



IANA

**INTERMODAL ASSOCIATION
OF NORTH AMERICA**

Compressed Natural Gas for Intermodal

*How to Save Money, Meet Sustainability
Targets, and Capture Grant Funding*

JANUARY 8, 2019, 2:00 PM ET

Housekeeping

- Panelist presentations will be followed by audience question and answer session
- Audience audio will be muted
- Submit questions at any time for Q&A session at the end of the webinar presentations
- A recorded version of this webinar, including the slides, will be available in the near future



Our Panel



Eric Bippus

SVP – Sales & Marketing
Agility Fuel Solutions



Greg Roche

Vice President, Clean
Energy Fuels



**Tom
Swenson**

Business
Development
Manager
Cummins Westport
Inc.



Jason Lewis

Senior Market Advisor
Clean Transportation,
SoCalGas

Agenda

2:00-2:10: Basics of natural gas in trucking applications

– Eric Bippus, Agility Fuel Solutions

2:10-2:20: Meeting emissions goals with near-zero-emissions engines

– Tom Swenson, Cummins-Westport

2:20-2:30: Fueling infrastructure and renewable natural gas

– Greg Roche, Clean Energy Fuels

2:30-2:40: Grant funding availability

– Jason Lewis, SoCalGas

2:40-3:00: Open Questions

Basics of Natural Gas in Trucking Applications

Eric Bippus
Agility Fuel Solutions

Natural Gas in Trucking

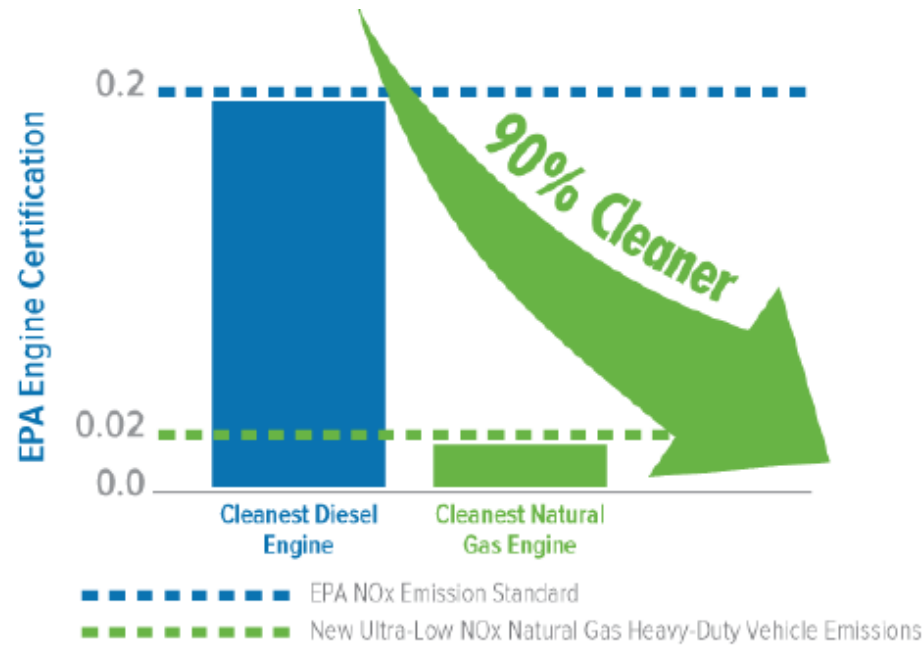
- Natural gas vehicles available in class 4-8, including terminal tractors and daycab and sleeper trucks
- Spark-ignited engines up to 12L, 400hp
- Typical application is regional haul daycab – perfect for intermodal operators

Natural Gas in Trucking

- Liquid natural gas (LNG) – cryogenic tanks
- Compressed natural gas (CNG) – 3,600 psi tanks
- Most trucks now CNG – range of 700+ miles typical
- Up-front cost of truck higher, significant fuel and maintenance savings – payback <2 years with incentives



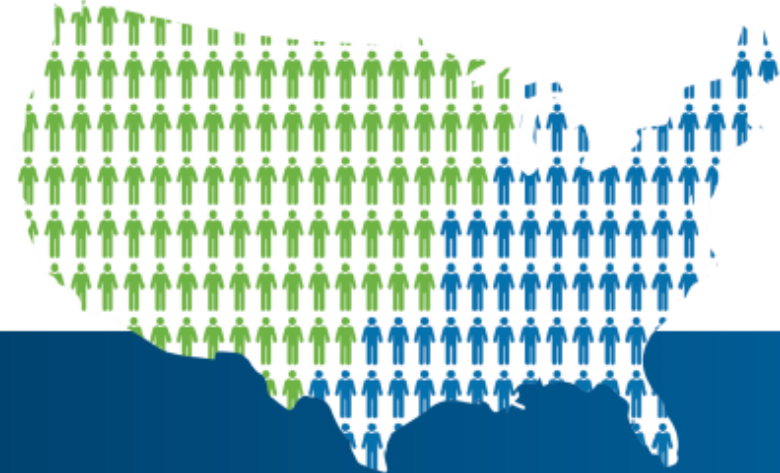
Natural Gas is Clean



The Cummins Westport Ultra-Low NOx engine is certified to a 0.02 g/bhp-hr standard, which is:

- 90% cleaner than the EPA's current NOx standard
- 90% cleaner than the latest available diesel engine

166 Million



≈ 50%

of Americans live in areas with air that is unhealthy to breathe

Source: American Lung Association's "State of the Air 2016"

Natural Gas is Clean

Natural Gas Reduces WTW Greenhouse Gas Emissions

Compared to Diesel:



- Renewable NG is growing rapidly and available everywhere
- Low-carbon to carbon-negative fuel from food waste, waste water, agriculture & landfill sources

Carbon Intensity Rating of Key Transportation Fuels

Transportation Fuel	EER-Adjusted Carbon Intensity
Diesel (conventional)	102.01
Natural gas (conventional)	88.60
Hydrogen (from natural gas)	55.61
Electricity (California grid)	38.95
RNG - Landfill gas	33.89 to 65.64
RNG - Wastewater biogas	8.61 to 34.36
RNG - Food/green waste biogas	-25.48
RNG - Dairy biogas (prospective)	-303.30

WTW Greenhouse Gas Emissions Reductions

Compared to Diesel:



