OptiFuel
SYSTEMS

ACCELERATING THE PACE TO
TOTALZERO™

Introducing our RNG, Hydrogen, and Battery-Electric Total-Zero™ Switcher & Line Haul Locomotives

Affordable • Modular • Zero Emission • Available Now

Stay connected with OptiFuel

OptiFuelSystems.com

Info@OptiFuelSystems.com

ABOUT OPTIFUEL

OptiFuel Systems is a solution provider designing and manufacturing zero emission products and services in the hard-to-abate transportation and industrial markets — specifically in rail, marine and power generation.

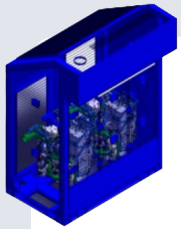
OptiFuel works as a systems integrator with strategic partners to engineer innovative technology that is low-risk, modular, and has flexible fuel options consisting of affordable renewable natural gas (RNG) and hydrogen fuels. Products include switcher and line haul freight locomotives, RNG & hydrogen tenders, stationary & mobile refueling systems, mobile & stationary standby as well as emergency generators.

Services include sales, leasing, long-term maintenance, and refueling services. Customers are expected to achieve heightened reliability, reduced lifetime maintenance costs, minimized downtime, optimized horsepower, and an impressive up to 30% enhancement in fuel economy. OptiFuel's Total-Zero™ RNG-electric locomotives and hydrogen-electric locomotives are EPA certified as zero NOx and PM emissions and have achieved FRA concurrence.

Learn more at OptiFuelSystems.com

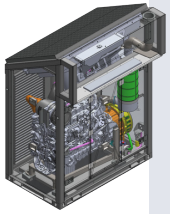
OptiFuel Total-Zero™ Modular Power & Fuel Storage Systems

RNG | Hydrogen | Battery-Electric



HYDROGEN FUEL CELL QUICK-POWER™ QD MODULE

Two Ballard H2 Fuel Cell • 300 kW (400 hp)

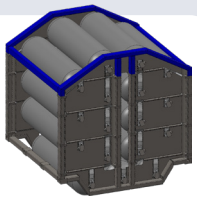


RNG QUICK-POWER™ QD MODULE

Cummins X15N (510 hp) • OptiFuel Starter/Generator (600 hp)

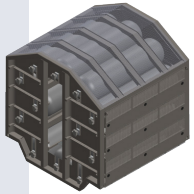
HYDROGEN QUICK-POWER™ QD MODULE

Cummins X15N (510 hp) • OptiFuel Starter/Generator (600 hp) • Available in 2027



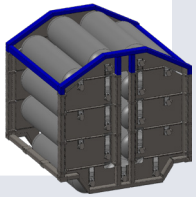
GEN 2 PLUS SWITCHER FUEL STORAGE

FRA Concurrence in 2024 • 80" x 120" • 11 cylinders • 900 DGE RNG OR 207 Kg H2



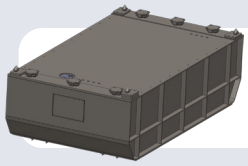
GEN 3 SWITCHER & LINE HAUL FUEL STORAGE

FRA Concurrence in 2024 • 123" x 120" • 12 cylinders • 990 DGE RNG or 226 Kg H2



GEN 4 TENDER FUEL STORAGE

FRA Concurrence in 2025 • 123" x 240" • 14 cylinders • 2,800 DGE RNG or 672 Kg H2



LFP BATTERY MODULE

400 kW (500 hp)

OptiFuel Modular Total-Zero™ Equipment

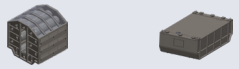
Available Product Range

OptiFuel Total-Zero™ Line Haul Locomotive with AC Traction

5600 HP RNG FUEL
2,500 DGE onboard fuel storage

10 Fuel Cell Modules | 10 RNG Modules | 10 H_2 ICE Modules

4500 HP HYDROGEN FUEL
600 Kg onboard fuel storage



2 Gen 3 Fuel Cell Modules | 1 LFP Battery Module 400 kW (500 hp)

STANDARD TENDER
11,800 DGE RNG or 2,950 Kg Hydrogen

4 Gen 4 Fuel Storage Modules

2500 HP POWERED TENDER
9,000 DGE RNG or 2,500 Kg Hydrogen

4 Fuel Cell Modules | 4 RNG Modules | 4 H_2 ICE Modules | 3 Gen 4 Fuel Cell Modules | 1 LFP Battery Module 400 kW (500 hp)

CENTER CAB SWITCHER
45' • 800 hp – 1500 hp
RNG | Hydrogen | Battery-Electric

SWITCHER
52' • 1000 hp – 2200 hp
RNG | Hydrogen | Battery-Electric

ROAD SWITCHER
62' • 2000 hp – 3000 hp
RNG | Hydrogen

MOBILE RNG LOCOMOTIVE REFUELING SYSTEM

MOBILE & STATIONARY STANDBY & EMERGENCY POWER RNG SYSTEMS 365 kW to 1.3 MW

MODULAR & SCALABLE DESIGN

OptiFuel's novel modularity makes customization, future transitions, and on-rail maintenance possible.

