Development and Deployment of Advanced Emission Controls for the Retrofit Market

DEER Meeting

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Outline

- Introduction
- Phase I – Product Development
- Phase II - Deployment

Cummins West, Cleaire, and CaTTS

- **Cummins West (CWI) is the regional distributor of Cummins engines and Komatsu Heavy Equipment**
  - > 350 employees
  - $100 M Revenue
- **Cleaire is a division of Cummins West, Inc.**
  - Headquartered in San Leandro, CA
  - Manufacturing facility in San Diego
- **CaTTS (California Truck Testing Services) is a division of Cummins West**
  - Located in Richmond, CA
  - 1 of 6 HD Chassis dynamometer labs in North America
  - Development and verification testing

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Cummins

Motivation - Why is Retrofit Important?

- If we wait for fleet turnover to take effect, we will give up on two generations of breathers
- Significant reductions in NOx and PM can be achieved NOW.
- Retrofit is a tool for planners and regulators to meet near term Ozone and Air Toxics requirements.

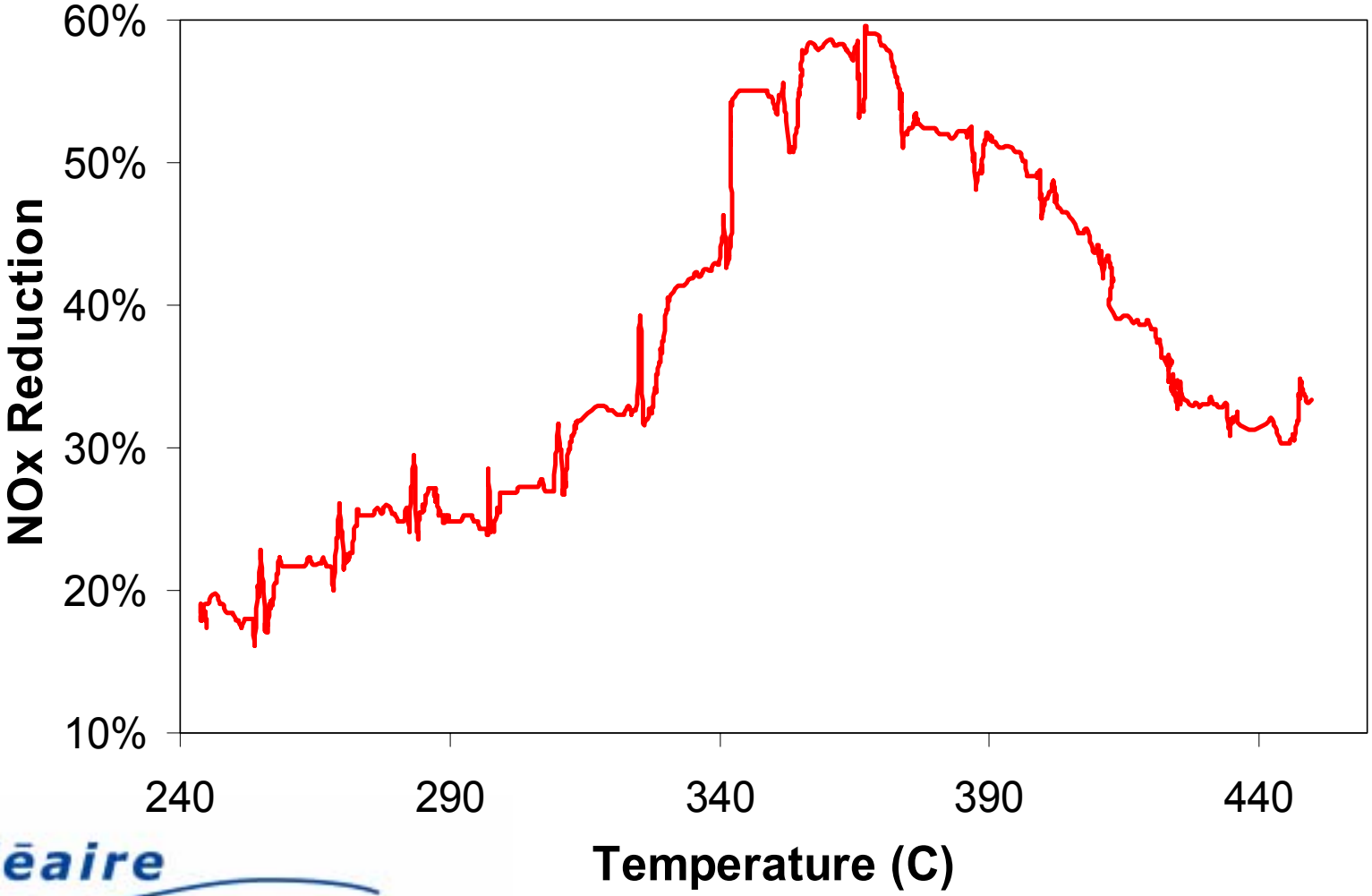
Development - System Components

- Modular packaging system
- Integrated NOx and PM control catalysts/filters
- Device for monitoring, logging, and control of system (MLC®)
- Fuel injection (Hydrocarbon dosing) system for NOx reduction and filter heating

Development - NOx Reduction Catalyst

- A.K.A.
  - Hydrocarbon Selective Catalytic Reduction (HC-SCR)
  - Lean NOx Catalyst (LNC)
- Diesel fuel (HC) <u>is</u> the reducing reagent
- No secondary reagent storage tank required
- No ammonia slip issues
- HC slip is addressed with catalyzed DPF or DOC

NOx reduction vs. temperature



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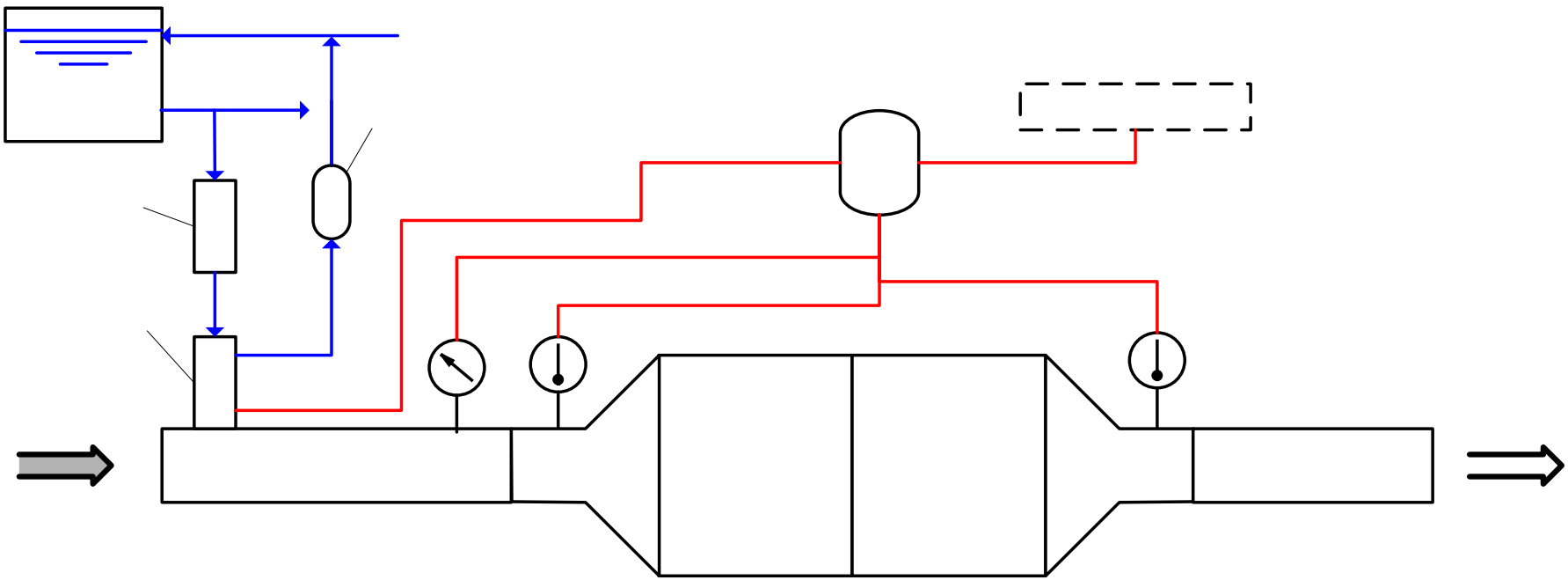
Cleaire Longview™