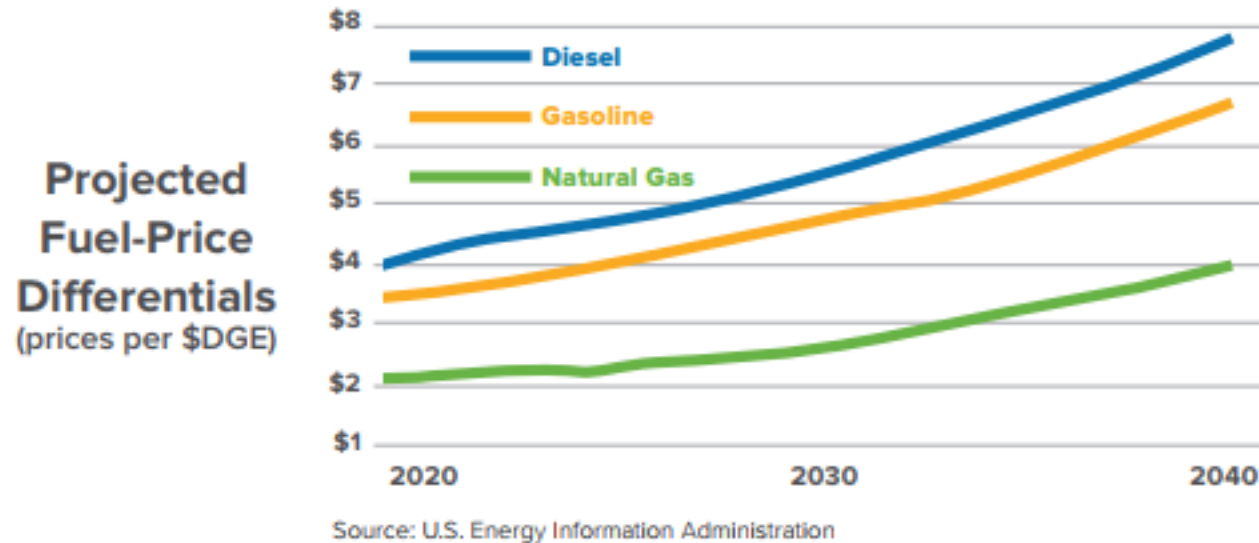
Source: www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm

NGVAMERICA

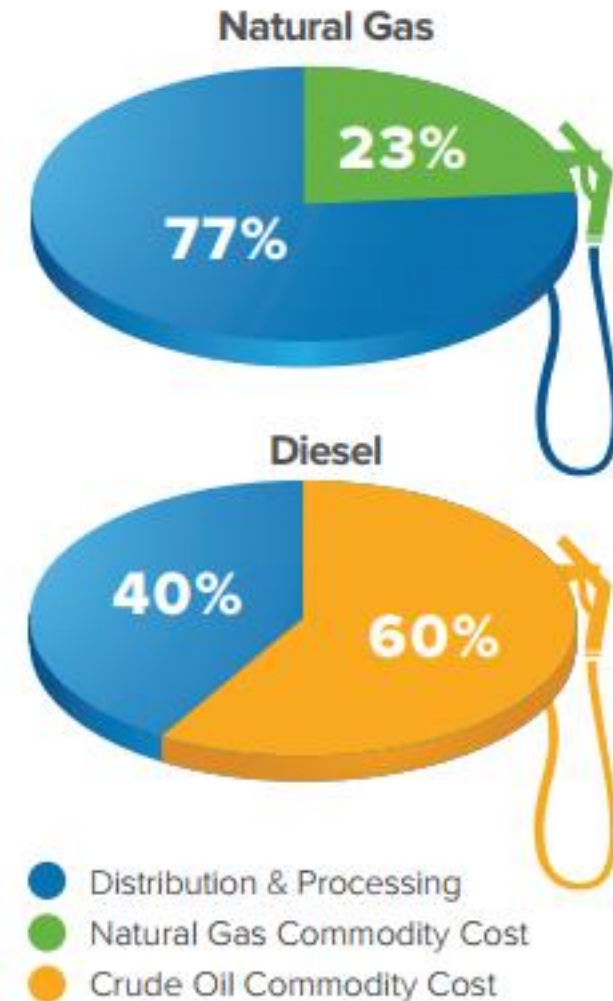
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Natural Gas Saves Fleets Money

Natural Gas Provides Long-Term Fuel Price Stability and Cost Savings



- Typically \$0.75 to \$1 lower than diesel
- Much more price stability because, unlike diesel, most of the delivered cost of natural gas is fixed



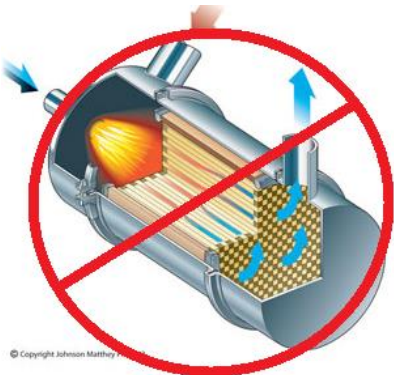
Additional Benefits



- Lower maintenance & total operational cost
“We're seeing a very nice payback for a CNG truck versus the diesel truck in terms of not only the cost of fuel, but also maintenance cost. – Jim Fish, WM CEO



- Engines make less noise compared to diesel
*Great for early morning routes and/or noise restrictions



- No DPF or SCR (DEF fluid)

Benefits Compared to EV/Hybrid



Long range: typical CNG tractor gets over 700 miles



Comparable filling time compared to diesel

- No need to change operations for charge cycle



Lowest available cost per ton of source-to-wheels GHG, SO_x, NO_x emissions reduction



Additional weight less than or slightly above 2,000lb alt fuel weight exemption

- Li-ion batteries significantly heavier

Moving Goods with RNG



TOYOTA



Meeting Emissions Goals With Near-Zero-Emissions Engines

Tom Swenson
Cummins-Westport

CWI North American Products

- EPA/ARB Ultra Low emissions certification
- Lowest Emission HD engines in North America
- On-Board Diagnostics (OBD) applied for optimal emissions system performance
- Base warranty identical to diesel counterpart



ISX12N™

Near-Zero Certified (0.02g NOx)

Peak rating: 400 hp, 1450 lb-ft

GVW: Up to 80,000 lbs



L9N™

Near-Zero Certified (0.02g NOx)

