Powertrain Technologies and Innovation

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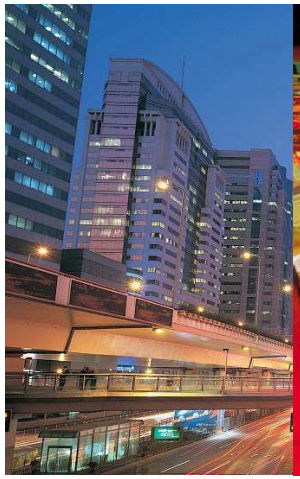
Powering Business Worldwide

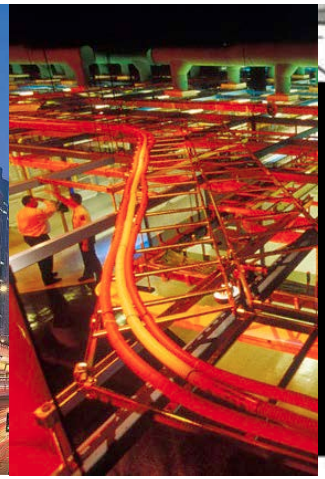
Celebrating 100 YEARS
Ideals that Endure

Eaton is a leader in power management…

We provide reliable, efficient and safe power management for…



Cities & Buildings



Industrial & Machinery

Information Technology

Transportation

Infrastructure

Energy & Utilities

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…serving global customers with innovative solutions.

Electrical Sector $6.4 B Sales	Industrial Sector $7.3 B Sales
Electrical Americas	Aerospace
Electrical Rest of World	Hydraulics
	Vehicle

Eaton is a leading manufacturer of CV transmissions and hybrid systems
Over 200 millions miles of hybrid commercial service worldwide.

