



# Technologies for Low Emissions

John Wall

June 24, 2015



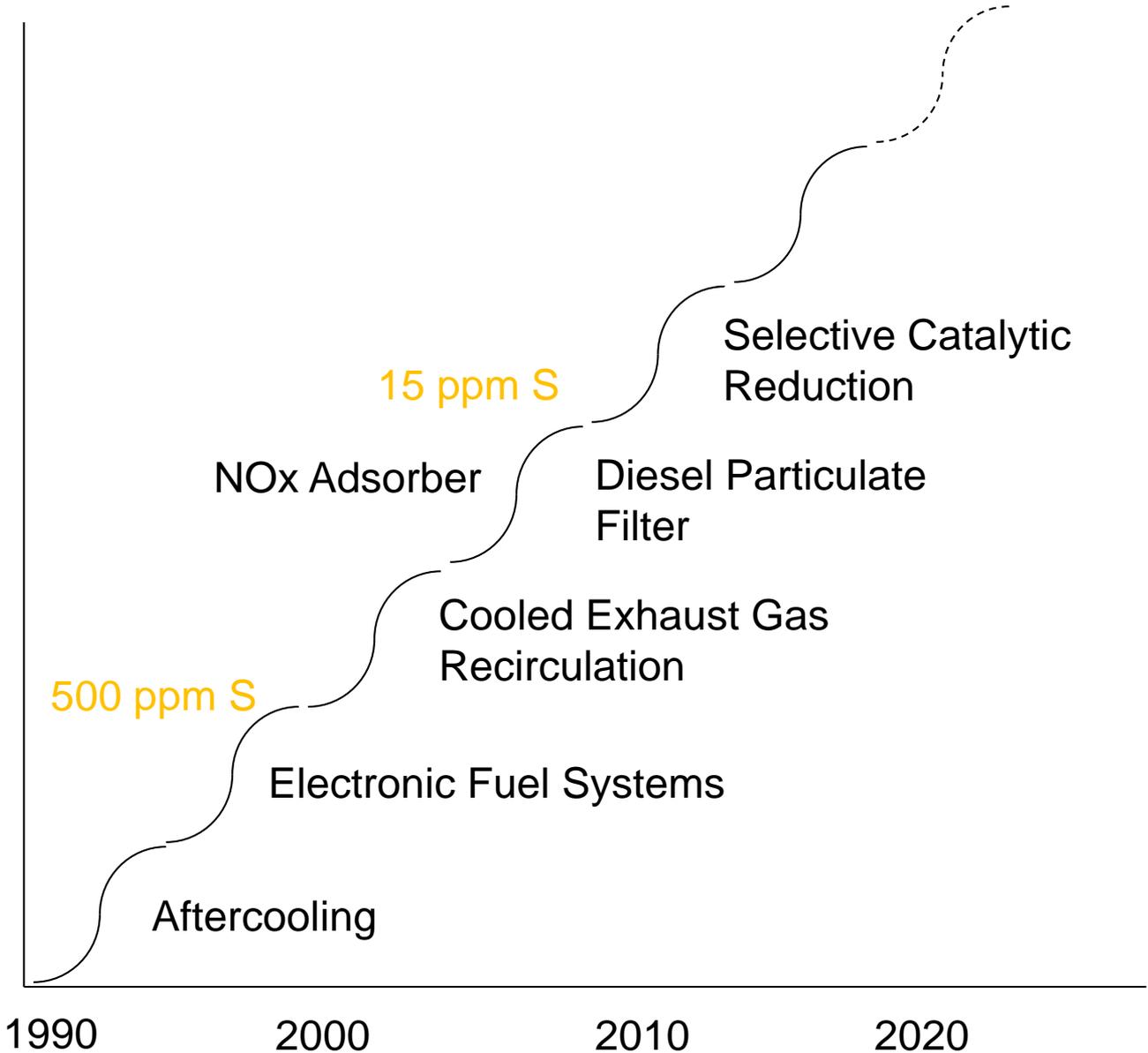
# Project EcoFlame



- Cummins Environmental Challenge Winner
- Deploying into 1000 residences in Nandal Village near Cummins Phaltan, India, manufacturing complex



# Evolution of Diesel Technology



# “The Right Technology Matters”

Match technology to market application

Application	First Date	In-Cylinder Only	Cooled EGR/VGT	NOx Adsorber	SCR	PM Aftertreatment
Tier 3 / EU Stage IIIA	2005	●				
EPA Tier 2 > 751 hp	2006	●				
Euro 4 On-Highway	2006				●	
EPA 07 On-Highway	2007		●			●
EPA 07/10 Pickup Truck	2007		●	●		●
Euro 5 On-Highway	2009				●	
EPA 10 On-Highway	2010		●		●	●
Tier 4 Interim / Stage IIIB	174-751 hp	2011	●			●
	75-173 hp	2012				





HEALTH  
EFFECTS  
INSTITUTE

RESEARCH REPORT

Advanced Collaborative Emissions Study  
(ACES): Lifetime Cancer and Non-Cancer  
Assessment in Rats Exposed to New-  
Technology Diesel Exhaust

## STUDY OF LIFETIME ANIMAL EXPOSURE TO NEW TECHNOLOGY DIESEL ENGINE EXHAUST **FINDS NO LUNG CANCER**

(Boston, January 27, 2015) The first study to conduct a comprehensive evaluation of lifetime exposure to new technology diesel exhaust (NTDE) has found no evidence of carcinogenic lung tumors...

