Truck Sector Overview
Technology Assessment

September 2, 2014
Sacramento, California

California Environmental Protection Agency
Air Resources Board

Overview

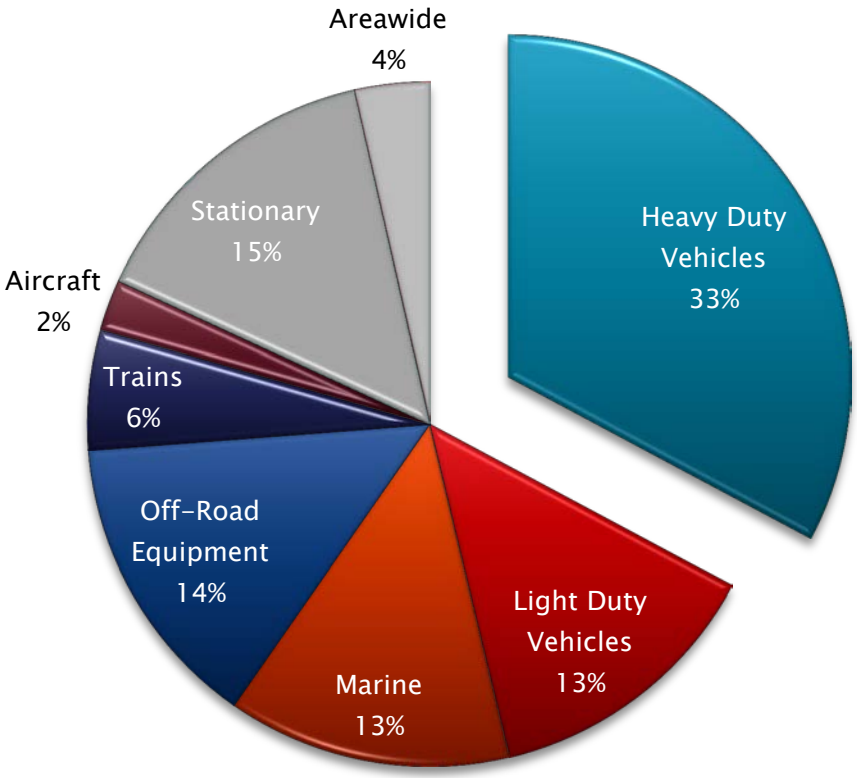
- Heavy-Duty Truck Emissions
- Heavy-Duty Truck Regulations and Emissions Trend
- How Heavy-Duty Trucks are Powered
- Truck Fleet Characteristics – How Trucks are Purchased and Used
- Characteristics of Truck and Trailer Manufacturing
- Time to Market for New Technologies

