



# Fuel Efficiency and GHG Standards for Heavy-Duty Vehicles in the U.S.

8<sup>th</sup> Forum on Energy Efficiency in Transport  
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American Council for an Energy-Efficient Economy

# American Council for an Energy-Efficient Economy (ACEEE)

- ACEEE is a 501(c)(3) nonprofit that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, & behaviors
- 50 staff; headquarters in Washington, D.C.
- Focus on end-use efficiency in industry, buildings, & transportation
- Other research in economic analysis; financing; behavior; energy efficiency programs; & national, utilities, state, & local policy
- Funding: foundation grants (52%); contract work & government grants (20%); conferences (20%); contributions & other (8%)

# 2014

ACEEE Summer Study on  
Energy Efficiency in Buildings

**The Next Generation: Reaching for  
High Energy Savings**





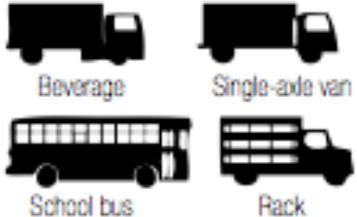






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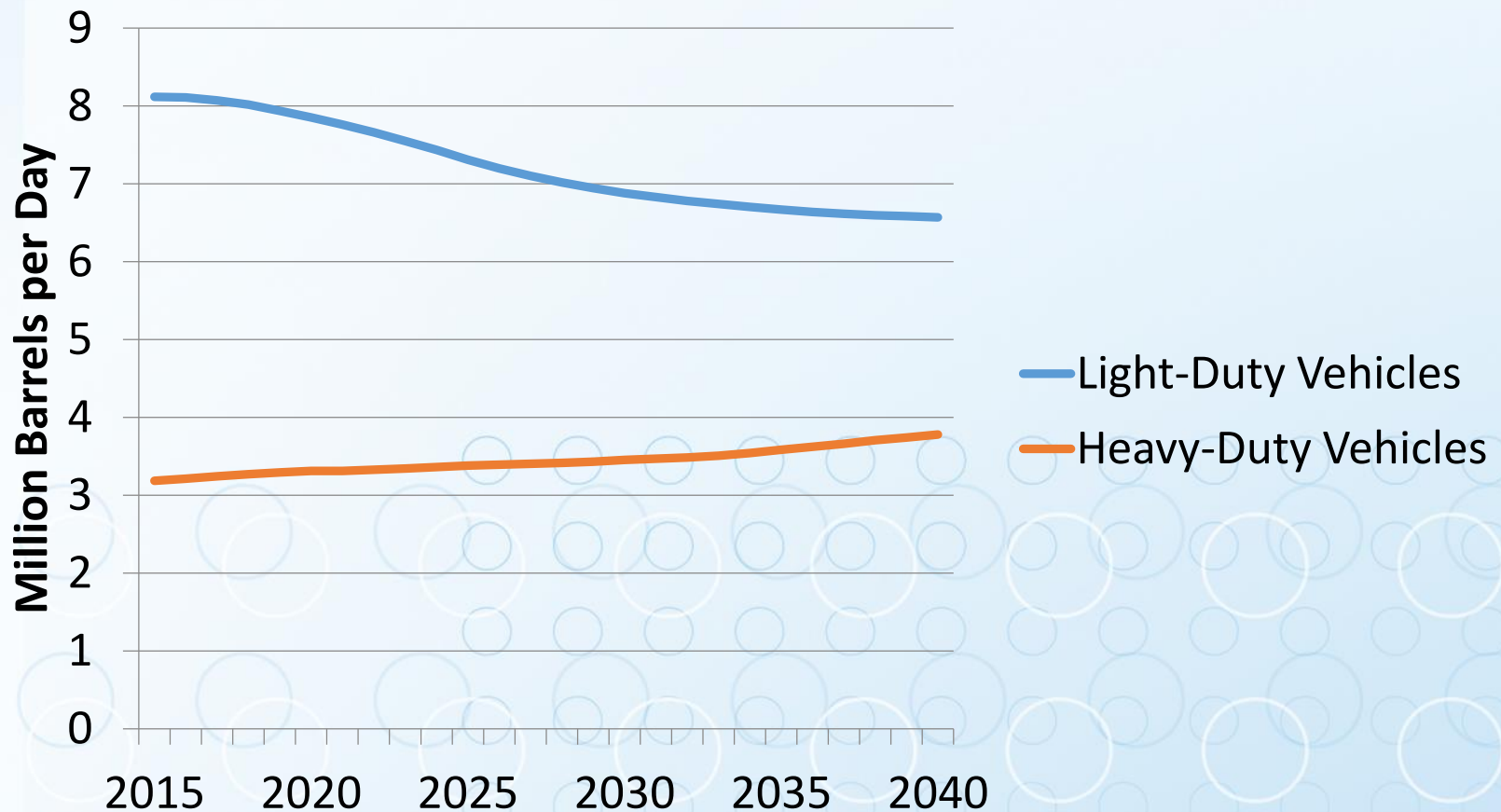
# Outline

- Background
- Overview of heavy-duty standards
- Benefits and costs
- Structural and methodological issues