In contrast to previous health studies of TDE, the ACES study found that lifetime exposure did not induce tumors or pre-cancerous changes in the lung and did not increase tumors related to NTDE in any other tissue...

Dan Greenbaum, President of HEI. **“These results confirm the great strides that government and industry have made to reduce diesel risk – and argue for even greater efforts to accelerate the replacement of older diesel engines.”**









Beijing, March 2015



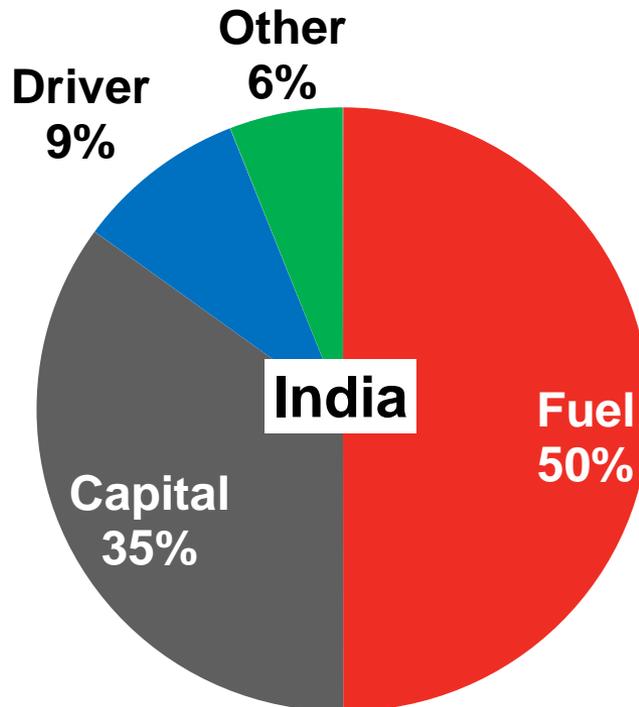
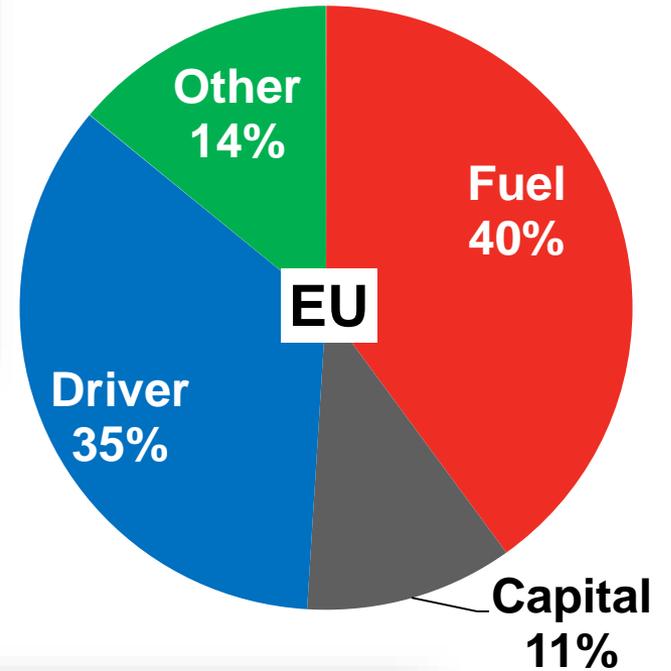








# Annual Truck Operation Cost Structure



# Service Environment

- Difficult (but creative!) work environment
- Highly skilled but illiterate mechanics
- High tech telecom





# 美国排放法规强制实施的演进

## Evolution of Emission Enforcement in US

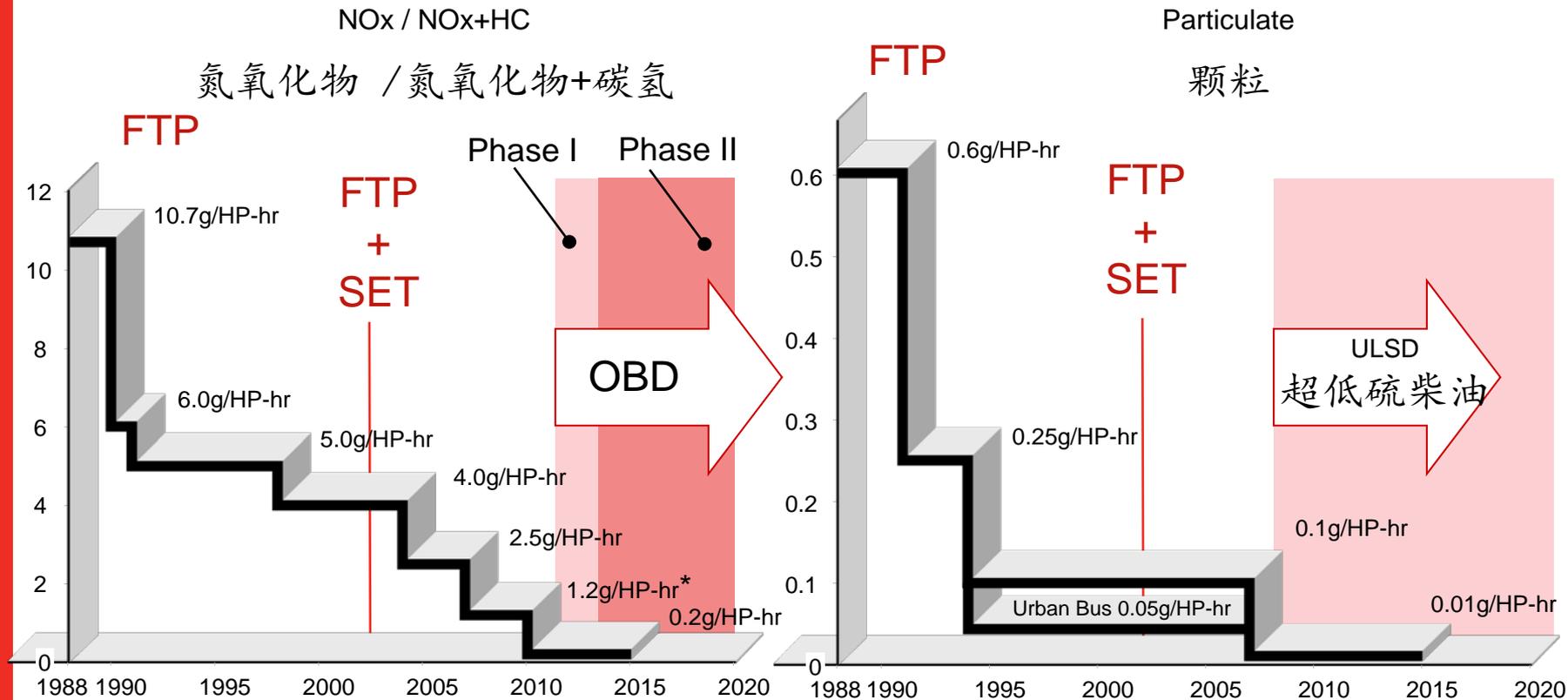
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副总裁- 首席技术官  
Vice President – Chief Technical Officer

