

Heavy Duty Vehicles- Engine fuel efficiency and emissions technologies for India



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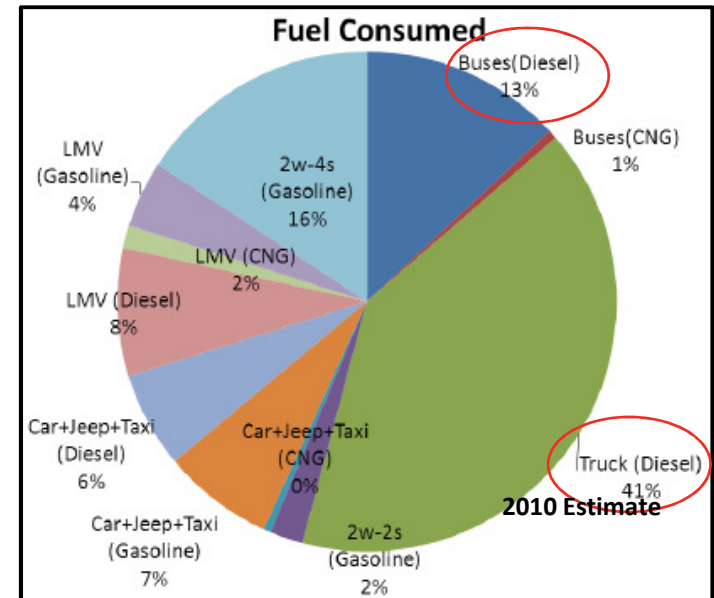
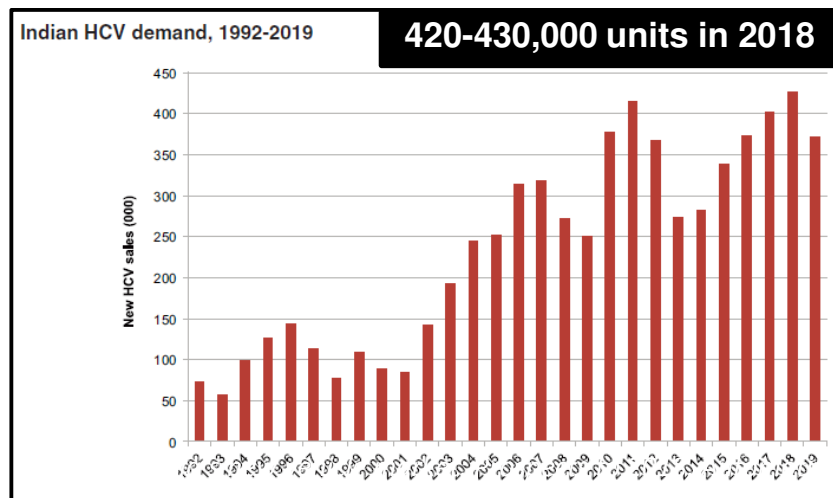


Outline

- Importance of the Heavy Duty Transportation Sector
- Technology Opportunities—USA SuperTruck Program
- Heavy Duty Vehicle Technologies for India
- Socio-Economic Factors
- Recommended Technology Scenario for India
- Summary

Importance of HD Transportation in India

- Heavy Duty Transportation Sector accounts for ~ 55% of total energy consumption
- The sector accounts for following transportation needs nationally
 - 60% of total freight movement
 - 80% of total people movement



Source-<http://shaktifoundation.in/wp-content/uploads/2014/02/Developing-pathways-for-fuel-efficiency-improvements-in-HDV-sector-in-India.pdf>

- One of the growing sector in India with a projected CAGR of 10.3% from 2014-18 → Critical from environment- energy security perspective



What Does the Customer Want: Now and Future?



