emissions relative to the overall transport fleet. Duty cycles, including the distance traveled and the heavy load hauled, mean that road freight is categorized as a harder to abate sector.[19] As global transportation energy demand is expected to grow due to global economic growth, a mix of vehicle and fuel technologies will be needed to meet consumers' needs and societal ambitions today and in the future. No one solution will be able to meet all of society's transportation needs while contributing to lower GHG emissions ambitions.

## 01

## Calculating and tracking emissions is a key challenge for fleets in meeting emission reduction goals

The research we commissioned of medium and large commercial heavy-duty fleets indicates the majority of the fleets interviewed have established emissions targets – with approaches varying around a series of common themes. The percentage of fleets with emissions targets appears to have risen in the last two years. Overall, the largest fleets are more likely to have established targets – see **Figure 18**.[4]

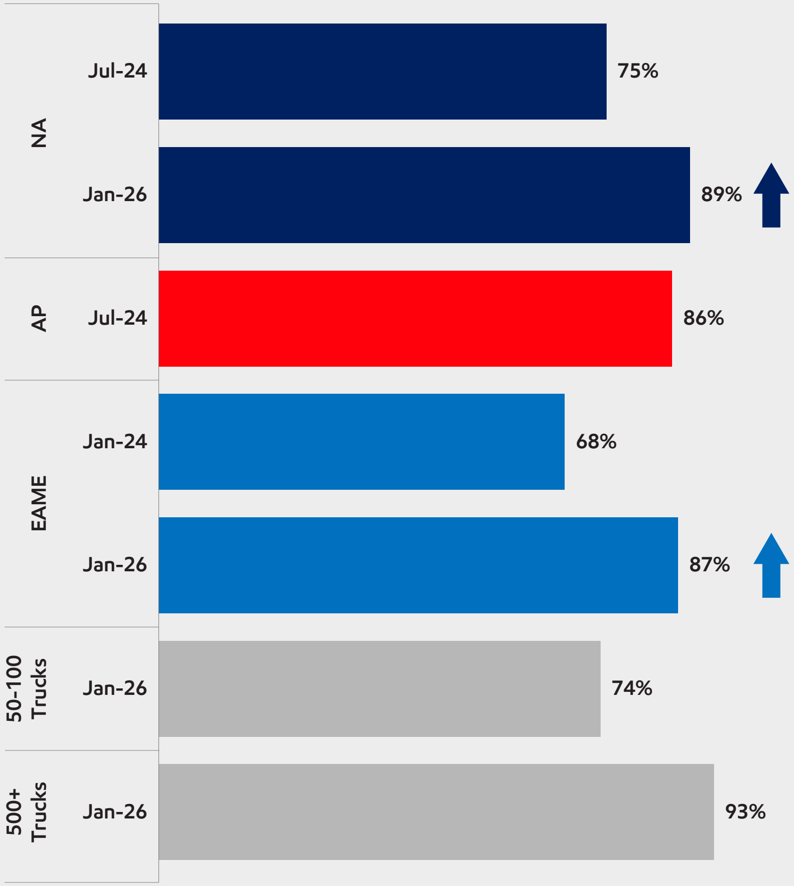
Many fleets indicated they are strengthening or accelerating their targets faced with regulatory pressures. This is also partly driven by customer interest in their fleet operator's emissions performance which fleets indicate has grown over the last two years, with interest stronger in Western Europe than in North America – see **Figure 19**.[4] In the European Union, fleets indicated that regulatory reporting directives are also having a bearing.[4]

In our research, around a third of commercial trucking fleet operators highlighted "understanding, calculating, and tracking fleet emissions" as one of the key barriers to their emission reduction efforts (along with the cost and availability of technology, vehicles, and fuels) – see **Figure 20**. Without measurement it is difficult to establish targets or plans and track progress.

Policy varies between regions, countries and indeed states/provinces. This influences how emissions are assessed locally and regionally. Most vehicle policies today consider tailpipe emissions only. To advance societal ambitions cost effectively, policy makers must consider both the full lifecycle emissions of vehicles and the fuels they use.

**Figure 18**
**Fleets are establishing emissions targets**[4]

**% of Trucking Fleets with Emissions Targets**

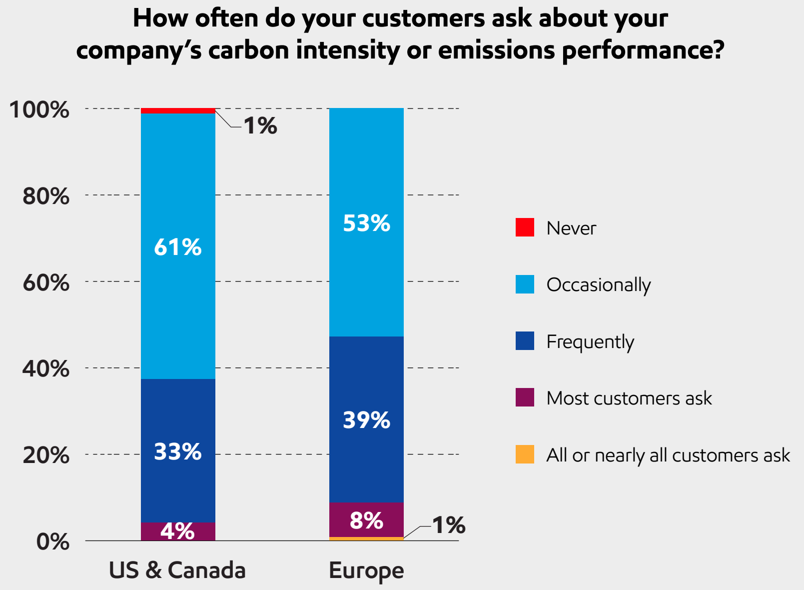


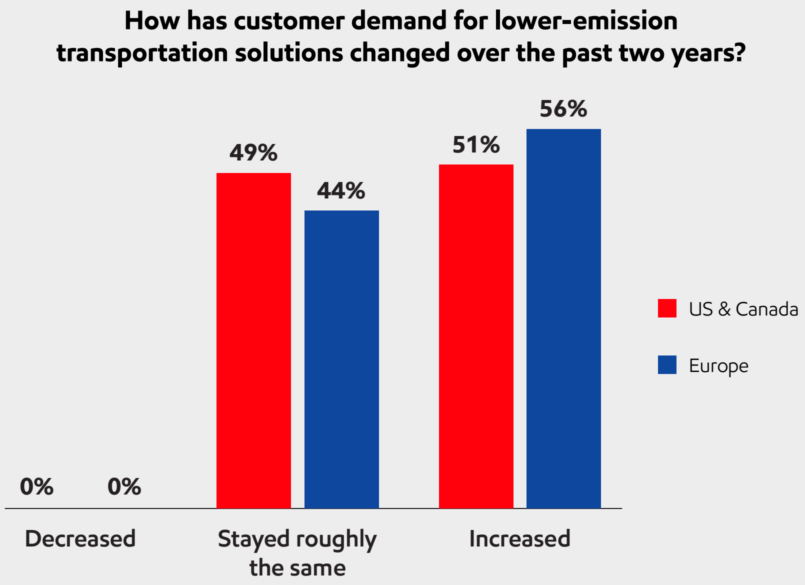

**Fleets with 50 or more heavy duty trucks for whom decarbonization is a strategic consideration**

**Question:**
Have you established emission targets for your fleet? N=150 for EAME, 148 for NA, 150 for AP. 120 for 50-100 trucks. 60 for 500+ trucks

**Source:** ExxonMobil-commissioned research by Frost & Sullivan of heavy duty fleets with 50+ trucks.[4]

**Figure 19**
## Fleet customer demand for lower emission transportation solutions[4]




**Source:** ExxonMobil-commissioned research by Frost & Sullivan. Interviews Dec-25 to Jan-26. N=150 Europe, N=150 NA.[4]

**Figure 20**
## Main decarbonization challenges reported by commercial trucking fleets[4]

| Ranking of Sector Barriers to Decarbonization (NA & EA, Top 2 Box) | | | |
|---|---|---|---|
| **Barrier** | **1Q26** | **1Q26 Rank** | **Prior Survey** |
| High upfront costs of new technology | 78% | 1 | 2 |
| High costs of lower emission fuels | 73% | 2 | 1 |
| Availability of lower emission fuels | 64% | 3 | 3 |
| Higher complexity of operations | 61% | 4 | 5 |
| Lower flexibility of routes (e.g. for charging) | 60% | 5 | 7 |
| Calculating & tracking emissions | 60% | 5 | 6 |
| Availability of suitable lower emissions vehicles | 58% | 7 | 4 |
| Complexity of changes to in-house refuelling / recharging | 58% | 8 | 8 |
| Reduced fleet efficiency | 56% | 9 | 11 |
| Availability of technology | 55% | 10 | 10 |
| Uncertiany on residual value / resale | 55% | 11 | 9 |
| Reduction in revenues | 52% | 12 | 13 |
| Driver experience | 47% | 13 | 12 |
| Pushback from management | 34% | 14 | 14 |

**Source:** 1Q26 survey of commercial fleets of 50+ HD trucks. (Sample – 150 NA, 150 EAME fleets with emission reduction targets)

## Section Two

**Lowering lifecycle GHG emissions and shifting towards a portfolio of alternative fuels**

## 02
## The importance of accounting for lifecycle emissions to help meet societal climate ambitions

The lifecycle assessment of the fuel being used can be broken down into simplified stages as shown in **Figure 21**.[20] This approach offers the most holistic solution towards reducing transportation emissions, as emissions occur at multiple stages along the value chain, both upstream and downstream of the fuel and vehicle. Utilizing a lifecycle approach would enable the quantification of emissions associated with the production, transport, use, and final disposition of both fuels and vehicles. Policies addressing the full lifecycle emissions of vehicles do not rely solely on vehicle replacement to achieve the policy objectives; they also encourage investment and technology development that could result in faster and more robust emissions reductions from existing fleets.

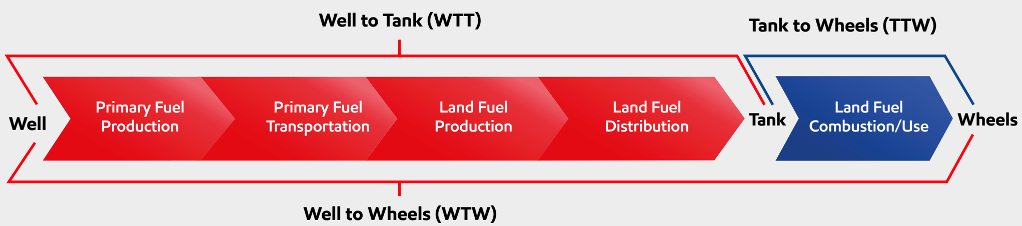
**Life Cycle Assessment (LCA)** is the process of systematically assessing a product's total GHG emissions over its complete lifecycle. The process calculates the Carbon Intensity of the fuel/energy source.

**Carbon Intensity (CI)** is a measure of lifecycle GHG emissions, expressed in units of $CO_2$ equivalent ($CO_2$ e) emissions per unit of energy. It is usually expressed per megajoule of energy. $CO_2$ e is used to account for the GHG potential of all emissions, not just $CO_2$, expressed in terms of an equivalent amount of $CO_2$ based on each emission's GHG potential. The fuel lifecycle assessment is described as Well to Wheels (WTW). The lifecycle assessment can be split into two phases: Well to Tank (WTT) and Tank to Wheels (TTW).

**WTT** represents the GHG emissions, expressed in $CO_2$ e/MJ, associated with fuel production and distribution to the end user vehicle refueling point.

**TTW** represents the GHG emissions from a fuel's use (combustion) phase, expressed in $CO_2$ e/MJ.

**Figure 21**
**Lifecycle approach to emissions assessments**




**Source:** ExxonMobil.

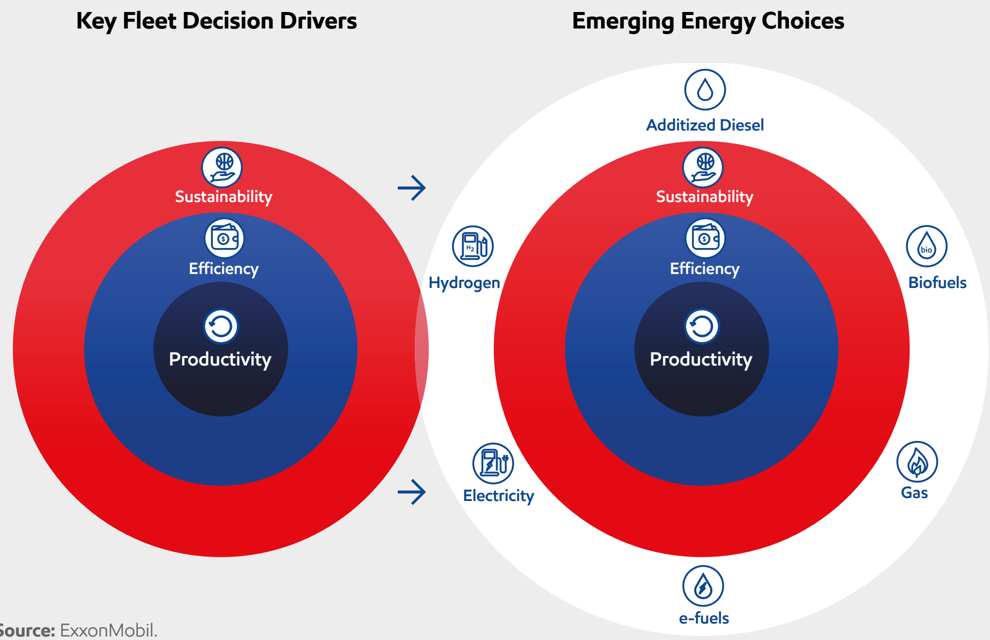
**WTW** analysis does not, however, consider the full lifecycle of the vehicle from production (including its components) through end of life, including disposal. So, while WTW methodology provides a structured mechanism for comparing the lifecycle emissions of different fuels, a more complete analysis of the comparative emissions of various vehicles and their associated fuel/ power source is required to make a fully informed choice.

## 03
## The emergence of a portfolio of fueling alternatives

A portfolio of alternative fuel solutions is emerging, offering choices that can contribute to varying degrees of reduction in lifecycle GHG emissions from land transport. Commercial fleets will view the attractiveness of these emerging solutions through the lenses of productivity, efficiency, and sustainability described in Section One. Fleets will naturally seek to prioritize win-win-win solutions which can help optimize fleet utilization, lower operational energy intensity (and associated costs per ton mile driven) and contribute to their emissions reduction goals. **Figure 22** offers a simplified view of these emerging choices.

Many pathways exist to lower GHG emissions in the road transport sector. A portfolio of solutions approach will be required as each option has advantages and limitations. All solutions will likely have roles to play in reducing emissions from land transport with prospective strengths across the wide range of duty cycles prevalent in land transport.

**Figure 22**
**Emerging alternative fueling choices for land transport**




**Source:** ExxonMobil.

**Figure 23** outlines these choices and specific considerations around productivity, efficiency, and sustainability, which will guide selection for different applications over time.

We will explore **Biofuels** further in Sections 3-5, with a focus on biodiesel and renewable diesel. They are an important part of the consideration set for regulators and commercial fleets and have the potential for use in existing vehicles, largely leveraging existing re-fueling infrastructure.

Other emerging land transport choices for future consideration include natural gas (conventional and renewable), battery electric vehicles, hydrogen (fuel cell electric vehicles or hydrogen ICE engines), and to a lesser extent, E-Fuels. They are briefly summarized below.

### Natural Gas

Some commercial operators use compressed and/or liquified natural gas (NG) today as part of their heavy duty mix. With some exceptions, in most markets, natural gas adoption for commercial transport has been relatively niche to date but, with the maturity of new natural gas-powered engine technology, a well-established natural gas distribution network, and the potential role of renewable natural gas in emissions reduction plans, many heavy duty fleets expect to grow adoption of natural gas in their transport energy mix.[4]

Compressed natural gas (CNG) vehicles are typically limited in range relative to heavy duty diesel alternatives due to a lower energy density and on-board storage limitations. Liquefied natural gas (LNG) has a higher energy density compared to CNG, and new LNG engine technologies such as the Cummins 15 litre natural gas engine[21] have extended range enabling the potential use of natural gas in heavier, longer haul applications.

Where policy and incentives are supportive, some fleets are adopting **Renewable Natural Gas** (RNG), sometimes known as bio-methane, to reduce the lifecycle GHG emissions[22] of their trucking operations. These incentives can improve the economics of natural gas adoption, which is heavily influenced by the diesel-natural gas price spread locally and subject to volatility.

Operationally, the refueling process for natural gas is similar to conventional diesel, but a switch to natural gas does require new trucks and or retrofitting existing models, which means added up-front costs. Switching also comes with the complexity of repurposing in-yard facilities and training of maintenance teams. In addition, from a safety and lifecycle GHG standpoint, additional attention is required to limit the potential for natural gas fugitive emissions. The business case for switching fleets from diesel to natural gas (RNG or otherwise) benefits from operational scale. This is consistent with the anticipated growth of natural gas adoption by 2040, across all geographies surveyed, by the mid-large sized commercial trucking fleets interviewed by Frost & Sullivan – see **Figure 7**.[4]

Examples of fleets adopting renewable natural gas in logistics operations, include many major grocery chains in the UK, such as John Lewis, who have switched more than 500 trucks to biomethane (bio-CNG) in their distribution center operations.[23]

**Figure 23**
**Overview of alternative fueling choices for land transport**

**Alternative energy solutions that may be leveraged within the portfolio include:**

- Biofuels and synthetic fuels that can be blended with or replace existing conventional diesel fuels.
- Renewable Natural Gas as a lower GHG emissions substitute for compressed or liquified natural gas (CNG or LNG).
- Electrification / EV charging that may provide a lower GHG emissions alternative where operating conditions are conducive.
- Lower lifecycle GHG emission hydrogen (e.g. green, blue) for a lower GHG emission alternative to hard-to-decarbonize transportation such as HD trucking.

**Key considerations:**

- **Scale (supply/infrastructure)**
- **Vehicle/fuel compatibility**
- **Technology readiness**
- **Affordability**
- **Varied transportation needs** (use cases, LD vs. HD)
- **Lifecycle GHG emission reduction potential**

## Electrification (Battery Electric Vehicles)

Electrified vehicles (EV) are one component of a multi-technology transportation future to reduce GHG emissions. The lifecycle GHG emissions reduction potential from battery electric vehicles is highly dependent on the carbon intensity of the electricity source utilized. The lifecycle GHG emissions of electricity production differ significantly by region. Significant investments in a lower carbon intensity grid, well-developed charging infrastructure, and responsible sourcing and manufacturing practices will be key factors enabling these technologies to scale in the future.

Early adopters are beginning to incorporate hybrids and full battery electric vehicles (BEVs) in their fleets with consideration of important factors such as range, charging times, and charging infrastructure. Additional considerations include duty cycle, use cases (e.g. refrigerated trucks), terrain, and cab temperature.

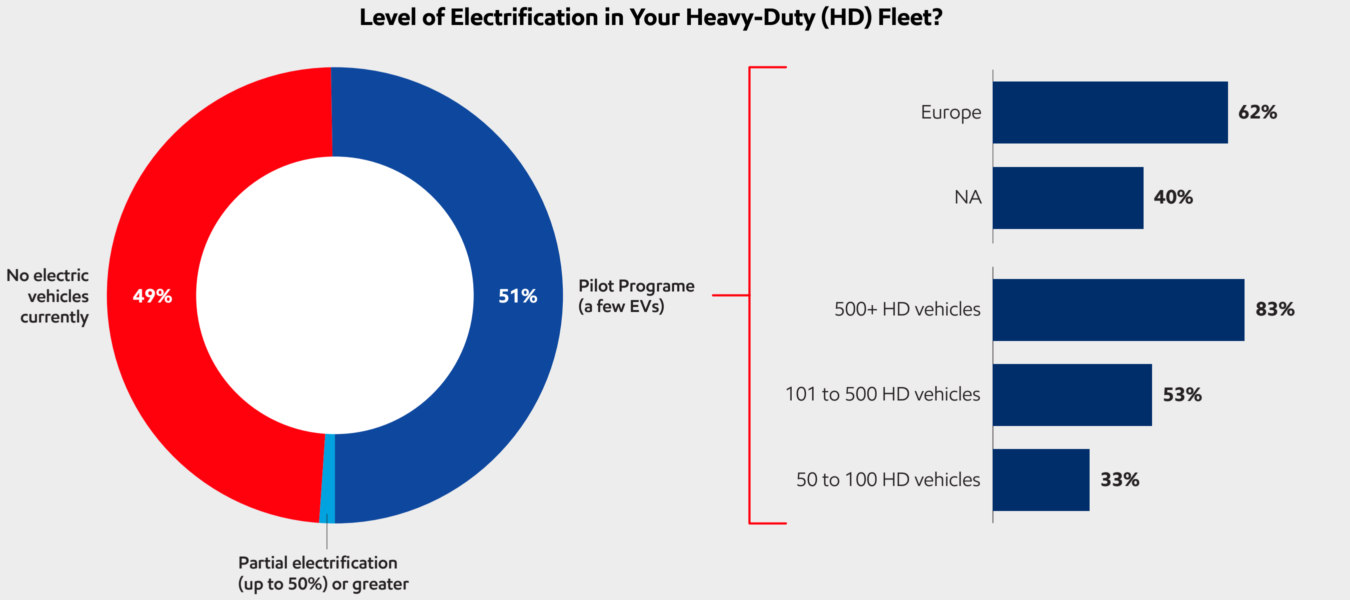
Current BEV adoption in heavy duty fleets is low but growing. OEMs are investing in the development of their EV offer and the range of BEV models has grown in recent years.[24] Many fleets are piloting BEVs as part of their emission reduction roadmaps – see **Figure 24**. The data shows that a higher percentage of European fleets are piloting BEVs compared to North American fleets and that a higher percentage of large fleets (>500 vehicles) are exploring BEV solutions. A small minority of heavy duty fleet operators have electrified >50% of their fleet.[4]

Currently, fleet operators perceive up-front vehicle costs the leading challenge facing electrification of their heavy duty fleets – see **Figure 25**. Additional challenges include the complexities of in-yard charging, charging times, high voltage grid access, and expertise required. Fleets indicate that unclear and changing government policies and incentives are a bigger challenge in US & Canada than in Europe. In North America, mid-sized fleets (101-500 heavy duty trucks), which have a wider range of customers to support than small fleets (50-100) but perhaps lacking the resources accessible to larger fleets (501+), appear to feel the challenge of electrification the most, across a range of dimensions.[4]

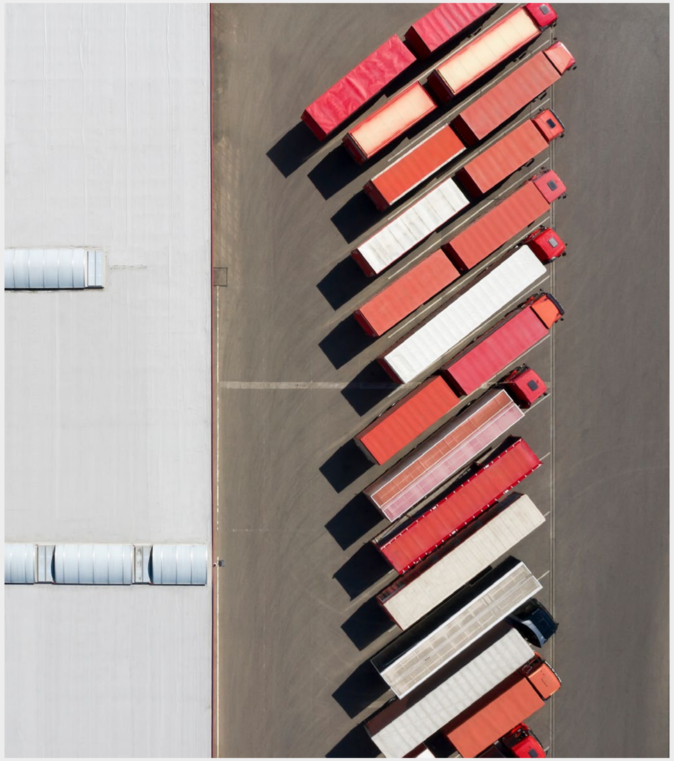
As battery and charging technology (and associated infrastructure) improves, and upfront costs fall relative to conventional diesel, the range of operationally suitable and economically viable duty cycles is likely to widen, and hence adoption of battery electric vehicles in heavier duty commercial applications is anticipated to expand.

In our latest research of mid-large sized heavy duty fleets, forecasted EV penetration by 2040 in North America has grown since our last checkpoint two years ago, with around 1 in 6 heavy duty trucks expected now to be fully electric by 2040 – see **Figure 7**.[4] The forecasted EV penetration of heavy duty fleets in Western Europe by 2040 saw little change with mid-large sized heavy-duty fleets expecting around 1 in 5 of their trucks to be electrified by 2040.

