

New Opportunities for RNG in Dairy Transportation



Darrin Monteiro
Sr. VP of Sustainability &
Member Relations
California Dairies, Inc.
(Moderator)



Justin Loyear
Business Dev. Manager
**Cummins Alternative
Technologies**



Trevor Shannon
Owner
Shannon Bros Trucking Co.

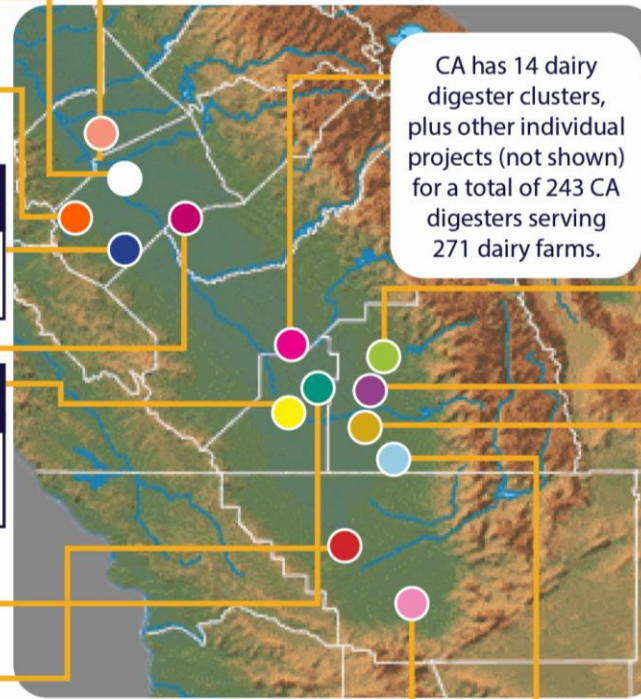


Zachary Lawson
Regional Sales Director
OPAL Fuels, LLC



California Dairy Digester Development

- 243 dairy digester projects, capturing methane from 271 dairy farms
- Creating electricity, renewable natural gas (RNG), or hydrogen fuel
- About 170 currently in operation, the rest in development.



● **CalBioGas Hilmar LLC**
Operating
 7 digesters (all operating)
 Serving 8 dairies

● **Aemetis Biogas LLC**
Operating
 39 digesters (16 operating)
 Serving 50 dairies

● **CalBioGas Gustine, LLC**
In Development
 10 digesters

● **RNG Moovers - Aligned Digesters**
Operating
 4 digesters (3 operating)

● **Five Points Pipeline LLC**
Operating
 5 digesters (all operating)

● **CalBioGas North Visalia LLC**
Operating
 12 digesters (11 operating)
 Serving 14 dairies

● **Merced Pipeline LLC**
Operating
 16 digesters (13 operating)

● **Lakeside Pipeline LLC**
Operating
 11 digesters (10 operating)

● **CalBioGas West Visalia LLC**
Operating
 5 digesters (all operating)

● **CalBioGas Hanford LLC**
Operating
 6 digesters (all operating)

● **CalBioGas Buttonwillow LLC**
Operating
 9 digesters (7 operating)

● **CalBioGas South Tulare LLC**
Operating
 29 digesters (23 operating)
 Serving 34 dairies

● **CalBioGas Kern LLC**
Operating
 11 digesters (8 operating)
 Serving 13 dairies

● **Calgren Dairy Fuels LLC**
Operating
 22 digesters (20 operating)
 Serving 23 dairies



Learn more at DairyCares.com/dairy-digesters

Evolution of RNG in California





CALIFORNIA CREAMERY OPERATORS ASSOCIATION

- Long-time transportation members/supporters
- Record transportation participation this year

Thank you, sponsors!

