Wabtec CORPORATION

Railway Association of Canada

2024 RAC SHORTLINE CONFERENCE

Wabtec Sustainability

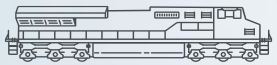
Chris Miller
Senior Director – Services Product Management

Locomotive Technology Road Map for Sustainability

2022 | 2024 | 2026 | 2028 | 2030+

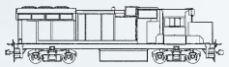
FUEL SAVINGS

AC44 – FDL Advantage



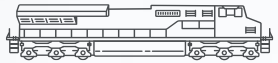
5% SFC Reduction

ET23



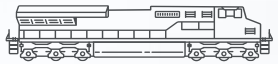
~15% SFC Reduction

ES44AC – EVO Advantage



~5% SFC Reduction

ET44AC – T4 Advantage



~5% SFC Reduction

HS44AC – EVO Hybrid

10-15% SFC Reduction

CARBON REDUCTION

- **Up to B5 Up to R30** — ~20% CO_2 Reduction
- **Up to B11 Up to R50** — ~37% CO_2 Reduction
- **Up to B20 Up to R100** — ~60% CO_2 Reduction

H2 ICE HHP/tender

Main line locomotive
EVO T3/T4T Advantage Dual Fuel H_2

Net Zero Fleet Transition (2050)