# U.S. Trucks and Buses

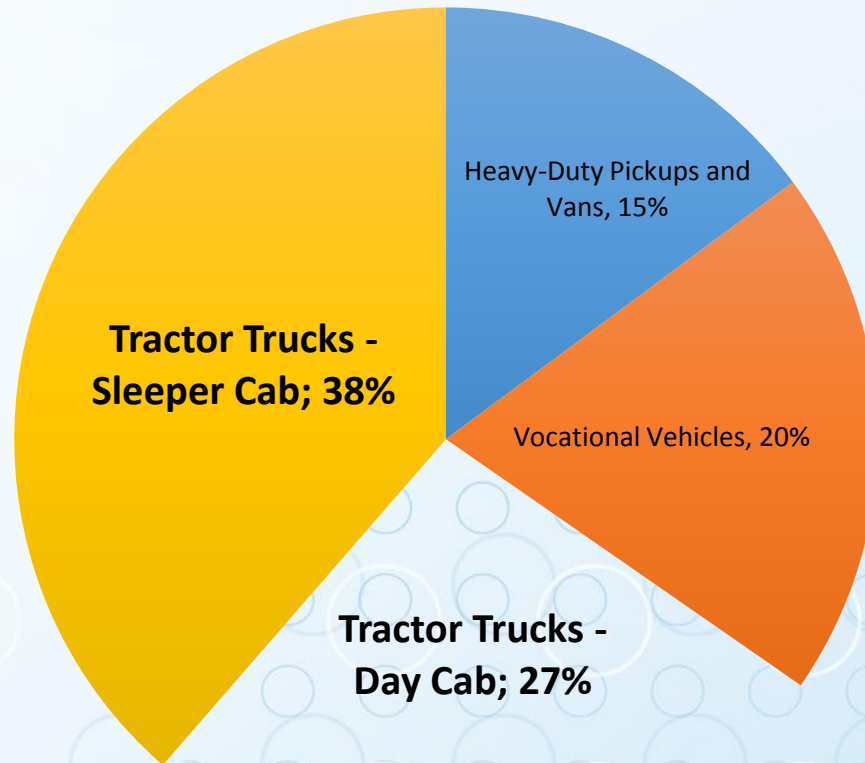
 <p>CLASS 1 6,000 lb &amp; less</p> <p>Minivan    Utility van</p> <p>Multi-purpose    Full-size pickup</p>	 <p>CLASS 5 16,000 to 19,500 lb</p> <p>Bucket</p> <p>City delivery    Large walk-in</p>
<p>CLASS 2a 6,001 to 8,500 lb</p>  <p>Minivan</p> <p>Full-size pickup</p> <p>CLASS 2b 8,500 to 10,000 lb</p>  <p>Step van</p> <p>Utility van</p> <p>Full-size pickup</p>	 <p>Beverage    Single-axe van</p> <p>School bus    Rack</p> <p>CLASS 6 19,501 to 26,000 lb</p>
 <p>Walk-in    Conventional van</p> <p>City delivery    Utility van    Full-size pickup</p> <p>CLASS 3 10,001 to 14,000 lb</p>	 <p>Refuse    Furniture</p> <p>City transit bus    Medium conventional</p> <p>CLASS 7 26,001 to 33,000 lb</p>
 <p>Conventional van    City delivery</p> <p>Large walk-in</p> <p>CLASS 4 14,001 to 16,000 lb</p>	 <p>Dump    Cement</p> <p>Heavy conventional    COE sleeper</p> <p>CLASS 8 33,001 lb &amp; over</p>