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Performance and Verification Testing

Vehicle

Cummins M11/ISM, ISC, ISX

International DT-466

Test Cycles

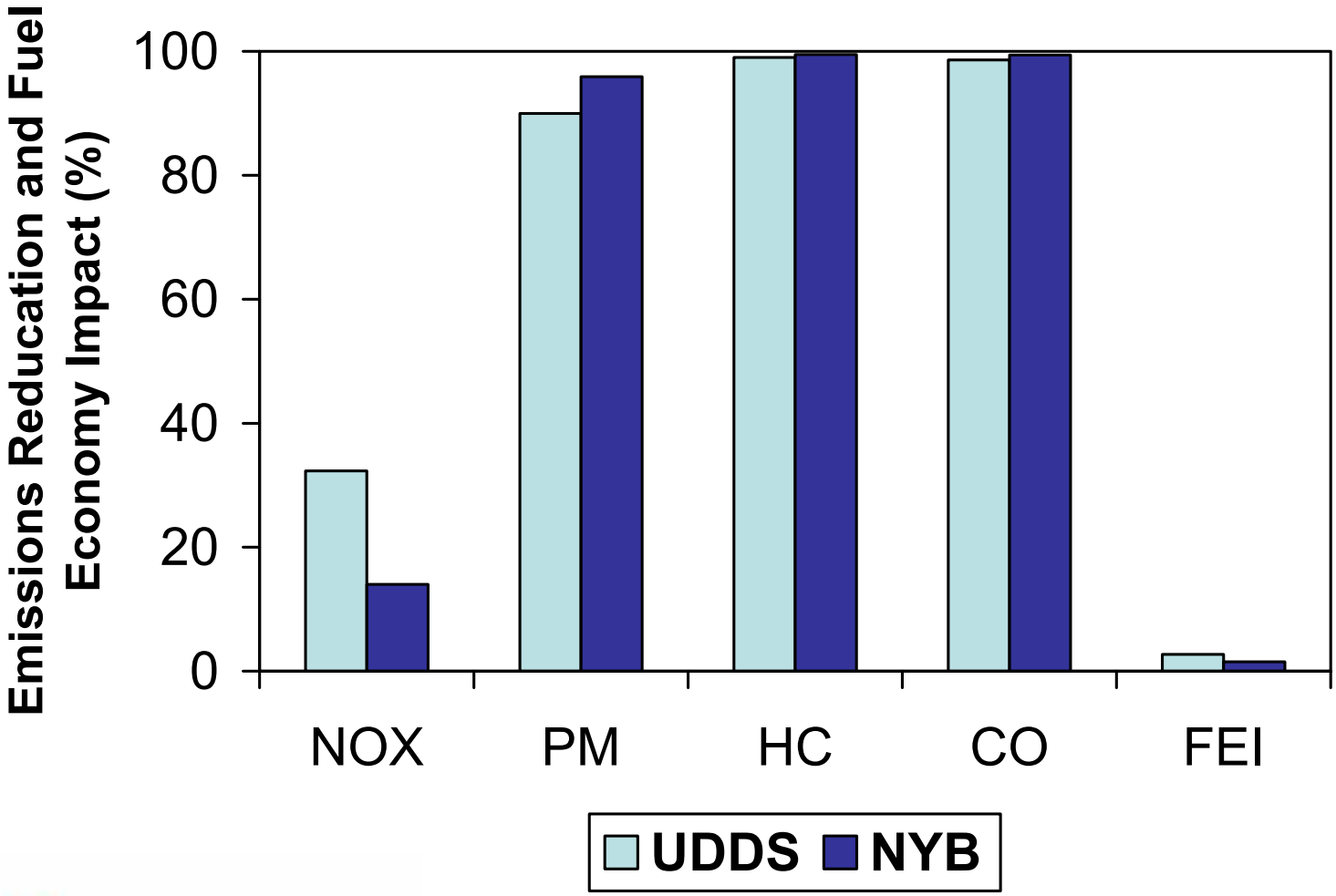
Transient (UDDS, NYCB), Steady (4-5-6)

Fuels

CARB #2 Diesel

ULSD

Emission Reductions with Longview and ULSD Fuel



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Engine: 1997 Cummins M11

Development - Field experience

- Field test and early demonstrations
  - ~90 systems operating in the field
  - Used in transit, refuse, line haul vocational, and non-road applications.
- Product success
  - Over 1,800 installations committed over the next 18 months.