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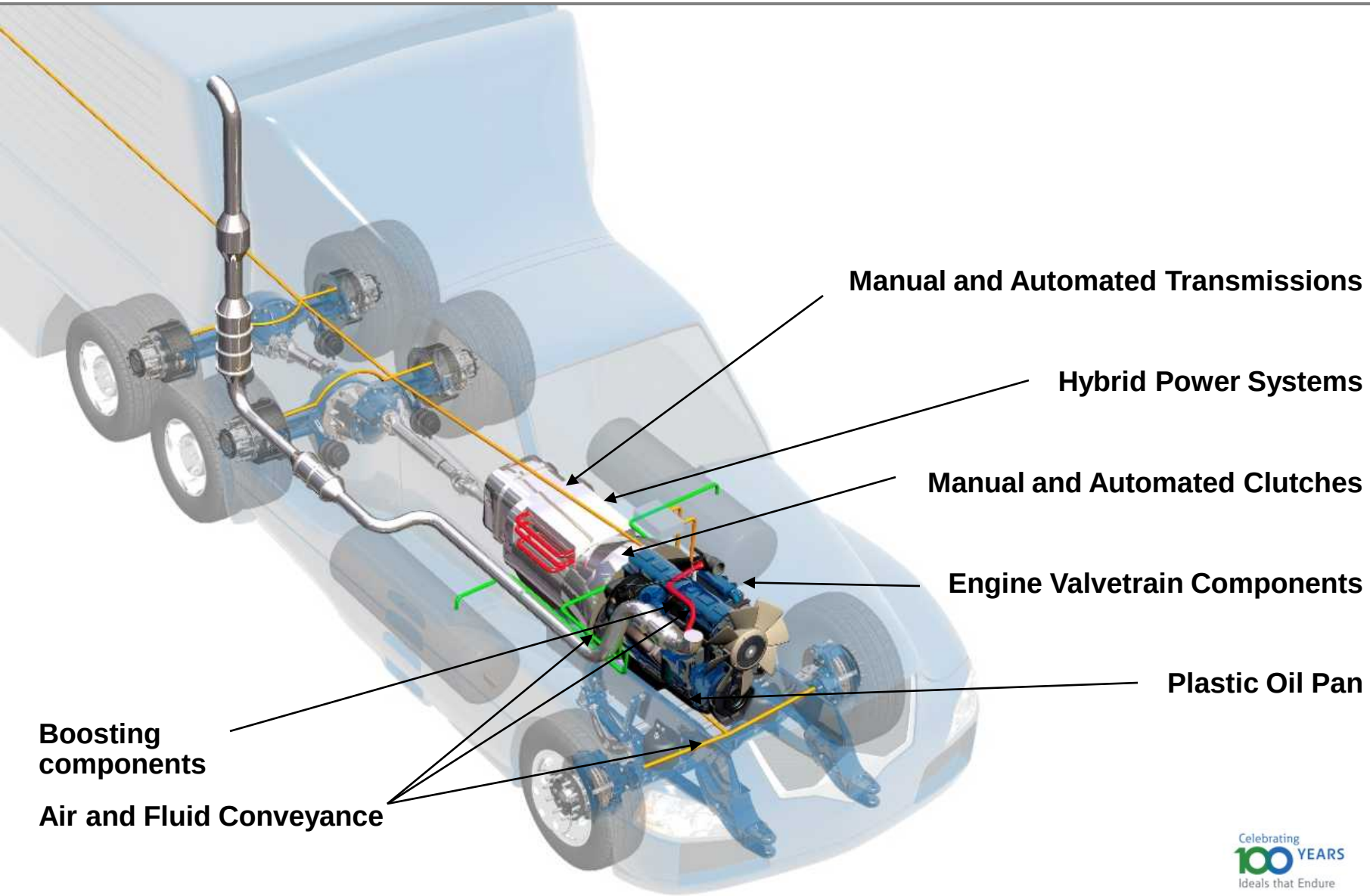
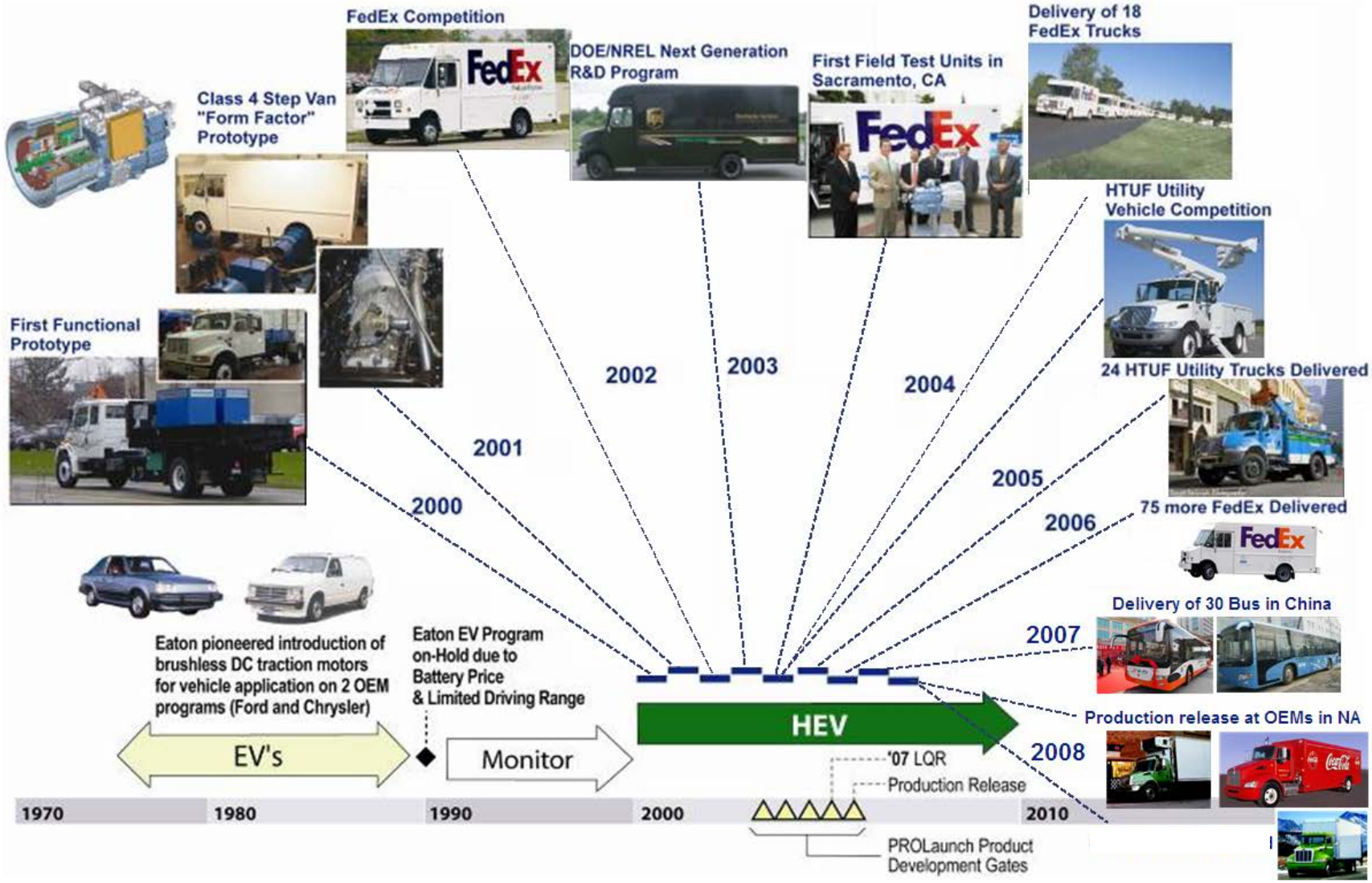
Product Portfolio – Commercial Vehicles



