Homogeneous Charge Compression Ignition (HCCI)

DEER Workshop

August 5-9, 2001

Gerald N. Coleman

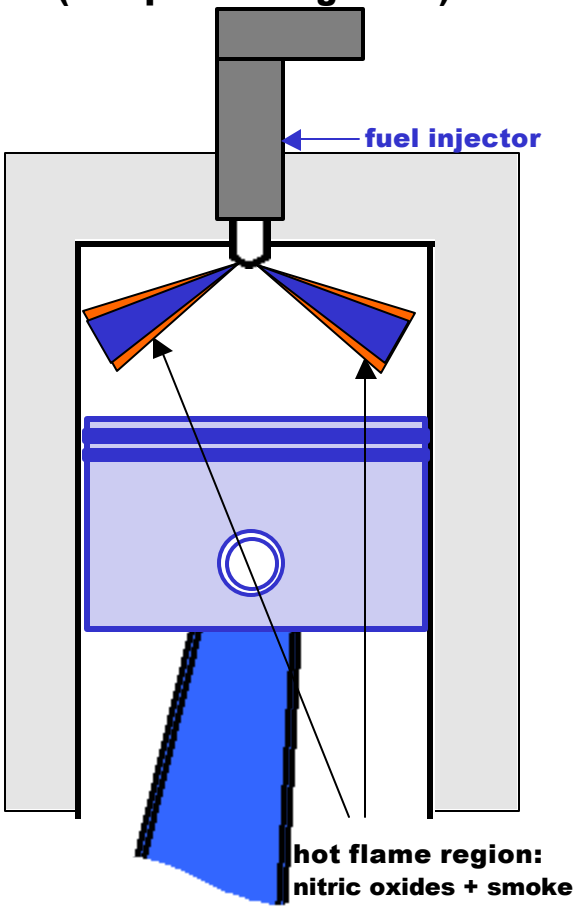
Outline

- Background - HCCI
- HCCI development process
- Review development tools
- Update on recent progress
- Concluding remarks

What is HCCI?

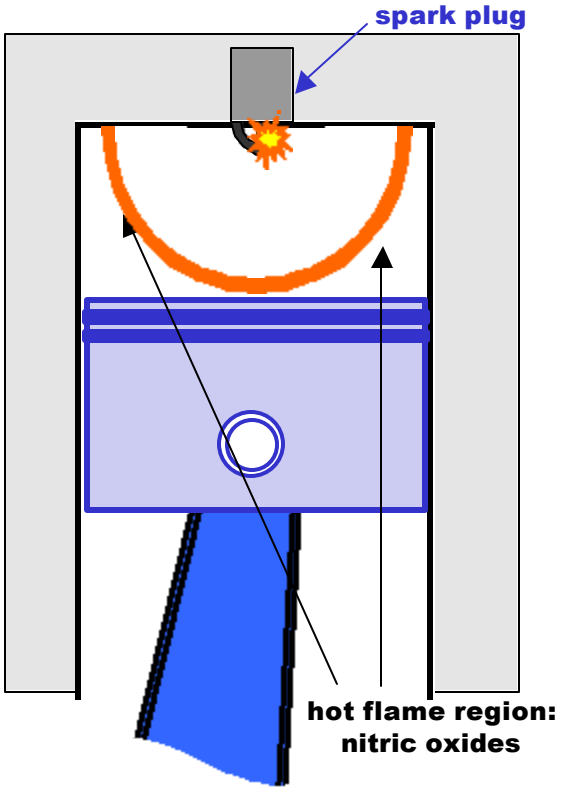
Diesel Engine

(compression ignition)



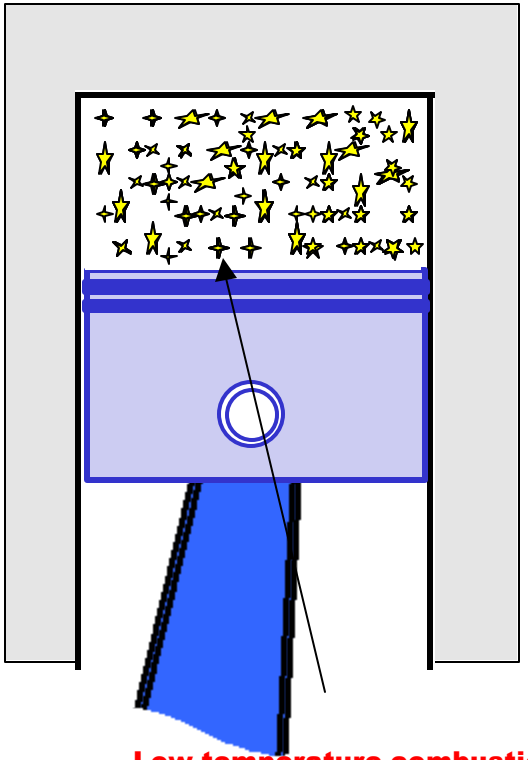
Gasoline Engine

(spark ignited)