**CALIFORNIA
FREIGHT**



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Cummins

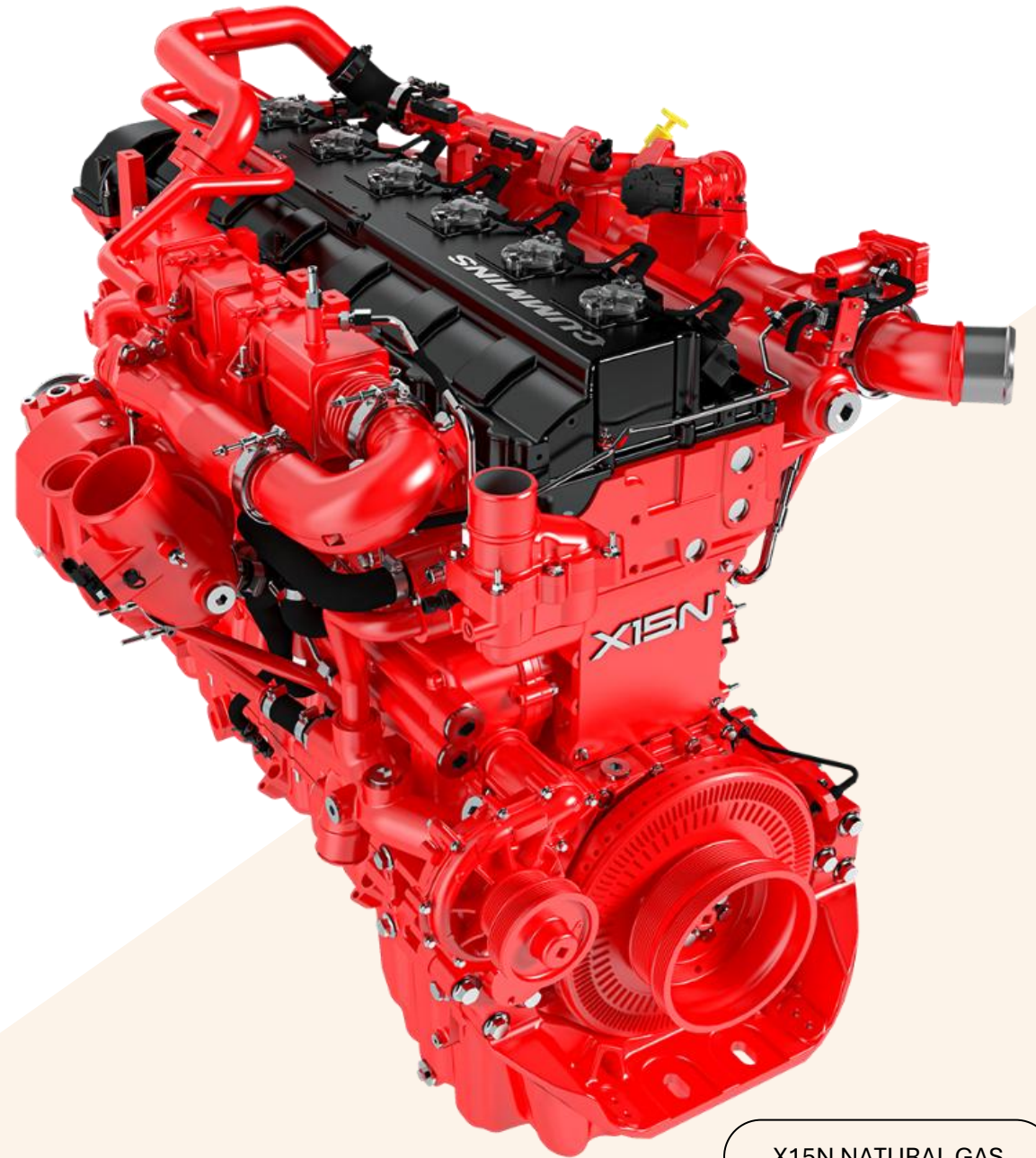
X15NTM

Update

CCOA 2025

Justin Loyear

Public



X15N NATURAL GAS

Accelerating toward **Destination Zero**

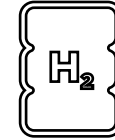
Cummins will continue to innovate and invest as we advance along the path to zero, but we can't do it alone.

- Action is required today.
- Progress requires partnership.
- Technology leadership is critical.

ENERGY SOURCES



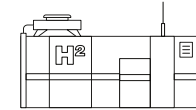
**LOW CARBON
FUELS**



**GREEN HYDROGEN
ECONOMY**

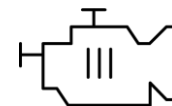


**DECARBONIZED
GRID**

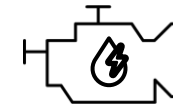


STORAGE

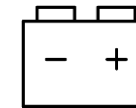
POWER SOLUTIONS



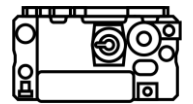
**ADVANCED
ENGINES**



HYBRID



**BATTERY
ELECTRIC**



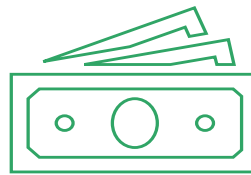
**FUEL CELL
ELECTRIC**

NATURAL GAS VALUE DRIVERS



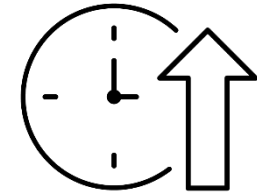
Environmental & Sustainability Benefits

- Lower GHG and NOx levels at the tailpipe
- Potential to reach sub-zero wheel to wheel emissions with Renewable Natural Gas (RNG)
- Start reducing total transportation footprint today



Economic Benefits

- Low cost of fuel
- Can provide competitive advantage to help you win business
- Much lower incremental vehicle cost than BEV / Fuel Cell



Operational Benefits

- Least disruptive and most mature alternative fuel technology (for all applications and routes)
- Only alternative fuel that can supply required range and power for long-haul/heavy-duty vehicles
- Suitable for multishift operation
- Optimized powertrain and fuel system
- High level of parts commonality with diesel



HELM™

HIGHER EFFICIENCY. LOWER EMISSIONS. MULTIPLE FUELS.

UNIFIED GLOBAL PLATFORM: X15 SERIES

Reliable | Durable | Scale | Common



Natural Gas



Advanced Diesel



Hydrogen





X15N™

The Future of Natural Gas Power IS NOW

Cummins Natural Gas Engines

L9N™



EPA & CARB24

ISX12N™



EPA only 2024

X15N™



NOW!
EPA & CARB24

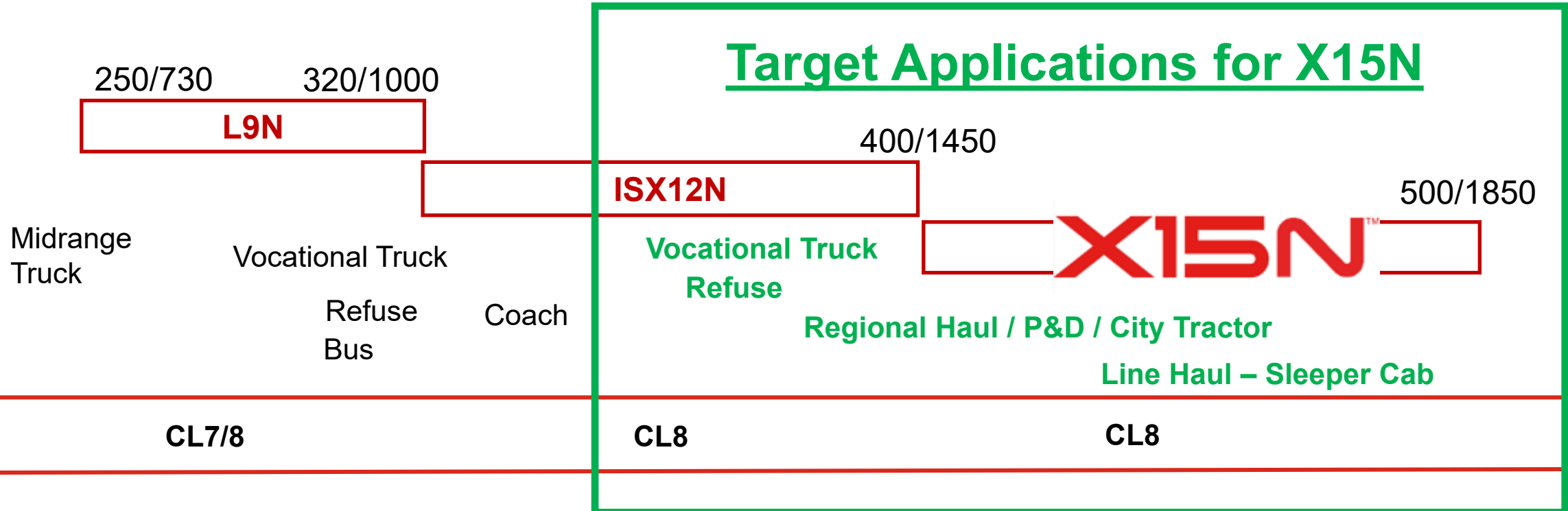
ISX12N Applications: Foundation of the HD Market

