Advanced Powertrain Forum

Management Briefing Seminars
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Doug Patton, Senior Vice President, Engineering Division
DENSO International America

DENSO

Intro

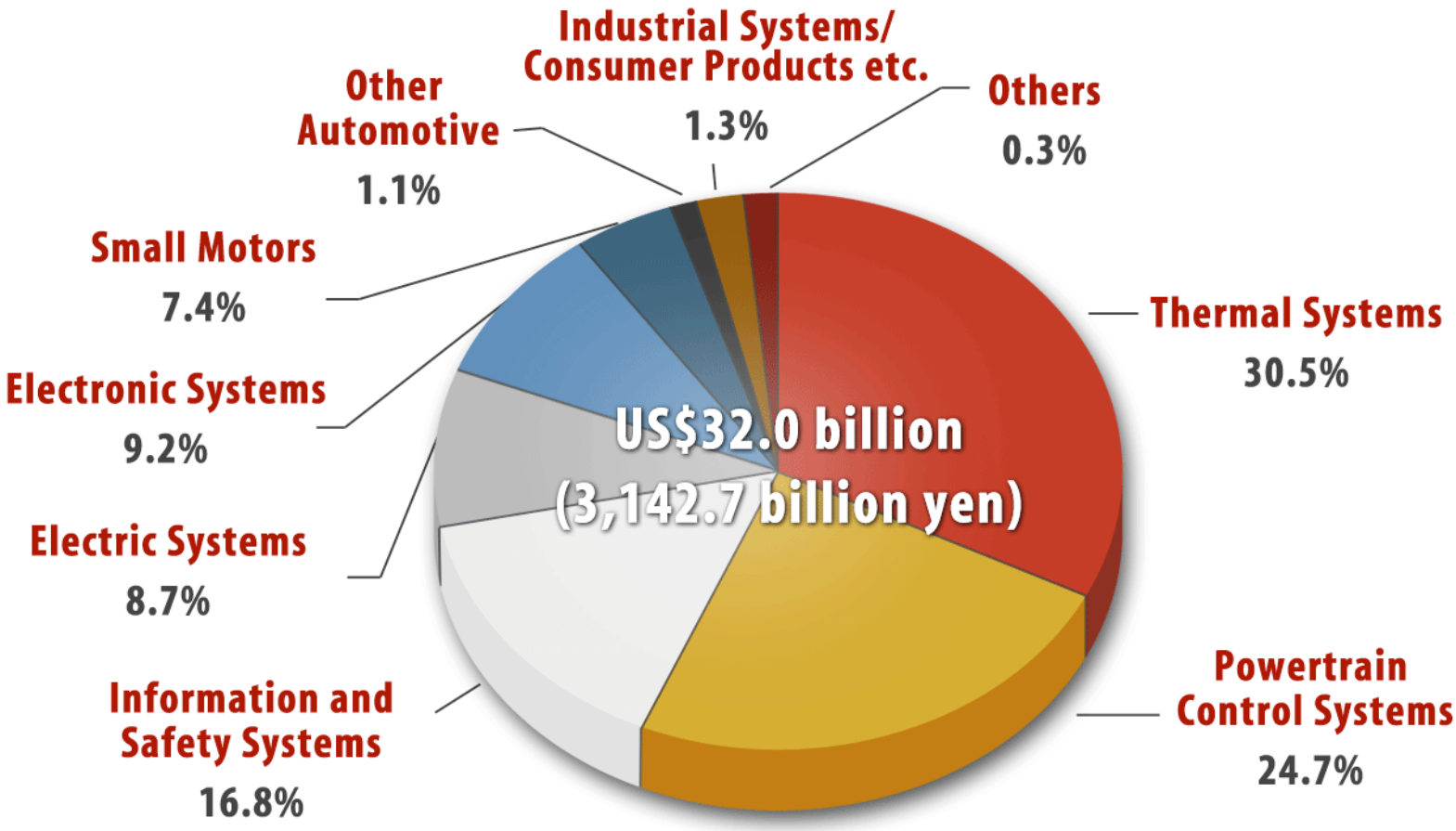
Anticipating Customer's Needs

Key Points

- About DENSO
- How do we get to 50+ mpg
- Beyond Powertrain
- Long-term: Electrification
- Mid-term: Start/stop
- Short-term: GDI
- Conclusion

