

DAIMLERCHRYSLER

DaimlerChrysler Powersystems

Advanced Diesel Engine and Aftertreatment Technology Development for Tier 2 Emissions

R. Aneja, B. Bolton, B. Oladipo, Z. Pavlova-MacKinnon, A. Radwan

Detroit Diesel Corporation



“Dieselization” of Vehicle Fleet Offers Significant Reduction to U.S. Transportation Energy Use

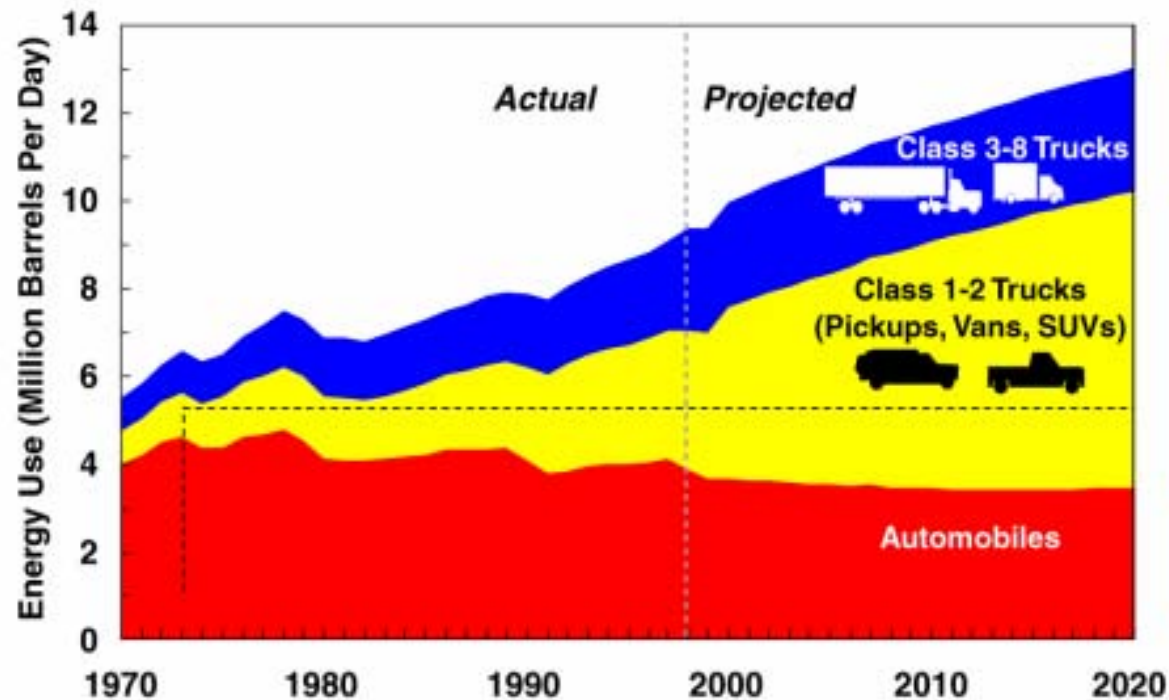


Fig. 2.2. Trucks account for increasing highway transportation energy use.

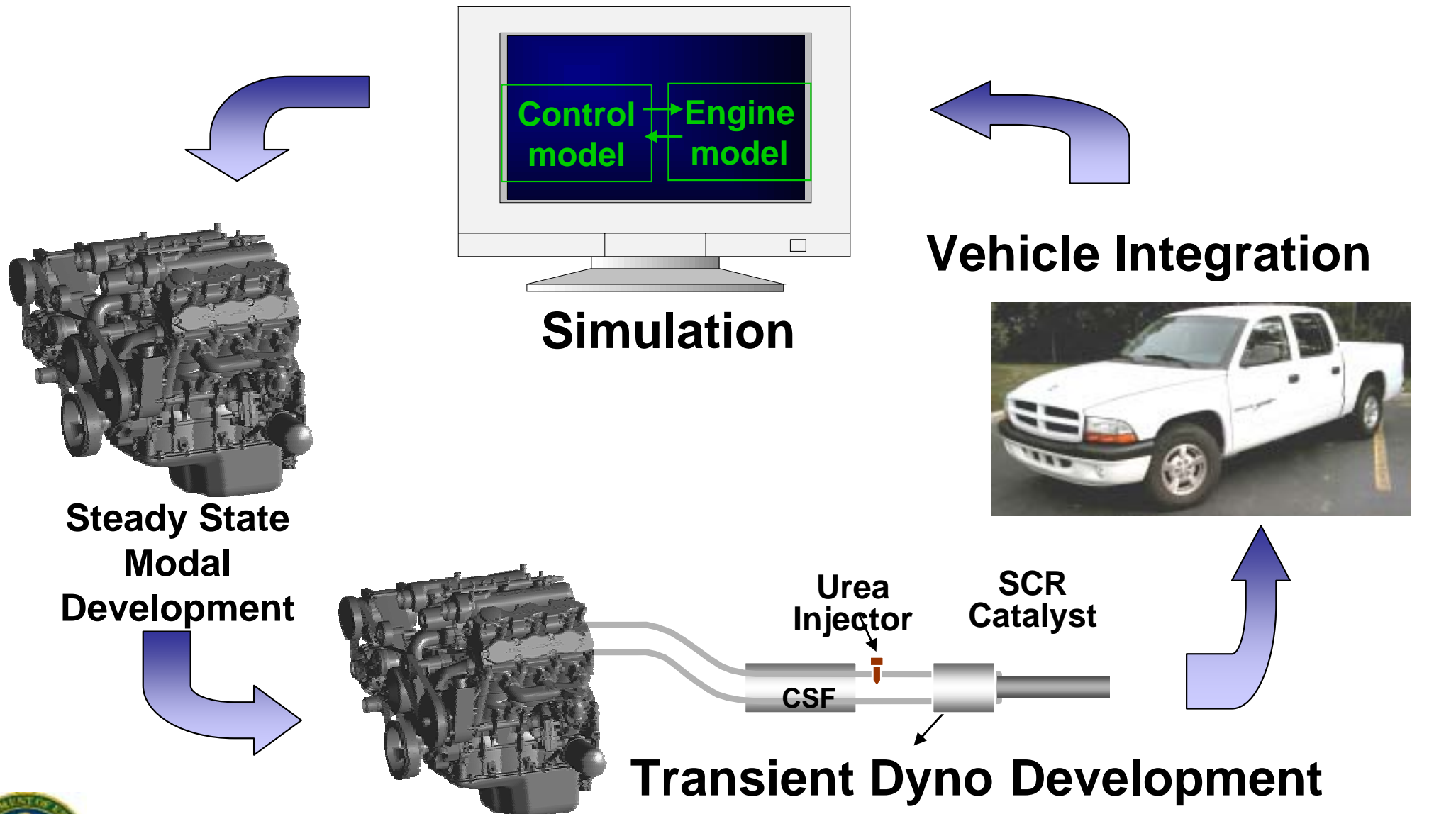
Sources: EIA Annual Energy Outlook 2000, DOE/EIA-0383 (2000), December 1999.

Transportation Energy Data Book: Edition 19, DOE/ORNL-6958, September 1999.

In 1999 Many Questioned the Diesel Engine’s Potential to Achieve Future Tier 2 Emissions and the Resulting Fuel Economy Improvement