# Fuel Consumption of Highway Vehicles in the U.S.

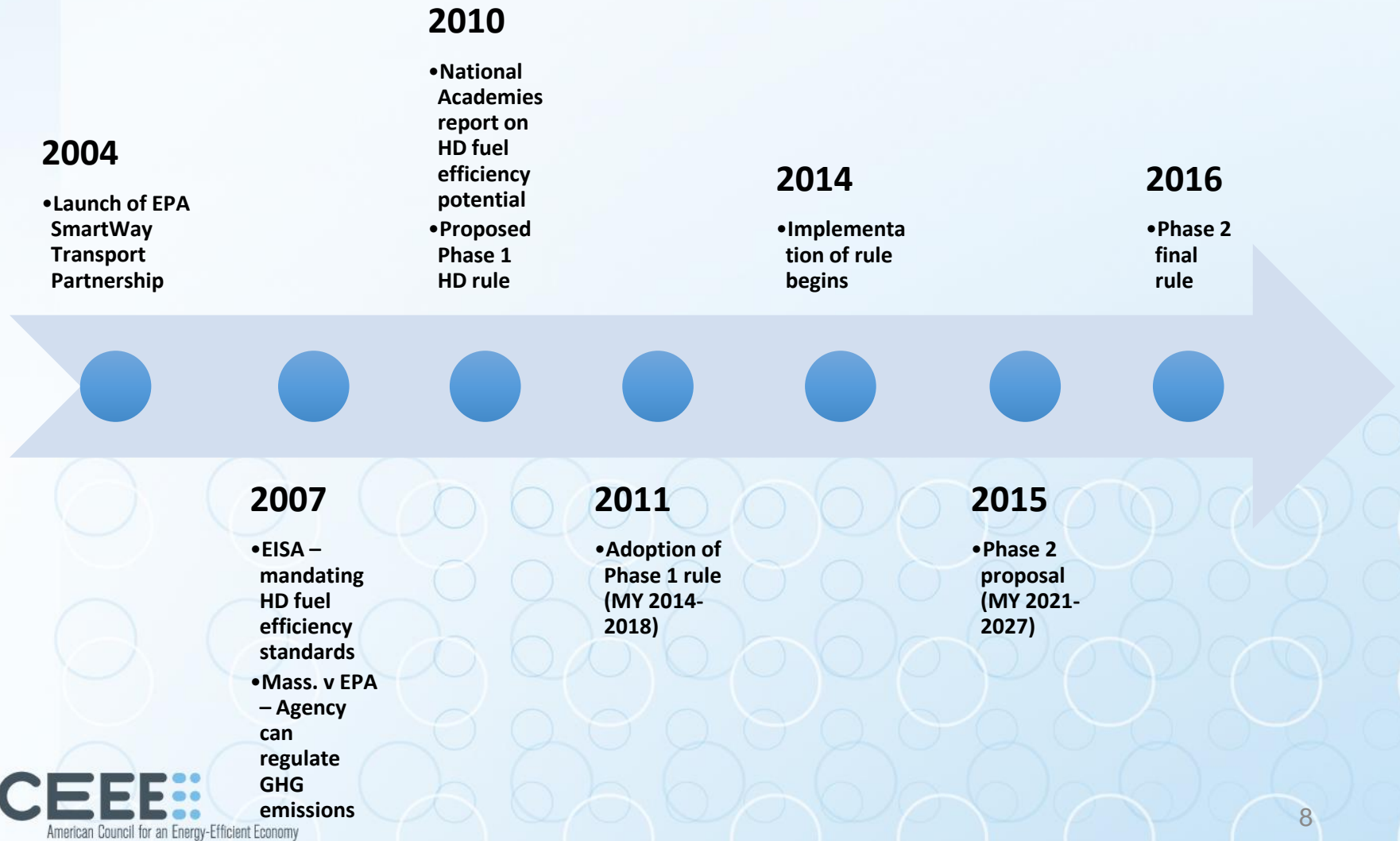




# U.S. Heavy-Duty Vehicle Energy Consumption

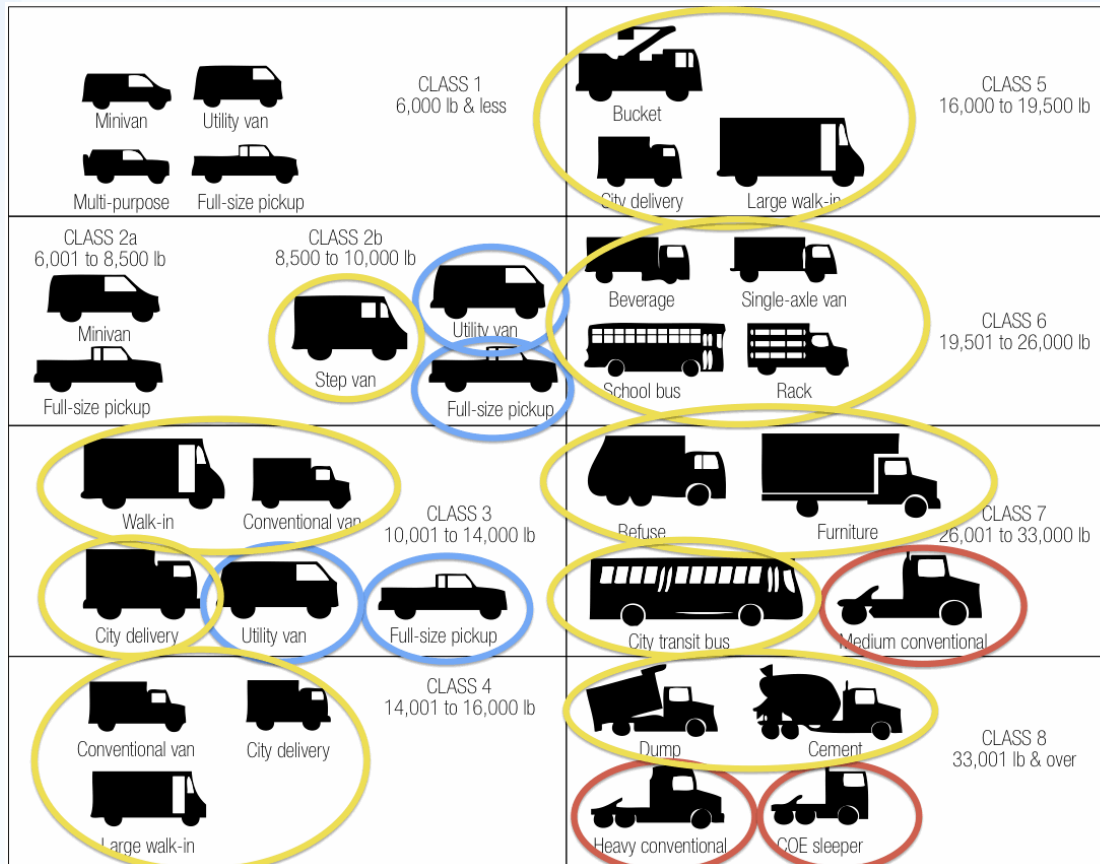


# Timeline of HD Standards for Greenhouse Gas Emissions and Fuel Efficiency in the U.S.





