

BEYOND INCREMENTAL HARNESSING SUPPLIER INNOVATION FOR SUSTAINABLE GROWTH

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SURFACE TRANSPORTATION BOARD HEARING | SEPTEMBER 16-17, 2024
GROWTH IN THE FREIGHT RAIL INDUSTRY

**A next-generation supplier focused
exclusively on zero emission
locomotives and refueling solutions.**



ACCELERATING THE PACE TO
TOTALZER 

INTRODUCTION

Cynthia Heinz, Venture Capital Investor & Board Member



Today, I'd like to spend a few minutes exploring the pivotal role that earlier-stage companies like OptiFuel can play in this complex environment - and where perhaps these contributions can intersect synergistically with some of the goals you have all set forth today.

HARNESSING SUPPLIER INNOVATION FOR SUSTAINABLE GROWTH

U.S. economic vitality, competitiveness, & national security hinge on our locomotive technology.

U.S. railroads are a masterpiece of logistics, strategy, and infrastructure, powered by technology engineered to last a lifetime. And while the focus of this presentation today will be on strategies to leapfrog the constraints imposed by obsolete technologies, the reason we are discussing these constraints is not because these technologies were flawed, but because they've served us so well.

Diesel locomotive technology was so good it has powered our railroads for nearly 100 years - that's a high bar to beat.



A blue diesel locomotive is shown from a front-three-quarter view, emitting a thick plume of black smoke that rises into the sky. The locomotive has two bright headlights on its front. The background shows some green trees and a grey, overcast sky.

The issue is simple: diesel locomotive technology has reached the end of its 100-year era

Without supplier innovation, the industry has become dangerously dependent on obsolete technology

A yellow and black diesel locomotive is shown from a side profile, pulling a long freight train. The locomotive has a red stripe running along its side. The train consists of several yellow freight cars. The background shows green trees and a grey, overcast sky.

While Class I Railroads have committed to improving profit margins, growth, & reaching zero emissions by 2050, they are currently forced into limiting measures—such as modernizations, a focus on longer routes, and using a smaller number of diesel locomotives to pull longer trains—which constrain both growth and service.

U.S. rail is a 200-year old industry with only two suppliers. In normal times, this is fine. But these aren't normal times. In times that demand innovation - our railroads are left vulnerable and constrained.

But what do you do when you can't settle for less, but there is nothing more?

GE

circa 1925

Diesel Engine: Ingersoll-Rand

Electrical Equipment: General Electric

Integrator & Original Supplier: ALCO

Current Supplier: Wabtec

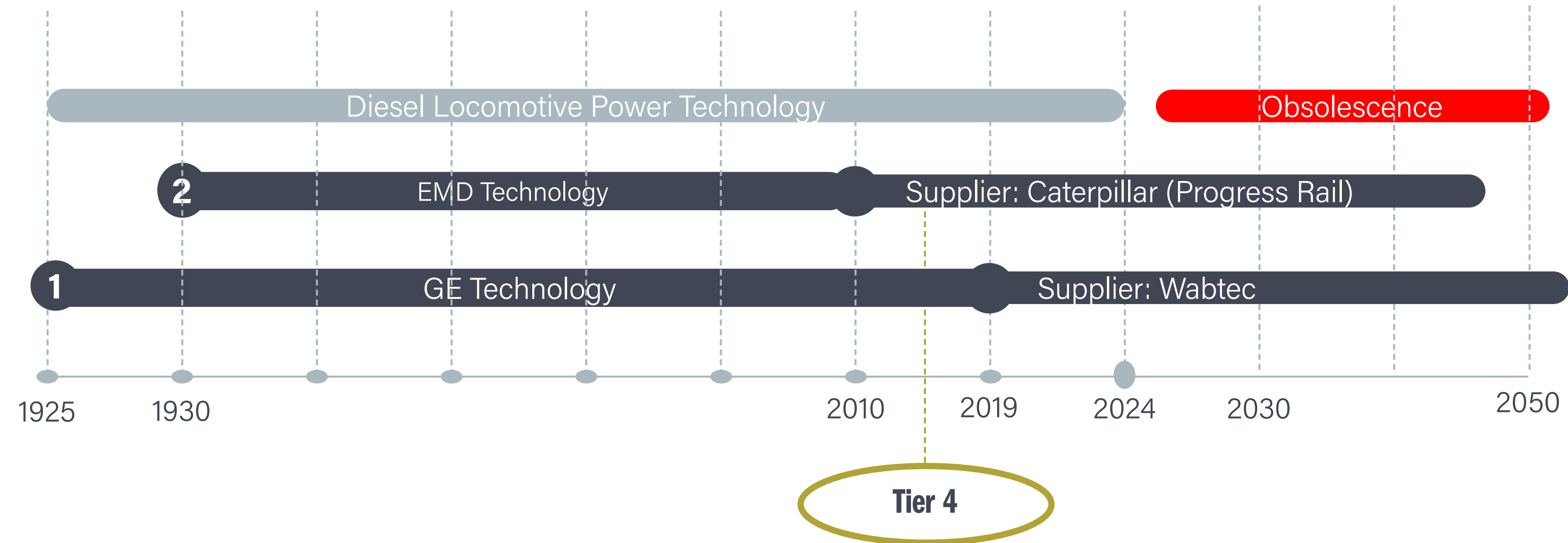
EMD

circa 1930

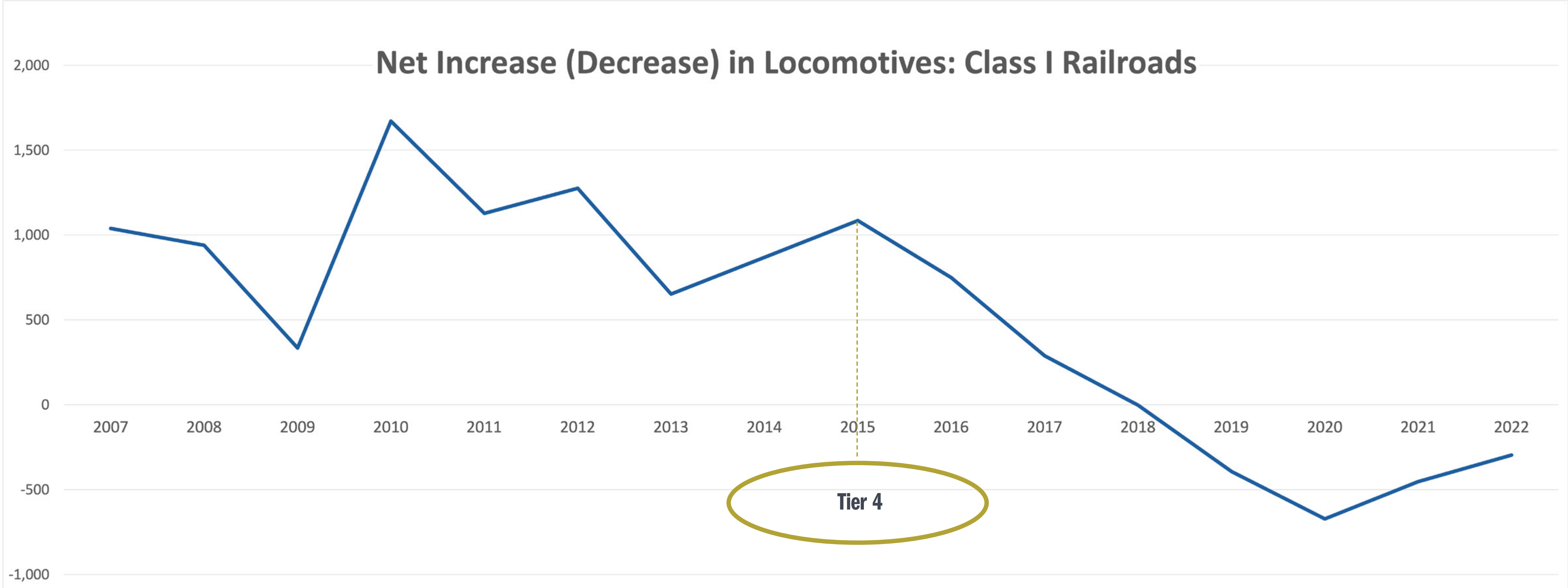
Diesel Engine: General Motors

Electrical Equipment: Electro-Motive Company

Current Supplier: Caterpillar (Progress Rail)



While tenured suppliers excel at later-stage strategies, innovation is not their strength
Since Tier 4 went into effect in 2015, locomotive purchases have plummeted.
Railroads are getting a lot of heat for this, but is this chart the sign of railroads digging in their heels or the sign of a dangerous shortage in viable supply?



