



# THE DRIVE TO DECARBONIZE

## Shell's Starship Initiative

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## Shell’s net carbon intensity

Also, in this content we may refer to Shell’s “net carbon intensity” (NCI), which includes Shell’s carbon emissions from the production of our energy products, our suppliers’ carbon emissions in supplying energy for that production and our customers’ carbon emissions associated with their use of the energy products we sell. Shell’s NCI also includes the emissions associated with the production and use of energy products produced by others which Shell purchases for resale. Shell only controls its own emissions. The use of the terms Shell’s “net carbon intensity” or NCI is for convenience only and not intended to suggest these emissions are those of Shell plc or its subsidiaries.

## Shell’s net-zero emissions target

Shell’s operating plan and outlook are forecasted for a three-year period and ten-year period, respectively, and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next three and ten years. Accordingly, the outlook reflects our combined Scope 1 and 2 target, NCI target and our oil products ambition over the next ten years. However, Shell’s operating plan and outlook cannot reflect our 2050 net-zero emissions target, as this target is outside our planning period. Such future operating plans and outlooks could include changes to our portfolio, efficiency improvements and the use of carbon capture and storage and carbon credits. In the future, as society moves towards net-zero emissions, we expect Shell’s operating plans and outlooks to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell may not meet this target.

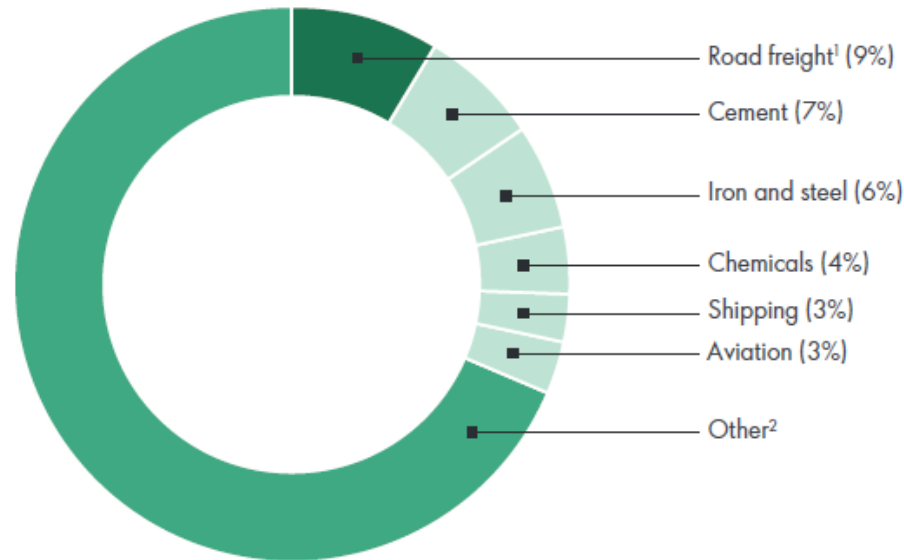
## Forward-Looking non-GAAP measures

This content may contain certain forward-looking non-GAAP measures such as free cash flow and underlying operational expenses. We are unable to provide a reconciliation of these forward-looking non-GAAP measures to the most comparable GAAP financial measures because certain information needed to reconcile those non-GAAP measures to the most comparable GAAP financial measures is dependent on future events some of which are outside the control of Shell, such as oil and gas prices, interest rates and exchange rates. Moreover, estimating such GAAP measures with the required precision necessary to provide a meaningful reconciliation is extremely difficult and could not be accomplished without unreasonable effort. Non-GAAP measures in respect of future periods which cannot be reconciled to the most comparable GAAP financial measure are calculated in a manner which is consistent with the accounting policies applied in Shell plc’s consolidated financial statements.

The contents of websites referred to in this content do not form part of this content.

We may have used certain terms, such as resources, in this content that the United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website [www.sec.gov](http://www.sec.gov)

# The Scale of the Challenge

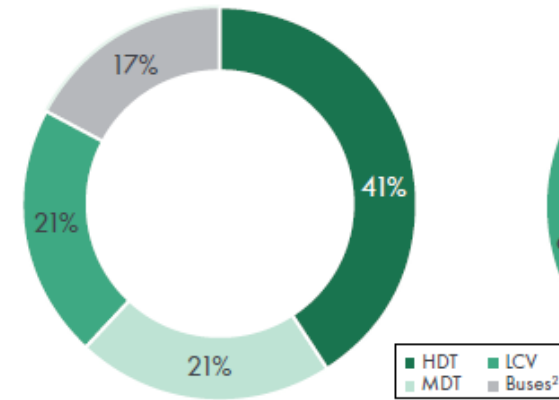


<sup>1</sup> Including LCVs, MDTs, HDTs and 1.5% from buses.

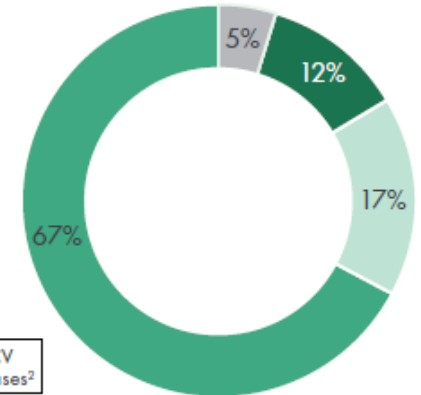
<sup>2</sup> Including power (46.5%), other transport (10.8%), buildings (8.6%), feedstock (1.9%) and other industry (1.6%).

Figure 1: Global CO<sub>2</sub> emissions from road freight

Global road freight CO<sub>2</sub> emissions<sup>1</sup>



Number of trucks and buses



<sup>1</sup> Emissions for light commercial vehicles (LCV), MDT and HDT are taken from Reference 4; emissions for buses are taken from Reference 5.

<sup>2</sup> Buses, including coaches, are not the primary focus of this article.