# Major Vehicle Segments for HD Standards

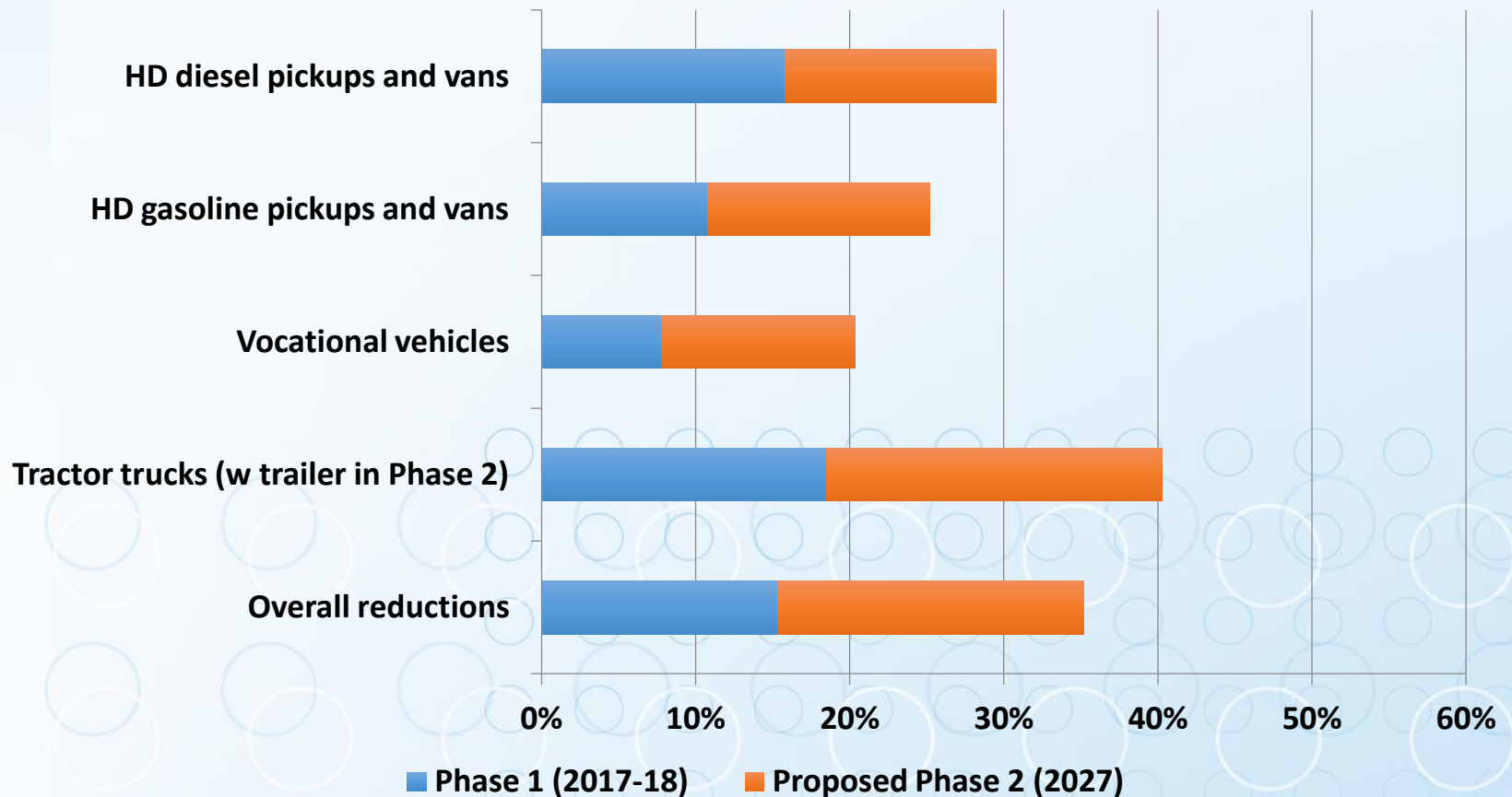


- Heavy-duty pickups and vans ----
- Vocational trucks - - - -
- Tractor trucks - - - -

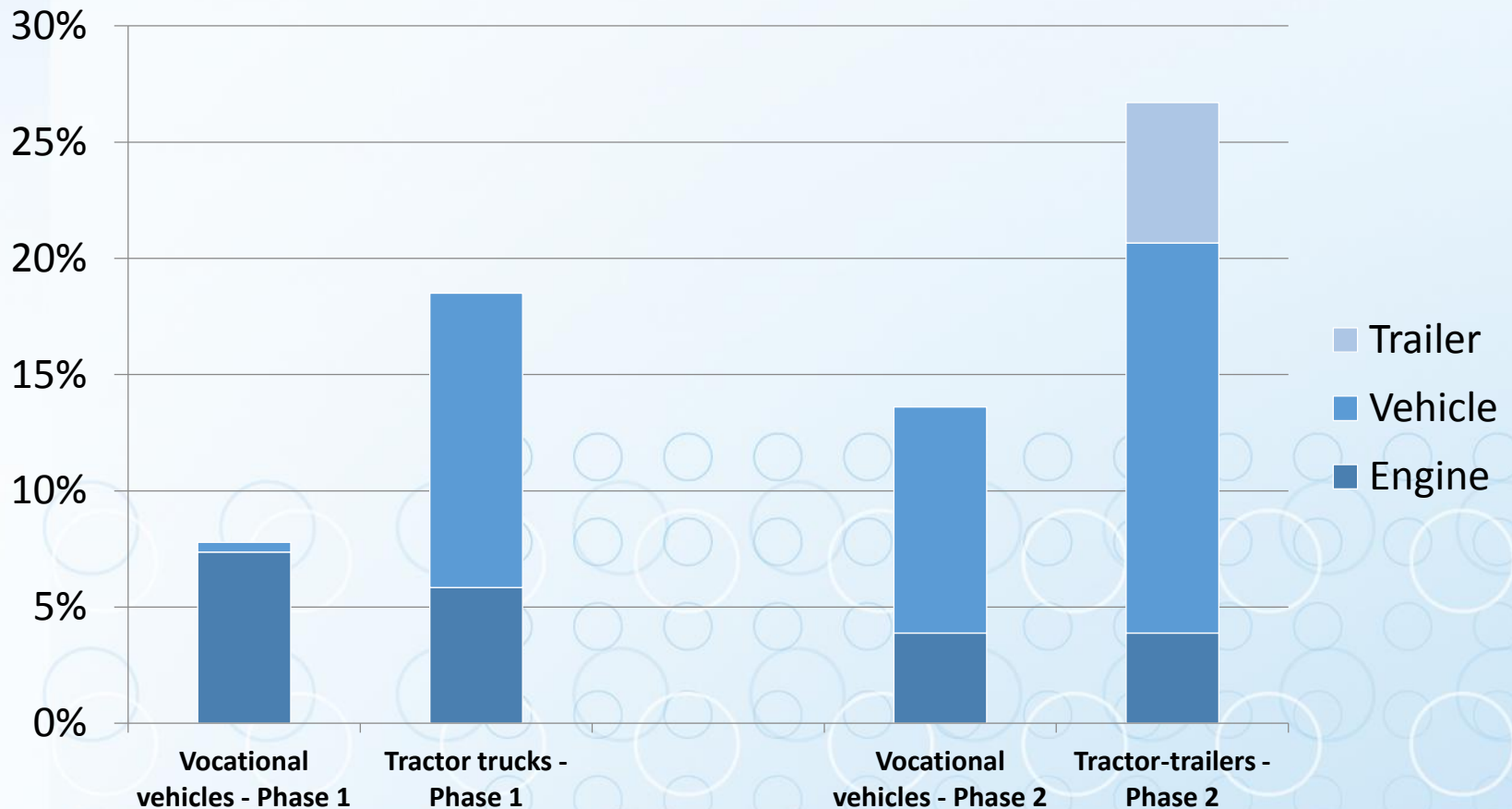
...and

- Engines
- Trailers (Phase 2)