About DENSO

Consolidated Base



Beyond Powertrain

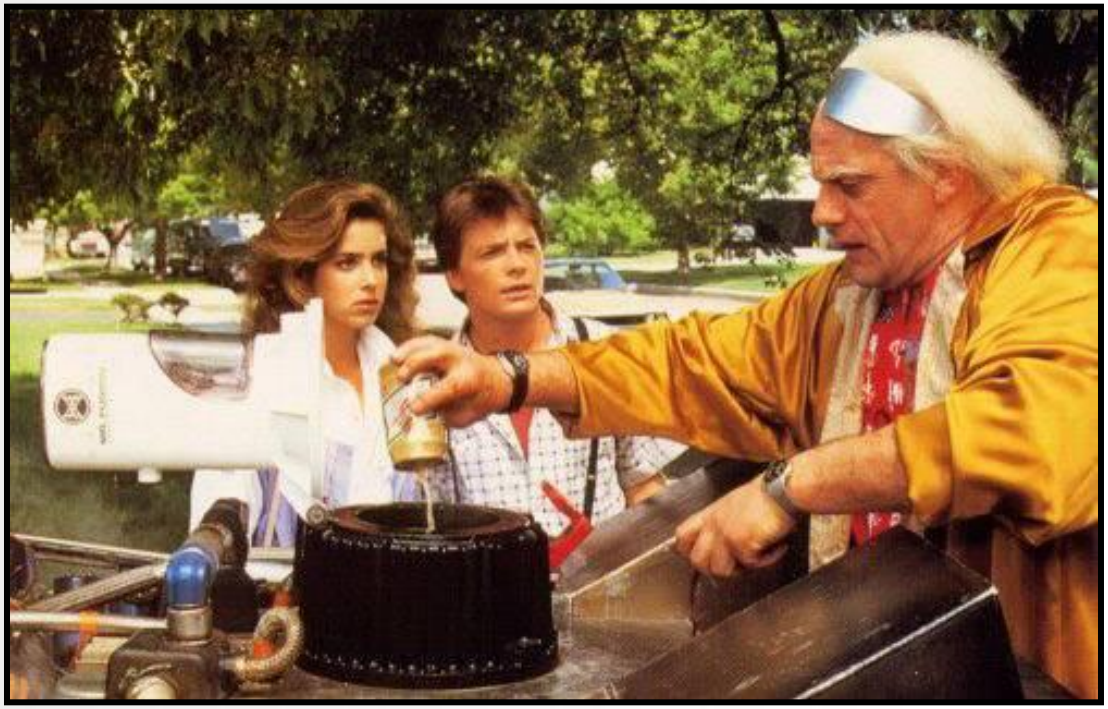
Have to Look at Entire Vehicle

- Aerodynamics
- Mass

Beyond Powertrain

Alternative Fuels

- Diesel
- Ethanol
- Hydrogen
- Bio-fuels



Beyond Powertrain

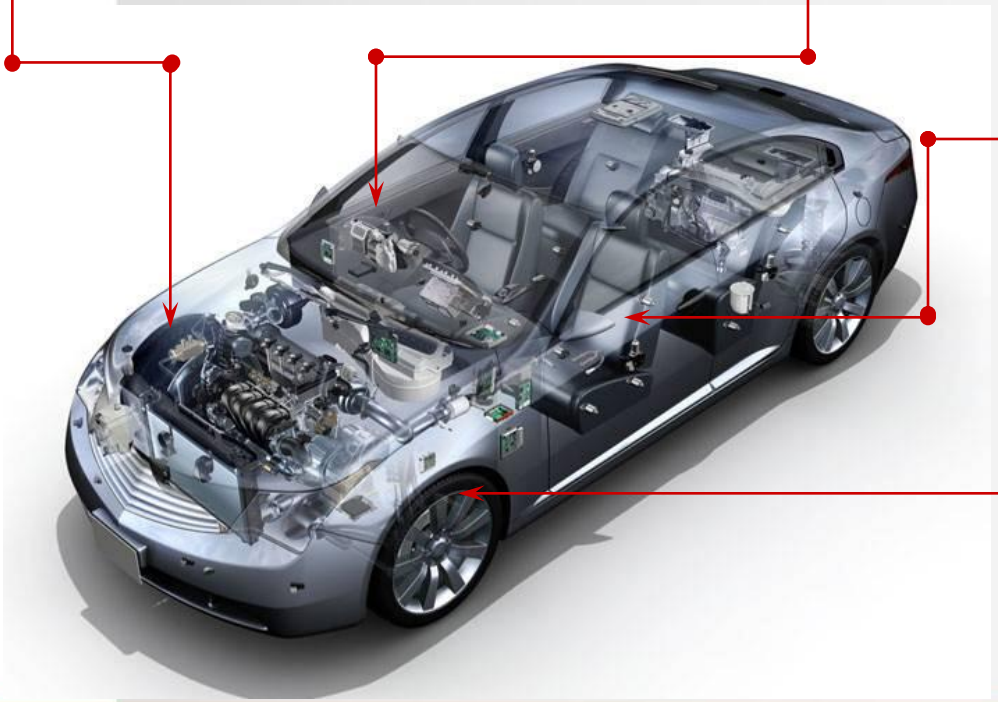
Overall Systems Approach

Powertrain Related Products

Engine management system,
electronically-controlled diesel system,
starter, alternator, radiator, etc.

Climate Control Products

Automatic air conditioner, car heater,
rear cooling unit, compressor,
sensors, etc.



Body Electronics Products

Instrument cluster, windshield wiper
remote keyless entry system,
IC flasher, horn, etc.

Driving Control and Safety

Cruise control system, airbag sensing system,
vehicle stability control, antilock braking system,
traction control system, etc.

Beyond Powertrain

How do all the pieces fit together?

- Collaboration is key
- Technology tradeoffs
- Weighing cost-benefits
- Best systems

Long-term Powertrain Advancements

How do we achieve more than 50 mpg?

Electrification

- Plug-in hybrids
- Extended range vehicles
- Advanced hybrids
- Battery electric vehicles