Peak rating: 320 hp, 1000 lb-ft

GVW: Up to 66,000 lbs



B6.7N™

Near-Zero Certified (0.10g NOx)

Peak rating: 240 hp, 560 lb-ft

GVW: Up to 33,000 lbs

Near Zero Emissions Technology

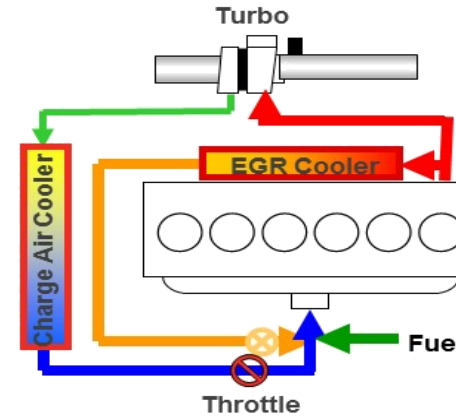
Spark-ignited combustion

- Stoichiometric combustion
- Computer controlled combustion across all operating conditions
- NZ has same engine footprint as previous engine for easy vehicle integration
- NZ still built in Cummins factories with 80% diesel parts commonality
- NZ parts, service, training still through Cummins Distribution



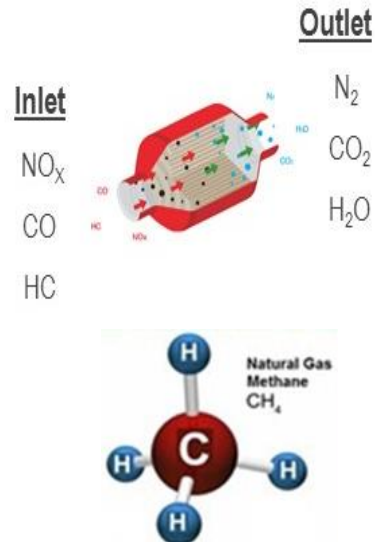
Cooled Exhaust Gas Recirculation

- Computer controlled Air/Fuel mixing across all conditions



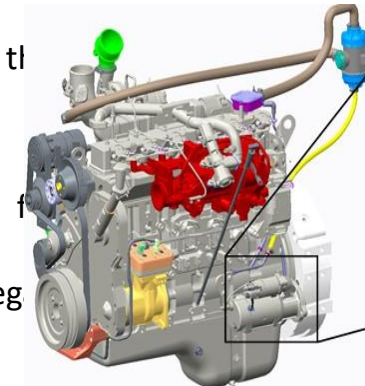
Three Way Catalyst

- Increased efficiency
- A little larger size
- Tighter integration between engine and after-treatment
- Still passive – no DPF, SCR
- Fuel agnostic - CNG, LNG, RNG
- NOx emissions from NZ certified as equivalent to an electric vehicle according to CARB and EPA definitions



Closed crankcase ventilation

- ISL G has an open breather system
- NZ engines captures any unburned hydrocarbons and reintroduces to the engine
- CCV filter change at 2,000 hrs
- Methane reductions combined with RNG can make NZ lower carbon emissions than electric... 'carbon neg'



Product Improvements

ISX12N™	L9N™	B6.7N™
<ul style="list-style-type: none">• Fuel system• Crankcase vapor filter• Engine control module• Wiring harness• Ignition control module• Slightly larger catalyst	<ul style="list-style-type: none">• Steel Pistons• Liners• Ring Pack• Valve Seat Material• Oil Cooler• Piston Cooling• Engine control module• Wiring harness• Ignition control module	<ul style="list-style-type: none">• Engine control module• Wiring harness• Ignition control module

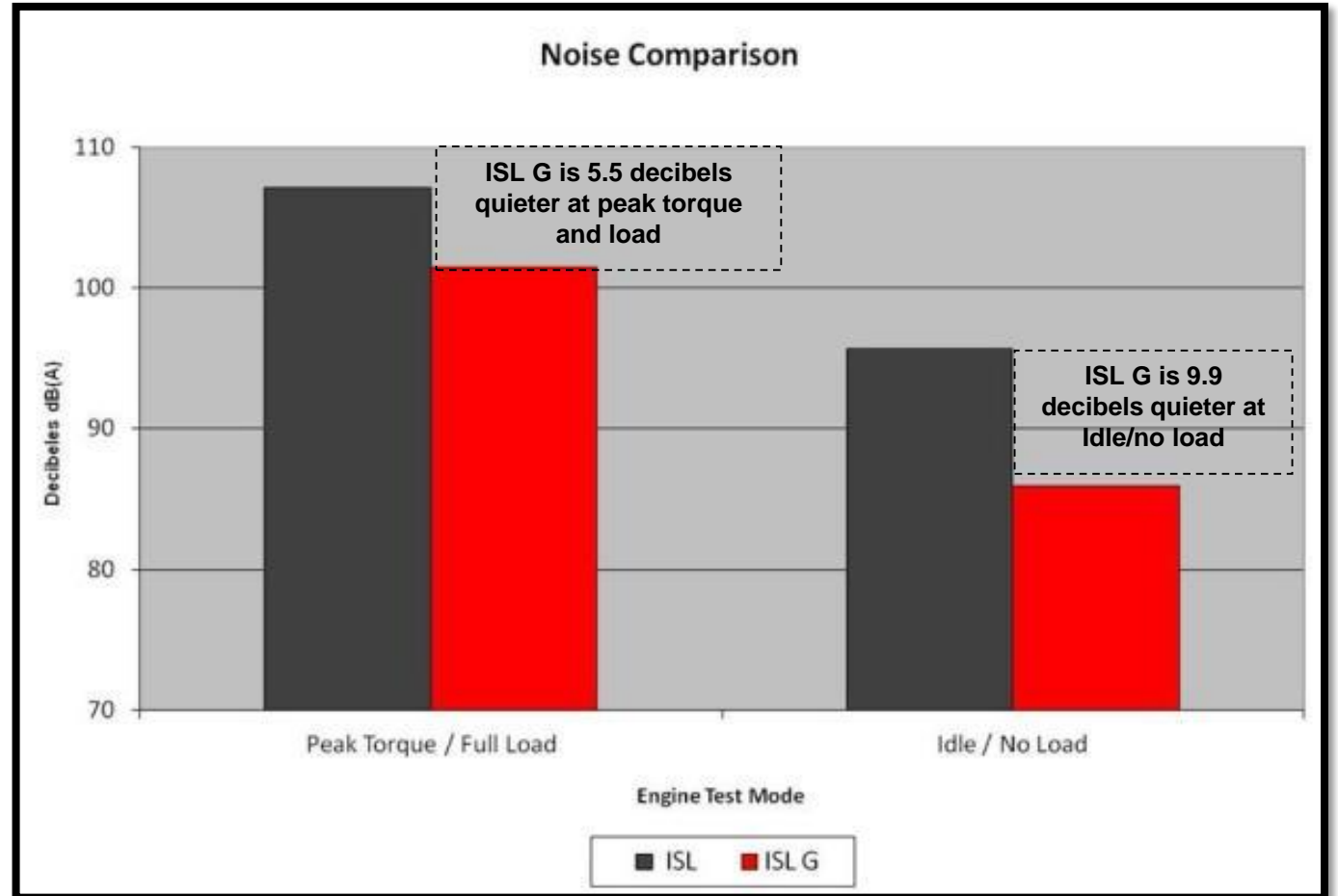
Maintenance & Fluid Free Exhaust Treatment: Three-Way Catalyst



