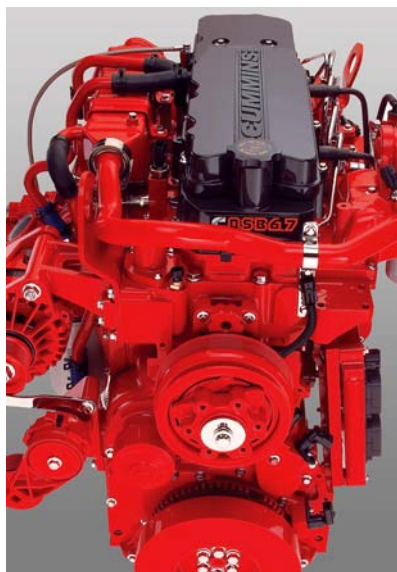




Cummins

Emissions Regulations and Technologies

April
2014



History of Regulation and Technologies



Government Regulations

+

Customer Needs

Product Design

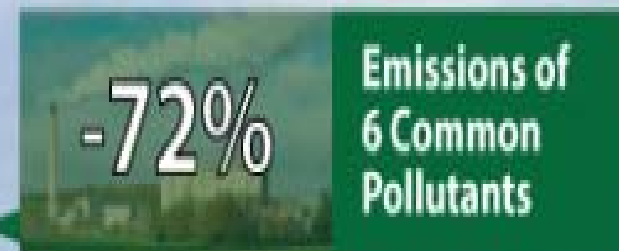
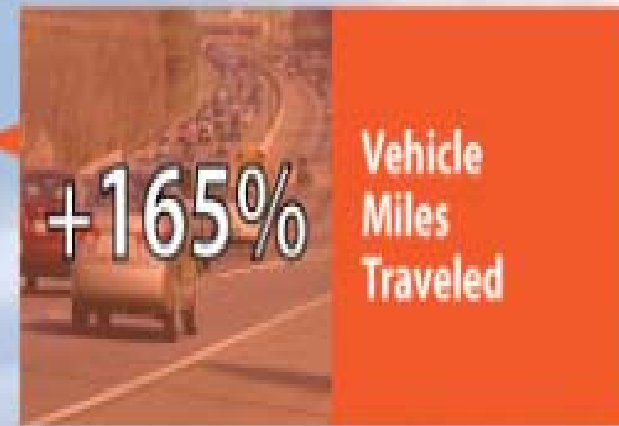
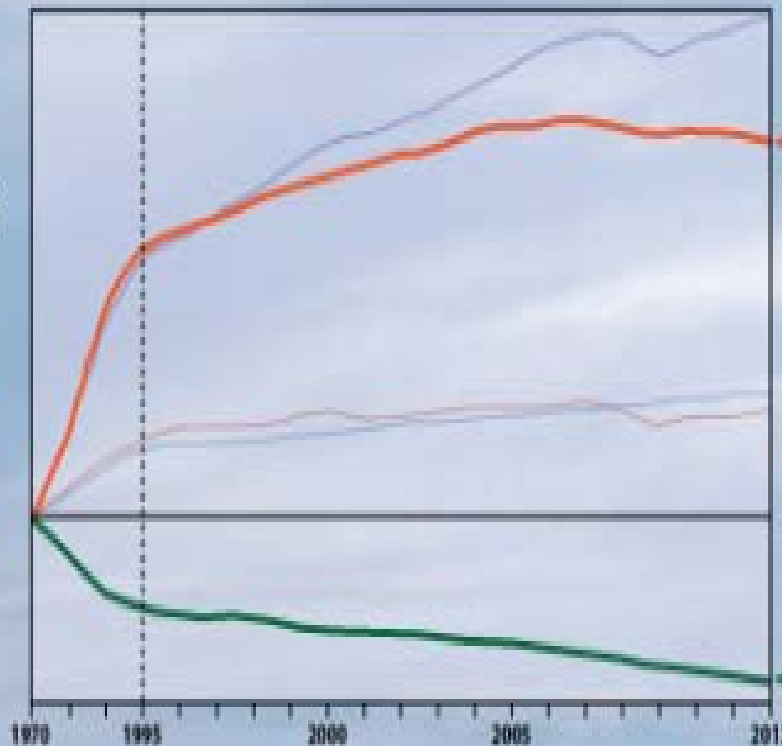


What Drives Emissions Regulation?