Development - Longview Verification

- CARB verified in April, 2003
- Some Cummins and ITEC engines, others to follow
- 25% NOx reduction
- >85% PM reduction
- Verified for use with ULSD fuel

New Product - Lonestar

- Product specification
  - 40% NOx Reduction
  - Cost effective ($/ton NOx)
  - Fuel tolerant (EPA, CARB, ULSD, GTL)
  - Does not require ULSD
  - No filter maintenance
  - Targeted at non-urban bus market
- Shares modular Longview platform
- EPA verification in progress
- Systems are available now

Longview and Lonestar Systems

Longview ™

- Modular Design
- Computer controlled HC dosing system
- NOx Reduction Catalyst (NRC)
- **Catalyzed Diesel Particulate Filter (DPF)**
- **25% NOx reduction**
- **> 85%PM reduction**

Lonestar™

- Modular Design
- Computer controlled HC dosing system
- NOx Reduction Catalyst (NRC)
- **Diesel Oxidation Catalyst (DOC)**
- **40% NOx reduction**
- **up to 25% PM reduction**

Longview and Lonestar Requirements

Longview™

- 4 stroke engines
- CARB of ULSD fuel
- >260 C for 25% of duty cycle
- Back pressure monitor
- Data logging

Lonestar™

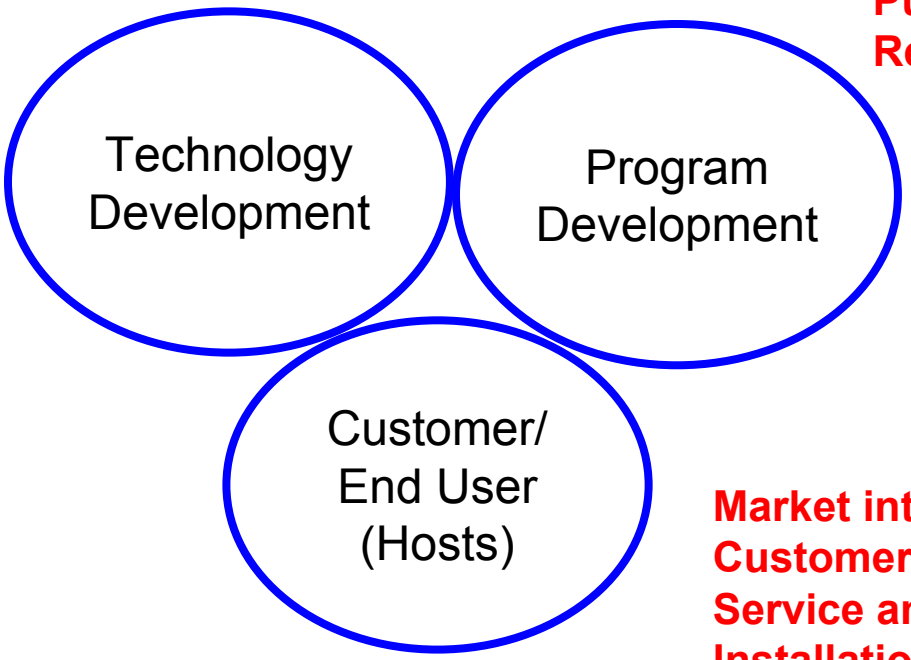
- 4 stroke engines
- EPA, CARB or ULSD fuel (< 500 ppmS)

Cleaire Systems are Broadly Applied

Phase II – Deployment Model

NOx & PM Funding
Public & private program
Regulation vs. Incentive

Verified Systems
NOx & PM
Broadly Applied



Market intelligence
Customer relationships
Service and Support
Installation
Service packages
Leasing packages

