



## Senior Sales Specialist Big Bore Engines

Steve Perkins



ALWAYS PERFORMING.

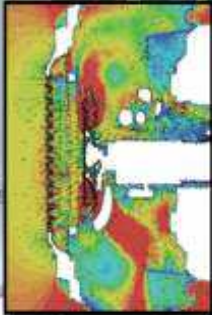


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- Agenda
  - Background of Achievement
  - Technology
  - EPA Requirements
    - Why we chose Advanced EGR

# 2010 AND BEYOND

30% FUEL ECONOMY IMPROVEMENT



2015

2012

2010



## ADVANCED EGR



## MAXXPOWER



**MAXXFORCE**  
ADVANCED DIESEL POWER

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# MaxxForce Power for International Vehicles

GREAT PRODUCTS  
ONE COMMON DENOMINATOR

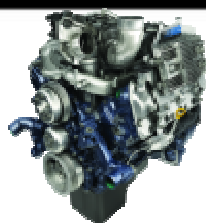


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A BETTER  
WAY TO

# POWER VEHICLES



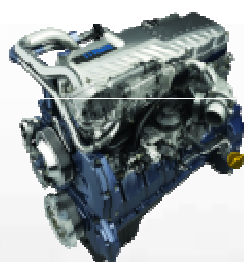
**MAXXFORCE 7**  
INTERNATIONAL DIESEL POWER™



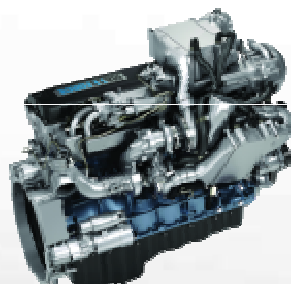
**MAXXFORCE DT**  
INTERNATIONAL DIESEL POWER™



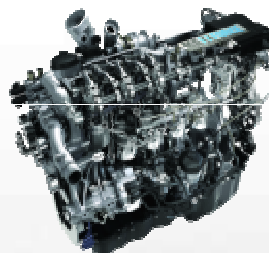
**MAXXFORCE 9**  
INTERNATIONAL DIESEL POWER™



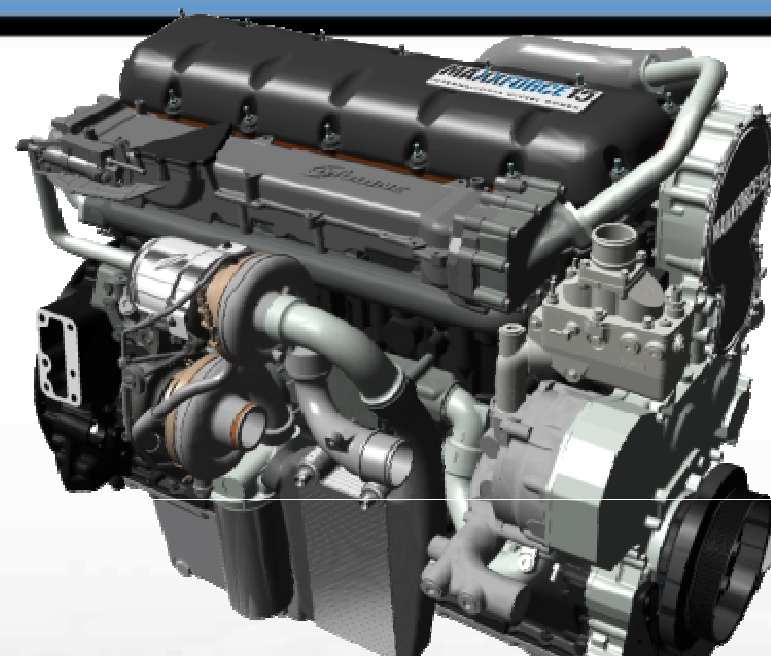
**MAXXFORCE 10**  
INTERNATIONAL DIESEL POWER™



**MAXXFORCE 11**  
INTERNATIONAL DIESEL POWER™



**MAXXFORCE 13**  
INTERNATIONAL DIESEL POWER™



**MAXXFORCE 15**  
INTERNATIONAL DIESEL POWER™

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# 2010 Changes

**ADVANCED  
EGR**



**MAXXFORCE**  
ADVANCED DIESEL POWER

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# Navistar 2010

- Why isn't Navistar going with EGR only?
  - What led to that decision?
- What are some of the steps that we took to be ready for 2010?
- What are long term emission strategies?