To regain market share from trucking and drive growth in intermodal traffic, railroads need affordable, nimble locomotives that are highly efficient, durable for extended operation, and deliver dramatically lower emissions.



TO CATALYZE CHANGE

WE NEED AN OPTION SO COMPELLING THAT INACTION BECOMES UNTHINKABLE

Imagine zero-emission locomotives that not only match or exceed diesel performance but also deploy seamlessly, improve uptime, boost profit margins, and fit within existing capex budgets and equipment replacement cycles—with fuel at a price comparable to diesel.



The question is... how do we get there?

How do we ensure the energy transition in rail doesn't disrupt operations or compromise our supply chain's integrity? And most importantly, how do we make it not just greener, but better?

When we talk about innovation in rail, the real benchmark is whether we can do it better - cheaper, faster, cleaner, and safer. Can we match the ingenuity of our predecessors with solutions that blend cutting-edge equipment, practical collaboration, and optimal use of existing resources? Can we reinspire the resiliency and economic vitality of the U.S. railroad network for the century ahead of us?

But when every technology seems to come up high on price & short on performance, what do we do?

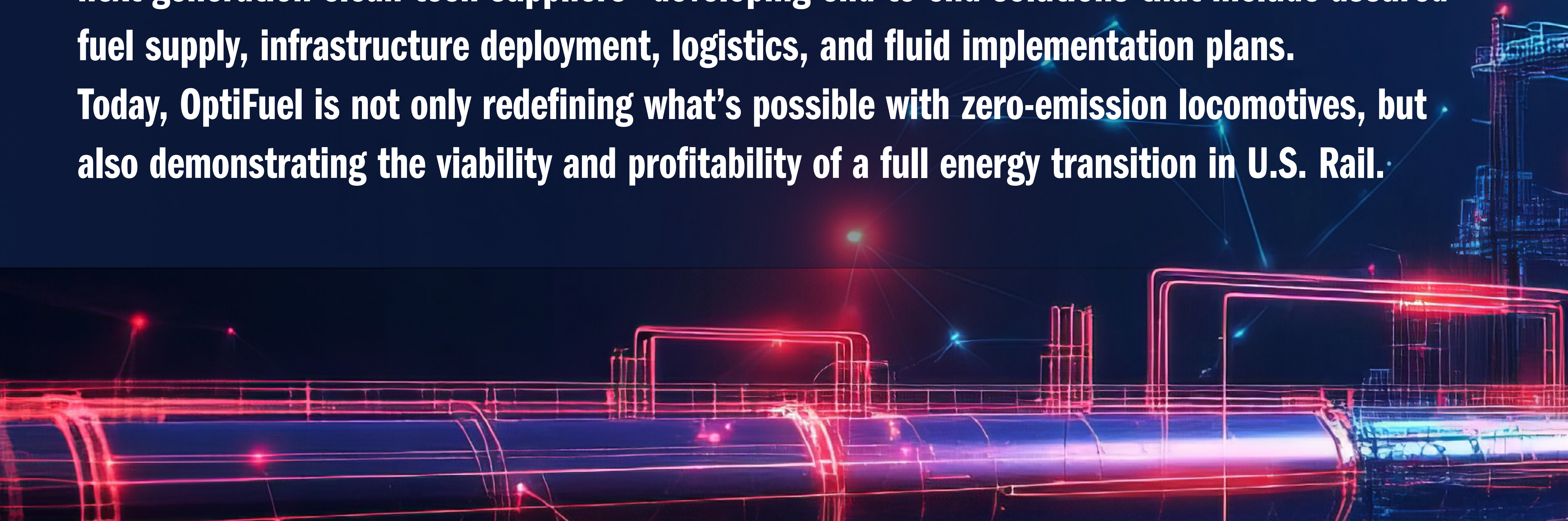
Moments like this offer a prime opportunity for innovators and established industries to collaborate.

CATALYZING CHANGE

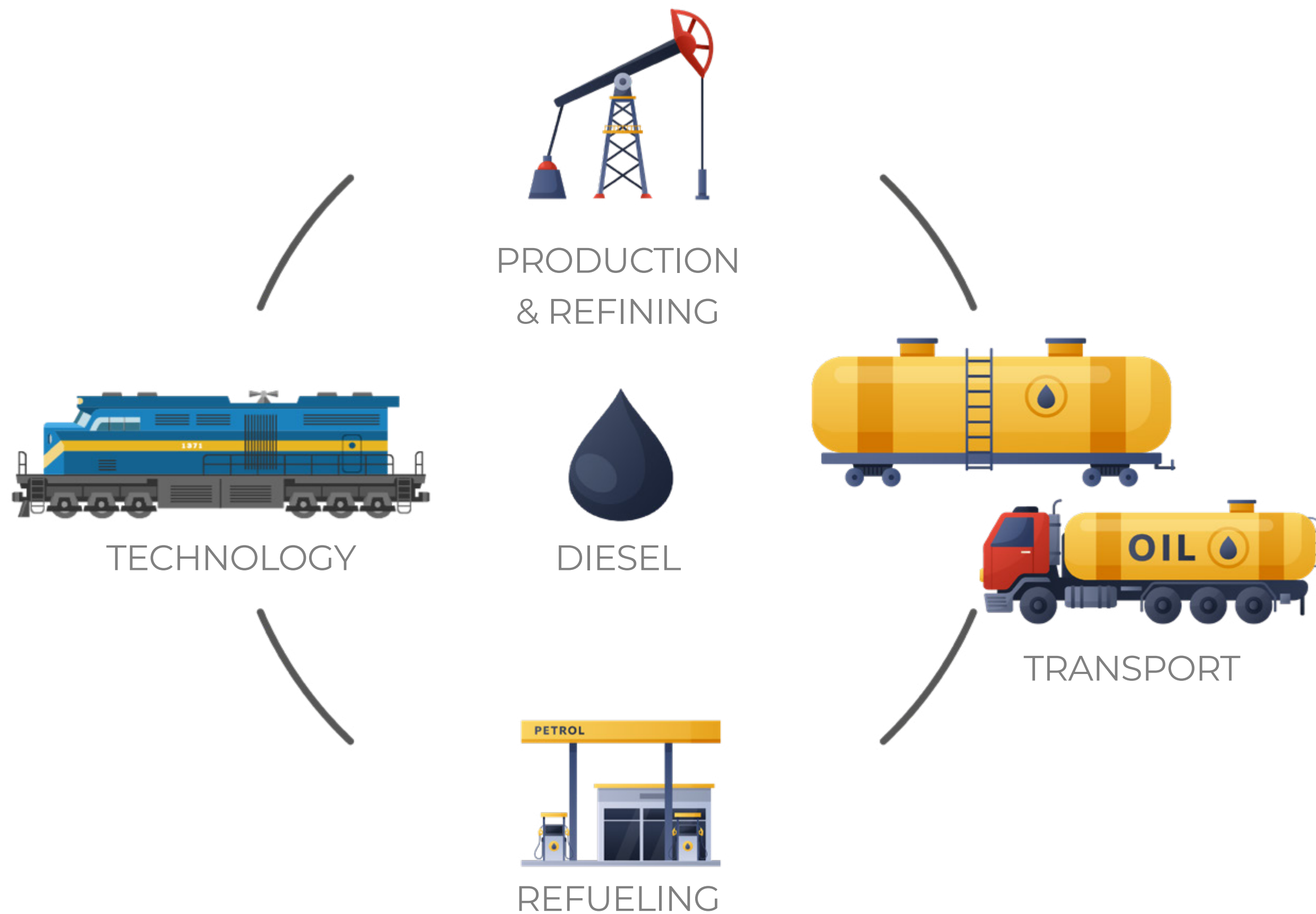
FROM 2013 TO TODAY

Over the past decade, OptiFuel has evolved from a visionary startup into the model for next-generation clean tech suppliers—developing end-to-end solutions that include assured fuel supply, infrastructure deployment, logistics, and fluid implementation plans.