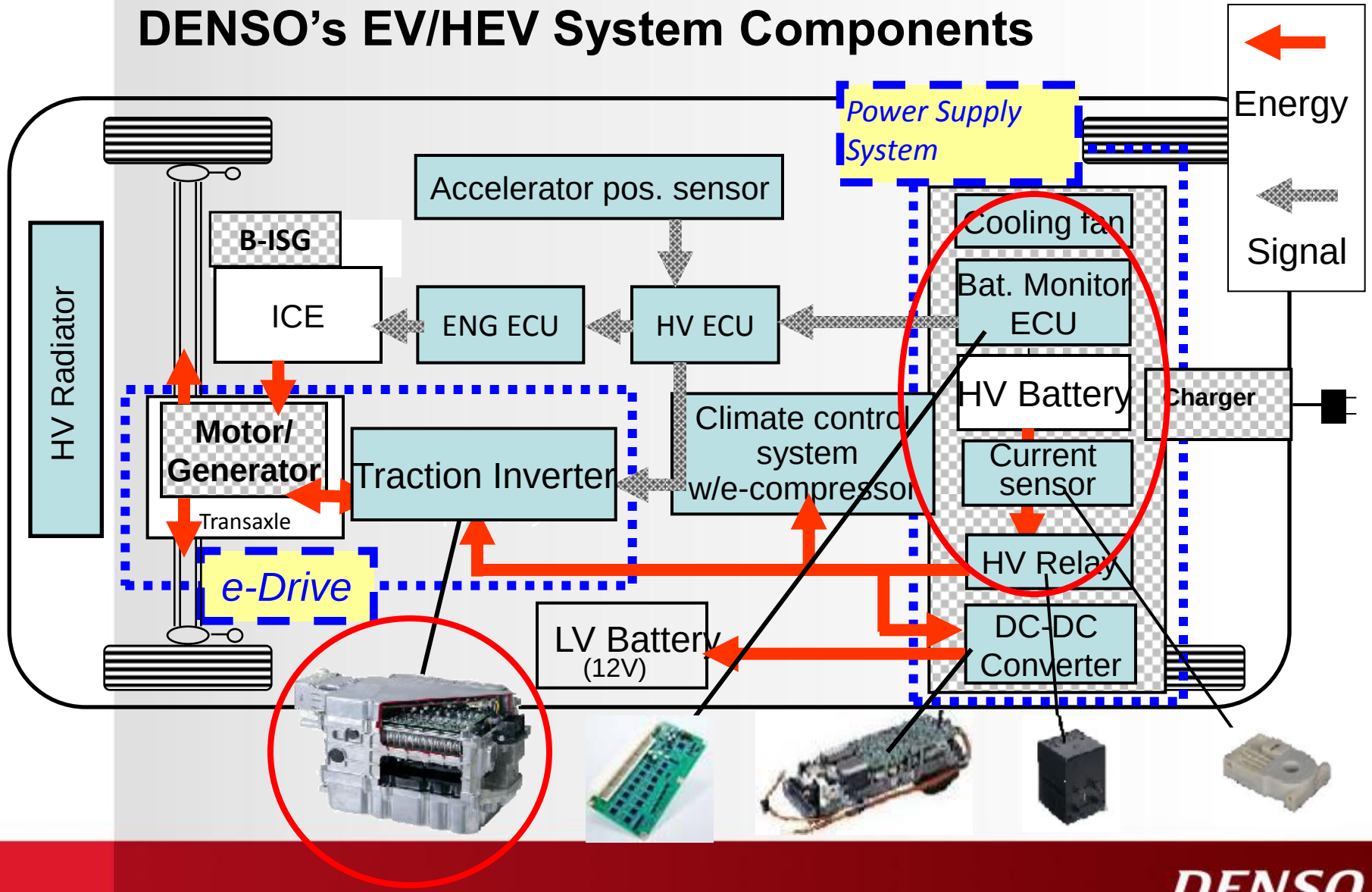
Long-term: Electrification

How Will We Get There?

- Components
- Cost-value
- Integration

Long-term: Electrification

DENSO's EV/HEV System Components



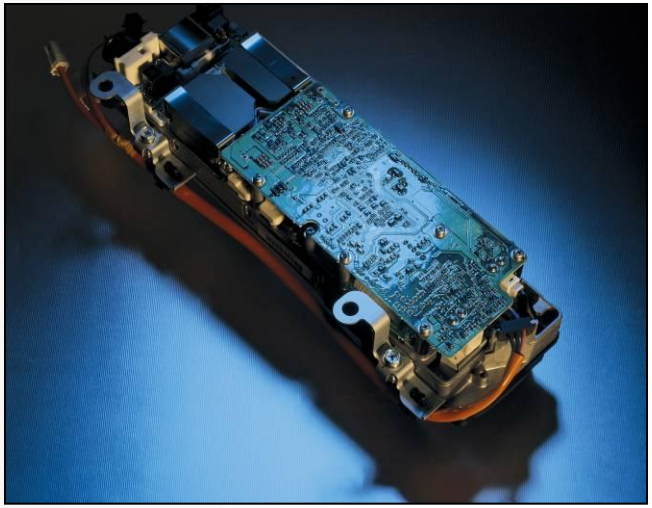
Long-term: Electrification

Cost-value