**Figure 24**
**Progress of Heavy Duty Fleet Electrification Reported by Commercial Trucking Fleets (NA & Europe, 1Q26)[4]**

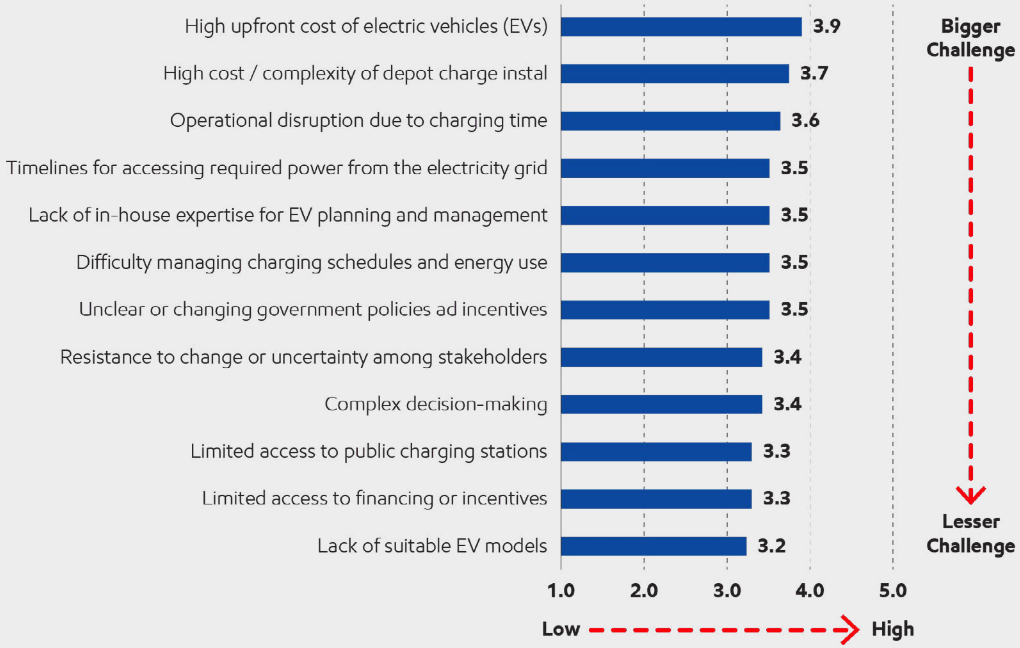



**Source:** ExxonMobil-commissioned research by Frost & Sullivan. Interviews Dec-25 to Jan-26. N=150 Europe, N=150 NA.[4]



## Figure 25

## Electrifying Heavy-Duty (HD) Fleet – Challenges reported by commercial trucking fleets[4]




| Biggest Challenges Faced in Electrifying Heavy-Duty (HD) Fleet | NA Rank | EA Rank |
|---|---|---|
| High upfront cost of electric vehicles (EVs) | 1 | 1 |
| High cost / complexity of depot charge installation | 7 | 1 |
| Operational disruption due to charging time | 5 | 3 |
| Timelines for accessing required power from the electricity grid | 5 | 5 |
| Lack of in-house expertise for EV planning and management | 2 | 5 |
| Difficulty managing charging schedules and energy use | 4 | 4 |
| Unclear or changing government policies ad incentives | **3** | 8 |
| Resistance to change or uncertainty among stakeholders | 11 | 5 |
| Complex decision-making across internal departments | 7 | 10 |
| Limited access to public charging stations | 10 | 9 |
| Limited access to financing or incentives | 12 | 10 |
| Lack of suitable EV models | 7 | 12 |

**Source:** 1Q26 survey of commercial fleets of 50+ HD trucks. (Sample – Fleets who have some BEV heavy duty trucks – 94 Europe, 60 North America). Fleets were asked to score a series of potential challenges from 1 (Low) to 5 (High).

### Hydrogen

Hydrogen can be used in both fuel cell electric vehicle (FCEV) and internal combustion engine applications. Hydrogen has potential as an alternative lower emission solution for heavier-duty, longer haul applications due to the low lifecycle GHG potential and higher gravimetric energy density relative to BEVs.[25] Similar to BEVs, hydrogen FCEVs also have zero tailpipe emissions while hydrogen internal combustion engines require aftertreatment solutions to control $NO_x$ and other criteria emissions.

Whilst the range of hydrogen vehicles is less well developed than BEV, many OEMs have been active in developing hydrogen-powered solutions as part of their portfolio. The Huyndai Xcient fleet, for example, recently exceeded 20 million kilometres of service.[26] In contrast to BEV solutions, hydrogen truck refueling times are more comparable with their conventional diesel counterparts.

There are a number of barriers[25] to the scale up of hydrogen adoption in heavy duty trucking. Firstly, with limited adoption, and, absent of incentives, the up-front costs of hydrogen trucks remain expensive. Secondly, significant infrastructure investment in infrastructure and hydrogen refueling facilities is required. Thirdly, the supply and unit cost of lower-carbon intensity hydrogen – for example, hydrogen produced by steam methane reformation (SMR) with carbon capture and storage (so-called blue hydrogen) and hydrogen from electrolysis using solar/wind electricity (so-called green hydrogen) or nuclear energy (pink hydrogen) – remains a barrier to wide-spread adoption.

Expectations amongst European fleets regarding hydrogen penetration in 2040 fell from 5% in our prior survey (completed Jan-24) to 1% in our latest pulse check (Jan-26). North America fleets also see hydrogen as having niche application potential by 2040.[4]

### eFuels

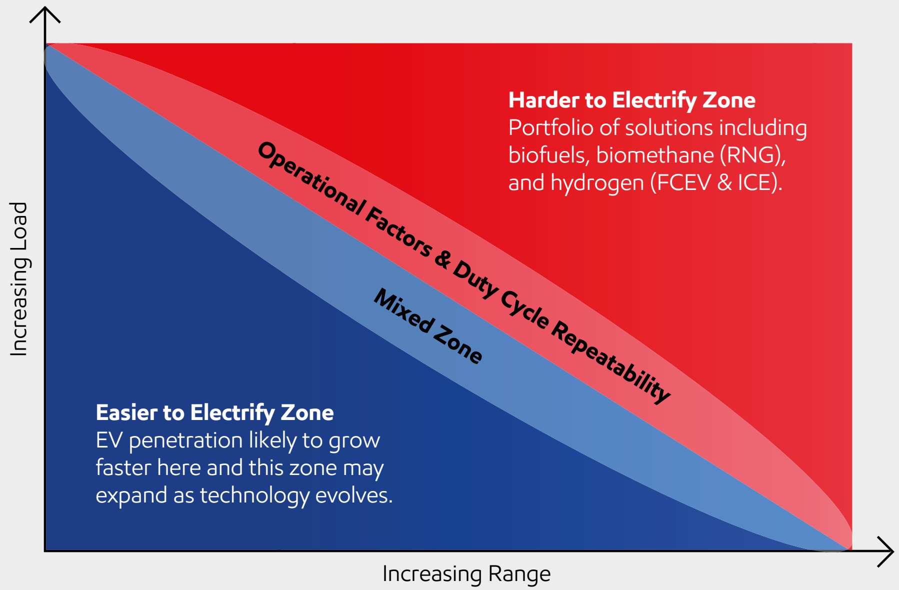
eFuels are synthetic fuels that can be made using renewable electricity to generate hydrogen, and when combined with captured carbon, create drop-in replacements for conventional petroleum fuels with a lower carbon intensity. Delivering lower-cost synthetic fuels, not just from renewable hydrogen, but also from lower carbon hydrogen, produced from natural gas with carbon capture, could accelerate the introduction of such synthetic fuels. Conventional liquid fuels and internal combustion engines provide convenient and affordable transportation options. Liquid fuels are preferred for commercial transportation (heavy-duty and long-haul trucks, ships and planes) due to energy density requirements where significant on-board energy storage is valued for long-haul driving ranges, heavy loads, or other energy-intensive applications. eFuels should be considered as part of the future lower carbon intensity liquid fuels solution set. Today, eFuels are expensive with current technology and would require regulatory incentives/drivers to become economically viable.

# 04
## The role of duty cycles in shaping pathways

Commercial fleets are typically made up of a range of vehicles from lighter to heavier-duty and operate over a range of operating conditions – see **Figure 26**. So, it is to be expected that larger commercial fleets, even though they might prefer to simplify operationally, are likely to operate a mixed regime of fueling choices. They may also choose to move in stages between choices over time as infrastructure is built and policy evolves to support certain pathways. As battery technology and vehicle choices evolve, and operational learnings build, there are different and constantly evolving views of the relative roles battery and hydrogen fuel cell electric vehicles will play in commercial transport and how it will evolve over time.

Fleet managers with the most ambitious plans to reduce GHG emissions in their operations are mapping their existing operations and segmenting their vehicles by their operational duty cycles taking into consideration load, range, utilization rates, and predictability of journeys. They are seeking to select the most suitable solution for different subsets of their fleet. Early adopters typically deploy EVs in the parts of their fleet with duty cycles that are best suited to current EV capabilities. This is often with a more accelerated deployment of EV for lighter duty, shorter haul, last mile delivery and urban operations. For heavier duty fleets, battery electric penetration has been stronger on last mile delivery applications and shorter haul drayage operations. Many are augmenting this approach with the deployment of alternative solutions for heavy duty, longer haul operations. Charging infrastructure and grid investment is a significant consideration with fleets potentially more likely to focus on return-to-base fleets first while reliable heavy-duty charging infrastructure develops for roadside fueling.[4]

**Figure 26**
**Overview of alternative fueling choices for land transport**

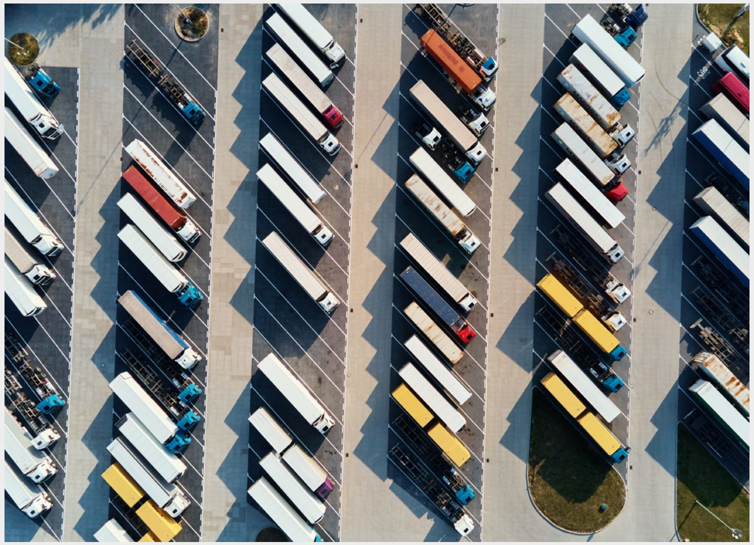



- Lighter duty use cases likely to electrify first.
- Drayage & yard tractor heavy-duty use cases most attractive to convert today.
- Return-to-base distribution center operations & point to point applications follow.
- Longer & heaviest haul more challenging to transition.
- Biofuel solutions can play a complementary role across the full range of duty cycles.

**Source:** ExxonMobil conceptual.

The extent the role hydrogen will play is uncertain. It may come to play a supporting role with an emphasis on longer haul, heavier duty applications, and where faster refueling times are needed to minimize downtime.

We will explore biofuels at greater length in the rest of this paper. They can play a supporting role across the duty cycle map. Use of 100% biofuels, rather than blends, is an additional option for fleet managers, particularly in harder to decarbonize duty cycles where BEV capabilities may be limited.



# 05
## The importance of infrastructure in shaping pathways

Battery Electric and Hydrogen-Powered (Fuel Cells and Internal Combustion Engine technology) require significant infrastructure development to support wide-spread, convenient deployment. Enabling the transition to EV requires significant investment in renewable power sources, the power grid and in a suitable high speed charging network (augmented by smart grid / load balancing capabilities and digital route-optimization enablers) to enable battery recharging where it is required to get vehicles back on the road quickly to avoid lost productivity.

Biofuels have the benefit that much of the existing fuel distribution and refueling infrastructure can be leveraged in the supply chain to connect these solutions with end users, conveniently, where and when they need them. Policy makers play an important role in shaping demand across the portfolio of solutions as well as supply-side incentives, supporting infrastructure development.

# 06
## The role of policy in enabling choices

For more than a decade, ExxonMobil has supported an economy-wide price on $CO_2$ as the simplest and most efficient way to reduce greenhouse gas emissions. Sector-based policy options, however, if designed appropriately, could also be an effective way to reduce emissions. To this end, we believe a holistic lower carbon intensity transport policy that combines a market-based, technology neutral fuel standard with a lifecycle vehicle $CO_2$ emission standard could drive emissions reductions from across the entire vehicle fleet. ExxonMobil believes that existing transportation sector-based policies could be improved to achieve meaningful GHG emissions reductions through complementary fuel policy and vehicles standards. This approach would encourage investment in lowering the carbon intensity of fuels (liquid, compressed/liquefied gas, electricity, hydrogen), improving the performance of vehicles on a lifecycle GHG emissions basis, including those upstream of a vehicle's tailpipe. Here are some of the desired features of such policy framework.

### Fuel policy

To encourage investment in technologies to reduce GHG emissions from existing fuel types, ExxonMobil is encouraging policymakers to consider the development of a holistic lifecycle and carbon-intensity based fuel standard. This would be measured in grams of $CO_2$ equivalent per Mega Joule (MJ) of fuel energy (g $CO_2$ e/MJ) that would provide a long-term market signal for the production and use of lower carbon intensity solutions. Such a standard, which could be increased in stringency over time, would establish a market for credit trading that would offer flexibility on compliance mechanisms and underpin investments in technologies to reduce carbon emissions from fuels and from both existing and new vehicles. Canada's Clean Fuels Regulations (CFR) is just one example that has several of the desired features.

> " To encourage investment in technologies to reduce GHG emissions from existing fuel types, ExxonMobil is encouraging policymakers to consider the development of a holistic lifecycle and carbon-intensity based fuel standard. "

Examples of lower carbon intensity fuels that might generate credits under such a standard would include ethanol, biodiesel, renewable diesel, renewable natural gas, hydrogen, electricity produced for EVs, and traditional fuels produced with lower emission technology such as carbon capture and sequestration. Moreover, the standard could be expanded beyond road transportation to the marine and aviation sectors that support multi-modal commercial freight journeys. Some key principles of such a standard are that it:

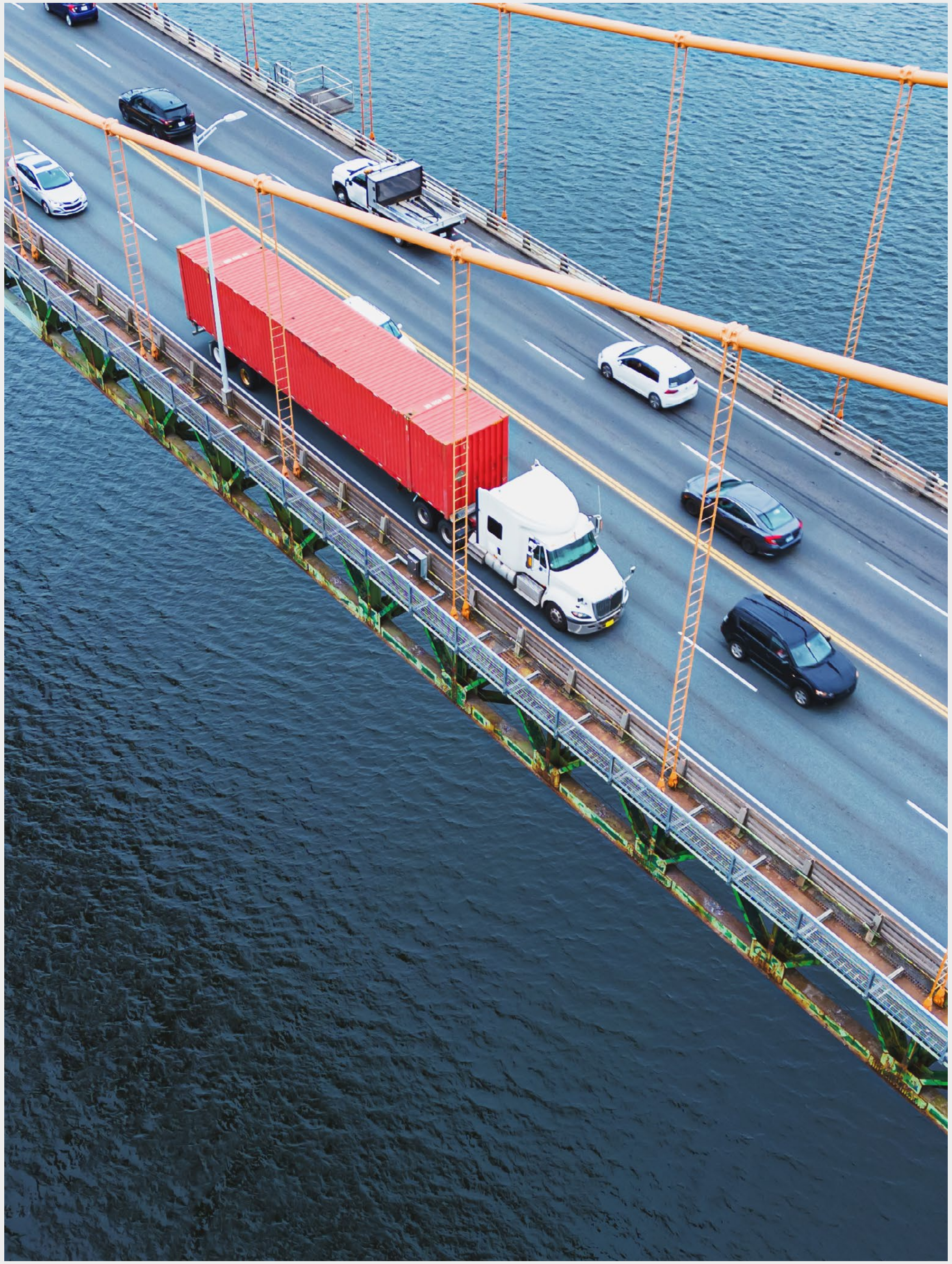
- Supports GHG emissions reductions while preserving consumers' access to affordable and reliable transportation.
- Relies upon credible, and transparent lifecycle assessment to measure GHG emissions reductions throughout the entire lifetime of the fuel and vehicle technology pathway.
- Establishes a clear framework that provides sufficient, long-term certainty to enable investments towards the production of lower emissions fuels and vehicles and avoids conflicts/duplication with other government policies.
- Establishes technology-neutral emissions performance standards and creates an opportunity for market-based solutions and innovations.

> "A lifecycle approach, which accounts for lifetime GHG emissions, allows for a more transparent comparison between the emissions associated with vehicle and fuel types."

## Vehicle standards

In addition, complementary emission standards for new vehicles, based on well-to-wheels lifecycle emissions accounting methodology, would encourage lower $CO_2e$ emissions per mile/km driven ($gCO_2e$/mile or km). Current vehicle GHG emissions standards account only for fuel combustion, or tank to-wheels emissions. A lifecycle approach, which accounts for lifetime GHG emissions, allows for a more transparent comparison between the emissions associated with vehicle and fuel types. Moreover, it enables consistent GHG accounting, and thus provides a more holistic approach toward encouraging advancement in vehicle technologies that can reduce GHG emissions. A lifecycle approach, which accounts for lifetime GHG emissions, allows for a more transparent comparison between the emissions associated with vehicle and fuel types.

Linked fuel and lifecycle vehicle $CO_2$ standards offer a preferred, technology-neutral policy pathway, relative to mandates which force specific technologies. A policy that aims to reduce GHG emissions from existing fuel types and that recognizes lifecycle emissions from new vehicles can help retain consumer choice for the type of vehicle they prefer to drive, would help lessen risks on energy security and supply disruption, would retain jobs throughout the transportation sector, could grow the role of agriculture in providing energy feedstocks, and ultimately, would be supported through a credit-based system, not taxes, whilst delivering emissions reductions in the most rapid and cost effective way.



## Section Two in Brief

**Lowering lifecycle GHG emissions and shifting towards a portfolio of alternative fuels**

- Given the anticipated continuing growth of commercial land transport, and the contribution land transport makes to global emissions, alternative energy pathways need to be developed to reduce emissions.
- These efforts are complementary to the job of improving the efficiency of the existing diesel fleet and solutions identified in Section One.
- A portfolio of transport energy solutions is emerging from bio and renewable fuels to electrified vehicles, renewable natural gas, and hydrogen.
- Commercial fleets will assess these choices through the lens of productivity, efficiency, and sustainability.
- Larger commercial fleets will likely need to avail themselves of a portfolio of solutions to achieve their goals, given the variety of use cases and duty cycles for land transport with different solutions being advantaged at differing points of the duty cycle map and at different stages in infrastructure and maturity development.
- Policy measures could shape the direction and pace of the energy transition in land transport. A lifecycle approach to emissions should be the preferred approach for evaluating energy choices for land transport.

# Biofuels as a portfolio solution for lowering lifecycle GHG emissions from commercial fleets

## 01
## Biofuels demand in land transport is expected to grow

ExxonMobil projects biofuels use will grow in land transport from 2024-2050, as shown in **Figure 27**.[6] Based on fleet research, commissioned by ExxonMobil, awareness around biofuel solutions lags behind other alternatives (see **Figure 28**), and fleet managers are still determining their potential and the distinctions between different propositions. We have found a need for more awareness of these alternatives, and clarification around terminology.

We also see an appetite for education about these choices, and associated benefits and tradeoffs, as well as actual experience of other fleet operators. The rest of this document is focused on addressing these questions.

**Figure 27**
**Projected demand for biofuels in land transport 2024-50**[6]

**Source:** ExxonMobil Global Outlook to 2050

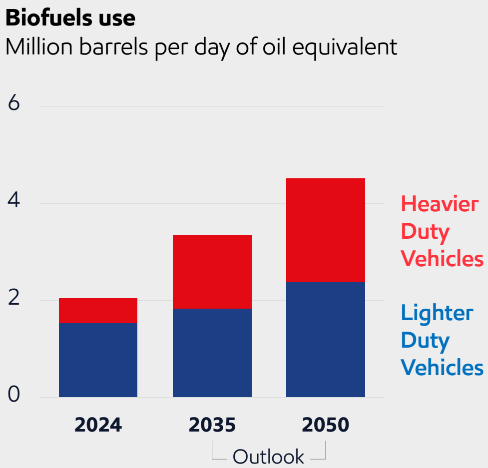
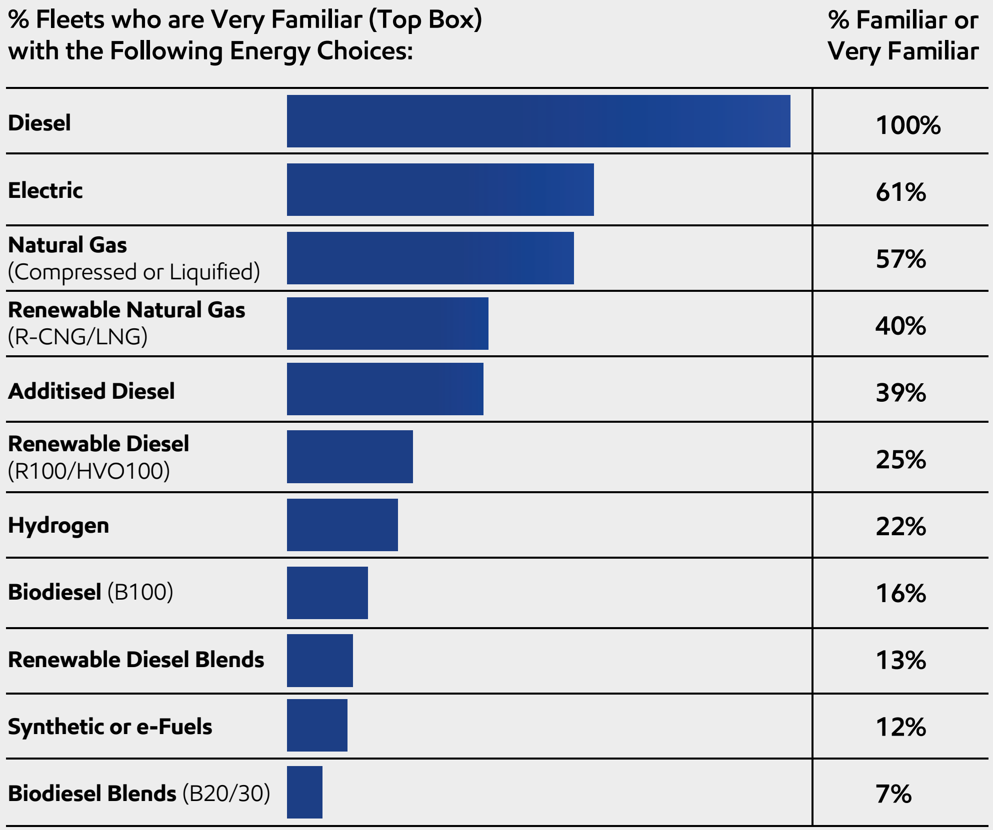



**Figure 28**
**Alternative fuels awareness – managers of medium to large sized heavy-duty fleets**
**(Europe and North America, 1Q26)**[4]




**Source:** ExxonMobil-commissioned research by Frost & Sullivan – Europe and North America Fleets. 1Q26 (N=300).

## 02
## Biofuels are not all the same

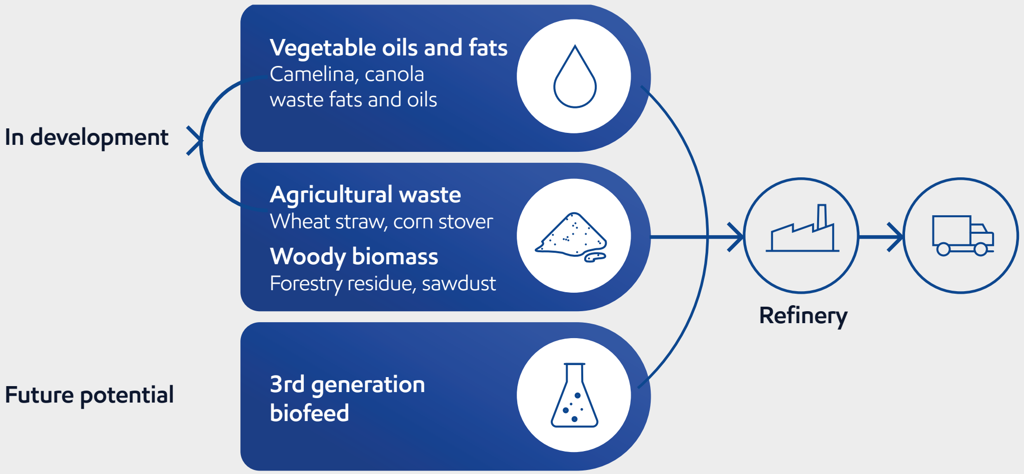
Firstly, and very importantly, not all biofuels are the same, given many variables and associated choices:

- Bio-feedstock.
- Production pathway.
- Carbon intensity (which depends on several factors including the above).