10+ years - Over 30K ISX12N Vehicles



Natural Gas Applications

The Natural Gas Power/Torque Landscape





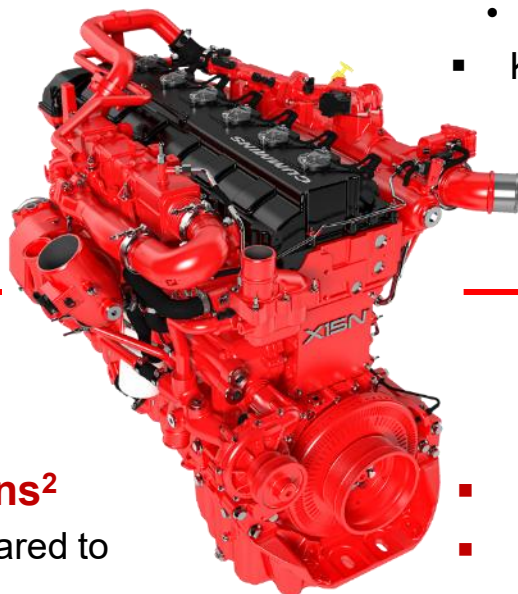
X15N™

- Industry-first & market-defining **Big Bore Natural Gas Powertrain**
- Capable to **meet stringent EPA/CARB24 and future NOx** regulations
- **Compact 15 Liter** – 500 lbs lighter than current 15L diesels
- Up to a **10% Fuel Economy/GHG improvement** over ISX12N for equiv. rating and duty cycle
- 12L-15L Diesel matching ratings - **up to 500hp & 1850lb-ft** of torque
- Compact **passive TWC aftertreatment** system
- **Integrated with Industry HD transmissions** – Endurant HD-N
- Incorporates Cummins **Powertrain Features & Strategies**
- Potential for **Carbon Negative Solution with RNG**

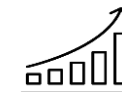


RELIABLE AND DURABLE

- **Power, torque and performance for the HD market**
- Built on **30+ years** of natural gas experience
- Integrated powertrain for a full Cummins solution
- **Full OE network and Cummins service channel support**
- Known maintenance practices
 - Simple aftertreatment
 - Familiar engine technology
 - X15N Extended Service Intervals vs. ISX12N
- X15N Reliability improvements over ISX12N



SCALABLE



- **Natural Gas is the least disruptive alt fuel technology**
- **1-to-1 vehicle replacement for diesel**
- Established supply chain for product production
- Over 800 + public stations
 - Behind the fence refueling options
- Known technology
 - Familiar engine architecture
 - Incremental technician training



COMMERCIALLY VIABLE

- **Over 1,000-mile range for line-haul applications²**
- Lower incremental acquisition cost for the vehicle compared to BEV and fuel cell
- **Multi-shift operation capable**
 - No additional downtime
 - Fast fill refueling time
- **Stable, low-cost fuel means price predictability**
- Natural Gas is available NOW!
 - 85,000+ NG vehicles operating in North America today

SUSTAINABLE



- **Best well-to-wheel GHG reduction option**
- **Net carbon negative solution when using RNG**
- ~ 750 new RNG production projects coming online³
- X15N Up to 10% fuel economy & GHG improvements over ISX12N⁴
- X15N CARB and EPA emissions solution for '24 at launch

¹ Driver education needed

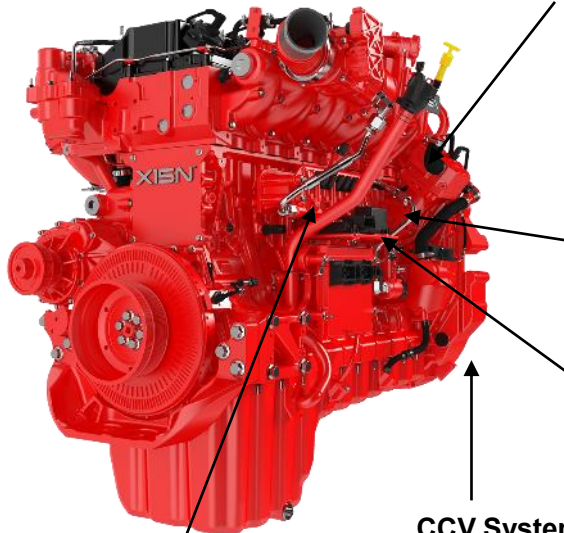
² Dependent on tank configuration, driving behavior

³ Includes sites that are currently operational, under construction or planned

⁴ With equivalent rating and comparable duty cycle



PRODUCT WALK-THROUGH



Power Cylinder
Improved oil control – Improved Oil drain intervals, reduced oil consumption and improved combustion control

Pistons
Steel pistons for durability and improved combustion chamber and component temperature control

