



# Diesel Technology

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## Diesel Engine Technology

Near Zero Emissions

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Vice President, Government Relations  
International Truck and Engine Corporation



# Diesel Technology

## Outline

- **International Truck and Engine Corporation**
- **Emissions Regulations**
- **The 5 Technologies - 2007**
- **Further Technological Advancements – 2010 +**
- **Ultrafine Impact**



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# International Truck and Engine Corp

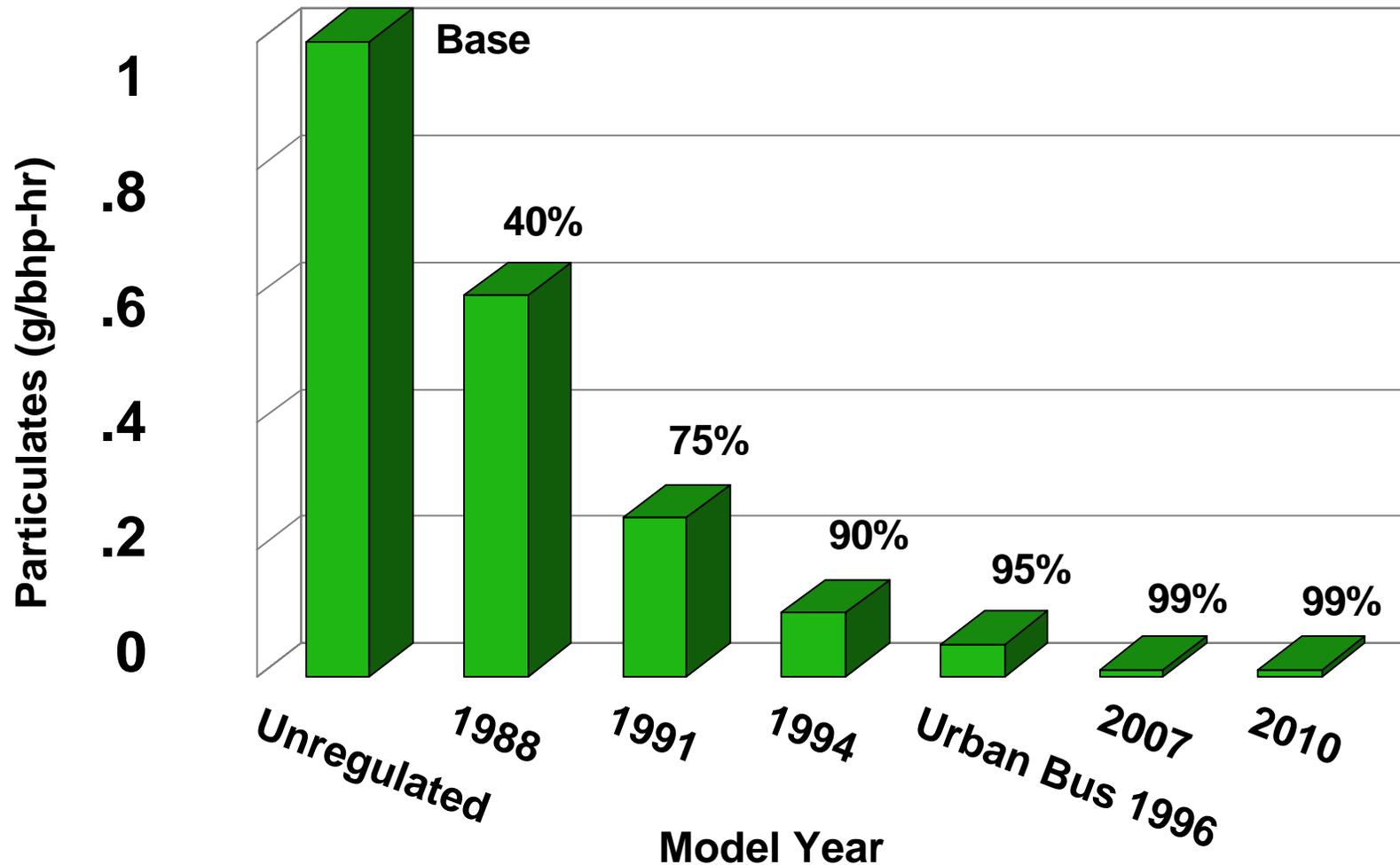
- **One of the major Truck and Bus manufacturers in the U.S.**
  - **Medium and Heavy duty trucks**
  - **Severe service vehicles (ie. Waste haulers)**
  - **School Buses**
- **Certified Green Diesel Technology School Bus in 2001**
- **Largest worldwide manufacturer of Mid-Range Diesel Engines**