System Development Methodology



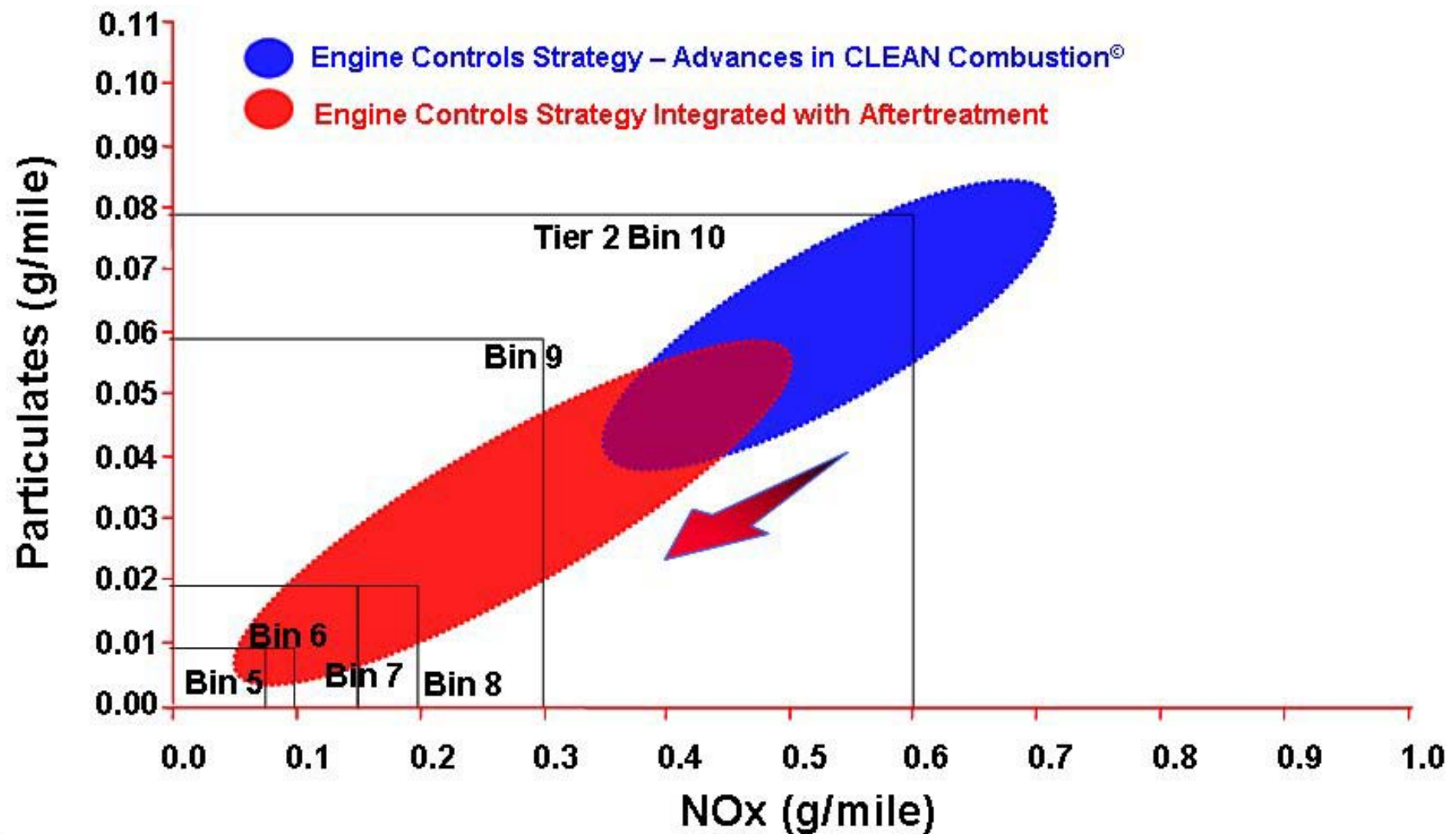
DAKOTA Light Truck Platform



**2001 Dakota Quad Cab Sport 4 x 2
Re-powered with DDC DELTA 4.0I V6
Twin VG Turbocharged, Common Rail Injection
235 hp @ 4000 RPM**

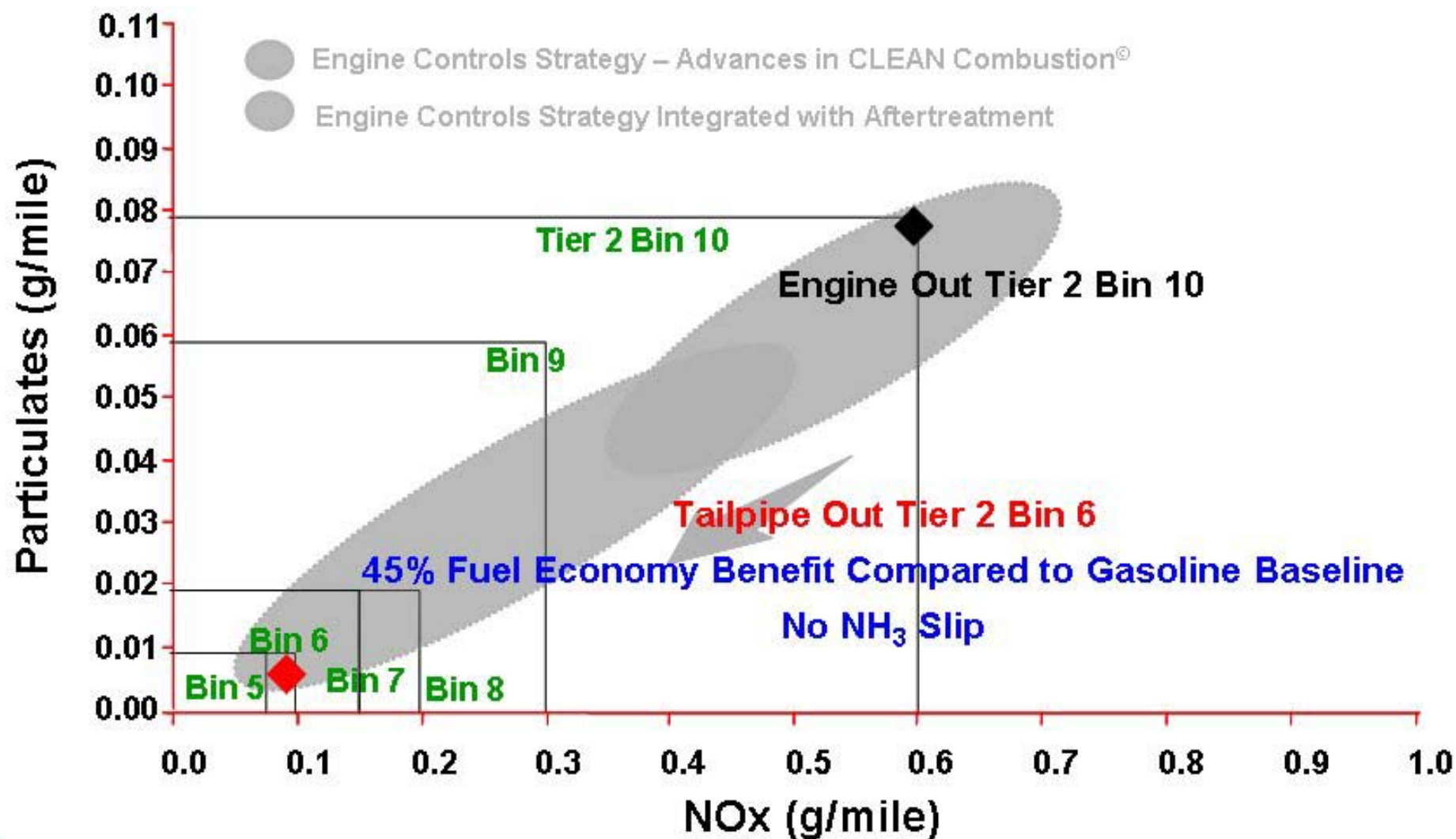


Integrated Emissions Reduction Roadmap Light Truck / SUV Platform



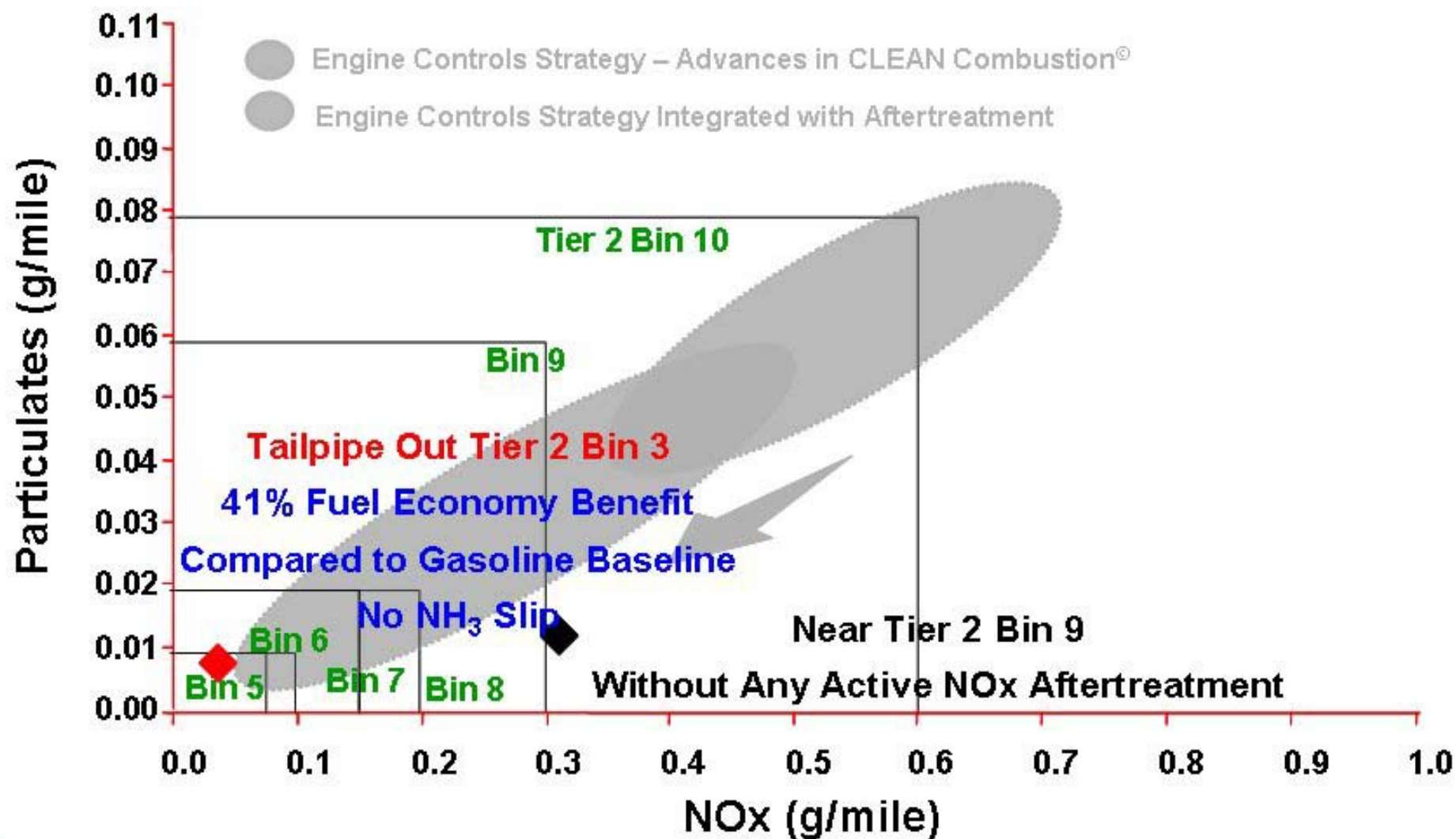
Integrated Emissions Reduction Roadmap Light Truck / SUV Platform