# Required Fuel Consumption Reductions in Phases 1 and 2, Relative to 2010



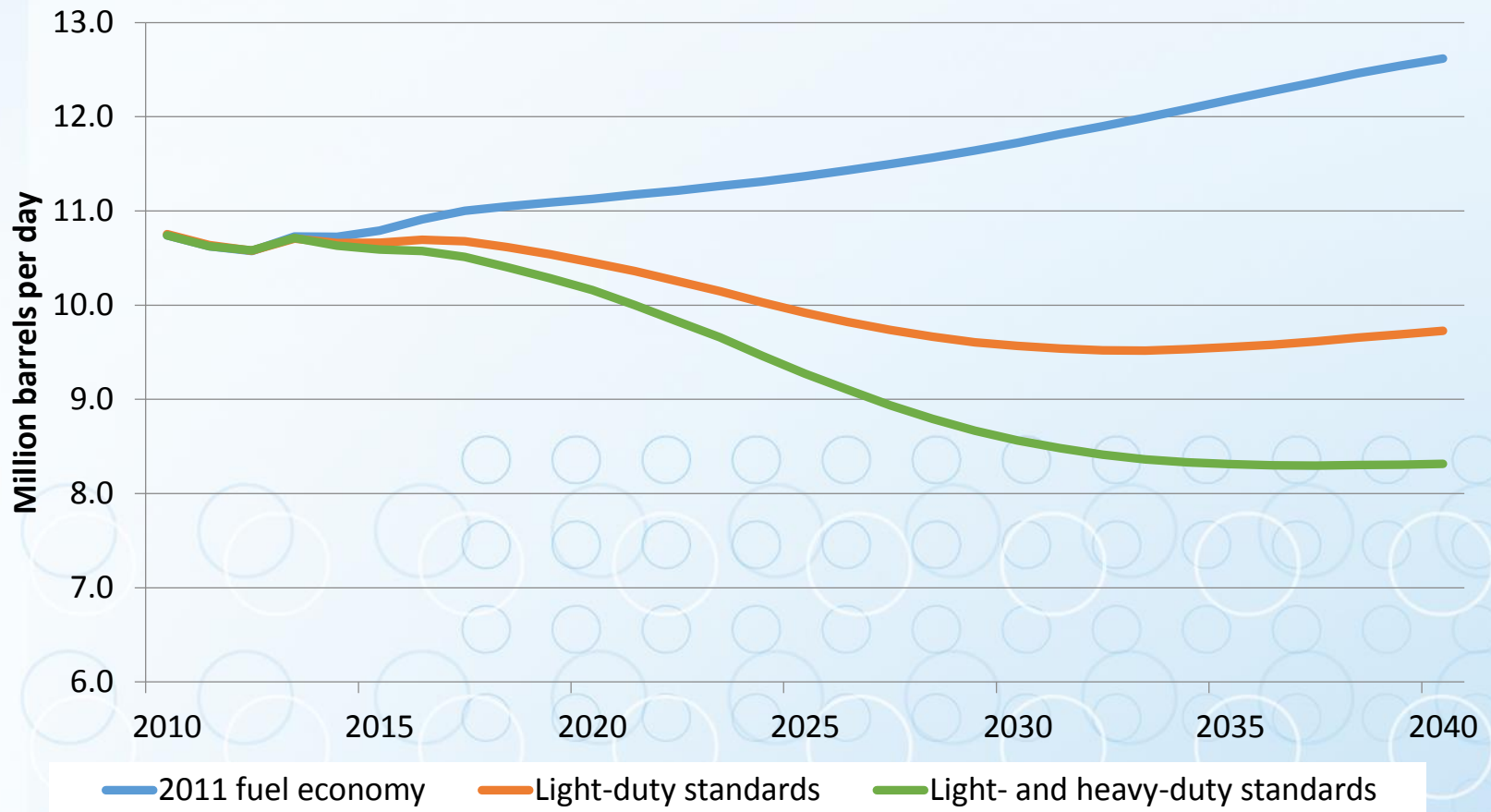
# Fuel Savings Breakdown – Average by Category



# Price Increment and Payback

Category	Phase	Upfront costs	Payback period (7% discount rate)
Pickups and Vans	1	\$1,048	1-2 years
Pickups and Vans	2	\$1,340	2-3 years
Vocational	1	\$378	<1 year
Vocational	2	\$3,380	5-6 years
Tractor	1	\$6,215	<1 year
Tractor	2	\$11,680	1-2 years
Trailer	1	\$1,170	

# Oil Savings: Light- and Heavy-Duty Standards (including Proposed Phase 2)



# Phase 2 Projected Annual Costs and Benefits

	2035	2050
Fuel Reductions (Billion Gallons)	9.3	13.4
GHG Reduction (MMT, CO <sub>2</sub> -equivalent)	127.1	183.4
Vehicle Program Costs (including Maintenance; Billions of 2012\$)	-\$6.0	-\$7.1
Fuel Savings (Pre-Tax; Billions of 2012\$)	\$37.2	\$57.5
Other Benefits (Billions of 2012\$)	\$20.5	\$32.9
Net Benefits (Billions of 2012\$)	\$51.7	\$83.2

Source: Phase 2 proposed rule, p.40143



# Structural and Methodological Issues

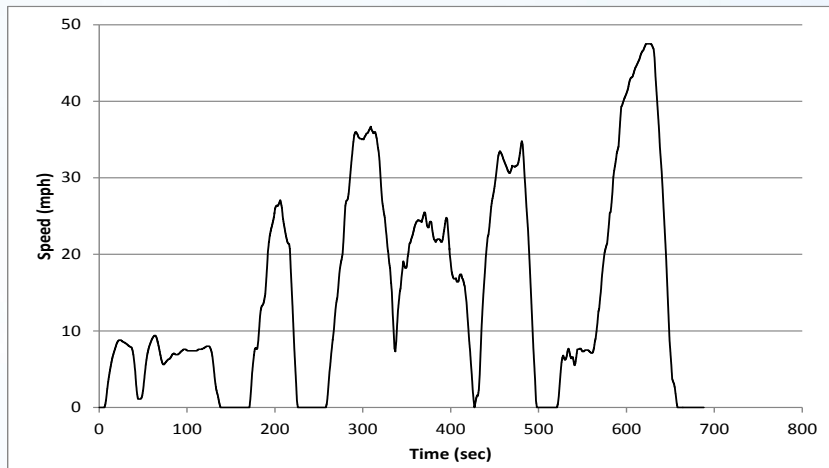
- Certification protocols (vocational and tractor)
- Test cycle (vocational and tractor)
- Separate engine standard (vocational and tractor)
- Inclusion of trailers (tractor)
- Gasoline vs. diesel (pickups and vans)
- Attribute-based standards (pickups and vans)