For commercial trucking, there are two main biofuel solutions.

- Biodiesel, also known as Fatty Acid Methyl Ester (FAME). For more details see **Section 4**.
- Renewable diesel, also known as hydrotreated vegetable oil (HVO) and HDRD (Hydrogenation Derived Renewable Diesel). For more details, see **Section 5**.

**Figure 29**
**Feedstock choices to replace crude oil with bio-feeds in lower GHG emission transportation fuels**




**Source:** ExxonMobil illustration.

## 03
## There are different kinds of bio-feedstocks

Biofuels producers are navigating a range of choices around biofeed. Depending on the feedstock chosen, biofuels are sometimes designated as 1st, 2nd, and 3rd generation biofuels.

Illustrations of the potential production pathways are summarized in **Figure 29**. Opening up a wider range of pathways would help mitigate potential shortfalls in supply and/or potential competition for feedstock between heavy land transport and marine / aviation transport.

Policy has a bearing on which pathways are supported in different geographies and/or will influence which are more likely to emerge. There are differences in how policy makers in various jurisdictions categorize and assess different feedstocks, with considerations including sustainability criteria, such as potential implications for both direct and indirect land use change (ILUC).

### a) Edible oils (First generation biofuels)

Edible, primarily vegetable oils, are currently the most abundant oil feedstock available to produce biofuels. The three most abundant edible oils are soy, canola (an edible variant of rapeseed), and palm. Each is developed in different conditions and regions. The crops are grown, harvested, crushed to separate the oil from the solid matter, and pretreated to remove impurities from the oil to improve its quality.

### b) Waste oils & fats (First generation biofuels)

Waste oils are primarily made up of used cooking oil, animal fats, or inedible wastes from the production of other products (e.g. palm oil mill effluent – POME from the production of palm oil, distiller's corn oil from the production of ethanol). As waste products, they have a wide range of impurities and must be pre-treated like edible oils. Because of their diversity, they also offer unique challenges in reaching the qualities desired for processing into fuels. However, products made from these waste oils generally have lower life cycle carbon intensities than products made from edible oils. For example, under the European Union Renewable Energy Directive Annex V, the default GHG emission saving vs conventional diesel for rapeseed biodiesel is 47%, whereas waste cooking oil-based biodiesel has an equivalent default saving of 84%.[27]

Two of the largest categories of waste oils are used cooking oil (UCO) and palm waste (palm fatty acid distillate or PFAD, and palm oil mill effluent or POME). The nature of waste value chains creates a barrier to accessing these feeds. Because waste is inherently a byproduct rather than a primary business, these feeds need to be aggregated by specialty companies. For example, the average US restaurant produces approximately 25 gallons per month[28] of UCO (there are approximately 1M27 US restaurants).

### c) Oilseed cover crops (First generation biofuels)

Cover crops are crops grown between cash crops to help manage soil erosion, soil fertility, soil health, water, weeds, pests, disease, and biodiversity.[29] These include a wide variety of crops, including oilseeds. Unlocking new supplies from oilseed cover crops offers important potential for growing available feedstock for biofuel production. Using cover crops may have agricultural benefits. It can protect and improve the soil during fallow periods.[30] Common practice has been to use non-oil-bearing plants and to plow under the crop when it is time to plant the primary cash crop (sometimes before the cover crop would even reach maturity). Combining the potential agricultural benefits of cover cropping with the production of a lower lifecycle GHG emission fuel feedstock could create conditions for expanding oily cover crops globally,[31] harvesting the oil seeds and plowing in the rest of the crop. These benefits will need to be considered alongside the resources required for additional cropping and policies on oilseed cover crops being accepted or incentivized in respective markets.

### d) Cellulosic feedstock (Second generation biofuels)

Cellulosic feedstocks may offer the largest potential supply of lower carbon intensity feedstock, but likely also present a greater challenge in conversion to liquid hydrocarbon fuels. First, they are low energy density solid materials like municipal solid waste (MSW), agricultural waste (straw, stover, bagasse), and forestry waste (branches and thinnings), which are difficult to move and process in existing assets. Second, they often contain more than 40% oxygen by mass, compared with closer to 10% for oils and 0% for hydrocarbon fuels, which reduces product yields. However, their global supply potential is larger than any other categories discussed previously. This waste needs to be collected and consolidated, so new value chains must be developed to collect and prepare the feedstock to an appropriately homogenized quality that can be converted into fuel. Two exceptions to this are the categories of municipal solid waste and forestry wood pellets. The first is widely collected in much of the developed world, but the degree to which it is sorted is often not sufficient to allow for processing into fuels. Additional municipal waste sorting would be an enabler of production of lower carbon intensity fuels from the organic waste which has been separated out.

The second is waste from the forestry industry, where there is a growing value chain collecting wastes like sawdust, slash (branches left in the field), and thinnings (small trees removed from commercial forests to facilitate growth of other trees). Frameworks are in place to help prevent this value chain from contributing to deforestation, harming biodiversity and ensuring that forestry waste genuinely is unavoidable waste from existing (necessary) activities. These wastes are processed into homogenous chips or pellets and transported globally for heat and power production, but they could also be suitable for conversion to hydrocarbon fuels. While cellulosic feedstock is the most abundant potential feed, it is highly distributed and difficult to move, so local supply may be advantaged. With the expected importance of cellulosic conversion pathways, access to affordable local feed will be important for competitiveness.

### e) Algae and seaweed (3rd generation biofuels)

Algae and seaweed, if they can be produced at commercial scale, are a potential bio-feed to consider as part of the mix of solutions for the longer term.[32]

> "Combining the potential agricultural benefits of cover cropping with the production of a lower lifecycle GHG emission fuel feedstock could create conditions for expanding oily cover crops globally."

## 04

## There are different production pathways

In conjunction with different bio-feedstocks, there are also different production methods. We will cover these in more detail in the following sections on biodiesel and renewable diesel. These pathways influence end product quality, suitability for different applications and carbon intensity.

## 05

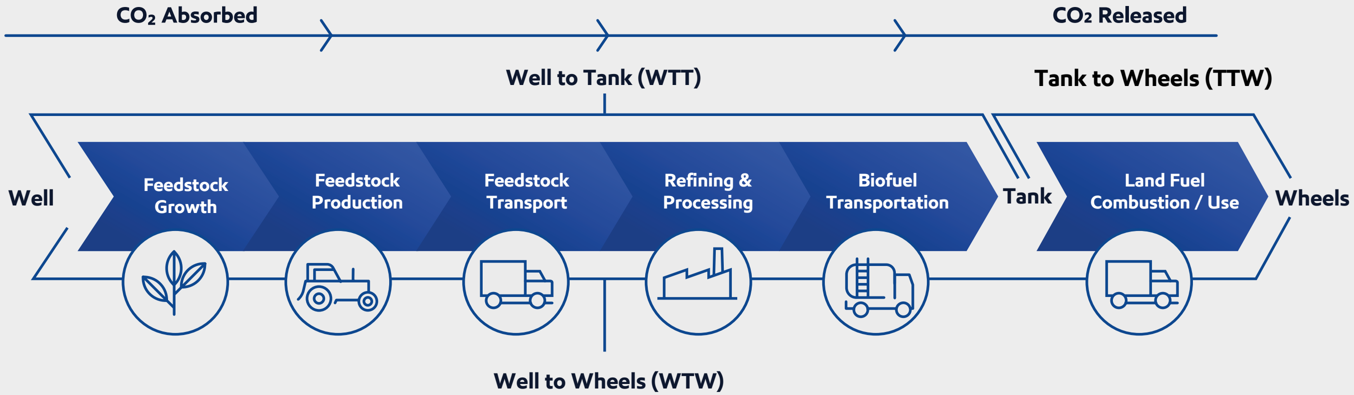
## Regulators have established frameworks for assessing the carbon intensity of biofuels

Increasingly, policymakers are establishing more standardized approaches for the lifecycle assessment of products like biofuels, which account for the GHG emissions along the entire chain, covering sourcing, distribution, and use of the products. Canada's federal Clean Fuel Regulations use an Environment and Climate Change Canada (ECCC) developed LCA model. Canadian provincial systems use the GHGenius Model. In California, California GREET (CA-GREET 3.0) life cycle model is used to calculate estimated GHG emissions for differing transport fuels under California's Low Carbon Fuel Standard (LCFS). The European Union's Renewable Energy Directive includes a WTW formula and some default values for different types of biofuels. **Figure 30** shows in conceptual terms how lifecycle assessment is applied to biofuels.

**Figure 30**
**Lifecycle approach to biofuels emissions**

### Biofuel Lifecycle Assessment

During the biofuels lifecycle, $CO_2$ released in the combustion phase of the product is at least partly abated by absorption in the growth phase, meaning biofuels often have a lower carbon intensity than conventional fuels




**Source:** ExxonMobil illustration.

## 06

## Biofuels are supported by certification agencies and voluntary schemes

Responsible sourcing of bio-feedstocks has an important bearing on the overall societal benefits of biofuels as part of a strategy to reduce lifecycle fleet GHG emissions. Voluntary Sustainability Certification Schemes like the ISCC EU (International Sustainability and Carbon Certification) issue Proof of Sustainability (POS) documentation that verify against the requirements of the Renewable Energy Directive. The POS conveys feedstock information and carbon intensity estimates. There are many sustainability certification schemes that verify against a variety of regulatory or voluntary requirements.

Voluntary assurance schemes like RFAS (The Renewable Fuel Assurance Scheme run by Zemo Partnership, a public-private partnership in the UK) seek to track proof of sustainability of fuels from the point of duty to the end user through multiple distributors and/or blenders.

## Section Three in Brief

**Biofuels as a portfolio solution for lowering lifecycle GHG emissions from commercial fleets**

- Biofuels can play an important role in reducing lifecycle GHG emissions from land transport and demand is expected to grow.
- Different choices of bio-feedstocks are available, from 1st generation crops to cover crops and waste oils, to the emerging potential of cellulosic materials and 3rd generation feeds like algae and seaweed.
- Different feedstocks may require different production pathways.
- Various types of biofuel are available for commercial fleets, with different production pathways and differing levels of carbon intensity.
- The assignment of carbon intensity values of biofuels is also impacted by the models adopted by policymakers in various jurisdictions.
- Certification schemes help document carbon intensity and feedstock origins of different biofuels. Voluntary assurance schemes play an important role in auditing the pass through of biofuels and their associated carbon intensity benefits to end users through a complex supply chain.

Section Four

# Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations

## 01
## What is biodiesel?

Biodiesel is what most people think of when they talk about biofuels for commercial applications. Biodiesel is typically FAME (Fatty Acid Methyl Ester), though less common variants such as fatty acid ethyl ester can also qualify. Biodiesel has been questioned for quality and performance, in part from examples of people "brewing" their own biodiesel in the back garden, something we would not recommend. Modern biodiesel production is significantly more controlled and sophisticated than that. Whilst biodiesel has some apparent constraints, we do believe a portfolio of solutions are needed in order to reduce lifecycle GHG emissions from land transport. Indeed, biodiesel is already being blended into conventional diesel in many markets around the world as part of bio-mandate compliance programs.

**Figure 31**
**End to end biodiesel (FAME) production pathway**

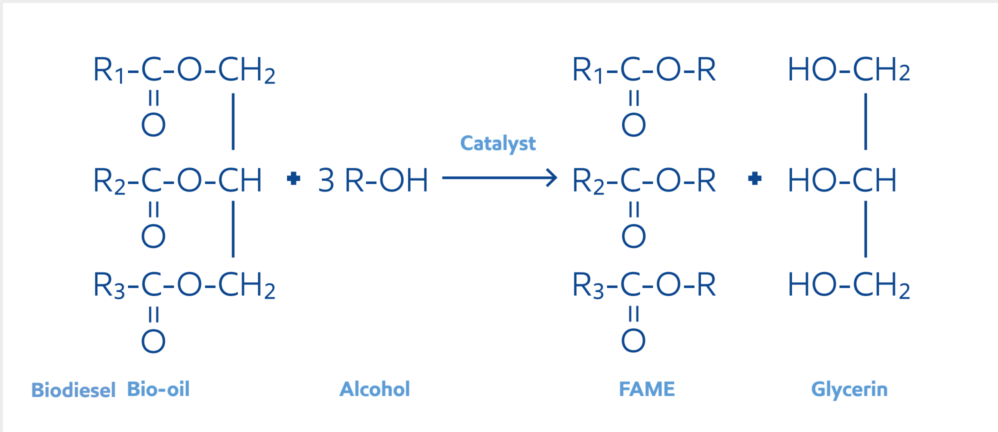
**How is Biodiesel Produced?**


**Source:** ExxonMobil illustration.

## 02
## How is biodiesel produced?

Biodiesel is derived from a variety of feedstocks (see the previous section). In biodiesel production, the feedstock is collected, consolidated, and pre-treated before undergoing an esterification step to produce Fatty Acid Methyl Ester or FAME, which is the generic chemical term for most biodiesel (see **Figure 31**). In the critical transesterification step, triglycerides derived from the feedstock, typically vegetable oils and animal fats, react with short chain alcohol in the presence of a catalyst, usually sodium hydroxide, to produce FAME (see **Figure 32**). Differences in processing and feedstocks result in varying levels of contamination (see below) and different low temperature properties. Biodiesel derived from soybean oil, is most commonly available in the US and is also referred to as SME (Soy Methyl Ester). RME (Rapeseed Methyl Ester) derived from rapeseed oil, is the most common biodiesel blendstock available in Europe. PME (Palm Methyl Ester) derived from palm oil, is the most common biodiesel blendstock available in Asia. FAME is more expensive to produce than conventional diesel due to the typically smaller scale of production and the increased effort of feedstock collation. Unlike conventional diesel, FAME is an oxygenate and this has implications in its application. Because FAME is chemically different from conventional diesel, national and international standards have been developed for biodiesel, as described in the next paragraph.

**Figure 32**
**Transesterification process producing biodiesel from bio-oils. For FAME, R is the methyl group (CH3)**




**Source:** ExxonMobil illustration.

Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations

## 03
## Biodiesel standards

Specifications like EN 14214 in Europe and ASTM D6751 in the US have been defined for biodiesel. These specifications not only establish standards for sulfur content and cold temperature properties (cold filter plugging point and cloud point) but are also designed to control contaminants specific to the biodiesel production process (acid, glycerin content, presence of catalyst, presence of free alcohol and fatty acids), ensuring products blended with biodiesel are fit for use.

## 04
## Biodiesel blending

Biodiesel has a place in the consideration set for commercial fleets. Its use as a blendstock, at least up to 5-7%, is a step adopted in many markets to reduce the carbon intensity of diesel fuel as a class. Pure biodiesel is often referred to as B100. It is typically used as a diesel fuel blendstock for on and off-road applications. Such biodiesel blends are designated as BX, where X represents the percentage by volume of pure biodiesel contained in the blend (e.g., B5, B20). In many markets, the level of bio-mandate targets or carbon intensity targets in low carbon fuel standards heavily incentivize producers to blend biofuels content into the diesel pool.

FAME is a more affordable blendstock than renewable diesel (see following section) and hence is typically adopted earlier than renewable diesel to meet these targets. In most markets, FAME blending is limited to help ensure compatibility with diesel vehicles. National or International standards like EN590 in Europe and ASTM D975 in US typically state an upper limit for FAME content (7% and 5% respectively). France recently changed its national fuel quality law to permit the sale of B10 under the EN16734 standard[33] and the German government followed suit in 2024.[34]

**Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations**

## 05
## Higher biodiesel content blends

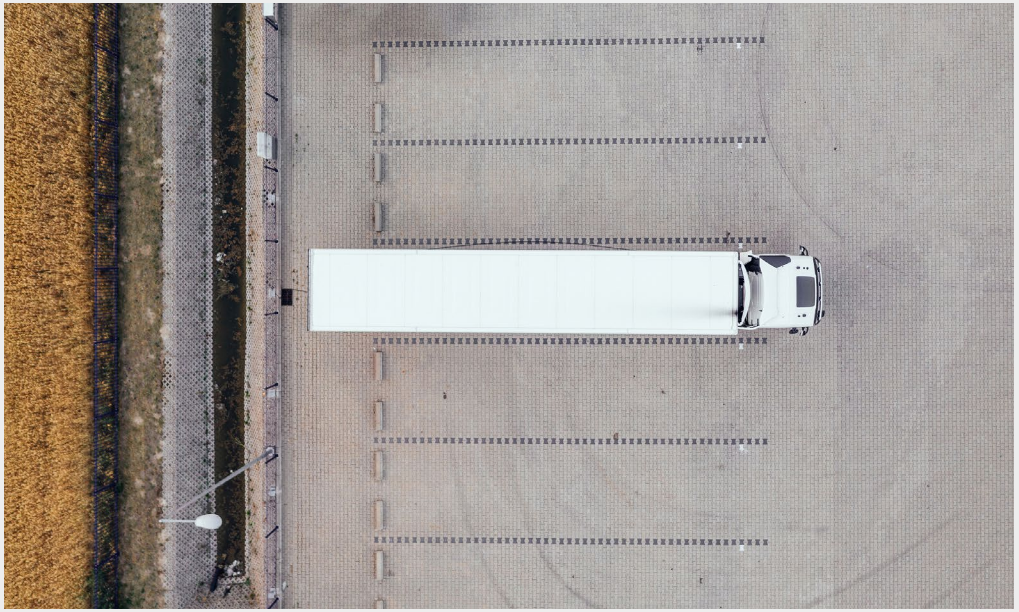
In markets like North America in many states/provinces, higher biodiesel content blends are preferred in warmer months, with use of conventional or lower biodiesel content blends in winter conditions. B5 is blended everywhere that blending facilities exist and in locations where there are incentives/mandates for higher biodiesel content blends (such as California and Illinois), levels up to B20 can be found. B11 is common in Illinois – even during the winter – due to the sales tax exemption for >10% FAME volume diesel.

B20 and B30 blends, where available, are more commonly used in road freight operations. These biodiesel blends are covered by their own specifications, such as ASTM D7467 in the US (B6-B20), CGSB 3.522 (B6-B20) in Canada, and EN 16709 (B20-30) in Europe. In a few markets, like Indonesia, in support of domestic production, governments mandate elevated FAME contents as high as 35-40% with a rise to 50% anticipated.

At FAME contents of B20 and above, particular care is required for storage and handling of the biodiesel product as FAME attracts water. The presence of free water can encourage microbial growth. In research conducted by ExxonMobil, operators have reported operational implications at FAME contents of 20% and above, including filter blocking. The actual experience of fleet operators may depend on factors such as the FAME quality, application, and operating conditions.[35]

Globally, the level of adoption of higher biodiesel content blends is relatively small, and primarily where incentives exist to offset the higher production price, making the product more attractive from a TCO comparison perspective.

Some markets have established specifications for the use of 100% biodiesel in land transport, e.g. EN14214. France has a relatively well-developed B100 market, supported by domestic agriculture and stimulated by local rapeseed methyl ester production. Financial incentives, the local production narrative and favorable treatment in Ultra-Low Emission Zones (ULEZ) under the Crit'Aire certificate system, have helped grow the market with truck manufacturers like Renault, which produce B100-compatible truck models.



## 06
## Advantages of biodiesel

Biodiesel has some advantages for fleets. Firstly, it offers the potential to reduce fleet GHG emissions on a lifecycle basis compared to conventional diesel. The exact emissions reduction potential depends on several factors, including the feedstock and production method. To illustrate the potential difference based on feedstock, the default values in Annex V of the Renewable Energy Directive estimate a 47% reduction in the lifecycle GHG emissions of rapeseed biodiesel and an 84% reduction in lifecycle GHG emissions of waste cooking oil biodiesel compared to conventional transportation fuel.[27] Models and methodologies recognized by policymakers vary and cause the lifecycle GHG emissions estimates to also vary by jurisdiction.

Secondly, biodiesel has good lubricity, offering additional protection against fuel pump wear. This means that ultra-low sulfur diesel blended with 2% or more FAME content typically does not require the addition of lubricity additive to meet the minimum lubricity level for road applications.

**Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations**

# 07

## Biodiesel and tailpipe emissions

The implications of biodiesel for tailpipe emissions are less clear cut. Generally, compared with conventional diesel, B100 reduces engine out particulate emissions, but increases engine-out $NO_x$ emissions.[36]

The EMA (Truck and Engine Manufacturers Association)[37] highlights research indicating that when biodiesel fuel is used in diesel engines not having the latest emission controls, engine-out emissions of particulate matter (PM), hydrocarbons (HC) and carbon monoxide (CO) are less than those from engines using conventional diesel fuel. The studies also show that use of biodiesel fuel blends may increase emissions of nitrogen oxides ($NO_x$) from those same engines. Analyses by the EMA show that $NO_x$ levels vary depending on the biodiesel blend used and the engine duty cycle employed.

The EMA's assessment concludes that any particulate matter, hydrocarbon, and carbon monoxide emission benefits from biodiesel will be significant only for that portion of the existing diesel fleet that is not equipped with exhaust aftertreatment systems. This section of the fleet will be larger in some less-developed countries than in other more advanced markets.

# 08

## Truck and engine manufacturer perspective on biodiesel

Whilst generally accepting of lower levels of FAME blending, engine and truck manufacturers are less supportive of the broad use of elevated biodiesel blends, on balance preferring renewable diesel. Many are happy to support 100% renewable diesel but express concern about biodiesel blends, primarily above B20 and in some cases above B5. We encourage operators to refer to their owner's manual to determine what level of biodiesel-blended product is right for their fleet.

In their position paper[38] on the Renewable Energy Directive Fuels Quality Directive, ACEA, the European Automotive Manufacturers Association, expressed concerns about expanding the availability of B10, citing vehicle compatibility with using B10 diesel as a concern. Instead of B10, they recommended a greater focus on fully compatible drop-in renewable diesel (see Section 5) that can deliver lifecycle greenhouse gas emission reductions and which the whole fleet, old and new, can use.

Engine and truck manufacturers are also concerned about the impact of biodiesel on after treatment device longevity. This is due to trace levels of metals left over from processing and naturally occurring in the feedstocks, such as vegetable oils. In response, ASTM recently approved a new low metals grade of biodiesel with a total 4ppm upper limit for sodium, potassium, calcium, and magnesium, combined.[39]

This is becoming more important as many jurisdictions, for example under the US EPA Clean Trucks Plan,[40] require emissions standards to be met for a longer period of time when these engines operate on the road.

The Truck and Engine Manufacturers Association (EMA), representing world-wide manufacturers of ICE and on-highway medium- and heavy-duty vehicles, recently stated[37] its position that additional performance testing will determine whether fuels with higher biodiesel content are acceptable for use in the new near zero emission engine and aftertreatment systems or if specification changes are required to improve compatibility.

Some engines can tolerate B10-B30 blends. For instance, in 2016, PACCAR endorsed use of B20 in its MX-11 engine and all model years of its MX-13 engine, both legacy models and new equipment. This followed approval in PX-7 and PX-9 engine equipped medium duty truck models. PACCAR diesel engines are sold in heavy-duty trucks under the Kenworth and Peterbilt nameplates in North America. At the time this meant around 1 million Peterbilt and Kenworth medium- and heavy-duty trucks were approved for running B20 biodiesel blends.[41]

And some modern vehicles, such as the latest generation of DAF XF, XG and XG+ trucks,[42] which can be delivered with a specially developed PACCAR MX-13 engine, have been specifically designed to use B100 should the biodiesel option be selected from the truck manufacturer.

Retrofit options also exist to convert existing vehicles to support the use of 100% biodiesel. Optimus Technologies, for instance, offers a hybrid biodiesel-conventional diesel solution featuring an add on biodiesel tank with an in-tank heat exchanger, fuel pick up / return lines, and their Vector manifold unit, featuring a heat exchanger, fuel pump and biodiesel filter and a fuel selector valve.[43] Converted vehicles retain a conventional diesel tank as well as the dedicated biodiesel tank. Using this system, the vehicles can cold-start on diesel before converting to biodiesel once the in-tank heating has the fuel suitable for use. This is designed to address concerns with biodiesel gelling at lower temperatures.