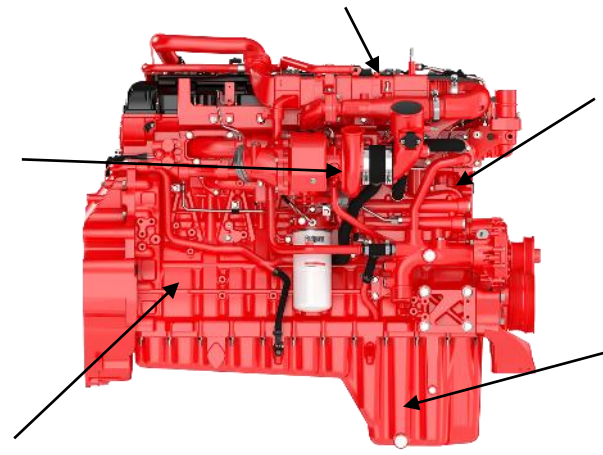
Ignition and Injection Control System
New integrated ignition and injector control system vs two independent systems

CCV System
Incorporates improved bearing system from ISX12N

Fuel Injection System
8 separate solenoids vs. large single fuel control valve for improved fuel control

Turbocharger
Dual entry wastegate and upgraded materials for improved durability and altitude capability and performance

Spark Plugs
Increased ceramic strength and electrode geometry and material for improved spark plug life



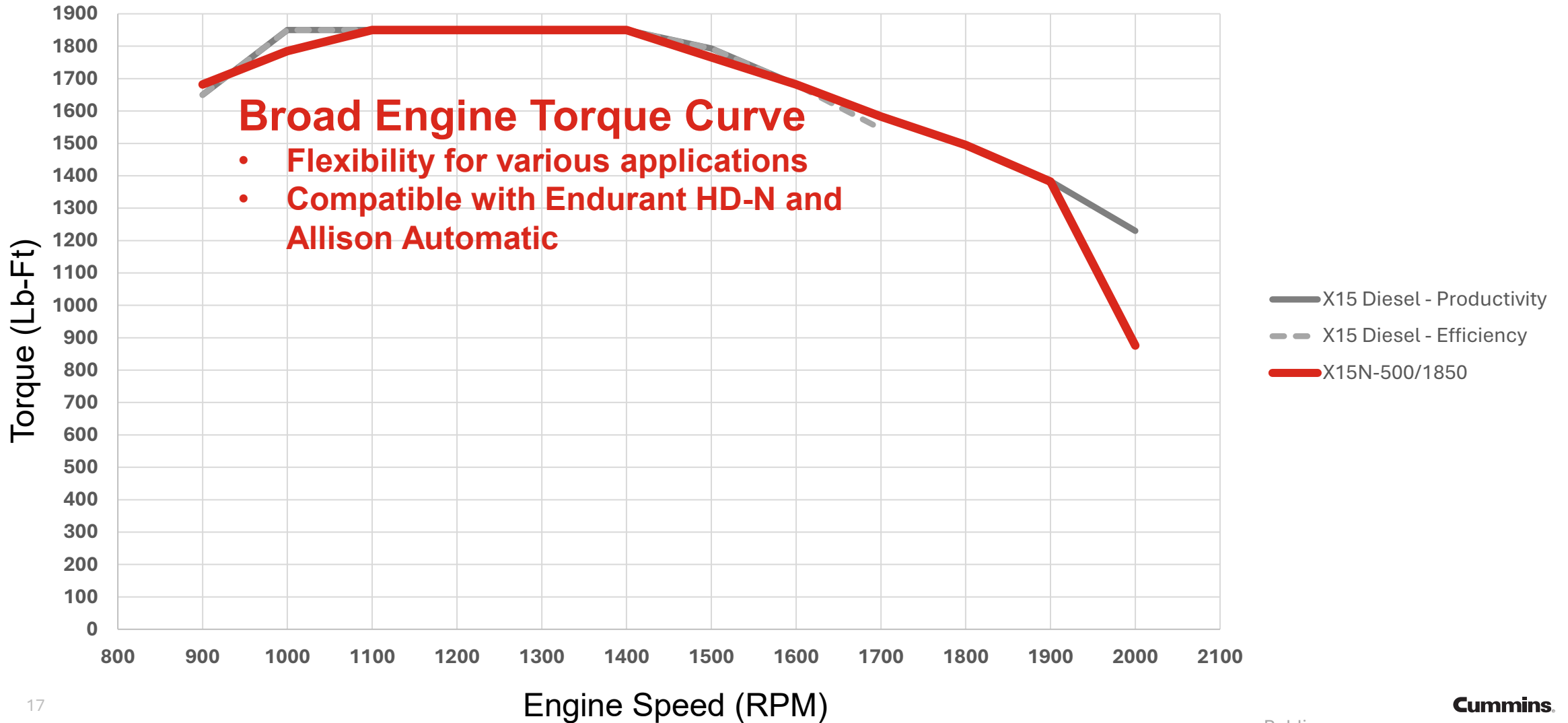
Cylinder Head
Natural gas specific head allowing for improved thermal distribution and improved spark plug life