HCCI Engine

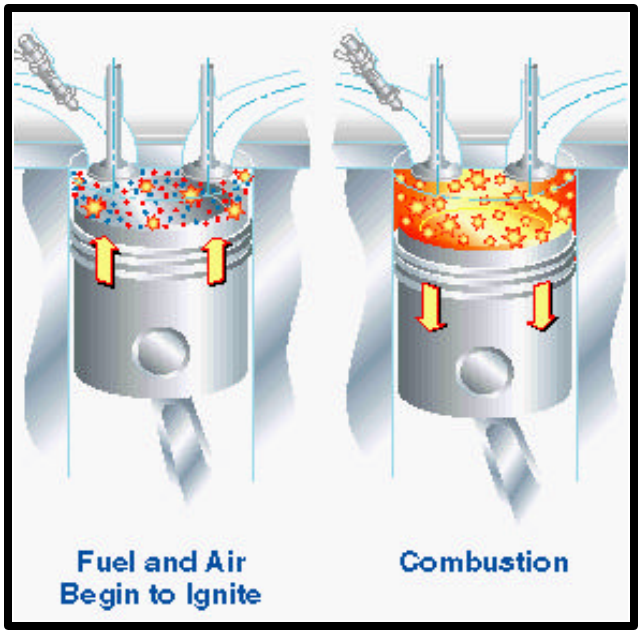
(Homogeneous Charge Compression Ignition)



Low temperature combustion

ultra low emissions

HCCI - The Challenge



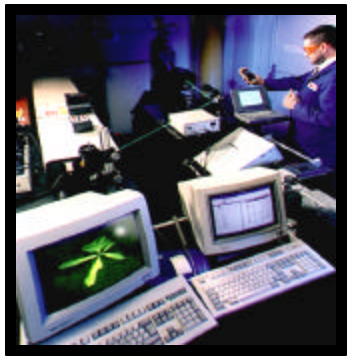
- Combustion phasing and control
- Proper air / fuel mixing
- Limited Load Range