康明斯公司  
Cummins Inc.  
Mar.27, 2015



# 美国清洁柴油机的演进

## Evolution of the Clean Diesel in US



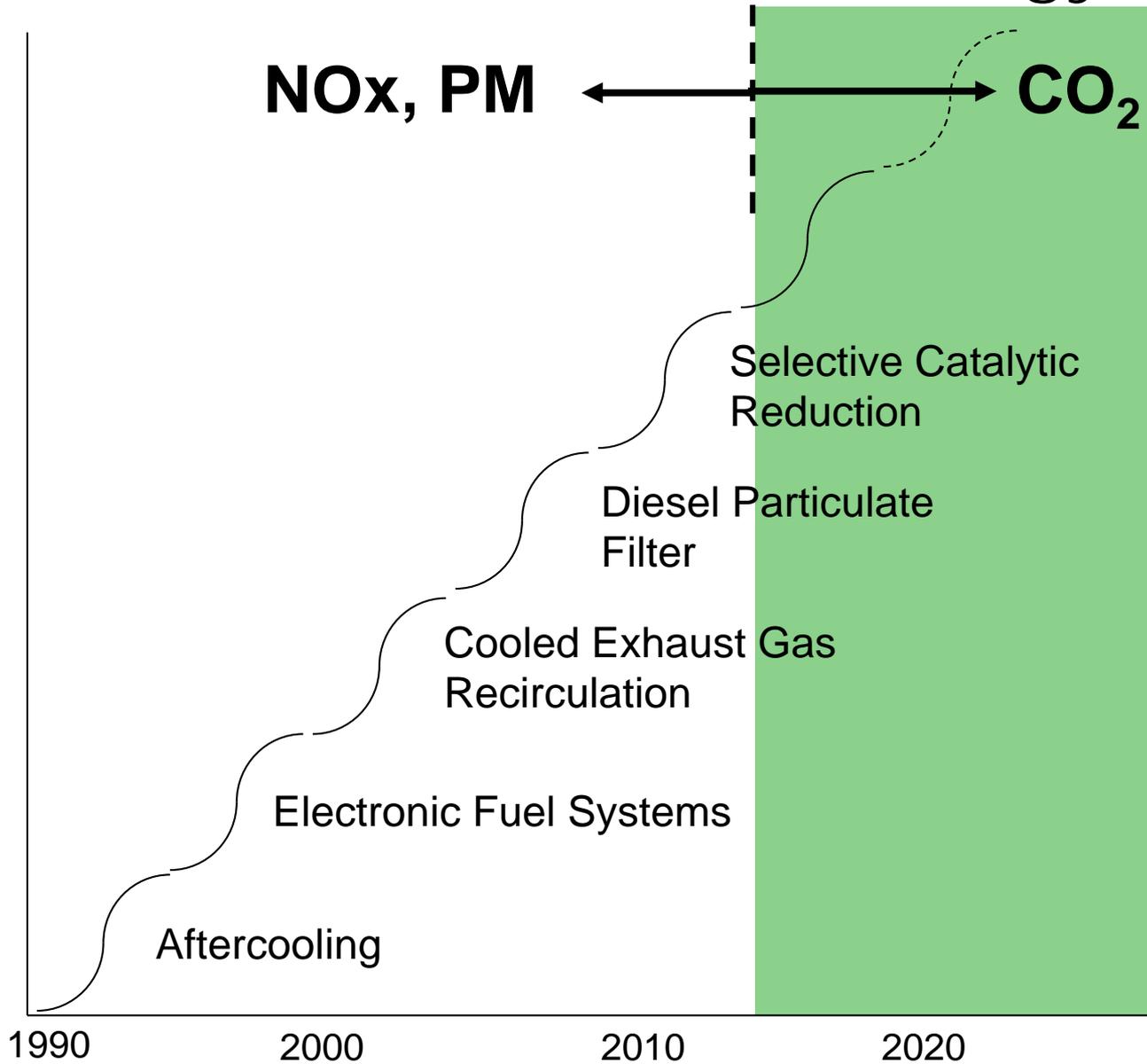
FTP- 瞬态测试循环 Federal Test Procedure  
 SET- 稳态测试循环 Steady-state Emission Test



