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“2010 Diesel Engine Emissions Update”

Outline . . .

- Background on EPA Regulations
- Description of Technology Options (EGR/SCR)
- Tradeoffs for Each Technology
- Operating Costs/Fleet Experience
- Impact on Equipment Demographics

First Wave of EPA Regulations in '90s

- Transition from mechanically controlled, naturally aspirated engines to electronically controlled, turbo-charged diesels
- *"I wish the emissions regulations had come sooner."*
 - Don Dawson, Vice President of Maintenance, Roadway Express

EPA 2010 Emission Limits

(grams per brake horsepower per hour)

	<u>2004 (U.S.)</u>	<u>2007 (U.S.)</u>	<u>2010 (U.S.)</u>	<u>(Euro 6- 2013)</u>
NOx	2.5	1.2	.2	.27
PM	.1	.01	.01	.015

Two Technology Options

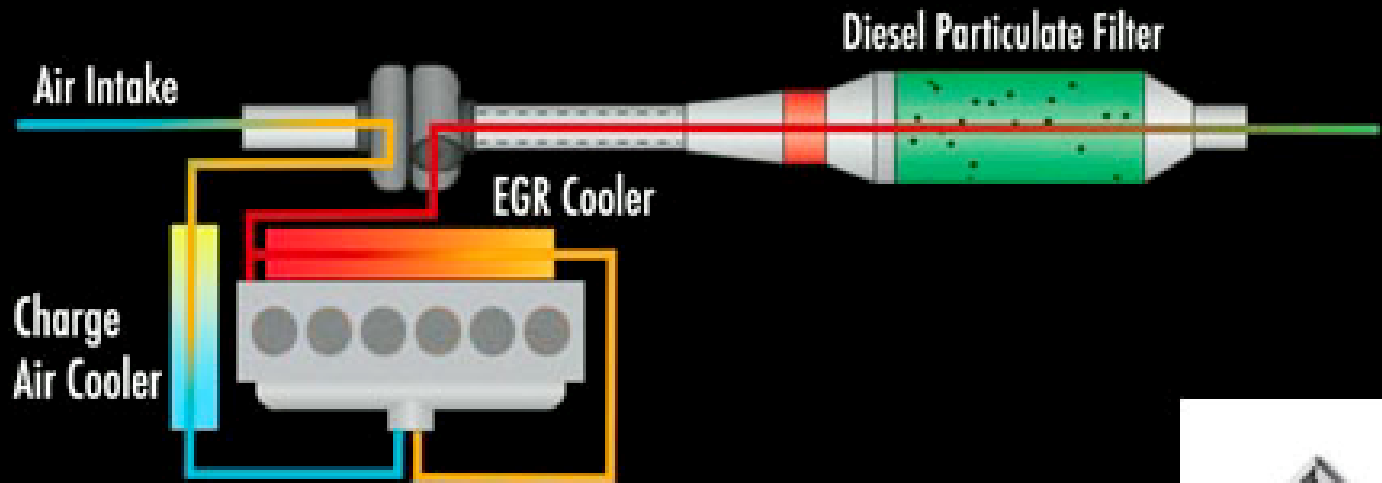
- Exhaust Gas Recirculation (EGR)
- Selective Catalytic Reduction (SCR)

EGR Offerings . . .

- Navistar/MAN 11 and 13-liter engines
- Navistar/Caterpillar 15-liter block

. . . For 15-liter, Caterpillar block for lower half of engine, Navistar for upper half and Navistar fuel system

Advanced EGR



SCR Offerings . . .

- Cummins
- Detroit Diesel
- Mack/Volvo
- Paccar
- Freightliner/Daimler
- Hino, Isuzu for mid-range engines

SCR/DEF System



Diagnostics Requirements Apply to Both EGR/SCR

- Applies to Diesel and Gas Powered Vehicles over 14,000#
- Applies to one horsepower rating within one engine family
- Service and repair information must be available to aftermarket
- “Useful life” of 435,000 miles or 10 years
- EPA recognizes sensor limitations
- ATA/TMC Recommended Practice 1210 *“Serial Communication Application Program Interface”* recognized by EPA as acceptable protocol for diagnostics

EGR/SCR Tradeoffs . . .