ZERO LOCOMOTIVE EMISSIONS

BATTERY

BEL Demo

2.4 MWh

FLXdrive

~8 MWh

FLXswitch

~3 MWh

FUEL CELL

FLX H2 Demo

Switcher / Short line

H2 Fuel Cell HHP/tender

Main line locomotive
Fuel Cell + Battery

MOVING CHARGING

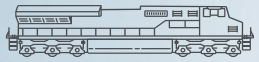
FLXdrive 3.0

>8 MWh Moving Charge

Sustainable Locomotive Technology Fleet Planning

NOW | 2025 | 2030 | 2035 | 2040 | 2045 | 2050

AC44 – FDL Advantage



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FLXdrive

~8 MWh

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>8 MWh Moving Charge

FLXswitch

~3 MWh

FLX H_2 Demo

Switcher / Short line

H_2 Fuel Cell HHP/tender

Fuel Cell + Battery

Net Zero Target

Up to B11
Up to R50
~37% CO_2 Reduction

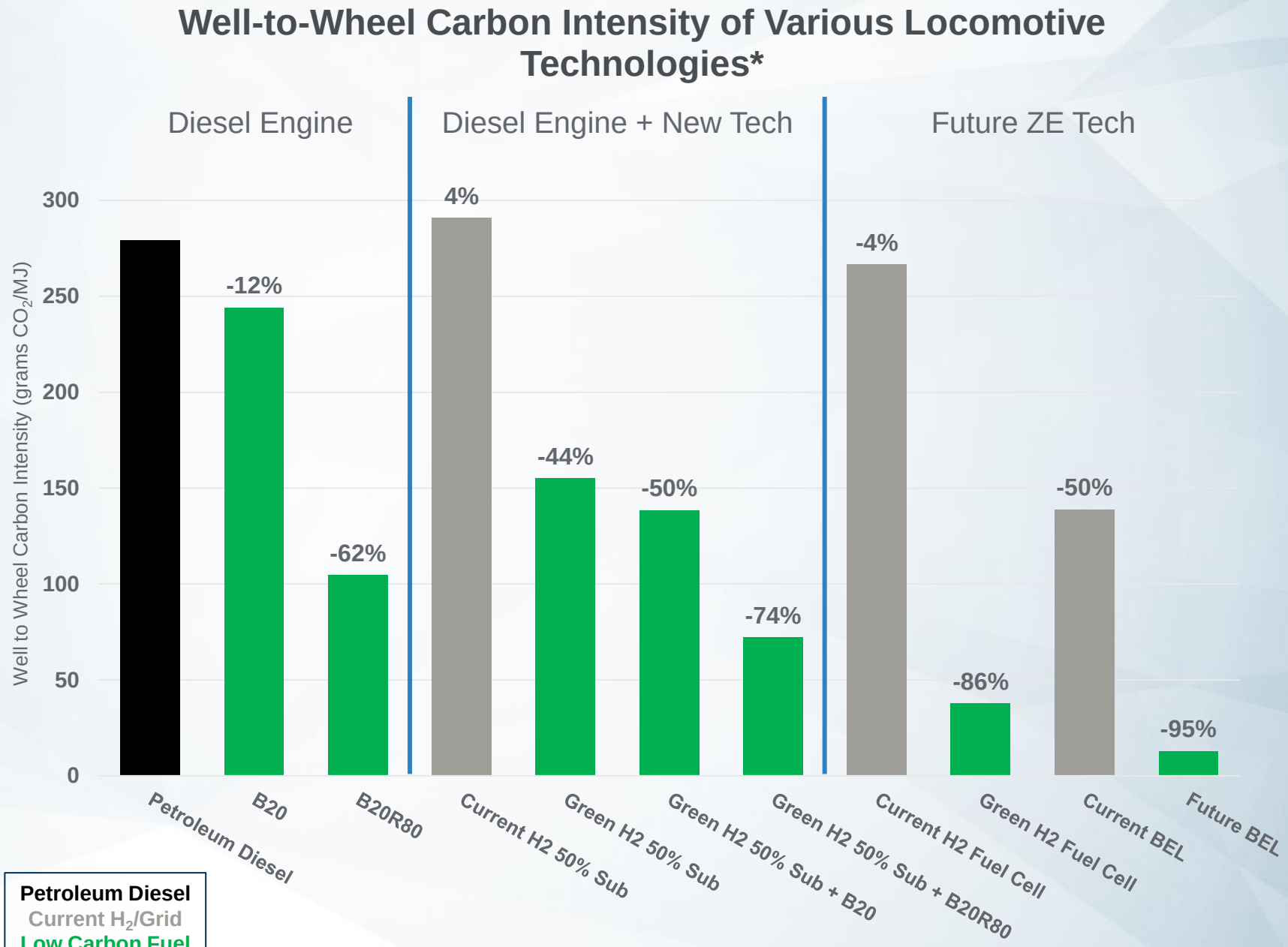
Up to B20
Up to R100
~60% CO_2 Reduction

FUEL SAVINGS
CARBON REDUCTION
ZERO EMISSIONS

CI REDUCTION
PRODUCT CAPABILITY

Well to Wheel Comparisons

- Internal Combustion Engine (ICE) can significantly reduce carbon intensity
- Biomass-based fuels can achieve lower carbon intensities today than technologies like fuel cells and battery electric with current infrastructure/supply