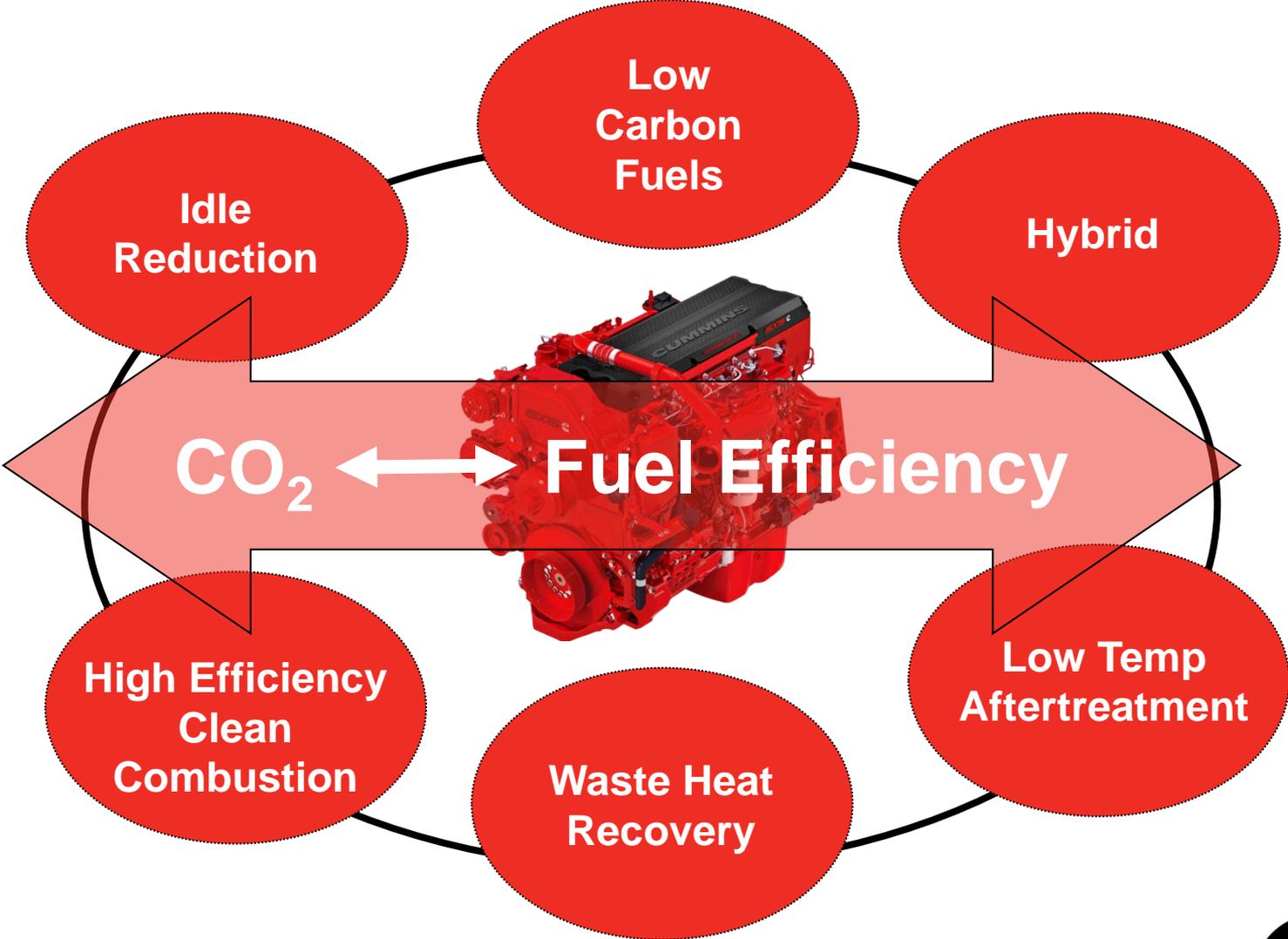
# Enforcement

- Emission standards must be enforced
  - Ensure environment really benefits from regulation
  - **Not just “punishment” → Fairness for all manufacturers**
    - “level playing field”
  - Everyone understands the rules