High-Capacity Oil Pan
Increased oil capacity for extended oil drain intervals

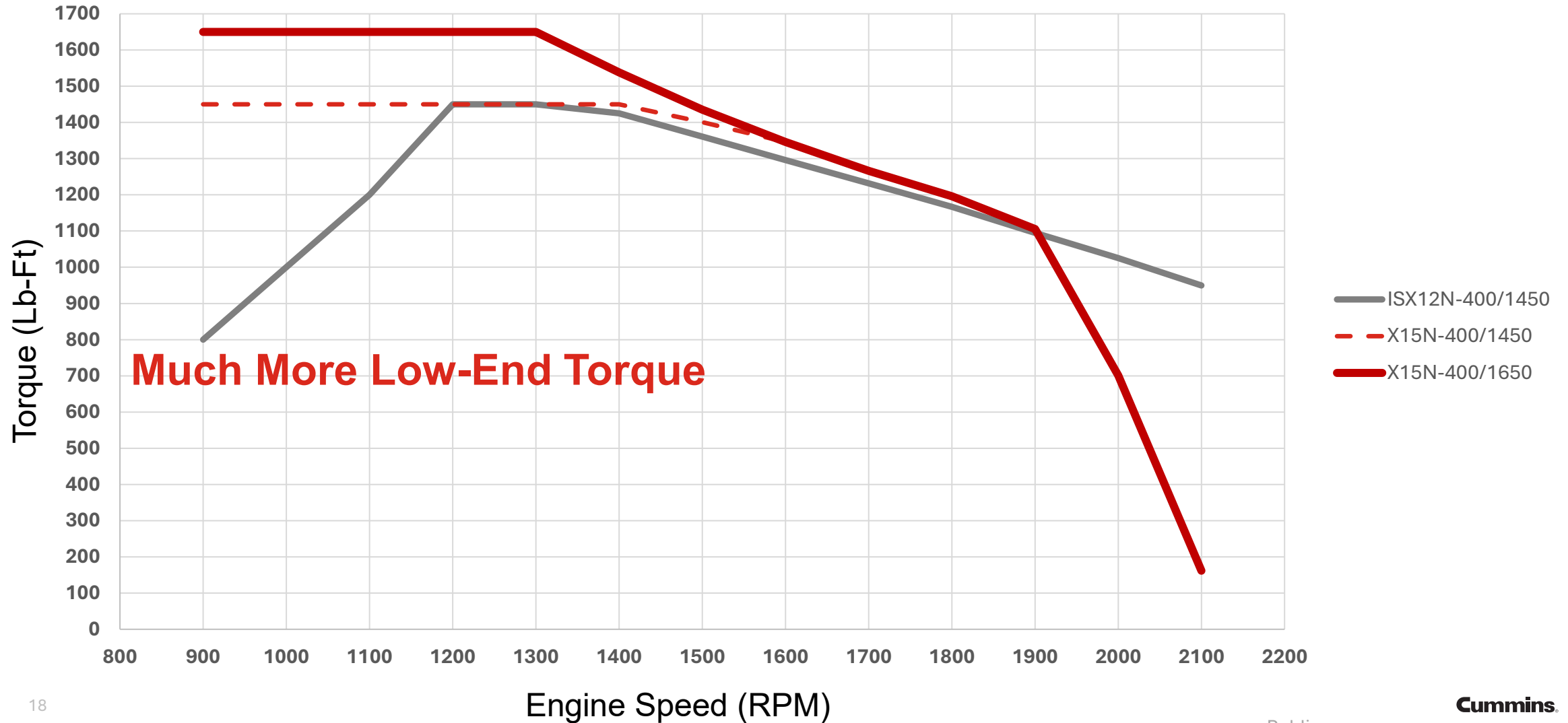
Sculpted Block
Compact design and reduced weight vs ISX12N

Increased Power & Torque
New platform with 15L displacement and engine management system to deliver up to 500 hp / 1850 lb-ft of torque

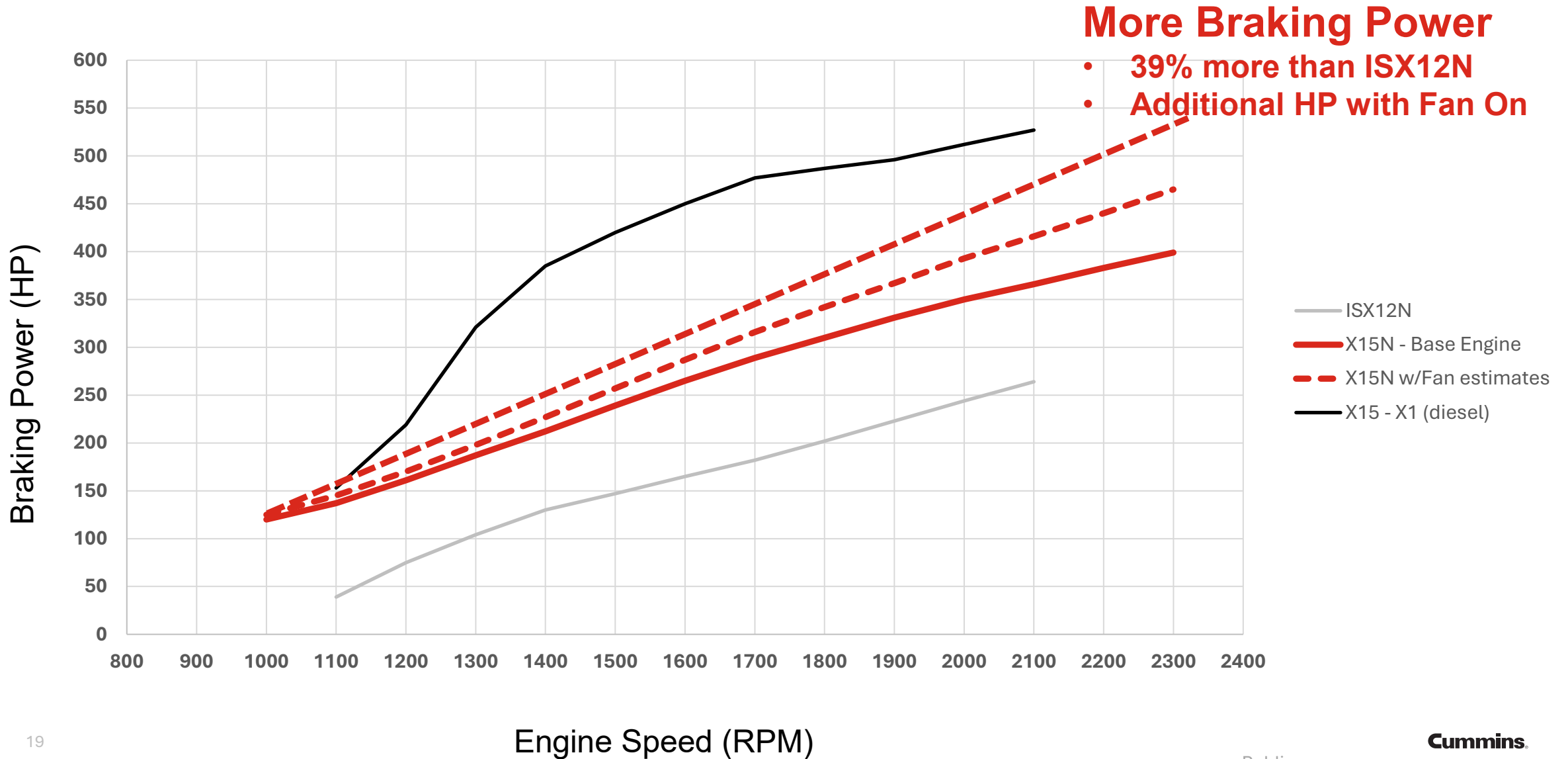
X15N™ COMPARISON TO X15 DIESEL (500 hp / 1850 lb-ft)