Heavy-Duty Truck Emissions

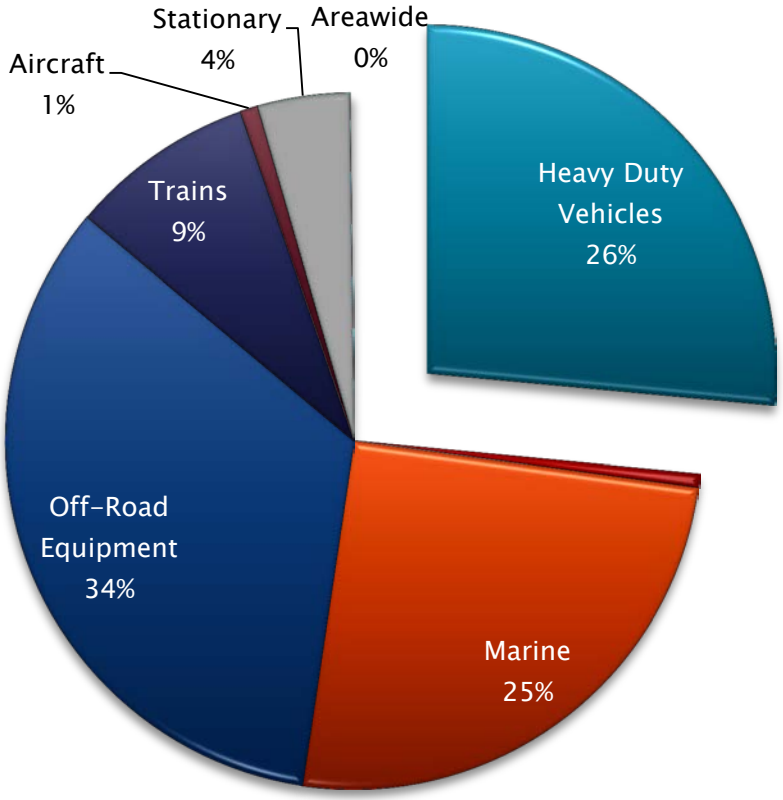
- Overall and by Truck Type

Statewide Emission Sources

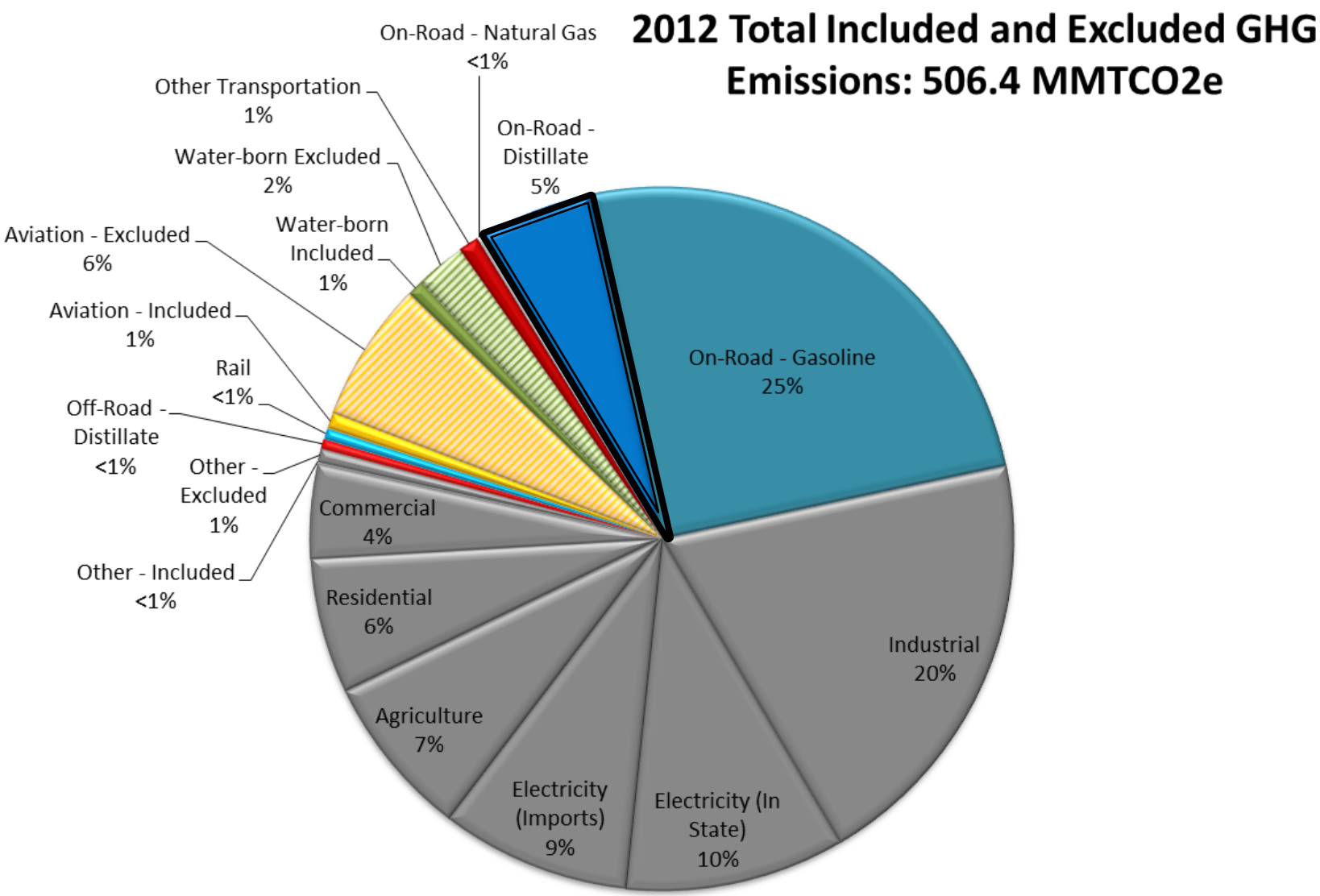
2014 Statewide NOx Emissions



2014 Statewide Diesel PM2.5 Emissions

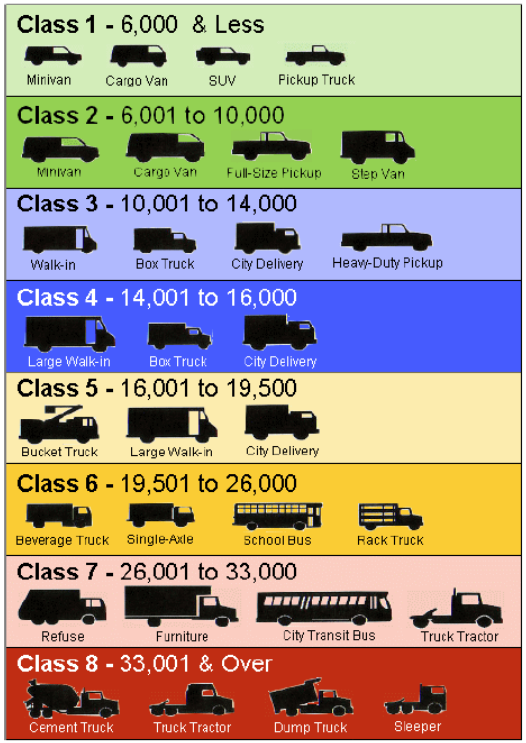


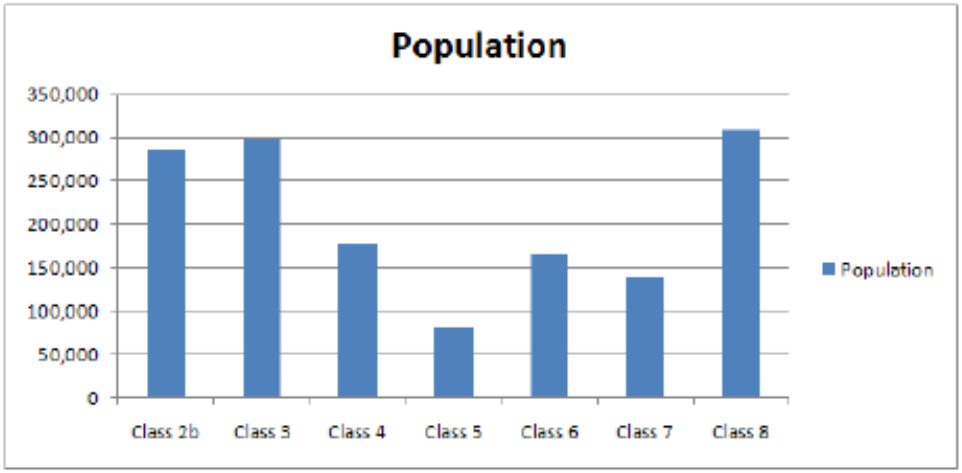
Statewide GHG Emissions



Types of Trucks

- Class 2b-8 Vehicles
- These vehicles are responsible for a variety of essential functions from transporting freight to support for a wide range of vocations





CalHEAT Study Classification

Class 7/8 Tractors

Over the Road

- Younger Trucks; High Annual VMT
- Mostly higher average speed, highway driving

Short Haul/ Regional

- Between cities; Drayage; Day Cabs
- Includes second use trucks; trucks with smaller engines

Class 3-8 Vocational Work Trucks

Urban

- Cargo, freight, delivery collection
- Lower VMT; Lower Average speed; Lots of stop start

Rural/ Intracity

- Cargo, freight, delivery collection
- Higher VMT; Higher Avg speed; Combined urban/ highway