Presented at DEER 2002

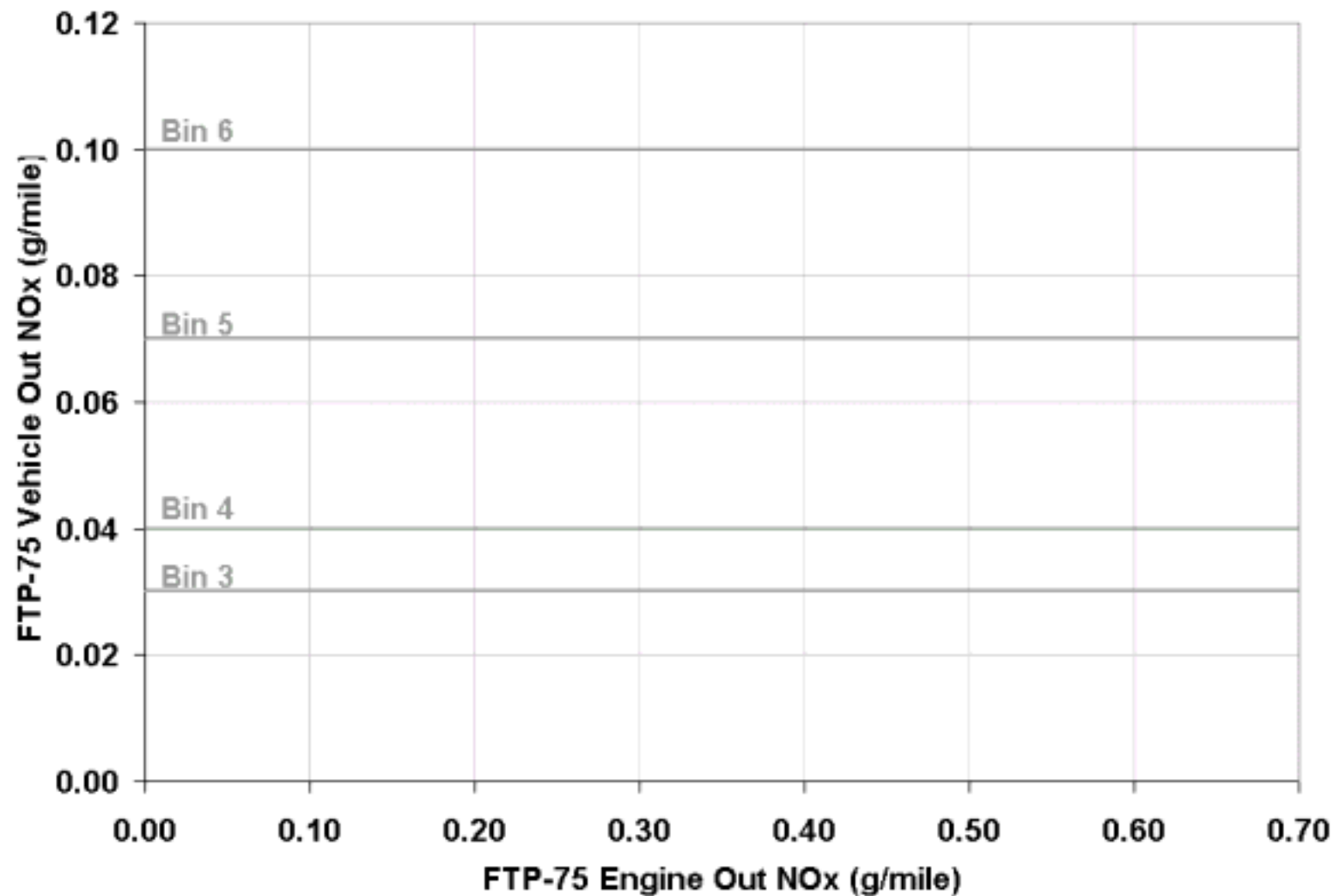


Integrated Emissions Reduction Roadmap Light Truck / SUV Platform

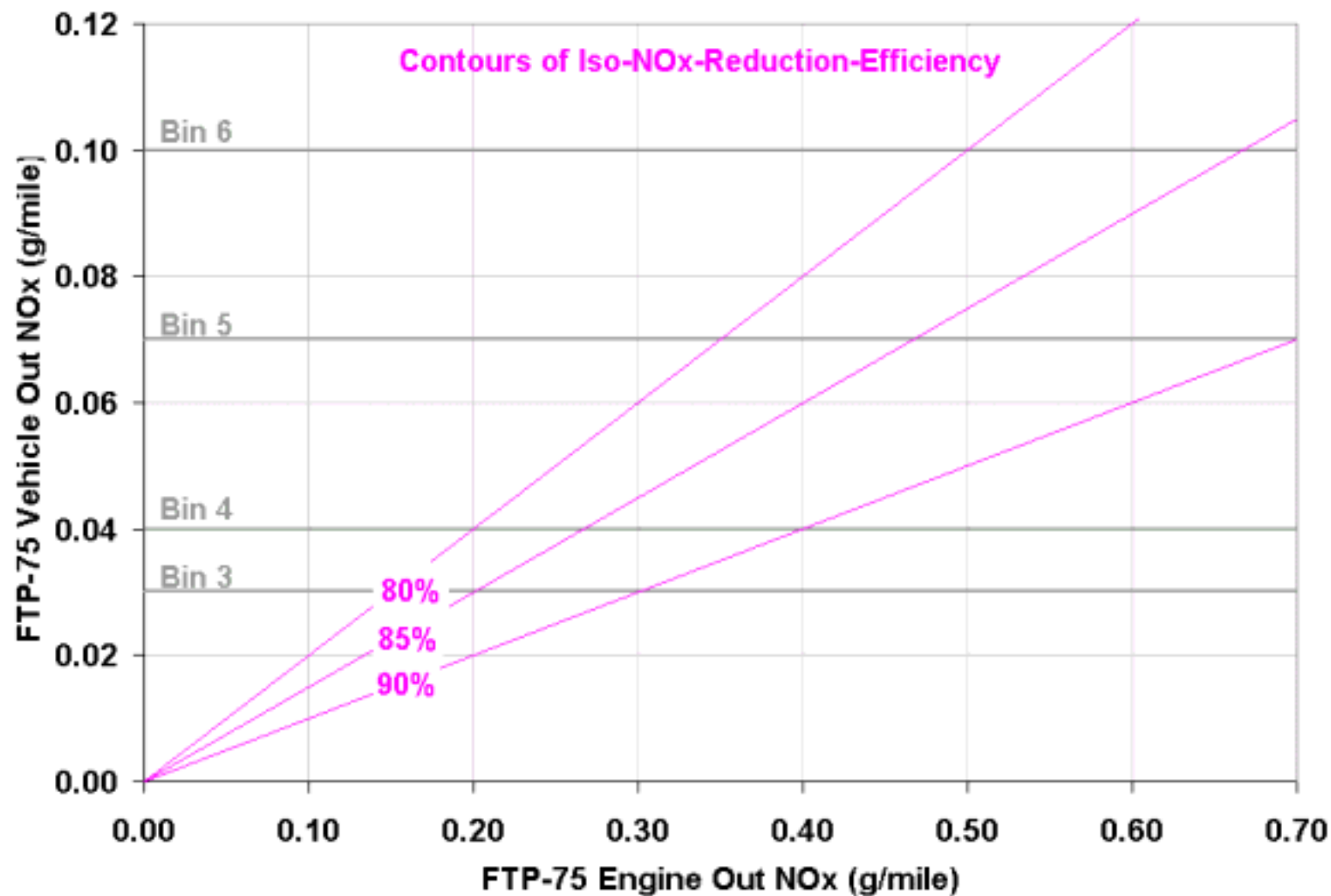
Accomplishments since DEER 2002



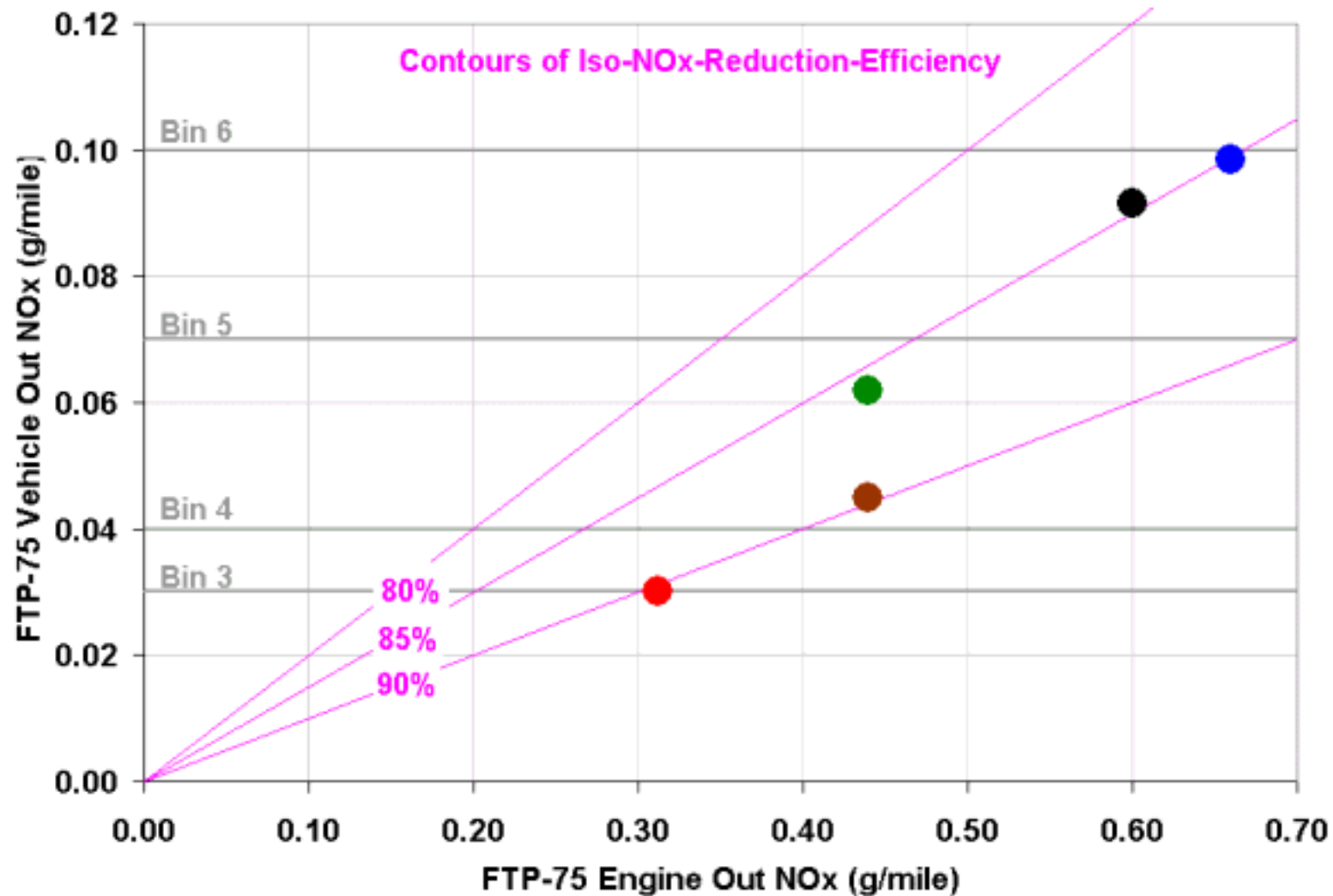