Today, OptiFuel is not only redefining what's possible with zero-emission locomotives, but also demonstrating the viability and profitability of a full energy transition in U.S. Rail.



Our predecessor's created the world's most efficient freight rail network. To protect this advantage, we must strategically align the entire supply chain.



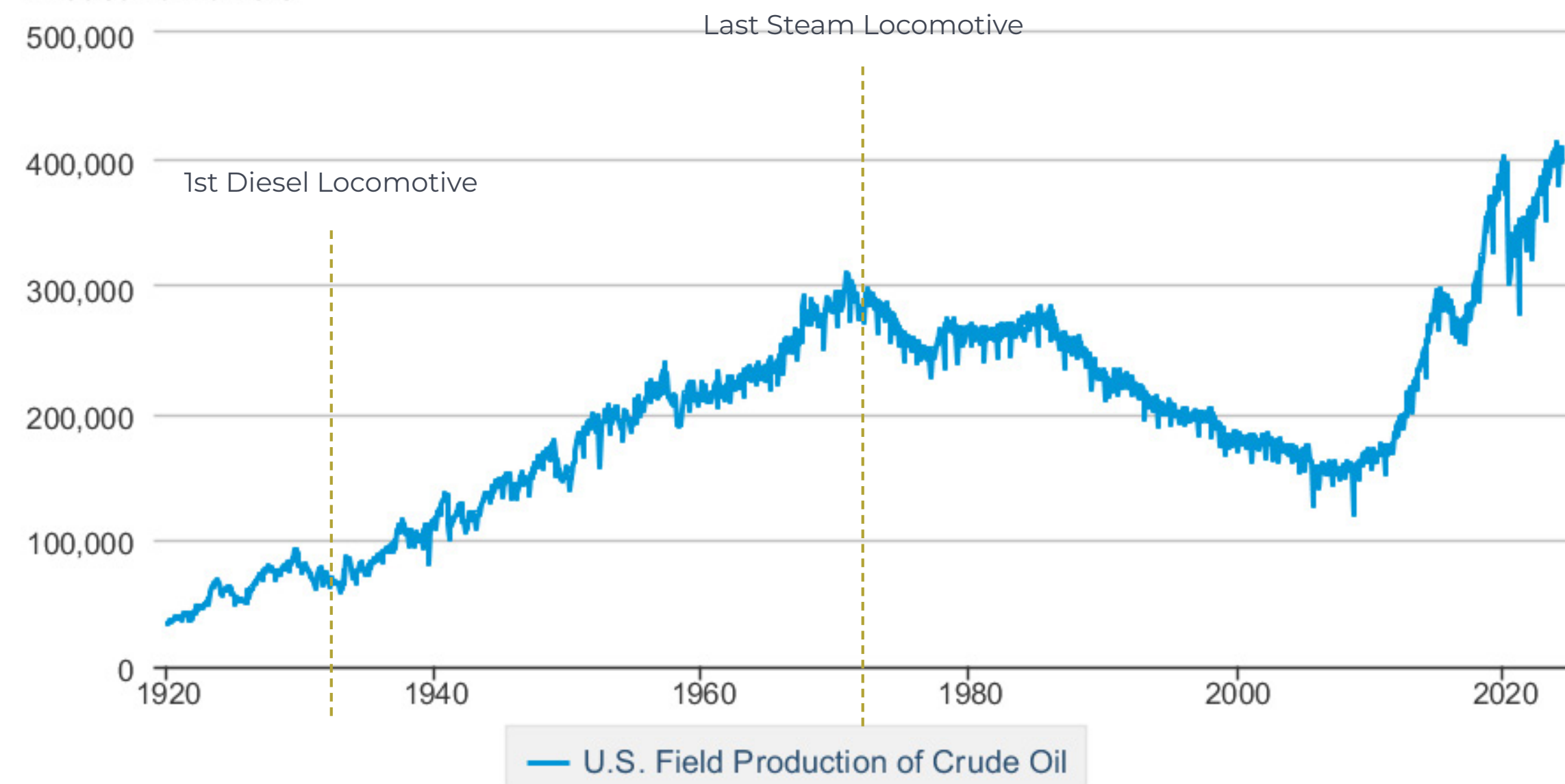
- > **Reliable Fuel Source:** A robust fuel production system is essential to guarantee a steady, reliable fuel source.
- > **Transport Logistics:** Efficient bulk fuel transport by truck, rail, and pipeline ensures timely and consistent delivery to railroads.
- > **Refueling Infrastructure:** Strategically placed, large-capacity fuel stations along the tracks enable seamless refueling operations.
- > **Powerful, Durable Technology:** Advanced locomotive technology delivers the power, range, efficiency, and affordability needed for long-distance travel over steep terrain.
- > **Interoperability:** A critical advantage of the U.S. railroad network, interoperability drives efficiencies, making it nearly 10 times more efficient than networks like those in Europe.

Aligned fuel production is the foundation.

U.S. locomotives require over 4 billion gallons of fuel per year.

U.S. Field Production of Crude Oil

Thousand Barrels



Data source: U.S. Energy Information Administration

Looking back at history, we see U.S. crude oil production surge from the 1920s to the 1950s as railroads transitioned from steam to diesel. This was the foundation for a robust supply chain that powered not only railroads –but the wealth of our entire nation.

If anyone sees this energy transition as merely an environmental mandate, I hope to change that perspective today. This transition is the biggest opportunity of our lifetimes.

The Tycoon Mindset: Start with the Profits

Great business leaders know: before solving the problem, you find the opportunity

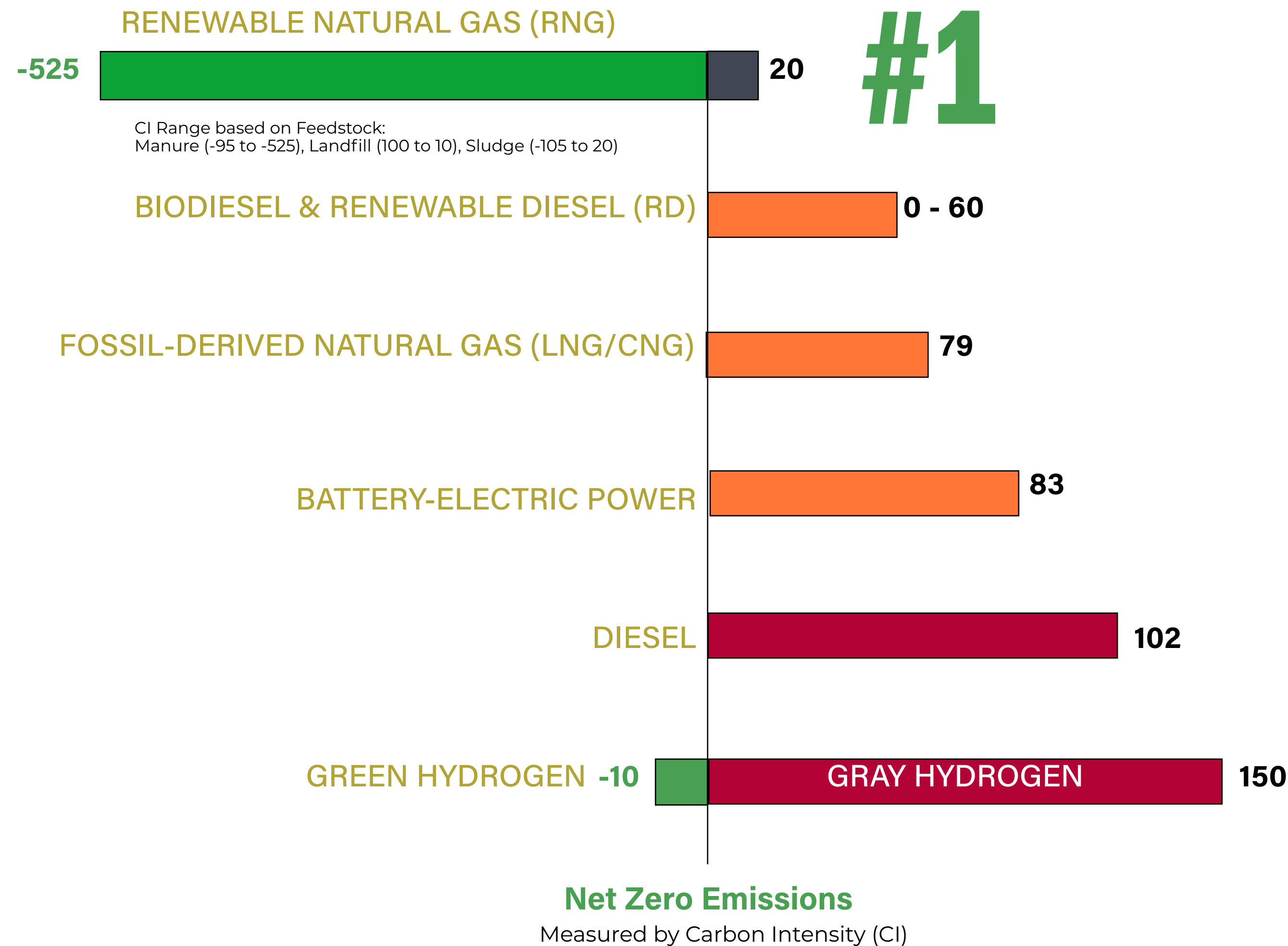
We can explore battery, overhead electric, or hydrogen—any energy source we want. But if we overlook the 3 million miles of pressured pipelines delivering compressed natural gas (CNG) along our railroad rights-of-way, and to nearly every home & business in the country, we'll miss the biggest profit opportunity U.S. rail has ever seen.