Work site support

- Utility trucks, construction, etc.
- Lots of idle time; Lots of PTO use

Class 2B/3

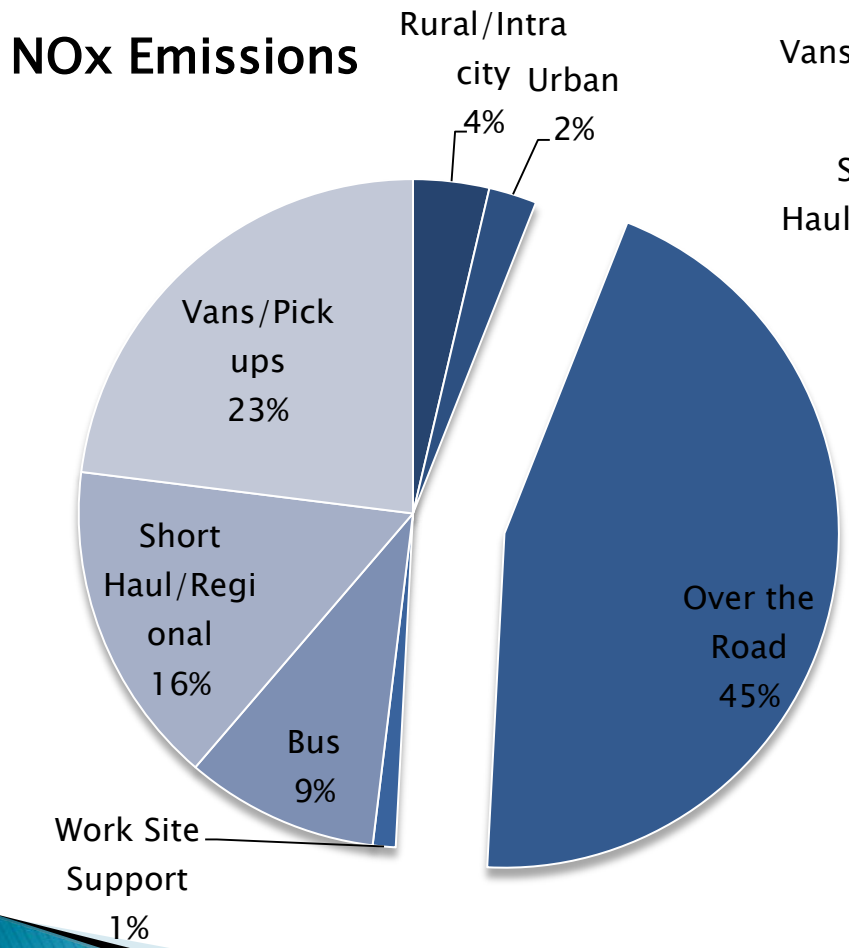
Pickups/ Vans

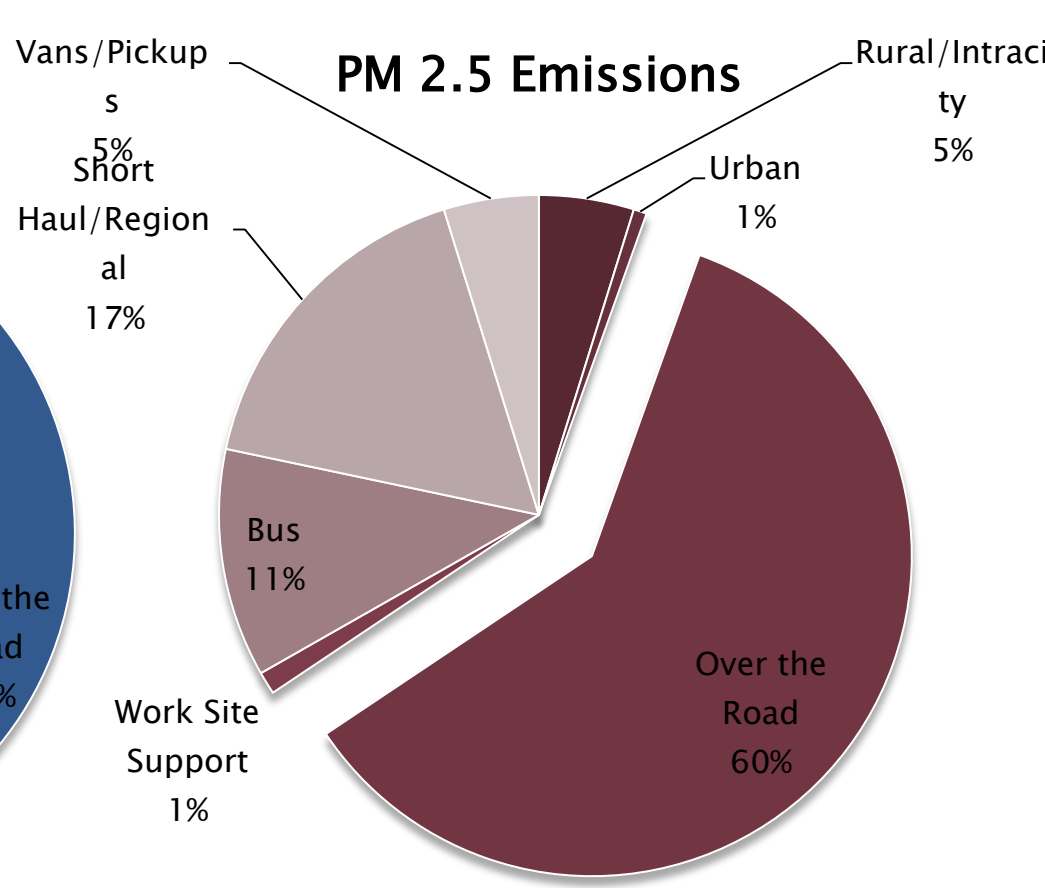
- Commercial use; Automotive OEMs & volumes