- Similar to catalyst on gasoline passenger cars
- Packaged as a muffler with vertical or horizontal mount
- Weighs ~100 pounds
- Benefits:
 - More reliable, no downtime
 - Maintenance-free, no filters to clean or replace
 - No active regeneration required
 - No SCR fluid or maintenance or costs

Quiet Operation

- Spark ignition provides quiet operation
- Communities notice the natural gas noise advantage.
- ONE Diesel engine idling is louder than 10 natural gas engines idling



Maintenance Item (Hours/Miles/Months)	B6.7N	L9N (Truck) ≤66,000 lbs GCVW	L9N Bus (transit/school) & Refuse	ISX12N ≤80,000 lbs GCVW
Oil And Filter	500 / 15,000 / 6	500 / 15,000 / 6	500 / 7,500 / 6	500 / 25,000 / 6
Spark Plugs	750 / 25,000 / 9	1,500 / 45,000 / 12	1,500 / 22,500 / 12	1,000 / 50,000 / 12
Spin-on Fuel Filter	Daily: Drain 1,000 / 30,000 / 12	Daily: Drain 1,000 / 30,000 / 9	Daily: Drain 1,000 / 15,000 / 9	Daily: Drain 1,000 / 50,000 / 12
Valve Adjustment	1,500 / 45,000 / 18	Initial: 1,000 / 30,000 / 9 On-going: 2,000 / 60,000 / 18	Initial: 1,000 / 15,000 / 9 On-going: 2,000 / 30,000 / 18	Initial: 1,000 / 50,000 / 8 On-going: 3,000 / 150,000 / 24
Coolant System Drain	2,000 / 60,000 / 24	2,000 / 60,000 / 18	2,000 / 30,000 / 18	6,000 / 300,000 / 24
Coolant Filter	Not Applicable	500 / 15,000 / 6	500 / 7,500 / 6	1,500 / 75,000 / 12
Closed Crankcase Ventilation Filter	2,000 / 60,000 / 24	2,000 / 60,000 / 18	2,000 / 30,000 / 18	10,000 / 500,000 / 60
Ignition Coil Extension	5,000 / 150,000 / 60	10,000 / 300,000 / 60	10,000 / 150,000 / 60	10,000 / 500,000 / 60
Engine Brake (Adjust)	Not Applicable	Not Applicable	Not Applicable	6,000 / 300,000 / 24 ²¹