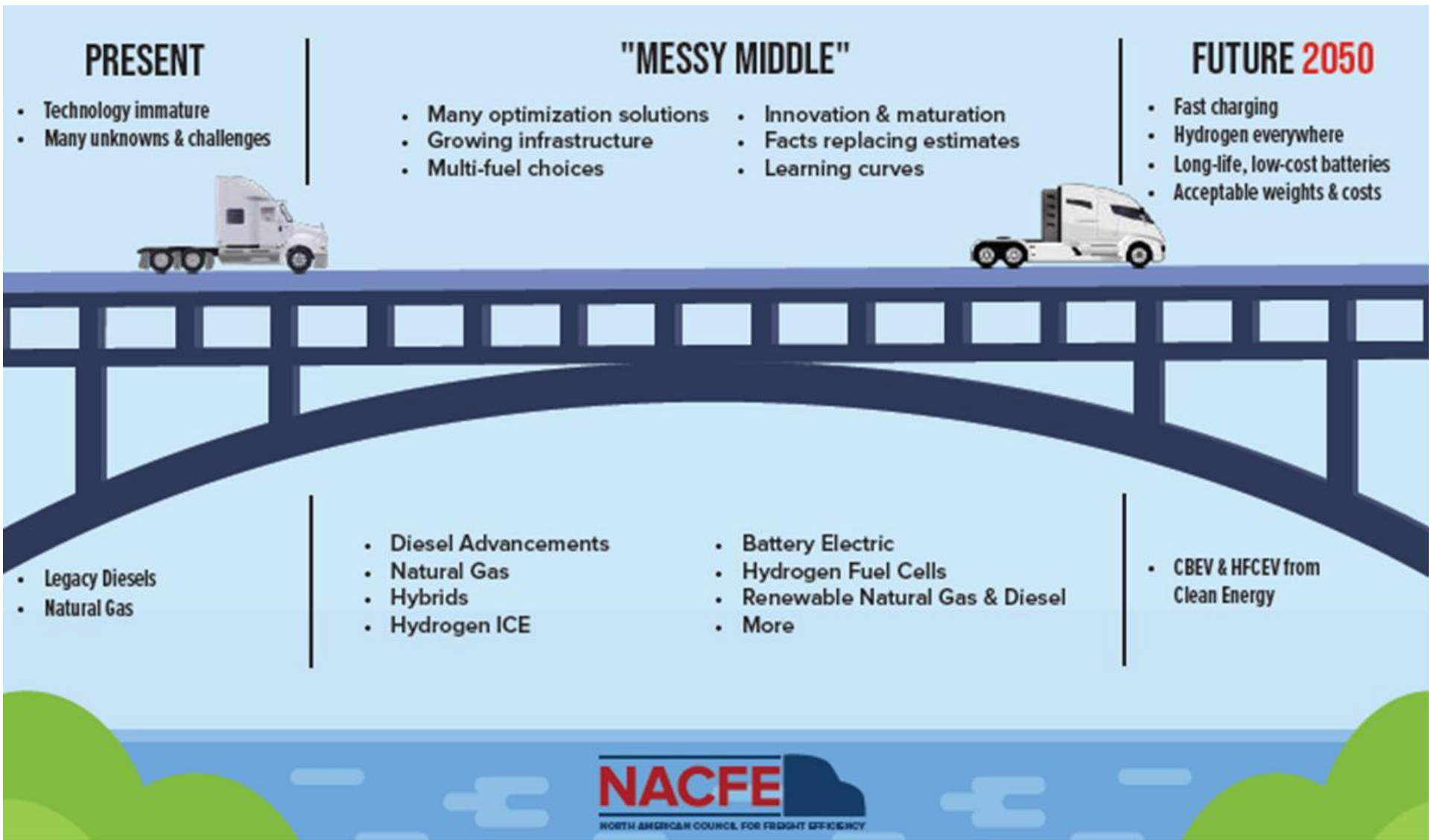
Figure 2: Overview of road freight and global CO<sub>2</sub> emissions.

Sources: IEA Future of trucks, OECD; IEA Energy technology perspectives; IEA Tracking transport 2020; Deloitte analysis.

[Ref 4] Shell: "Decarbonising road freight: Shell's route ahead" (2021)

[Ref 5] IEA: "The future of trucks: Implications for energy," second edition, OECD/IEA (2017)

# The Messy Middle



# Technology Pathways

## POWERTRAIN ALTERNATIVES

Estimate of Technology Readiness by 2025

	SUSTAINABILITY			FLEET OPERATIONAL		INFRASTRUCTURE	INTEGRATION CHALLENGES	MATURITY
	ZEV	Well-to-Wheels	NOx/PM	Range	Route Flex.			
DIESEL	○	○	○	●	●	●	●	●
ICE RENEWABLE *	○	◐	◐	◐	◐	◐	◐	◐
NATURAL GAS	○	◐	◐	◐	◐	◐	◐	◐
HYDROGEN ICE	○	◐	◐	◐	◐	◐	◐	◐
BATTERY ELECTRIC	●	◐	●	○	○	◐	○	◐
HYDROGEN FUEL CELL	●	◐	●	◐	◐	◐	○	○

\* ICE Renewables = Renewable Natural Gas, Renewable Diesel, Renewable Propane, etc. ○ = UNFAVORABLE ● = FAVORABLE

Image Ref: Powertrain alternatives - estimate of technology readiness by 2025 (NACFE - The Messy Middle: A Time for Action)