But wait...doesn't natural gas have emissions?

Heavy investment during the 1950s and '60s into a 3 million-mile compressed natural gas (CNG) pipeline network offers U.S. railroads unmatched fuel distribution efficiency. Over 95% of the natural gas used in the U.S. is transported from well to market entirely via pipeline, compared to just 80% for crude oil and diesel.

Natural Gas: 300,000 miles of mainline, Crude/Diesel: 150,000 miles (Source: [API](#))

Renewable Natural Gas (RNG), which is chemically equivalent to CNG but produced from waste rather than fossil fuels, is emissions free. RNG offers the highest reduction in greenhouse gas (GHG) emissions among locomotive power options and leads in price, safety and production volumes.



R/CNG (CI: 0): **\$3.00 - \$3.48**

B20: **\$3.94** | B99-B100: **\$4.57** | RD¹: **\$5.30**

¹ National RD price similar to CA diesel (Source: [Energy.gov](#))

CNG: **\$2.90** | LNG: **\$3.85¹**

¹ Source: [Energy.gov](#) (April 1-15, 2024)

Electricity: **\$1.41¹**

¹ (2022 est) Source: [Yale Climate Connections](#)
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Diesel: **\$4.07¹**

¹ Source: [Energy.gov](#) (April 1-15, 2024)

Gray Hydrogen: **\$33.48¹**

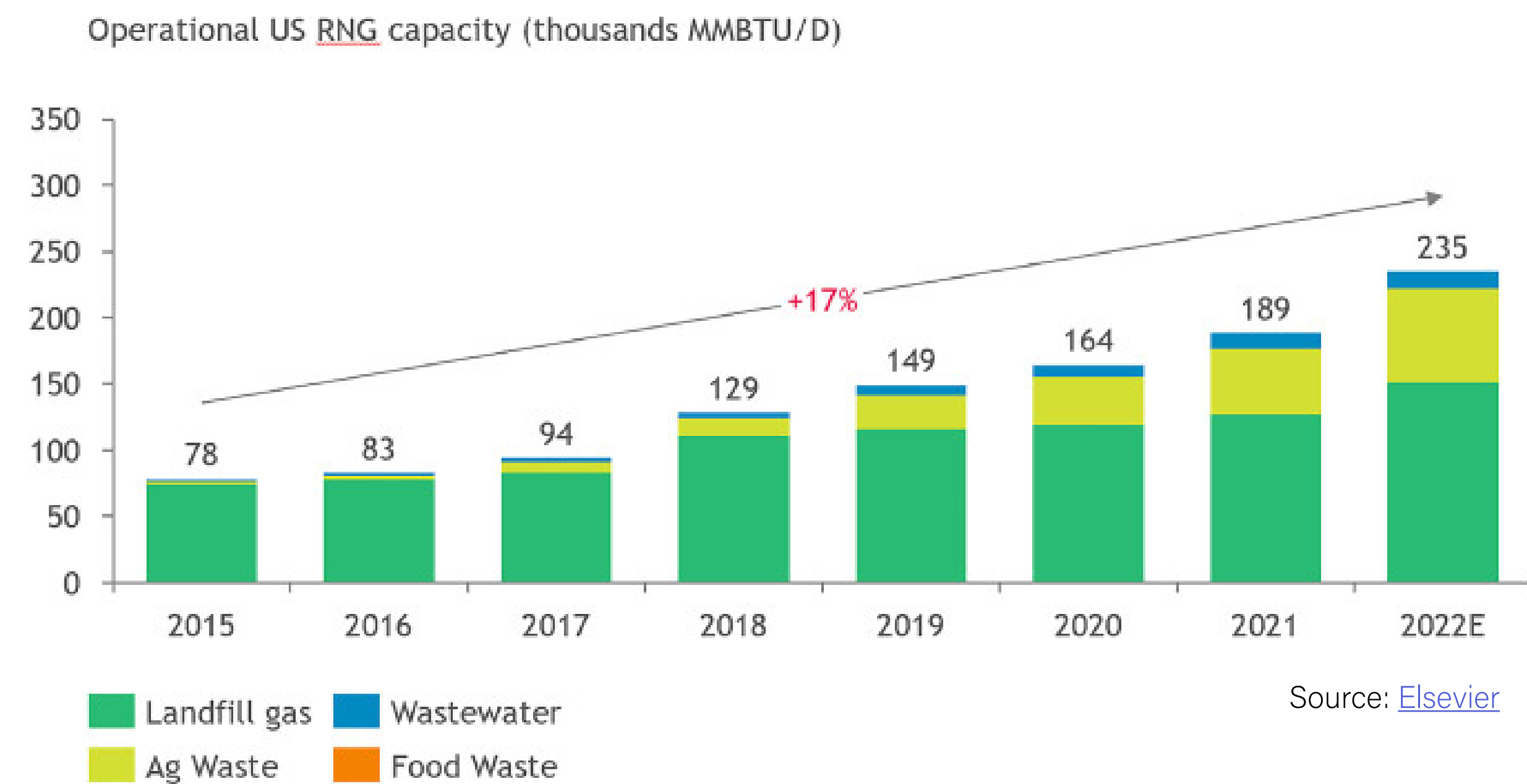
¹ Source: [Platts](#) (weighted avg price across CA as of Jan 4, 2023)

National Avg Price (April 1-15, 2024)