HCCI Development at Caterpillar

Design

FEA

System Simulation

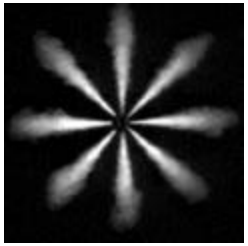


CAT3D Combustion Model

Leading Edge Technology

Testing

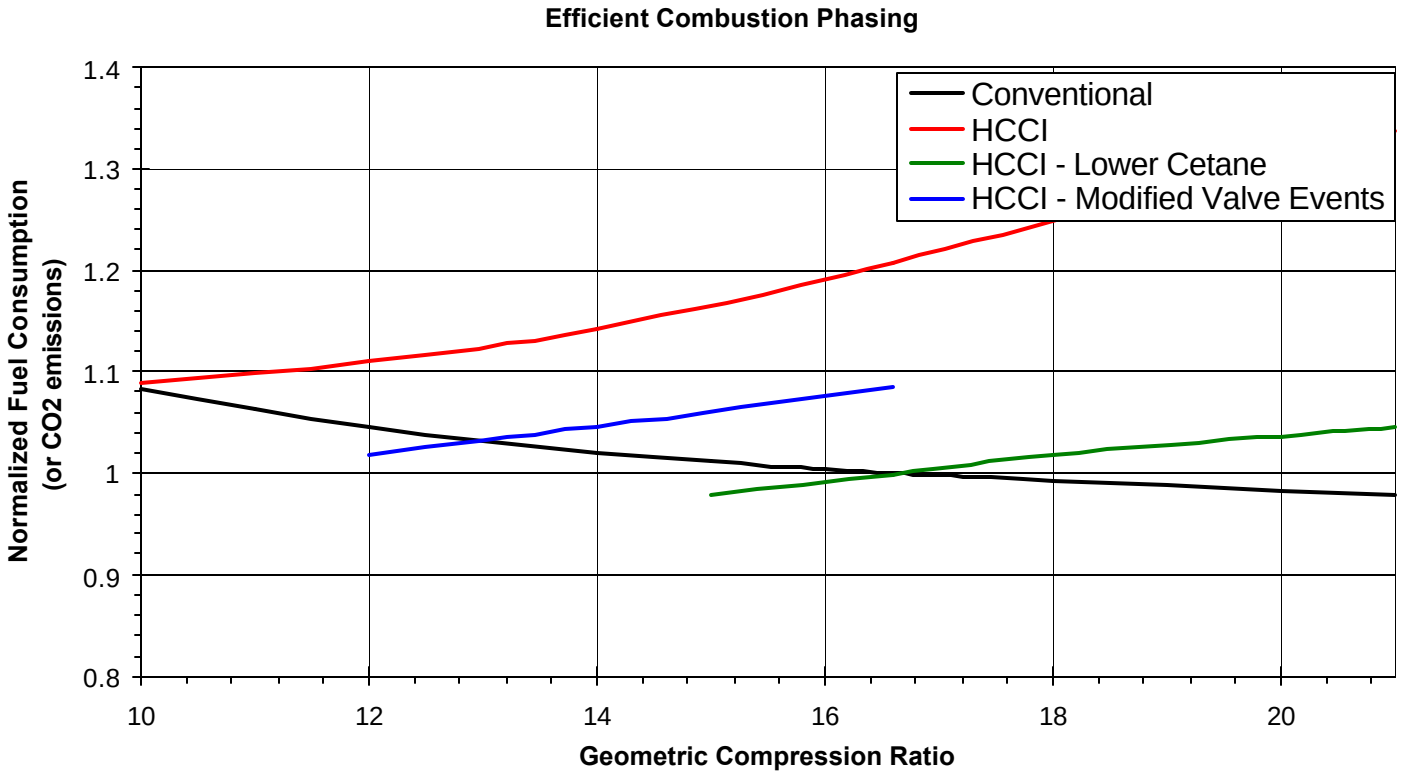
Spray Visualization



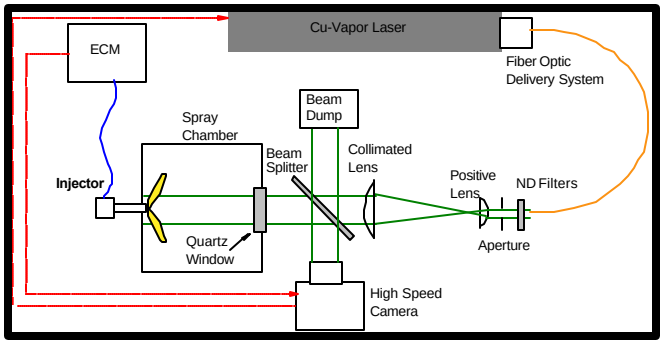
Optical

System Simulation

System simulation guides combustion phasing strategy

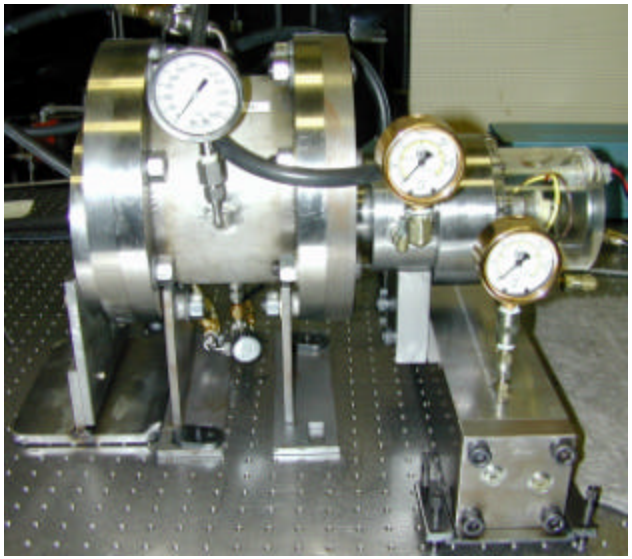


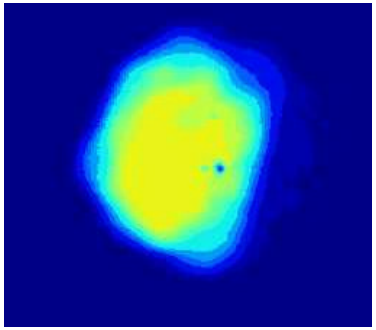
Fuel Spray Visualization



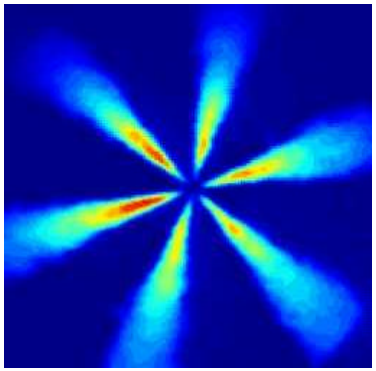
Bench tests specifically target:

- Improved physical understanding
- CAT3D model validation



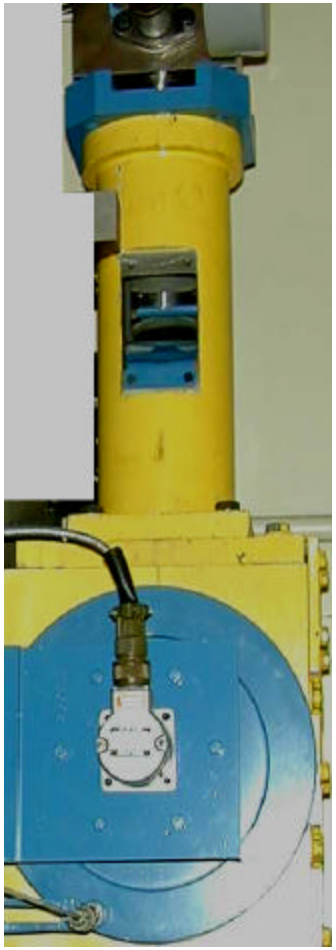


HCCI



Conventional

Optical Engine



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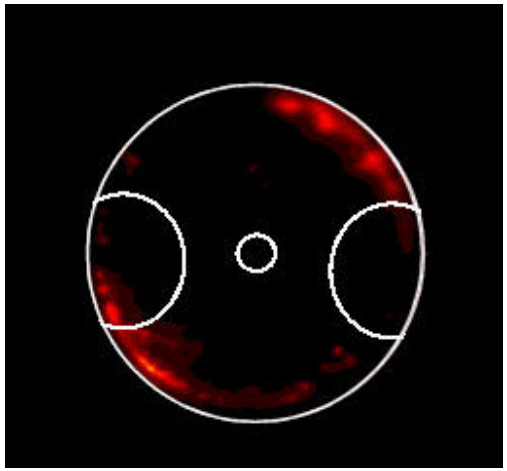