EGR "Considerations"

- Proven technology . . . albeit at lower concentration level
- No DEF (urea) to carry on-board the vehicle
- No urea infrastructure to worry about
- Some additional hardware (40 VMRS codes)
- Simplicity in design
- Lower combustion temperatures can rob engine of power
- Regeneration cycle and DPF cleaning remain the same

SCR "Considerations"

- Cost premium of \$9,000 to \$10,000
- 3 to 5% better fuel economy from 2007 engines
- Additional weight of 400 to 500 lbs.
- SCR systems take up a lot of space
- More complex design (160 VMRS codes)
- DEF quality must be maintained at 32.5% urea and 67.5% de-ionized water per ISO standard

Fleet Experience/Operating Costs

- Need 400,000 to 500,000 miles for fleet comfort
- Up-front capital costs of 2 cents per mile if employing 500,000 mile trade-in cycle
- European truck maker imposing \$40 per truck per month under “contact maintenance” agreement
- Diesel engines are like software . . . it pays to buy the second release
- 2002/04 engines . . . 4 to 8% fuel penalty
- 2007 engines . . . another slight fuel hit
- 2002-07 . . . B-50 life decreases from 1.3 million miles to 900,000 miles

European Experience

- Germany provided financial incentives for Euro V in favor of SCR
- United Kingdom did not provide any financial incentives
- Larger market forces at work . . . OEMs want to consolidate and standardize engine platforms

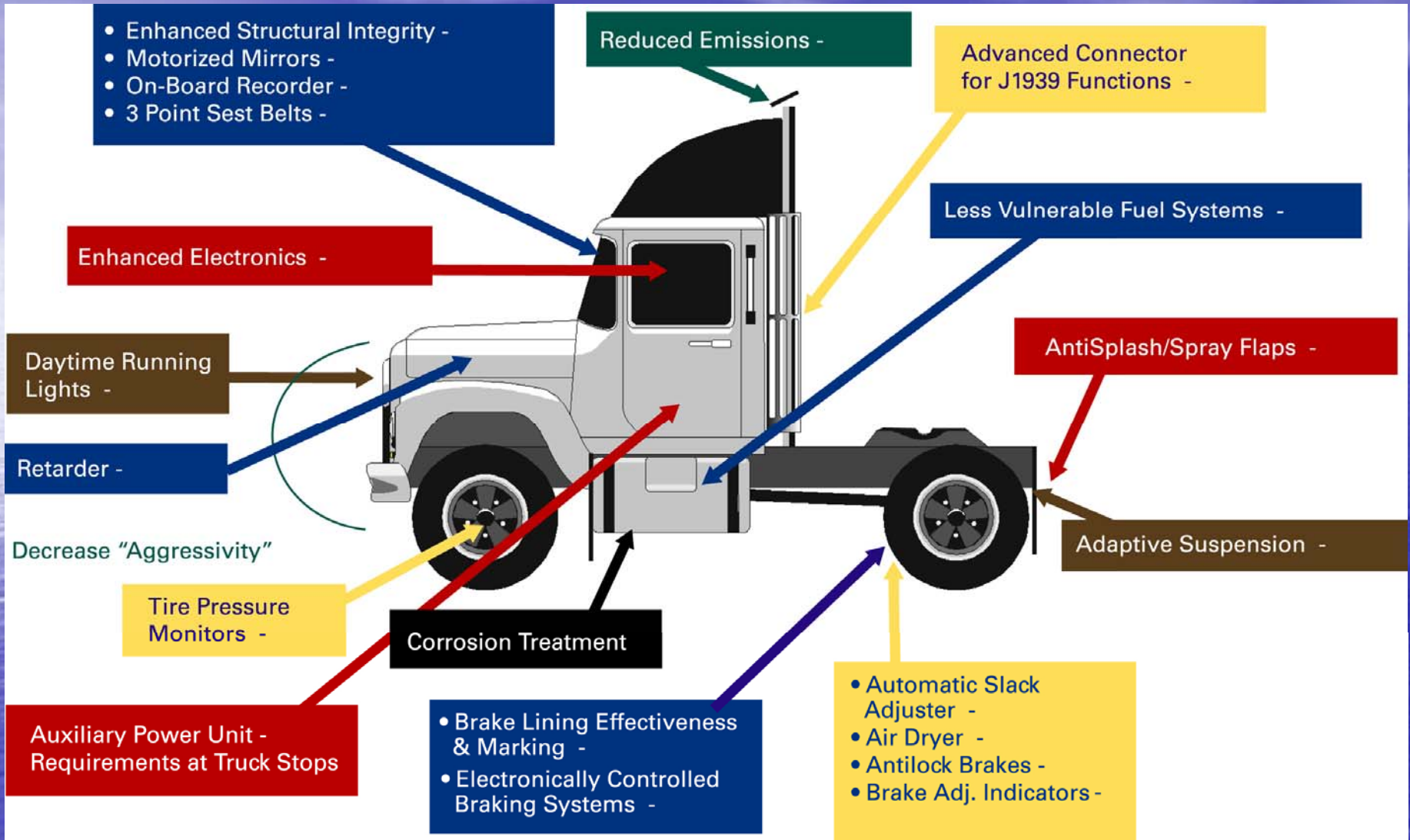
Pre-buy? No!