- Goal to reduce size and cost by 40 – 60 percent using our experience in thermal management, power electronic design and manufacturing.

Complex Component Integration

- Marry or bundle technologies into a single package or box.



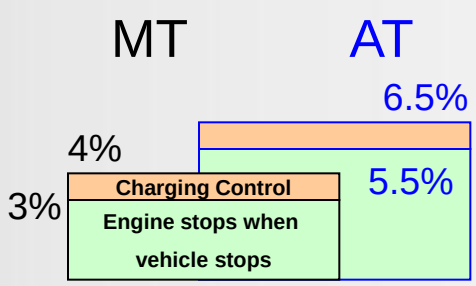
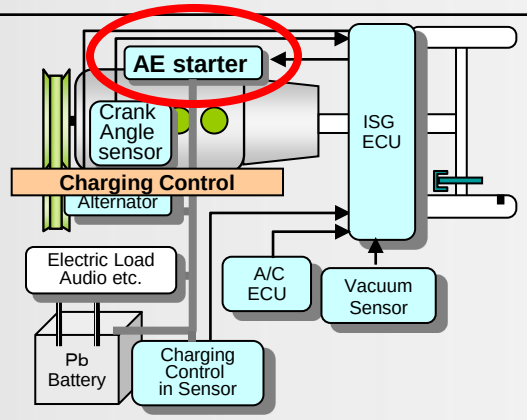
Mid-term: Start/Stop Technology