PERFORMANCE

Advanced power system achieves equivalent torque rating and broader horsepower range than traditional diesel powertrains by managing engine, generator, and battery power for optimal performance.

RELIABILITY

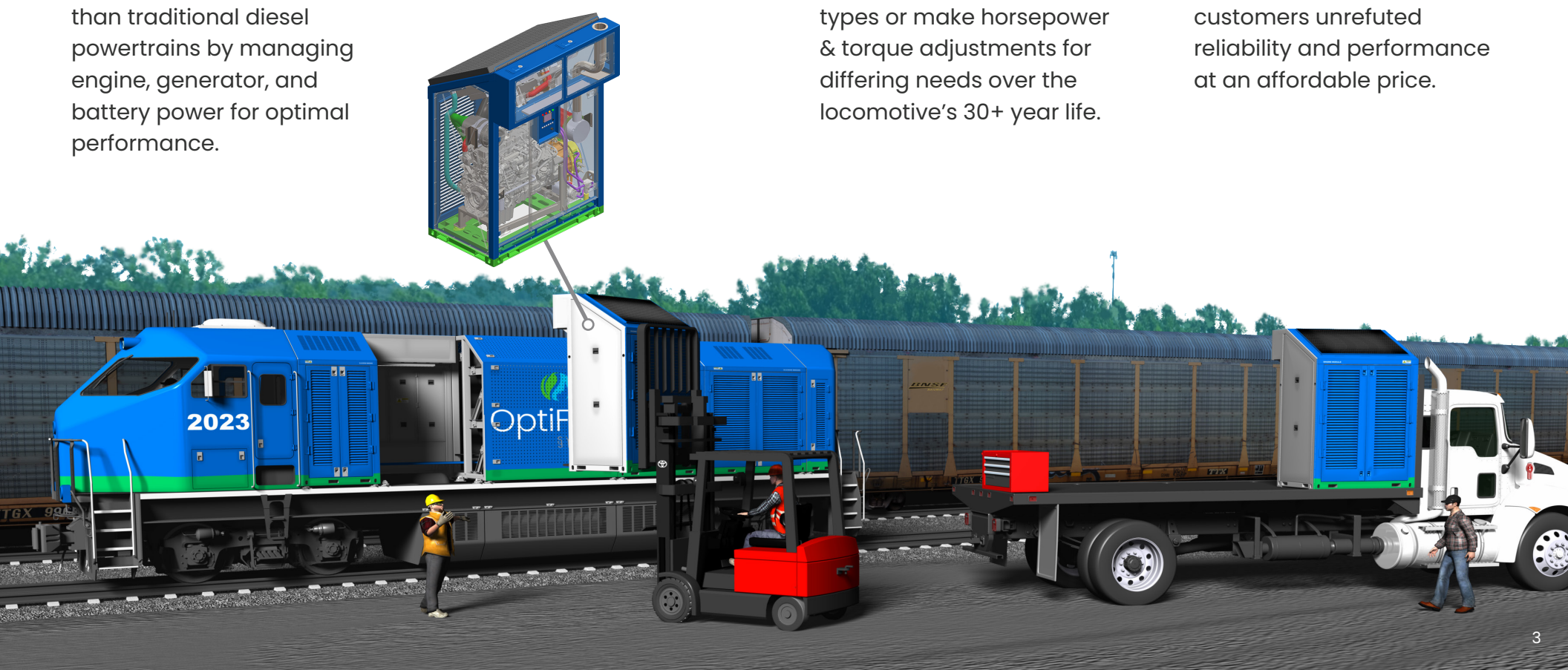
Multi-engine engineering keeps locomotives running even with an engine down.

FLEXIBILITY

Pods can be added, removed, replaced or reconfigured, offering the versatility to change fuel types or make horsepower & torque adjustments for differing needs over the locomotive's 30+ year life.

AFFORDABILITY

OptiFuel's novel modular engineering and world-class manufacturing partnerships provide customers unrefuted reliability and performance at an affordable price.