FIT FOR MARKET (FFM) Themes

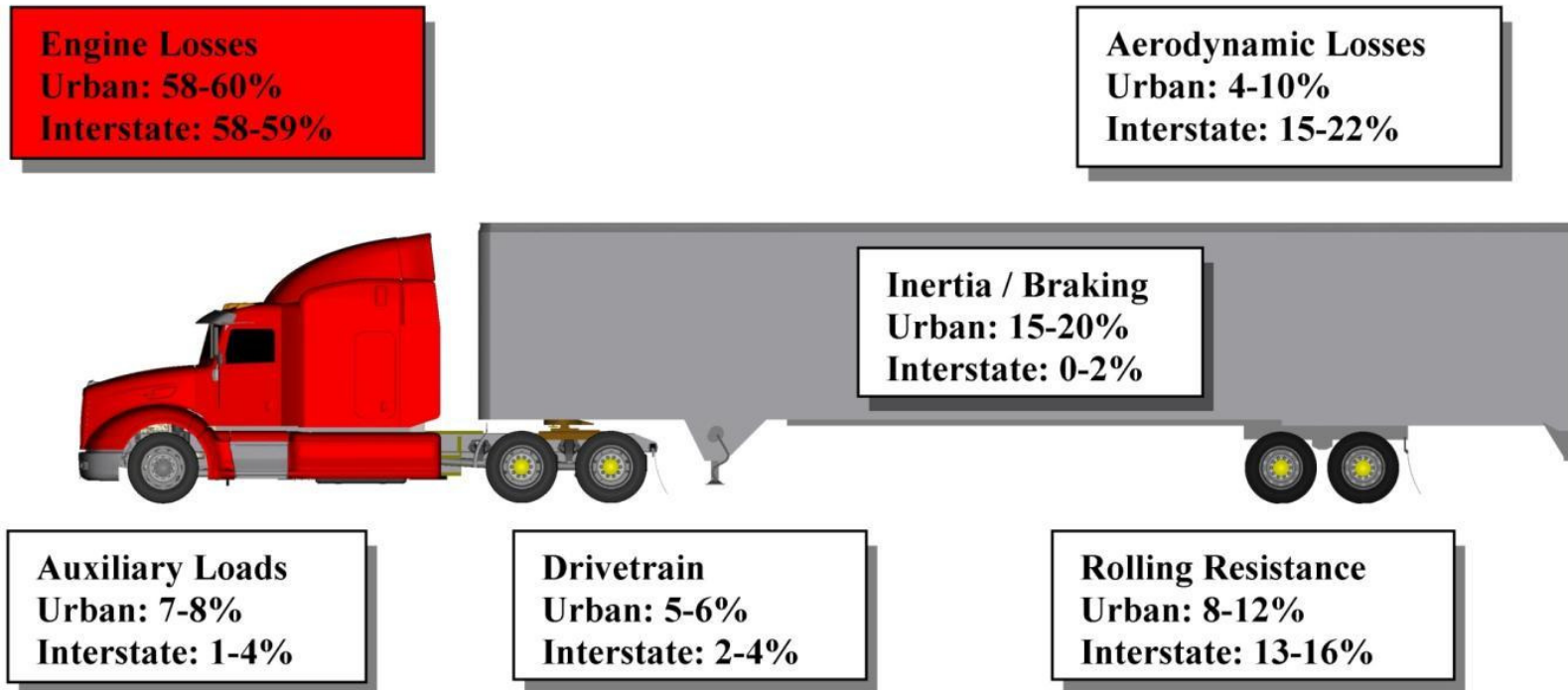


Prioritized customer requirement (Current View)