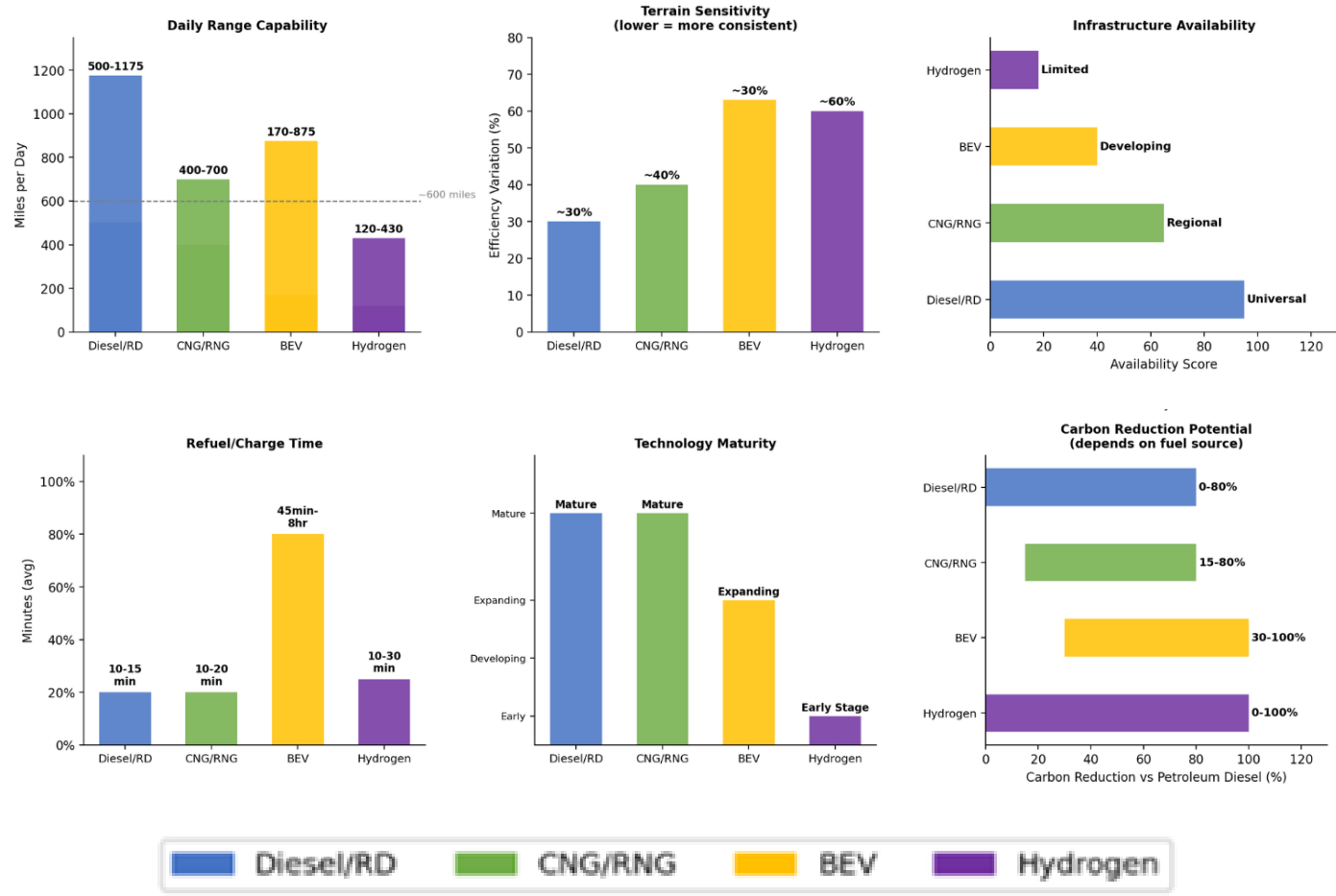


Image Ref: 2025 Run On Less Messy NACFE

## Optimum Duty Cycle Sweet Spot

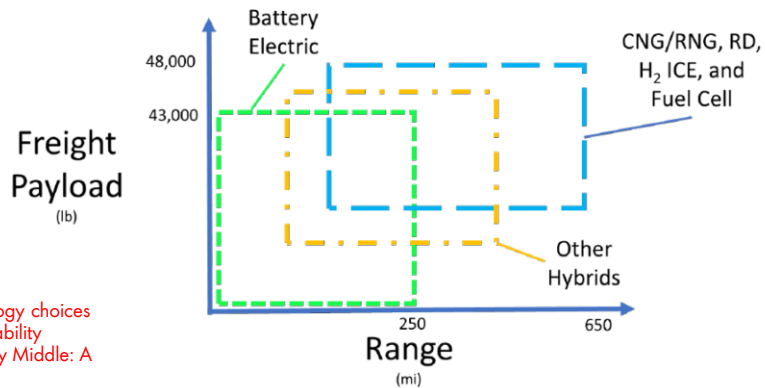


Image Ref: Technology choices for optimum applicability (NACFE - The Messy Middle: A Time for Action)

\*Carbon reduction versus petroleum diesel baseline. Actual reduction depends on fuel source and production pathway. BEV reduction varies with grid carbon intensity; hydrogen reduction varies with production method (gray hydrogen from natural gas reforming vs. green hydrogen from renewable electrolysis).

# The Starship Initiative

With each generation of the Starship, Shell continues to inspire and enable impactful change by demonstrating how the CRT sector can collaborate to reduce energy usage and CO<sub>2</sub> emissions using the best available technologies in a holistic, tested and connected way.

Our technology leadership consists of four pillars:

Aerodynamic design 

Super fuel economy 

Sustainability 

Digitalisation 

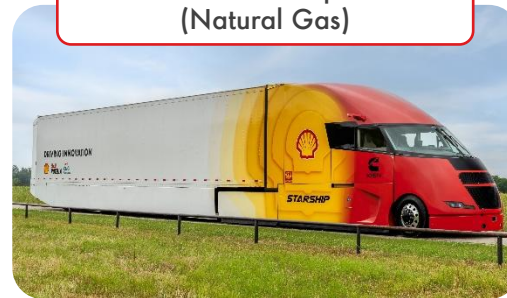
2018 – Starship 1.0



2021 – Starship 2.0



2024 – Starship 3.0  
(Natural Gas)



2025 – Starship 3.0  
(Hybrid)



Both the Starship 1.0 and 2.0 versions of the Shell Starship initiative achieved leading results as we continued to improve on our own success with demonstration runs resulting in improved fuel economy and increased freight-ton efficiency far exceeding the national average for Class 8 Diesel Trucks.

The Shell Starship 3.0 Natural Gas (NG) features a Cummins X15N™ natural gas engine, which has more than triple the national average for Class 8 diesel truck in freight-ton efficiency assessed on a tonne miles per kg of CO<sub>2</sub>e emitted basis.

Taking the learnings from the previous versions, the Starship Initiative has gone global with the Shell Starship 3.0 Hybrid in China, the latest version of Starship trucks.