X15N™ COMPARISON TO ISX12N™ @ 400 hp / 1450 lb-ft



X15N™ BRAKING POWER



X15N™ Maintenance Intervals

Oil Drain Interval by Fuel Consumption					
	Extreme Severe (< 3 mpg)	Severe (< 3-5 mpg)	Short Haul (5 – 5.9 mpg)	Normal (> 6 mpg)	
Oil Classification	Miles (Kilometers)	Miles (Kilometers)	Miles (Kilometers)	Miles (Kilometers)	ISX12N Hours (Miles)
CES 20092	15,000 (24,000)	25,000 (40,000)	50,000 (81,000)	60,000 (97,000)	1000(40,000*)
Valvoline™ Premium Blue™ One Solution™ Gen 2	15,000 (24,000)	30,000 (48,000)	55,000 (89,000)	65,000 (105,000)	N/A

* Assumes average speed of 40mph for Regional and Line-haul truck

Spark Plug Life:

- X15N - 60K miles on a Normal duty cycle (aligned with ODI)
 - ISX12N – 1000HRS(assume 40K* miles) on a Normal duty cycle (aligned with ODI)

Over-head Reset:

- X15N - 60K miles for the initial reset
 - ISX12N – 1000HRS(Assume 40K* miles) for the initial reset
- X15N -180K for subsequent resets
 - ISX12N – 3000HRS(assume 120K* miles) for subsequent resets

X15N™ Reliability & Durability

CUMMINS HELM™ X15 GLOBAL PLATFORM VALIDATION

10 years
research & development

57,500 hours
in-house and overload testing

13.4 million mi
on-road testing

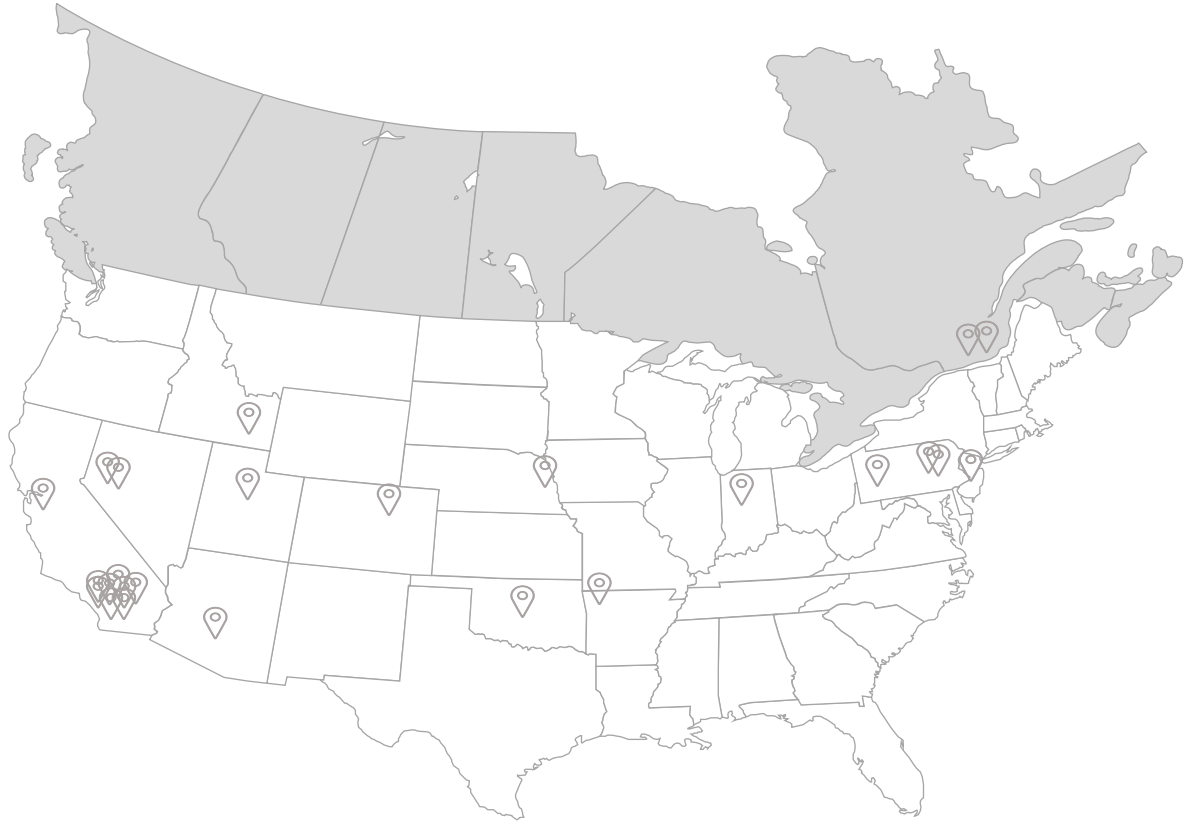
Global Production **47,000+** engines

**Natural Gas
15N Platform**

58 K+ Production engines operating globally

7.3 B+ Miles logged by production engines globally

X15N™ NORTH AMERICA FIELD TEST UNITS



3 Applications

- Linehaul
- Regional Haul
- Vocational - Refuse

24 Units

16 Fleets

2.2+ Million miles* driven



X15N™ FIELD TEST FLEETS



OZINGA®

WWM®

Ryder®

ROBERT



Walmart 

WERNER
ENTERPRISES

KNIGHT
TRANSPORTATION



NATIONAL
Ready Mixed Concrete Company

FXI
FOOD EXPRESS, INC.