NOx Reduction Via Combustion and Aftertreatment Development Light Truck / SUV Platform



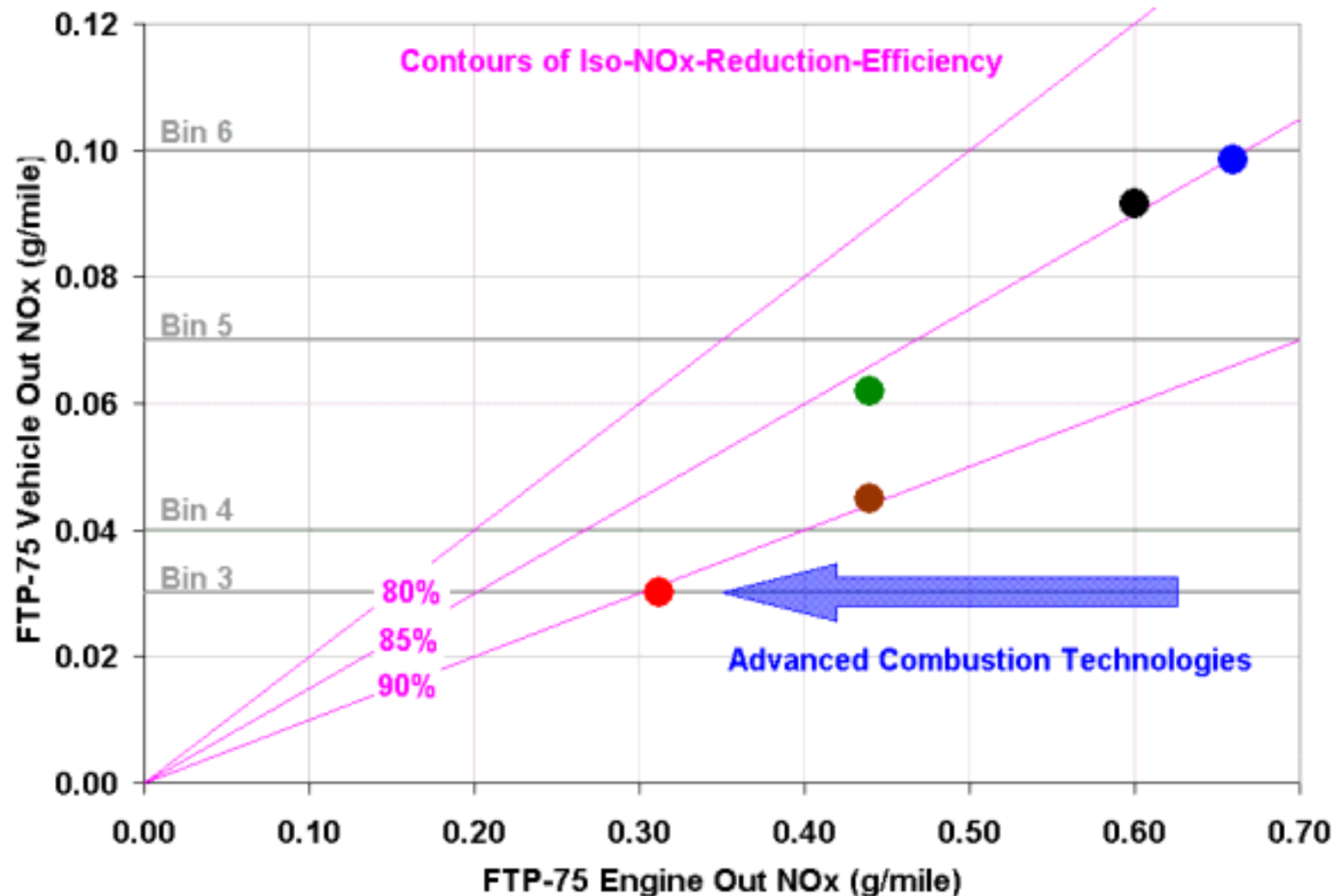
NOx Reduction Via Combustion and Aftertreatment Development Light Truck / SUV Platform