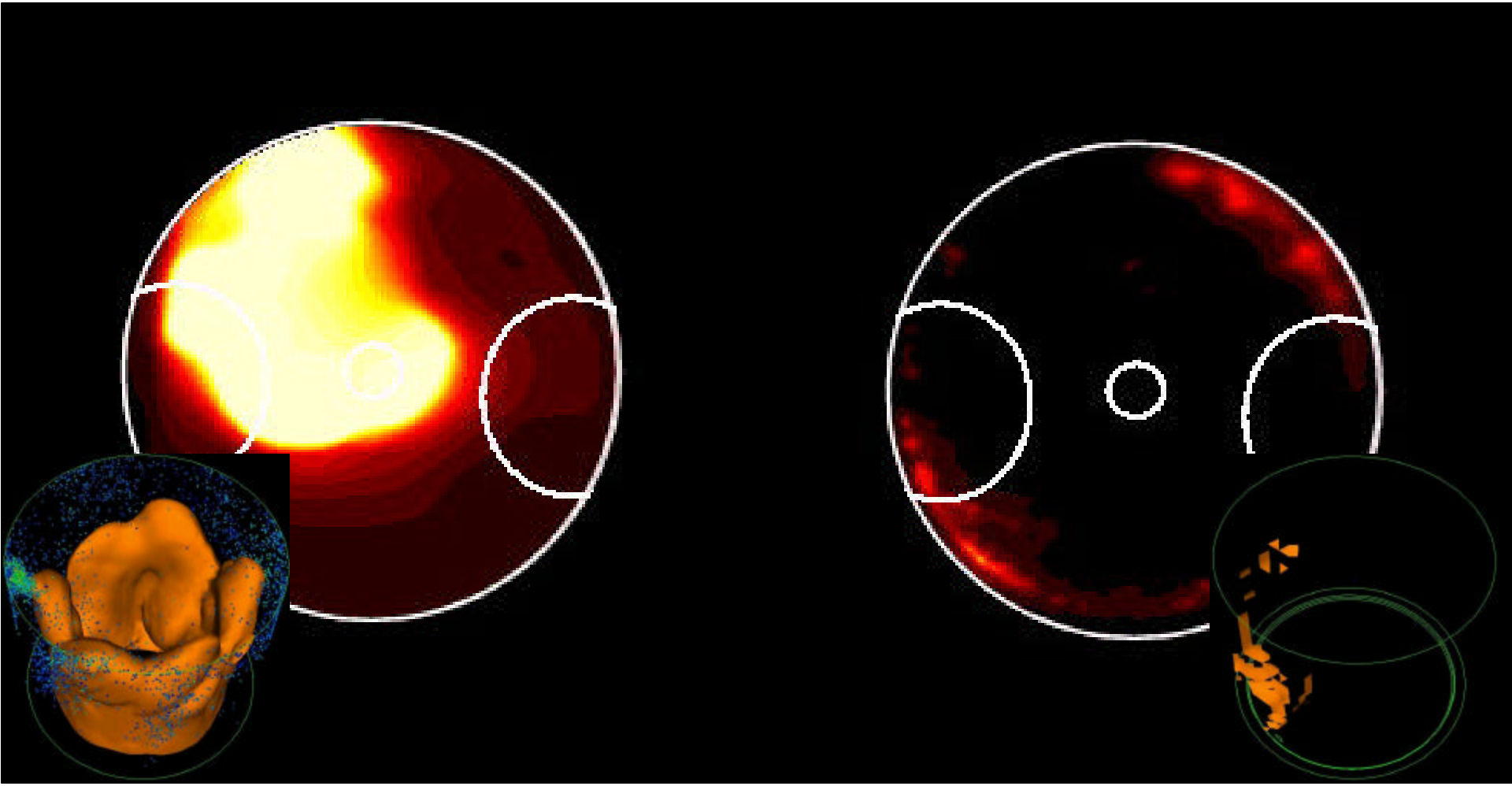
Phase I capability:
View soot formation

Phase II capability:
View NO formation
View OH and CH distribution
Temperature Distribution