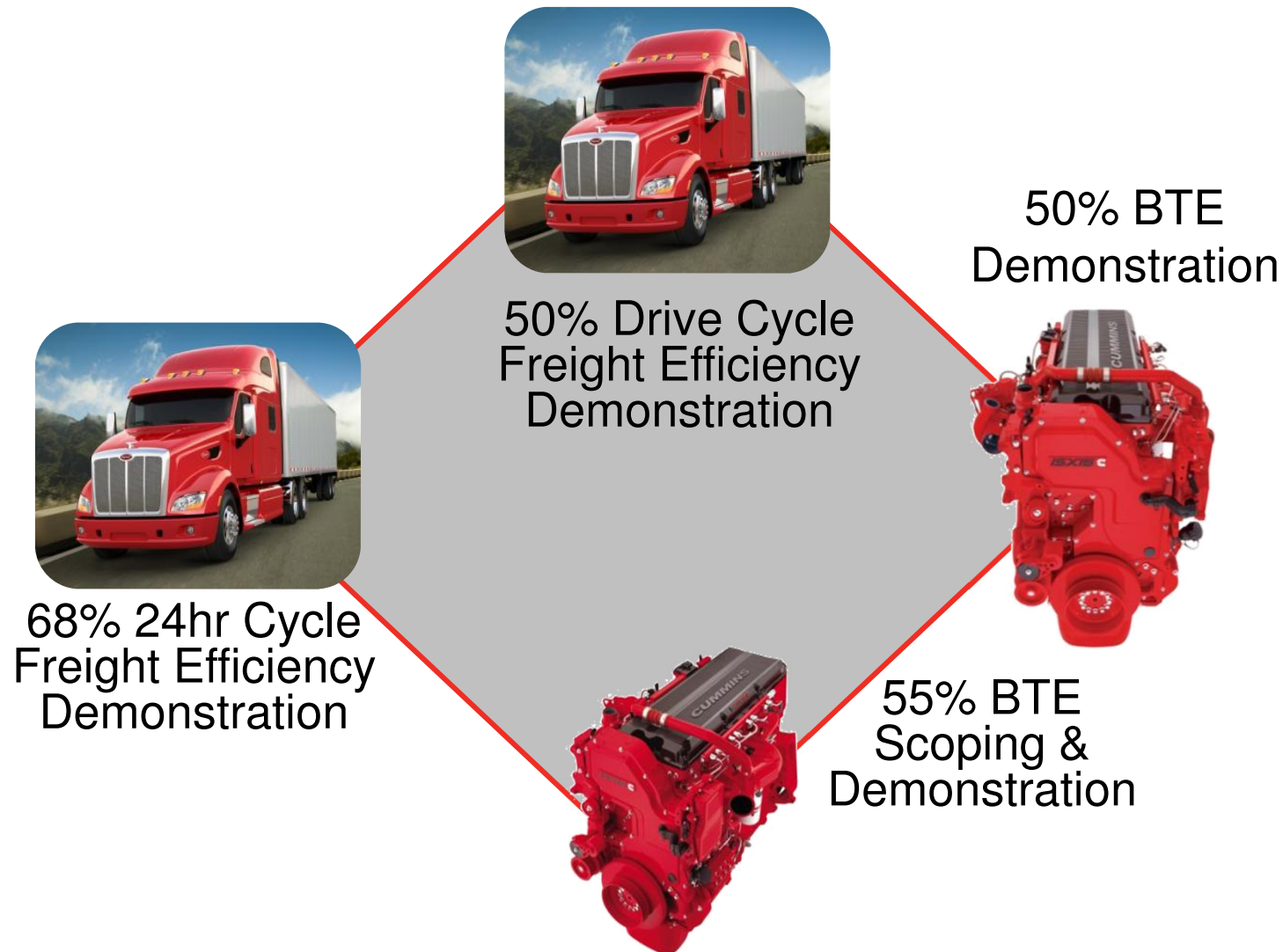
Total Cost of Ownership (TCO)

- Total cost of ownership (TCO)- a key consideration of current and future Indian consumer; Consists of product initial cost and operational cost
- Fuel cost accounts for up to 50% of total operational cost for a typical fleet owner → Significant constituent of total cost of ownership is product efficiency
- Technologies developed globally can be applied in India to leapfrog to high efficiency vehicles

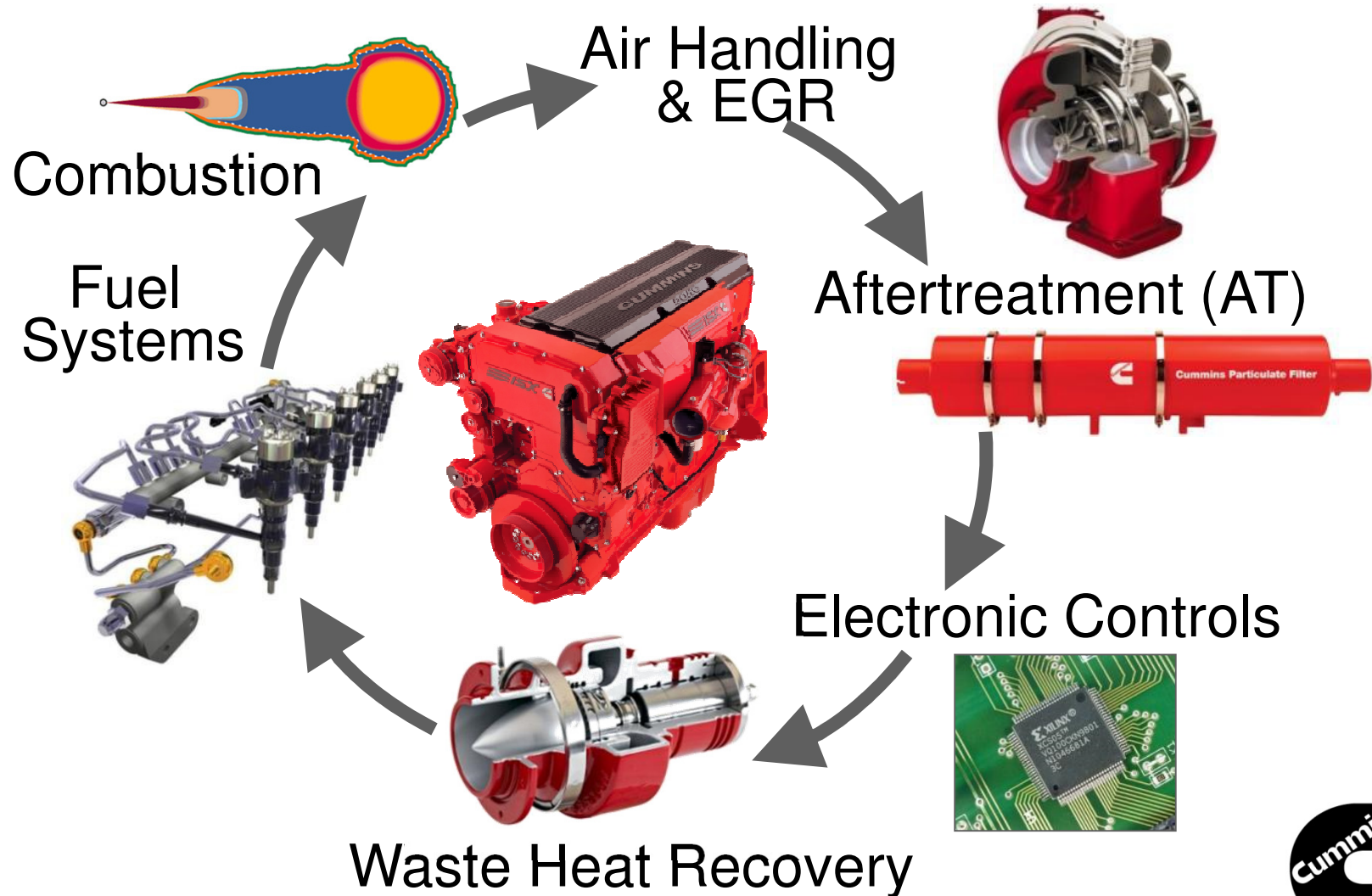
Super Truck Exploratory Research Program for Demonstrating Breakthrough Technology