THE CHALLENGE

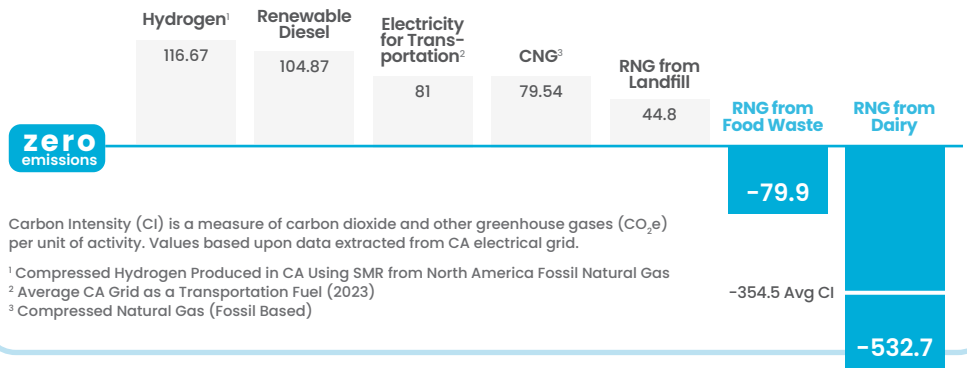
How can we effectively and affordably decarbonize U.S. line haul locomotives that emit 85% of all criteria and greenhouse gas emissions?

OUR SOLUTION: RNG

OptiFuel leverages a low cost, off-the-shelf, and low risk decarbonization approach that requires minimal operation changes by the railroads.

Renewable natural gas (RNG) takes a product that is negatively impacting the environment — organic waste — and creates a clean, reliable energy resource that is fully compatible with our current rail infrastructure and operations, serving a productive role in the clean energy transition. Readily available landfill RNG with a CI (Carbon Intensity) of +40 can easily be blended with 400 million DGEs of RNG with a CI of -350 from agriculture waste to provide 3 billion DGEs of final locomotive fuel with a CI of 0 or less for all 25,000 line haul locomotives in the U.S. This provides not only a clean source of fuel for locomotives, but also an incentive to increase the capture of methane from waste streams that would otherwise be emitted directly into the atmosphere.

COMPARING CARBON INTENSITY (gCO_2e per MJ)



Carbon Intensity (CI) is a measure of carbon dioxide and other greenhouse gases (CO_2e) per unit of activity. Values based upon data extracted from CA electrical grid.

[1] Compressed Hydrogen Produced in CA Using SMR from North America Fossil Natural Gas
[2] Average CA Grid as a Transportation Fuel (2023)
[3] Compressed Natural Gas (Fossil Based)

COMPARING POWER, DISTANCE & TRANSITION COST

DIESEL

Two Tier 4, 4500 hp diesel line haul locomotives, each holding **4,700 gallons of diesel**, will go **1,500 miles**.

RNG

Two 5600 hp RNG-Electric line haul locomotives, each holding **2,500 DGEs of RNG**, and **ONE 11,800 DGE RNG tender**, will go approximately **2,500 miles**.

LA→CHICAGO without refueling!

L-HYDROGEN

Two 4500 hp hydrogen fuel cell line haul locomotives, each holding **350 kg of hydrogen**, and **Two 5,000 Kg liquid hydrogen tenders**, will go approximately **1,500 miles**.

G-HYDROGEN

Two 4500 hp hydrogen fuel cell line haul locomotives, each holding **350 kg of hydrogen**, and **Four 2,250 Kg gaseous hydrogen tenders**, will go approximately **1,500 miles**.

BATTERIES

Two 4400 hp 100% battery line haul locomotives, each with **2,400 kW-hr of battery storage** and **Eight 8,000 kW-hr battery tenders**, will go approximately **750 miles**.