As part of their biodiesel journey, fleets considering using B100 or B10+ blends should check with the manufacturers of vehicles in their specific fleet when making decisions on their fueling choices and fuel choice compatibility.

**Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations**

# 09
## Adapting to the use of biodiesel

The oxygenates and unsaturated molecules in fuels containing higher biodiesel contents (typically B20 and above) have implications for long-term storage stability, especially for product exposed to higher temperatures, due to the risks of polymerization and oxidation. Cold temperature performance is another consideration. FAME typically has poorer low temperature properties than conventional diesel, resulting in an elevated risk of gelling in storage. The oxygenates in FAME also mean it has elevated affinity toward moisture content than conventional diesel. High water content in biodiesel and conventional diesel can cause problems such as water accumulation and microbial growth in fuel tanks and transportation equipment. Together with impurities that can be present in biodiesel, this can give rise to the risk of filter blocking and increased vehicle and storage tank maintenance costs (see **Figure 33**). A by-product of microbial growth is production of acids, which can cause corrosion.

Contamination from unconverted feedstock (incomplete processing), trace chemicals and byproducts from manufacture (e.g., glycerin, soaps), water from the washing process, and naturally occurring impurities such as plant sterols that are carried along with the feedstocks, are largely controlled by B100 specification limits. However, they are an important product quality consideration when choosing a supplier. A premium grade of B100 (also known as "super-FAME") is preferred for truck use in France as this grade has been subject to additional filtration to remove impurities from FAME production. Distillation is another technique used by some FAME producers to remove impurities and is relatively common in North America. Buying from a trusted supplier, with good technical capabilities and product quality standards is crucial.

Users need to elevate housekeeping routines (water draw off and tank cleaning) and potentially use heated tanks with circulation during cold weather. They are encouraged to have their tanks cleaned before switching from conventional diesel.

Similarly, users likely need to reduce drain/service intervals for their vehicles when converting from conventional diesel to a fuel with elevated biodiesel content. Residual fuel system deposits may accumulate in fuel filters due to biodiesel's higher solvency; thus, vehicle filters may also need to be replaced more frequently, at least initially.

Finally, biodiesel has lower fuel efficiency due to reduced energy content vs. conventional diesel. B100 contains about 10% less energy on a volumetric basis compared with conventional diesel. Whilst this scales down for lower biodiesel content blends, this may translate to lower fuel economy and fleets should pilot usage first in their own operations and take this into consideration in final TCO calculations.

**Figure 33**
**Use of biodiesel of inadequate quality in fuel blends can have negative operational implications**

**Potential Issues:**
- Fuel system corrosion.
- Fuel decomposition.
- Filter blocking.

**Potential Implications:**
- Premature fuel filter failure.
- Decreased overall performance.
- Decrease in engine power.

**Source:** ExxonMobil.

Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations

## 10
## The experience of biodiesel users

Experiences from commercial fleets using B100 or B20+ fuels have been mixed. Some fleets who have tried these solutions went on to abandon biodiesel as a solution. For instance, the US Military tried B20 and experienced problems with biodiesel oxidation, low-temperature operability, water separation, microbial growth, and material compatibility.[44] After many years working with B20, they ultimately concluded there were substantial unexpected costs and unintended consequences with B20 use. They indicated a preference for renewable diesel instead.

The US Military was an early user of elevated biodiesel blends and industry quality specifications and practices for biodiesel have matured over time to help address these issues.

On the other hand, Transport for London announced a Biodiesel program in 2015 and by 2017 approximately one third of buses in London were operating on B20.[45]

And commercial freight carriers, like G&D Integrated, a specialized transportation and logistics services provider with more than 450 trucks and 20 facilities in North America announced in 2021 it was running its diesel-powered units year-round on B20.[46]

Restaurant chain McDonald's has also been a visible champion of biodiesel, building circular economy relationships with suppliers and haulers, incorporating the collection and processing of used cooking oil from its chain. For instance, McDonald's UK aims to reach net zero emissions by 2040 for their entire business and value chain. McDonald's has used its own used cooking oil as a feedstock for biodiesel production, collaborating with its hauler Martin Brower, to run many McDonald's branded trucks on biodiesel since 2007. According to its Corporate Social Responsibility Report, Martin Brower has over 100 trucks operating in France with B100 and its entire United Arab Emirates operation has shifted over to B100.[47]

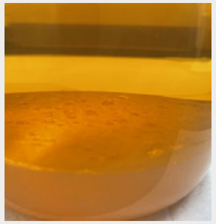
Beyond buses and commercial trucking, train operating companies are also exploring biodiesel. For instance, in 2021, SNCF announced a pilot of B100 (RME) made in France on 15 Regiolis trains on the Paris-Granville line. They declared the results conclusive and in July 2022 the Normandy Regional Council approved the continued use of this product.[48]

So, fleets in a number of countries have shown that using biodiesel at blend rates of B20 and above, up to and including B100, is possible but it is evident that the quality of biodiesel used is critical, housekeeping disciplines for storage are essential, and vehicle compatibility requires close scrutiny.

**Figure 34**
**Benefits of Esso Diesel Efficient™ B20 fuels technology in reducing microbial growth in B20 fuels***

**ExxonMobil's proprietary additive technology mitigates the growth of microbial growth in B20 Fuels**

**Unadditized B20**
**Week 11**
mold widely distributed



**Esso Diesel Efficient™ B20**
**Week 11**
flat interphase, clear fuel

* Microbial growth performance demonstrated with first generation Diesel Efficient™ technology.

**Source:** ExxonMobil Research.

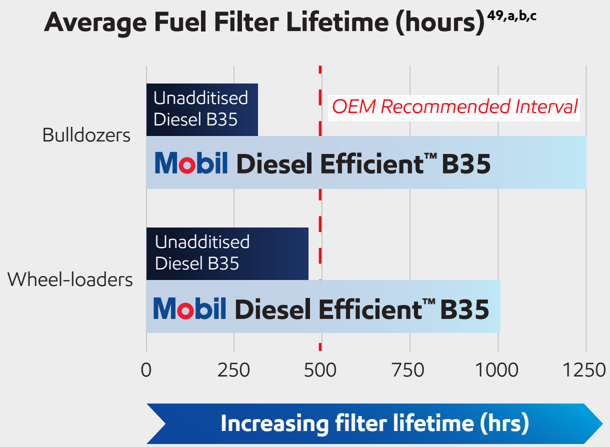
# 11
## The benefits of performance additive technology in biodiesel

Some of the challenges associated with biodiesel blends can be addressed with additive technology. As with conventional diesel, deposits build up in injection systems using biodiesel blends without detergent additive technology, impacting fuel efficiency and engine out emissions (including $NO_x$ & particulates) over time. The right detergent-based technology can help clean up these deposits, ensuring high pressure, precision direct injection systems operate as they should and optimizing fuel efficiency performance vs unadditized B20.[49]

ExxonMobil also demonstrated incremental benefits from its first generation performance additive technology for storage stability, water handling, reducing microbial growth (see **Figure 34**) and reducing filter blocking vs unadditized B20. Consequently, ExxonMobil is supplying Esso or Mobil branded Biodiesel Efficient™ B20 fuel at select terminals in North America to help meet the needs of strategic customers, incorporating the performance additive technology which underpins its global Esso, Mobil and Exxon branded Diesel Efficient™ fuel product line.

In Indonesia, which with government bio-mandates operates at 40% biodiesel contents, in sectors like mining, Mobil Diesel Efficient technology has successfully demonstrated capability of extending filter life and thereby increasing uptime of mobile equipment like bulldozers and wheel loaders (see **Figure 35**).[49]

**Figure 35**




Based on 1st generation technology.

a) Mobil Diesel Efficient™ B35 fuel claims are based on internal and third-party vehicle engine testing, laboratory testing and/or industry or other scientific literature. Basis of comparison for all claims is versus unadditised Mobil Diesel B35 in Indonesia. Vehicle type, engine type, driving behaviour and other factors may impact actual results. Mobil Diesel Efficient fuel may be used in other heavy equipment, but results may vary.

b) This Proof of Performance is based on the experience of a single customer who used Mobil Diesel Efficient B35 for approximately 2000 operating hours in wheel-loaders and approximately 3500 operating hours in bulldozers, after baseline monitoring of approximately 2000 operating hours using unadditised Mobil Diesel B35. Trial was performed in Indonesia, with a major mining operator across 6 mining vehicles. Actual results can vary depending on factors such as type of operation, vehicle, engine, driving conditions, driving behavior and fuel previously used.

c) Based on extrapolation of test data, reduced downtime for filter changes would correspond to an estimate of up to +24 hours/year per bulldozer.

## Section Four in Brief

**Biodiesel has a role to play in reducing lifecycle GHG emissions from commercial fleets, with some limitations**

- Biodiesel (technically FAME) has a role to play as part of reducing lifecycle GHG emissions from commercial fleets, representing a lower capital investment pathway, relative to many other alternatives, and more frequently deployed by industry to date.
- These solutions continue to have their place in the transport energy portfolio but are reaching blend limitations.
- Blending of biodiesel in conventional diesel at up to 5-7% by volume has been shown to be suitable for most applications without significant compromise.
- Blends with elevated biodiesel content, such as B20, can be used in compatible vehicles. Fleet managers must weigh several factors before proceeding with such blends for the first time and they must be integrated into overall TCO assessments. We recommend the use of the right performance additive technology as part of a fleet's operational strategy to support engine cleanliness and mitigate issues associated with biodiesel use.
- Some commercial operators may feel neat biodiesel, B100, has its place in their strategy portfolio. This requires significant thought, careful piloting and consideration of the overall costs and benefits.
- Biodiesel-containing products such as B20 and B100 can contribute to lower lifecycle GHG emissions, but implications for fleet efficiency and productivity are important considerations and not all fleets will reach the same conclusions. A trusted supplier, with a relentless focus on product quality, is critical. Also crucial is operational commitment to manage biodiesel introduction carefully, allied with the right housekeeping and optimized servicing regimes.

Section Five

# Renewable diesel is a potential solution for reductions in lifecycle GHG emissions from commercial fleets with fewer compromises

## 01
## What is renewable diesel?

Renewable diesel is an alternative biofuel for land transportation that offers comparable lifecycle emissions reductions compared to conventional diesel without some of the potential operational compromises associated with biodiesel. We see this product continuing to grow in commercial land transport and offering an attractive pathway for fleets who wish to reduce their carbon footprints ahead of, or in line with, legislative timetables.

Renewable diesel, while made from bio-feedstocks, undergoes a completely different transformation process to that involved in biodiesel production.

Chemically, renewable diesel is similar to conventional diesel but with a lower aromatic content. Critically, production largely eliminates the oxygenates, which drive many of the challenges of biodiesel. So renewable diesel can be used as a drop-in fuel, even in neat form in many vehicles. It has high storage stability and, depending on the production pathway, can offer the potential for great low temperature performance.

## 02
## Renewable diesel production

There are different potential pathways to renewable diesel production. The most common pathway, driving production scaling today, is through hydro-processing of the bio-feeds, which come from similar sources to biodiesel.

### a) Hydro-Processing Path to Renewable Diesel

This is known as renewable diesel but is also referred to as HDRD (Hydrogenation-Derived Renewable Diesel) in North America, and HVO (Hydrogenated Vegetable Oil) in Europe. In Asia, the terms renewable diesel and HVO are becoming more recognized. Three key processes (decarboxylation, decarbonylation and hydrodeoxygenation) combine to convert the feedstocks. Dependent on the exact production methods deployed, the hydro processing pathway (see **Figures 36**[50] and **37**) can produce a paraffinic, high cetane hydrocarbon diesel, typically with excellent stability and flexible cold flow properties. That being said, renewable diesel producers have different capabilities and some differences in the processes they adopt. Not all renewable diesel is produced to optimize cold flow performance or fractionated to the same degree.

Investment in biofuels is growing and shifting to hydro-treating / HEFA (Hydrotreated Esterified Fatty Acids) pathways to produce renewable diesel (RD) and sustainable aviation fuel (SAF). While more capital intensive, the resultant renewable diesel can be used as a higher percentage blend stock or in neat 100% renewable diesel form. This opens a route for further lifecycle GHG emissions reduction potential versus conventional diesel in existing vehicles (see later in this section).

### b) Co-Processing

Another pathway for renewable diesel production is co-processing. It is the simultaneous transformation of renewable feedstocks with conventional crude-derived streams through manufacturing process units to produce intermediate or final products with renewable content. This can represent an effective option to drive the societal ambition of lowering greenhouse gas emissions.

Co-processing at existing facilities has benefits versus standalone production, allowing existing facilities to produce volumes of product with renewable content at the scale and potential speed needed to support society's growing ambitions. In this pathway a proportion of end distillate production can be designated as renewable diesel.

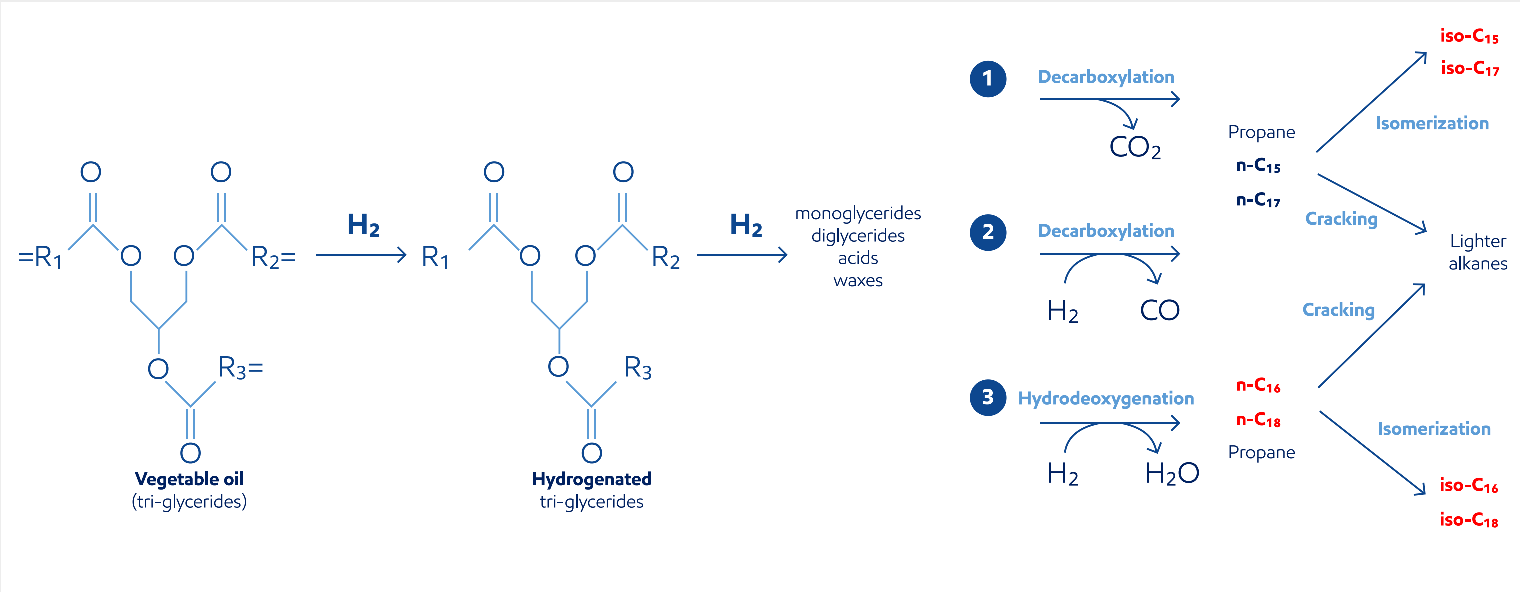
Co-processing depends on policy and prevailing regulatory frameworks. Policymakers have a role in defining the methodologies and protocols governing renewable diesel designation and carbon intensity/footprint value of co processed product. These guidelines must be lifecycle based, technology neutral, practical to implement, and science-based.

Amongst the benefits of co-processing, is that it allows increased supply of renewable fuels at lower levels of investment in pre-existing facilities.

ExxonMobil is already working to adopt this pathway. In Canada, for instance, Imperial Oil (an ExxonMobil majority-owned affiliate) has successfully piloted co-processing[51] at its refineries, using bio feedstock alongside conventional feed to produce co-processed commercial fuels.

## Figure 36
### Molecular redesign to produce renewable diesel via hydrotreating[49]

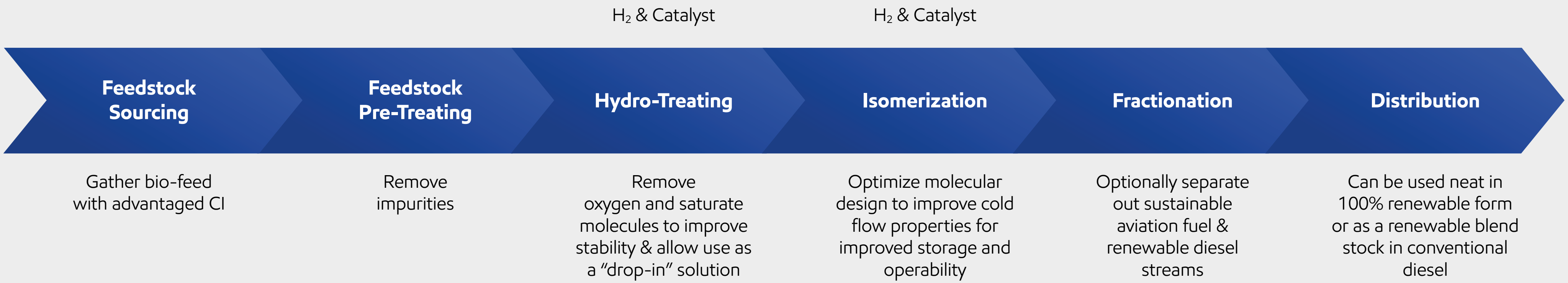
- The most common way to produce renewable diesel is hydro-treating or hydro-processing.
- **Hydro-processing** saturates double bonds & removes oxygen from the tri-gylcerides in vegetable oil, the most common feedstock.
- It does this via three key pathways, **decarboylation, decarbonylation & hydrodeoxygenation**.




**Source:** Illustration derived from Huber et al 2007.[45]

## Figure 37
### Simplified renewable diesel production process flow (bio-feed hydro-processing pathway)

**How is Renewable Diesel Produced?**




**Source:** ExxonMobil illustration.

### c) Biomass Gasification

Whilst not in scale production today, another emerging future pathway to renewable diesel is biomass gasification. This is a process that converts biomass into syngas (a mixture of carbon monoxide and hydrogen). This is achieved by reacting the feedstock material at high temperatures (typically >700° C), without combustion, controlling the presence of oxygen and/or steam in the reaction. Syngas can be turned into synthetic liquid hydrocarbon fuels, via the Fischer Tropsch process. When this process is incorporated with carbon capture and storage (CCS), the lifecycle carbon intensity of the renewable diesel produced is very attractive (and can even potentially result in negative WTW GHG emissions, i.e. removing more $CO_2$ from the atmosphere than is produced upon combustion).[52] Gasification with CCS is an example of BECCS (Bioenergy with carbon capture and sequestration).

Whilst more energy intensive than existing hydro-processing pathways, one of the benefits of gasification is it reduces reliance on first generation bio-feeds and opens up second generation cellulosic materials (see Section 3, sub-section 3d). Furthermore, as noted above, it has the potential to achieve negative WTW GHG emission pathways that could further help societal GHG emission reduction ambitions.

More capital intense pathways like BECCS are expected to come to market slower and later than HEFA pathways but likely to become attractive based on lower effective feedstock costs and higher $CO_2$ abated so, over time, a much bigger role for gasification is anticipated, depending on supportive regulatory developments.

### d) Pyrolysis

One additional process that looks attractive longer-term is pyrolysis. In this process, biomass is heated rapidly at high temperatures (500-700C) in an oxygen-free environment. Vapors are cooled and condensed into a liquid pyrolysis oil (also known as Bio-Pyoil), which can be used to produce renewable fuels.

# 03
## Growth of renewable diesel

Renewable diesel production capacity growth to date has primarily followed the hydro-processing pathway. As production scales, renewable diesel availability has grown, enabling commercial sales of renewable diesel blends or 100% renewable diesel (also known as R100 or HVO100) for off- and on-road applications via in-yard and retail/truck stop channels. In the Netherlands there are now over 100 public access stations[53] selling renewable diesel.

In California, supported by incentives and the Californian LCFS standard, the renewable diesel network has grown fast and is now over a 1,000 stations strong.[54] Unlike in the Netherlands and California, in some markets, regulators have historically restricted the sale of renewable diesel. As confidence in renewable diesel as a solution grows, these restrictions are easing. The use of renewable diesel in Germany, for example, in commercial fleets was restricted until recently for testing purposes. However, in March 2024, The German Bundesrat amended regulations to allow HVO100 sales and the HVO100 refueling network has been growing.[34] Similarly, effective Oct 1st 2024, the French government also withdrew restrictions which until then had restricted sale of HVO100 to captive fleets.[34]

Renewable diesel is an emerging solution for reductions in lifecycle GHG emissions from commercial fleets with fewer compromises

# 04
## Renewable diesel production, a case study – Strathcona

Recognizing the need for solutions for reducing GHG emissions in heavy transportation in Canada, Imperial Oil, an ExxonMobil majority-owned affiliate, started up in 2025 a renewable diesel facility at its Strathcona refinery in Alberta. Imperial's renewable diesel production leverages bio-feedstocks such as canola oil sourced from Canadian suppliers. The facility is now supplying customers in western Canada and Imperial operations in northern Alberta.[55] Not all renewable diesel is the same. ExxonMobil's proprietary catalyst technology is being used to optimize yields and deliver excellent cold temperature properties. **Esso and Mobil Ethos+™ Renewable Diesel** also features the proprietary performance additive technology in our Esso, Exxon, or Mobil branded Diesel Efficient fuel.

### Strathcona Refinery renewable diesel project

# 05
## Renewable diesel specifications

Unlike for biodiesel, in North America there is currently no separate renewable diesel specification. Renewable diesel must meet the diesel specification of ASTM D975 (US) or CAN/CGSB 3.517 (Canada).

These specifications were not designed with renewable diesel in mind — however, due to the hydrocarbon chemistry of renewable diesel, they have generally been found to be adequate. Any renewable diesel (or blends) sold in North America must, at a minimum, meet their requirements.

By contrast, in Europe, EN 15940, a paraffinic diesel specification, has been established, which defines the quality requirements of renewable diesel and other paraffinic fuels such as Gas-to-Liquid (GTL) diesel. Similar to North America, blends containing conventional and renewable diesel are covered by the prevailing diesel specification, EN 590, though EN 590 is more restrictive for renewable diesel content than the North American equivalents due to its minimum density specification.

In 2025, Australia has recently introduced a new paraffinic diesel specification.[56]

## Section Five

**Renewable diesel is an emerging solution for reductions in lifecycle GHG emissions from commercial fleets with fewer compromises**

# 06

## Feedstocks and carbon intensity of renewable diesel

As with biodiesel, the carbon intensity of renewable diesel depends on the feedstock, its source, the transportation of feedstock, the production process, and the transportation of the finished product. Models, such as Argonne National Laboratory's GREET model, help guide calculation of estimated renewable diesel carbon intensity based on feedstock and pathway.[57]

Production from non-edible, waste-based feedstocks including used cooking oil, typically offer lower carbon intensities relative to production from other feedstocks. Calculations and estimates vary between models and across jurisdictions but, by way of illustration, EU's RED III (Renewable Energy Directive III) assigns to renewable diesel from used cooking oil a default carbon intensity reduction vs conventional diesel of 83%.[27]

The carbon intensity of renewable diesel is dependent upon production pathways. Lower carbon intensities can be achieved when using lower GHG emission H2 in hydrotreating or gasification pathways and/or using gasification pathways in conjunction with CCS.[57,58]

# 07

## Renewable diesel and tailpipe criteria pollutant emissions

Research by CARB highlighted that renewable diesel fuel's high cetane number and low aromatic content can result in lower $NO_x$ emission levels for pre 2010 on-highway and pre-Tier 4 non-road engines compared with those from conventional diesel fuels.[36,37] South-West Research Institute (SWRI) reported in 2023 that 100% renewable diesel fuels significantly reduced soot loading rates on the Diesel Particulate Filter (DPF). They highlighted that this would likely lead in turn to a lower active regeneration frequency for the DPF under part-load transient duty cycles, the implication being less fuel consumption associated with active regeneration, and possibly improved durability of the downstream SCR system due to less high temperature exposure.[59]

# 08

## Renewable diesel blends

Bio-mandates in Europe, and low carbon fuel standards in California, Washington, Oregon, New Mexico and Canada mean that renewable diesel is being used as a blend stock for compliance purposes in many markets.

For end customers renewable diesel blends may offer an attractive pathway to fleets looking to lower their operational carbon intensity. In North America, the percentage of renewable diesel blended into conventional diesel is recognized by the naming convention RX, where X represents the volume percentage of the renewable diesel that has been blended. Accordingly, R30 represents a 30% by volume blend of renewable diesel in conventional diesel.

In Europe, where renewable diesel is also referred to as HVO (Hydrotreated Vegetable Oil), the product is more typically classified as HVOX, for example HVO30, a 30% by volume blend of renewable diesel in conventional diesel. Asia Pacific typically follows the North America convention.