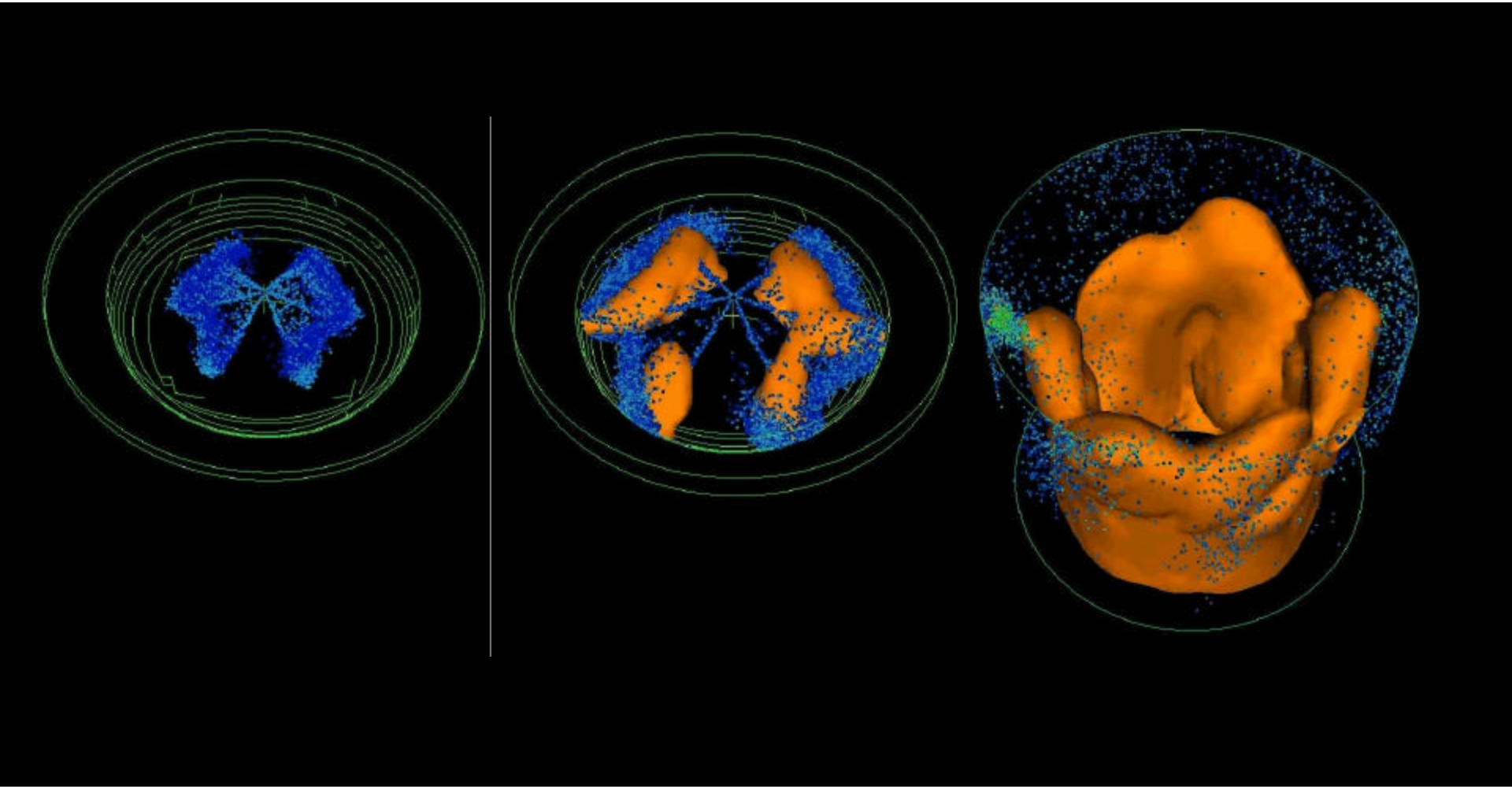
Optical Engine v. CAT3D

Conventional

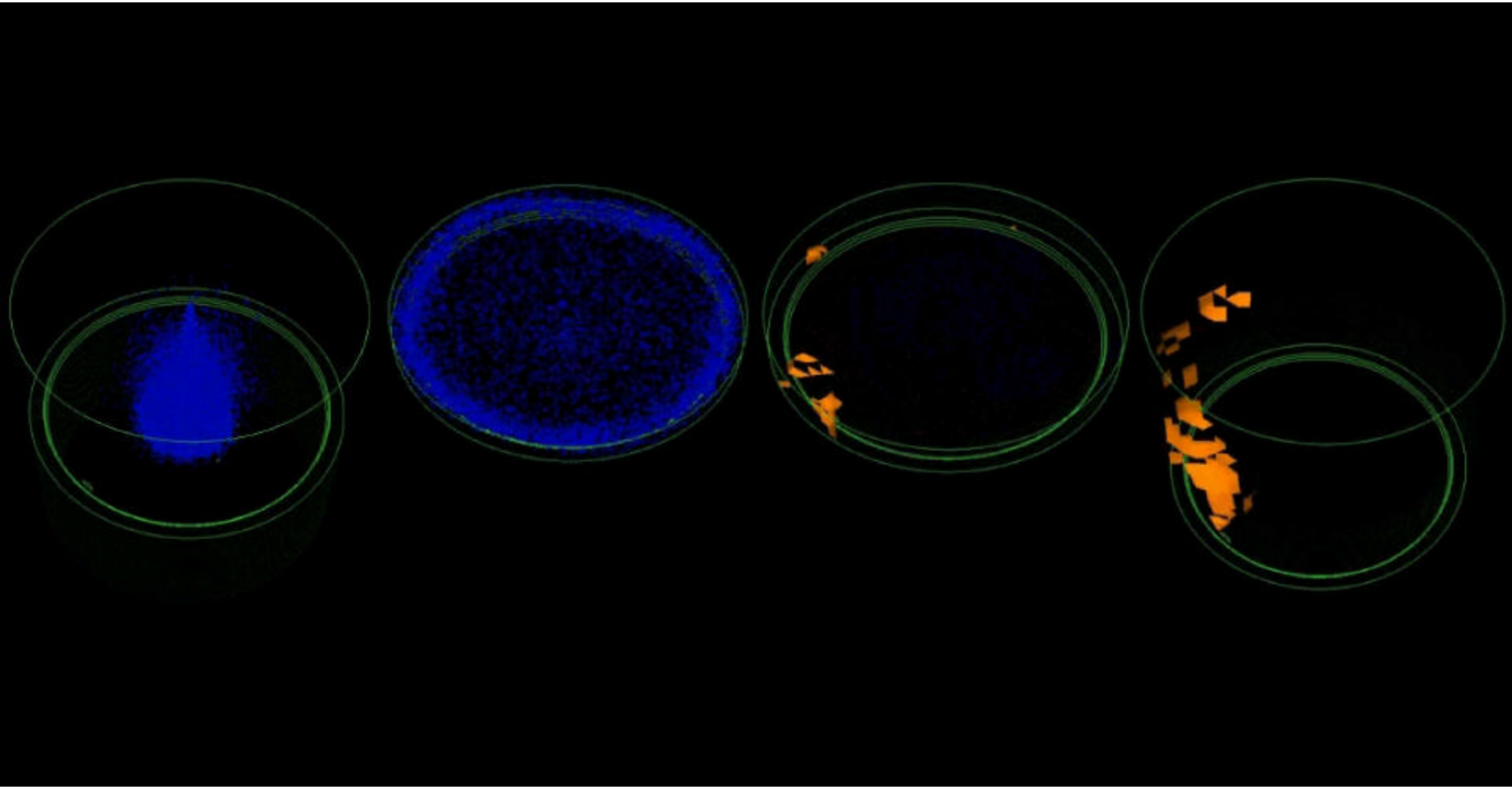
HCCI