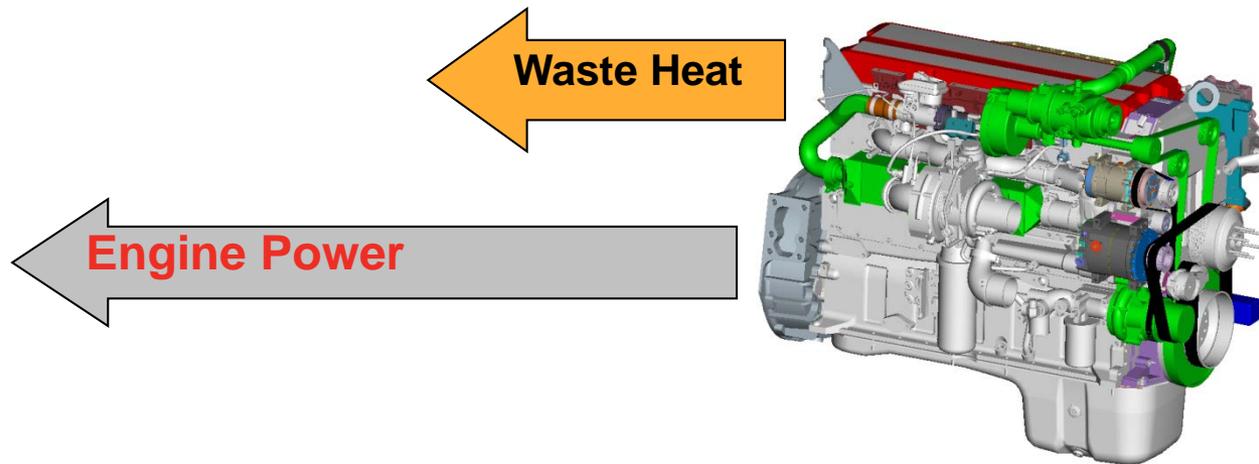
# Evolution of Diesel Technology



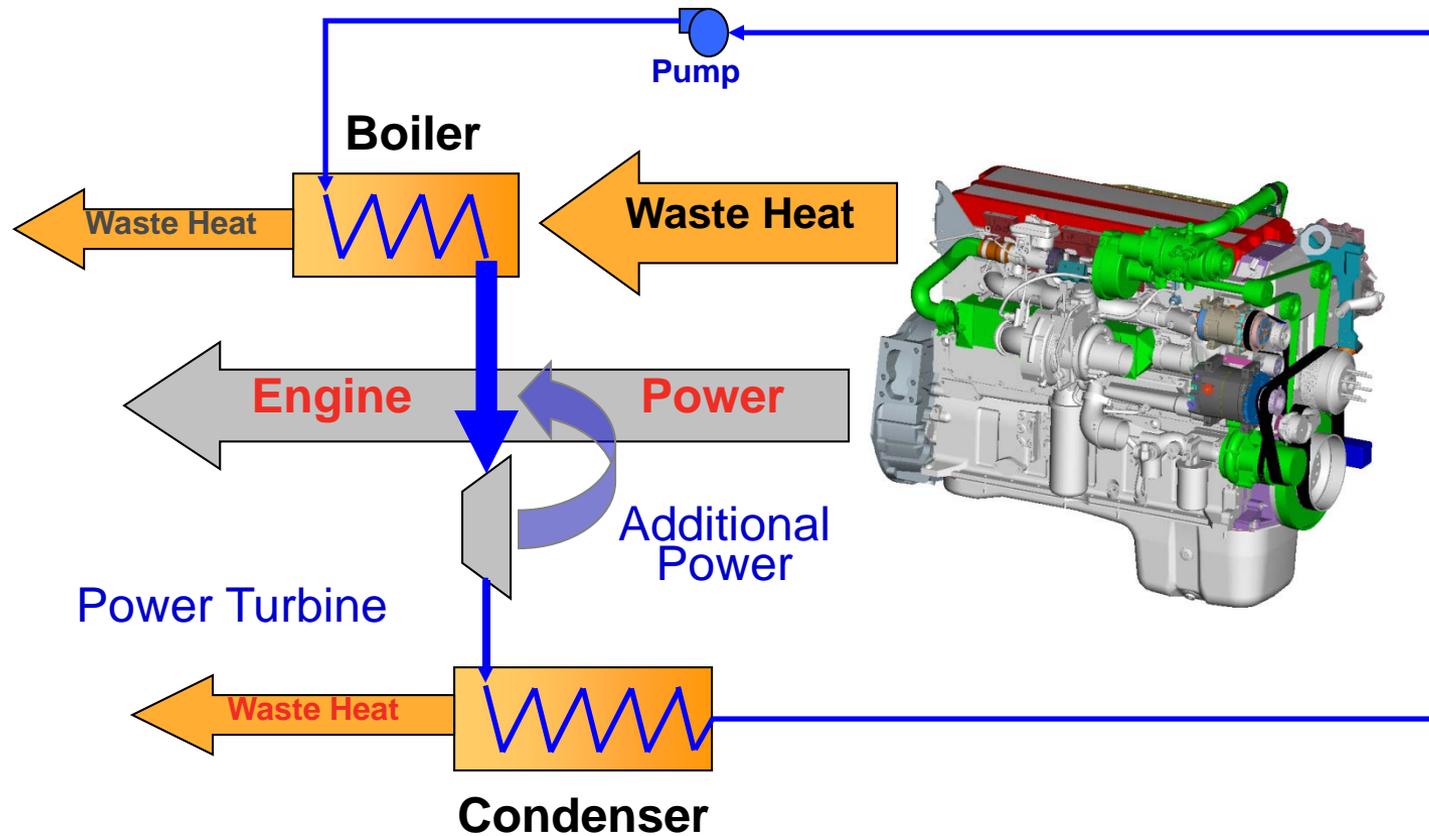
# Reducing CO<sub>2</sub>



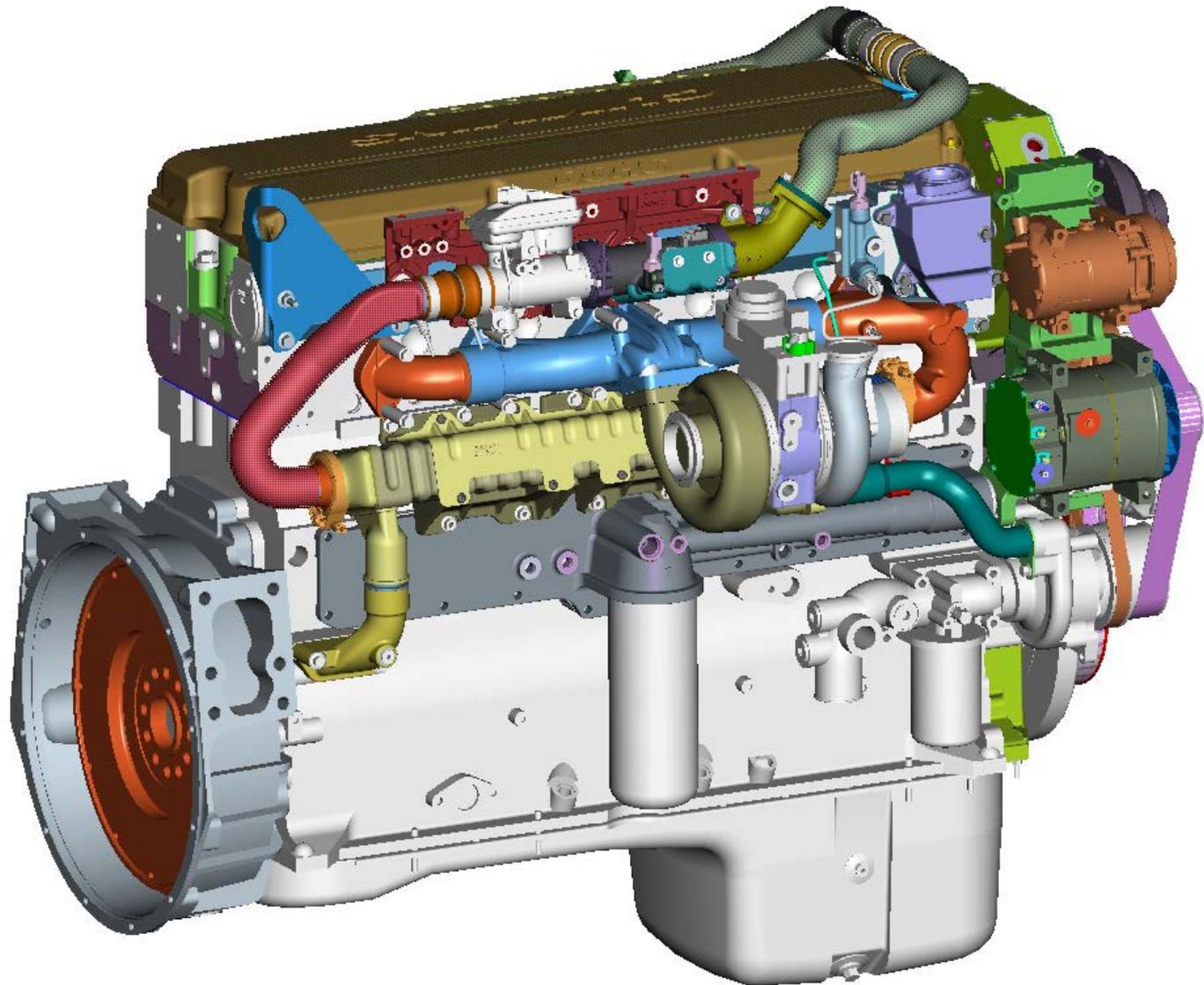