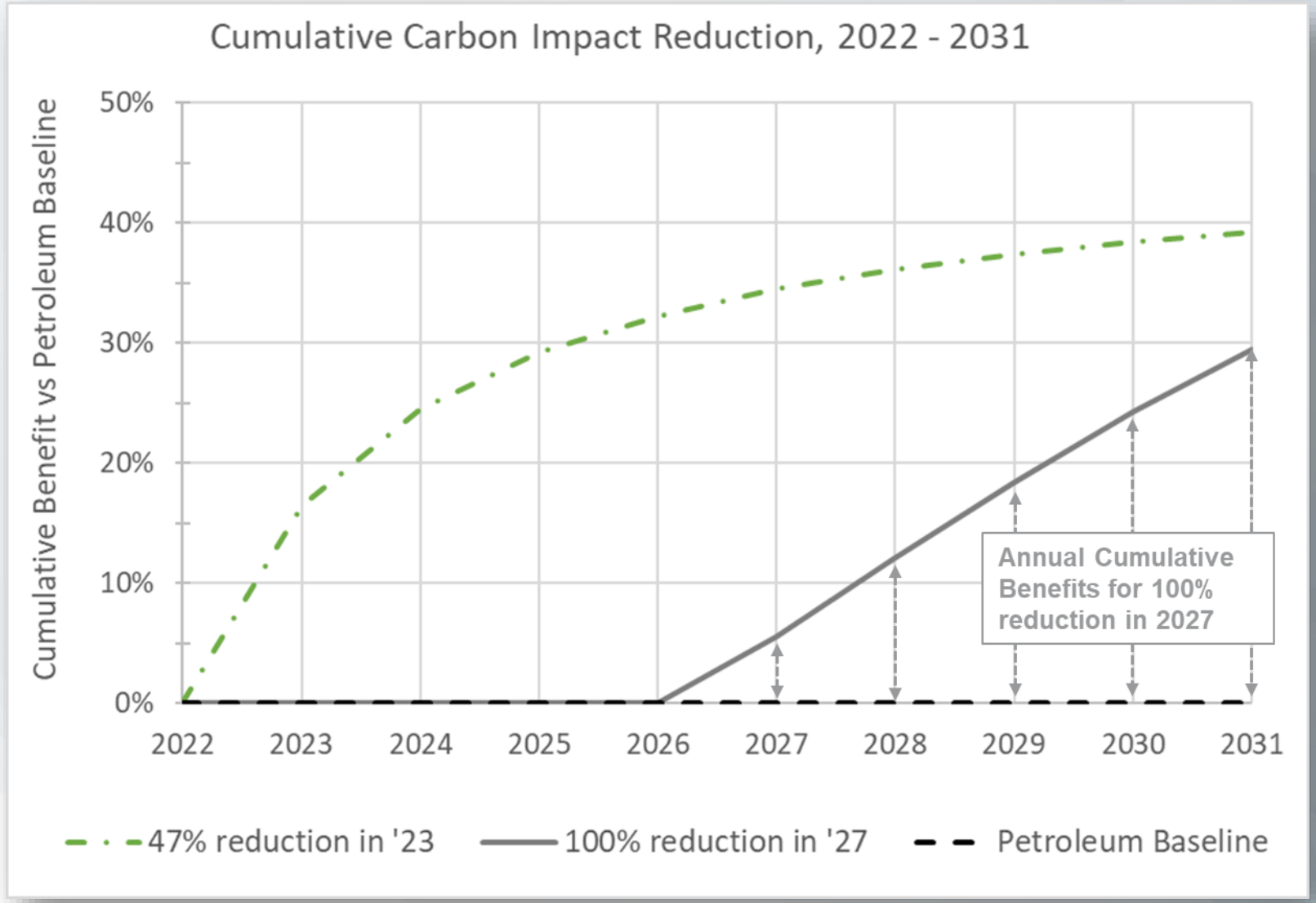
Petroleum Diesel
Current H_2/Grid
Low Carbon Fuel Source

* Average values subject to change based on supply chain and technology advancements

GHG REDUCTION

Cumulative Carbon Impact

- Looks at the cumulative level of GHG in the atmosphere, not the current level of emissions
- More accurately determines the extend of the warming effect of GHG emissions on the planet
- GHG persist in the atmosphere creating negative impact for many years



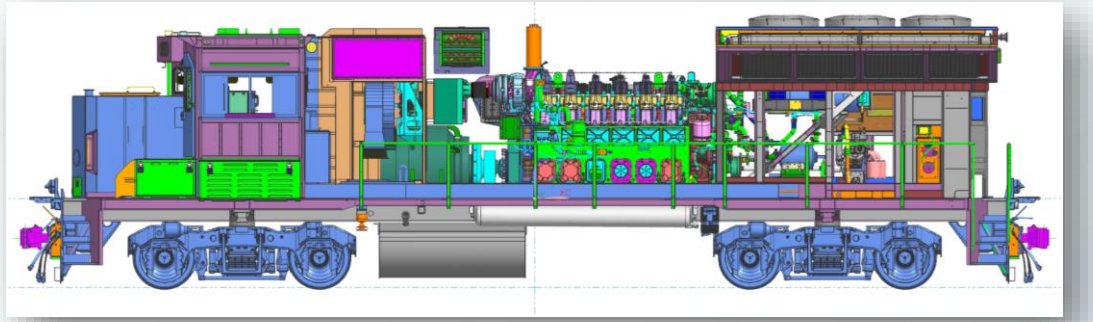
ET23

T4 Repower… Leverage existing GP/SD's

Features:

- EPA T4 Certified & CARB Verified
- In-line, 6-cylinder engine, shared technology with 4,500HP V12
- No exhaust aftertreatment
- Reuse existing propulsion & traction equipment
- Applies to GP38-2, GP40-2, and SD40-2
- **85%+** NOx & PM reduction (T4 vs. T0+);
- **~15%** fuel savings
- **50%** oil consumption reduction
- **20+** year OH cycle
- Future Hydrogen internal combustion engine (ICE) capabilities