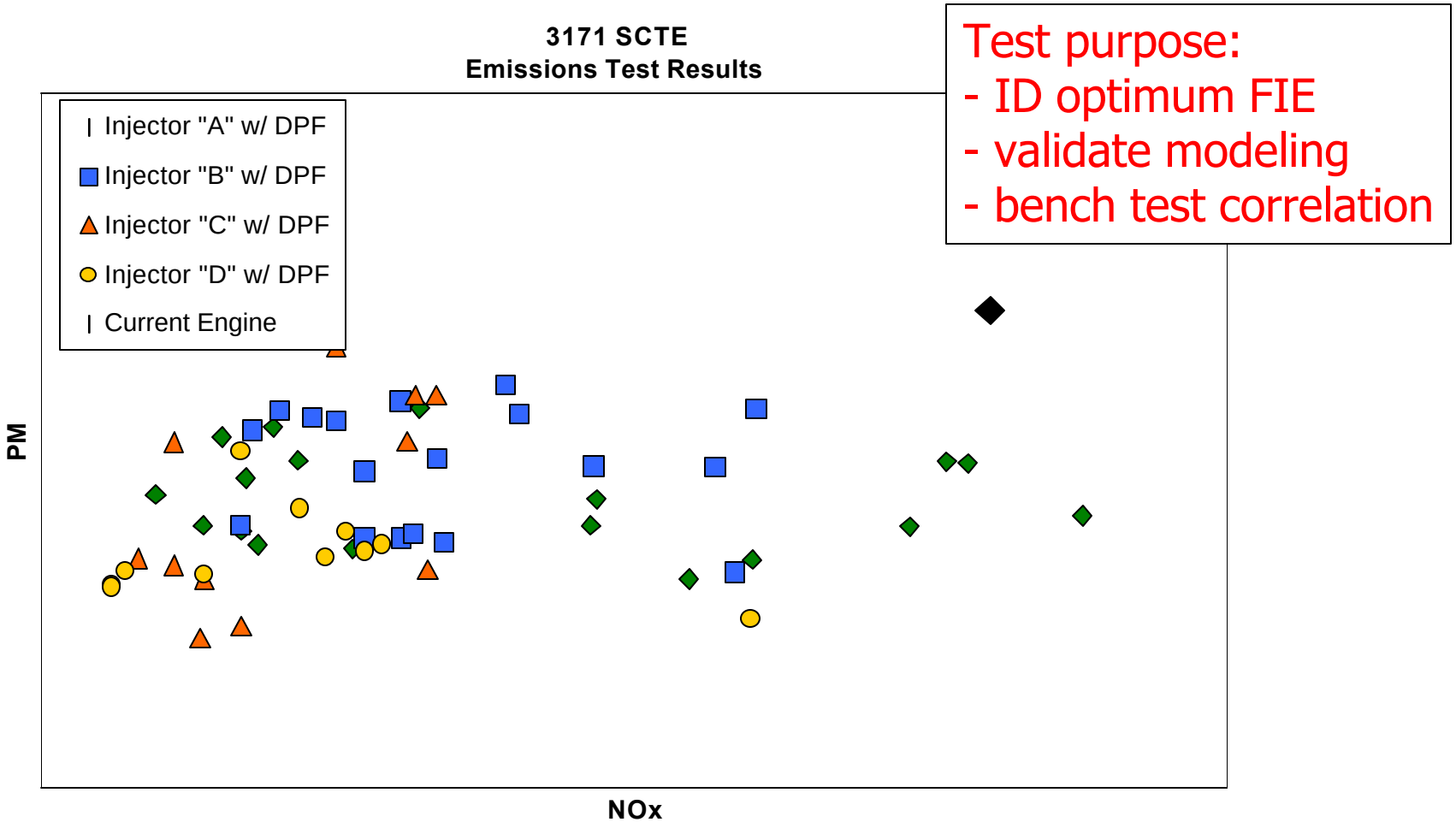
Conventional Diesel Combustion Modeling



HCCI Combustion Modeling



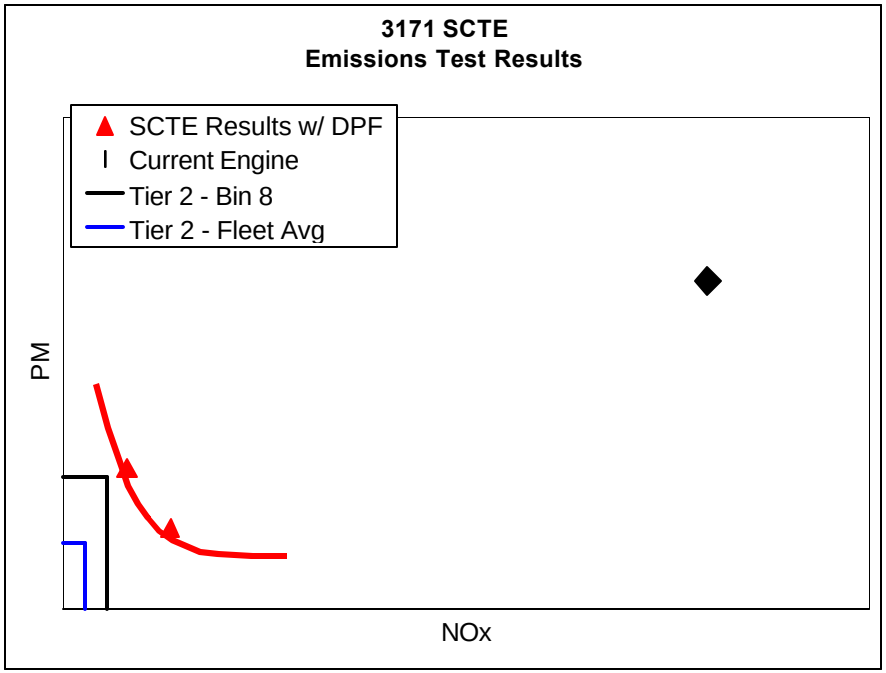