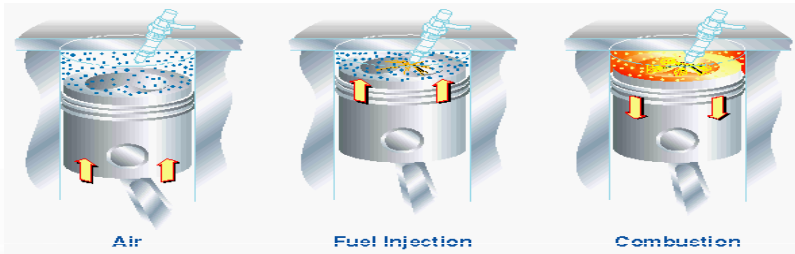
# Why EGR

- First and foremost – burden of Compliance rests with us
  - the manufacturer
- Driver interface is unchanged
- Packaging and payload superiority
- Technician requirements are unchanged
- Lower Operating Costs
- Vehicle Complexity Reduced
- Urea Requirements avoided
- Value



# Why Worry About NO<sub>x</sub>?

- NO<sub>x</sub> is created in the cylinders by high combustion temperature



- NO<sub>x</sub> causes ground level ozone and smog
- NO<sub>x</sub> can be reduced by:
  - Chemical reaction in the exhaust
  - Lower combustion temperatures



# ADVANCED EGR TECHNOLOGY ENABLERS

1) Advanced Fuel Injection Technology

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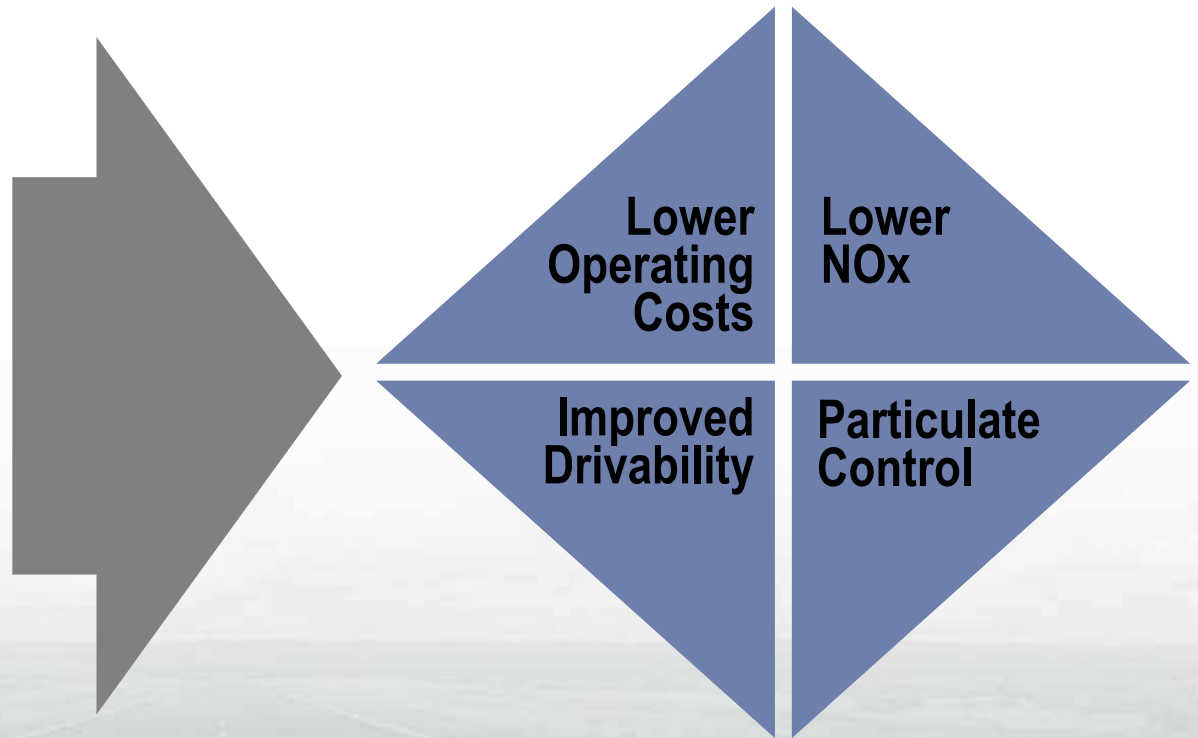
2) Proprietary Combustion Bowl Designs