Eaton HEV History & Progress

Over 5500 systems sold; 200M miles of service; 9M gallons fuel saved



Hybrids in the Vocational space

- Challenge: Diversity of configurations to get the work done
- Low-resistance tires and engine technology 5%-9% improvement
- Offset tractor-trailer compliance (e.g., need for APU)

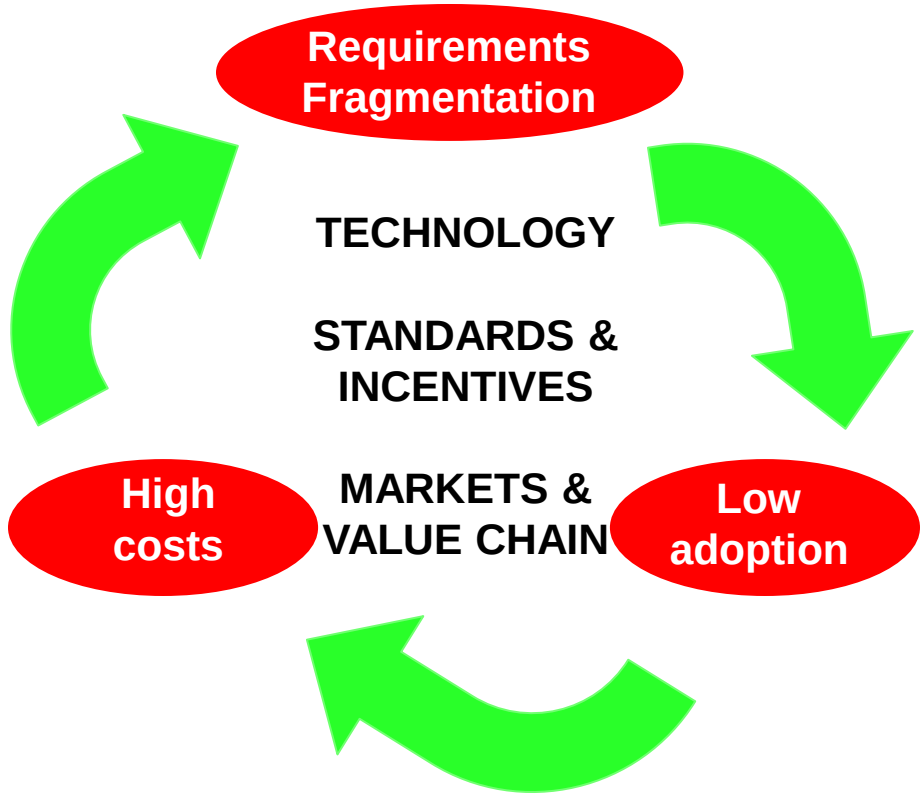
Table III-14: Final Vocational Vehicle Standards and Percent Reductions