# Starship 3.0 - Renewable Natural Gas



# Starship 3.0 NG tech summary



Roof-mounted solar panels

Predictive/Adaptive Cruise Control



Aerodynamic features have been enhanced



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



Boat tail streamlines air flow to reduce drag



Zeus Door redesign

Automatic Air Gap Closures



Mirror Eye Camera Driver Vision System

Tank to wheels efficiency  $\eta CV \rho$

$$FTE = k \frac{\eta CV \rho}{\left\{ 1 + \frac{m_T}{m_C} \right\} \{ \mu g + accel + g \sin \theta \} + \frac{1}{m_C} \left\{ \frac{1}{2} \rho V^2 C_D A \right\}}$$

US ton-miles per US gallon

Truck weight  $m_T$

Cargo weight  $m_C$

Rolling resistance  $\mu g + accel + g \sin \theta$

Speed  $V$

Drag coefficient  $C_D A$



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



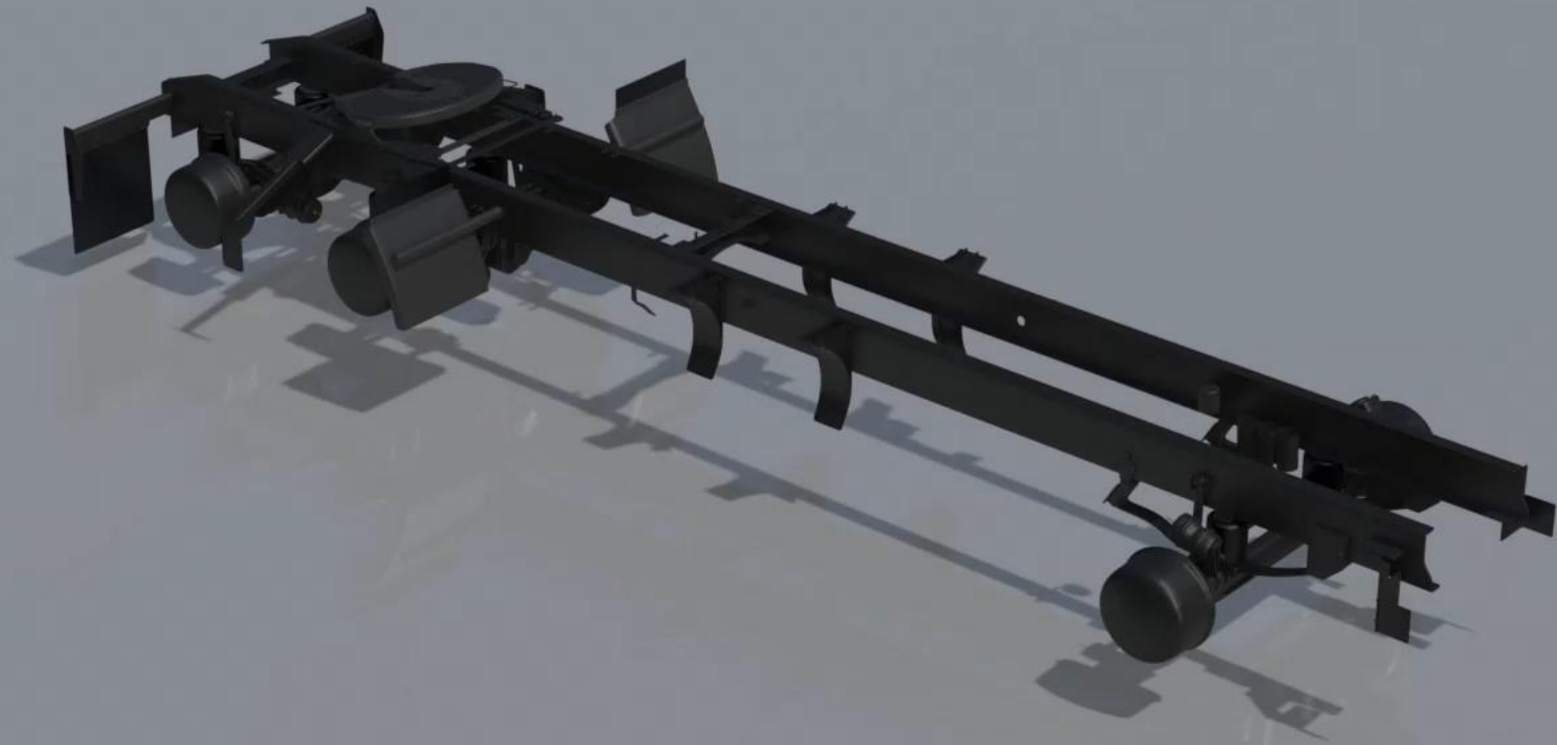
Meritor FUELite Plus Axle with optimised 2.64 axle-ratio