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3) Advanced Air-Management Systems

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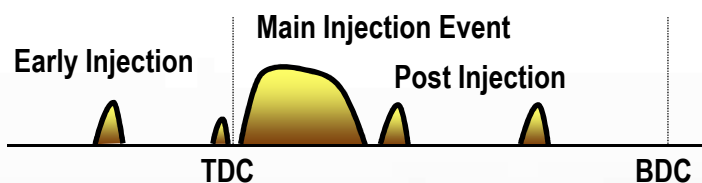
4) Proprietary Electronic Calibration Strategies



# ADVANCED EGR

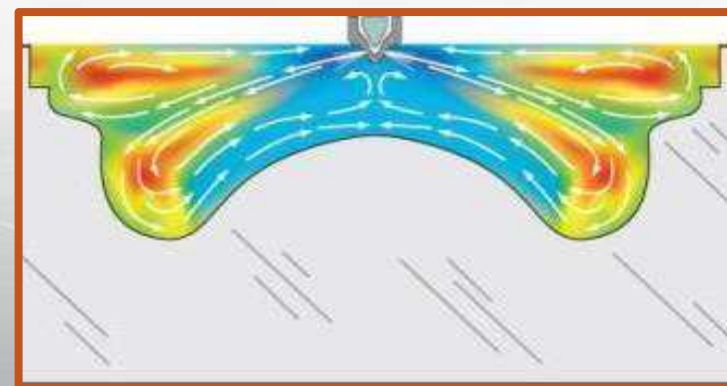
## STEP 1 Advanced Fuel Injection Technology

Multiple injections per cycle  
Higher injection pressures  
Less NO<sub>x</sub> created



## STEP 2 Proprietary Combustion Bowl Design

Finer mist  
More even distribution in  
cylinder  
More complete burn



# ADVANCED EGR



## STEP 3

Advanced Air  
Management

Dual turbochargers

Interstage cooling

Lower combustion temp.



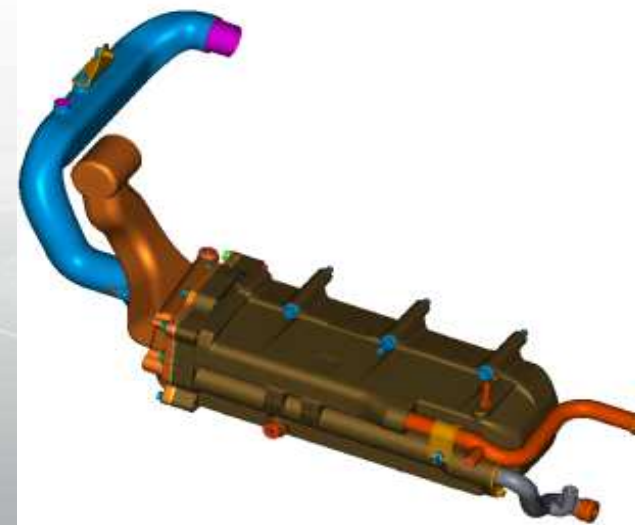
## STEP 3

Exhaust Gas  
Recirculation

More flow

Cooler temperature

Lower combustion temp.