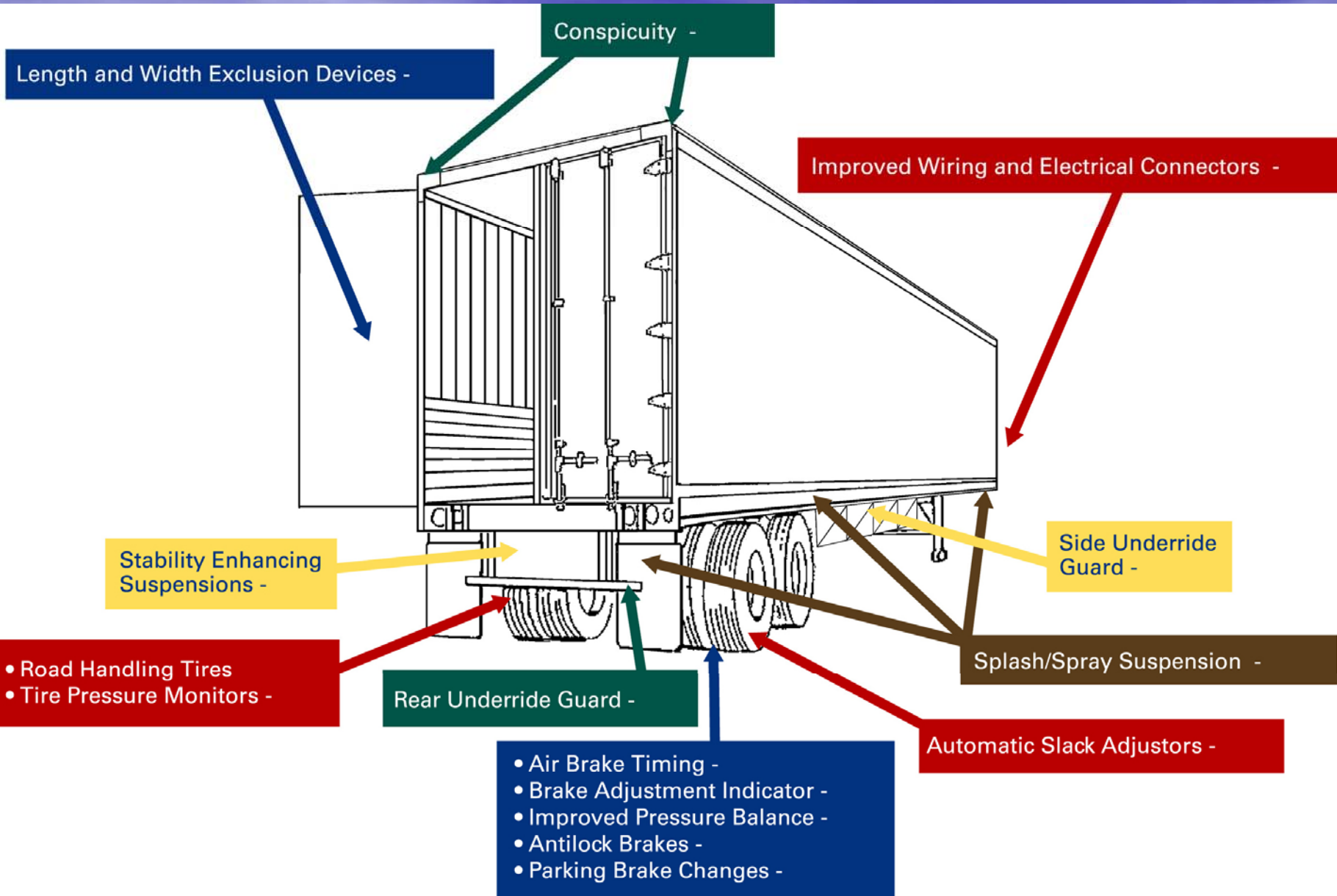
. . . result = an aging fleet

- Major investment bank survey reports and confirms no pre-buy
- Historical fleet average = 5.9 years
- At end of 2009, average age = 6.4 years
- At end of 2010, average age = 6.61 years, the oldest on record

Maintenance Cost Trends . . .

- Maintenance Costs:
- ½ cents per mile when placed in service
- 1.8 cents per mile after 2 years
- 3.6 cents per mile after 4 years
- 6.5 cents per mile after 6 years





Thank You Very Much
for
Your Attention!

Questions?