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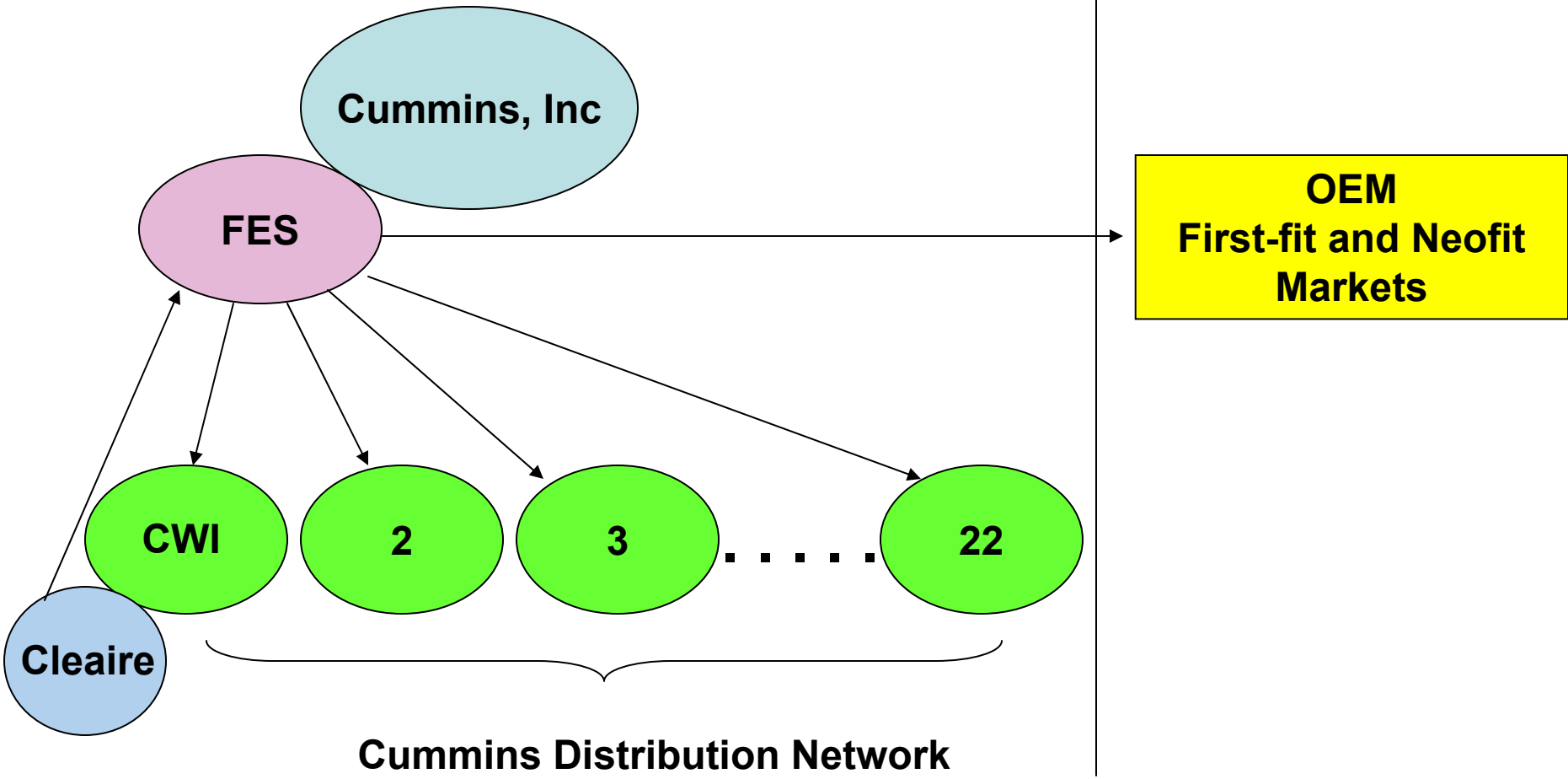
Phase II - Distribution Network



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Fleetguard
EMISSION Solutions™

Phase II - Deployment

- **Partner with Fleetguard Emission Solutions**
  - Manufacturing
  - Distribution
  - Training
  - Warranty administration
  - Program management
- **Leverage Cummins Distribution Network**
  - Sales and Marketing
  - Installation
  - Service
  - Lease and maintenance agreements

Summary

Development - Cleaire has developed novel, state of the art retrofit systems to provide immediate emissions benefits to existing engines with no major engine or infrastructure changes.

Deployment - Fleetguard Emission Solutions and the Cummins Distribution Network is well positioned to support the widespread deployment of these technologies today.

Closing Statement

The potential for massive reductions in NOx and PM is possible through widespread deployment of “retrofit” and “neofit” technologies in on-road and non-road applications.