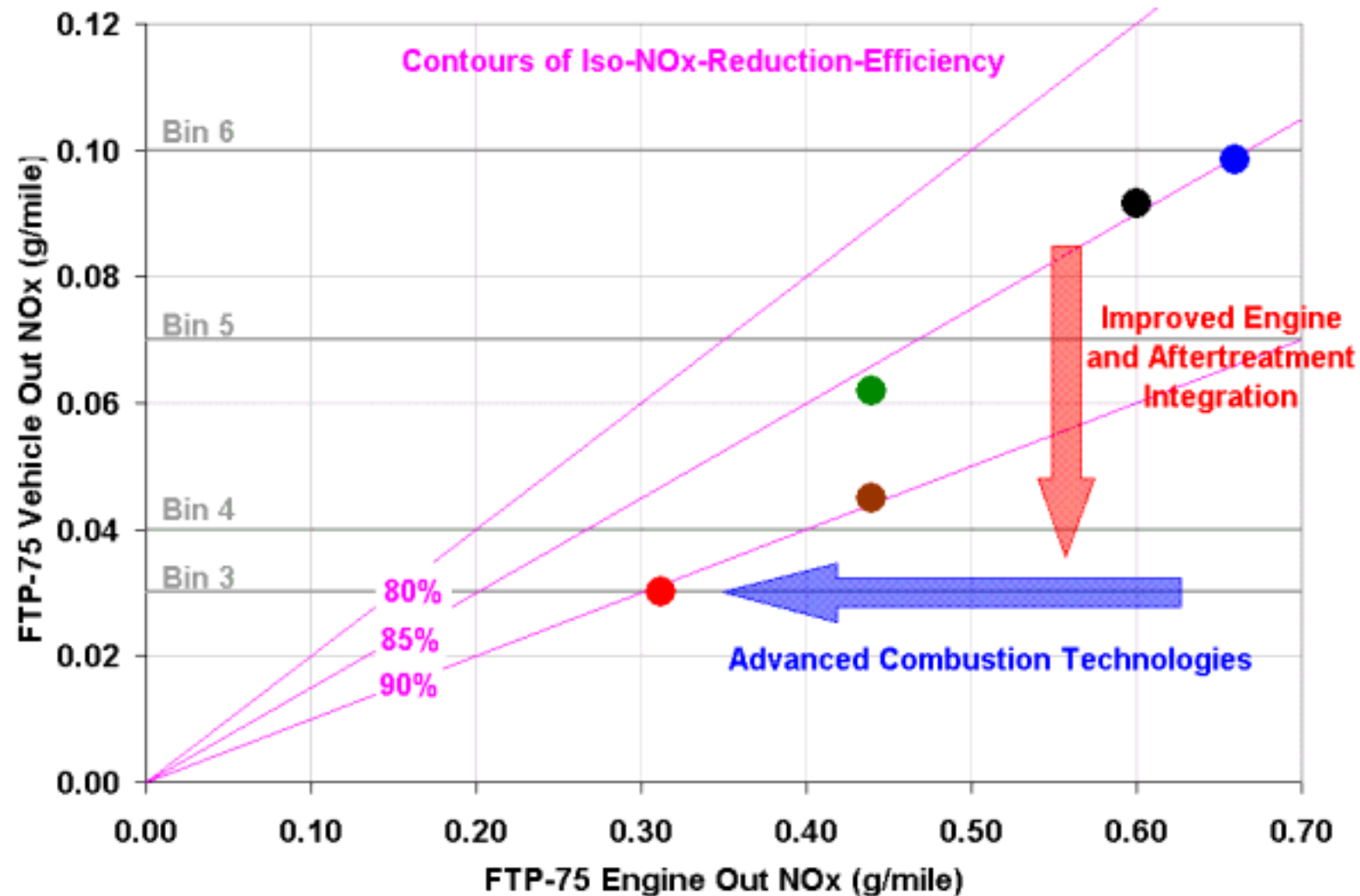
NOx Reduction Via Combustion and Aftertreatment Development Light Truck / SUV Platform



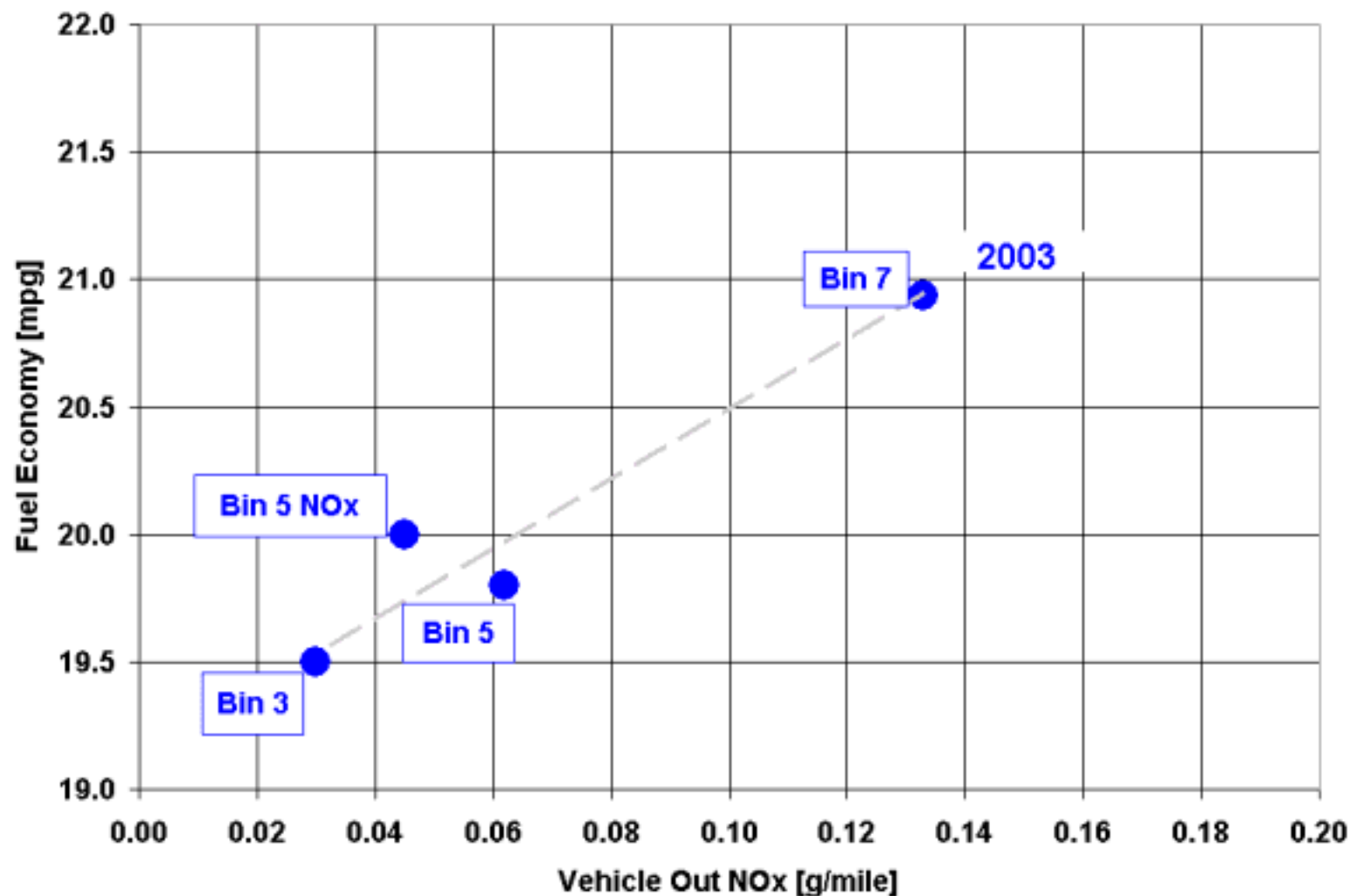
NOx Reduction Via Combustion and Aftertreatment Development Light Truck / SUV Platform



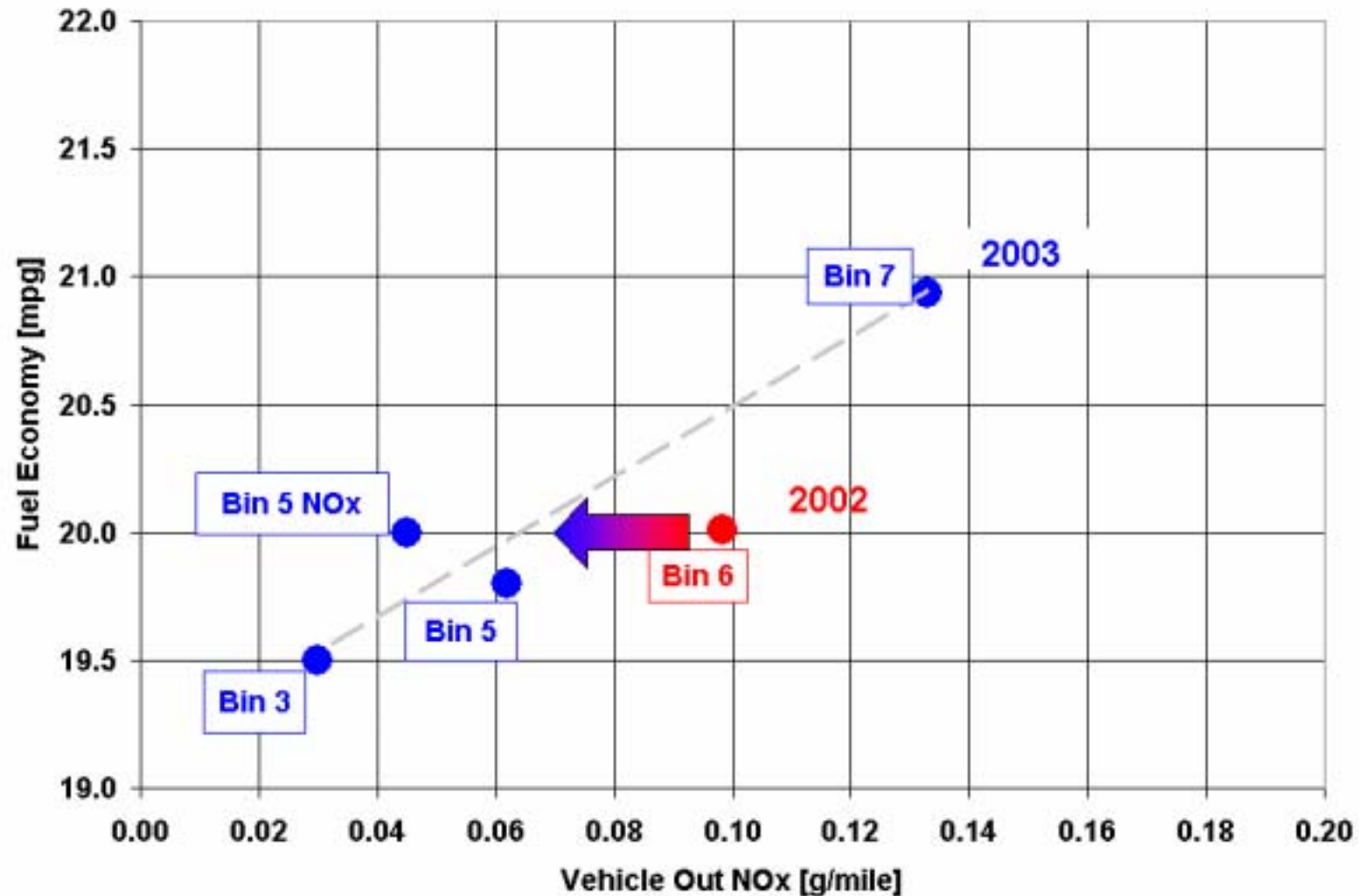
NOx Reduction Via Combustion and Aftertreatment Development Light Truck / SUV Platform