# Base Engine



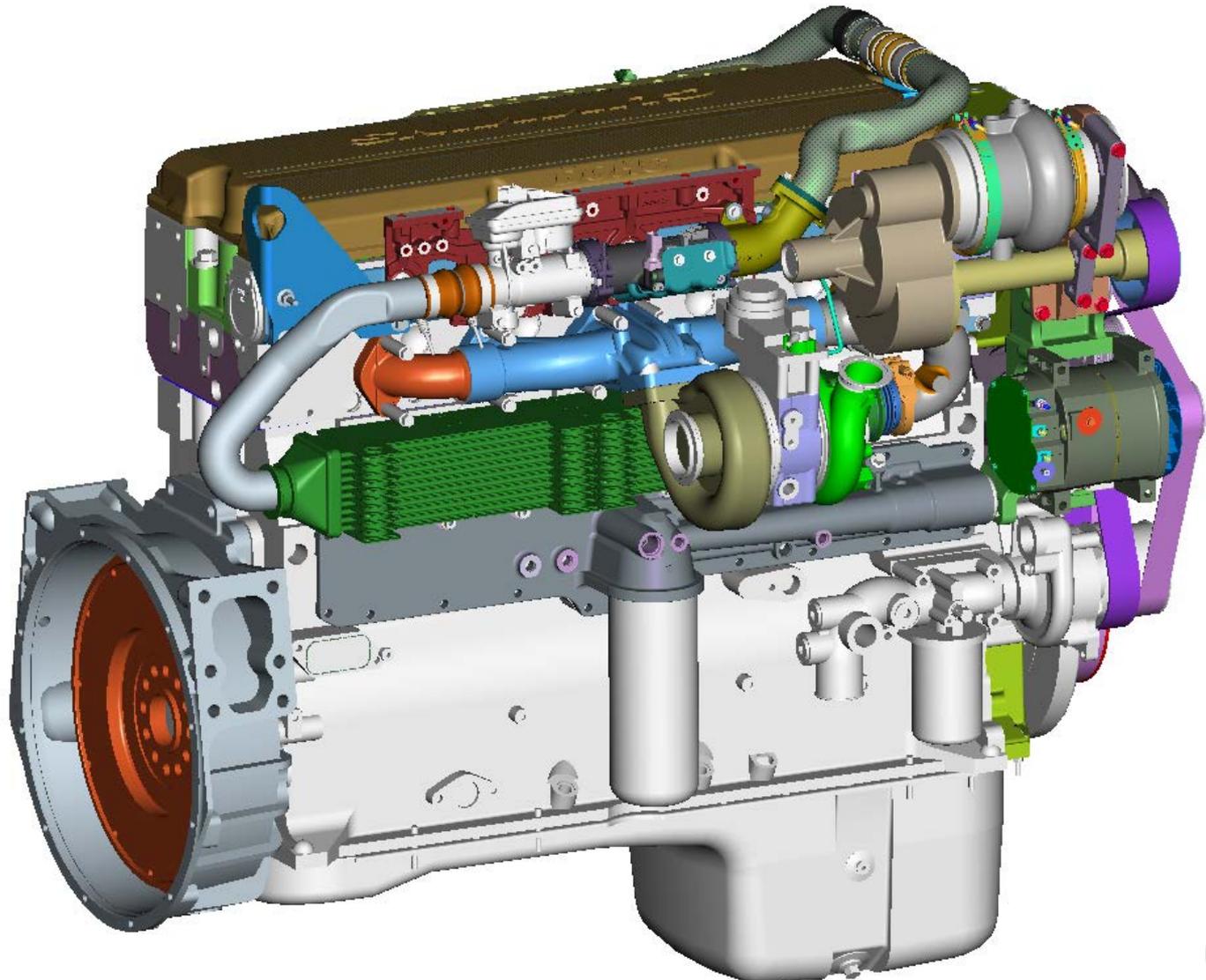
# Waste Heat Recovery



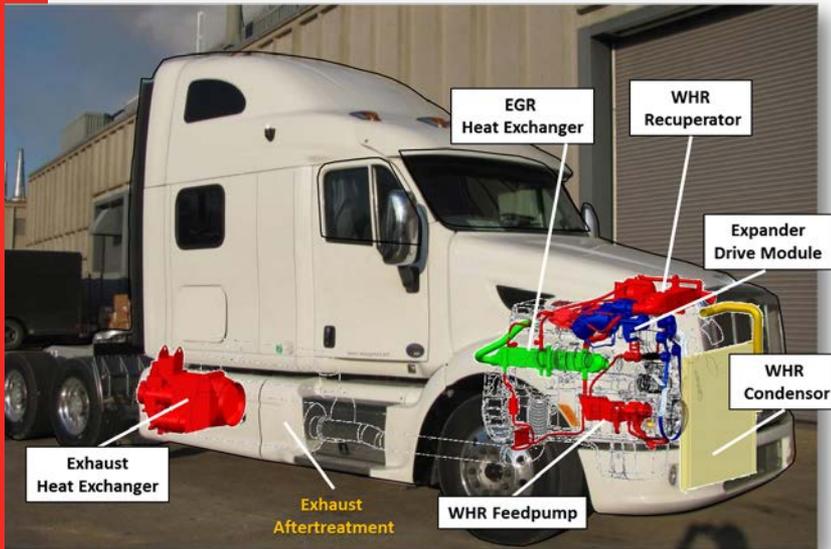
# ISX Engine with EGR



# ISX