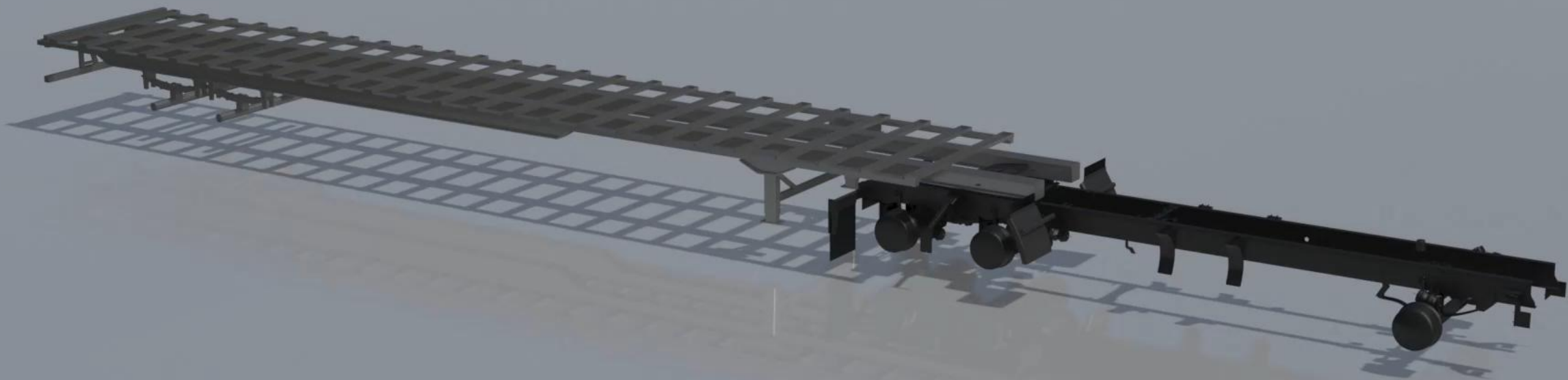


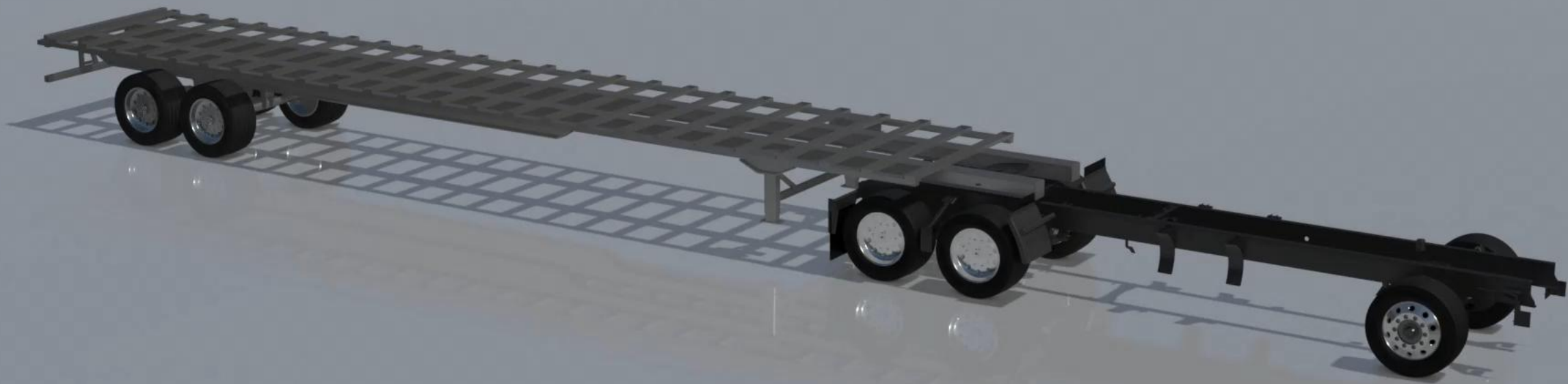
Eaton Endurant 12-Speed Automated Manual Transmission

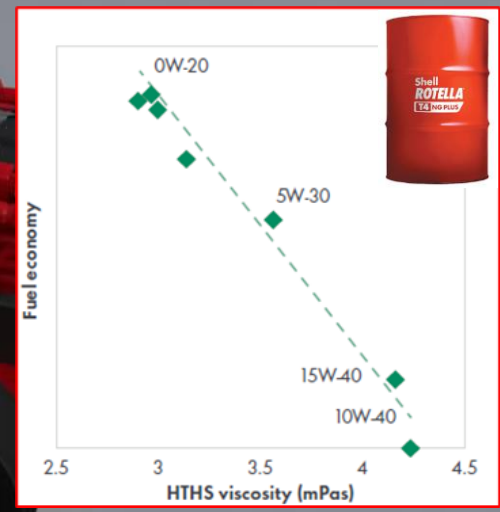


Bridgestone wide-based, low-rolling resistance fuel economy tyres on the truck and trailer