- Public opinion – green mindset
 - Climate change
 - Environmental concerns

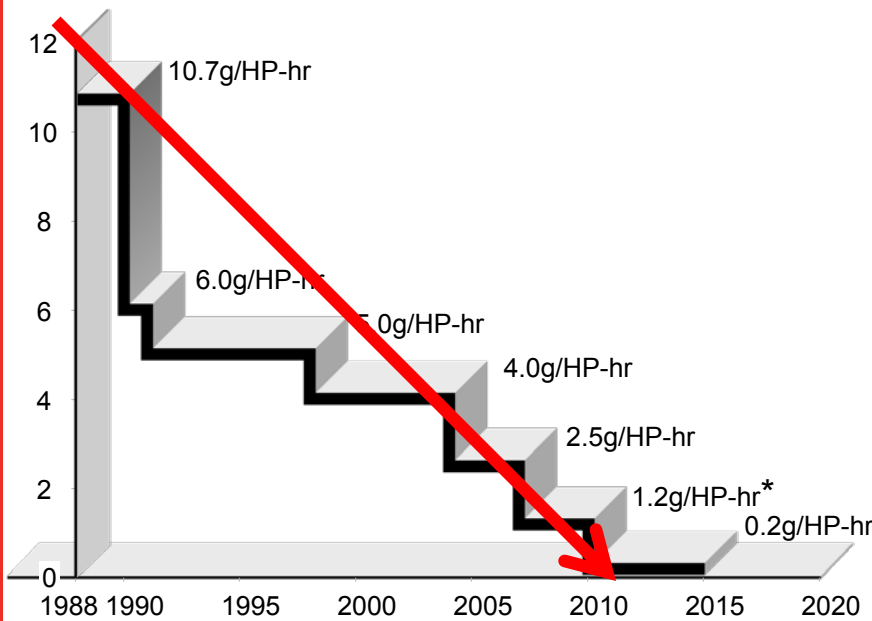
Experience with the Clean Air Act since 1970 has shown that protecting public health and building the economy can go hand in hand