Inventory Data base on CalHEAT Classifications

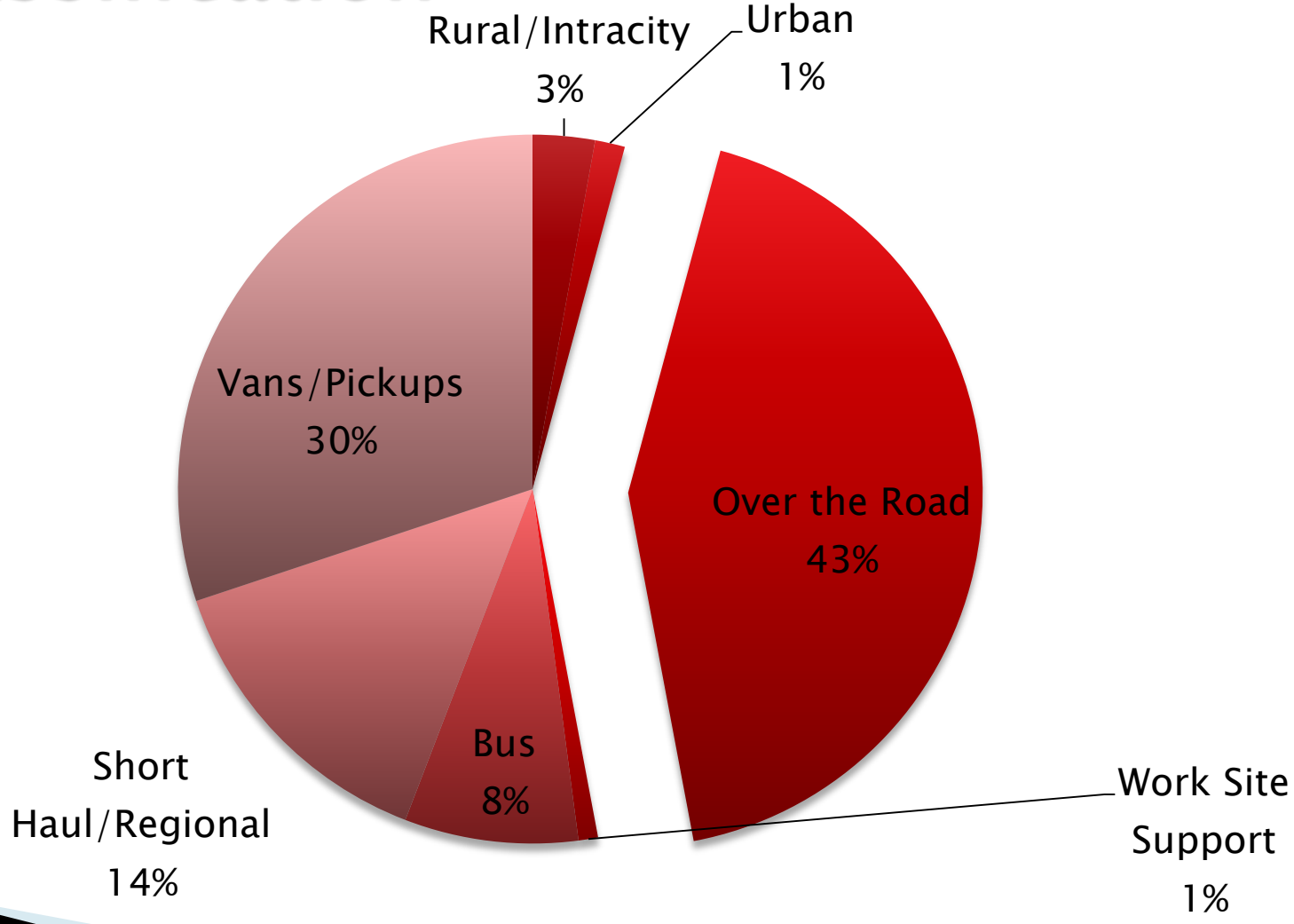
- Over the Road trucks represent the majority of emissions and vehicle miles traveled in all of the major categories while only accounting for 10% of the population of these vehicles in the state
- Short Haul/Regional is the next biggest source of emissions while accounting for 11% of the population
- California Truck fleet is diverse and perform a variety of vocations