Cummins Westport 2018 OEM Availability



B6.7N™



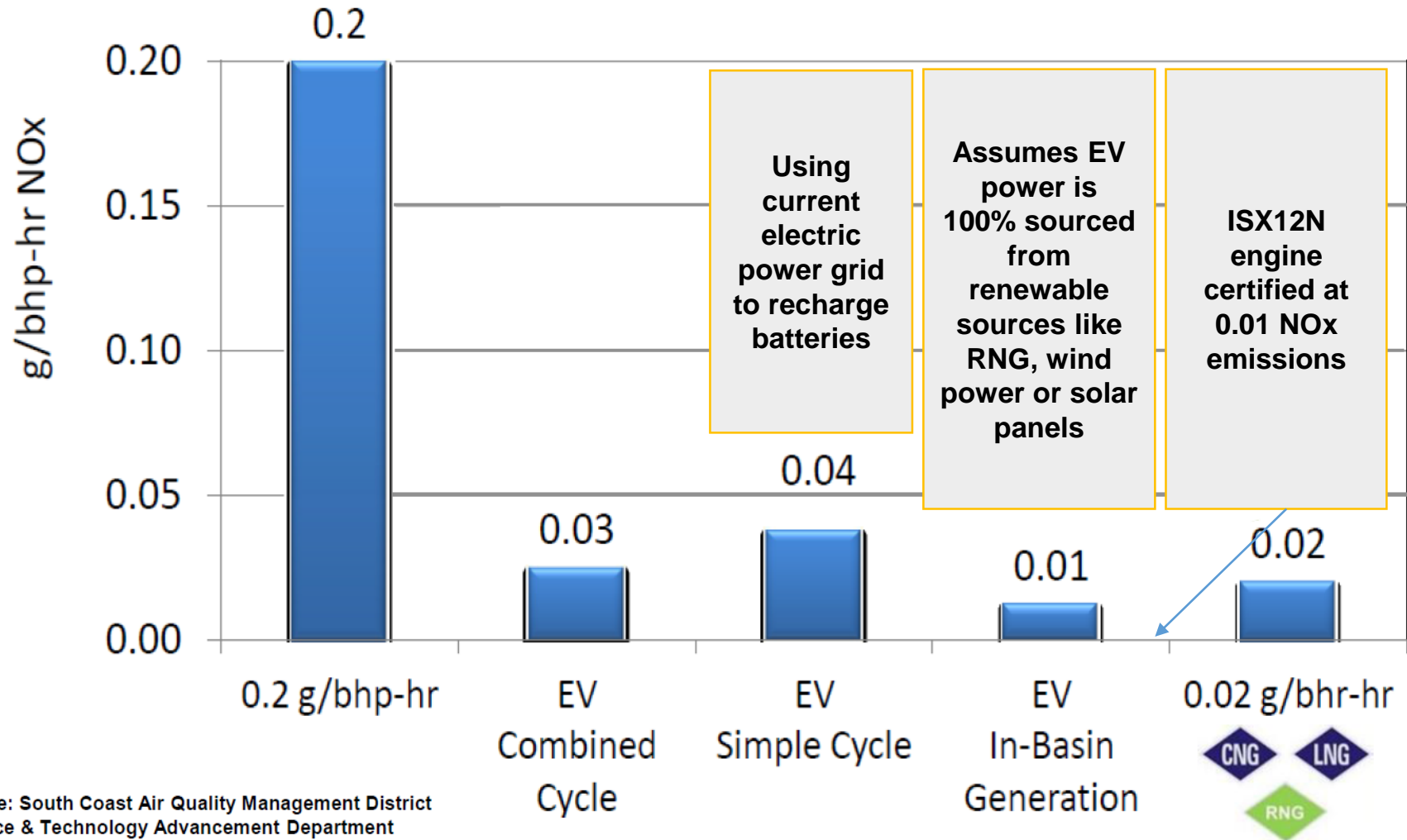
L9N™



ISX12N™

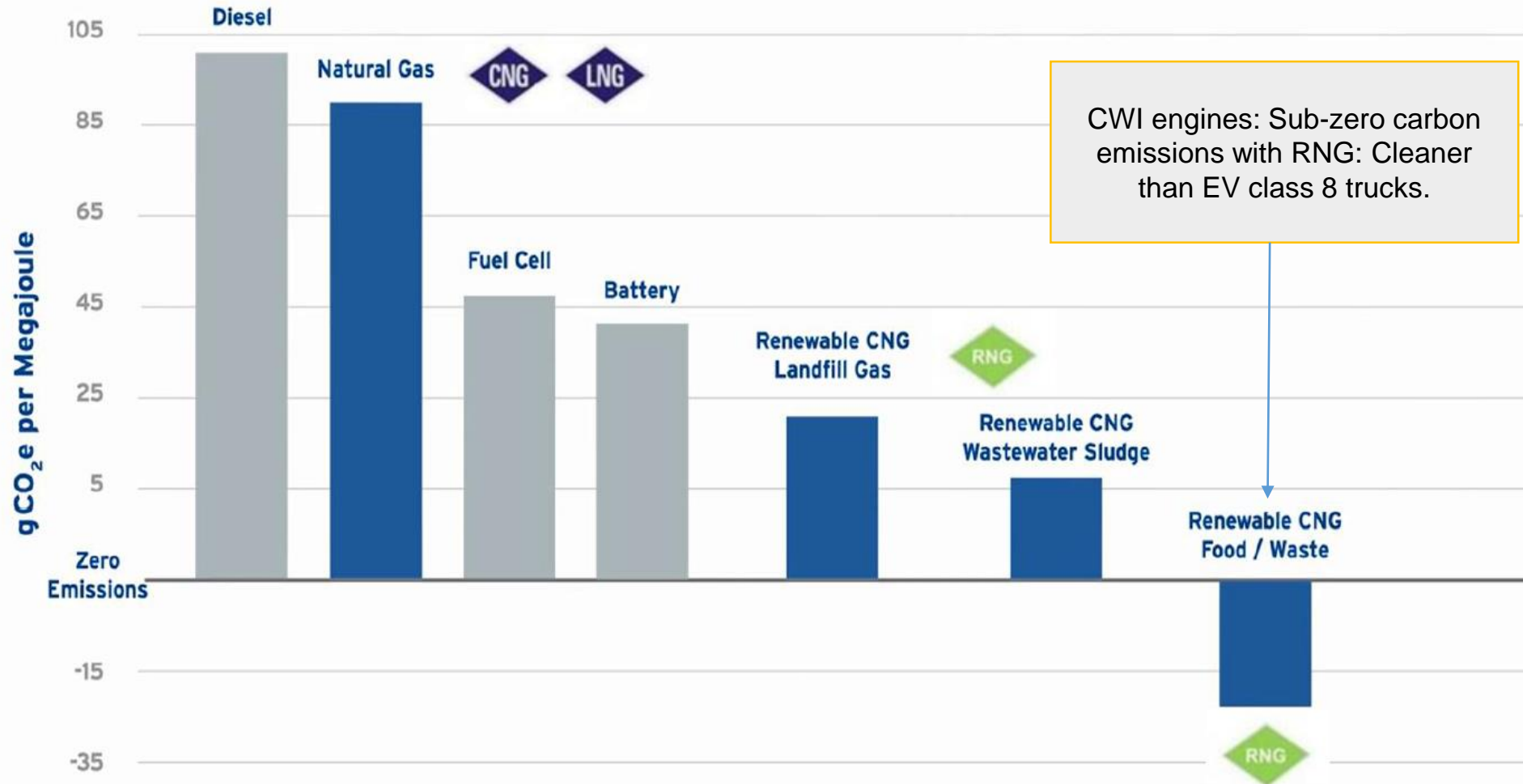


Electric Equivalent NOx



Source: South Coast Air Quality Management District
Science & Technology Advancement Department

Sub-zero Carbon Intensity



Source: California Air Resources Board, "LCFS Illustrative Fuel Pathway Carbon Intensity Determined using CA-GREET2.0" 9/17/15.

Natural Gas Playbook Emissions Calculator



HOME ABOUT CWI CONTACT US

YOUR

STEP 1

Region

Applica

Model

Vehic

Measur

Existing
(mpg)

Annual
vehicle

RESULTS

Region	US Typical
GHG Specification/Model	GREET1_2016
Annual Total WTW GHG (CO2eq) Savings with NGVs (Metric Tonnes per year)	5,893.3
% Reduction Relative to Current Vehicle Fleet	80.4%
Truck Equivalent GHG Avoided by Converting to NGV	20.1
# of Near Zero Gas Trucks it Would Take to Generate GHG of Current Fleet	127.4
Tailpipe NOx Emissions Reduction with NGV	90%