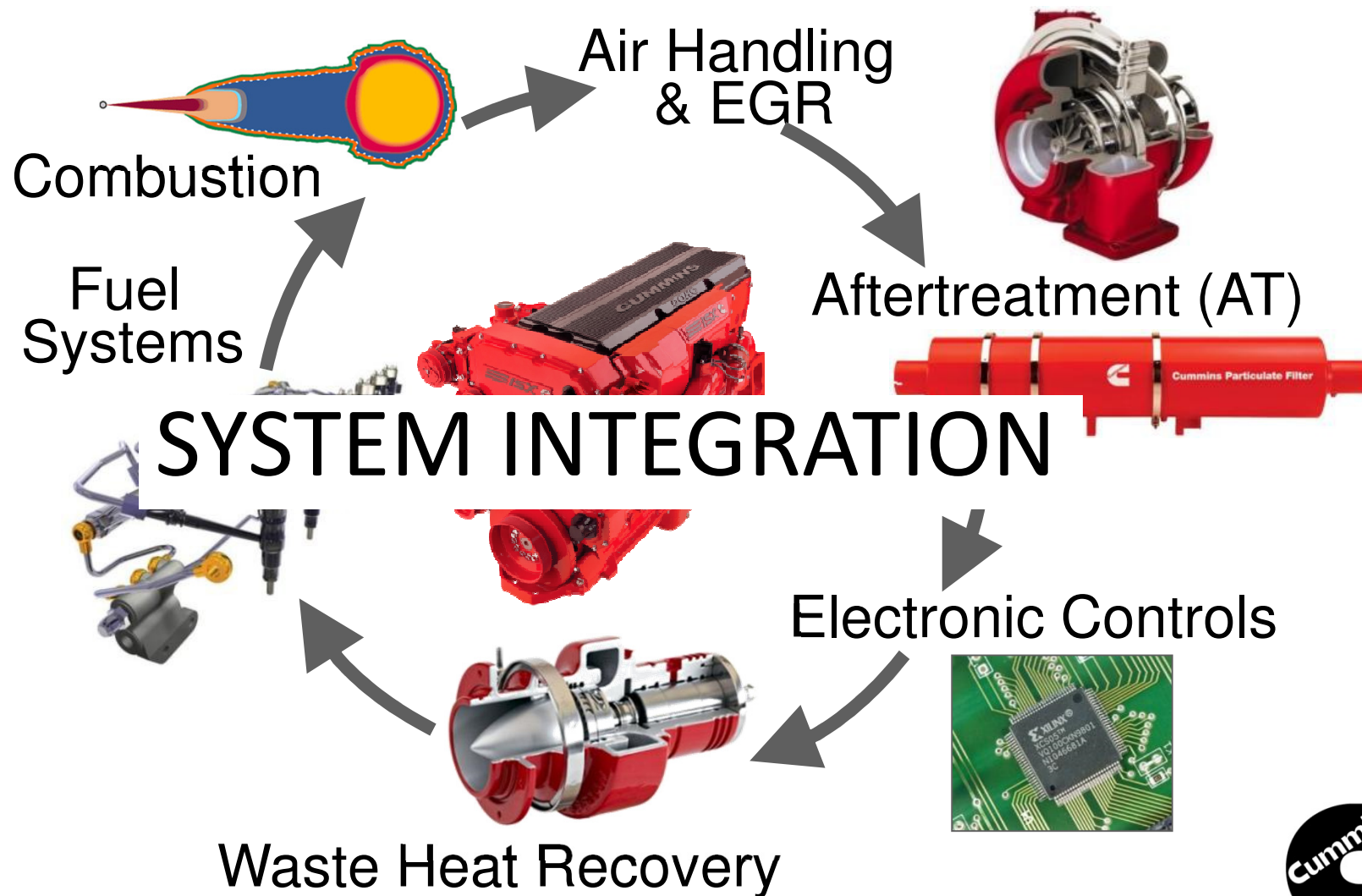
U.S. SuperTruck Program



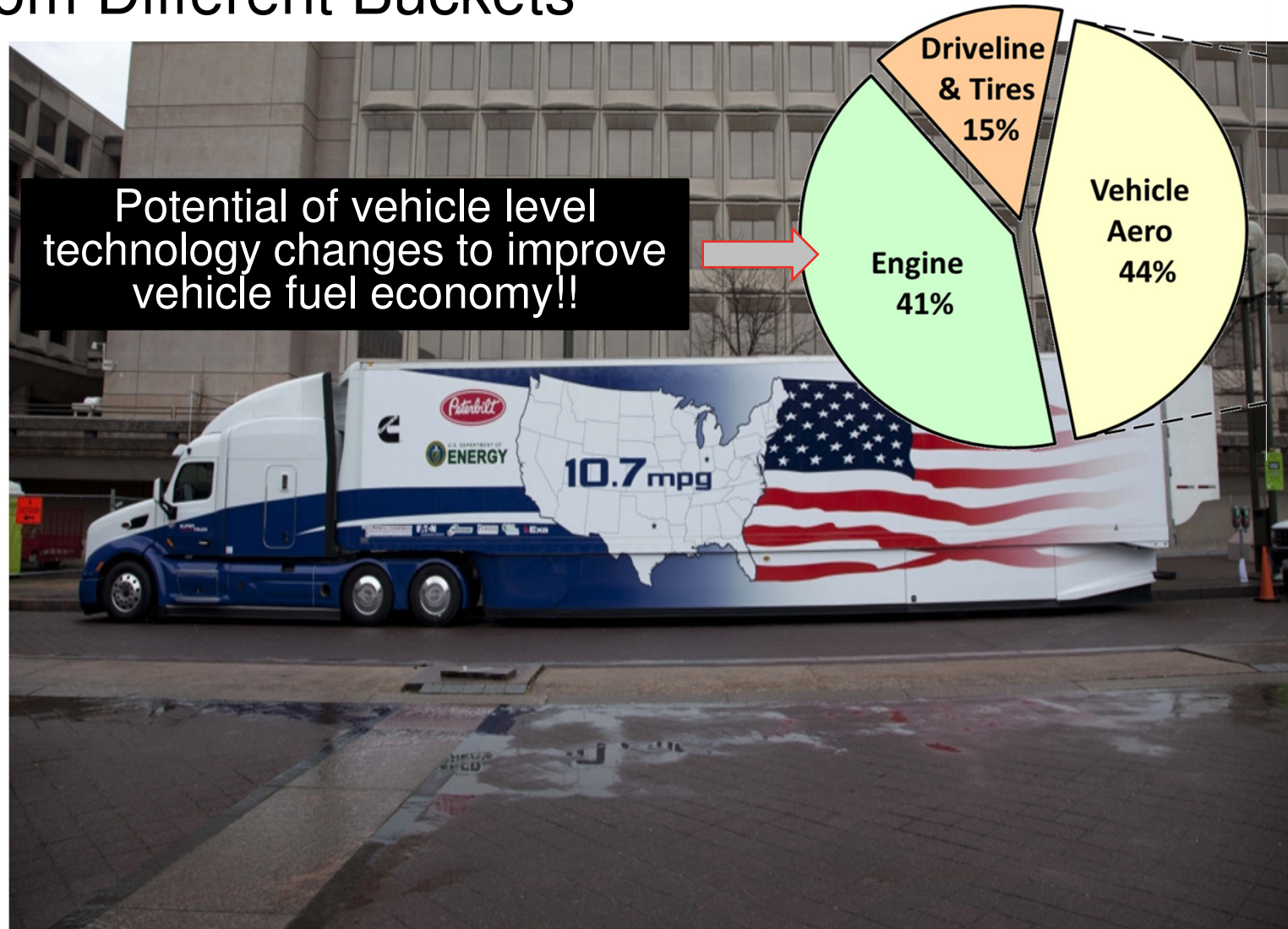
Cummins Component Technologies Integration