# Diesel Technology

## How Far Diesel Technology Has Come:

### Progress In Reducing Particulate Matter Emissions *Industry Reductions*



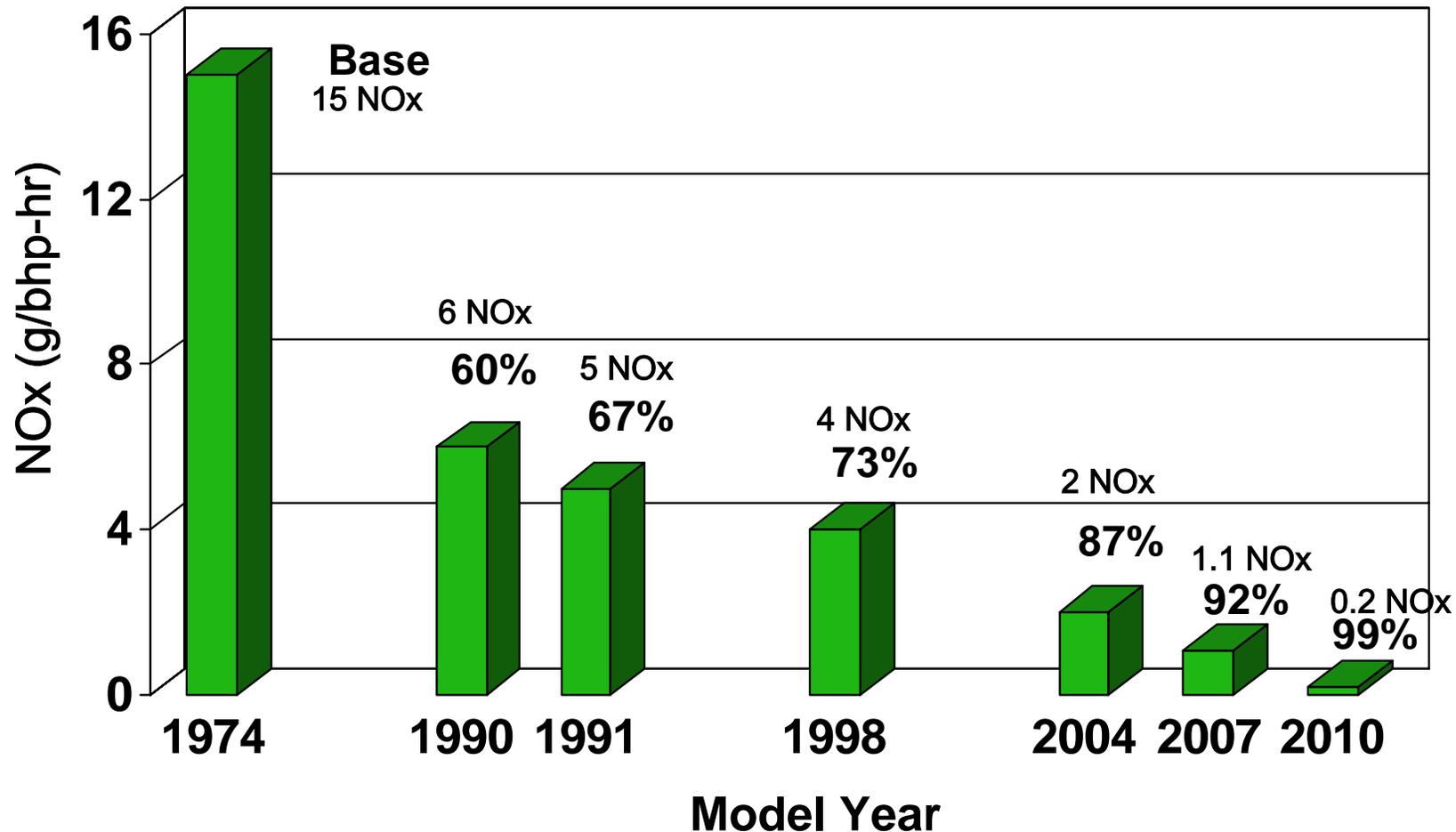


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## How Far Diesel Technology Has Come:

### Progress In Reducing Nitrogen Oxides Emissions

#### Industry Reductions

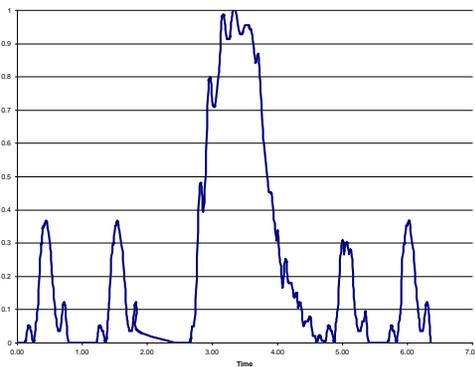




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## The Five Technologies

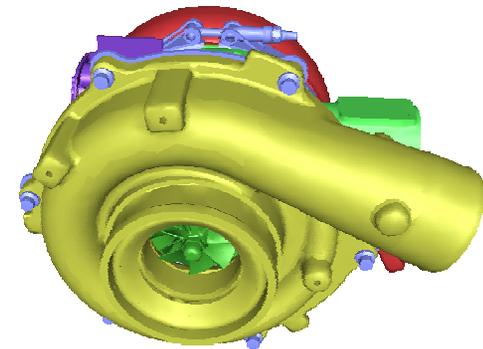
### Fuel System



### Electronics and Electrical Systems



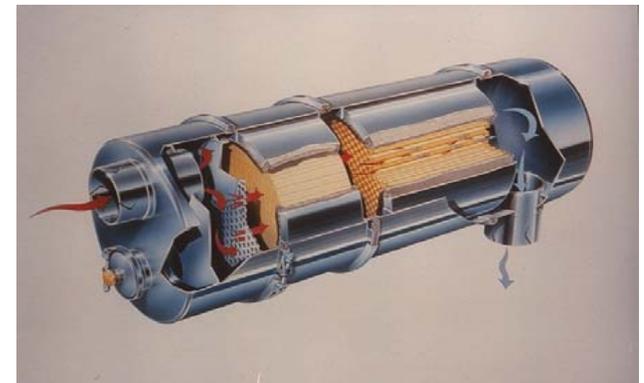
### Boost Technologies



### Combustion



### Diesel Particulate Filter

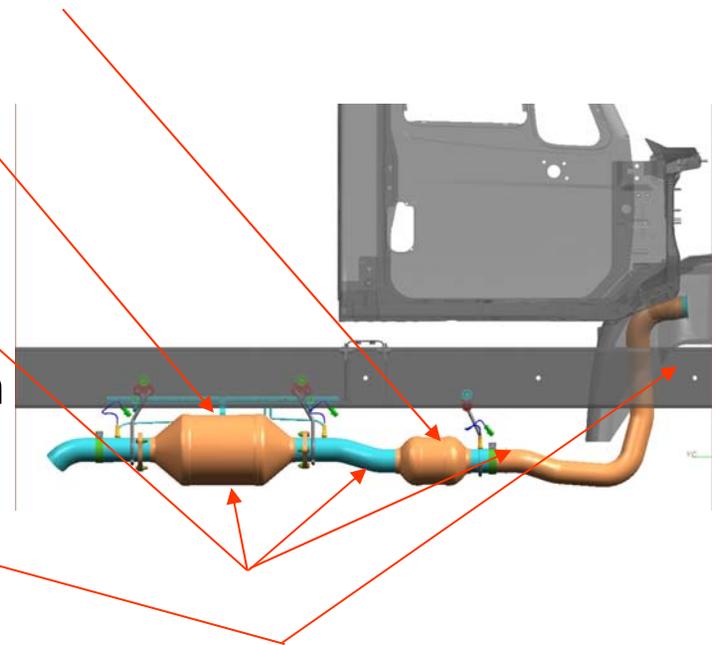




## Diesel Technology

# Aftertreatment System Overview - 2007

- **Diesel Oxidation Catalyst - DOC**
  - Converts fuel to heat for regeneration of DPF
- **Diesel Particulate Filter - DPF**
  - Filters and stores Particulate Matter
  - Also stores ash (non-combustibles)