NOx and PM 2.5 Emissions by Truck Classification





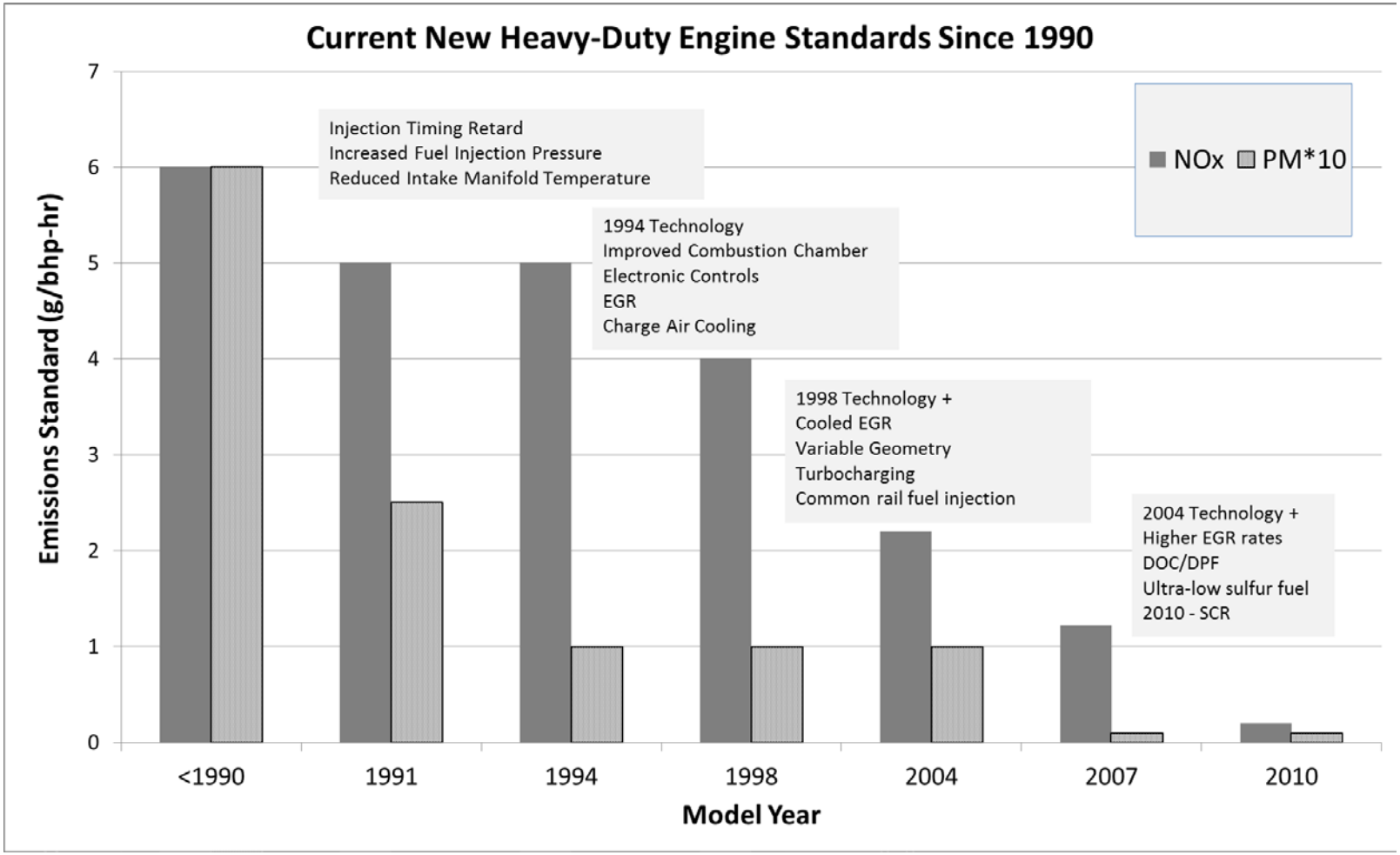
CO_2 Emissions by Truck Classification



Heavy-Duty Truck Regulations

- Emission Trend Over Time

Heavy-Duty Engine Regulations and Standards Since 1990

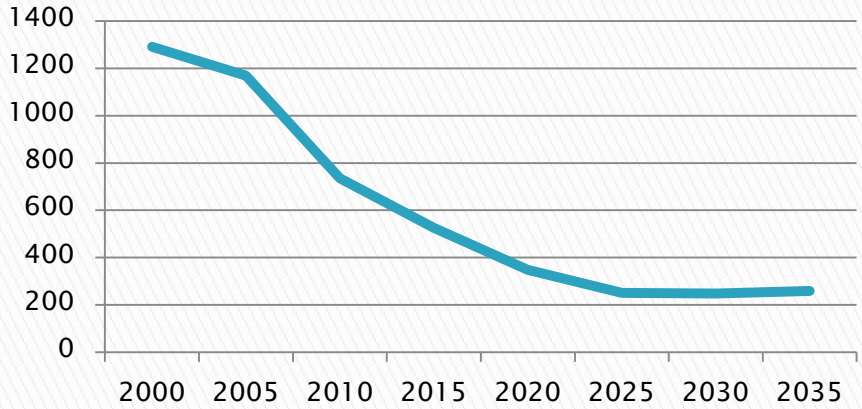


ARB Rules and Regulations targeting Heavy-Duty Emissions