SWIFT
TRANSPORTATION

X15N™ FIELD TEST FEEDBACK



“Very viable option.”

“It shifts better and better each time it gets driven.”

“I love this truck.”

***“Pulled 55 (mph) up Donner Pass fully loaded.”
(7,056 ft elevation)***

“Really good on the highway.”

“The more they drive it, the better it’s getting all the way around.”

“The drivers love the truck. The engine has a nice pull, very quiet, plenty of torque.”

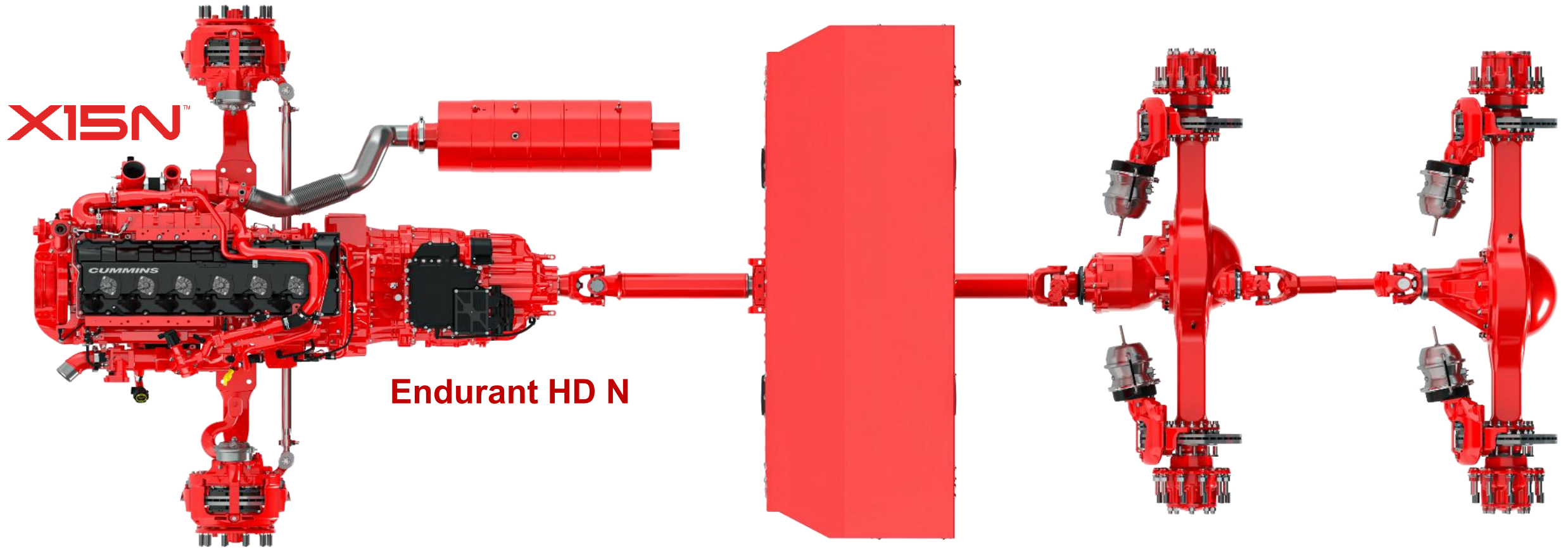
“It feels and drives like a diesel which is a good thing.”

“Pulling power like diesel. Quiet. Short refueling times.”

“They love the torque of the engine - noticeably different compared to the ISX12N”

“The truck responded well and handled the load similarly to the X15s he has driven. All while being noticeably quieter.”