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CWI ENGINE SELECTED

ISX12N

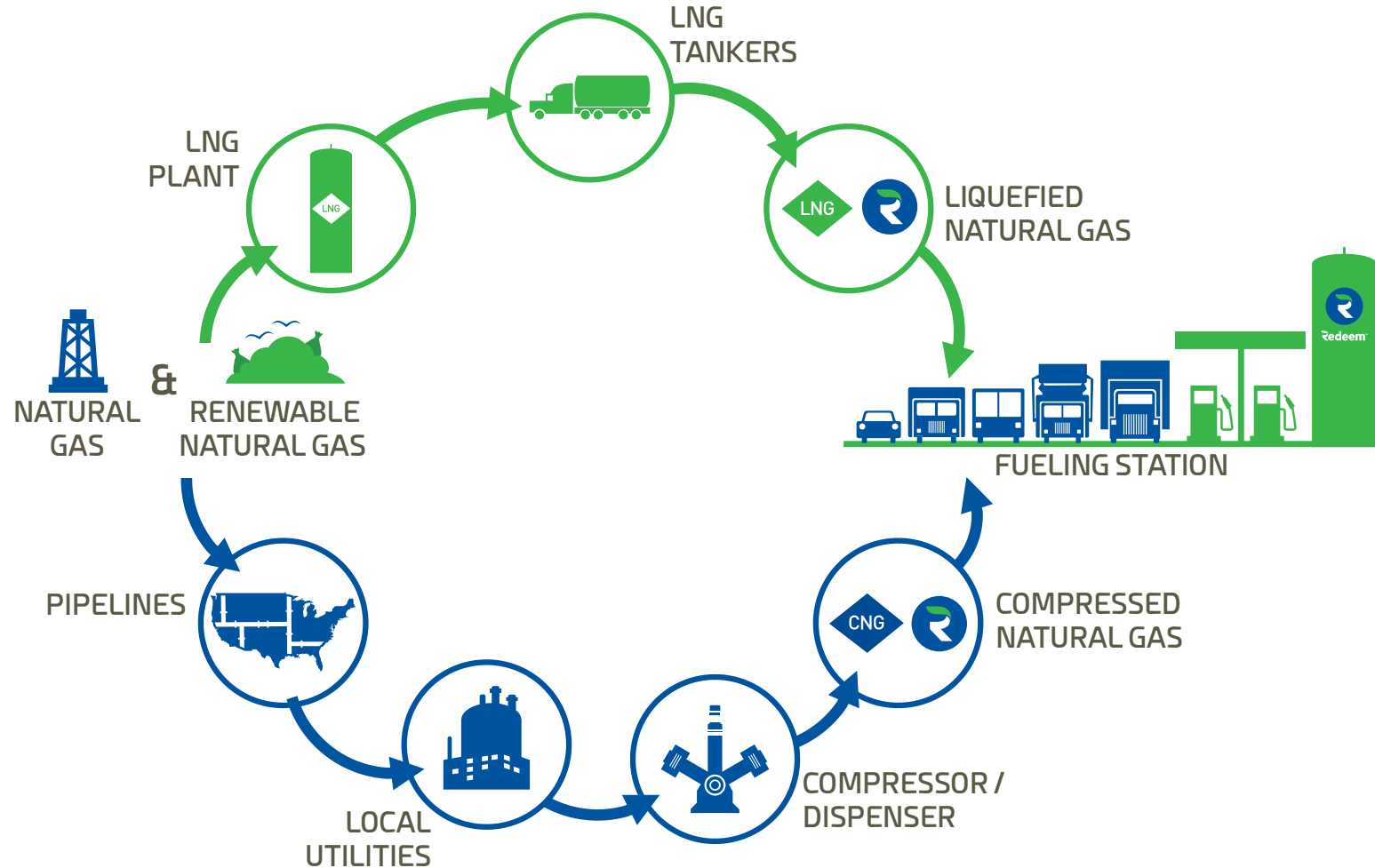


Fueling Infrastructure and Renewable Natural Gas

Greg Roche
Clean Energy

Natural Gas Fueling is Proven & Reliable

Decades of innovation give fueling experience similar to traditional fuels.