- **System Sensors and Controls**
  - Monitors and adjusts system operation
- **Hydrocarbon Dosing**
  - Provides fuel to DOC
  - In-cylinder for most applications





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# 2010 Technology Alternatives

- Aftertreatment
- Advanced Combustion
- Vehicle System



# Diesel Technology

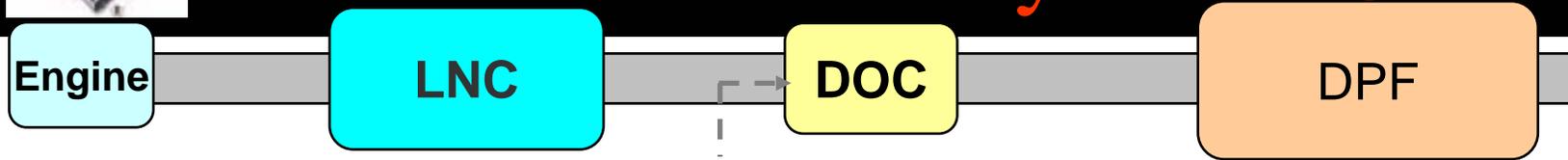
## 2010 Aftertreatment

- PM
  - DPF
- NOx
  - In Cylinder
  - Lean NOx Catalyst
  - Lean NOx Trap
  - Selective Catalytic Reduction (Urea)
  - Hybrid Systems
    - LNT/SCR
    - Reformer/H<sub>2</sub> SCR

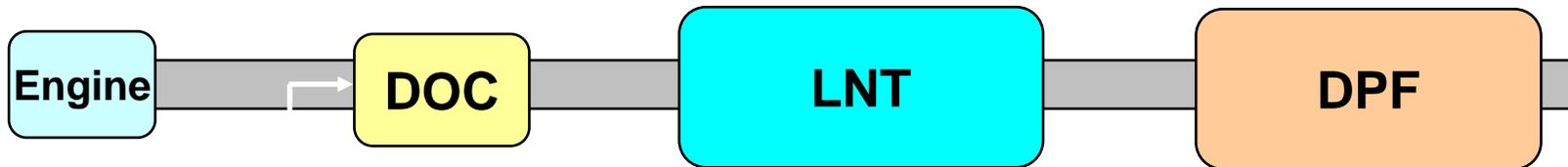


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## Aftertreatment System Options



Fuel Injector ?