1 2 3 4

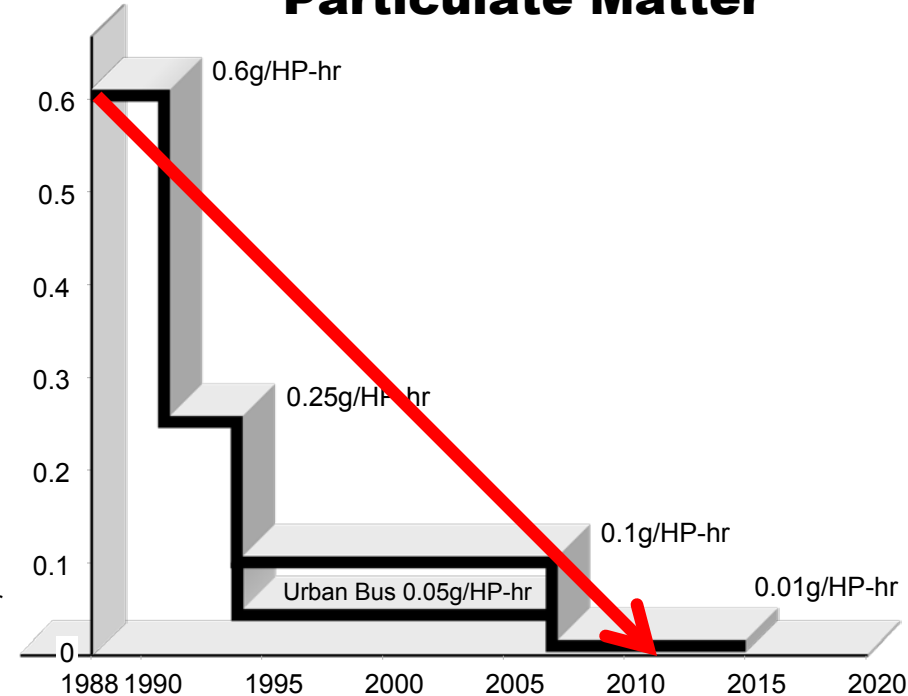


EPA Diesel Emissions Legislation

NOx / NOx+HC



Particulate Matter

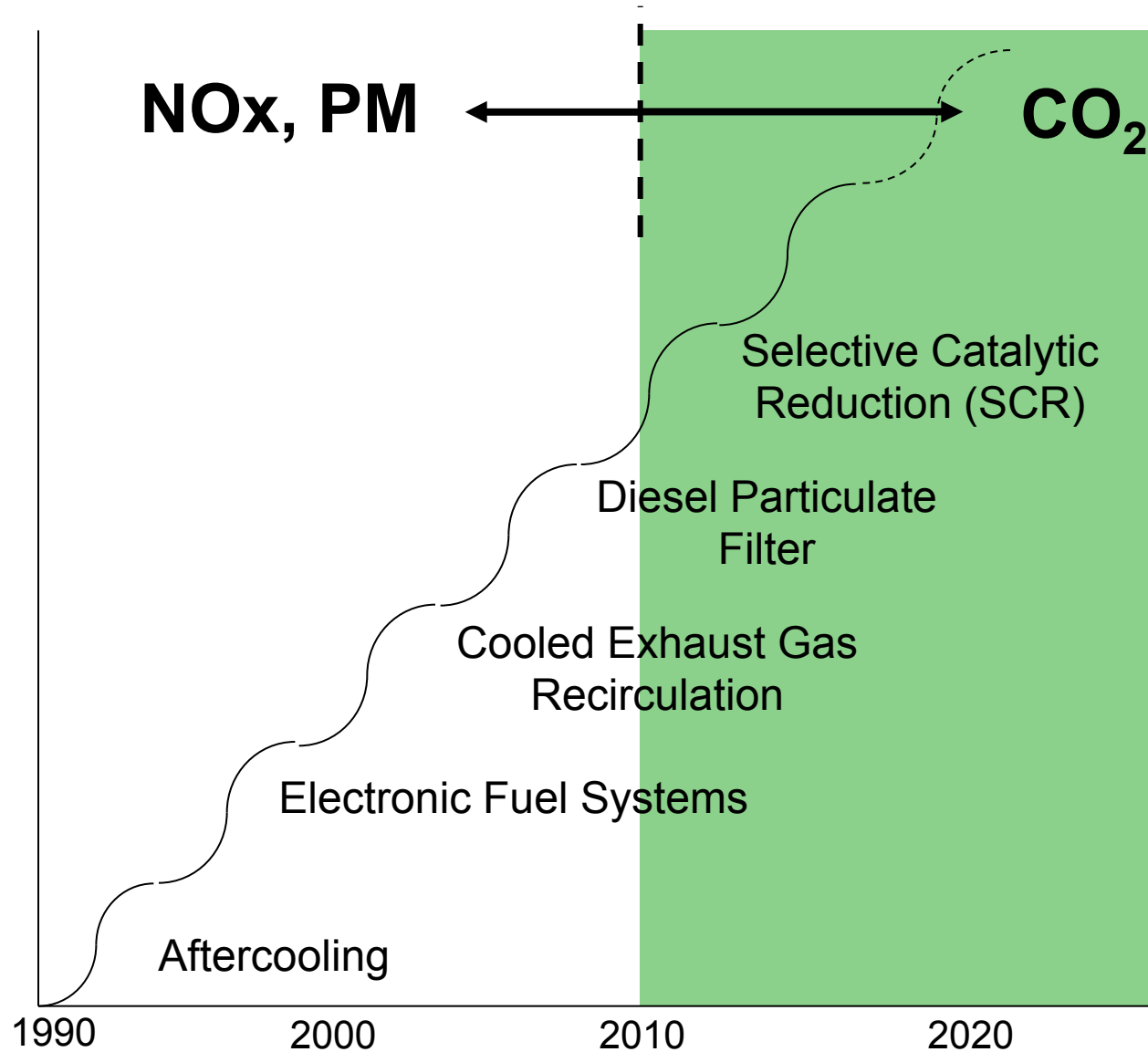


* Phase-In Average

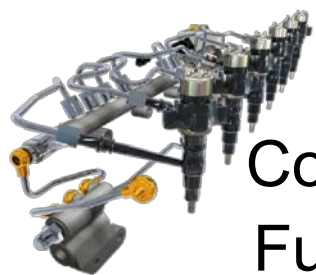
Near Zero
Emissions



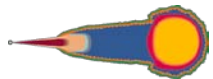
Evolution of Technology



Innovation Through Technology Integration



Combustion & Fuel Systems



Air Handling & EGR



Aftertreatment



Electronic Controls



Energy Recovery



Transmission Integration



Examples of Customer Benefits

- More horsepower from the same package
- Increased reliability
- Better engine control (fire pump governing)
- Enhanced diagnostics (diagnostic codes)
- Operational information (trip information)



Upcoming Regulation



Upcoming Regulation

- EPA 2017 regulations are finalized
 - Greenhouse Gas (GHG) reduces CO2
 - Further fuel economy improvements
 - On Board Diagnostic (OBD) ensures clean operation
 - Assists technicians in troubleshooting
 - Improved reliability