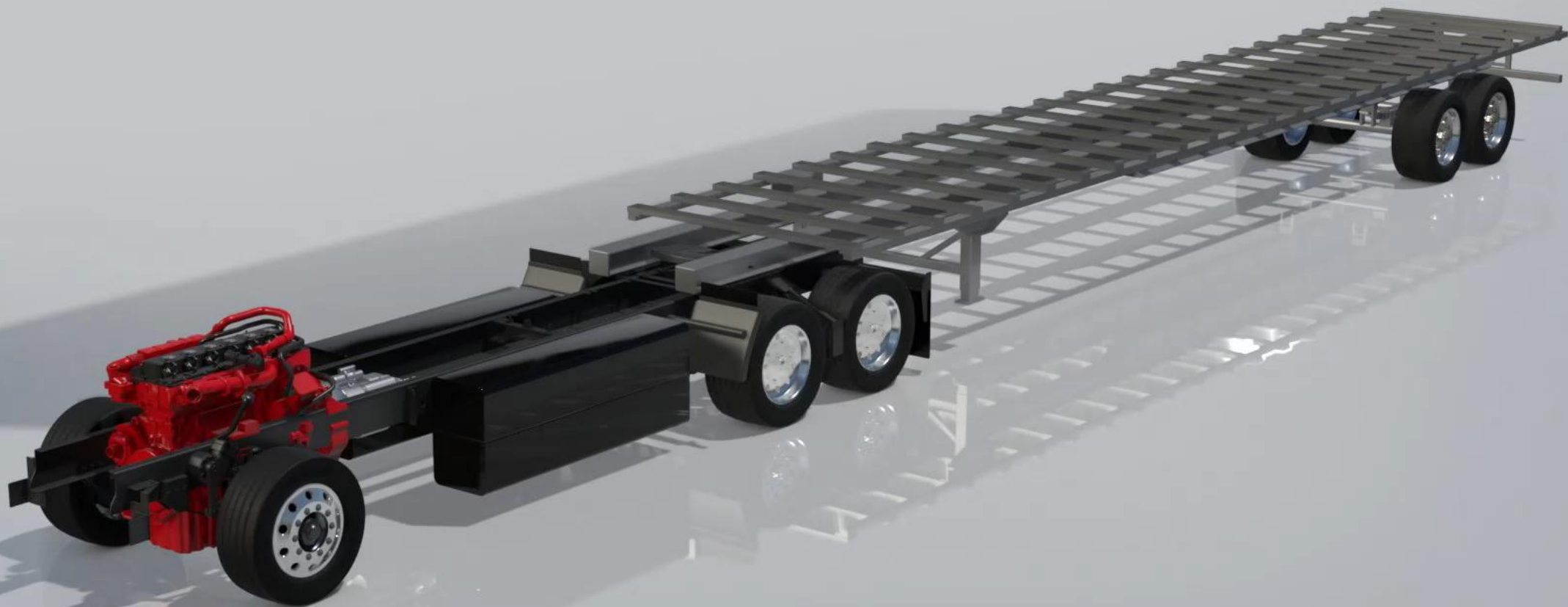


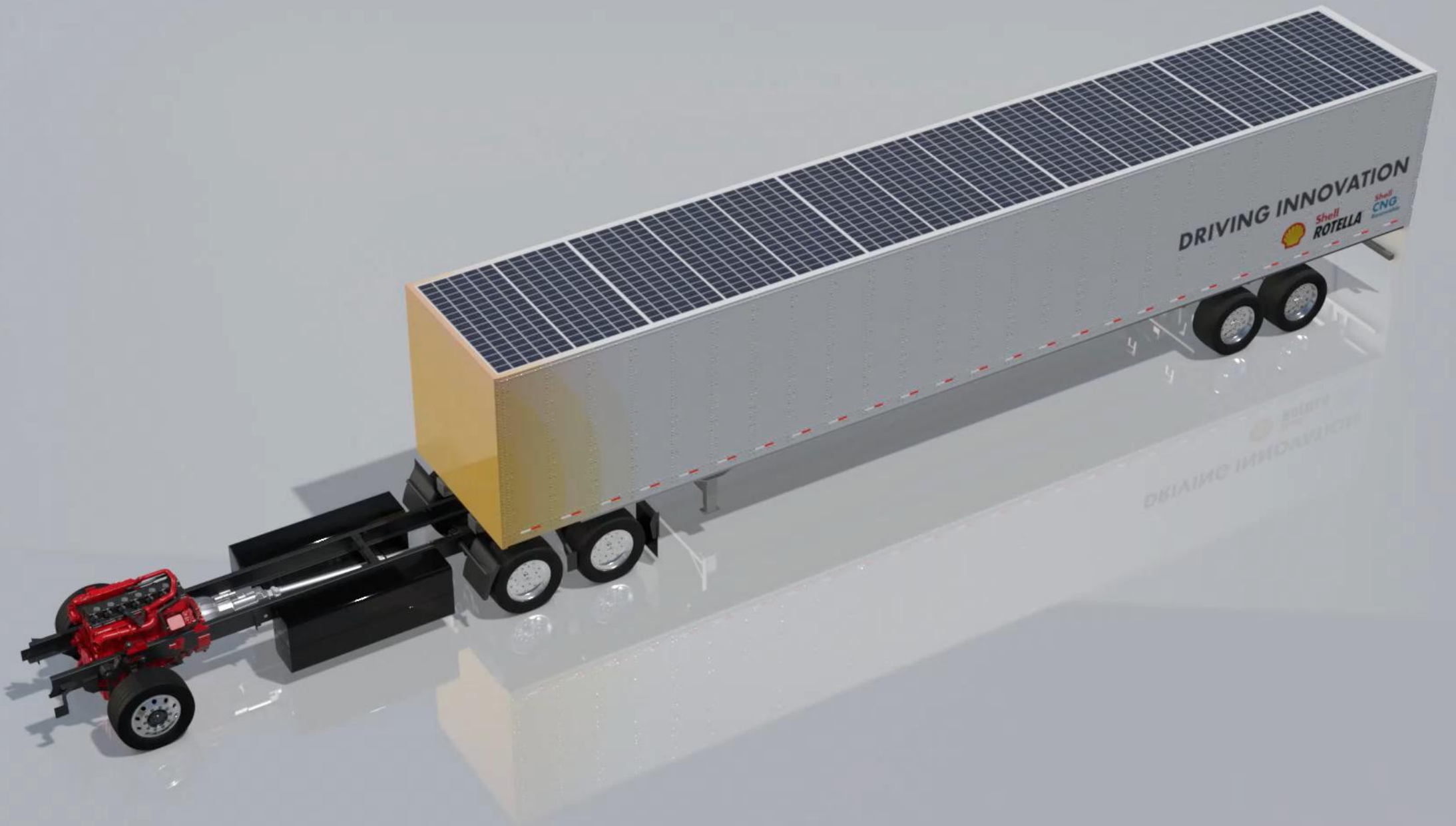


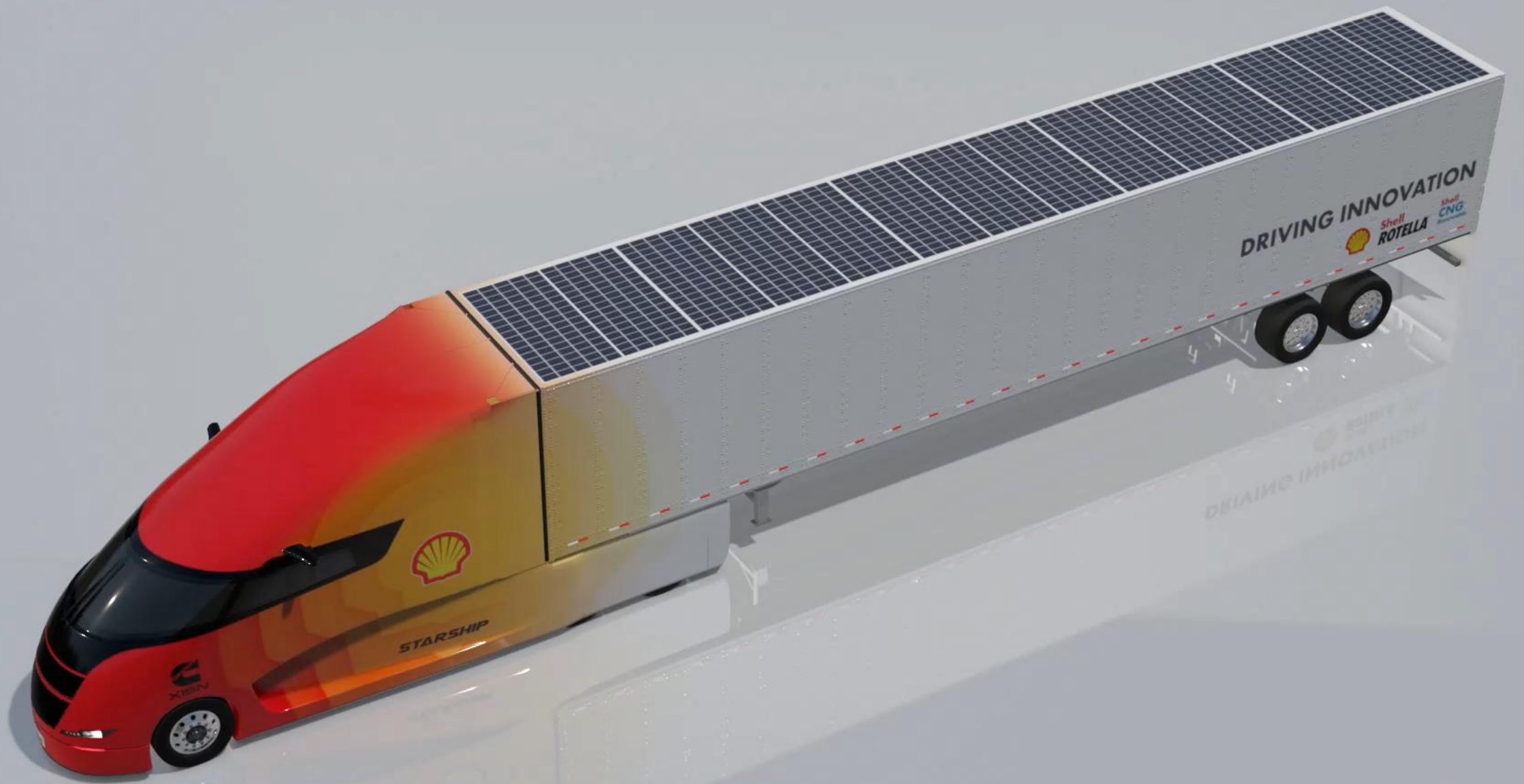
















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Shell  
ROTELLA

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CNG  