35.5+ MPG 2016 and Beyond

Start/Stop Technology

- Technical capability
- Market acceptance

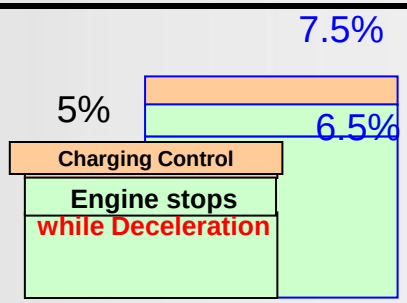
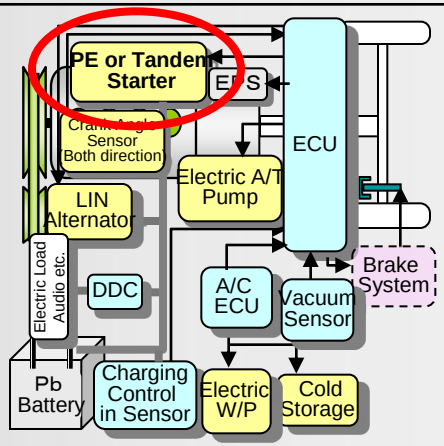
Mid-term Start/Stop Technology

Fuel Consumption (2L GDI MT & AT)	
System Configuration	

System 1:

- Advanced Engagement (AE) Starter
- Not “change of mind” capable as engine needs to be at zero rpm before restart
- 3% to 5% fuel savings
- Existing proven technology
- Simple integration

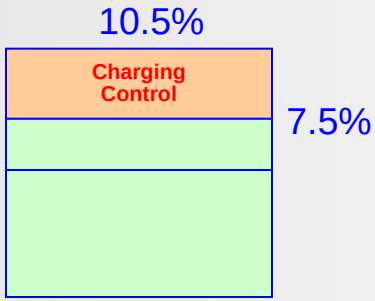
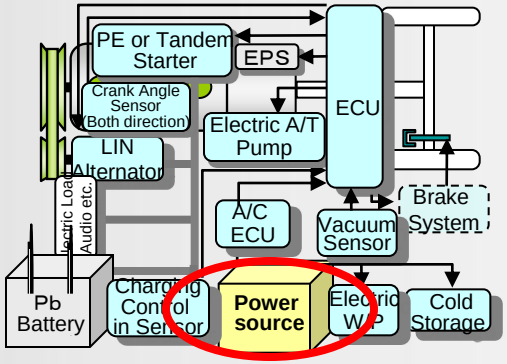
Mid-term: Start/Stop Technology

Fuel Consumption (2L GDI MT & AT)	
System Configuration	

System 2:

- "Change of mind" capable
- Restart engine ***before*** zero rpm
- **Permanently Engaged** (PE) and **Tandem Solenoid** (TS) starters
- Integration
- Increase fuel savings potential to more than 4%

Mid-term: Start/Stop Technology

Fuel Consumption (2L GDI MT & AT)	
System Configuration	

System 3:

- **Electrical system** tailored to repeated on/off cycling of start/stop systems
- Overall fuel savings potential increases to more than 7%

Market Acceptance: Start/Stop Technology

Market Acceptance

- Driving environment: Rural vs. City Driving
- Fuel economy: Real world vs. Sticker

Market Acceptance: Start/Stop Technology

Market Perception

Physical
- Restart time
- Occupant Comfort
- Noise, vibration, harshness (NVH)