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# ADVANCED EGR

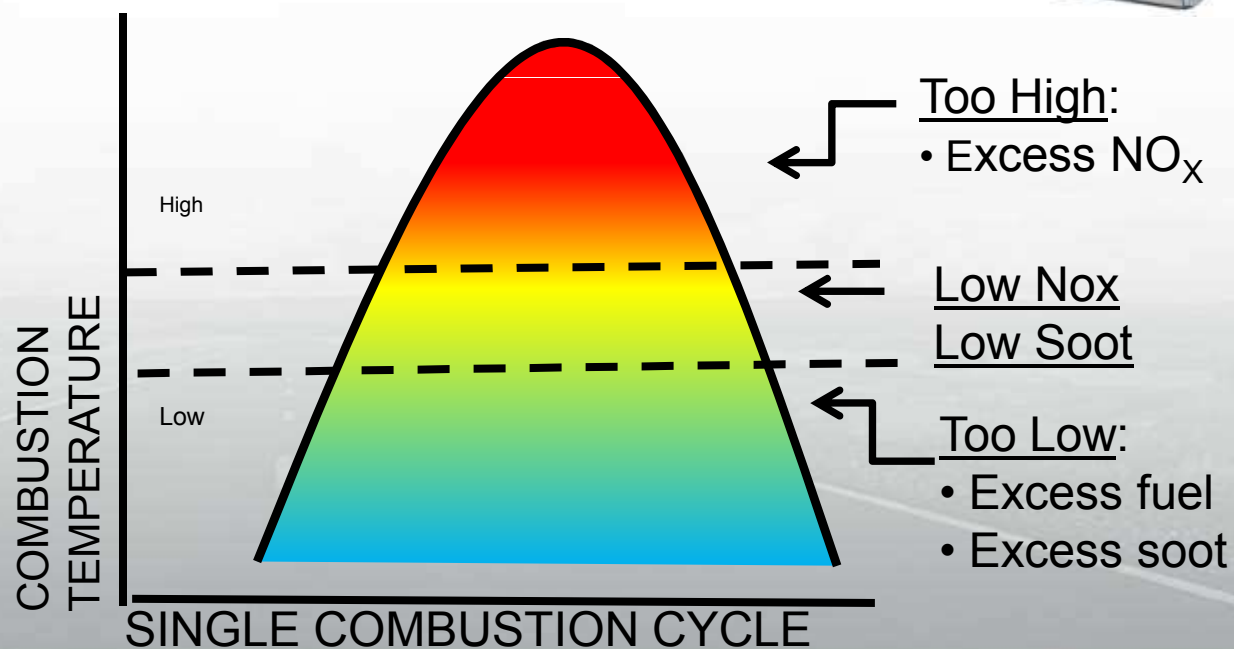
## STEP 4

Electronic  
Calibration  
Strategies

Increased Computing power

Continuous calculation

Maximum power and efficiency



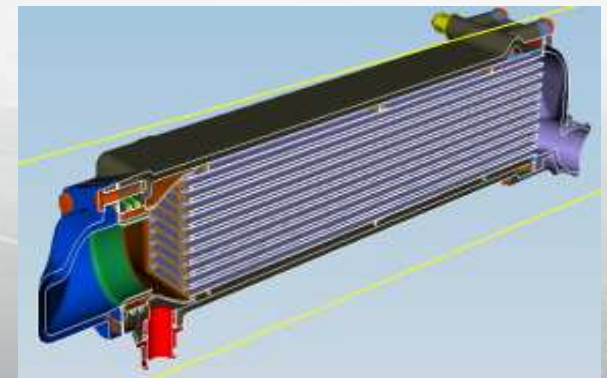
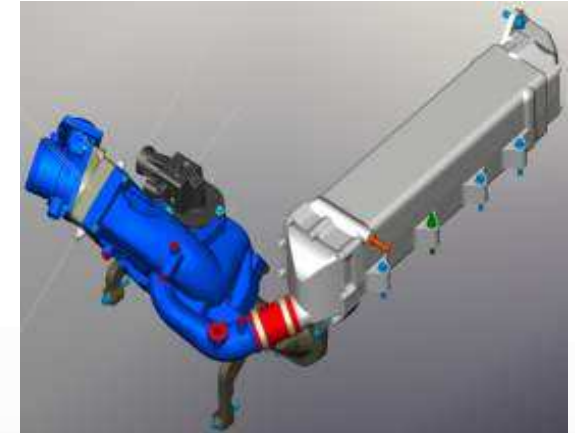
Total  
Advanced  
EGR

# Product - Reliability

## EGR Cooler / EGR Valve

### Durability and Reliability

- Larger Aluminum cast housing
  - Cast design successful on MxF 11/13
- Floating core suspends internal heat exchanger
  - Improved solid mounting reduces vibration
- Single cooler reduces plumbing
  - Integral with mating surfaces
- Next generation integrated EGR valve with dual stepper motor actuation eliminates prior spring return
- **Design Improvement**
  - Enhanced Reliability at higher flow rates



# Navistar 2010 Commitment

- Meet 2010 with minimal customer burden
- EPA / CARB compliance and certification
  - CARB Best Available Control Technology



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# 2010 Alternatives for Navistar

- Run hot combustion, create NOx, reduce out of engine
  - Liquid SCR effective - requires customer involvement
    - European technology
    - All 2010 SCR engines will retain EGR
    - What is the longer term future of liquid SCR with so many strong alternatives under development?
  - NOx adsorbers, Lean NOx traps do not scale
  - GE / Tenneco SCR catalyst not mature