Cummins Component Technologies Integration



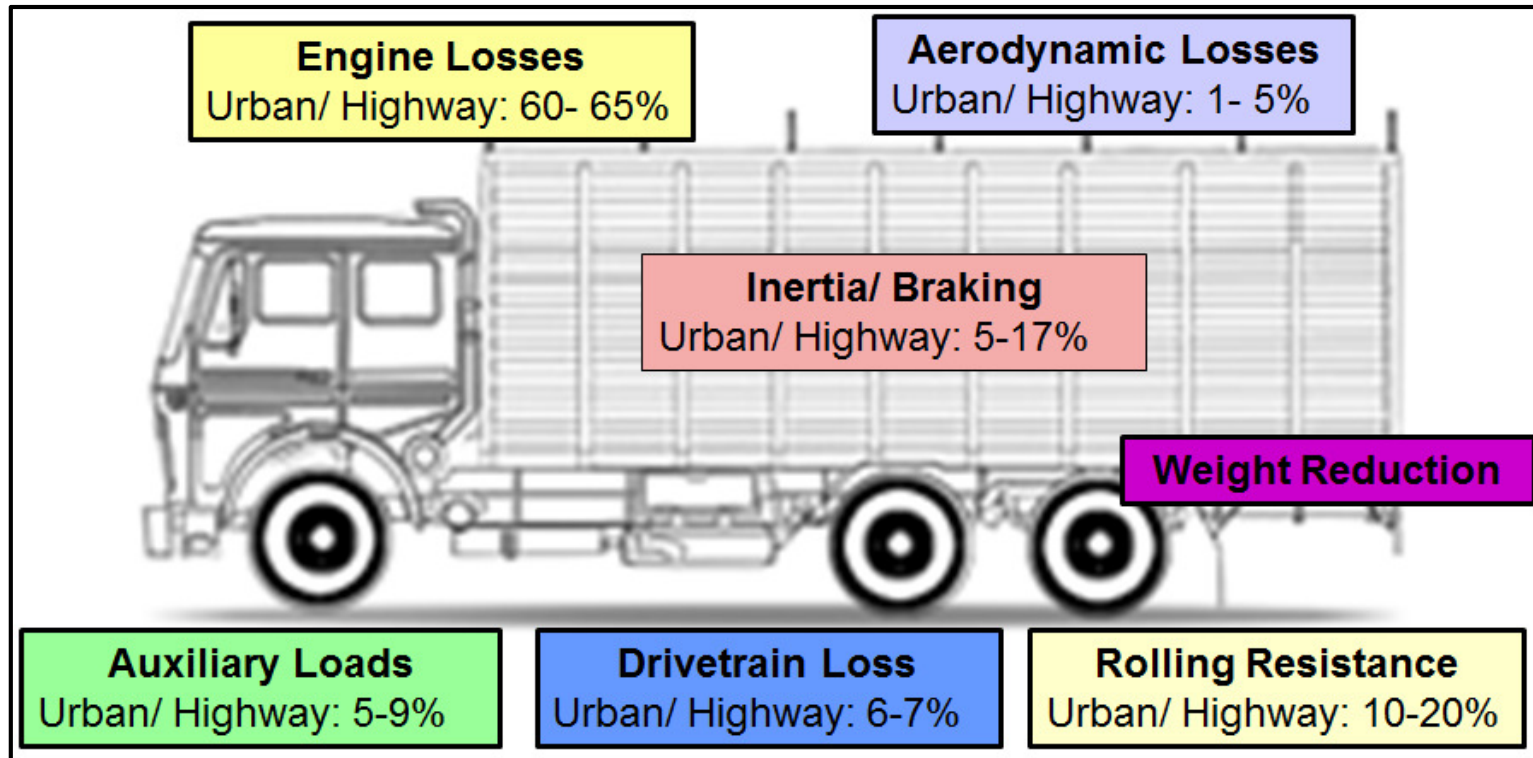
Contribution in Vehicle Fuel Economy Improvements from Different Buckets



This Class 8 tractor-trailer by heavy-duty manufacturers Cummins and Peterbilt reaches more than 10 miles per gallon under real world driving conditions. The truck was on display at the Energy Department today. | Photo by [Sarah Gerrity](#), Energy Department