Engine with WHR



# Equivalent Aerodynamics

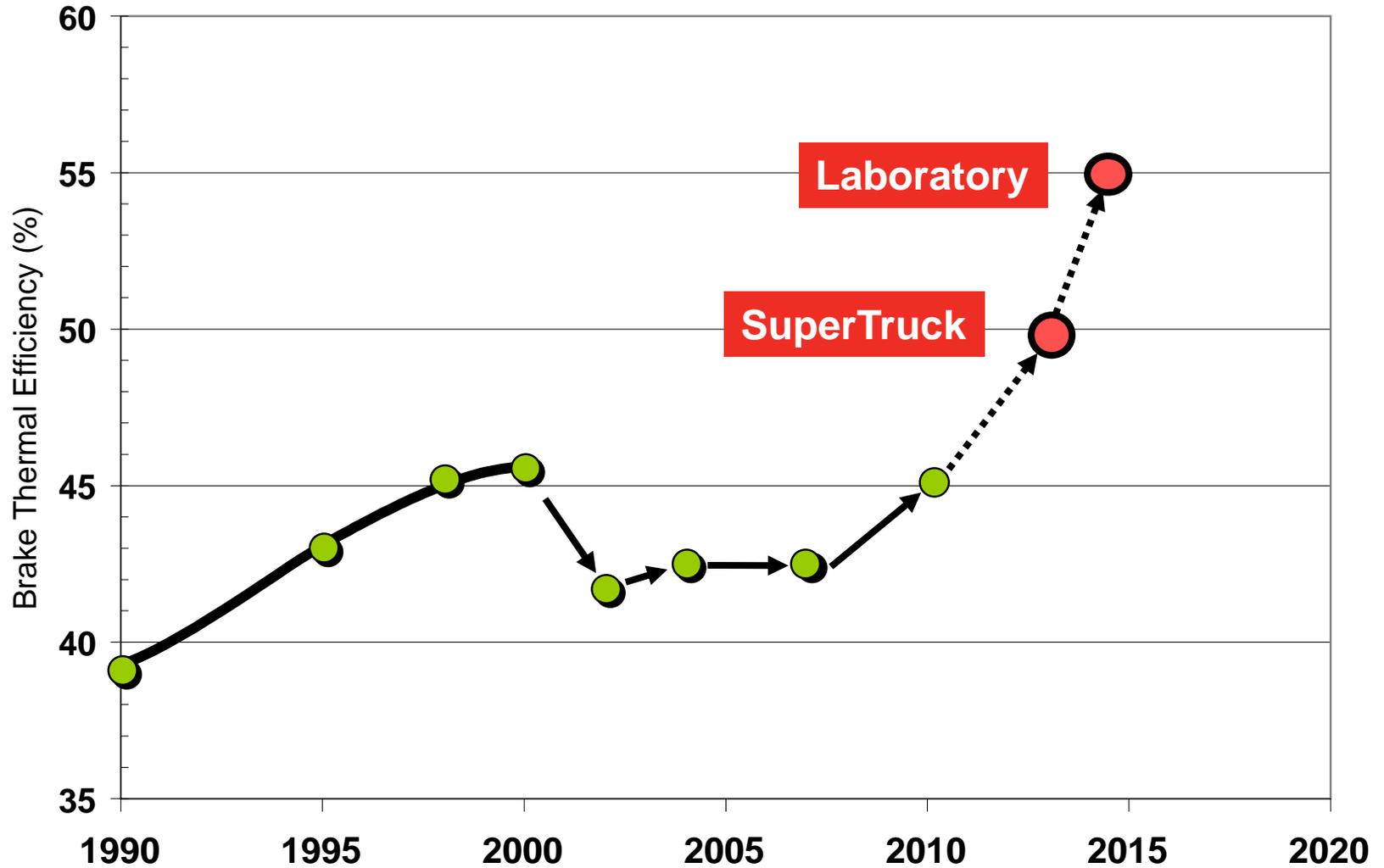


CMI WHR Current Architecture on Peterbilt Truck

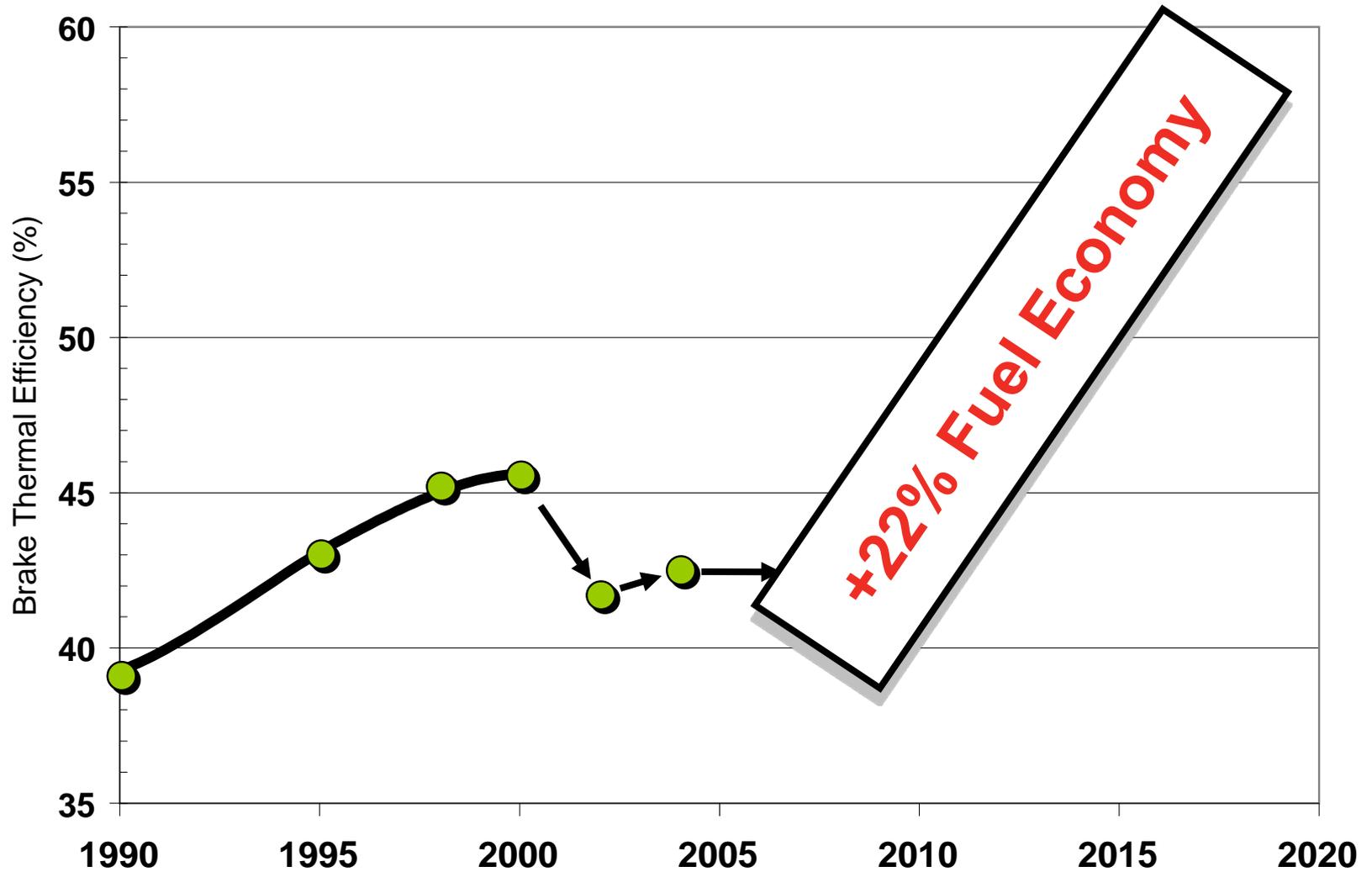


Walmart Advanced Vehicle Experience (WAVE)

# Heavy Duty Engine Efficiency



# Heavy Duty Engine Efficiency



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