The density of renewable diesel in Europe is typically around 780 kg/m$^3$ and hence lower than allowed in the EN590 diesel fuel specification. Accordingly, this may limit the percentage of renewable diesel, which can be blended to around 30% or less. This is dependent on the actual density of the conventional diesel used, if the resultant blend is to meet the higher EN590 minimum density specification.

In addition to its production plans in Canada, ExxonMobil currently offers branded renewable diesel offers in several markets globally, across Europe and Asia Pacific, in collaboration with key customers (see **Figure 38**). Look out for our Esso and Mobil Ethos+™ Renewable Diesel products.

**Figure 38**

**Examples of renewable diesel product deployments by ExxonMobil affiliates & brand partners globally**


Product availability as of April 2026 except as otherwise noted. GHG emission reductions vary by product. Find more information on your regional Esso/Mobil website.

* For commercial in-yard offer only.

In North America, the percentage of renewable diesel blended into conventional diesel is recognized by the naming convention RX, where X represents the volume percentage of the renewable diesel that has been blended. Accordingly, R20 represent a 20% by volume blend of renewable diesel in conventional diesel. In Europe, where renewable diesel is also referred to as HVO (Hydrotreated Vegetable Oil), the product is more typically classified as HVOx, for example HVO30, a 30% by volume blend of renewable diesel in conventional diesel. Asia Pacific typically follows the North America convention.

**Source:** ExxonMobil.

# Ethos+™ Renewable Diesel introduction

Esso Ethos™ Renewable Diesel | Exxon Ethos™ Renewable Diesel | Mobil Ethos™ Renewable Diesel

At ExxonMobil we understand the important role of land transportation in helping people and goods move from A to B efficiently and reliably. We also recognise that an increasing number of our customers are ready to contribute to a lower emissions future.

Renewable diesel (HVO), is an attractive immediate pathway to help fleets achieve lifecycle GHG emissions reductions[b] compared to conventional diesel while meeting operational performance criteria.

"Ethos" reflects our belief that our renewable diesel containing product solutions is an important forward-looking addition to our diesel portfolio, combining the quality and performance[d] of Exxon/Mobil/Esso brands` diesel heritage with the added potential for lifecycle GHG emissions reduction[b].

The + in the name refers to the formulation of this product with proprietary Synergy™ additive technology. Ethos+™ fuel offers engine protection and cleaning power to help deliver the reliability and efficiency busy drivers and fleets need.[d]

**Ethos+™ Renewable Diesel R100 is a high-quality diesel fuel made with 100% renewable content and features proprietary Synergy™ additive technology, engineered to help protect and clean engines.[d]**


### Case studies – transition to Ethos+™ Renewable Diesel R100[a]

#### Impact

The introduction of and transition to Esso Ethos+™ HVO100 were seamless for the distributors and their customers, who reported no issues when switching.[c]

Customers also appreciated the distributors' own dedication and supply of a reliable fuel to help lower lifecycle GHG emissions.[b]

The strength and familiarity of the Esso brand name ensured smooth and confident adoption of the new product.


## Why consider the switch?

- No engine modifications[c] or upfront capital investment
- Lower lifecycle GHG emissions compared to conventional diesel[b]
- Offers engine protection and cleaning power featuring proprietary Synergy™ additive technology[d]
- Can be used during the wintertime[e]

"We have received very good feedback from our customers who are very satisfied that they have had no problems switching to Esso Ethos+™ HVO100 at all."

**CEO, Distributor, Belgium[a]**

"We can't afford to change our fleet or switch to vehicles that are restricted to a single type of fuel. Moreover, EVs can't be used to transport hazardous products. Esso Ethos™ Renewable Diesel HVO100 can be used as an immediate replacement to conventional diesel. This makes it the optimum solution to meet both our safety constraints and GHG emissions reduction ambitions.

Today 80% of our fleet runs on HVO100 and we plan to reach 100% soon. I have no hesitation in recommending HVO100. It's a straightforward, flexible solution that in our experience doesn't compromise efficiency or reliability."

**Deputy Director, Petroleum Distributor, France[a]**

a. Testimonials in the case studies are by real customers of ExxonMobil. ExxonMobil makes no representation that your experience will be similar or identical to that of the customers in this testimonial. Actual results may depend on factors such as equipment used, its maintenance, operating conditions and fuel previously used.
b. Estimated (est.) minimum lifecycle greenhouse gas (GHG) emissions savings of 85% compared to a 100% fossil fuel comparator (B0) of 94g $CO_2e$/MJ energy as per Directive (EU) 2023/2413 ("RED III"), amending Directive (EU) 2018/2001 ("RED II"), including Annex V. Weighted average GHG emissions savings were calculated by the HVO supplier/producer or its aRliates, and provided to ExxonMobil and its aRliates by the supplier/producer proof of sustainability. Actual GHG emissions saving of final product may vary.
c. Esso Ethos+™ Renewable Diesel HVO100 is a drop-in fuel suitable for use in diesel engines certified to use CAN/CGSB 3.520, ASTM D975 and EN15940 specifications fuel. It is suitable for all vehicles marked as compatible with XTL fuel. Verify fuel compatibility with your vehicle owner's manual or by contacting your vehicle manufacturer.
d. The + in Mobil/Esso Ethos+™ Renewable Diesel HVO100 refers to the formulation of this production with proprietary additive technology, offering protection and cleaning power to protect your engine. Benefits apply to Mobil/Esso Ethos+™ Renewable Diesel HVO100 fuel compared to fuel without detergent additive with the same level of renewable content. Actual benefits will vary depending on factors such as vehicle/engine type, driving style, diesel fuel previously used, and other factors. Concentration and availability of our proprietary additive package may vary. Product offerings and availability vary per region.
e. Cold flow operability of renewable diesel is processing dependent. Always check that the properties of renewable diesel meet seasonal temperature requirements as purchased.

# Case study – transition to Ethos+™ Renewable Diesel R20[a]

Esso Ethos™ Renewable Diesel | Exxon Ethos™ Renewable Diesel | Mobil Ethos™ Renewable Diesel

- Is made with a minimum 20% renewable content
- Helps deliver an estimated 15.4% lower lifecycle GHG emissions vs. conventional diesel[b]
- Confirmed that it could be used in diesel engines without modification[c]
- Customer reports[a] the product has performed on par with, or better than, traditional diesel, with no loss in efficiency or reliability. The fuel's cleaning properties have contributed to cleaner engine operation[d]


## Situation

A major fuel and lubricants distributor, operating a fleet of over 140 vehicles, was seeking lower- emission solutions to help support New Zealand's future energy needs. The company required a fuel compatible with its existing fleet that would help ensure supply reliability and have limited impact on vehicle performance or maintenance.

## Solution

To meet these needs, the Mobil Oil New Zealand team recommended Mobil Ethos+™ Renewable Diesel R20. Made with a minimum 20% renewable content refined from used cooking oil, the fuel helps deliver an estimated 15.4%[b] lower life cycle greenhouse gas (GHG) emissions compared to conventional diesel. It also features proprietary Esso Synergy™ additive technology, engineered to help protect and clean engines.[d]

After controlled trials confirmed the fuel's compatibility with their modern diesel engines and a consistent, certified supply,[e] the company began a pilot program. This allowed them to carefully monitor fuel performance, driver feedback, and maintenance data before wider adoption.

## Impact

The customer reported[a] the transition was straightforward, requiring no engine modifications[c] or additional infrastructure. The feedback has been overwhelmingly positive, with the customer also reporting Mobil Ethos+™ Renewable Diesel R20 has performed[d] on par with, or better than, traditional diesel, with no loss in efficiency or reliability, and the fuel's cleaning properties have contributed to cleaner engine operation.

> Mobil Ethos+™ Renewable Diesel R20 offers a practical and effective way to reduce GHG emissions without compromising on performance or reliability. Based on the trial's success, we've expanded R20 use across more of our fleet.

**General Manager, Distributor, New Zealand[a]**

a. Testimonial in this case study is by a real customer of ExxonMobil. ExxonMobil makes no representation that your experience will be similar or identical to that of the customer in this testimonial. Actual results may depend on factors such as equipment used, its maintenance, operating conditions and fuel previously used.

b. The estimated reduction in life cycle greenhouse gas emissions, also referred to as Carbon Intensity (CI), is based on a comparison of Esso Renewable Diesel R20 to conventional diesel using the United States GREET 2023 model estimates to compare the life cycle emissions of each fuel. Actual results may vary.

c. Esso Ethos+™ Renewable Diesel R20 is a drop-in replacement for conventional diesel that meets EN590 specification requirements and is suitable for all diesel engines. Verify fuel compatibility with your vehicle owner's manual or by contacting your vehicle manufacturer.

d. The + in Mobil/Esso Ethos+™ Renewable Diesel R20 refers to the formulation of this production with proprietary additive technology, offering protection and cleaning power to protect your engine. Benefits apply to Mobil/Esso Ethos+™ Renewable Diesel R20 fuel compared to fuel without detergent additive with the same level of renewable content. Actual benefits will vary depending on factors such as vehicle/engine type, driving style, diesel fuel previously used, and other factors. Concentration and availability of our proprietary additive package may vary. Product offerings and availability vary per region.

e. Mobil Oil New Zealand Limited is certified under the ISCC EU Scheme. Refer to ISCC website: www.iscc-system.org

## 09
## The vehicle and engine manufacturer perspective on using 100% renewable diesel

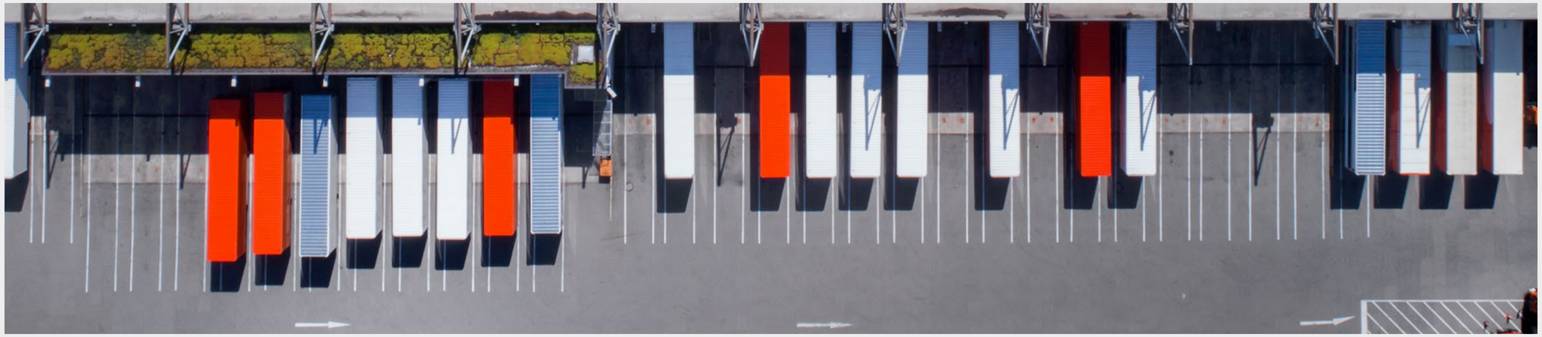
Its molecular make up means 100% renewable diesel (R100) is a superior product for use in modern trucks vs. 100% biodiesel (B100) and many engine and vehicle manufacturers support R100 use in regular production engines. In 2016 and 2017, Cummins, for instance, confirmed the compatibility of 100% renewable diesel meeting EN15940 with Euro VI engine technology (Cummins F3.8, B4.5, B6.7 and L9 engines) after an extensive test program running on 100% HVO renewable diesel meeting EN15940. This was followed by approval in August 2023 of use of R100 in all its larger industrial high-horsepower engines.[60] Also in 2016, Mercedes-Benz Trucks approved the use of renewable diesel (HVO) in the US for trucks fitted with its in-line six-cylinder engine variants of the Mercedes-Benz OM 470, OM 471 (first generation) and OM 936 as well as the in-line four-cylinder variants of the OM 934 meeting the Euro VI emissions standard.[61] In 2015 Volvo Trucks North America approved the use of renewable diesel in all their proprietary engines and more recently announced the use of renewable diesel as factory fill in their diesel-powered trucks. In Europe in 2015, after significant testing, Volvo certified all its Euro V engines for use with renewable diesel, and EN15940 HVO100 is certified for all new Euro VI Volvo truck engines with no engine issues or service interval changes.[62]

In 2015, heavy-duty truck and bus manufacturer Scania approved the use of renewable diesel, or hydrotreated vegetable oil (HVO), in its Euro 6 range provided it meets technical specification EN15940.[63] ACEA, representing European vehicle manufacturers, is more favorable of renewable diesel than biodiesel.[64] The international Truck and Engine Manufacturers Association (EMA) acknowledges that renewable diesel fuels "show great promise". It highlights similarity to conventional petroleum-based diesel fuel, eliminating certain concerns with biodiesel. and renewable diesel properties such as high cetane and low aromatic content that may be advantageous.[65] A more comprehensive list of compatibility of various models with renewable diesel can be found in the Appendix. We recommend that you verify fuel compatibility with your vehicle owner's manual or by contacting your vehicle manufacturer.

## 10
## Other considerations in using renewable diesel

European renewable diesel meeting EN 15940 has a lower density and slightly lower volumetric energy content compared to conventional diesel, so some fleets may see a small reduction in fuel efficiency, likely to be imperceptible in blends, but potentially noticeable when using R100. Relative to biodiesel, the main challenge renewable diesel may face is cost. Even for a relatively small production capacity, renewable diesel production start-up requires more capital investment than bringing biodiesel production on-stream. Even absent of investment cost, renewable diesel is more expensive than biodiesel given the extra processing steps.

However, in many markets, bio-mandates, low carbon fuel standard credits and other regulatory incentives make renewable diesel a more attractive commercial proposition. Given it is suitable for use in most modern diesel vehicles, without a need to make fleet or storage adaptations or reduce vehicle service intervals, renewable diesel can be an attractive proposition with minimal operational impacts. It offers the potential for reduction in lifecycle GHG emissions (see 6 above) versus conventional diesel whilst leveraging existing infrastructure. It also offers potential as a flexible turn-key solution for use in trucks for specific end customers with more ambitious plans to reduce lifecycle GHG emissions. This is a significant factor amongst early adopters.



**Renewable diesel is an emerging solution for reductions in lifecycle GHG emissions from commercial fleets with fewer compromises**

# 11
# Adoption of renewable diesel to reduce commercial transport GHG emissions

To meet their own GHG emissions reduction goals, and those of the companies whose goods they are moving, many fleets globally are seeing renewable diesel as an attractive proposition. Publicly announced examples of use and/or trial of renewable diesel across different countries include:

## Benelux

- Logistics specialist, H. Essers is using HVO100 as part of an insetting program for their shippers, working with shippers like Nike.[66]
- Soft drinks company Coca Cola Europacific Partners announced a collaboration with its local transport suppliers in the Netherlands (Van Rijen, Zandbergen, Snel Logistics Solutions, and T-Trex) to run their truck fleet on HVO100.[67]
- Restaurant chain McDonalds, announced a collaboration with logistics partner Havi on circular recycling of used cooking oil into HVO100.[68]
- Package delivery company Post NL is increasing its use of HVO100.[69]

## UK

- Soft drinks company, Coca Cola EuroPacific Partners, announced it was working with its packaging manufacturer Ball Beverage to trial use of HVO100 in the transportation of its aluminum cans from the manufacturer's factory.[70]
- Competing soft drinks company PepsiCo UK announced in Nov 2022 it will power more than 1M miles of truck journeys each year with used cooking oil based renewable diesel, working with its haulage partner, Pollock (Scotrans). The announcement states that HVO will replace diesel in trucks travelling between the Quaker Oat mill in Cupar and Leicester, home of Pepsico subsidiary Walkers. Pepsico also announced a further expansion of HVO100 usage in 2024 in its distribution operations with haulier, Eddie Stobart Logistics.[71]
- Mining company and plasterboard manufacturer British Gypsum announced in October 2022[72] plans to convert 40% of its UK fleet to renewable diesel (HVO). British Gypsum is part of Saint Gobain.

## US

- Oregon-based logistics company Titan Freight Systems announced in 2021 the switch to renewable diesel across its operations with favorable TCO outcomes without the need to make any vehicle or infrastructure modifications.[73]
- In November 2022, truck leasing company, Penske, announced[74] availability of renewable diesel across 32 refueling locations in California, noting it found an overall net positive effect on the vehicles related to renewable diesel, including reduced maintenance-related issues along with the added benefits of lower overall emissions.

## Singapore

- In 2024, dnata collaborated with ExxonMobil to become the first ground handler at Singapore Changi Airport to use renewable diesel, trialing Esso Renewable Diesel R20 in 12 of dnata's airside vehicles and generator set.[75]

## New Zealand

- In 2025, HW Richardson Group's Allied Petroleum started a trial of Renewable Diesel R20 supplied by ExxonMobil.[76]

> "HVO100 is a very viable alternative to traditional Diesel fuel; it is the best alternative that we can think of until 2030, and still a very good one till 2035 — as these trucks will last long."
>
> **CEO, automotive logistics specialist, Netherlands**[77]

> "I am an evangelist for HVO100. There are absolutely no barriers to adoption."
>
> **Fleet manager, Public Fleet, California**[78]

"CSG and environmental aspirations of the customer are big factors. The customer is really important. They are the ones who are going to pay for you to invest in these things ... Renewable diesel is the lowest risk. It is not a completely different truck. It's not a significant capital investment ... If you have got any uncertainty ... that feels like the safest thing to do. If you are running overnight vehicles on your primary network and you are going to the other side of the country, quite a few of the other options are not viable for you. Going to these fuels feels like the safest option."

**Manager, Large Truck Fleet for major brand, UK**[77]

"1st generation biodiesel comes with constraints. Maintenance of trucks is different – a lot of engines are ready to use but the maintenance cost goes up. It requires a dedicated tank which is a constraint. 10-15% of bulk fuel is HVO100 today ... If the customer is ready to pay a little more for benefit of decarbonization, it is simple and efficient. The big difference is HVO is miscible so we can use the same tank and periodically drop in the HVO ... there is no impact on maintenance and no extra consumption whereas for 1st gen biodiesel we saw over-consumption."

**Purchasing Director, Large France-based European Specialist Logistics Service provider**[77]

"Biofuel for us is an extremely good way for us to go to reduce our carbon footprint. For example, Sweden has been using HVO for quite a while now and we are looking at it for other countries too. It is interesting because it doesn't imply additional investments as you can use it with your diesel trucks. And if you don't have access to HVO then you can just use diesel either way .... We did tests, several of them for quite a long time now – it is going pretty well."

**Procurement Manager, Large European Dairy Group**[77]

## Figure 39
## The end user experience with renewable diesel

### a) On-Road Experience

To share with you a wider range of feedback, ExxonMobil collaborated with Frost and Sullivan to interview 15 commercial truck fleets who have used renewable diesel in their operations in the US and various European markets.[78]

**Overall Experience:**
Frost and Sullivan reported that experience of these commercial fleets with renewable diesel was very promising. Each fleet is different (operating varying fleets with a range of duty cycles in a range of markets) and their perspectives unsurprisingly varied to some degree. But there were common themes to their feedback.

**Efficiency:**

- Usually, no difference in fuel consumption.
- Some users report slightly lower, or slightly higher consumption.

**Performance:**

- Reports on performance are good.

**Emissions:**

- Reports of fewer regenerations, reduced DEF consumption and longer after-treatment life in modern diesel trucks. Reduced tailpipe emissions ($NO_x$ and Particulate Matter) in older trucks.

**Handling and User Experience:**

- Some report favorably on no odor / no smell of the exhaust gases, and lower engine noise by operators whose vehicles are idling or operated in a confined environment.
- Storage experience is excellent. No algae / no bacteria in contrast to biodiesel.

**They used Renewable Diesel as part of an Integrated Strategy:**

- The fleets' choice to use renewable diesel does not stand-alone, but part of their broader sustainability plan covering installations, routes optimization, vehicles specs and a (relatively) methodical review of different fuel / powertrain alternatives, based on suitability of solution.

**They regard Renewable Diesel and Biodiesel as complementary, not competing:**

- Biodiesel use is essentially limited to blends, limiting scalability. Their perception of biodiesel's reputation appears to be a potential deterrent from both a user's and the public's standpoint. Renewable Diesel is seen as drop in fuel which means scalability, can be used neat, and can be sourced from waste products.
- Renewable Diesel may be preferred over Renewable Natural Gas as the latter requires special equipment (truck, refueling), and implies an additional technology diversity that is particularly unwelcome in a period in which fleets will introduce BEV; again, an advantage for HVO100.

**Most continued to use Renewable Diesel post an initial trial period:**

- Post trial adoption was ~70% in fleets interviewed, with non-adopters pursuing a focus on other solutions, like battery electric vehicles, and increased focus on intermodal operations, or a pivot towards sustainable aviation fuel in wider operations.

### b) Off-Road Application

Off-road, ExxonMobil recently collaborated with Finning, the world's largest Caterpillar dealer, to test the use of renewable diesel in haul truck operations as shown in **Figure 40**.[79]

## Figure 40
## Renewable diesel case study – haul trucks in Alberta, Canada

- Imperial Oil collaborated with Finning, the world's largest Caterpillar dealer on the potential for renewable diesel as a practical solution for helping the Canadian mining sector's productivity and lower lifecycle GHG emission ambitions.
- They worked together to trial renewable diesel in CAT haul trucks at the Kearl oilsands mine in Alberta.
- The results confirmed that this equipment can operate on a fully renewable fuel, with similar equipment power and performance.*

* All trial results and comparisons throughout are renewable diesel compared to conventional diesel fuel. Actual benefits will vary depending on factors such as vehicle/engine type, driving style and diesel fuel previously used. Consult the original equipment manufacturer (OEM) for guidance on compatibility with renewable diesel.

**Source:** Imperial Oil & Finning Trial.[79]

# 12

## Enablers for scaling renewable diesel adoption

**Renewable diesel is an emerging solution for reductions in lifecycle GHG emissions from commercial fleets with fewer compromises**

Amongst managers of medium to large heavy duty commercial fleets, renewable diesel's lifecycle GHG emission reduction potential and performance are perceived as the key reasons to consider switching. However, there are barriers that are commonly highlighted around biofuels for land transport (see **Figure 41**). These can be linked back to different dimensions of the productivity, efficiency, sustainability model for land transport (see **Figure 22**):

### Productivity (uptime and reliability)

- Limited network of / access to biofuels solutions "where and when I need them."
- Engine / Truck manufacturer acceptance and implications for warranties.
- Confidence in performance.
- Implications for maintenance intervals.

### Efficiency (cost/Ton mile)

- Price and TCO competitiveness with ZEV solutions and/or conventional diesel.

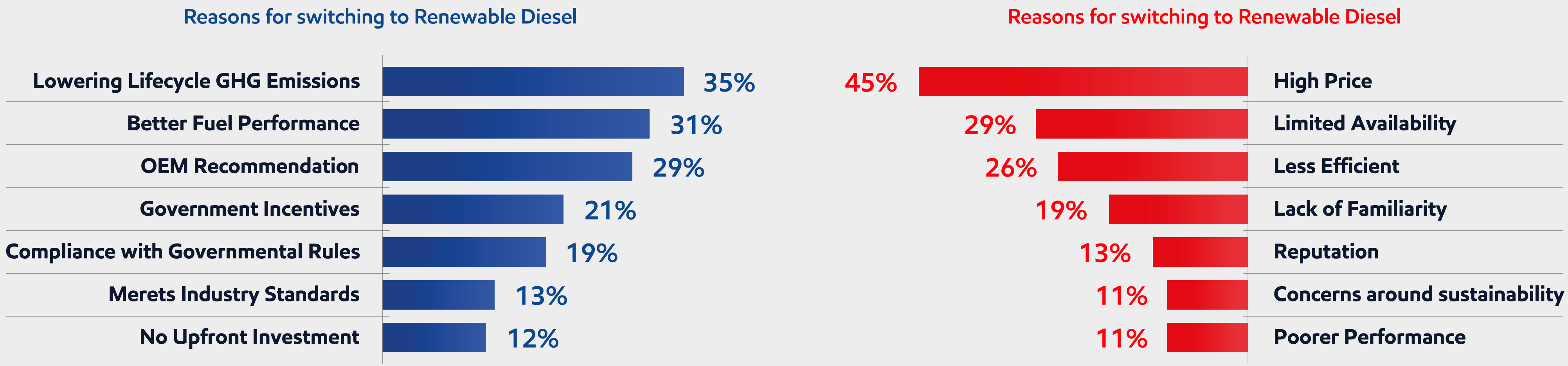
### Sustainability

- Sustainable sourcing of biofuels.
- Traceability of claims around emissions and the percentage of renewable fuel content.

**Figure 41**

**Renewable Diesel: Reasons for and against switching (Europe & NA Fleets, 1Q26)[4]**

Please rank the top 2 potential reasons that would make you switch to HVO / Renewable Diesel and the top 2 reasons you would not consider switching




**Source:** ExxonMobil-commissioned research by Frost & Sullivan. Interviews Dec-25 to Jan-26. N=150 Europe, N=150 NA. [4]

Whilst many fleets have navigated these kinds of questions, we share our thoughts for those who are still thinking through the issues.