Fuel Economy Recovery Potential Light Truck / SUV Platform



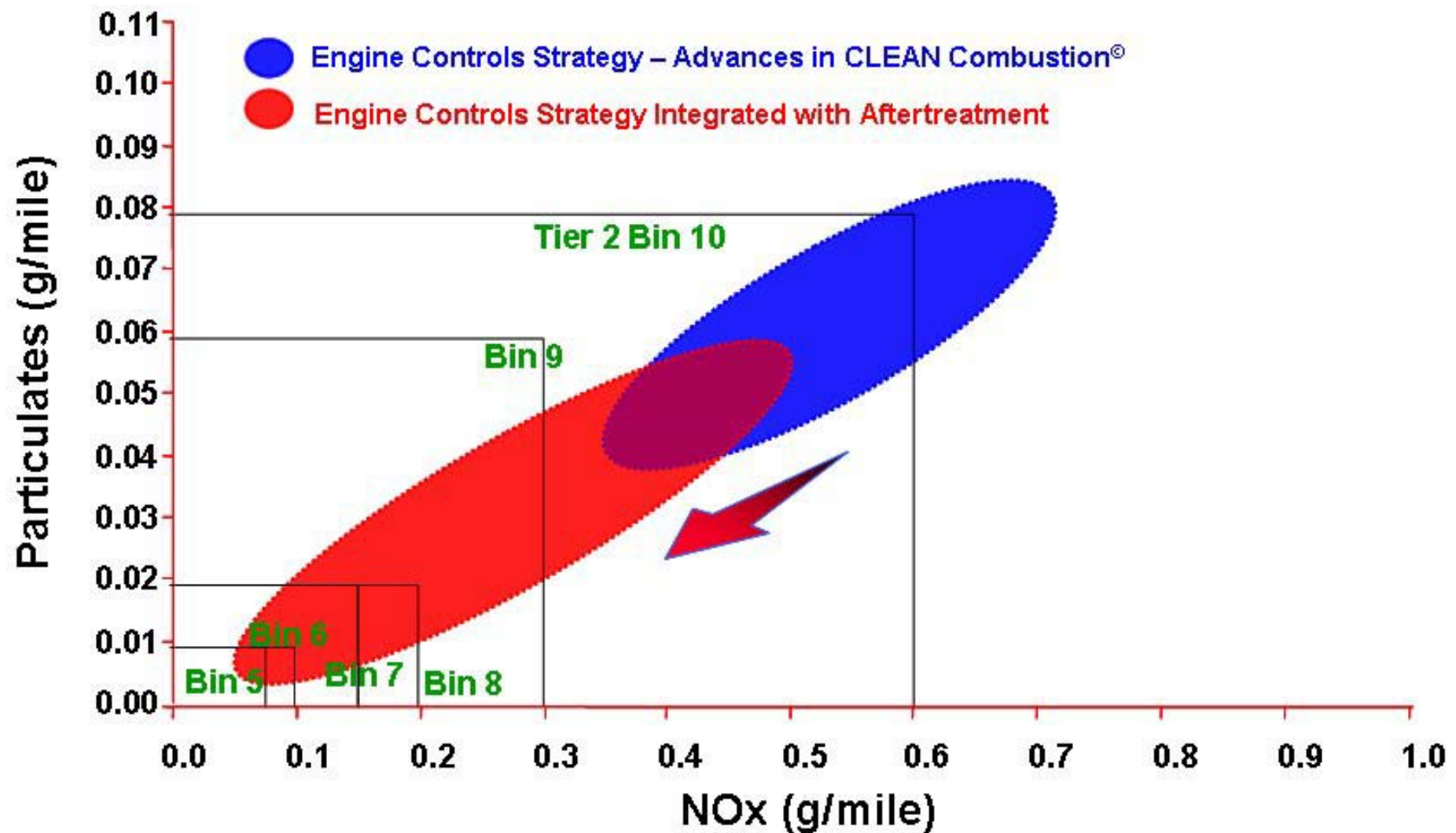
Fuel Economy Recovery Potential Light Truck / SUV Platform



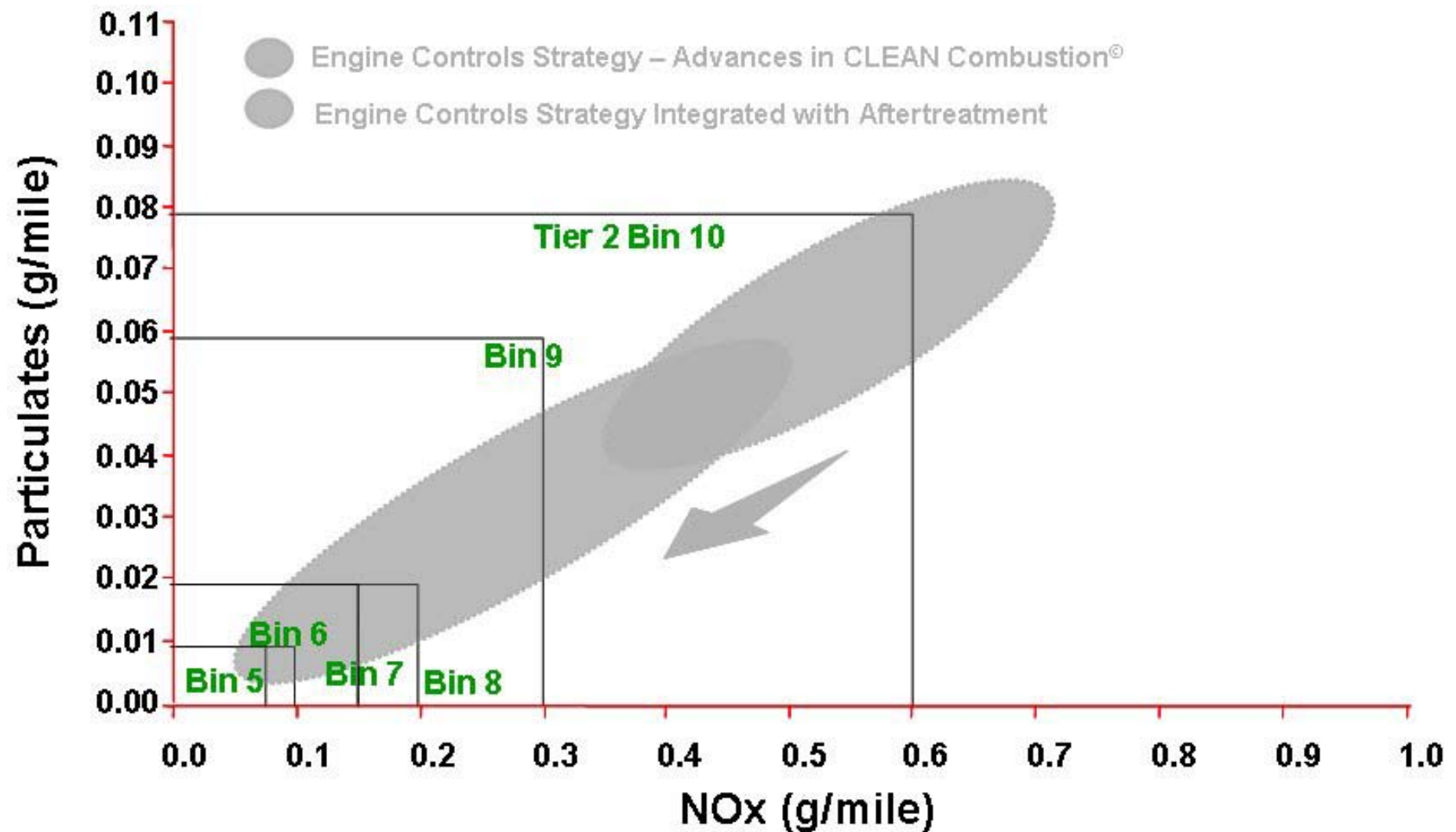
2003 Data Demonstrates MPG can be Selectively Recovered