	Vocational Vehicle		
	Light Heavy-Duty	Medium Heavy-Duty	Heavy Heavy-Duty
2016 MY Fuel Consumption Standard (gallon/1,000 ton-mile)	38.1	23.0	22.2
2017 MY Fuel Consumption Standard (gallon/1,000 ton-mile)	36.7	22.1	21.8
2014 MY CO_2 Standard (grams CO_2/ton-mile)	388	234	226
2017 MY CO_2 Standard (grams CO_2/ton-mile)	373	225	222
Percent Reduction from 2010 baseline in 2014 MY	5%	5%	4%
Percent Reduction from 2010 baseline in 2017 MY	8%	9%	6%

Hybrids: opportunity to over-comply
1 hybrid = 8-9 conventional trucks

Affordable Hybrids

30% and up fuel savings in the vocational segment can have real impact… yet the business and technology is still fragile



Short term goal: achieve volume with 5 year payback
End game: 3 year payback

The Rule and Drivetrain Technology

AW summit: Are hybrids the only solution in the vocational segment?

HYBRIDS

- Path: Advanced Technologies Credits
  - 1.5 multiplier
  - Fungibility
- Implementation: Ease of certification
  - PowerPack testing
  - A-to-B comparison

CONVENTIONAL

- In rule: low resistance tires
- Innovative technology credits promote fuel efficient drivelines
  - Added flexibility beyond tires
  - PowerPack and A-to-B testing: pre-defined framework for advanced transmissions

ATC program: right solution for hybrid technology at this time

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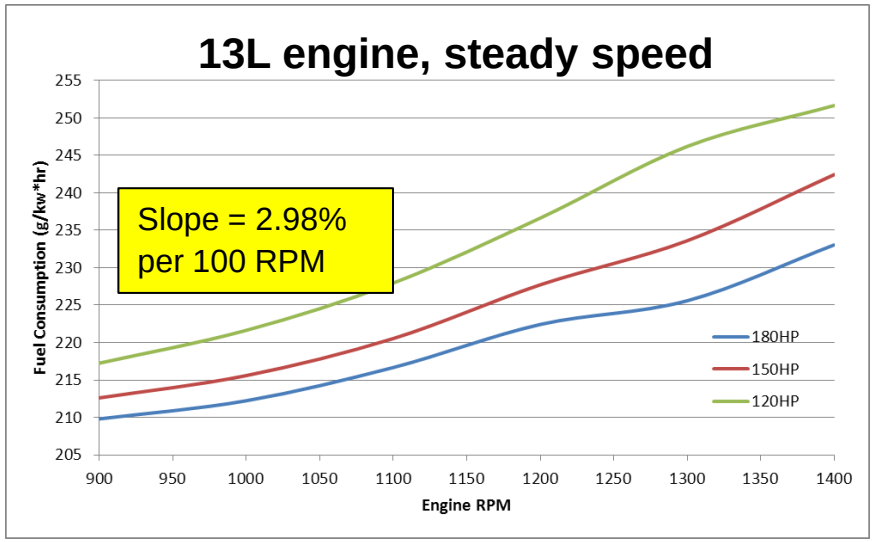
Engine Efficiency