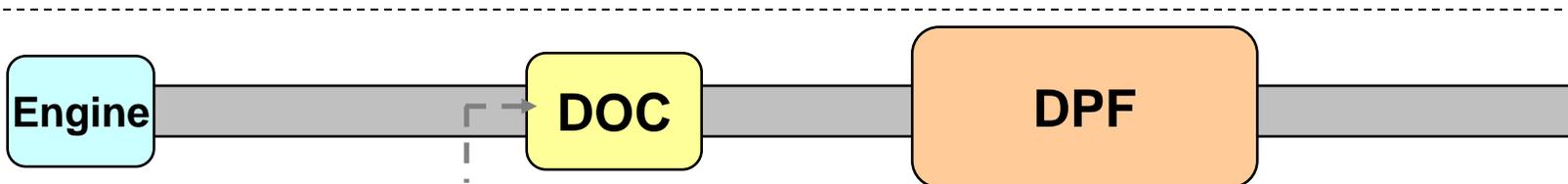
Fuel Injector

2010  
NOx/PM  
Targets



Urea Injector

Fuel Injector



Fuel Injector or  
in cyl

2007  
NOx/PM  
Targets



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# Advanced Combustion

- HCCI
- PCCI
- Fuel System
- Air Management



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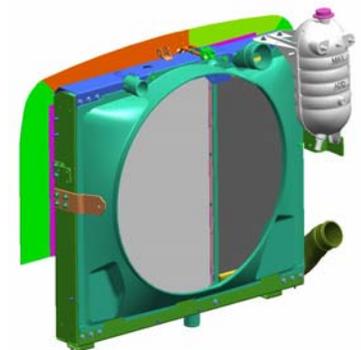
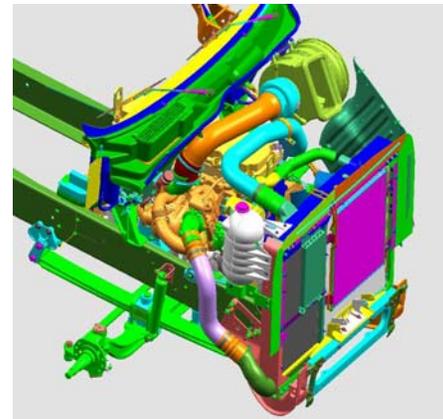
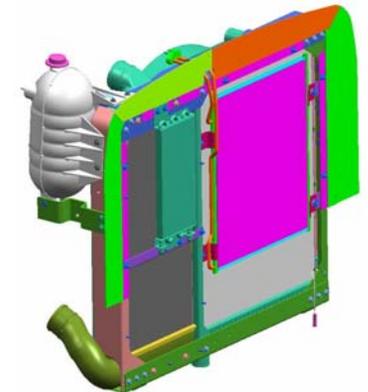
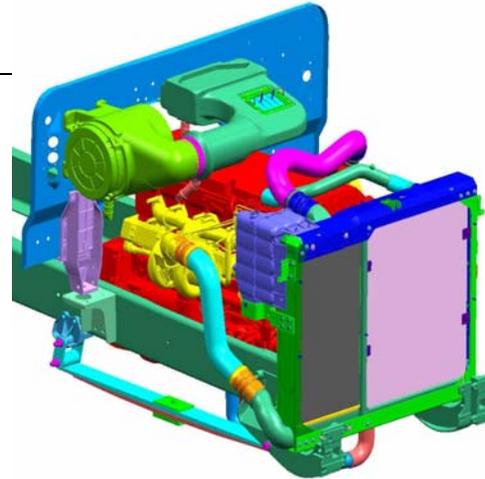
# Vehicle System

- Electronics integration
- Parasitic loss attenuation
- Packaging
- Thermal management



## Integrated Cooling Systems

- Developing new or improved cooling systems
- Targeting installations that minimize hood or major body/chassis changes
- Leveraging 2007 experience and technology
- Cooling systems development ahead of 2008 field test





- Catalyzed PM Filter
  - Ultrafine PM at background levels
    - Dr. Kittelson et al, Journal of Aerosol Science
- Active Regeneration
  - Desulfurization impact
- Precious metal loading of DOC and PM filter



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# Sulfur in fuel

- Biodiesel B20
- F-T fuel blended with ULSD
- Fuel Sulfur Filter



## Conclusions

- **Diesel Technology continues with both evolutionary and revolutionary change**
- **The future emissions reductions for diesel products involve a vehicle system approach**



## Conclusions

- **All on highway diesels will utilize active regeneration catalyzed PM filters in 2007 and beyond**
- **Opportunities exist for further reductions in fuel sulfur content**