Single Cylinder Test Results



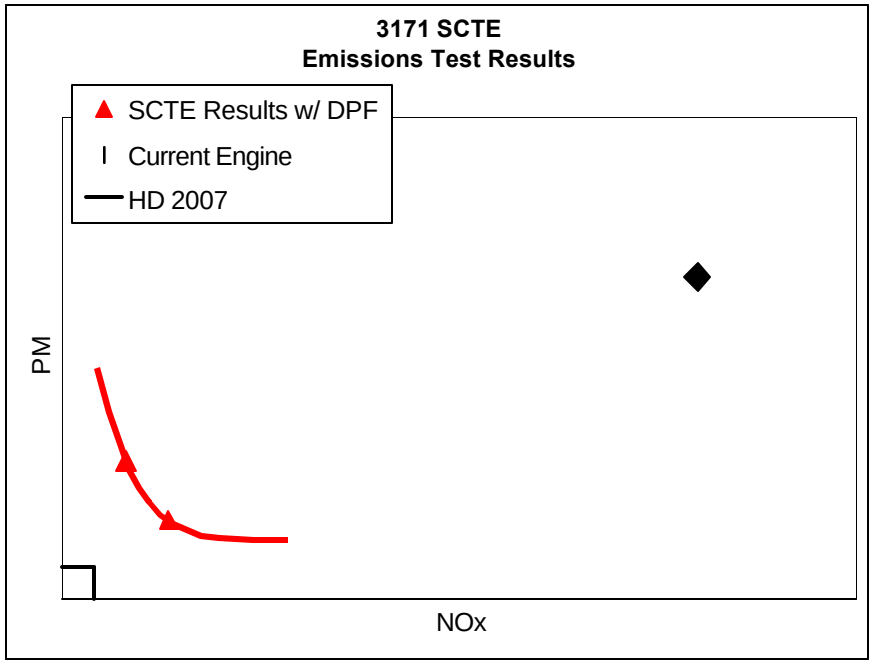
Test purpose:
- ID optimum FIE
- validate modeling
- bench test correlation