**a) Accessibility** — Opening up renewable diesel in restricted markets

Not all markets support the sale of biofuels like renewable diesel (HVO) in public access stations. Some, like France, have historically restricted sales to captive fleets, with in-yard fueling. This limits the potential for fleets with a mix of use-cases including on-road fueling to maximize usage of biofuels should they wish. Some markets continue to restrict the sale of HVO. Where restrictions remain in place, we believe this restricts the potential for fleets seeking to accelerate their GHG emissions reductions to do so and encourages regulators to review these restrictions. Germany and France both eased their restrictions in 2024 which is a positive development.

**b) Infrastructure costs** — The potential for mass balance solutions for fleets

In some markets today, renewable diesel sales are mainly limited to segregated storage/distribution. We see no reason why renewable diesel could not be sold in the same way as say renewable natural gas or renewable electricity, leveraging grid/gas network systems and effective verification and traceability. We are willing to work with third party assurance schemes to build out systems to support such applications.

**c) Warranties** — Engine / Truck manufacturer acceptance of renewable diesel

Many truck models are implicitly suitable for renewable diesel blends as their manuals reference industry standards that treat renewable diesel equivalently to conventional diesel. Many newer engine platforms have been explicitly approved for use with blends up to R100 so long as the finished product meets industry diesel standards. ExxonMobil is working with equipment manufacturers and distributors in the off-road sector to demonstrate performance of both renewable diesel and biodiesel blends.

**d) Traceability along the supply chain** — The rise of assurance schemes

We support the development of reassurance schemes which provide an independent oversight of biofuels suppliers. We think this can add confidence to biofuels as a solution. Industry associations, public-private collaborations, and/or consultancies may step in to provide this kind of service. An example is the Zemo Partnership in the UK and its Renewable Fuel Assurance Scheme (RFAS). Zemo offers a standardized process and third party audit of RFAS Renewable Fuel Declarations. This oversight gives confidence in sourcing, lifecycle GHG emissions savings and ensuring the renewable nature of product received.[80]

**e) Confidence in performance** — Differentiation via performance additive technology

We believe that the growing experience of fleets using renewable diesel, and sharing some of their learnings in this white paper, should build confidence over time. ExxonMobil testing shows that, as with conventional diesel, renewable diesel can leave deposits in fuel injection systems which can impact fuel efficiency and engine-out emissions over time. These deposits can be cleaned up with the right performance additive technology, adding confidence to adoption of renewable diesel as a portfolio solution to reduce lifecycle GHG emissions from commercial fleets.

**f) Affordability and TCO** — The expansion of bio-mandates and low carbon fuel standards

Biofuels like renewable diesel are inherently more expensive to produce due to the complexity of aggregation of feed stocks, production scale, and logistics. Without policy support to level the playing field, the cost of biofuels makes adoption by fleets a less affordable proposition in comparison to conventional fuels. Regulators in California and Canada have significantly incentivized biofuels production by introduction of LCFS programs. In Europe, under REDIII and the associated country mandates, bio-blending contributes towards compliance and mandate levels are rising. This is allowing renewable diesel to be made available on a more competitive basis versus conventional diesel. As noted above, The Netherlands now has more than 100 public access stations selling renewable diesel HVO100.[53] We continue to encourage governments for supportive policy which incentivizes investment and innovation to provide solutions to the marketplace. As the playing field is levelled, adoption and production of lower GHG emission fuels grows as we have seen across many markets. This also helps lower GHG emission fuel accessibility.

## Section Five in Brief

**Renewable diesel is an emerging solution for reductions in lifecycle GHG emissions from commercial fleets with fewer compromises**

- Renewable Diesel offers an emerging solution for fleet lifecycle GHG emission reductions with many advantages.
- Renewable Diesel is different from biodiesel, being chemically similar to conventional diesel and without the oxygenates which give rise to many of biodiesel's drawbacks.
- There are different pathways to renewable diesel. Today, renewable diesel is predominantly produced by hydrotreating bio-feeds. Some is produced via co-processing. Gasification with carbon capture and storage of cellulosic bio feeds offers potential as an attractive future pathway to lower carbon intensity renewable diesel.
- Renewable diesel production is growing rapidly, including co-processing operations, and the startup of a large-scale renewable diesel unit at Imperial Oil's Strathcona Refinery in Canada.
- Renewable diesel can be blended at higher percentages than biodiesel, whist still meeting existing diesel specifications and the needs of existing fleets. A number of fleets are taking advantage of R20-30 blends to reduce lifecycle GHG emissions as a drop-in solution.
- As many vehicle/engine manufacturers are now accepting of 100% renewable diesel for use in modern lower emission diesel engines, R100 is increasingly part of the plans established by fleets and brands to meet fleet GHG emission targets as a drop-in solution without associated capital investments.
- Many opportunities exist to accelerate the adoption of renewable diesel in markets around the world. A collaborative approach across the ecosystem, between producers, marketers, regulators, assurance schemes, commercial fleets, and shippers, is a key enabler.

# Summary

## Planning your journey to lower emission operations

Many fleet managers will already be evaluating their options for reducing fleet emissions. However, what is clear is that for most operators there won't be a single route towards lower GHG emissions from their operations. As we've already seen, mixed fleets and complex operational patterns will require a range of solutions, now and in the future. From additized diesel to new vehicles running on novel fuel formulations, the range of options is large and increasingly complex. Also, fleet managers may choose a staged progression between choices over time as infrastructure is built and regulatory policies evolve. ExxonMobil therefore suggests that fleet managers assess their short- to long-term options to help devise a path that meets both their operational requirements and emission reduction goals.

**With this in mind, operators should generally first look at relatively simple measures that can be implemented today, and can make a difference, including:**

- Inventorying GHG emissions.
- Establishing fuel efficiency and emissions reduction goals.
- Leveraging inter-modal options where feasible to replace truck tonne miles with rail where it is a feasible option and represents a viable lower GHG emission choice.
- Secure win-win-wins (productive use of assets, lower fuel consumption/costs per ton mile and lower associated emissions), by optimizing diesel consumption of the existing truck fleet via:
  - Enhancing attention to reducing empty miles driven to eliminate unproductive truck miles.
  - Increasing emphasis on data analytics and telematics.
  - A renewed focus on fuel efficient driving practices, underpinned by driver training.
  - Switching to running the fleet on detergent-additized diesel and use of high-performance lubricants.

Taken together, these measures can help enhance fleets' day-to-day operations, improve efficiency, lower operating costs and lower emissions per mile driven.

From there, fleet managers could establish a roadmap for progressive adoption of lower-emission technologies, which are increasingly playing a role in helping meet their GHG emissions targets. **These include:**

- Accelerating the replacement of older, less fuel efficient, higher emission trucks with more efficient, lower emission models featuring the latest powertrain, drivetrain and aerodynamic enhancements.
- Leveraging new trailer designs (lightweight, longer, higher, more aerodynamic) and optimizing pairings with front-end tractor units.
- Leveraging latest tire technology enhancements in collaboration with tire suppliers, including real-time tire pressure monitoring, auto-inflation and lower roll resistance technologies.
- Considering biodiesel blends or renewable diesel to lower lifecycle GHG emissions from this optimized diesel fleet.
- In parallel with exploring and learning with alternatives like battery electric, starting with the most suitable, easier to electrify, more TCO favorable duty cycles. Where available fleet managers should look for grant funding and incentives available in their geographies.

There are pros and cons to all options, so fleet managers will need to fully assess the alternatives – in terms of availability, cost, and suitability – before choosing the best combination for their specific fleet. The determining factors may change over time, so it will be important to reassess decisions as technologies evolve.

For the longer-term, managers can start to replace portions of their fleet with new vehicles designed to run on lower-emission fuels. Some operations will be more suitable than others for this transition.

**Fleet managers will consider many factors, including:**

- Sustainability goals, with a particular emphasis on emissions reduction targets and timelines.
- Constraints with existing in-yard operations (space limitations, power infrastructure & local regulations).
- Operating range/routing of the different vehicles in their fleet, including rest breaks, dwell times and suitability for fast charging.
- Some operators are considering adapting their operating practices to accommodate a more digitized, electrified, and longer term potentially more autonomous operation.

Due to the complexities involved, and the potential operational ramifications if sub-optimal decisions are made, it is essential that fleet managers work with technology suppliers that have a proven track record of supporting their customers with the fuel options they need, when and where they need them.

All this requires careful consideration, a learning culture, and upfront engagement and collaboration with drivers, maintenance and operations teams, and other stakeholders including customers. This is fundamental and must be built into the roadmap plans as a critical workstream to deliver superior outcomes and return on investment.

## Comparing solutions for commercial fleets

We realize all this is a lot to take in, so we have summarized below a high-level directional comparison between conventional diesel, biodiesel, and renewable diesel options available to commercial fleets today (see **Figure 42**).[81]

**Figure 42 Directional comparison of different diesel solutions[81]**

Directional

| Diesels Compared | Conventional Diesel | Additized Diesel[(a)] | Biodiesel (B100)[(b)] | Renewable Diesel (R100)[(c)] |
|---|---|---|---|---|
| **European Specification** | EN590 | EN590 | EN14214 | EN15940 |
| **US Specification** | ASTM D975 | ASTM D975 | ASTM D6751 | Per Diesel |
| **Vehicle Compatibilty[(d)]** | All Diesel | All Diesel | Adapt/Change | Good % Compatibility |
| **Cetane** | Baseline | Baseline | Similar or Better | Best |
| **Cold Flow Properties** | Baseline | Baseline | Usually Inferior | Similar to Diesel[(e)] |
| **Storage & Handling** | Baseline | Baseline | Adaptation Required | Better |
| **Fuel Efficiency** | Baseline | Improved | Lowest | Lower[(f)] |
| **Engine Out $NO_x$ Emissions** | Baseline | Lower | Higher | Similar or Lower |
| **Lifecycle GHG Emission Saving Potential[(g)]** | Baseline | Baseline | Better | Better |

(Results vary dependent on fleets, specific fuels, feedstock & production methods and fleet operating practices)

**Source:** ExxonMobil analysis.

a) Modelled off Esso Diesel Efficient™ fuel. Other additised diesel fuels may have different formulations and properties. Esso Diesel Efficient™ fuel benefits are based on internal and third-party vehicle engine testing, laboratory testing, and/or industry or other scientific literature. Basis for comparison for all claims is versus Esso™ unadditised Diesel. Vehicle type, engine type, driving behaviour, and other factors also impact fuel and vehicle performance, emissions, and fuel economy. Esso Diesel Efficient™ fuel may be used in all heavy-duty and light-duty vehicles, but results may vary. Fuel economy testing was performed in the UK on first generation Diesel Efficient™ fuel using road-trucks (Euro III and Euro V specifications) and our first generation detergent additive package. Our upcoming second generation detergent additive package is expected to have similar or better cleaning performance than that of the first generation additive package if compared in the same engine/vehicle type with the same test protocol.

b) Product specifications including cetane vary according to local regulations. Depends on supplier & quality level. Properties shown assume EN14214 vs EN590.

c) Product specifications vary, depending on supplier, quality level & local specifications. Properties shown assume EN15940 specification renewable diesel vs EN590 diesel.

d) Check with vehicle manufacturer for specific models.

e) Actual experiences of commercial fleets with renewable diesel vary with some reporting no difference in consumption.

f) Depends on feedstock, production method & policy. For our qualitative GHG comparisons, EU Renewable Energy Directive (2018/2001/EU) ANNEX V has been used to compare the greenhouse gas emission saving default values vs conventional diesel for 100% biodiesel & 100% renewable diesel from comparable used cooking oil feedstock sources.

g) Additised diesel with the potential to improve fuel economy can help reduce $CO_2$ tailpipe emissions per mile driven. Indicated lifecycle emissions for biodiesel and renewable diesel are based on biofuel content. Depends on feedstock, production method & policy. For our qualitative GHG comparisons, EU Renewable Energy Directive (2018/2001/EU) ANNEX V has been used to compare the greenhouse gas emission saving default values vs conventional diesel for 100% biodiesel & 100% renewable diesel from comparable used cooking oil feedstock sources.

## Our land fuels business

Our Product Solutions land fuels business currently markets lower emission fuels in multiple countries around the world such as the US and Canada in North America, to the UK and the Netherlands in EAME, to Singapore and Indonesia in Asia Pacific. We are excited about our plans and the ecosystem collaborations that are enabling them and look forward to continuing the productive conversations, which can lead to lower lifecycle GHG emissions solutions in on- and off-road sectors.

To learn more about our land fuels plans, we invite you to follow our ExxonMobil Global Land Fuels **LinkedIn** page so we can share ecosystem developments, input from those we work with and updates on product solutions we are bringing to market.

We look forward to hearing from you.


**ExxonMobil Global Land Fuels**

Transforming land transportation

Follow

**Follow us for news, views and best practices from the global land transportation industry.**
**We look forward to taking this journey together!**

## Appendix

# Definitions

## Fuel Terminology

**Biodiesel (B100):** Renewable, biodegradable form of diesel typically manufactured by trans-esterification of plant oils, waste oils and/or animal fats (tallow). Also known as FAME (Fatty Acid Methyl Ester). The product is not hydrotreated before blending and contains oxygen.

**Biofuel:** Fuel produced from biomass, including waste vegetable oils and animal fats (such as used cooking oil). Examples include Biodiesel, Renewable Diesel, Renewable Natural Gas etc.

**Biomass:** A feedstock comprised of organic matter derived from living or recently living organisms; e.g. wood, crops, algae.

**Bx:** Biodiesel blend into conventional diesel at x vol% biodiesel, e.g. B10.

**Compressed Natural Gas (CNG) and Liquified Natural Gas (LNG):** Natural gas stored in compressed gaseous form and liquified form, respectively.

**eFuels:** Broad category of synthetic fuels that includes fuel produced from green $H_2$ which is combined with CO. The CO comes from $CO_2$, either from direct air capture or from a point source. The Point source is generally biogenic for a lower CI. The fuels produced include methane, methanol, ethanol, gasoline, jet, diesel, or various chemicals. This procedure is now commonly known by the terms Power-to-X (PtX), Power-to-Liquids (PtL) and Power-to-Gas (PtG).

**$H_2$ (Hydrogen):** Fuel used for land transportation in ICE engines or more commonly in fuel cell electric vehicles (FCEV). Like natural gas, hydrogen can be stored in compressed or liquified form. The carbon intensity of $H_2$ is influenced by the production process and colors are often used as a shorthand for the production pathway, e.g. Grey $H_2$, from natural gas SMR (steam methane reformation), Blue $H_2$ from SMR or ATR (autothermal reformation) with Carbon Capture and Storage (CCS), Green $H_2$ from electrolysis of water using green electricity (e.g. solar, wind, geothermal, hydro-power), Pink $H_2$ from electrolysis of water using nuclear power.

**Liquefied Petroleum Gas (LPG):** Fuel gas in liquified form, principally propane and/or butane.

**Renewable Diesel (RD, R100):** Drop-in form of diesel, made from same feedstocks as biodiesel (vegetable oil, waste, residues). Primarily produced through hydro-processing edible and waste oils but can be produced through pathways like gasification. The hydro-processing step removes impurities and oxygenates which means, unlike biodiesel, it can be used more interchangeably with conventional diesel, and has good cold weather performance. Also known as **HDRD** (Hydrogenation-Derived Renewable Diesel), and **HVO** (Hydro-treated Vegetable Oil).

**Renewable Energy:** Energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas.

**Renewable Fuel:** Renewable fuels include liquid and gaseous fuels and electricity derived from renewable biomass energy sources. Examples include ethanol, biodiesel, cellulosic diesel and compressed natural gas and electricity from renewable biomass.

**Renewable Natural Gas (RNG):** Also known as biogas, RNG is a renewable form of natural gas (primarily methane) usually captured from anaerobic digestion in a landfill or from livestock manure. Can be used for land transport.

**Rx:** Renewable diesel blend into conventional diesel at x vol% renewable diesel, e.g. R30.

## Biofuels Production Related Terminology

**BECCS:** Bioenergy with carbon capture and sequestration (CCS). Gasification with CCS is an example.

**Cellulosic feed:** Feedstock that contains cellulose including forestry waste, agricultural waste, and municipal solid waste (MSW). Can be used for gasification or pyrolysis.

**Co-processing:** Utilization of bio-feedstock in conjunction with traditional crude oil / petroleum feedstock in fuel production to help reduce the overall carbon intensity of the end-products produced. The bio-feed can be inserted at different points in the production process (e.g. hydro-treating) depending on the refinery configuration and the desired products.

**Gasification:** Process that converts biomass into syngas (mixture of carbon monoxide, and hydrogen. This is achieved by reacting the feedstock material at high temperatures (typically >700°C), without combustion, controlling the presence of oxygen and/or steam in the reaction. Syngas can be turned into synthetic liquid hydrocarbon fuels, via the Fischer Tropsch process.

**Hydro-processing:** Refining process, using hydrogen in the presence of catalyst, to remove sulfur and oxygen from fuel products.

**Pyrolysis:** Process in which biomass is heated rapidly at high temperature (500-700C) in an oxygen-free environment. Vapors are cooled and condensed into a liquid pyrolysis oil (also known as Bio-Pyoil) which can be used to produce renewable fuels.

## Commercial Transport Terminology

**Battery Electric Vehicle (EV):** Electric vehicle powered by a rechargeable battery.

**Fuel Cell Electric Vehicle (FCEV):** Electric vehicle that uses a fuel cell, sometimes in combination with a small battery or supercapacitor, to power its onboard electric motor. Fuel cells in vehicles generate electricity generally using oxygen from the air and compressed hydrogen.

**Heavy-Duty (HD):** Category of heavy road transportation, typically for commercial carriage of freight.

**Intermodal:** Use of successive modes of transport (e.g., ocean ship, inland waterway, air, rail, trucking) to move goods within one and the same loading unit without handling of the goods themselves when changing modes.

**Internal Combustion Engine (ICE):** Engine in which fuels are burned (e.g., gasoline, diesel) through spark ignition or compression to release energy and cause motion.

**Light-Duty (LD):** Category of lighter road transportation, primarily 2-4 wheelers including motorbikes, cars and small vans.

**Medium-Duty (MD):** Category of road transportation at intermediate load levels, including smaller buses and trucks.

**Total Cost of Ownership (TCO):** Estimate of the expenses associated with purchasing, deploying, operating, maintaining and retiring a product or piece of equipment, across the product's entire lifecycle. TCO can be calculated as the initial purchase price plus costs of operation across the asset lifespan and takes into account resale value. It is key measure used by commercial transport companies in selecting between vehicles and fueling choices.

## Vehicle Emissions Control Terminology

**Diesel Exhaust Fluid (DEF):** DEF is a liquid used to reduce the amount of air pollution created by a diesel engine. Specifically, DEF is an aqueous urea solution made with 32.5% urea and 67.5% deionized water. DEF is consumed in a selective catalytic reduction (SCR) that lowers the concentration of nitrogen oxides ($NO_x$) in the diesel exhaust emissions from a diesel engine. DEF is widely marketed under the trade name AdBlue™.

**Diesel Oxidation Catalysts (DOCs):** Exhaust aftertreatment devices reducing tailpipe emissions from diesel fueled vehicles and equipment. Generally, consist of a precious metal coated flow-through honeycomb structure contained in a stainless-steel housing. As hot diesel exhaust flows through the honeycomb structure, the precious metal coating causes a catalytic reaction breaking down pollutants into less harmful components. DOCs promote oxidation of exhaust gas components – carbon monoxide (CO), hydrocarbons (HC), and the organic fraction of diesel particulates (OF). In modern diesel aftertreatment systems, an important function of the DOC is to oxidize nitric oxide (NO) to nitrogen dioxide ($NO_2$), a gas needed to support the performance of DPFs and SCR catalysts used for $NO_x$ reduction.

**Diesel Particulate Filter (DPF):** Filter that captures and stores exhaust soot to reduce tailpipe emissions from diesel engines. DPFs only have a finite capacity, so trapped particulates are periodically 'burned off' to regenerate the DPF, reducing the harmful exhaust emission and helps to prevent black smoke emissions during acceleration.

**Exhaust Gas Recirculation (EGR):** Technique to reduce $NO_x$ tailpipe emissions. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders. The exhaust gas displaces atmospheric air, reducing $O_2$ in the combustion chamber, in turn reducing the amount of fuel that can burn in the cylinder, thereby reducing peak in-cylinder temperatures. The amount of recirculated exhaust gas varies with the engine operating parameters. In modern diesel engines, the EGR gas is usually cooled with a heat exchanger to allow the introduction of a greater mass of recirculated gas.

**Selective Catalytic Reduction (SCR):** Technique for reducing nitrogen oxide ($NO_x$) tailpipe emissions from diesel engines. Static mixers are widely used in SCR systems before reactors to promote the mixing of ammonia and exhaust streams.

## Emissions Related Terminology

**Assurance Scheme:** Independent program which audits renewable fuel claims including feedstock origin and GHG emissions reductions through the supply chain. Examples include the Renewable Fuels Assurance Scheme (RFAS), run by the Zemo Partnership in the UK.

**Carbon Intensity (CI):** Measure of lifecycle GHG emissions, expressed in units of $CO_2$ equivalent ($CO_2e$) emissions per unit of energy. It is usually expressed per megajoule of energy. $CO_2e$ is used to normalize Greenhouse Gases such as methane to a recognized Global Warming Potential (GWP) value by applying universally accepted conversion factors. It is a measure of the GHG potential of all emissions, not just $CO_2$.

**Greenhouse gas emissions (GHG):** Emissions expressed in $CO_2e$, including carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($NO_x$).

**GREET:** The Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET™) suite of models developed by The Department of Energy's Argonne National Laboratory. These models are a publicly available tool to assess lifecycle emissions associated with a wide range of energy sources and production pathways.

**Indirect Land Use Change (ILUC):** Occurs when cultivation of crops for biofuels, bioliquids and biomass fuels displace traditional production of crops for food and feed purposes. This additional demand may increase the pressure on land and can lead to the extension of agricultural land into areas with high carbon stock such as forests, wetlands and peat land causing additional lifecycle GHG emissions.

**Life Cycle Assessment (LCA):** A life cycle assessment (LCA) is a holistic method to assess environmental aspects and quantify potential environmental impacts throughout a product's defined life cycle.

**Lower Emission Fuel (LEF):** Fuel which has lower lifecycle GHG emissions compared to conventional fuel as measured by lifecycle analysis.

**Tank To Wheels Emissions (TTW):** GHG emissions, expressed in $CO_2e$/MJ, from the use (combustion) phase of a fuel – also known as vehicle exhaust or tailpipe emissions.

**Well To Tank Emissions (WTT):** GHG emissions, expressed in $CO_2e$/MJ, associated with fuel production and distribution to the end user vehicle refueling point.

**Well To Wheels Emissions (WTW):** Full lifecycle assessed fuel GHG emissions, expressed in $CO_2e$/MJ.

**Zero Emissions Vehicle (ZEV):** Vehicle which emits no $CO_2$, particulates, or $NO_x$ from the exhaust/tailpipe. Battery Electric Vehicles and Fuel Cell Electric Vehicles are classed as Zero Emissions Vehicles.

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Appendix

# HVO100 compatibility* with diesel engines (EAME region)

The following information only applies to the listed medium and heavy-duty engines and vehicles.