Emotional
- Green
- Financial

Short-term: Fuel Efficiency

Gasoline Direct Injection

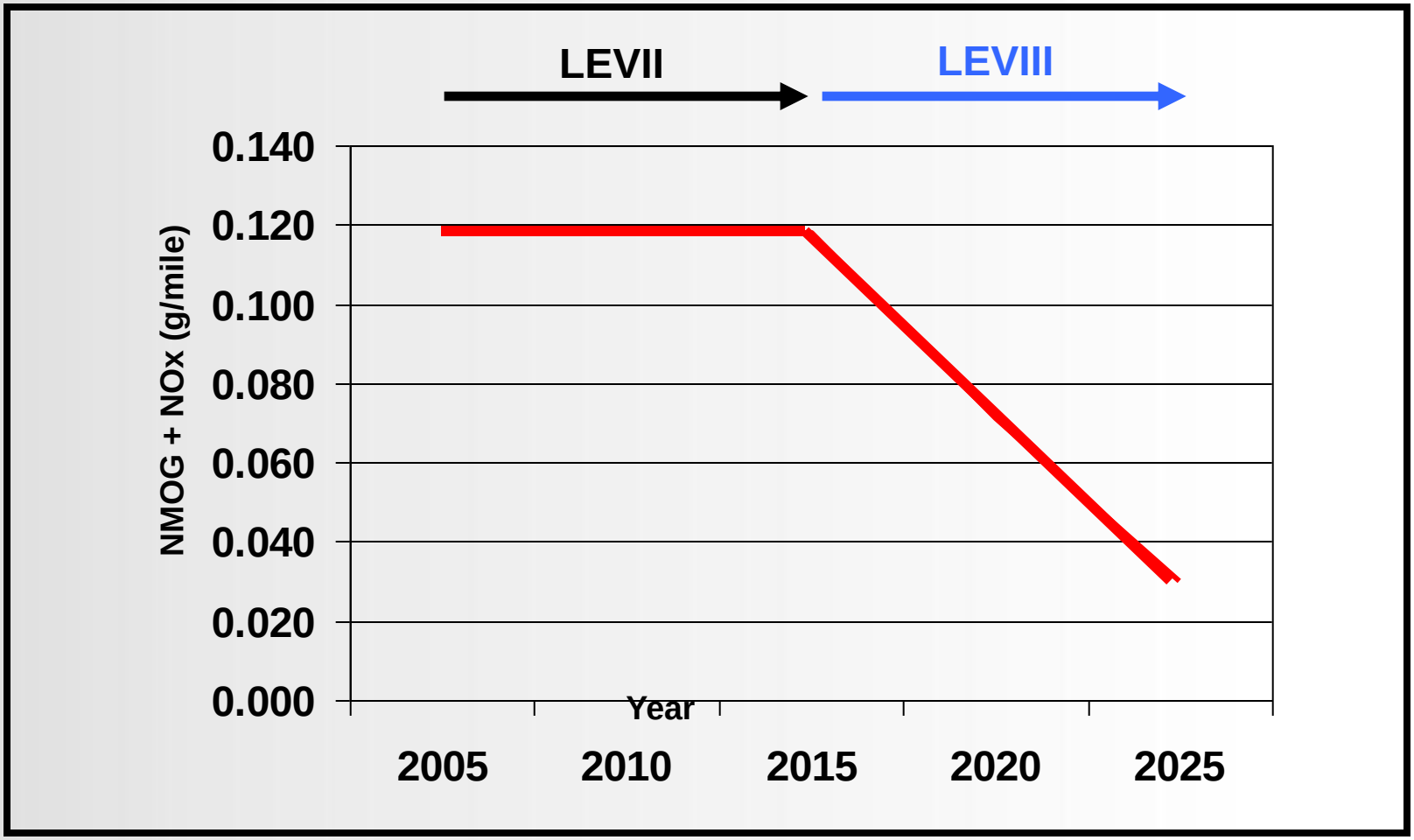
- High-pressure fuel pump
- High-pressure fuel injectors
- Advanced combustion

Other Improvements:

- Down-sizing
- Turbo-charging
- Intercooler

Short-term: Emissions

Emissions Requirements



Conclusion

Overall Strategy to Meet Future Requirements

Have to look at multiple solutions – under the hood and beyond the powertrain

- Integration of technology
- Maximize system efficiency - Cost
- Quality
- Manufacturing

Affordable and Appealing Vehicles

THANK YOU

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