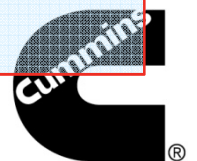
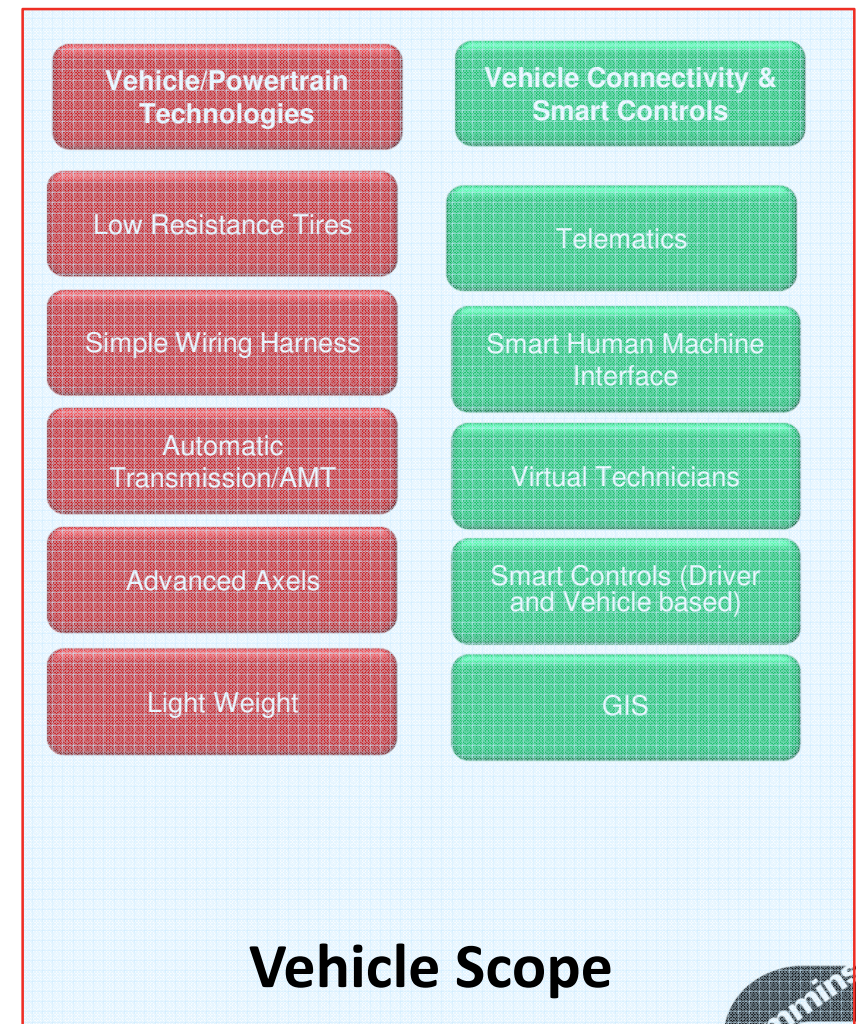
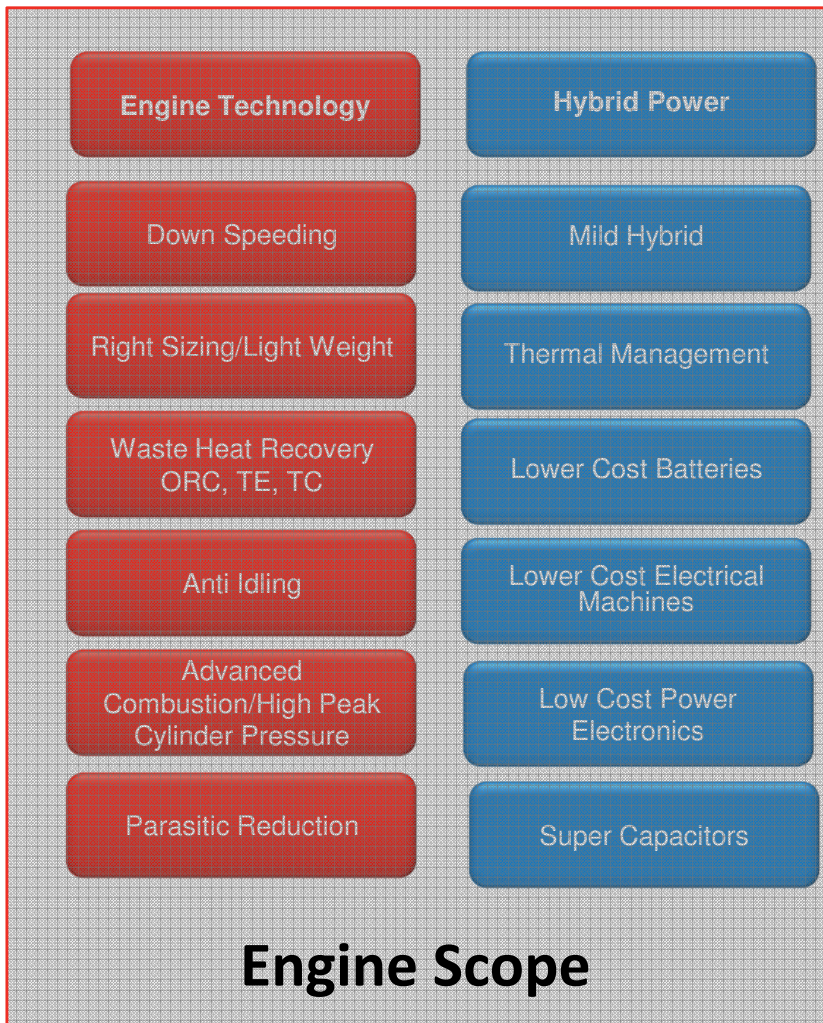