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **DAF** | On-road | New Generation XG+ | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XG+ | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | New Generation XG | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XG | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | New Generation XF | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XF | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | New Generation XD | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XD | Paccar PX-7 | Euro III to VI | |
| **DAF** | On-road | New Generation XB | Paccar PX-5 | Euro III to VI | |
| **DAF** | On-road | New Generation XB | Paccar PX-7 | Euro III to VI | |
| **DAF** | On-road | XF | Paccar XE | Euro III and earlier | |
| **DAF** | On-road | XF | Paccar MX | Euro IV and V | |
| **DAF** | On-road | XF Model Year 2017 and later | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | XF Model Year 2017 and later | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | CF | Paccar BE | Euro III and earlier | |
| **DAF** | On-road | CF | Paccar CE | Euro III and earlier | |
| **DAF** | On-road | CF | Paccar PE | Euro III and earlier | |
| **DAF** | On-road | CF | Paccar XE | Euro III and earlier | |
| **DAF** | On-road | CF | Paccar PR | Euro IV and V | |
| **DAF** | On-road | CF | Paccar GR | Euro IV and V | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **DAF** | On-road | CF | Paccar PX-7 | Euro III to VI | Model Year 2015: only if the engine complies with the OBD-C standard |
| **DAF** | On-road | CF Model Year 2017 and later | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | CF Model Year 2017 and later | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | LF | Paccar PX-5 | Euro III to VI | |
| **DAF** | On-road | LF | Paccar PX-7 | Euro III to VI | Model Year 2015: only if the engine complies with the OBD-C standard |
| **DAF** | On-road | LF | Paccar FR | Euro IV and V | |
| **DAF** | On-road | LF | Paccar GR | Euro IV and V | |
| **DAF** | On-road | LF | Paccar BE | Euro III and earlier | |
| **DAF** | On-road | LF | Paccar CE | Euro III and earlier | |
| **DAF** | Off-road | New Generation XFC | Paccar MX-11 | Euro III to VI | |
| **DAF** | Off-road | New Generation XFC | Paccar MX-13 | Euro III to VI | |
| **DAF** | Off-road | New Generation XDC | Paccar MX-11 | Euro III to VI | |
| **Iveco** | On-road / Off-road | Eurocargo | Tector 5 | Euro VI E | |
| **Iveco** | On-road / Off-road | Eurocargo | Tector 7 | Euro VI E | |
| **Iveco** | On-road | S-Way | Cursor 9 | Euro VI E | |
| **Iveco** | On-road | S-Way | Cursor 11 | Euro VI E | |
| **Iveco** | On-road | S-Way | Cursor 13 | Euro VI E | |
| **Iveco** | On-road | S-Way | Xcursor 13 | Euro VI E | |
| **Iveco** | Off-road | T-Way | Cursor 9 | Euro VI E | |
| **Iveco** | Off-road | T-Way | Cursor 13 | Euro VI E | |
| **Iveco** | Off-road | T-Way | Xcursor 13 | Euro VI E | |
| **Iveco** | On-road / Off-road | X-Way | Cursor 9 | Euro VI E | |
| **Iveco** | On-road / Off-road | X-Way | Cursor 11 | Euro VI E | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Iveco** | On-road / Off-road | X-Way | Cursor 13 | Euro VI E | |
| **Iveco** | On-road / Off-road | X-Way | Xcursor 13 | Euro VI E | |
| **MAN** | On-road / Off-road | TGX | D3876 | Euro VI C (On-road)<br>Euro V and earlier (Off-road) | |
| **MAN** | On-road / Off-road | TGX | D2676 | Euro VI (On-road)<br>Euro V and earlier (Off-road) | On-road trucks: only following engine types<br>• LF45 to LF50 (Euro VI A)<br>• LF51 to LF53 (Euro VI C)<br>• LF66 to LF68 (Euro VI C)<br>• LF78 to LF80 (Euro VI D)<br>• LF84 to LF86 (Euro VI D)<br>• LFAB and LFAE (Euro VI D)<br>• LFAF, LFAI, LFAJ, LFAK, LFAL (Euro VI E)<br>• LFAP, LFAQ, LFAS (Euro VI E) |
| **MAN** | On-road / Off-road | TGS | D2676 | Euro VI (On-road)<br>Euro V and earlier (Off-road) | On-road trucks: only following engine types<br>• LF45 to LF50 (Euro VI A)<br>• LF51 to LF53 (Euro VI C)<br>• LF66 to LF68 (Euro VI C)<br>• LF78 to LF80 (Euro VI D)<br>• LF84 to LF86 (Euro VI D)<br>• LFAB and LFAE (Euro VI D)<br>• LFAF, LFAI, LFAJ, LFAK, LFAL (Euro VI E)<br>• LFAP, LFAQ, LFAS (Euro VI E) |
| **MAN** | On-road / Off-road | TGX | D1556 | Euro VI D (On-road)<br>Euro V and earlier (Off-road) | |
| **MAN** | On-road / Off-road | TGS | D1556 | Euro VI D (On-road)<br>Euro V and earlier (Off-road) | |
| **MAN** | On-road / Off-road | TGM | D0836 | Euro VI C (On-road)<br>Euro V and earlier (Off-road) | |
| **MAN** | On-road / Off-road | TGL | D0836 | Euro VI C (On-road)<br>Euro V and earlier (Off-road) | |
| **MAN** | On-road / Off-road | TGL | D0834 | Euro VI C (On-road)<br>Euro V and earlier (Off-road) | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Mercedes-Benz** | On-road | Actros L | OM473 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros L | OM471 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros L | OM470 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros L up to 500 t | OM473 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros L up to 500 t | OM471 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros | OM473 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros | OM471 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros | OM470 | Euro VI | |
| **Mercedes-Benz** | On-road | Actros | OM936 | Euro VI | |
| **Mercedes-Benz** | On-road / Off-road | Atego | OM936 | Euro VI | |
| **Mercedes-Benz** | On-road / Off-road | Atego | OM934 | Euro VI | |
| **Mercedes-Benz** | Off-road | Arocs | OM473 | Euro VI | |
| **Mercedes-Benz** | Off-road | Arocs | OM471 | Euro VI | |
| **Mercedes-Benz** | Off-road | Arocs | OM470 | Euro VI | |
| **Mercedes-Benz** | Off-road | Arocs | OM936 | Euro VI | |
| | | | | | |
| **Renault** | On-road | T High | DE13 | Euro VI E | |
| **Renault** | On-road | T High | DE13 TC | Euro VI E | |
| **Renault** | On-road | T | DE11 | Euro VI E | |
| **Renault** | On-road | T | DE13 | Euro VI E | |
| **Renault** | On-road | T | DE13 TC | Euro VI E | |
| **Renault** | On-road | D Wide | DTi8 | Euro VI E | |
| **Renault** | On-road | D Wide | DE11 | Euro VI E | |
| **Renault** | On-road | D | DTi5 | Euro VI E | |
| **Renault** | On-road | D | DTi8 | Euro VI E | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Renault** | Off-road | K | DE11 | Euro VI E | |
| **Renault** | Off-road | K | DE13 | Euro VI E | |
| **Renault** | Off-road | C | DE11 | Euro VI E | |
| **Renault** | Off-road | C | DE13 | Euro VI E | |
| **Renault** | Off-road | C | DE13 TC | Euro VI E | |
| **Scania** | On-road | Super | Super 13-litre | Euro VI | |
| **Scania** | On-road | G-series | DC13 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | G-series | OC13 | Euro VI | |
| **Scania** | On-road | G-series | DC09 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | P-series | Super 13-litre | Euro VI | |
| **Scania** | On-road | P-series | DC13 | Euro III to Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | P-series | DC09 | Euro III to Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | P-series | DC07 | Euro V to VI | With the exception of DC07 101 |
| **Scania** | On-road | R-series | DC16 | Euro III to Euro VI | Only trucks with chassis number<br>• 9172445 and higher (Angers production site)<br>• 2081940 and higher (Sodertalje production site)<br>• 5306936 and higher (Zwolle production site) |
| **Scania** | On-road | R-series | Super 13-litre | Euro VI | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Scania** | On-road | R-series | DC13 | Euro III to Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | R-series | DC09 | Euro III to Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | S-series | DC16 | Euro VI | Only trucks with chassis number<br>• 9172445 and higher (Angers production site)<br>• 2081940 and higher (Sodertalje production site)<br>• 5306936 and higher (Zwolle production site) |
| **Scania** | On-road | S-series | Super 13-litre | Euro VI | |
| **Scania** | On-road | S-series | DC13 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | S-series | OC13 | Euro VI | |
| **Scania** | On-road | L-series | DC07 | Euro VI | With the exception of DC07 101 |
| **Scania** | On-road | L-series | DC09 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | Crewcab | DC13 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | Crewcab | DC09 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | On-road | Crewcab | DC07 | Euro VI | With the exception of DC07 101 |
| **Scania** | On-road | V8 | V8 | Euro VI | |
| **Scania** | Off-road | XT | DC16 | Euro VI | Only trucks with chassis number<br>• 9172445 and higher (Angers production site)<br>• 2081940 and higher (Sodertalje production site)<br>• 5306936 and higher (Zwolle production site) |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Scania** | Off-road | XT | Super 13-litre | Euro VI | |
| **Scania** | Off-road | XT | DC13 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | Off-road | XT | DC09 | Euro VI | Only trucks with chassis number<br>• 9172513 and higher (Angers production site)<br>• 2082023 and higher (Sodertalje production site)<br>• 5307129 and higher (Zwolle production site) |
| **Scania** | Off-road | XT | DC07 | Euro VI | With the exception of DC07 101 |
| **Volvo** | On-road | FH16 Aero | D17 | Euro VI | |
| **Volvo** | On-road | FH Aero | D13 | Euro VI | |
| **Volvo** | On-road | FH Aero | D13 I-Save | Euro VI | |
| **Volvo** | On-road | FH16 | D17 | Euro VI | |
| **Volvo** | On-road | FH | D13 | Euro VI | |
| **Volvo** | On-road | FH | D13 I-Save | Euro VI | |
| **Volvo** | On-road | FMX | D11 | Euro VI | |
| **Volvo** | On-road | FMX | D13 | Euro VI | |
| **Volvo** | On-road | FM | D11 | Euro VI | |
| **Volvo** | On-road | FM | D13 | Euro VI | |
| **Volvo** | Off-road | Penta | D5 | Euro II to V | Since 2016, all Volvo Penta diesel engines have been compatible with HVO 100 |
| **Volvo** | Off-road | Penta | D8 | Euro II to V | Since 2016, all Volvo Penta diesel engines have been compatible with HVO 100 |
| **Volvo** | Off-road | Penta | D11 | Euro II to V | Since 2016, all Volvo Penta diesel engines have been compatible with HVO 100 |
| **Volvo** | Off-road | Penta | D13 | Euro II to V | Since 2016, all Volvo Penta diesel engines have been compatible with HVO 100 |
| **Volvo** | Off-road | Penta | D16 | Euro II to V | Since 2016, all Volvo Penta diesel engines have been compatible with HVO 100 |

* Information contained in this Appendix is only applicable to HVO 100 meeting EN 15940 specifications. The above table is for information purposes only and contains third-party content. As of October 2024. ExxonMobil is not responsible for any errors or omissions, or for the results obtained from the use of this information. All information in this page is provided ""as is"", with no guarantee of completeness, accuracy, timeliness or of the results obtained from the use of this information. ExxonMobil makes no representation or warranty as to any third-party content, including but not limited to engine compatibility data, and ExxonMobil's use thereof is not an endorsement, recommendation, or adoption of such content. Please contact your engine manufacturer for more information.

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XTL

To check compatibility with HVO 100 for passenger cars, please, check the manufacturer's drivers guide and/or check the fill point for the XTL mark.

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****Sources**

DAF Alternative Fuels Guidelines
DAF Alternative Fuels Guidelines Page 3
DAF Alternative Fuels Page 3
DAF CF
DAF $CO_2$ Emissions Reductions
DAF New Generation for HVO 100
DAF New Generation Trucks
DAF New Generation XB
DAF XB
DAF XF
Daimler HVO 100 Engine Approval
IVECO 2021 Solutrans Offering
IVECO Sustainable Mobility of Commercial Vehicles Announcement
IVECO S-Way Viewer
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MAN HVO 100 Article
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Renault Alternative Energy for Trucks
Renault Environment and Sustainable Mobility
Scania Crewcab Specifications
Scania G Series
Scania L Series
Scania P Series
Scania R Series
Scania S Series
Scania Super
Scania V8 Specifications
Scania XT Specifications
Volvo Alternative Fuels for Trucks Guide
Volvo FH16 Aero Specifications
Volvo Penta and Sustainability
Zemo Renewable Fuels Guide

# HVO100 (R100) compatibility* with diesel engines (North America region)

The following information only applies to the listed medium and heavy-duty engines and vehicles.

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Caterpillar** | Off-road | - | See comment | - | Cat-branded Diesel engines can use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. Model TH255C with Deutz TD 2.9 engines with exhaust gas aftertreatment of US EPA Tier 4 interim compatible. |
| **Chevrolet** | On-road | Silverado 2500 HD | Duramax Turbo V8 6.6L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On-road | Silverado 3500 HD | Duramax Turbo V8 6.6L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On/Off-road | Silverado 4500 HD | Duramax Turbo V8 6.6L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On/Off-road | Silverado 5500 HD | Duramax Turbo V8 6.6L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On/Off-road | Silverado 6500 HD | Duramax Turbo V8 6.6L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On-road | 4500 XD Low Cab Forward | I-4 Turbo Diesel 5.2L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On-road | 5500 XD Low Cab Forward | I-4 Turbo Diesel 5.2L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On-road | 6500 XD Low Cab Forward | Cummins Turbo Diesel 6.7L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **Chevrolet** | On-road | 7500 XD Low Cab Forward | Cummins Turbo Diesel 6.7L | - | R99 or R95 for 2006-2023 GM brands all diesel engines |
| **CLAAS** | Off-road | Xerion 4500 | Mercedes-Benz 12.8L | Tier 4F / Stage 5 | Both Tier 4F / Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Xerion 5000 | Mercedes-Benz 12.8L | Tier 4F / Stage 5 | Both Tier 4F / Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **CLAAS** | Off-road | Axion 810 | FPT 6.7 | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Axion 820 | FPT 6.7 | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Axion 830 | FPT 6.7 | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Axion 840 | FPT 6.7 | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Axion 850 | FPT 6.7 | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Axion 860 | FPT 6.7 | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Axion 880 | FPT 6.7 | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Arion 630 | DPS 6.8 L | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Arion 650 | DPS 6.8 L | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Arion 660 | DPS 6.8 L | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Trion 740 | Cummins L9 8.9L | US Tier unlisted / Stage V | Both US Tier as well as Stage V, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 990 | MAN D2862 24.2L | Tier 4 / Stage V | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 980 | MAN D2862 24.2L | Tier 4 / Stage V | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 970 | MAN D4276 16.2L | Tier 4 / Stage V | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 960 | MB OM 473 LA 15.6L | Tier 4 / Stage V | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 950 | MB OM 473 LA 15.6L | Tier 4 / Stage V | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **CLAAS** | Off-road | Jaguar 940 | MB OM 471 LA 12.8L | Tier 4 / Stage V | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 930 | MB OM 471 LA 12.8L | Tier 4 / Stage V | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 880 | MB OM 473 LA 15.6L | Tier 4 | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 860 | MB OM 471 LA 12.8L | Tier 4 | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 850 | MB OM 471 LA 12.8L | Tier 4 | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **CLAAS** | Off-road | Jaguar 840 | MB OM 470 LA 10.6L | Tier 4 | Brochure lists as HVO Ready, HVO (hydrotreated vegetable oil) has been approved for use in CLAAS harvesters and tractors that meet the latest Stage V emissions standard since 1 October 2023. |
| **Cummins** | Off-road | - | Generator sets in standby applications, see comment | - | Generator sets in standby applications, EN15940 required |
| **Cummins** | Off-road | - | QSK19 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | K19 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | QSK23 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | QST30 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | QSK38 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | K38 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | QSK45 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | K50 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Cummins** | Off-road | - | QSK60 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | QSK78 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | QSK95 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | V903 | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | Off-road | - | ACE | - | EN15940 required, for use in industrial segments, contact distributor for more information and most recent fluids manual |
| **Cummins** | On-road | - | ISB | - | EN15940 required |
| **Cummins** | On-road | - | ISL | - | EN15940 required |
| **Cummins** | On-road | - | ISF | - | EN15940 required |
| **Cummins** | Off-road | - | QSB | - | EN15940 required |
| **Cummins** | Off-road | - | QSC | - | EN15940 required |
| **Cummins** | Off-road | - | QSL | - | EN15940 required |
| **Cummins** | Off-road | - | QSF | - | EN15940 required |
| **Cummins** | Off-road | - | B4.5 | - | EN15940 required |
| **Cummins** | On-road | - | B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Cummins** | On-road | - | L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Cummins** | On-road | - | X12* | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Cummins** | On-road | - | X15* | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Detroit Diesel** | On/Off-road | - | Series 60 | - | Renewable Diesel fuel must meet the industry standard specifications: ASTM D975, CAN/GCSB-3.517, EN 15940 |
| **Detroit Diesel** | On/Off-road | - | MBE 900 | - | Renewable Diesel fuel must meet the industry standard specifications: ASTM D975, CAN/GCSB-3.517, EN 15940 |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Detroit Diesel** | On/Off-road | - | MBE 4000 | - | Renewable Diesel fuel must meet the industry standard specifications: ASTM D975, CAN/GCSB-3.517, EN 15940 |
| **Detroit Diesel** | On/Off-road | - | DD5 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Detroit Diesel** | On/Off-road | - | DD8 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Detroit Diesel** | On/Off-road | - | DD13 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Detroit Diesel** | On/Off-road | - | DD15 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Detroit Diesel** | On/Off-road | - | DD16 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Deutz AG** | Off-road | - | D 2.2 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment<br>(DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively.<br>Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TD 2.2 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment<br>(DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively.<br>Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 2.2 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment<br>(DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively.<br>Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | D 2.9 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment<br>(DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively.<br>Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TD 2.9 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment<br>(DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively.<br>Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Deutz AG** | Off-road | - | TCD 2.9 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TD 3.6 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 3.6 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 4.1 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 5.2 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 6.1 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 7.8 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Deutz AG** | Off-road | - | TTCD 6.1 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TTCD 7.8 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 12.0 V6 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TD 16.0 V8 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 9.0 L4 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 12.0 L6 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Deutz AG** | Off-road | - | TCD 13.5 L6 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Deutz AG** | Off-road | - | TCD 18.0 L6 | - | Fuels meeting EN 15940 and ASTM D975. Engines without exhaust gas after-treatment (EDG engines) and engines with exhaust gas after-treatment (DOC / DPF / SCR) of emission stages EU Stage III B / EU Stage IV, or US EPA Tier 4 interim / US EPA Tier 4 final respectively. Engines with exhaust gas after-treatment with active regen (combustion) of emission stage US EPA Tier 4 Interim are excluded. |
| **Ferris** | Off-road | IS-6200 | Caterpillar C1.7 | - | Ferris literature indicates compatibility and instructs to verify with engine manufacturer Cat-branded Diesel engines can use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Ferris** | Off-road | IS-2600 | Yanmar 3TNM74F-SAFS | - | Ferris literature indicates compatibility and instructs to verify with engine manufacturer |
| **FPT Industrial** | Off-road | - | F34 | - | All of FPT Industrial's Tier 4 Final and Stage V engines are fully compatible with diesel and paraffinic/ renewable fuels, such as HVOs. |
| **FPT Industrial** | Off-road | - | F36 | - | All of FPT Industrial's Tier 4 Final and Stage V engines are fully compatible with diesel and paraffinic/ renewable fuels, such as HVOs. |
| **FPT Industrial** | Off-road | - | N67 | - | All of FPT Industrial's Tier 4 Final and Stage V engines are fully compatible with diesel and paraffinic/ renewable fuels, such as HVOs. |
| **FPT Industrial** | Off-road | - | Cursor 9 | - | All of FPT Industrial's Tier 4 Final and Stage V engines are fully compatible with diesel and paraffinic/ renewable fuels, such as HVOs. |
| **FPT Industrial** | Off-road | - | Cursor 13 | - | All of FPT Industrial's Tier 4 Final and Stage V engines are fully compatible with diesel and paraffinic/ renewable fuels, such as HVOs. |
| **Freightliner** | On-road | Cascadia | Detroit DD13 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document. Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document. Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document. Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel. EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America. Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Freightliner** | On-road | Cascadia | Detroit DD15 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Freightliner** | On-road | Cascadia | Detroit DD16 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Freightliner** | On-road | Cascadia | Cummins X12 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |
| **Freightliner** | On-road | Cascadia | Cummins X15 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Freightliner** | On-road | M2 112 Plus | Detroit DD13 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Freightliner** | On-road | M2 112 Plus | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Freightliner** | On-road | M2 106 Plus | Detroid DD5 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Freightliner** | On-road | M2 106 Plus | Detroid DD8 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Freightliner** | On-road | M2 106 Plus | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Freightliner** | On-road | M2 106 Plus | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Freightliner** | On-road | 114SD Plus | Detroit DD13 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Freightliner** | On-road | 114SD Plus | Detroit DD8 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Freightliner** | On-road | 114SD Plus | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Freightliner** | On-road | 114SD Plus | Cummins X12 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |
| **Freightliner** | On-road | 108SD Plus | Detroit DD8 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Freightliner** | On-road | 108SD Plus | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Freightliner** | On-road | 108SD Plus | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Freightliner** | On-road | EconicSD Plus | Detroit DD8 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **GMC** | On-road | Sierra 2500 HD | Duramax Turbo V8 6.6L | - | R99 or R95 for 2006-2023 GM brands all diesel engines, no further update |
| **GMC** | On-road | Sierra 3500 HD | Duramax Turbo V8 6.6L | - | R99 or R95 for 2006-2023 GM brands all diesel engines, no further update |
| **IC Bus** | On-road | CE Series | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **IC Bus** | On-road | TC Series | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **IC Bus** | On-road | RE Series | Cummins L9 | - | Retired model:<br>Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **International** | On/Off-road | MV Series | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **International** | On/Off-road | LT Series | Cummins X15 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |
| **International** | On/Off-road | HV Series | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **International** | On/Off-road | HV Series | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **International** | On/Off-road | HX Series | Cummins X15 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
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| **Isuzu** | On-road | FTR | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America.<br><br>Isuzu mute to renewable. |
| **Isuzu** | On-road | FVR | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America.<br><br>Isuzu mute to renewable. |
| **JCB** | Off-road | - | JCB 430 | - | Fuels must meet EN 15940, compatable models with JCB 430/444/448 from Stage IIIB – Stage V, but call dealer to confirm compatibility. |
| **JCB** | Off-road | - | JCB 444 | - | Fuels must meet EN 15940, compatable models with JCB 430/444/448 from Stage IIIB – Stage V, but call dealer to confirm compatibility. |
| **JCB** | Off-road | - | JCB 448 | - | Fuels must meet EN 15940, compatable models with JCB 430/444/448 from Stage IIIB – Stage V, but call dealer to confirm compatibility. |
| **John Deere** | Off-road | - | See comment | - | All John Deere engines can use renewable diesel in blends up to 100%. Must meet D975, EN 590, or EN 15940. |
| **Kenworth** | On-road | T680 | Paccar MX-11 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On-road | T680 | Paccar MX-13 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On-road | W990 | Paccar MX-11 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On-road | W990 | Paccar MX-13 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Kenworth** | On-road | W900L | Paccar MX-13 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On-road | T800W | Paccar MX-13 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On-road | T880 | Paccar MX-11 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On-road | T880 | Paccar MX-13 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On/off-road | T880 | Cummins X15 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |
| **Kenworth** | On-road | W990 | Paccar MX-11 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kenworth** | On-road | W990 | Paccar MX-13 | - | For MX-powered chassis, Kenworth bulletin (Paccar company), EN 15940 required |
| **Kubota** | Off-road | - | All | - | U.S. only, not Canada: Use EN15940 HVO, extension of approval to U.S.superseding all EU announcement |
| **Mack** | On-road | All Mack Class 8 models | MP7, MP8 and MP10 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | Anthem | MP7 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | Anthem | MP8 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | Anthem | MP8HE | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | Titan | MP10 | - | Discontinued NA 2017, HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Mack** | On-road | Granite | MP7 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | Granite | MP8 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | LR | MP 7 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | MD Series | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Mack** | On-road | Terra PRO | MP7 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | Terra PRO | MP8 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **Mack** | On-road | Mack Pinnacle | MP8 | - | HVO can be used interchangeably with petroleum diesel. Renewable diesel at any blend up to a maximum of 100% (RD100) that conforms to ASTM D975 or EN15940 will not adversely affect engine or aftertreatment performance or durability. |
| **New Holland** | Off-road | Workmaster 50 | FPT R753 | Tier 4B Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Workmaster 55 | S8000 2.9L | Tier 4B CEGR + DOC | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Workmaster 60 | FPT R753 | Tier 4B Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Workmaster 65 | S8000 2.9L | Tier 4B CEGR + DOC | FPT Tier 4f and Stage V compatible with HVO |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **New Holland** | Off-road | Workmaster 70 | FPT R753 | Tier 4B Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Workmaster 75 | S8000 2.9L | Tier 4B CEGR + DOC | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Workmaster 95 | FPT F5 3.4L | Tier 4B SCR + CUC | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Workmaster 105 | FPT F5 3.4L | Tier 4B SCR + CUC | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Workmaster 120 | FPT F5 3.4L | Tier 4B SCR + CUC | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T7 | FPT NEF 6.7L | Tier 4B Final-Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T9 Series | FPT Cursor 13 | Tier 4B/Final-Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T5 Series | FPT NEF 4.5L | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T5 Series Dual Command | FPT F5G 3.4L | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T6 Series | FPT NEF, 4.5L and 6.7L | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | TS6 Series | NH FPT / NEF 4.5L, 6.7L | Tier 4B Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Powerstar Series | FPT F5C | Tier 4B DOC+ lt. CEGR, Tier 4B Hi-ESCR+Lt CEGR | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T4 F/V | FPT F34 and F36 3.4L, 3.6L | Tier 4B Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T3 Series | S8000 2.9L | Tier 4B CEGR+DOC | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T3F Series Compact | S8000 2.9L | Tier 4B CEGR+DOC | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T4F S | FPT F36 F5C | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | TH Series | FPT NEF 4.5L | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **New Holland** | Off-road | Genesis T8 Series | FPT Cursor 9 6 531 in3 | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T6 Series II | FPT NEF N45 4.5L | Tier 4B Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Stackcruiser Series | New Holland 6.7L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Speedrower Plus Series | FPT 4.5L | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | FR480 | FPT Cursor 13 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | FR550 | FPT Cursor 13 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | FR650 | FPT Cursor 16 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | FR780 | FPT Cursor 16 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | FR920 | FPT Vector 20 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | CR7.80 | FPT Cursor 9 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | CR7.90 | FPT Cursor 9 | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | CR8.90 | FPT Cursor 13 | Tier 4B / Stage V Opti-Clean | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | CR9.90 | FPT Cursor 13 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | CR10.90 | FPT Cursor 16 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | CX8.80 | FPT Cursor 9 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | CX8.90 | FPT Cursor 9 | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | T4 F/V | FPT F34 and F36 3.4L, 3.6L | Tier 4A and Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Braud 9070M | FPT Tier 4B HI-eSCR 4cyl | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Braud 9070L | FPT Tier 4B HI-eSCR 4cyl | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Braud 9090L | FPT Tier 4B HI-eSCR /6cyl | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **New Holland** | Off-road | Braud 9090X | FPT Tier 4B HI-eSCR /6cyl | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Braud 9090X Olive | FPT Tier 4B HI-eSCR /6cyl | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Braud 9090X Olive | FPT Tier 4B HI-eSCR /6cyl | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Braud 7030M Grape | FPT NEF 4.5L | Tier 4B / Stage 4 | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | Braud 8030L Grape | FPT NEF 4.5L | Tier 4B / Stage 4 | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | C327 | FPT / FSH FL463A 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | C330 | Perkins 404F-E22TA 2.2L | - | EN 15940, meet D975, EN590 (ex. Density), Perkins diesel (ex. Density). Any blend with diesel, and blend bio up to B20 |
| **New Holland** | Off-road | C332 | FPT / FSH FL463A*G001 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | C337 | FPT / FSH FL463A*G001 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | C345 | FPT / FSBFL413E*B002* 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | C362 | FPT / FSBFL4130*C005 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | L328 | FPT / FSH FLA463A*F001 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | L334 | FPT / FSBFL413E*N002 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | C314 | Kubota D1305-E4B | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | B75D | FPT F5BFL413B 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **New Holland** | Off-road | B95D | FPT F5BFL413B 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | B95D TC | FPT F5BFL413B 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | B110D | FPT F5BFL413B 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | U80D | F5HFL463D*F005 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | ML15 | Kubota D1105 1.1L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | ML12T | Kubota D902 0.9L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | ML12 | Kubota D902 0.9L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | ML23 | Kubota C1505 1.5L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | ML35T | Kubota V2403 CR 2.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | ML50T | Kubota V3307 CR 3.3L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | W50C | FPT F5H FL463B 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | W60C | FPT F5H FL463C 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | W70C | FPT F5H FL463A 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | W80C | FPT F5H FL463A 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | W80C LR | FPT F5H FL463A 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | E70D | Kubota V2607-CT-T 2.6L | Stage V | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | E17C | Kubota D902 0.9L | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | E26C | Kubota D1305 1.3L | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **New Holland** | Off-road | E30C | Kubota D1305 1.3L | Tier 4B | FPT Tier 4f and Stage V compatible with HVO |
| **New Holland** | Off-road | F50C | FPT F5HFL463D 3.4L | Tier 4 Final | FPT Tier 4f and Stage V compatible with HVO |
| **Perkins** | Off-road | - | 400 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 904 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 1100 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 1200 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 1500 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 1700 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 2000 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 2200 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 2400 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 2500 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 2800 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Perkins** | Off-road | - | 4000 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Perkins** | Off-road | - | 5000 Series | - | Diesel engines use renewable diesel in blends up to 100%. Must meet D975, EN 590 (except density), or EN 15940. Some elastomers prior to early 1990's may not be compatible, refer to dealer for guidance. Diesel generators compatible for over a decade, consult dealer for guidance. |
| **Peterbilt** | On-road | 579 | Paccar MX-11 | - | Post-2021 Emissions/2022 Model Year Warranty: PACCAR Inc. approves the use of paraffinic diesel at any blend level or as a stand-alone fuel, providing that the following conditions are met:<br>• The paraffinic diesel in the fuel meets EN 15940 specifications, and<br>• The finished fuel meets the properties of ASTM Standard D975<br>The use of approved paraffinic diesel fuel does not affect the PACCAR engine warranty, or its maintenance intervals. |
| **Peterbilt** | On-road | 579 | Paccar MX-13 | - | Post-2021 Emissions/2022 Model Year Warranty: PACCAR Inc. approves the use of paraffinic diesel at any blend level or as a stand-alone fuel, providing that the following conditions are met:<br>• The paraffinic diesel in the fuel meets EN 15940 specifications, and<br>• The finished fuel meets the properties of ASTM Standard D975<br>The use of approved paraffinic diesel fuel does not affect the PACCAR engine warranty, or its maintenance intervals. |
| **Peterbilt** | On-road | 589 | Paccar MX-13 | - | Post-2021 Emissions/2022 Model Year Warranty: PACCAR Inc. approves the use of paraffinic diesel at any blend level or as a stand-alone fuel, providing that the following conditions are met:<br>• The paraffinic diesel in the fuel meets EN 15940 specifications, and<br>• The finished fuel meets the properties of ASTM Standard D975<br>The use of approved paraffinic diesel fuel does not affect the PACCAR engine warranty, or its maintenance intervals. |
| **Peterbilt** | On-road | 589 | Cummins X15 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |
| **Peterbilt** | On/Off-road | 567 | Paccar MX-11 | - | Post-2021 Emissions/2022 Model Year Warranty: PACCAR Inc. approves the use of paraffinic diesel at any blend level or as a stand-alone fuel, providing that the following conditions are met:<br>• The paraffinic diesel in the fuel meets EN 15940 specifications, and<br>• The finished fuel meets the properties of ASTM Standard D975<br>The use of approved paraffinic diesel fuel does not affect the PACCAR engine warranty, or its maintenance intervals. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Peterbilt** | On/Off-road | 567 | Paccar MX-13 | - | Post-2021 Emissions/2022 Model Year Warranty: PACCAR Inc. approves the use of paraffinic diesel at any blend level or as a stand-alone fuel, providing that the following conditions are met:<br>▪ The paraffinic diesel in the fuel meets EN 15940 specifications, and<br>▪ The finished fuel meets the properties of ASTM Standard D975<br>The use of approved paraffinic diesel fuel does not affect the PACCAR engine warranty, or its maintenance intervals. |
| **Peterbilt** | On/Off-road | 567 | Cummins X15 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |
| **Peterbilt** | On/Off-road | 520 | Paccar MX-11 | - | Post-2021 Emissions/2022 Model Year Warranty: PACCAR Inc. approves the use of paraffinic diesel at any blend level or as a stand-alone fuel, providing that the following conditions are met:<br>▪ The paraffinic diesel in the fuel meets EN 15940 specifications, and<br>▪ The finished fuel meets the properties of ASTM Standard D975<br>The use of approved paraffinic diesel fuel does not affect the PACCAR engine warranty, or its maintenance intervals. |
| **Thomas Built** | On-road | Saf-T-Liner C2 | Detroit DD5 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Thomas Built** | On-road | Saf-T-Liner C2 | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Thomas Built** | On-road | Saf-T-Liner EFX | Cummins ISB | - | ISB approved |
| **Thomas Built** | On-road | Saf-T-Liner HDX | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Thomas Built** | On-road | Saf-T-Liner HDX | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Thomas Built** | On-road | Transit-Liner C2 | Detroit DD5 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Thomas Built** | On-road | Transit-Liner C2 | Cummins ISB | - | ISB approved |
| **Thomas Built** | On-road | Transit-Liner EFX | Cummins ISB | - | ISB approved |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Thomas Built** | On-road | Transit-Liner HDX | Detroit DD8 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document. Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document. Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document. Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel. EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America. Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Thomas Built** | On-road | Transit-Liner HDX | Cummins B6.7 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Thomas Built** | On-road | Transit-Liner HDX | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Volvo** | On-road | VNL | D11 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo** | On-road | VNL | D13 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo** | On-road | VNR | D11 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Volvo** | On-road | VNR | D13 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo** | On-road | VNX | D13 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo** | On/Off-road | VHD | D11 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo** | On/Off-road | VHD | D13 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo** | On-road | VAH | D11 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo** | On-road | VAH | D13 | - | Use interchangeably up to 100% maximum if conforms to ASTM D975 or EN15940, will not adversely affect engine or aftertreatment performance / durability. All diesel engines certified for HVO100. |
| **Volvo Penta** | Off-road | - | All on / off-road | - | All 2016 and greater Volvo Penta diesel engines compatible with EN 15940 HVO |
| **Wartsila** | Off-road | - | 34DF | IMO Tier III, EPA Tier 3 | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment.<br>Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 31 | IMO Tier II | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment.<br>Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 31DF | IMO Tier II | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment.<br>Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Wartsila** | Off-road | - | 32 | IMO Tier II | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 20 | IMO Tier II | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 26 | IMO Tier II | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 38 | - | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 46 | - | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Wartsila** | Off-road | - | 46F | IMO Tier II | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 50 | - | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 64 | - | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 20DF | IMO Tier II | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Wartsila** | Off-road | - | 46DF | - | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Wartsila** | Off-road | - | 50DF | - | Paraffinic diesel fuels from synthesis and hydrotreatment can be mixed with fossil distillate fuel and residual fuel with various ratios. Fossil fuel being used as a blending component has to fulfil Wärtsilä's distillate and residual fuel specification based on the ISO 8217:2017(E) standard. Depending on the bio component type its quality has to meet either the EN 14214:2012 standard included in the table FAME, or the EN 15940:2016 standard included in the table Paraffinicdiesel fuels from synthesis and hydrotreatment. Expectation to operator to meet EN 15940:2016 but also to contact Classification Society and/or Flag Administration for confirmation. |
| **Western Star** | On-road | 47X | Detroit DD13 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document. Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document. Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document. Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel. EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America. Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Western Star** | On-road | 49X | Detroit DD13 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document. Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document. Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document. Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel. EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America. Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Western Star** | On-road | 57X | Detroit DD13 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document. Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document. Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document. Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel. EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America. Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Western Star** | On-road | 49X | Detroit DD15 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Western Star** | On-road | 57X | Detroit DD15 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Western Star** | On-road | 49X | Detroit DD16 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |
| **Western Star** | On-road | 57X | Detroit DD16 | - | Renewable Diesel (R100) is compatible provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with diesel fuel in any blend ratio (R1 to R99) provided that it meets the specifications listed in this document.<br>Renewable Diesel can be blended with up to 5% biodiesel (B5/R95) provided that the finished fuel meets the specifications listed in this document.<br>Renewable Diesel blends up to 100% must be produced to meet the specifications of EN15940 prior to blending with petroleum or biodiesel.<br>EN15940 fuel will meet ASTM D975 standards and may be marketed as either in North America.<br>Renewable Diesel blends with a maximum concentration of 5% biodiesel (B5) must meet ASTM D975, or CAN/GCSB- 3.520 at a minimum, and DETROIT™ requirements detailed at DDC-SVC-BRO-120. |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Western Star** | On-road | 47X | Cummins L9 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Western Star** | On-road | 47X | Cummins X12 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022.<br><br>B4.5, B6.7 and L9 engine platforms are compatible with paraffinic renewable diesel fuels meeting the EN 15940 specification. Both On-Highway and Off-Highway versions of the B6.7 and L9 platforms and all vintages are approved to use paraffinic diesel fuels in North America. |
| **Western Star** | On-road | 49X | Cummins X12 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |
| **Western Star** | On-road | 49X | Cummins X15 | - | Cummins has approved up to 100% blend of paraffinic fuels for B6.7, L9, X12*, X15* On-Highway engine series. Cummins HELM™ platforms and advanced diesel engines are also supporting customers in their journey to lower emissions through renewable diesel compatibility.<br><br>*While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. *While running with Paraffinic Fuel, check or reset valve lash at half the specified service interval. Refer to the owner's manual. X15 CM2350 X130C must be built or have an ECM calibration code released after November 9, 2022. X15 CM2350 X140C must be built or have an ECM calibration code released after December 19, 2022. |