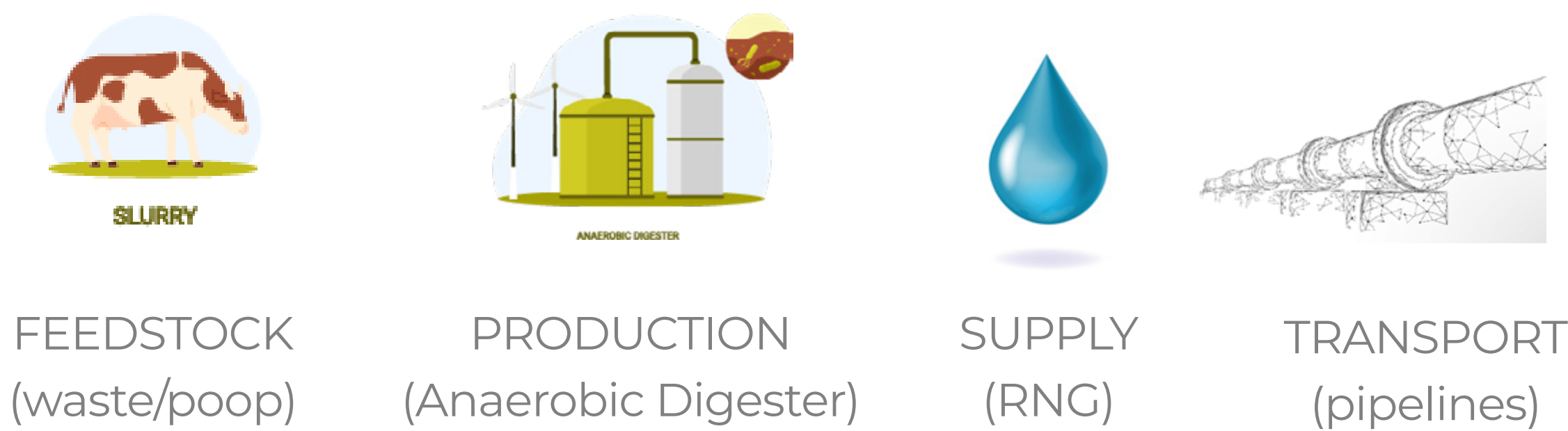


Supplier innovation at OptiFuel opens new opportunities for U.S. railroads

By partnering strategically on production & fuel station projects, U.S. railroads have the potential to unlock new revenue streams, offset infrastructure costs, and secure a reliable, fixed-cost fuel supply.

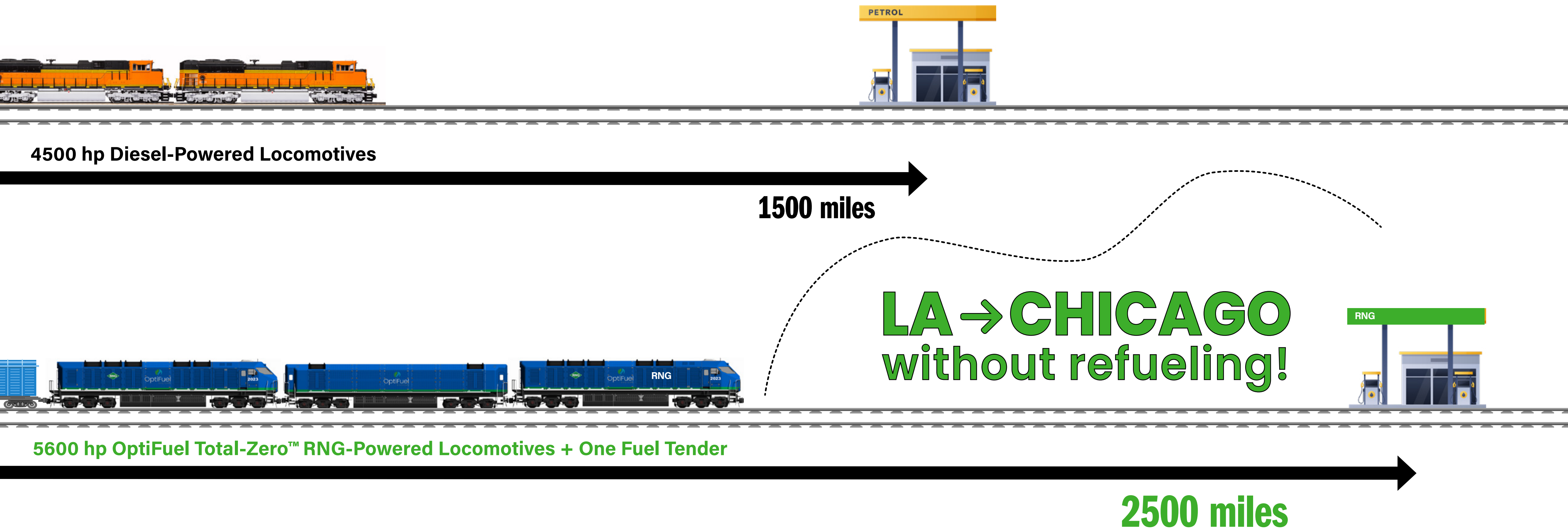


- > Modular deployment of fuel stations and RNG production sites through co-ops with railroads ensure a reliable supply and stable, fixed-cost pricing.
- > Robust federal and state incentives support increased RNG production, with opportunities to extend credits to the rail sector, offsetting infrastructure costs.
- > Automated tracking and monetization of environmental attributes unlock new revenue opportunities for participating railroads.



Innovation at OptiFuel is redefining performance in rail

While RNG is slightly less efficient than diesel, the right technology changes everything. In digital trials, OptiFuel Total-Zero™ RNG line-haul locomotives outperformed diesel by nearly 1,000 miles, traveling an impressive 2,500 miles between fuel stops.



OptiFuel is ready to fuel U.S. Railroads

OptiFuel built its first prototype CNG/RNG fuel station for Indiana Harbor Belt Railroad in 2018. For Class I railroads, OptiFuel is now scaling up to larger stations, each capable of dispensing approximately 260,000 gallons of fuel per day.

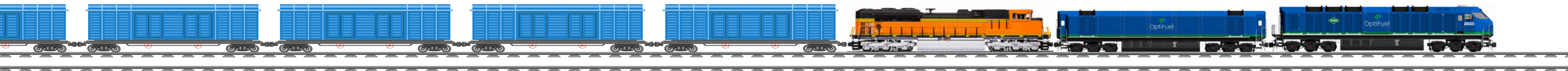


OptiFuel enables seamless fleet transitions

Diesel locomotives can be gradually phased out as new refueling infrastructure and RNG production sites are built in stages, aligning with the pace of new locomotive deployments. During the transition, diesel & RNG locomotives can operate seamlessly together within a single train consist.



LOCOMOTIVES CAN REFUEL SIDE-BY-SIDE



LOCOMOTIVES CAN OPERATE TOGETHER IN A TRAIN CONSIST

OptiFuel Total-Zero™ Locomotives can be refueled in the same amount of time as diesel locomotives, with local employees handling the process.

CATALYZING CHANGE

Transitioning to RNG-powered locomotives could save Class I railroads an estimated \$3.8 billion in fuel cost each year.

Assumes a \$3.00 per gallon average diesel cost, with RNG priced at 85% of diesel and a 20% improvement in fuel economy.

- > **Secure reliable, fixed-cost fuel supply**
- > **Offset infrastructure costs with credit & other incentive opportunities**
- > **Unlock new sources of revenue**