Available starting Q4 '25 for ET23C and Q2 '26 for ET23B



4-axle (ET23B)
GP38-2 and GP40-2 Donor
286,000 lbs max weight
65 mph max speed
Plate M Clearance
1,700 gallons fuel capacity

6-axle (ET23C)
SD40-2 Donor
432,000 lbs max weight
65 mph max speed
Plate M Clearance
3,600 gallons fuel capacity

Proven mid-speed engine designed for rail … no aftertreatment

Diesel Engine & Drive Train
T4 EVO Inline 6 Engine (2,350 HP)
Driveshafts for AR10/CA5, Aux Gen, and Air Compressor

Control System
BrightStar Control System
Tier 4 Engine Controller
AESS equipped

DB & Ventilation
Extended Range Dynamic Braking
AC Driven Equipment Blower
OH DC exhauster

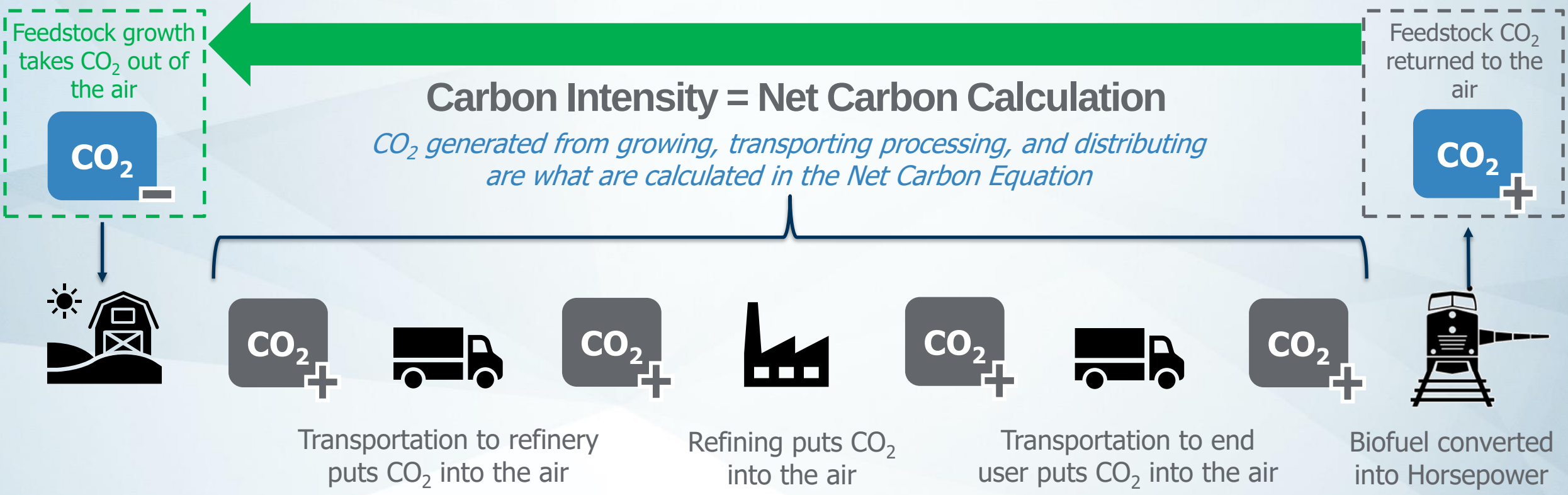
Traction & Drives
OH AR10/CA5
OH Trucks & Combos
OH 18kW Aux Gen

Operator Cab
Refresh Flooring, Windows & Seats
Rooftop Air Conditioning

BIOFUEL

Carbon Intensity (CI) Reduction

Biofuel ranges from **20 to 50** gCO_2/MJ versus petroleum diesel of **100** gCO_2/MJ



CALSTA DEMO GRANT

Utilize Adjacent/Broader Funding Opportunities to Advance Rail

What?

$35M+ of funding to demonstrate Hydrogen Fuel Cell Locomotive and LH_2 Ecosystem

Who?

CalSTA – Port Freight Infrastructure Program

Wabtec – providing locomotive and fueling equipment

When?

3-year development of locomotive / 1-year trial period

Why?

Demonstrate LH2 in freight rail space with a hydrogen fuel cell locomotive in port freight rail application

Where?

In and around POLA & POLB in Los Angeles, California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