Extreme "Gear Fast, Run Slow" is key to fuel economy

Line-haul

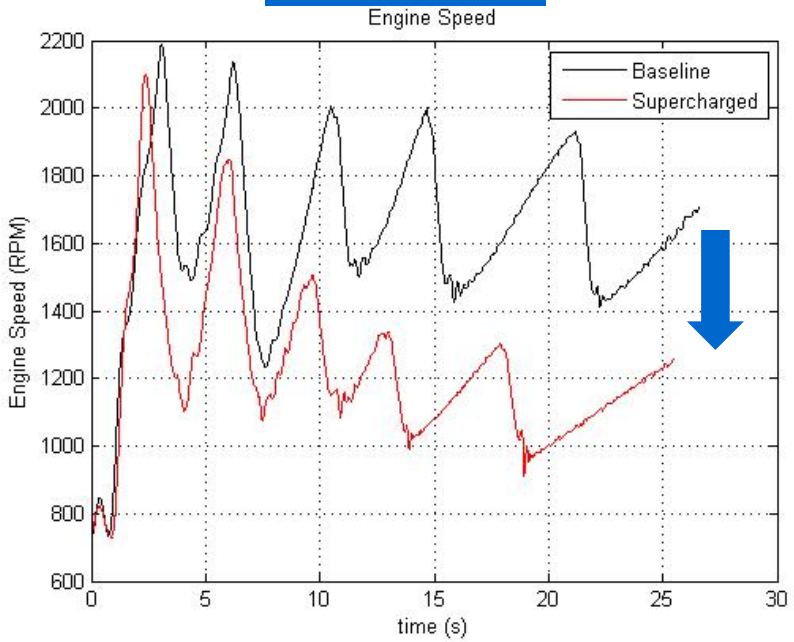


Performance powertrains needed to recover drivability loss

- Fast, efficient shifting
- Supercharging

Bonus: Enable turbo optimization

Vocational



Supercharger and 400 rpm downspeeding = maintain baseline acceleration

Fuel improvement during transient: 12.4% mpg

Engine - drivetrain integration

EPA and DOE can create a well defined path for OEMs and merchant providers to ensure maximum impact

DOWNSPEEDING

EFFICIENCY

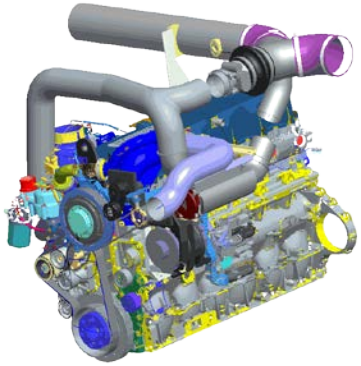
300 – 400 rpm

150 – 200 rpm

100 - 150 rpm

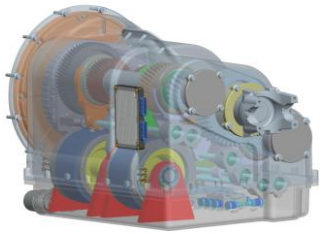
Existing technology
New calibrations

Near term



New controls
New boosting

2014-2016



New architectures
Radical technologies

Long term

8-12%

4-6%

2-3%

A light-duty vision

Feasible for passenger cars – extendable to light trucks and vans

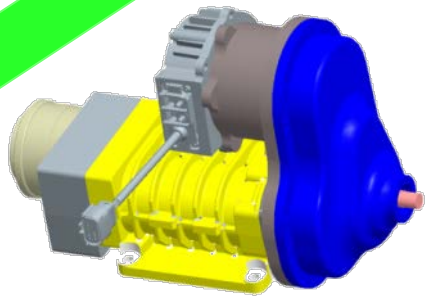
3.0L V6

Baseline

GM e-Assist
Mild hybrid enables
20% engine downsize

2.4 L I4
Ecotec

Integrated boosting
and mild hybrid
50% engine downsize



1.4 L I4
Ecotec

- Technology
  - Supercharging
  - Variable Valve Actuation
  - Cylinder deactivation
- Regulatory framework

  Similarity between light vehicles and Class 2b-3

Existing components, new integrated solutions

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Going forward

- Steer investments in cost reduction & performance improvement
  - Scalable architectures
  - Intelligent controls
  - Not just batteries
- Drive scalable electrical systems
  - Beyond batteries
  - Need to drive standards
- Change market behavior
  - Pooled specifications where appropriate (e.g., busses)
  - Drive standards
- Government – industry partnership
  - Explicit direction for ATC and ITC
  - PowerPack: simple, common option to test/quantify driveline innovation
  - Gather data for Phase 2


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