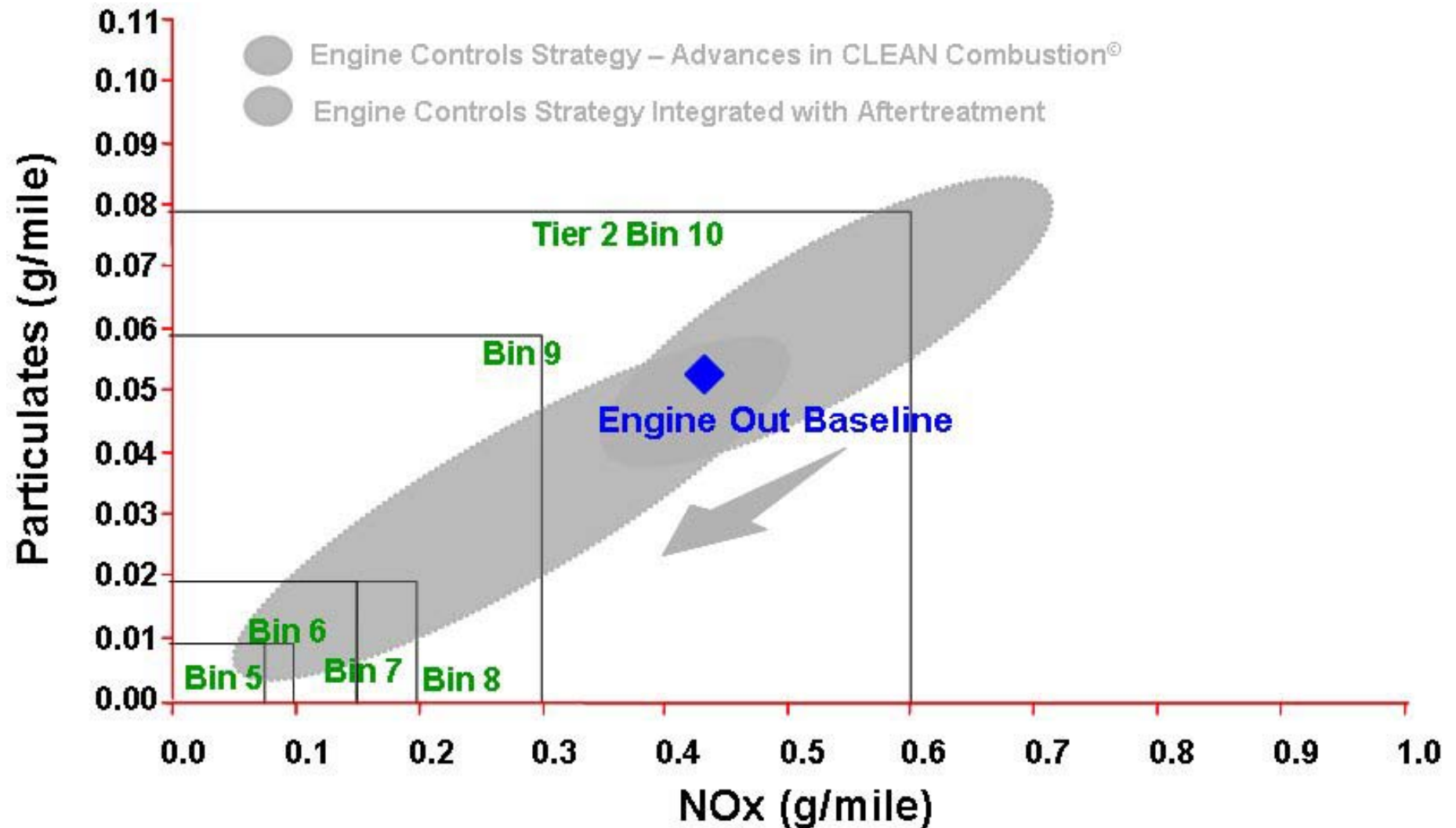
Integrated Emissions Reduction Roadmap Passenger Car Platform



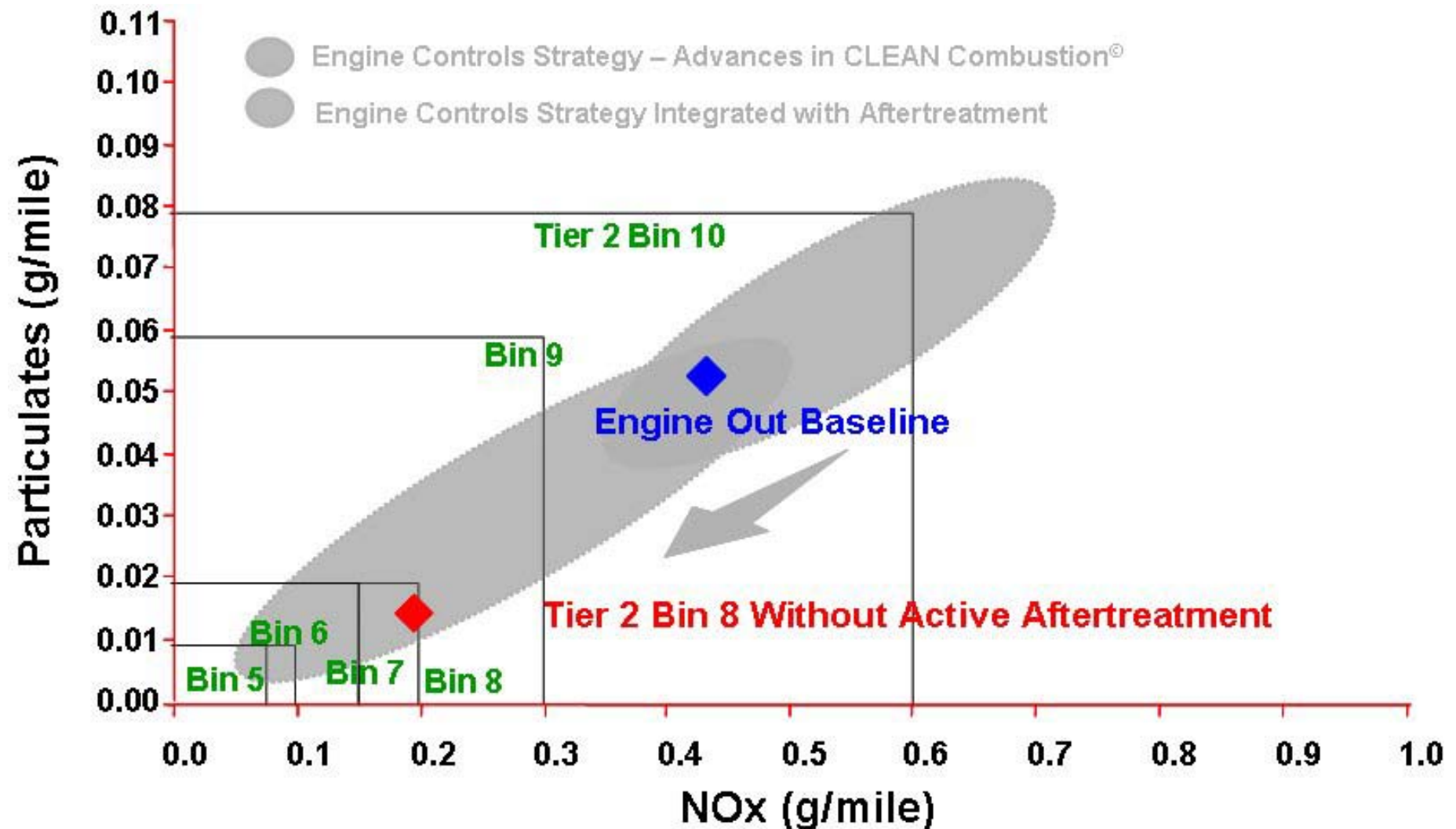
Integrated Emissions Reduction Roadmap Passenger Car Platform