* Information contained in this Appendix is only applicable to 100% Renewable diesel (HVO 100) meeting ASTM D975 and CAN/CGSB-3.520 specifications. The above table is for information purposes only and contains third-party content. As of October 2024. ExxonMobil is not responsible for any errors or omissions, or for the results obtained from the use of this information. All information in this page is provided ""as is"", with no guarantee of completeness, accuracy, timeliness or of the results obtained from the use of this information. ExxonMobil makes no representation or warranty as to any third-party content, including but not limited to engine compatibility data, and ExxonMobil's use thereof is not an endorsement, recommendation, or adoption of such content. Please contact your engine manufacturer for more information. ExxonMobil has also provided links in this document to third-party websites for ease of reference (see sources** for more information). These links direct you to third-party websites not controlled by ExxonMobil, and you will be subject to their terms and conditions. All statements and opinions expressed on these sites are solely those of the content provider.

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New Holland Agriculture – NEW T4FV ROPS T4FV CAB
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## Appendix

# HVO100 compatibility* with diesel engines (Asia-Pacific region)

The following information only applies to the listed medium and heavy-duty engines and vehicles.

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **DAF** | Off-road | New Generation XDC | Paccar MX-11 | Euro III to VI | New Generation DAF trucks (LF, CF, XF, XG, XG+) in Australia, New Zealand, and Singapore are approved and ready for renewable diesel (HVO 100 or blends). Additional information available in the Sources linked at the end of this Appendix. |
| **DAF** | Off-road | New Generation XFC | Paccar MX-11 | Euro III to VI | |
| **DAF** | Off-road | New Generation XFC | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | CF | Paccar BE | Euro III and earlier | |
| **DAF** | On-road | CF | Paccar CE | Euro III and earlier | |
| **DAF** | On-road | CF | Paccar GR | Euro IV and V | |
| **DAF** | On-road | CF | Paccar PE | Euro III and earlier | |
| **DAF** | On-road | CF | Paccar PR | Euro IV and V | |
| **DAF** | On-road | CF | Paccar PX-7 | Euro III to VI | |
| **DAF** | On-road | CF | Paccar XE | Euro III and earlier | |
| **DAF** | On-road | CF Model Year 2017 and later | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | CF Model Year 2017 and later | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | LF | Paccar BE | Euro III and earlier | |
| **DAF** | On-road | LF | Paccar CE | Euro III and earlier | |
| **DAF** | On-road | LF | Paccar FR | Euro IV and V | |
| **DAF** | On-road | LF | Paccar GR | Euro IV and V | |
| **DAF** | On-road | LF | Paccar PX-5 | Euro III to VI | |
| **DAF** | On-road | LF | Paccar PX-7 | Euro III to VI | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **DAF** | On-road | New Generation XB | Paccar PX-5 | Euro III to VI | |
| **DAF** | On-road | New Generation XB | Paccar PX-7 | Euro III to VI | |
| **DAF** | On-road | New Generation XD | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XD | Paccar PX-7 | Euro III to VI | |
| **DAF** | On-road | New Generation XF | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XF | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | New Generation XG | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XG | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | New Generation XG+ | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | New Generation XG+ | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | XF | Paccar MX | Euro IV and V | |
| **DAF** | On-road | XF | Paccar XE | Euro III and earlier | |
| **DAF** | On-road | XF Model Year 2017 and later | Paccar MX-11 | Euro III to VI | |
| **DAF** | On-road | XF Model Year 2017 and later | Paccar MX-13 | Euro III to VI | |
| **DAF** | On-road | XG | Paccar PX-15 | Euro VI | |
| | | | | | |
| **Iveco** | On-road | Motorhome | 136EVID | Euro VI | CNH Industrial (Iveco). The areas of collaboration envisaged by the LoI include Eni's offer of 100% pure HVO for IVECO heavy trucks equipped with engines able to operate on it. High-quality HVO biofuel can be used in its pure form in all of the most recent diesel engines. |
| **Iveco** | On-road | Motorhome | 180EVID | Euro VI | |
| **Iveco** | On-road | Motorhome | 210EVID | Euro VI | |
| **Iveco** | On-road | S-Way | Cursor 11 | Euro VI | |
| **Iveco** | On-road | S-Way | Cursor 13 | Euro VI | |
| **Iveco** | On-road | S-Way | Cursor 13 (2) | Euro VI | |
| **Iveco** | On-road | S-Way | Cursor 9 | Euro VI | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Iveco** | On-road / Off-road | ACCO 6X4 | Cursor 9 | Euro VI | |
| **Iveco** | On-road / Off-road | ACCO 8X4 | Cursor 9 | Euro VI | |
| **Iveco** | On-road / Off-road | Eurocargo 4x2 | Tector 7 | Euro VI | |
| **Iveco** | On-road / Off-road | Eurocargo 4x4 | Tector 7 | Euro VI | |
| **Iveco** | On-road / Off-road | T-way | Cursor 13 | Euro VI | |
| **Iveco** | On-road / Off-road | T-way | Cursor 9 | Euro VI | |
| **Mack Trucks** | On-road | All models (factory fill) | MP 7, 8, 11 | Euro VI | Starting December 2024, all Mack trucks built at Wacol QLD (including Anthem, Trident, Super-Liner) will be factory-filled with HVO100.<br>No engine modifications required; HVO100 can be used as a standalone fuel or blended with conventional diesel. |
| **Mack Trucks** | On-road | Anthem | MP 8 | Euro VI | |
| **Mack Trucks** | On-road | Super-Liner | MP 11 | Euro VI | |
| **Mack Trucks** | On-road | Titan | MP 11 | Euro VI | |
| **Mack Trucks** | On-road | Trident | MP 8 | Euro VI | |
| **Mercedes-Benz Trucks** | Off-road (Special truck) | Extreme off-road Unimog | OM 934 LA | Euro VI | Currently, Mercedes-Benz Trucks and Freightliner are distributed in NZ by Daimler Truck Australia Pacific based in Mulgrave, Victoria. |
| **Mercedes-Benz Trucks** | On-road | Actros L with ProCabin | OM 470 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road | Actros L with ProCabin | OM 471 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road | Actros L with ProCabin | OM 473 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road | Atego construction transport | OM 934 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road | Atego construction transport | OM 936 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road | Atego distribution haulage | OM 934 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road | Atego distribution haulage | OM 936 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Distribution) | Actros | OM 470 | Euro VI | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Mercedes-Benz Trucks** | On-road (Distribution) | Actros | OM 471 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Distribution) | Actros | OM 473 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Distribution) | Actros | OM 936 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Long-distance) | Actoros L up to 500 t | OM 471 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Long-distance) | Actoros L up to 500 t | OM 473 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Long-distance) | Actros L | OM 470 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Long-distance) | Actros L | OM 471 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Long-distance) | Actros L | OM 473 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road (Special truck) | Econic | OM 936 LA | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Construction) | Arocs | OM 470 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Construction) | Arocs | OM 471 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Construction) | Arocs | OM 473 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Construction) | Arocs | OM 936 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Construction) | Arocs up to 500 t | OM 471 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Construction) | Arocs up to 500 t | OM 473 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Distribution / Construction) | Atego | OM 934 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Distribution / Construction) | Atego | OM 936 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Special truck) | Unimog implement carrier | OM 934 | Euro VI | |
| **Mercedes-Benz Trucks** | On-road / Off-road (Special truck) | Unimog implement carrier | OM 936 | Euro VI | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Scania** | Off-road | XT | 7-litre | Euro VI | All of our Euro 5 and 6 engines can run on Hydrotreated Vegetable Oil (HVO), while nearly all our vehicles can run on FAME biodiesel. |
| **Scania** | Off-road | XT | 9-litre | Euro VI | |
| **Scania** | Off-road | XT | 13-litre | Euro VI | |
| **Scania** | Off-road | XT | Super 13-litre | Euro VI | |
| **Scania** | Off-road | XT | 16-litre | Euro VI | |
| **Scania** | On-road | Crewcab | 7-litre | Euro V | |
| **Scania** | On-road | Crewcab | 7-litre | Euro VI | |
| **Scania** | On-road | Crewcab | 9-litre | Euro III | |
| **Scania** | On-road | Crewcab | 9-litre | Euro IV | |
| **Scania** | On-road | Crewcab | 9-litre | Euro V | |
| **Scania** | On-road | Crewcab | 9-litre | Euro VI | |
| **Scania** | On-road | Crewcab | 13-litre | Euro III | |
| **Scania** | On-road | Crewcab | 13-litre | Euro IV | |
| **Scania** | On-road | Crewcab | 13-litre | Euro V | |
| **Scania** | On-road | Crewcab | 13-litre | Euro VI | |
| **Scania** | On-road | Crewcab | Super 13-litre | Euro VI | |
| **Scania** | On-road | G-series | 9-litre | Euro III | |
| **Scania** | On-road | G-series | 9-litre | Euro IV | |
| **Scania** | On-road | G-series | 9-litre | Euro V | |
| **Scania** | On-road | G-series | 9-litre | Euro VI | |
| **Scania** | On-road | G-series | 13-litre | Euro III | |
| **Scania** | On-road | G-series | 13-litre | Euro IV | |
| **Scania** | On-road | G-series | 13-litre | Euro V | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Scania** | On-road | G-series | 13-litre | Euro VI | |
| **Scania** | On-road | G-series | Super 13-litre | Euro VI | |
| **Scania** | On-road | L-series | 7-litre | Euro V | |
| **Scania** | On-road | L-series | 7-litre | Euro VI | |
| **Scania** | On-road | L-series | 9-litre | Euro V | |
| **Scania** | On-road | L-series | 9-litre | Euro VI | |
| **Scania** | On-road | P-series | 7-litre | Euro V | |
| **Scania** | On-road | P-series | 7-litre | Euro VI | |
| **Scania** | On-road | P-series | 9-litre | Euro III | |
| **Scania** | On-road | P-series | 9-litre | Euro IV | |
| **Scania** | On-road | P-series | 9-litre | Euro V | |
| **Scania** | On-road | P-series | 9-litre | Euro VI | |
| **Scania** | On-road | P-series | 13-litre | Euro III | |
| **Scania** | On-road | P-series | 13-litre | Euro IV | |
| **Scania** | On-road | P-series | 13-litre | Euro V | |
| **Scania** | On-road | P-series | 13-litre | Euro VI | |
| **Scania** | On-road | P-series | Super 13-litre | Euro VI | |
| **Scania** | On-road | R-series | 9-litre | Euro III | |
| **Scania** | On-road | R-series | 9-litre | Euro IV | |
| **Scania** | On-road | R-series | 9-litre | Euro V | |
| **Scania** | On-road | R-series | 9-litre | Euro VI | |
| **Scania** | On-road | R-series | 13-litre | Euro III | |
| **Scania** | On-road | R-series | 13-litre | Euro IV | |
| **Scania** | On-road | R-series | 13-litre | Euro V | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Scania** | On-road | R-series | 13-litre | Euro VI | |
| **Scania** | On-road | R-series | Super 13-litre | Euro VI | |
| **Scania** | On-road | R-series | 16-litre | Euro III | |
| **Scania** | On-road | R-series | 16-litre | Euro IV | |
| **Scania** | On-road | R-series | 16-litre | Euro V | |
| **Scania** | On-road | R-series | 16-litre | Euro VI | |
| **Scania** | On-road | S-series | 13-litre | Euro III | |
| **Scania** | On-road | S-series | 13-litre | Euro IV | |
| **Scania** | On-road | S-series | 13-litre | Euro V | |
| **Scania** | On-road | S-series | 13-litre | Euro VI | |
| **Scania** | On-road | S-series | Super 13-litre | Euro VI | |
| **Scania** | On-road | S-series | 16-litre | Euro III | |
| **Scania** | On-road | S-series | 16-litre | Euro IV | |
| **Scania** | On-road | S-series | 16-litre | Euro V | |
| **Scania** | On-road | S-series | 16-litre | Euro VI | |
| **Scania** | On-road | V8 | V-8 | Euro VI | |
| **Volvo** | On-road | FE | D8 | Euro VI | Volvo Trucks New Zealand announces sales start of revamped heavy-duty range. All power ratings are HVO (Hydrotreated Vegetable Oil) compatible. All Volvo trucks built at Wacol QLD factory from Dec 2024 receive HVO100 first fill. No engine mods required. |
| **Volvo** | On-road | FH | D13 | Euro VI | |
| **Volvo** | On-road | FH | D13 I-Save | Euro VI | |
| **Volvo** | On-road | FH16 | D17 | Euro VI | |
| **Volvo** | On-road | FH16 Aero | D17 | Euro VI | |

| Manufacturer | Application | Model | Engine | Emission Level | Comments |
|---|---|---|---|---|---|
| **Volvo** | On-road | FM | D11 | Euro VI | |
| **Volvo** | On-road | FM | D13 | Euro VI | |
| **Volvo** | On-road | FMX | D11 | Euro VI | |
| **Volvo** | On-road | FMX | D13 | Euro VI | |

* Information contained in this Appendix is only applicable to HVO 100 meeting EN 15940 specifications. The above table is for information purposes only and contains third-party content. As of January 2026. ExxonMobil is not responsible for any errors or omissions, or for the results obtained from the use of this information. All information in this page is provided “”as is””, with no guarantee of completeness, accuracy, timeliness or of the results obtained from the use of this information. ExxonMobil makes no representation or warranty as to any third-party content, including but not limited to engine compatibility data, and ExxonMobil's use thereof is not an endorsement, recommendation, or adoption of such content. Please contact your engine manufacturer for more information. ExxonMobil has also provided links in this document to third-party websites for ease of reference (see sources** for more information). These links direct you to third-party websites not controlled by ExxonMobil, and you will be subject to their terms and conditions. All statements and opinions expressed on these sites are solely those of the content provider

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DAF LF

DAF XF

DAF XG

DAF XG & XG+ Brochure

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IVECO ACCO 8x4 Rigid AD

IVECO EURCARGO

IVECO EUROCARGO (Brochure)

IVECO Motorhome

IVECO S-WAY

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SCANIA – P-Series 7-litre Euro VI Specifications
SCANIA – P-Series 9-litre Euro IV Specifications
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SCANIA – R-Series 9-litre Euro III Specifications
SCANIA – R-Series 9-litre Euro IV Specifications
SCANIA – R-Series 9-litre Euro V Specifications
SCANIA – R-Series 9-litre Euro VI Specifications
SCANIA – S-Series 16-litre Euro III Specifications
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**Version 3.0**