# EPA's Greenhouse Gas Emissions Model (GEM)

- Certification of tractors and vocational vehicles done via simulation using GEM
- Inputs for engine, aerodynamics involve separate (physical) testing protocols
- Phase 2 proposes that manufacturers chassis test a small number of models to provide data on the quality of GEM results

# Test Cycles for Vocational Vehicles and Tractors

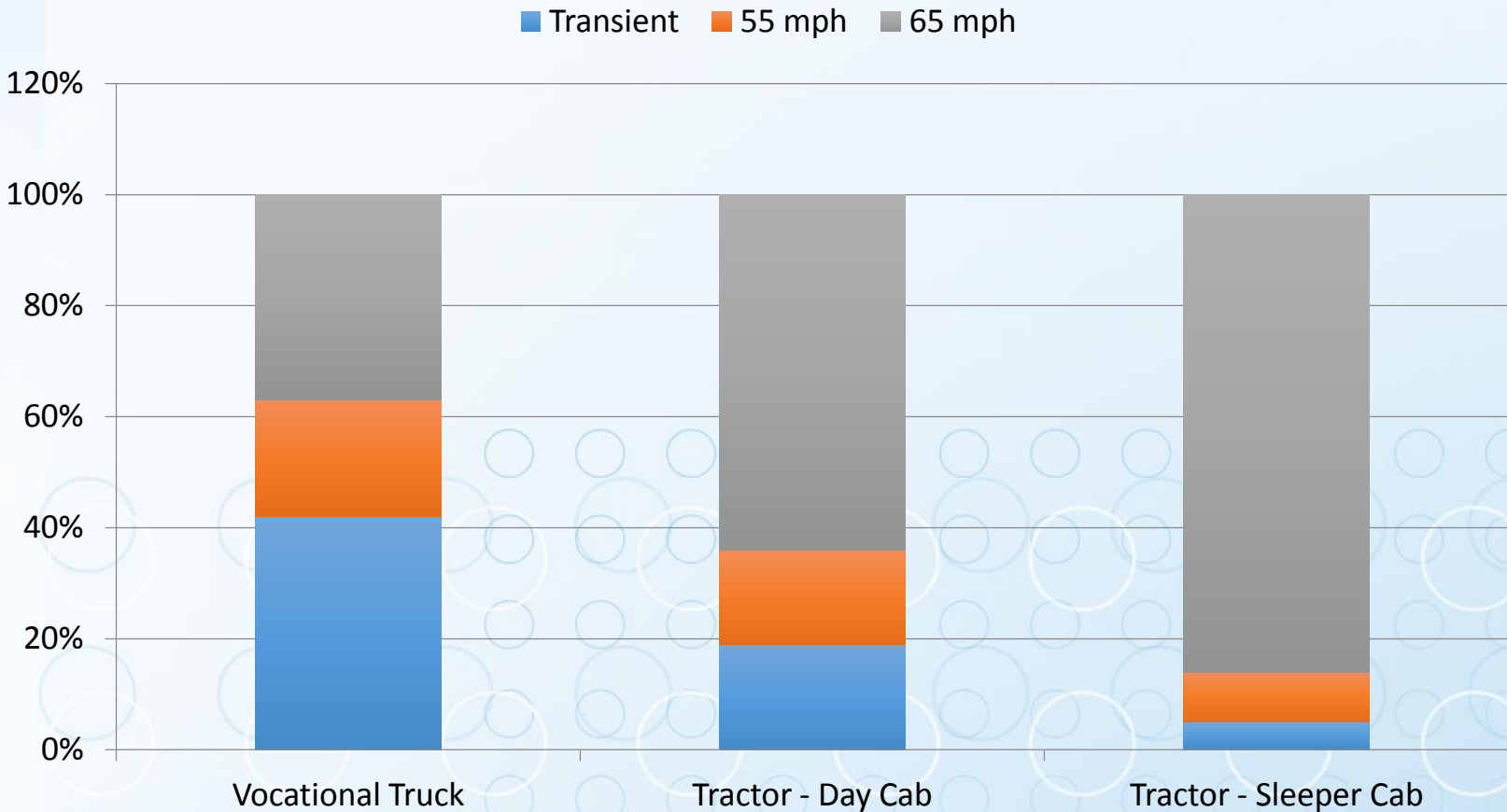
**CARB Transient Cycle + 2 Steady-State Cycles**