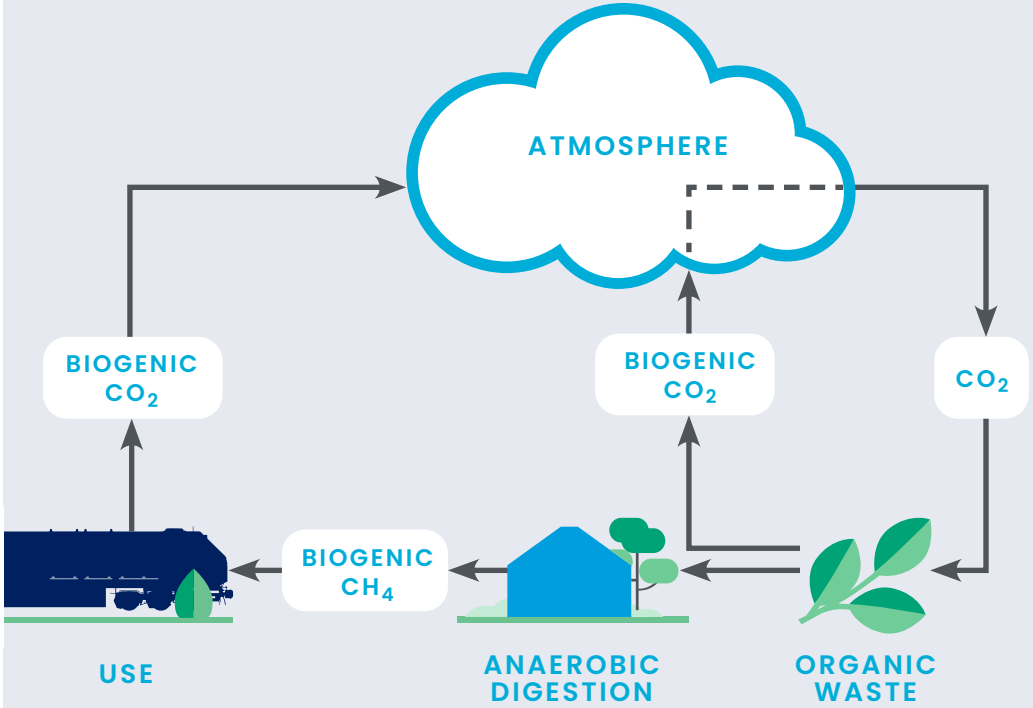
Renewable Natural Gas (RNG) in a Nutshell

RNG production converts the biogenic GHG emissions already generated by the normal activities of the sectors where organic materials originate, into value-added inputs for the Anaerobic Digestion process.

For example, RNG production makes it possible to:

- Capture and convert biogas, containing CH4 produced by landfills.
- Avoid producing CO2-emitting chemical fertilizers by substituting them for digestate, a by-product of the Anaerobic Digestion process.
- Significantly reduce methane emissions from manure and wastewater management.

RNG production recovers energy that is already available in organic waste and converts it to higher value use. It has the same benefits as conventional natural gas, but 100% renewable with a ZERO or NEGATIVE Carbon Intensity.



Gas that is interchangeable with conventional natural gas since they both share the same pipes, equipment, benefits, and applications.

Derived from the biomethanation of organic matter and therefore 100% renewable. Does not contribute to additional GHG emissions.

Energy that gives a second life to organic matter, contributes to the circular economy and can be produced locally.

Renewable Natural Gas (RNG), produced from 100% existing USA organic waste streams, is the only readily-available, turnkey renewable biofuel with *negative* carbon intensity, has the lowest cost, and can be conveniently accessed through existing natural gas pipeline infrastructure running along US railroad right-of-ways.

ORGANIC WASTE SOURCES

RAW BIOGAS

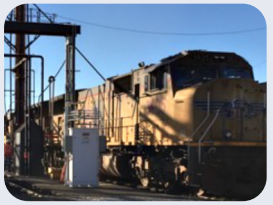

Nutrient-Rich Biofertilizer

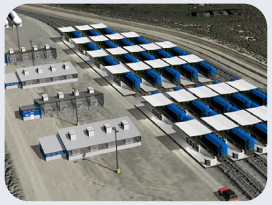
RNG DELIVERY THRU EXISTING PIPELINES

Pure, Pipeline-Grade RENEWABLE NATURAL GAS (RNG)

TURNKEY RNG REFUELING

for Switcher & Line Haul Locomotives & Tenders





OptiFuel TOTAL-ZERO™ Solutions

We use the same TOTAL-ZERO™ rail assets to transport organic waste back to central digester locations throughout the US, resulting in the lowest end-to-end system cost.

A Sustainable, Circular Economy With Affordable, Hard-to Abate, TOTAL-ZERO™ Transportation and Mobile Power Assets Using Low-Cost RNG and Hydrogen Fuels

REFUELING SOLUTIONS

OptiFuel's RNG approach for Line Haul will spearhead the sustainable revolution with locomotives and refueling solutions that make fleet transitions affordable.

This approach is railroad-focused and is underscored by its comprehensive refueling services and fuel station infrastructure plan, not only addressing the capital expenditure challenges related to refueling, but also resolving the logistical and planning burden of combined diesel-RNG fleets. This approach will facilitate smooth fleet transitions from diesel to renewable fuels without disrupting operations. Line haul operators can run trains in a consist with both old (diesel) and new (RNG) locomotives without changes to routes, distance between stops, refueling time, or capital expense budgets.