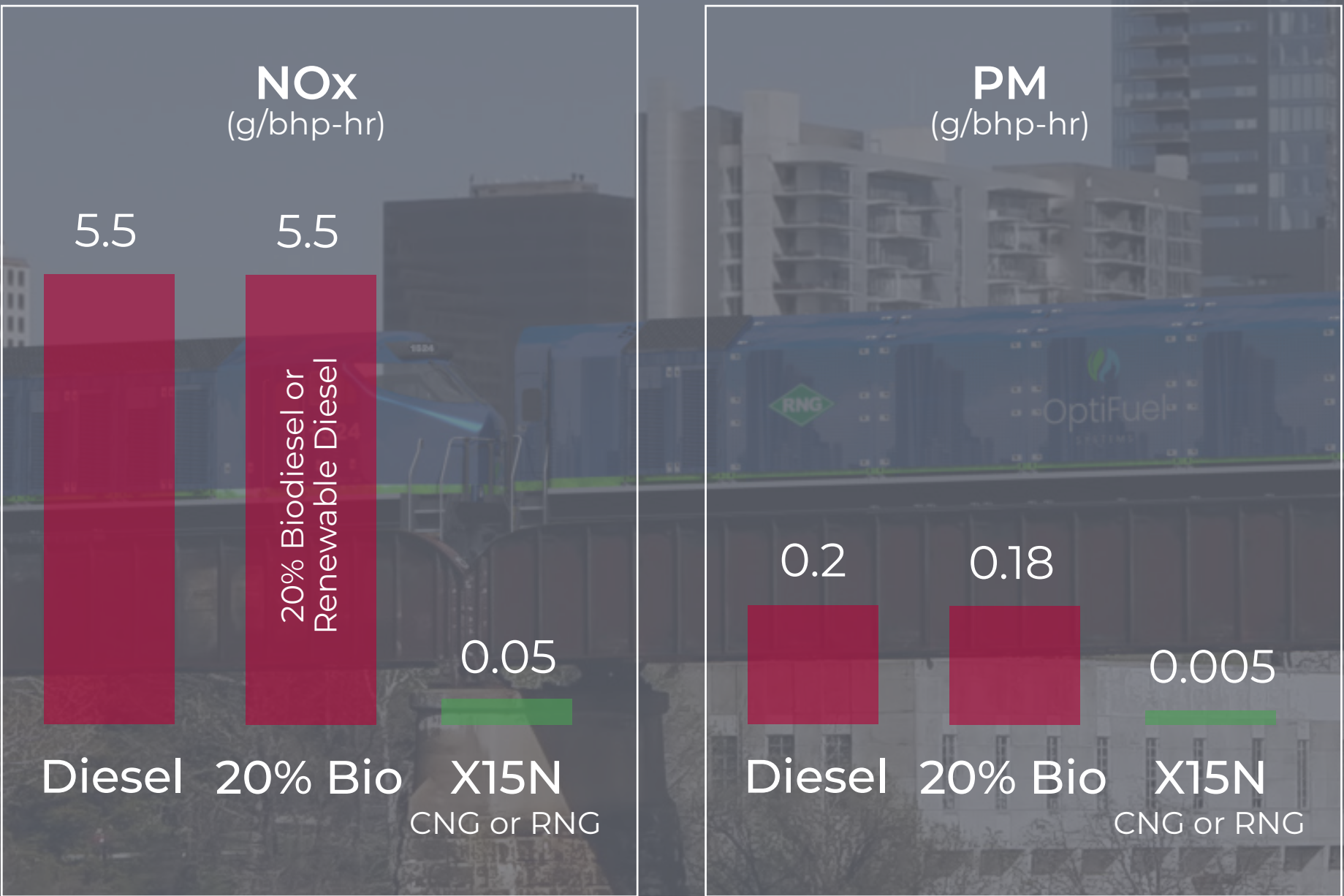
OptiFuel Total-Zero™ Locomotives ensure compliance with CARB zero-emission regulations, producing zero NOx or PM emissions—even if operated on fossil fuels.

To simplify the transition, OptiFuel developed a pathway for locomotives to either run on zero-emission RNG from Day 1 or start with fossil-based natural gas and transition gradually. NOx and PM emissions are eliminated in both cases, thanks to the technology. The only difference is the level of GHG emissions.

Compliance with CARB regulations requires eliminating NOx and PM emissions. Use of biodiesel and renewable diesel do not reduce or eliminate these criteria emissions.

Local Criteria Emissions

Nitrous oxides (NOx) and particulate matter (PM) are “criteria emissions”—local pollutants that linger in the air and can cause a range of serious health issues



Diesel locomotive engines produce approximately 110x more NOx and 40x more PM than OptiFuel-Cummins X15N locomotive power systems.

Smaller, more nimble companies like OptiFuel excel at rapid optimization

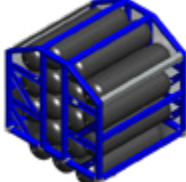
Today, OptiFuel is advancing FRA concurrence for its second- and third-generation fuel storage systems, along with EPA certification for its third-generation power system.