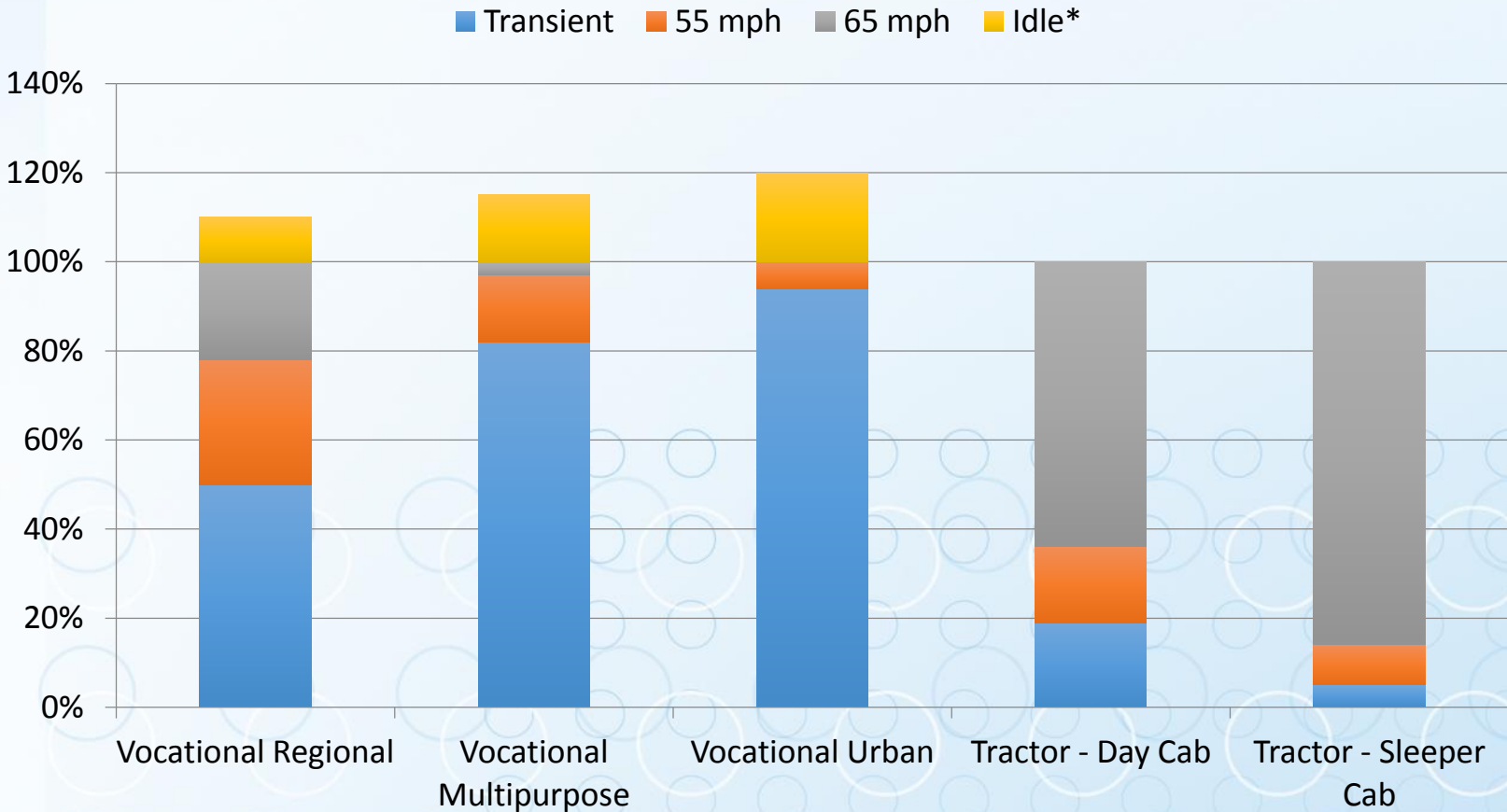
- 89 km per hour
- 105 km per hour

**Plus idle cycle in Phase 2**

# Cycle Weights – Phase 1



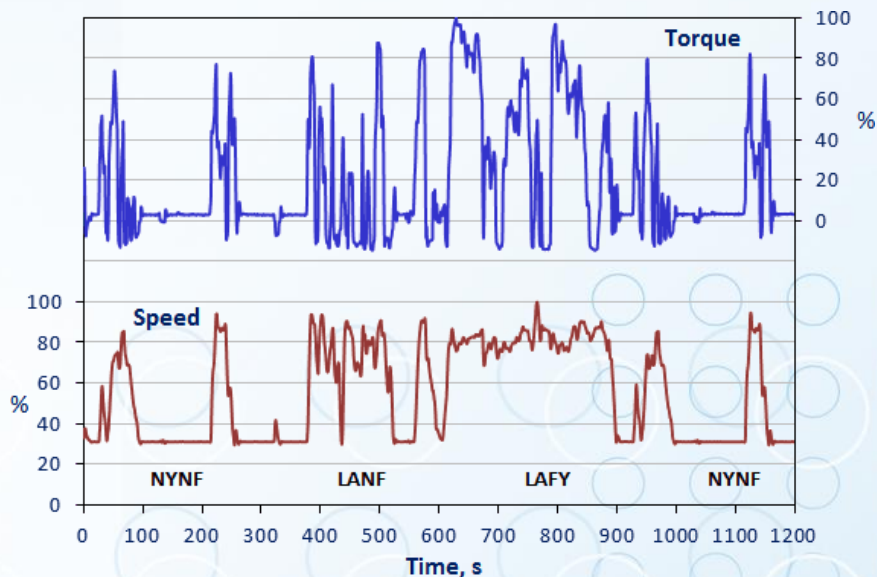
# Cycle Weights – Phase 2



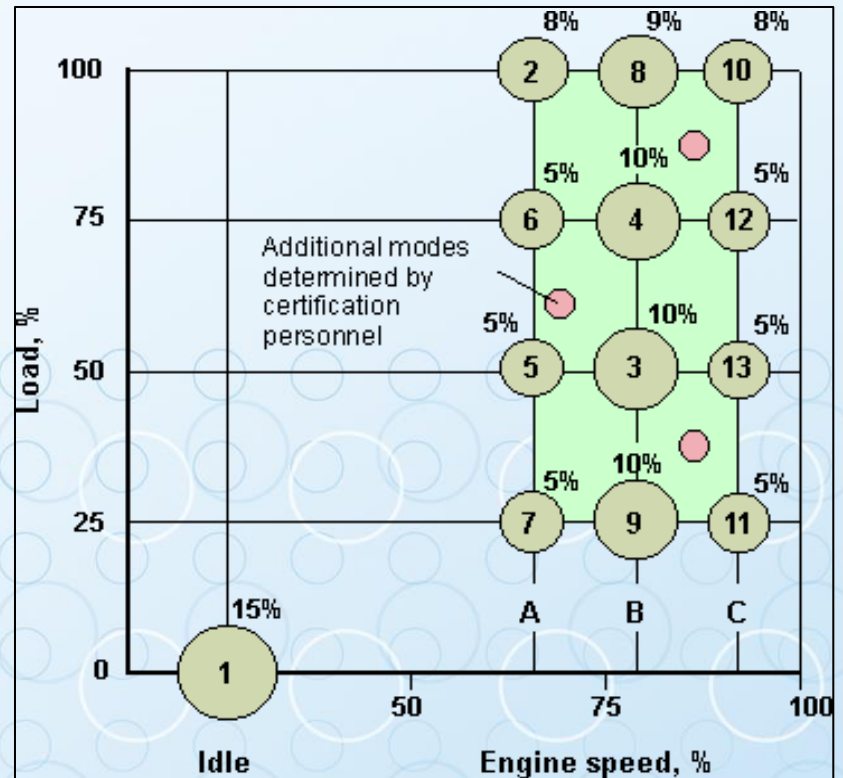
\*Idle as % of total time

# Test Cycles for Engines: Transient and Steady-State

## Federal Test Procedure (HD FTP)

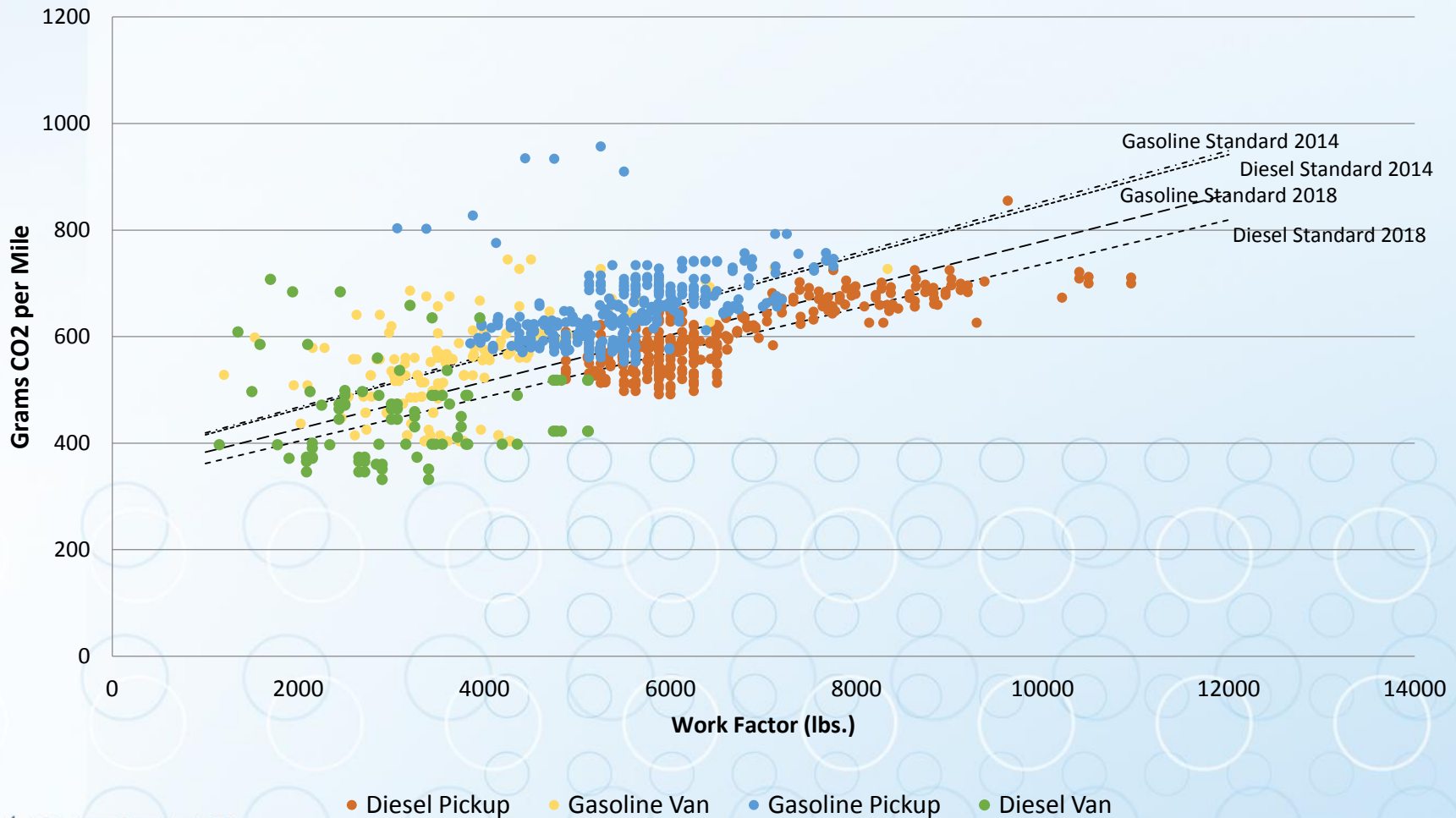


## Supplemental Emissions Test





# Emissions of HD Pickups and Vans, MY 2014



# Advanced technology

- Program seeks to accelerate adoption of advanced technology; EPA has authority to set a “technology-forcing” standard
- Phase 1: Advanced tech credits
- Phase 2: Stringency based on
  - Powertrain integration
  - Vocational hybrids
  - Advanced aerodynamics for tractors and trailers
  - Rankine cycle (waste heat recovery) for tractor engines

# Improvements from Phase 1 to Phase 2

Rule Features	Phase 1	Phase 2
Transmission included	No	Yes
Full-vehicle standard	Not really	Yes
Trailers included	No	Yes
Realistic test cycles	Limited	Improved
Vocational vehicle segmentation	Limited	More extensive
Appropriate treatment of HD pickups and vans	Moderate	Moderate
Advanced technologies	Credits available	Reflected in stringency

# Thanks!

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# Oil Savings from Heavy-Duty Standards