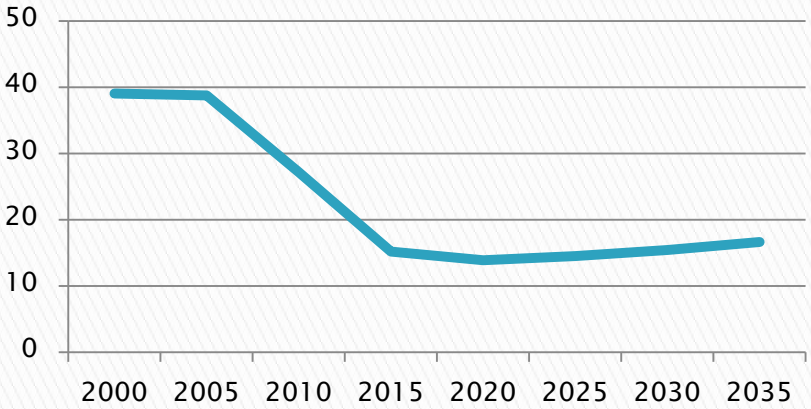
- Stricter new engine standards over time
- ARB Fleet Rules:
  - Commercial Vehicle Idling Regulations
  - Truck and Bus In Use Regulation
  - Tractor-Trailer GHG Rule
  - Drayage (port, rail yard) Regulation
  - TRU (Reefer) ATCM
  - Solid Waste Collection Vehicle Rule
  - Fleet Rule for Public Agencies and Utilities