Typical Energy Balance for India HD Application



- Need to analyze typical drive cycle for desired application (Bus- Truck/ Highway- City)
- Appropriate technologies (Globally developed/ Indigenous) can then be chosen based on environmental factors and customer requirements
 - Infrastructure Availability, Payback period demand a Fit For Market (FFM) approach while selecting and adopting technologies to India context (typically 18 months)

Technology Focus Areas for Commercial Vehicles for India



Socio-Economic Drivers

■ Emissions Regulation

INDIA - AUTOMOTIVE APPLICATION																	
Applicable for Heavy Duty Commercial Diesel vehicles above 3500 kg GVW																	
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
For select cities***	BS III : 5.0 / 0.66 / 2.1 /	BS IV : (ESC) 3.5 / 0.46 / 1.5 / 0.02** (ETC) 3.5 / 0.55* / 4.0 / 0.02** OBD Stage II effective from 1st April 2013											BS V Countrywide Similar to Euro-V				BS VI??
Rest of India	BS II : 7.0 / 1.1 / 4.0 / 0.15**	BS III : 5.0 / 0.66 / 2.1 / 0.10**						BS IV Countrywide									

— Fuel Economy Standards for HD Vehicles?

■ Infrastructure

— Roads; Urea Availability; Internet Connectivity; Fuel Availability



Recommendations

- For HD Transportation industry
 - Engine technologies are available to significantly improve fuel efficiency and while reducing tailpipe emissions
 - Appropriate technologies for India need to be identified considering India context and cost effectiveness
 - Opportunity to leap frog current architectures by taking advantage of India technology accelerators
- For end customer
 - Technology spectrum is rich and diverse; Choice dependent on acceptable payback expectations
 - Demand clean, high efficiency, top performance, smart products from the industry suppliers
- For policy makers
 - Synchronize legislative requirements (emission, GHG, road safety) with infrastructure availability to improve deployment of technologies and improve fuel availability with clear enforcement policies.
 - Engine fuel efficiency regulation may be introduced from ease of implementation and real life greenhouse gases reduction
 - Long term- strategic thinking needed to address issues such as traffic management, increasing penetration of public transport, leveraging non-motorized transport, improving roads etc.
 - Significant R&D investment needed for cost effective implementation of technologies
- For industry- government liaisons (such as ARAI, PCRA, BEE , etc)
 - Partner with government and industry in developing and deploying regulations
 - Focus on test methods, cycles and conditions (vehicle, engine) ensuring transparency between test conditions and real life road conditions
- 14 ■ Collaborate with Industry- Government- Universities for development of technologies

Summary

- Engine technologies that can deliver significant improvements in fuel efficiency and reduced tailpipe emissions are available
 - Easier control and regulate “In Field” green house gas emissions through engine level regulations
 - Such engine level regulations also ensure reduction in criterion pollutant and green house gases together thereby improving overall environmental well-being
- In choosing the right technology, key market themes in India are Fuel Efficiency, Reliability/Durability, Low Maintenance, and Low Initial Cost
- Fuel Efficiency Improvements will likely be driven by TCO and CO2 emissions considerations
- The development of the Indian infrastructure and Emissions Regulations will have a major impact on technology selection
- There is a strong need for all key players (Manufacturers, End Customers, Policy Makers, Test Agencies, Liaisons, Research Universities/ Labs) to work together to select and develop right Fit for India Technologies
- There is an opportunity to leap frog current proposed architectures by taking advantage of India technology accelerators