Renewable



Shell

XISN



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# Results

# Freight efficiency – per gallon basis



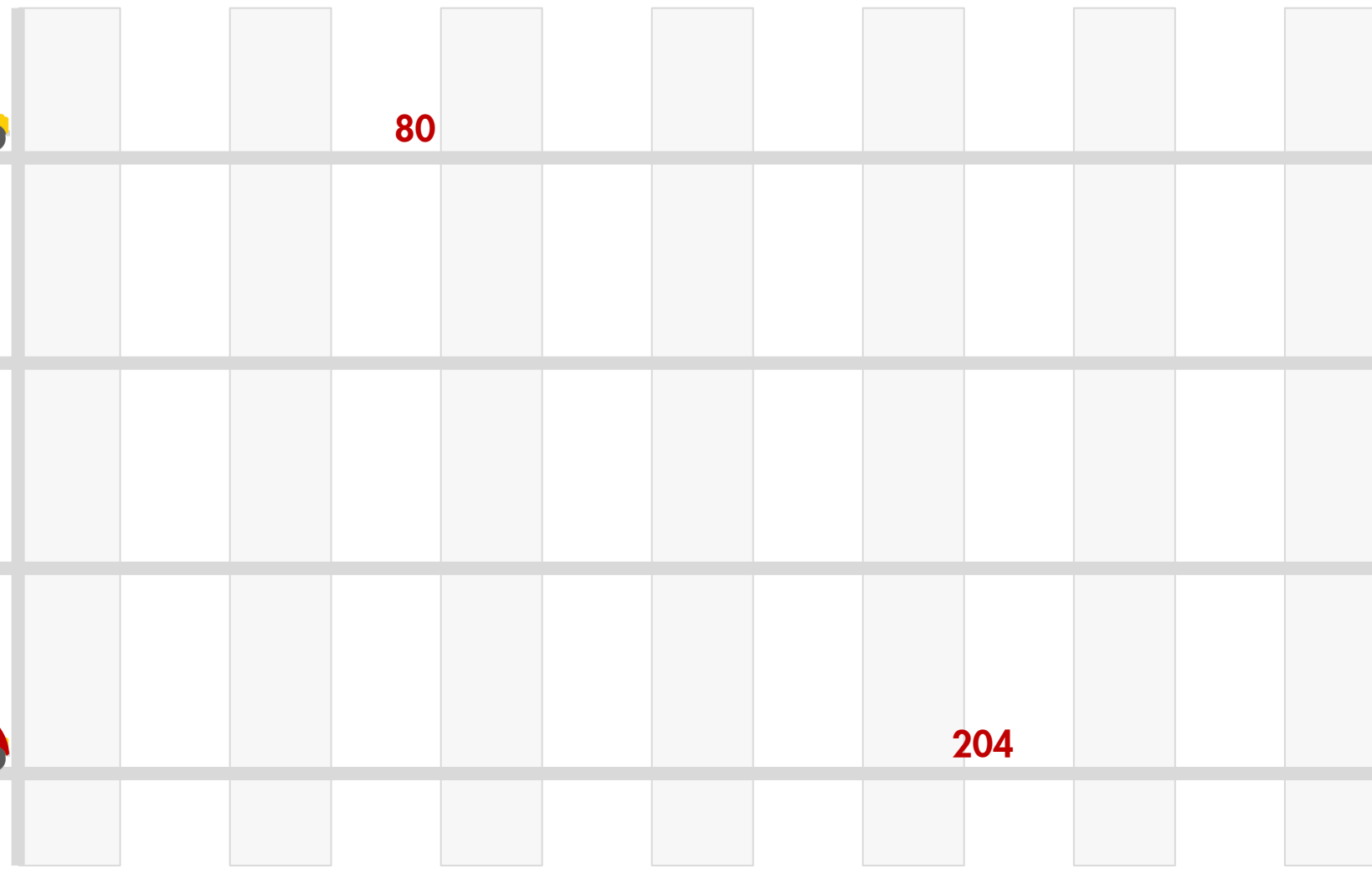
80

US Average Diesel

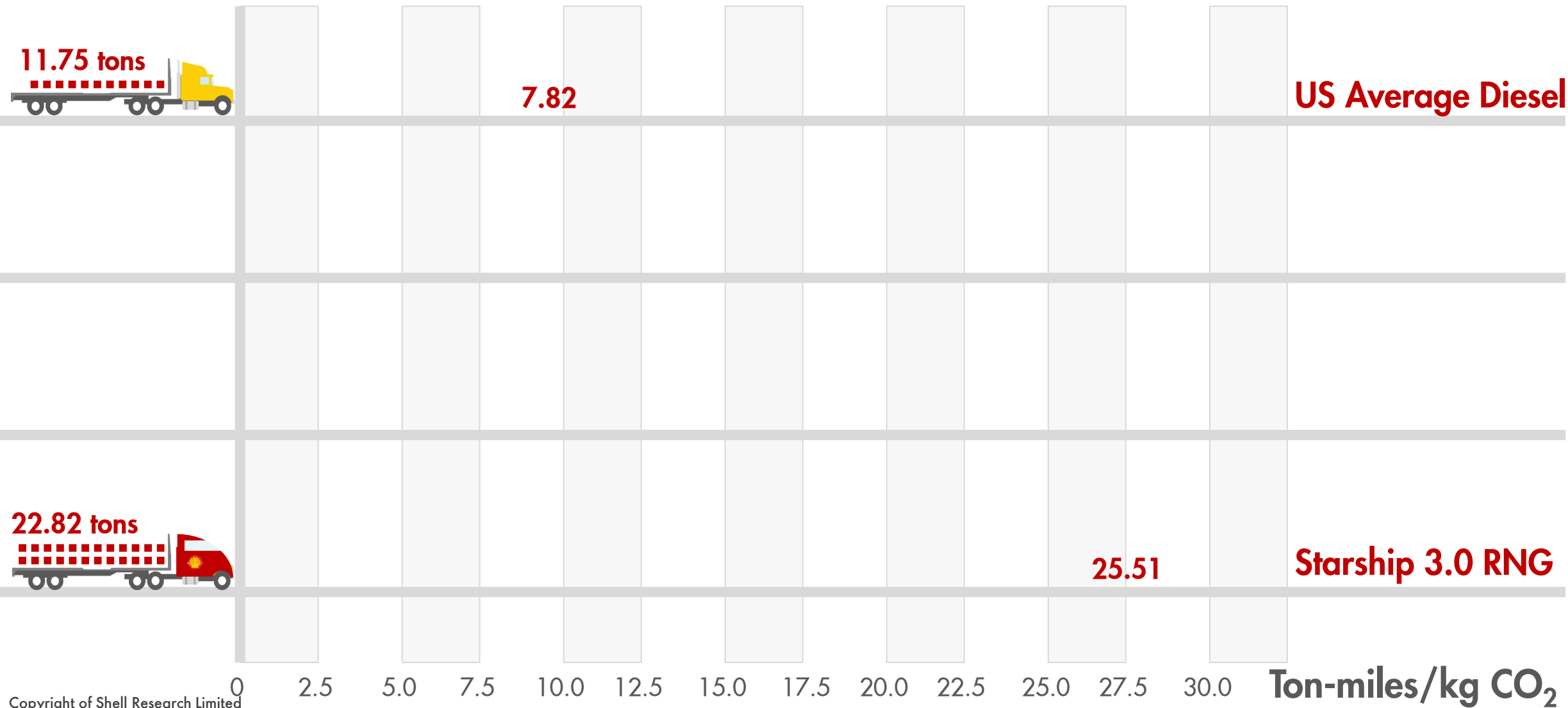