Single Cylinder Test Results

Light Duty Application

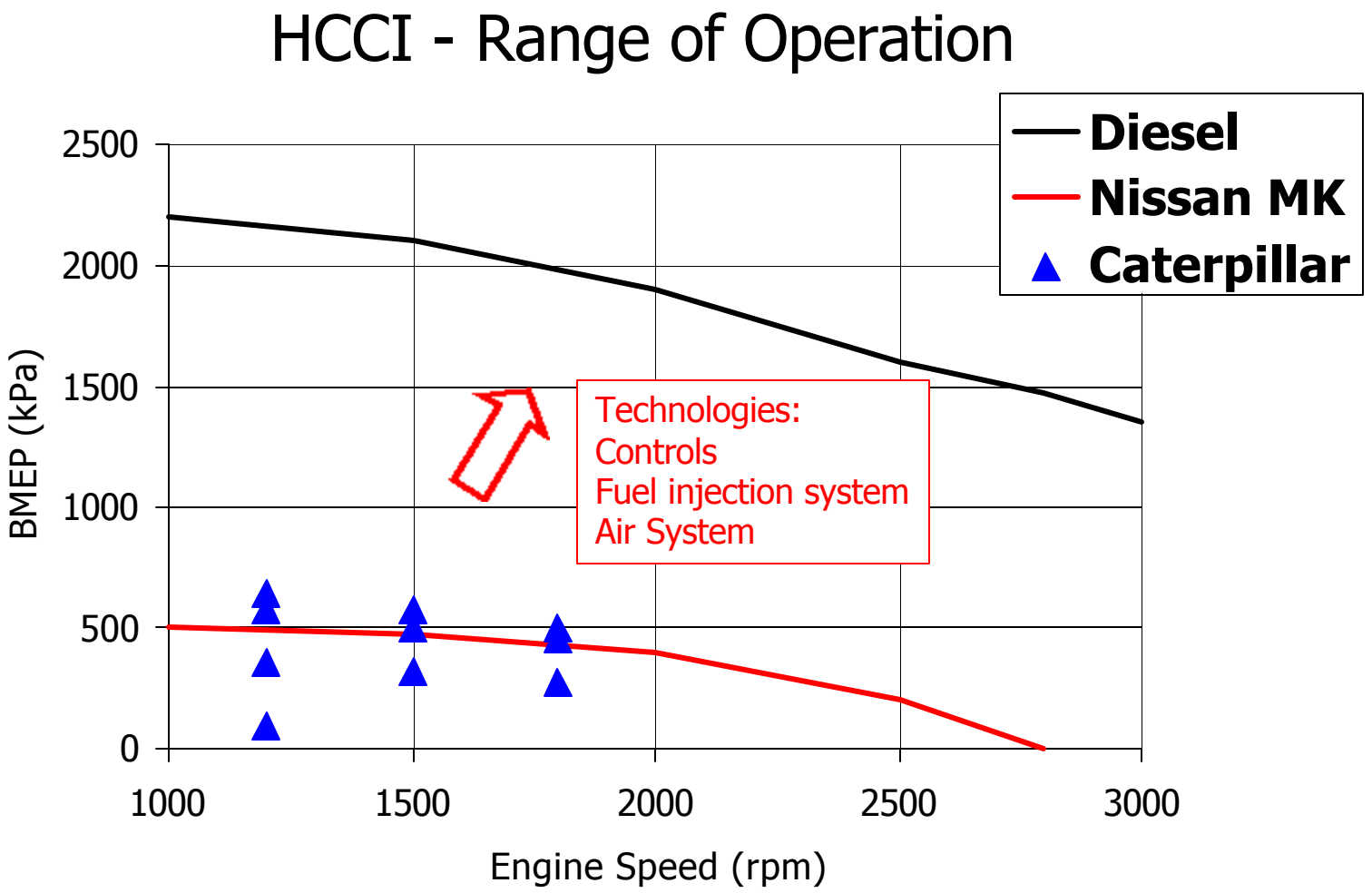


Heavy Duty Application



Data at Single Steady State Operating Condition

Single Cylinder Test Results



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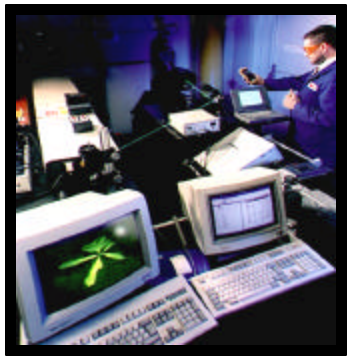

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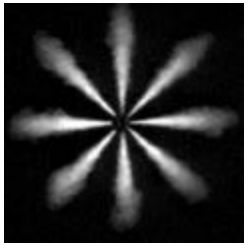

Optical

Technology Deployment

Components:

Leading Edge Technology

Complete Vehicle:

Power Source: