

Technological Advances Affecting the Diesel Industry

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Clean Diesel, Clean Air

Diesel Technology

- ▶ Diesel is the workhorse of the economy
- ▶ Efficient
- ▶ Durable
- ▶ Clean



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Diesel Emissions Advances



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Technology Advances

- ▶ Emissions Reduction through
 - ▶ Advanced Combustion Management
 - ▶ Electronics
 - ▶ Fuel Delivery
 - ▶ Air Management
 - ▶ Application of Aftertreatment
- ▶ Maintaining the Customer Requirements
 - ▶ Fuel Economy
 - ▶ Reliability
 - ▶ Durability

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2007 Technology

- ▶ Advances in Combustion Management
- ▶ Diesel Particulate Filters



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Ultra Low Sulfur Diesel Fuel

- ▶ Reduces sulfur in fuel from 500 ppm to 15 ppm
- ▶ Critical for performance of aftertreatment systems



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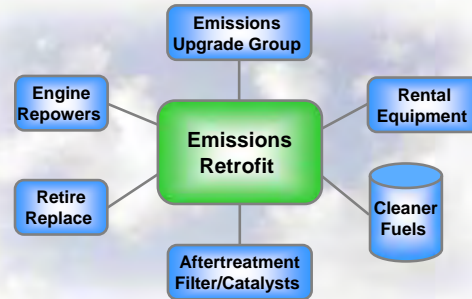
What About Legacy Engines?

- ▶ Diesel Advantage of Long Life
- ▶ Important Capital Asset for Owners



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Solutions Overview



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Clean Diesel Retrofit

The adaptation of emissions reduction technologies to existing products to reduce emissions output.

Off-Highway	On-Highway	Stationary
Emissions Upgrade Group 	Emissions Upgrade Group 	Selective Catalytic Reduction 
Repower 	Diesel Oxidation Catalyst 	Diesel Particulate Filter 
Catalyzed Converter Muffler 	Diesel Particulate Filter 	Diesel Oxidation Catalyst 
Diesel Particulate Filter 		

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Emissions Retrofit Upgrade Groups

An innovative use of previously certified technology!



- Available for select off-road applications
- Upgrade at overhaul from unregulated to Tier 1 levels
- Cost effective solutions
- Same OEM reliability and serviceability

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Oxidation Catalyst Technology

Diesel oxidation catalysts promote chemical oxidation of CO and HC as well as the soluble oil fraction (SOF) of diesel particulates.

- Up to 20% PM reduction
- Up to 90% reduction of CO, HC
- No significant NOx reduction
- Proven technology
- Easy maintenance
- ULSD not required



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Diesel Particulate Filters

Diesel particulate filters are devices that physically capture diesel particulates (soot) to prevent their release to the atmosphere.

- 85% to 95% PM reduction
- Thermal soot regeneration
 - > Passive regeneration
 - Majority of field experience
 - Application dependant
 - Minimum exhaust temp profile
 - > Active regeneration
 - Emerging technologies
 - Performance not dependent on application and duty cycle
- Regular ash cleaning intervals
- ULSD fuel required < 15 ppm sulfur



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Alternative Diesel Fuels

- Biodiesel
 - Up to B20 for engines > 150 HP
 - Up to B5 for engines < 150 HP
 - Must meet Caterpillar's biodiesel specification, ASTM D6751, or EN 14214
 - Blending, Transport, and Storage certification is critical

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Clean Diesel Retrofit

- ▶ Sustainability
- ▶ Voluntary programs with incentives
- ▶ Industry Engagement



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Diesel Technology Summary

- ▶ Achieved significant gains in clean diesel technology
- ▶ 2007 is the next major step forward
- ▶ ULSD is critical to 2007 success
- ▶ Retrofit of the legacy diesel fleet is needed
- ▶ Voluntary programs with incentives are key

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