Modular Fuel Storage System



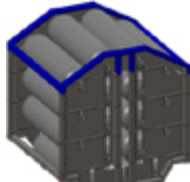
Gen 1
Concurrence



Gen 2
in process



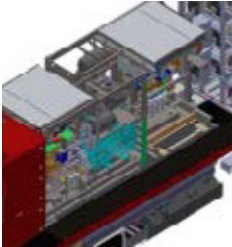
Gen 3
in production



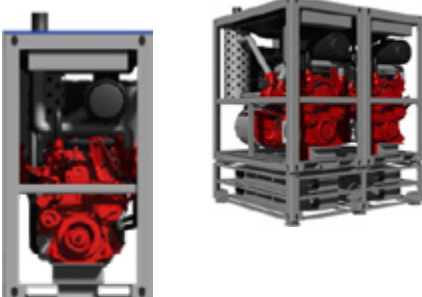
Gen 4
pre-production



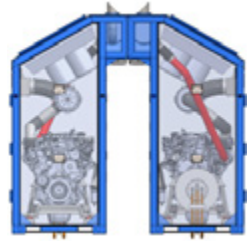
Locomotive Power System



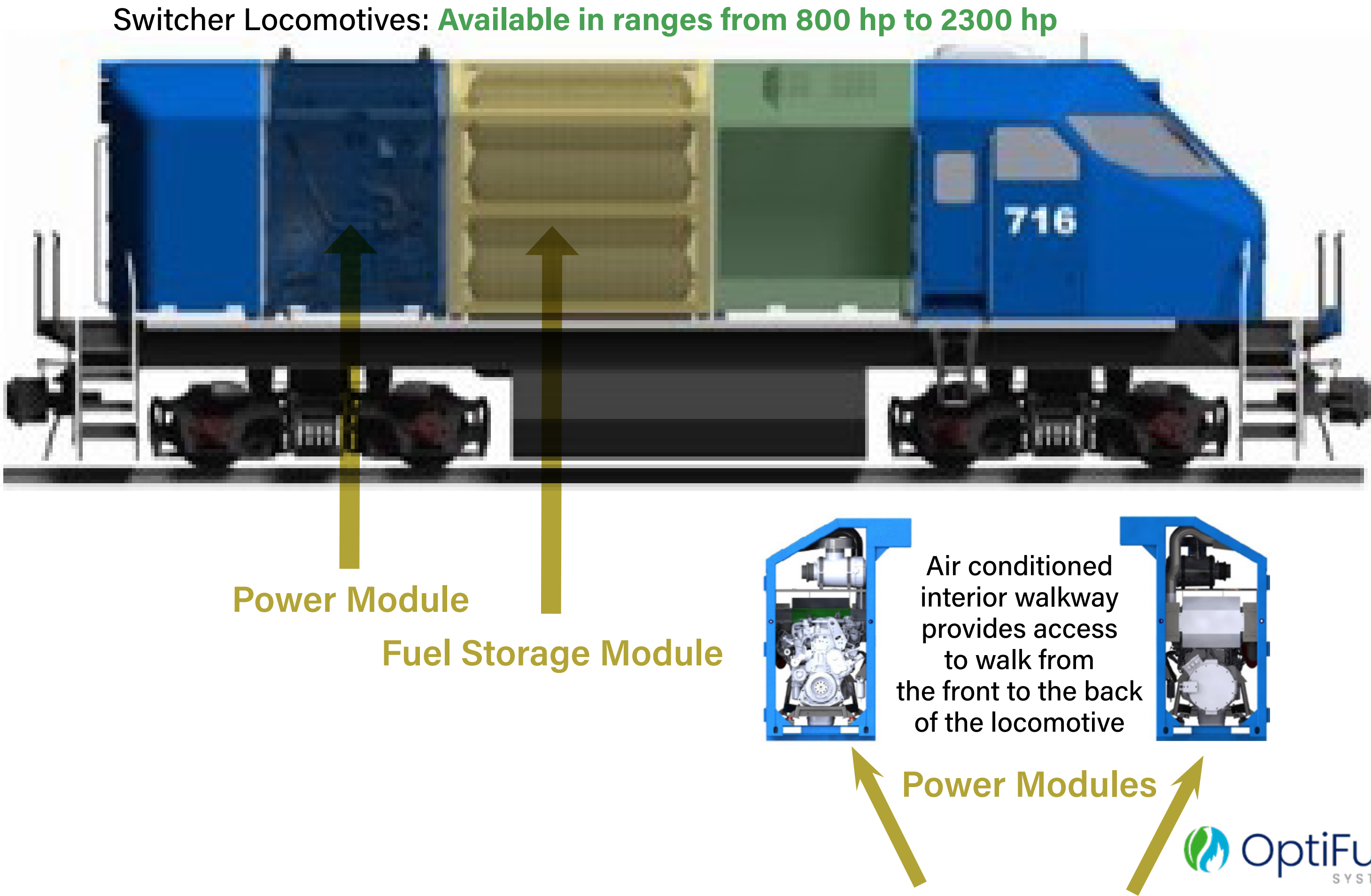
Gen 1 - complete
Dual-Fuel
Tier 4



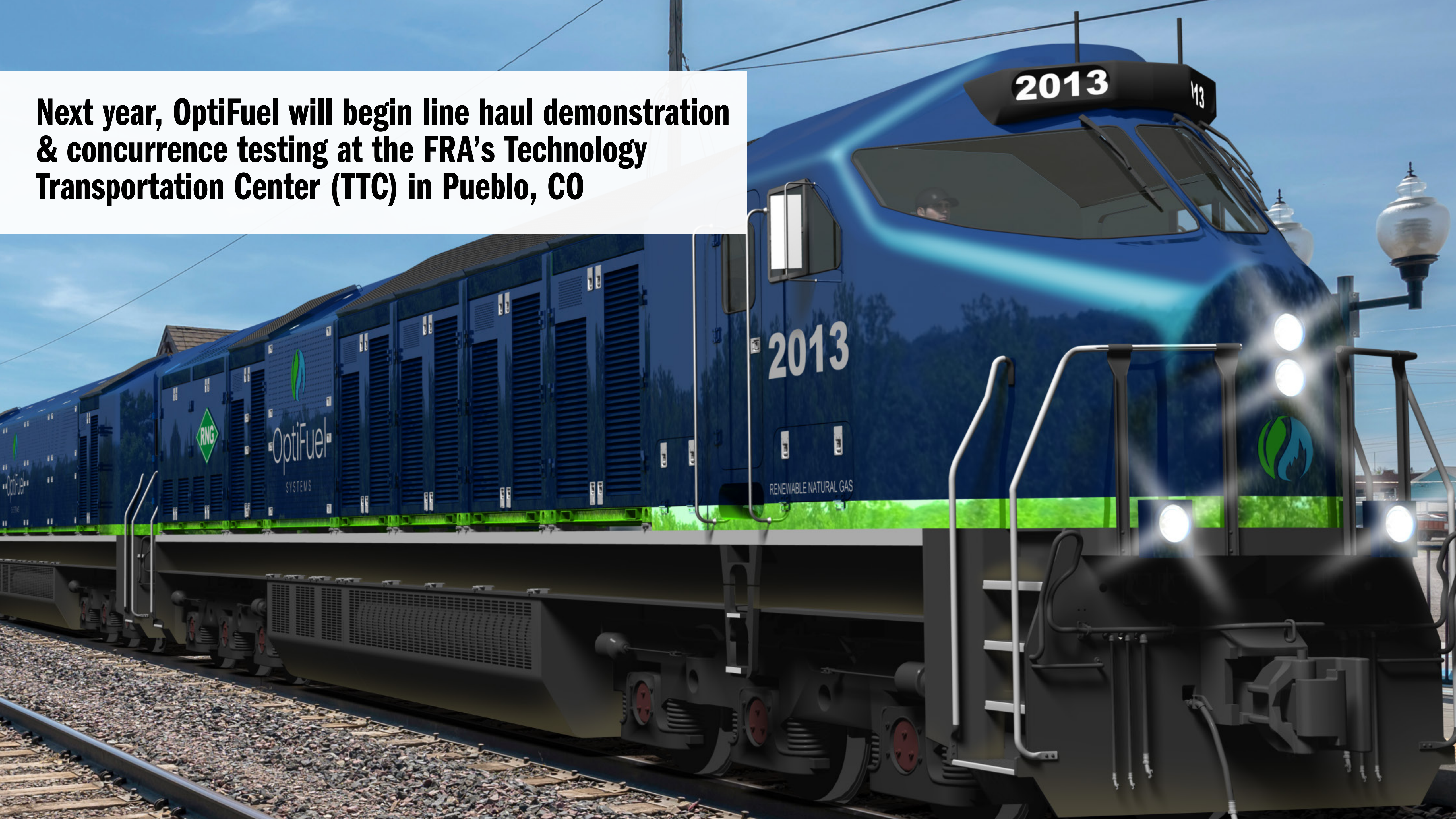
Gen 2 - complete
NOx: 0.00
PM: 0.00



Gen 3 - in process
Expected:
NOx: 0.05
PM: 0.005



**Next year, OptiFuel will begin line haul demonstration
& concurrence testing at the FRA's Technology
Transportation Center (TTC) in Pueblo, CO**



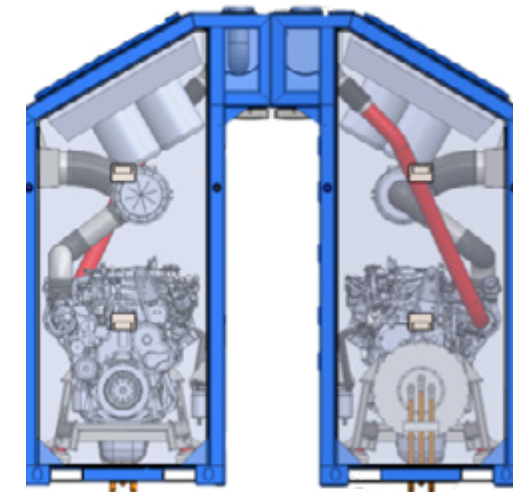
1-million-mile testing will begin in 2026



Supplier innovation transforms the industry for the better

OptiFuel Total-Zero™ Locomotives feature a modular design that introduces new efficiencies for railroads, like 95% operating uptime and on-track engine replacement in about an hour.

- > **Enhanced fuel economy**
- > **Quicker responsiveness**
- > **Safer operations**

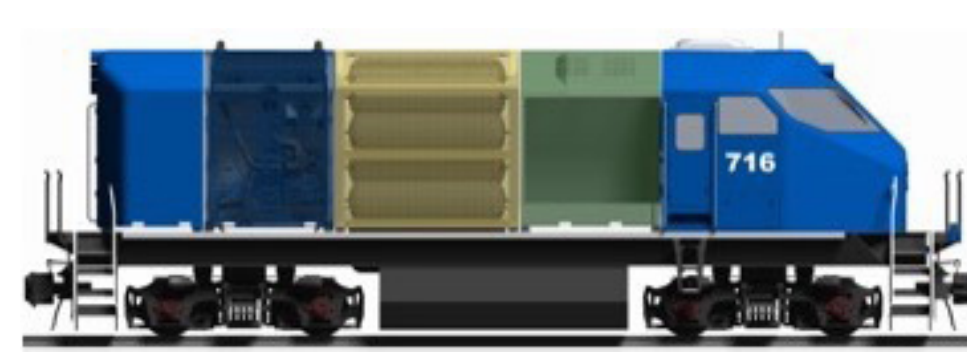


Flexible Configuration
Swap as Needed



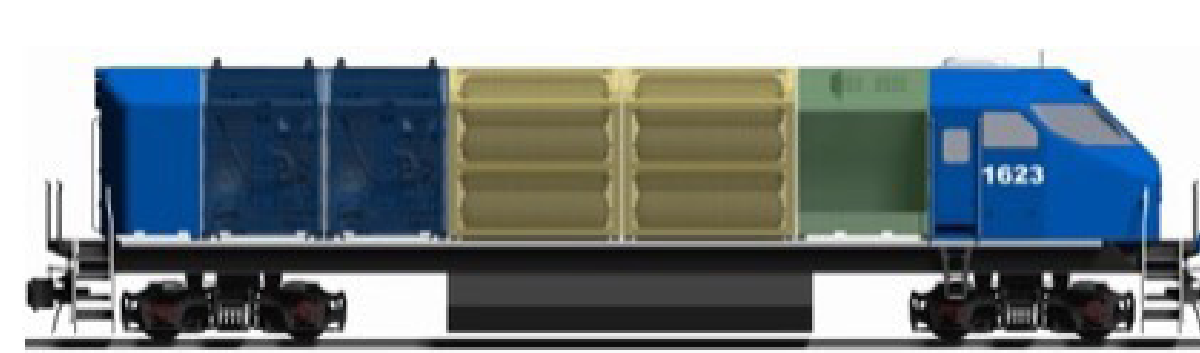
45'

800 - 1500 hp
Center Cab Switcher
RNG | Battery-Electric



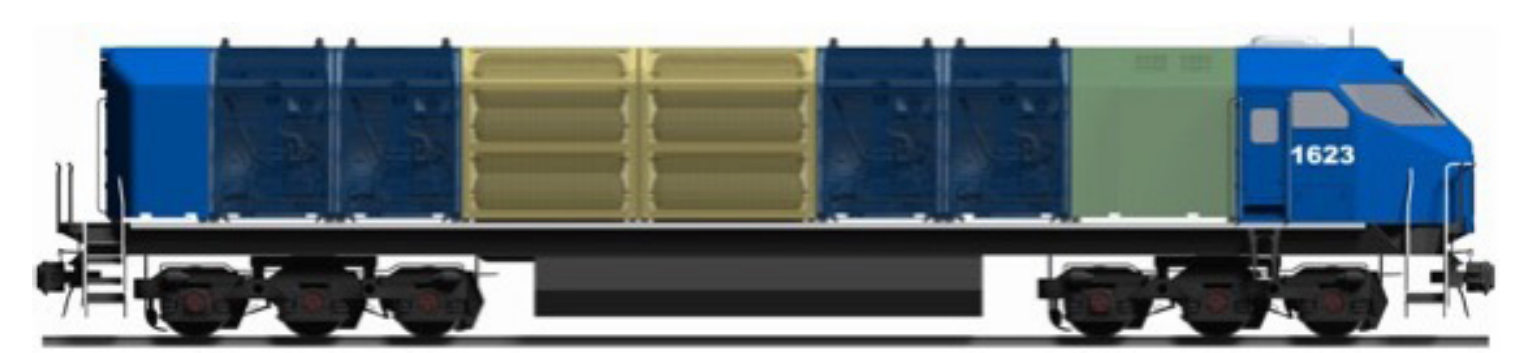
50'

500 - 1500 hp
Switcher
RNG | Battery-Electric | Hydrogen



62 or 72'

2000 - 3000 hp
Switcher or Road Switcher
RNG | Battery-Electric | Hydrogen



80'

4500 - 5600 hp
Line Haul
RNG

800 hp



up to 5600 hp

Designed for exceptional efficiency and 24/7 performance, OptiFuel Total-Zero™ locomotives empower railroads to boost profitability, meet regulatory standards, and lead in customer service & environmental stewardship.

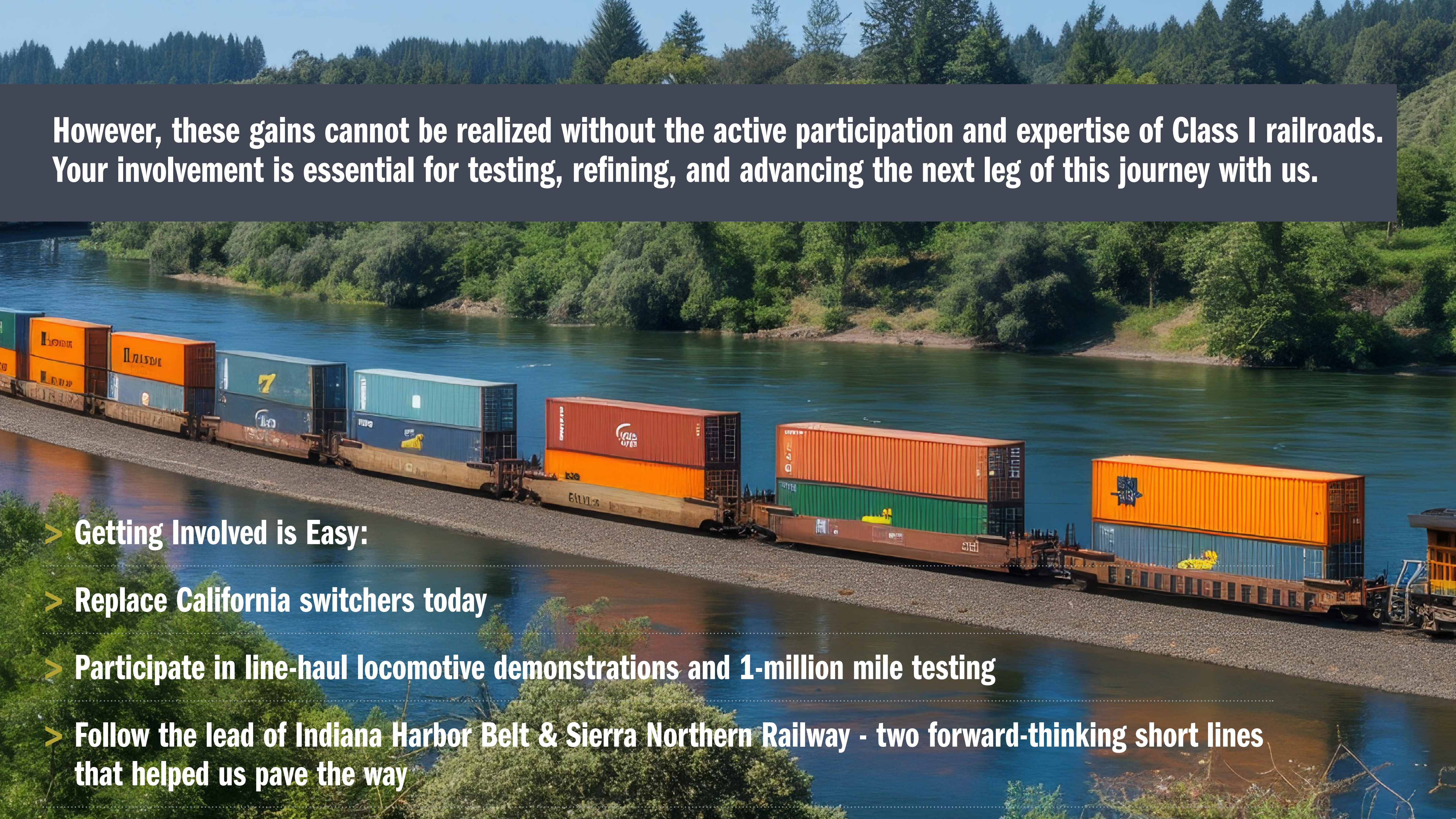


OptiFuel Total-Zero™ Locomotives are affordable, durable, reliable, & nimble

OptiFuel has done the heavy lifting to make a transition that once seemed distant - now within reach



However, these gains cannot be realized without the active participation and expertise of Class I railroads. Your involvement is essential for testing, refining, and advancing the next leg of this journey with us.

- 
- > Getting Involved is Easy:**
 - > Replace California switchers today**
 - > Participate in line-haul locomotive demonstrations and 1-million mile testing**
 - > Follow the lead of Indiana Harbor Belt & Sierra Northern Railway - two forward-thinking short lines that helped us pave the way**

BEYOND INCREMENTAL

HARNESSING SUPPLIER INNOVATION FOR SUSTAINABLE GROWTH

Thank you for the opportunity to present this perspective to the Board and to each of you.

DOWNLOAD TODAY'S PRESENTATION ON LINKEDIN:



[WWW.LINKEDIN.COM/COMPANY/OPTIFUEL-SYSTEMS/](https://www.linkedin.com/company/optifuel-systems/)



ACCELERATING THE PACE TO
TOTALZER 