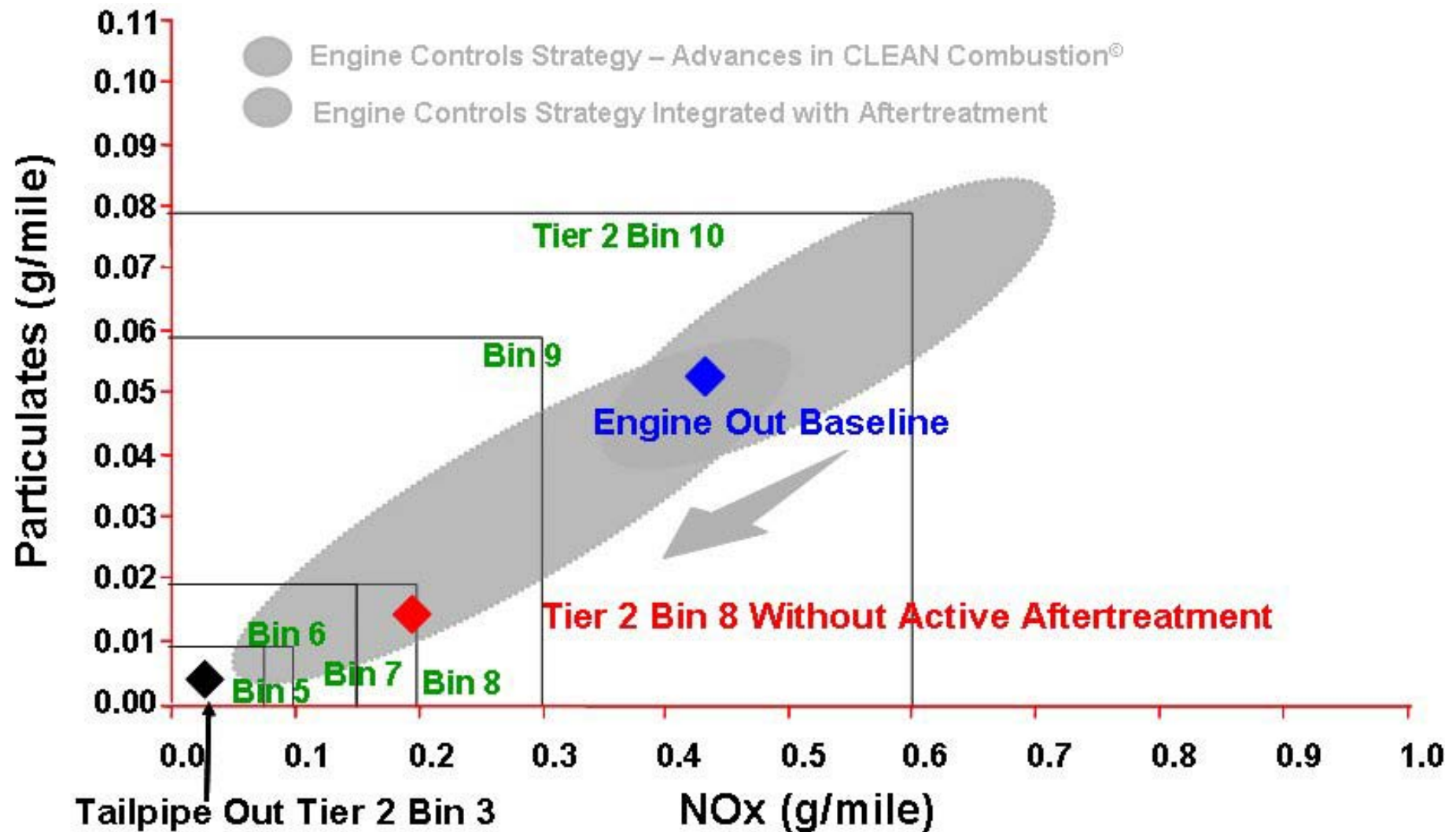
Integrated Emissions Reduction Roadmap Passenger Car Platform



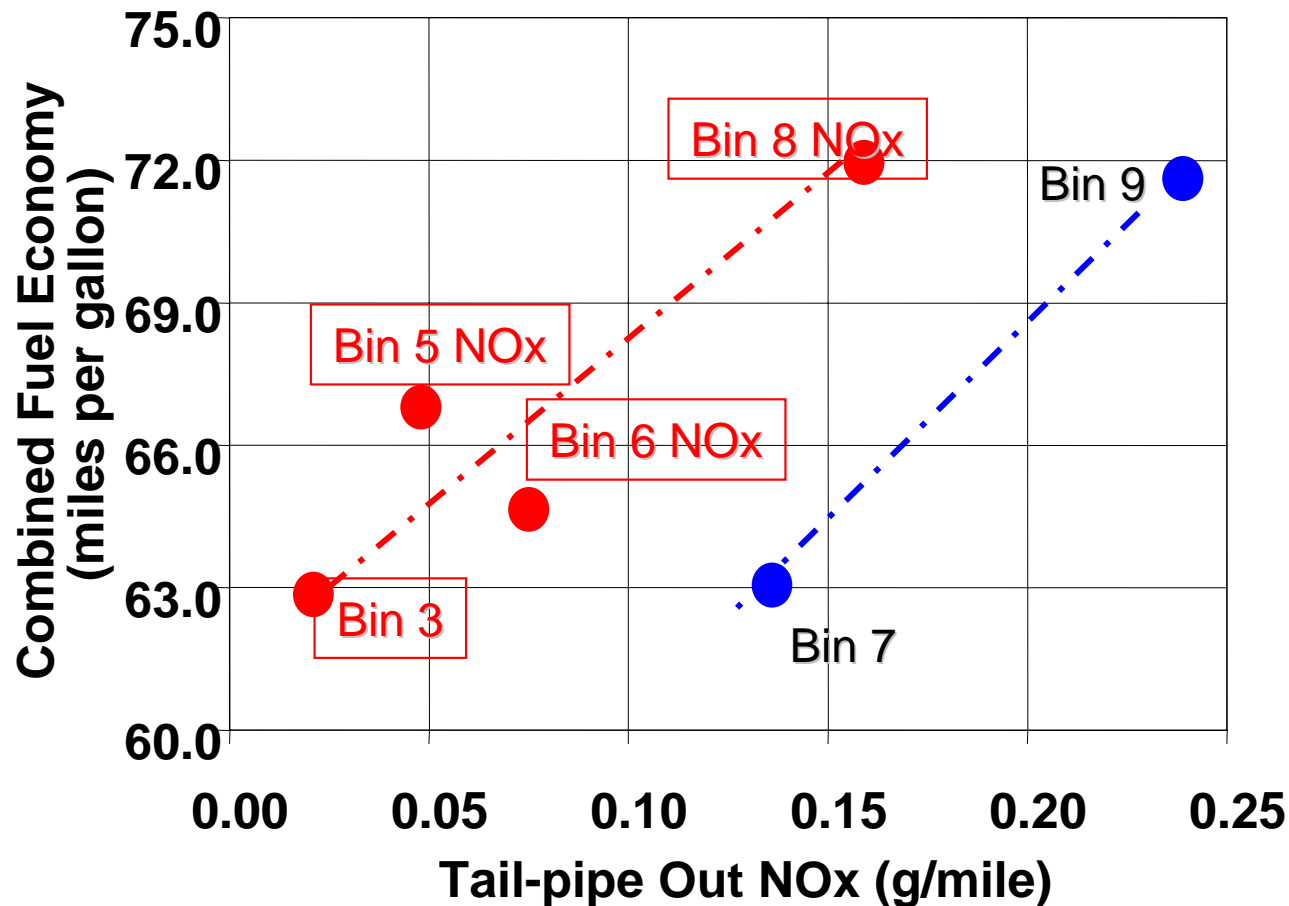
Integrated Emissions Reduction Roadmap Passenger Car Platform



Integrated Emissions Reduction Roadmap Passenger Car Platform



Fuel Economy Recovery Evolution Passenger Car – FTP 75



Data Demonstrates MPG can be Selectively Recovered



Summary

- Tier 2 Bin 3 Emissions Demonstrated for Light Truck / SUV and Passenger Car Platform with Integrated Diesel and Aftertreatment (CSF and Urea SCR) System
 - » Tier 2 Demonstrated for the Light Truck Platform over the US06 Cycle
 - » 41% City Fuel Economy Advantage Over Light Truck Gasoline Baseline
- Emissions Reduction Attributed to
 - » Advanced Combustion Technology
 - ✓ Near Bin 9 Engine Out NOx
 - » Engine and Aftertreatment Integration
 - ✓ Controlled NO₂/NO_x Ratios at SCR Inlet
 - ✓ High Fidelity Urea Mixing
 - » Urea Injection Control Strategy
 - ✓ Minimize Risk of NH₃ Slip while Maximizing NO_x Reduction
- Development Methodology Emphasizes Integrated Testing & Analysis



Conclusions

- Tier 2 Technology Demonstrated
 - » FTP75 and US06
- Drivers for Commercialization Potential
 - » Reduce AT System Complexity by Increased Engine/AT Integration
 - » Sophisticated Controls Technology Integration
 - ✓ Multi-mode Combustion Strategy
 - ✓ Soot Filter Regeneration Strategy
 - ✓ Urea Reductant Injection Strategy
 - » Infrastructure
 - ✓ Low Sulfur Fuel (<15 ppm)
 - ✓ Urea Reductant
 - » Measurement Techniques & Emissions Variability at Tier 2 Levels
 - » Effect of Aging or Device Variability on Aftertreatment Performance
- Integrated Test/Analytical Approach is Valuable and Supports Overcoming the Technical Challenges Referenced Above
 - » Fundamental Aftertreatment Data is a Key Need Pacing the Application of These Tools/Methodologies