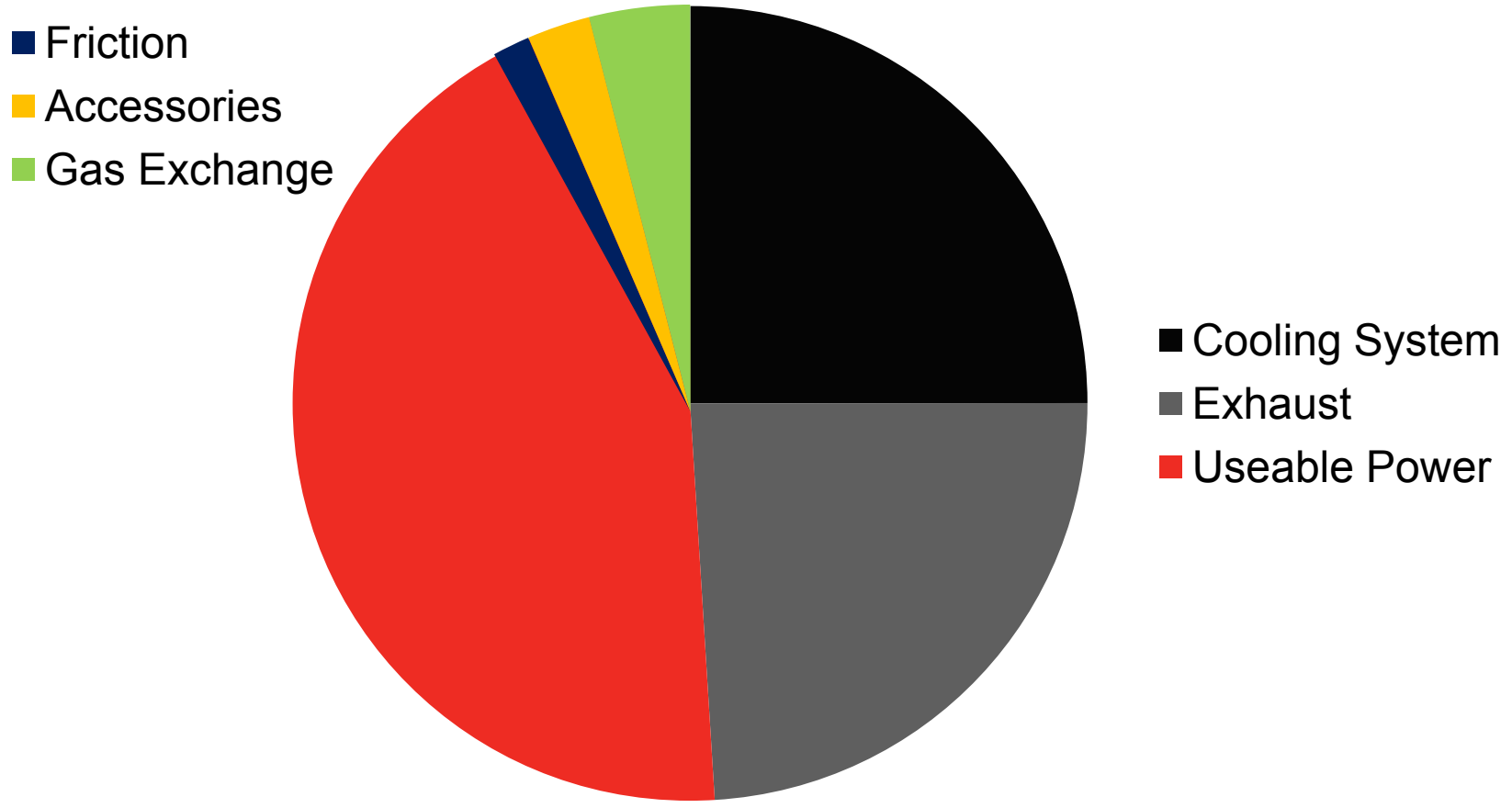
- EPA 2020 regulations are being drafted (GHG)
 - 2014 Framework established
 - 2015-2016 Comment period
 - 2016 Rule finalized



The Future



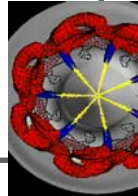
Energy Conversion



Potential Technologies to Enable Greater Efficiency

Combustion & Air Handling

- Piston bowl size and shape
- Injector specification
- Calibration optimization
- Turbocharger efficiency
- Aftertreatment optimization



Heat Recovery

- EGR, exhaust, recuperation
- Turbine expander
- Low GWP refrigerant



Parasitic Reductions

- Cooling and fuel pump power
- Shaft seal
- Variable flow lube pump
- Low viscosity lubricant
- Geartrain
- Cylinder kit friction



Other trends

- Rear Engine PTO
- Lightweighting
- Space saving technology
- Telematics/Data Analysis
- Electrification



Customer Needs
+
Government Regulations

Product Design



Questions?