Fueling Options Give Flexibility

1 VEHICLE TYPE



CARS



TRUCKS

2 FILL TIME



STANDARD FILL



TIMEFILL

3 FUEL TYPE



COMPRESSED NATURAL GAS



LIQUIFIED NATURAL GAS

4 STATION TYPE



PUBLIC



PRIVATE

5 TEMPORARY STATION



6 MOBILE FUELING



CNG is Widely Available for Trucks

828 Heavy Duty Truck Public Stations in Canada and the United States



From afdc.energy.gov

Fueling: Public, Private, Large, Small, CNG, LNG



Back to the Future with RNG

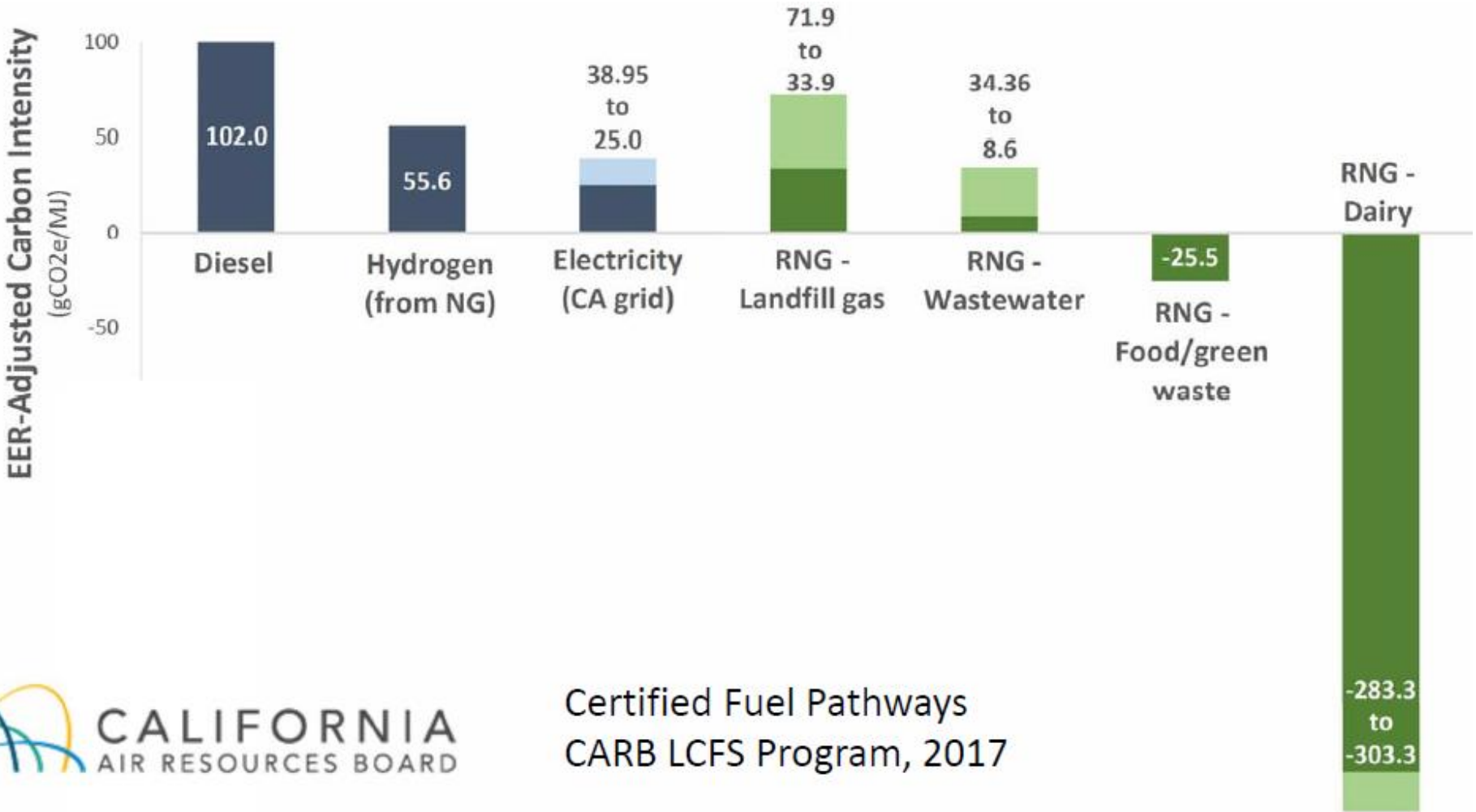


What is Renewable Natural Gas (RNG)?



- RNG is renewable energy – natural, sustainable, recycled
- RNG is methane captured and recovered from decaying organic material
 - Landfills
 - Wastewater Treatment
 - Green Waste, Food Waste, Forest Waste
 - Livestock Waste (dairy cows, hogs, chickens)
- RNG is used as a direct replacement for natural gas
- RNG is produced & distributed under the same federal & state programs as other biofuels
- RNG is over 70% of the natural gas vehicle fuel in California, and will quickly climb to almost 100%
- RNG production volume is rapidly growing nationally

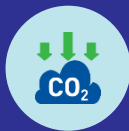
RNG is the Lowest Carbon Fuel Available



Certified Fuel Pathways
CARB LCFS Program, 2017

RNG Turns Waste Into Energy

Every 100,000 Diesel Gallons Replaced by Redeem RNG



899

METRIC TONS OF GHG EMISSIONS



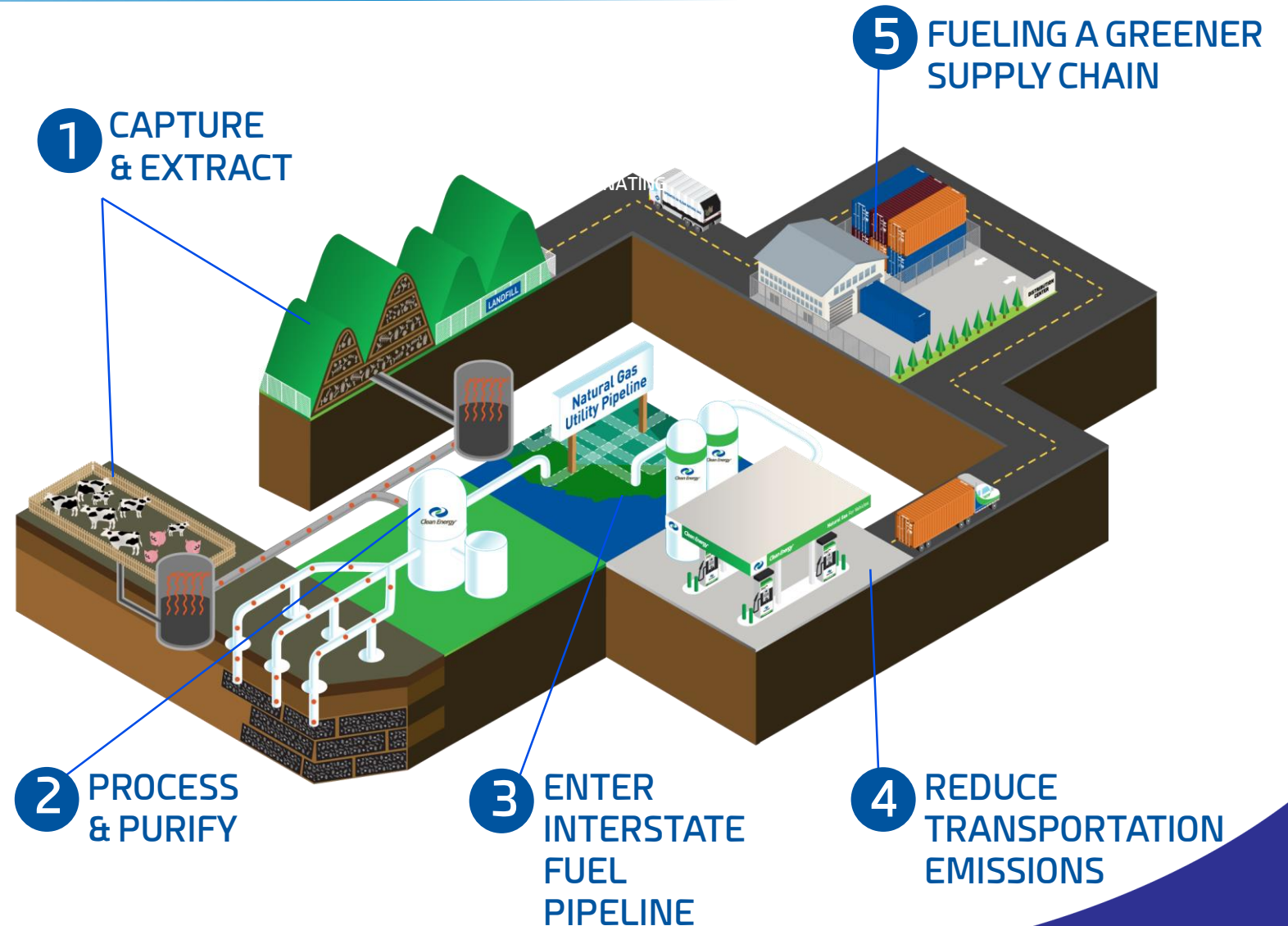
REMOVING **190**

CARS OFF THE ROAD

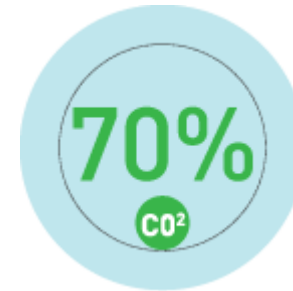


23K

TREES PLANTED



RNG Will Transform Trucking Sustainability



CLEANER

The cleanest fuel available – with 70% to over 100% reduction in GHG Emissions



COST EFFICIENT

Substantially less expensive than diesel and gasoline



RENEWABLE

Made from 100% organic waste from sources like landfills and farms



DOMESTIC

Moving the country towards energy independence

Clean Energy's Market Moving Incentive Programs



Limited time &
limited quantity offers...