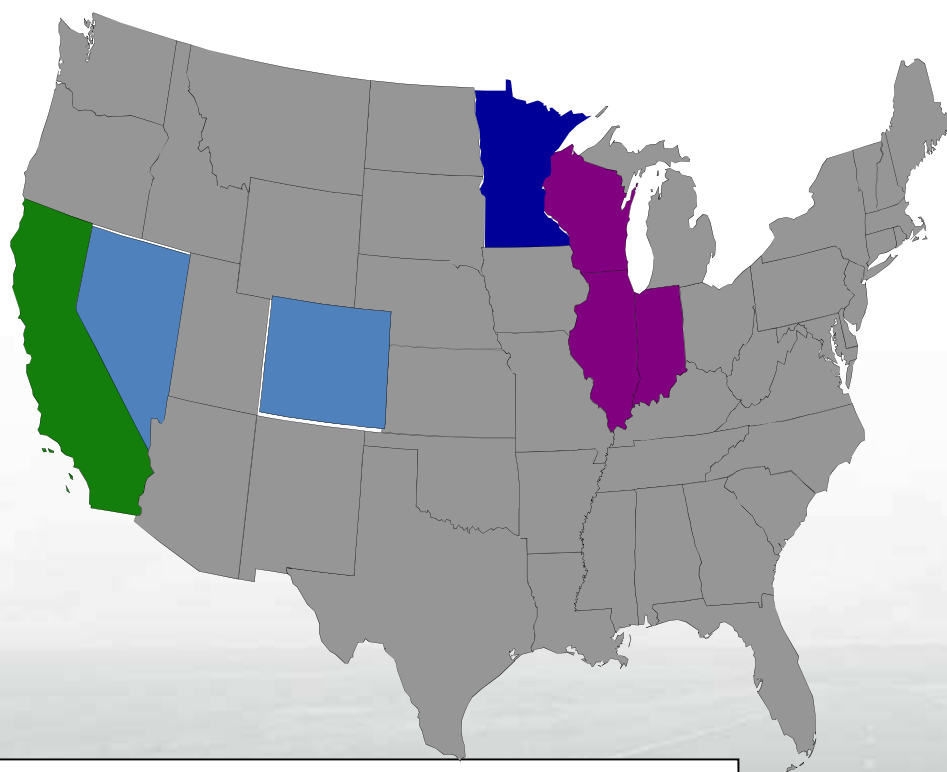


# 2010 Alternatives

- Run cool combustion with EGR, reduce NOx
  - Best for customers
  - Doable with High Pressure Common Rail - timing challenge
    - Navistar 5 million engines produced since 1995 with High Pressure Common Rail – unmatched experience
  - Large investment in R&D

# Tested, Proven and Delivered

100 Vehicle Fleet - 15 million test miles since early 2008



- High altitude and high temperature testing
- Cold weather testing
- General testing
- CARB certified 2010 emissions approach



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# Development Issues and Solutions

- Development - EGR runs engine “cold” with reduced oxygen
  - Issue: Condensation can form
  - Solution: Cycle EGR 100-130 degrees
  - Condensation effectively reduced to safe levels

# Development Issues and Solutions

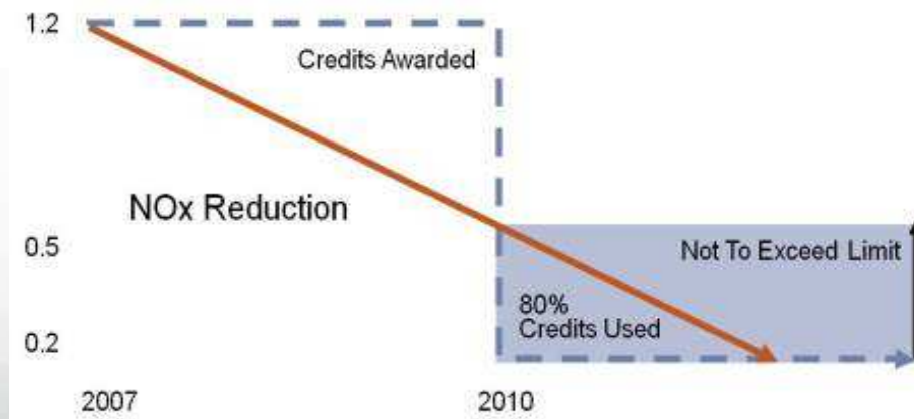
- Cool combustion reduces efficiency
  - Issue: Could reduce power and fuel economy
  - Issue: Could increase DPF regen, oil intervals
  - Solution: Increase fuel pressure, recalibrate
    - Restores power and efficiency to 2007 levels
      - V-8 increases in power for 2010 from 230 HP to 300 HP
    - Restores oil intervals, DPF regen to 2007 levels



# Timing challenge

**Development Strategy: mature the technology for customers**

***EPA and CARB reward cleaning environment earlier***



**Sustainability: As credits deplete, increase EGR levels (to 35% range) to achieve 0.2 NOx , increase fuel pressure, recalibrate to retain and improve fuel economy and performance.**

# Navistar Advanced EGR – Summary

## Easy for Operators

- Easy to Operate
- Maintain fuel economy
- “Business as usual” for fleet operators
  - No added hardware – no space restrictions
  - Minimal added weight (~100 lbs.) for larger cooling system

## Easy to Understand

- Built on mature 2007 platform
- Over 2 million Navistar EGR engines in service

## Easy to Maintain

- No urea
- No technician and driver training, no increased maintenance

Easy on the Environment – Phase-in strategy = cleaner engines earlier



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# Questions?

Introducing The  
All New  
**TERRA Star**



**Engine Sales and Marketing**  
**Steve Perkins**

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# THANK YOU



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