Cummins Integrated Powertrain



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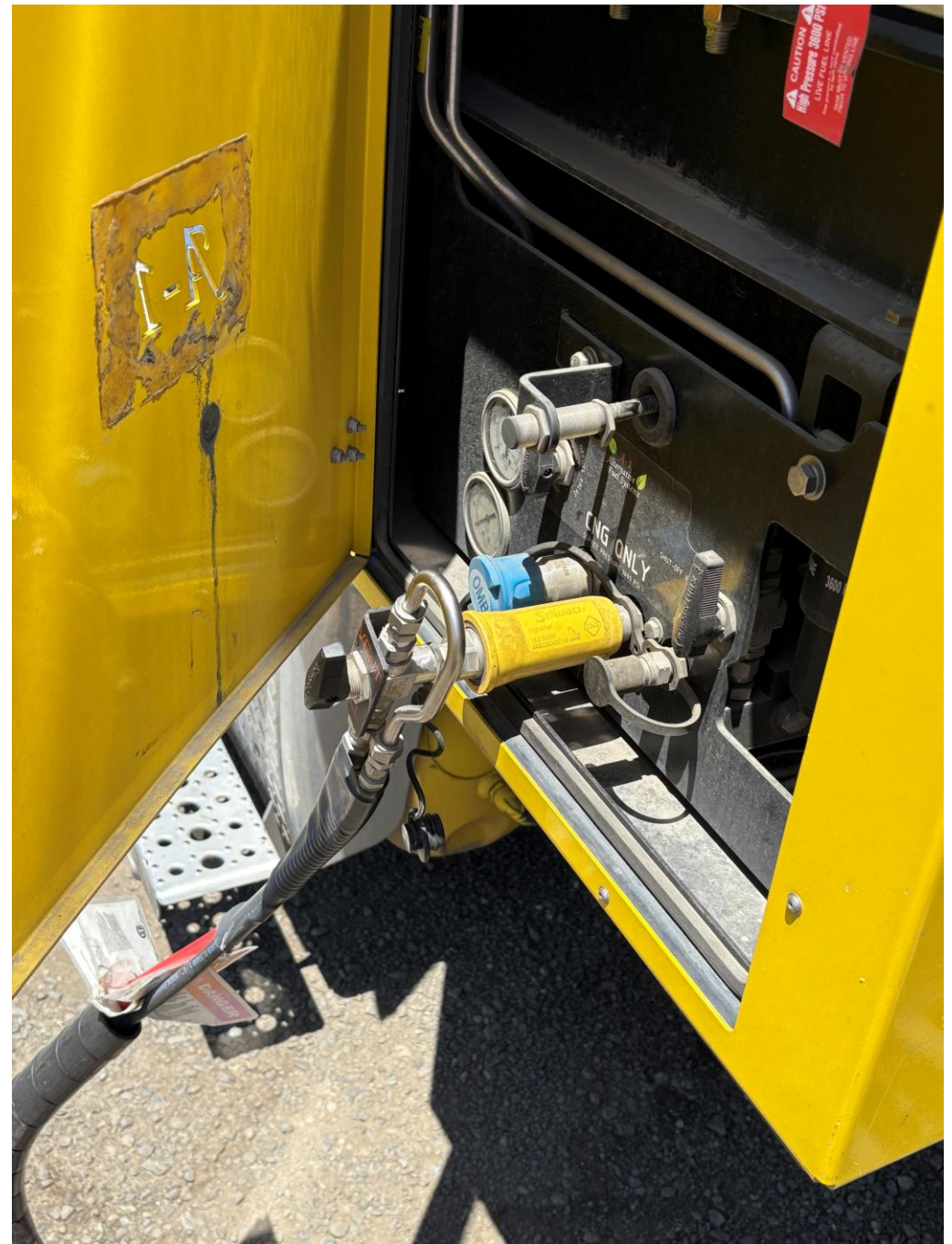
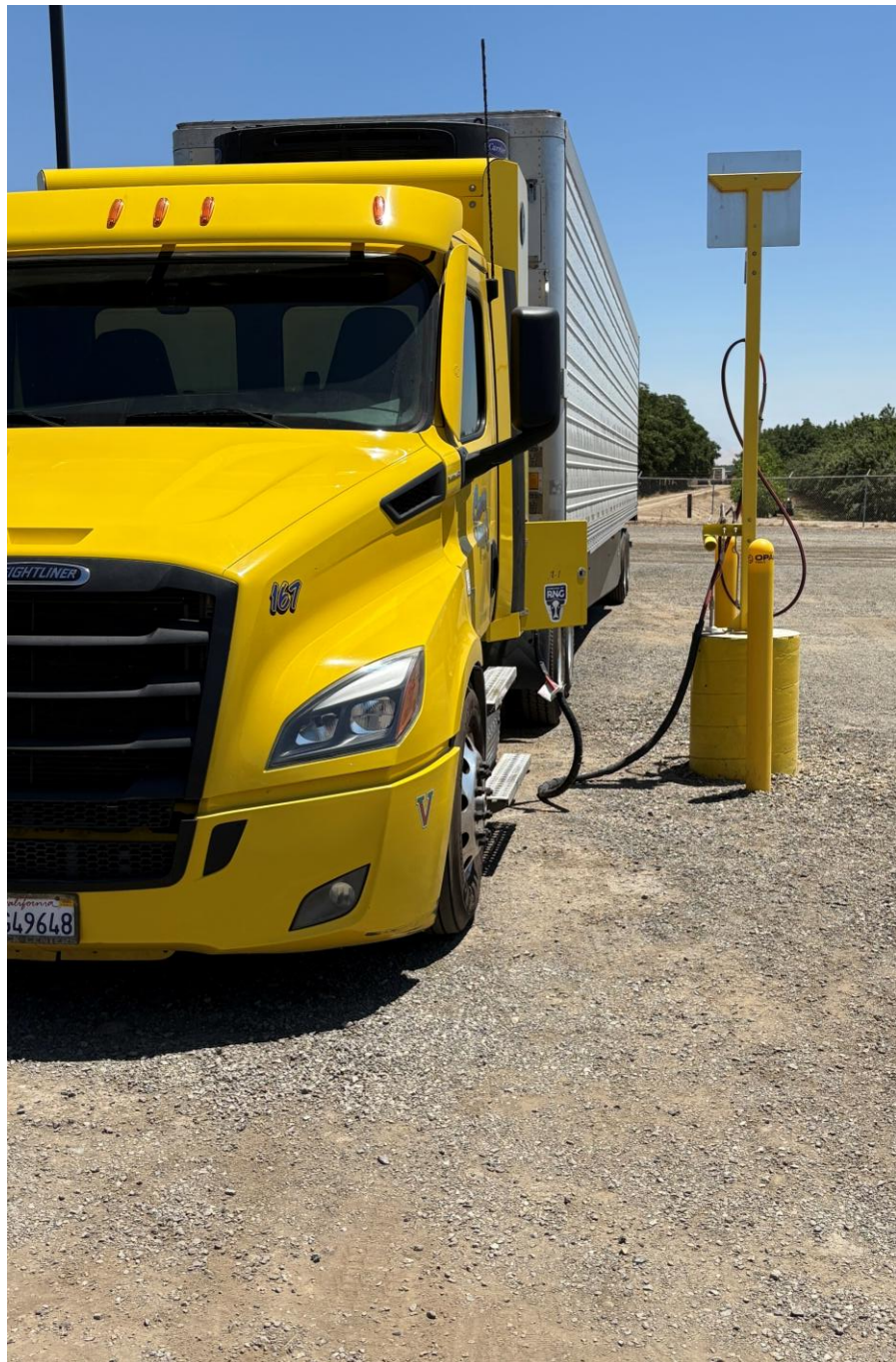


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**STOP MOTOR
NO SMOKING
FLAMMABLE GAS**

NATURAL GAS VEHICLE FUEL
CYLINDERS SHALL BE
PERIODICALLY INSPECTED
NOMINALLY EVERY 3 YEARS TO
ENSURE SAFE OPERATION OF THE
VEHICLE. CONTACT VEHICLE OR
CYLINDER MANUFACTURER.
NATURAL GAS FUEL CYLINDERS PAST
THEIR END-OF-LIFE DATE SHALL NOT
BE REFUELED AND SHALL BE
REMOVED FROM SERVICE.

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Presenting



LOOK FOR THE SEAL.
RealCaliforniaMilk.com



GE VERNOVA

Platinum



Hospitality



Gold



Silver



Bronze