- CNG or LNG fuel for only \$1.00 per gallon during the first 12 months of operation
- Continue saving over diesel after the first 12 months

ZERONOW
FINANCING

Zero Emissions Trucking.
Zero Added Cost.

- Natural gas truck costs the same as a diesel truck
- CNG and LNG sold at a guaranteed discount to diesel
- Assistance with grants to further reduce truck cost
- Over 110 truck-ready CNG and LNG fuel stations nationwide

Grant Funding Availability

Jason Lewis
SoCalGas

Discussion Points

- Grant Funding
- Diesel Defeat Device Settlement
- Applications
- Industry Support



Grant Funding

- Diesel Emissions Reduction Act (DERA)
 - Federal program
 - Grants available through states
 - Renews annually



Grant Funding: California

- Carl Moyer Program
 - Air District administered program
 - Up to \$100,000 per Low NOx CNG Truck
 - Scrappage required
- Mobile Source Air Pollution Reduction Review Committee
- HVIP – vouchers through dealerships



Southern California Ports

- South Coast Air Quality Management District Port Truck Replacement Project (Oct. 2018)
 - \$14 million total to replace 140 port trucks
 - Ports of Long Beach and Los Angeles each contributed \$2 million



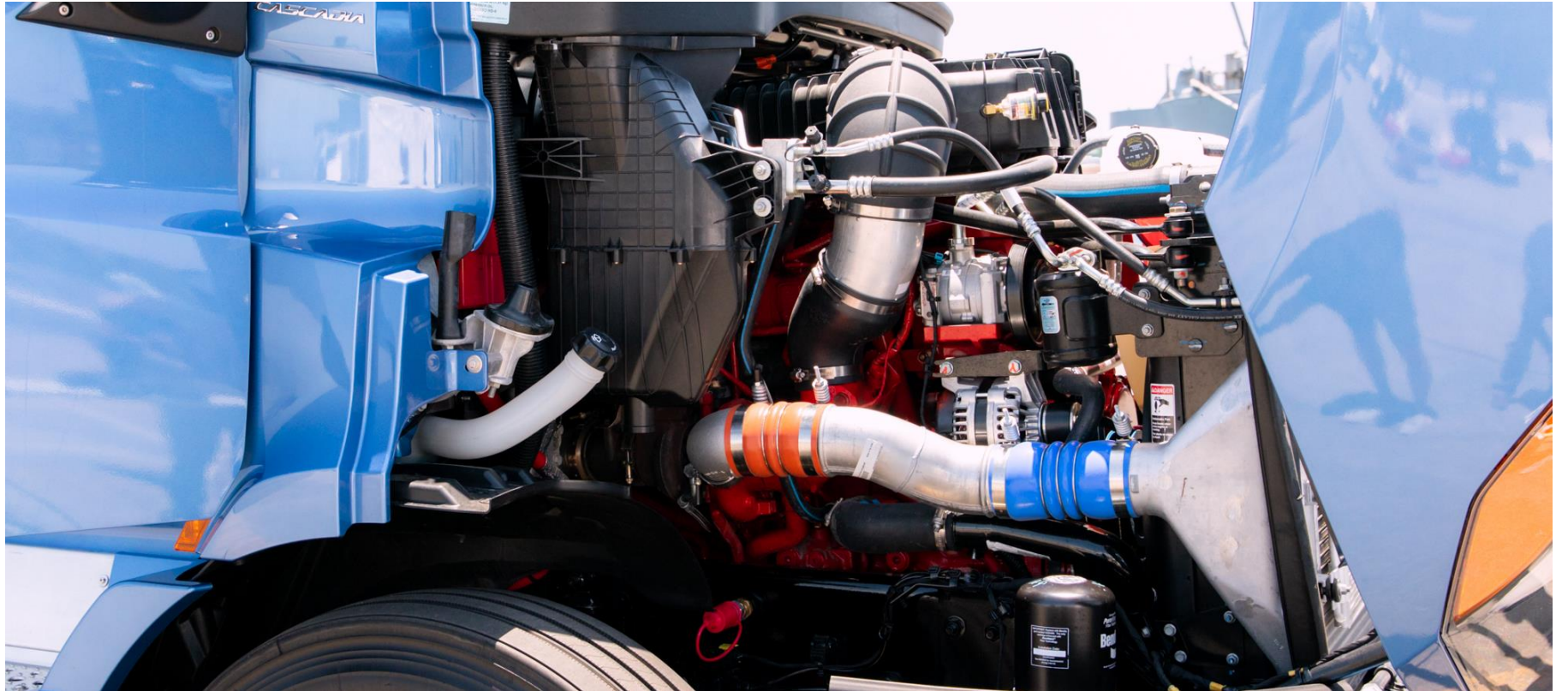
Diesel Emissions Environmental Mitigation Trust

- \$14.7 billion settlement



Applying for Funding

- Dealerships
- Fueling providers
- Consultants and industry organizations



Industry Support

- Port authorities, local air districts
- Dealerships
- Fuel providers, consultants



SoCalGas' Truck Loan Program



- Free trial
 - 11.9L CNG truck
 - 750 mile range
 - Refueling included
- Up to 2 weeks
- Customers who:
 - Are looking to make a new truck purchase in < 2 years
 - Currently operate a class 6, 7, or 8 truck
- Accepting applications for 2019
- CleanTransportation@semprautilities.com

A blue Freightliner truck is parked on a paved surface at a port. In the background, there is a large suspension bridge with green towers and a stack of colorful shipping containers. The sky is clear and blue.

Questions?

Enter your questions in the control panel

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