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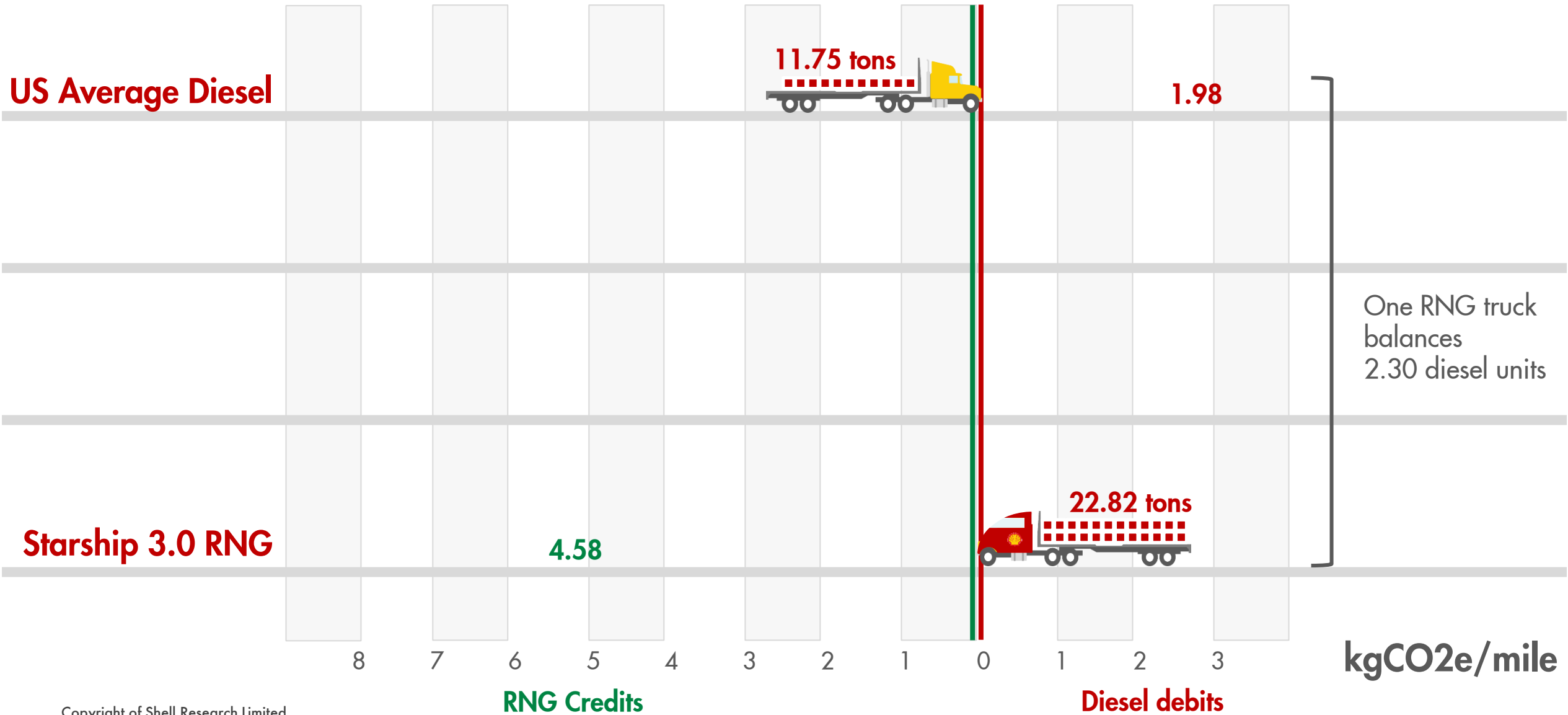
Starship 3.0 RNG



# Freight efficiency – per kg CO<sub>2</sub> basis



# LCFS Credits and debits



# Shell Starship & INDYCAR 2026 Collaboration







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