Emission Trends for Mobile Sources

NOx Emission Trends (Tons/day) from On Road Heavy-Duty Trucks



PM 2.5 Emission Trends (Tons/day) from On Road Heavy-Duty Trucks



*Using EMFAC 2011 Data for On Road Heavy-Duty Truck Emissions

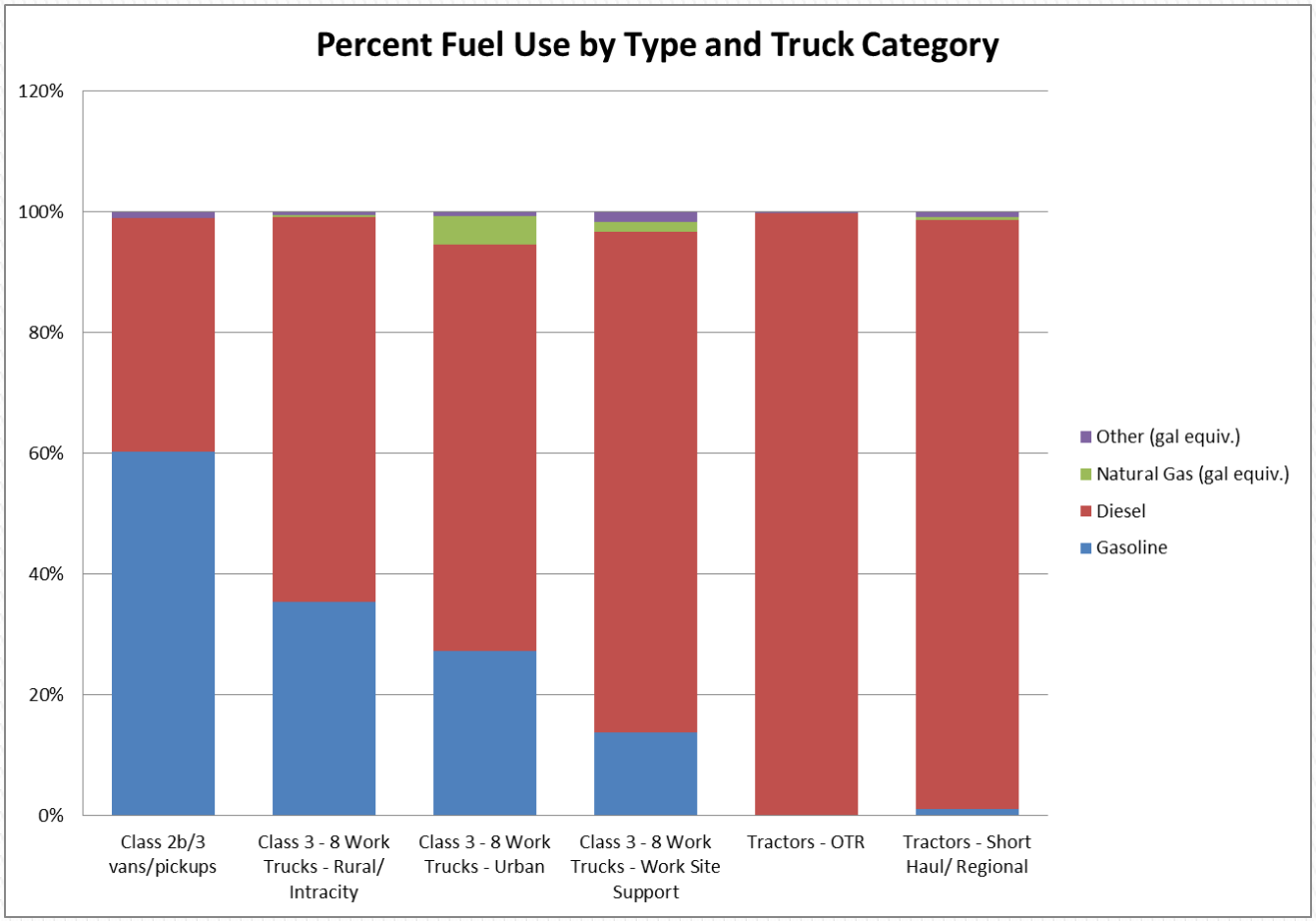
Previous regulations have resulted in decreases in both NOx and Diesel PM Emissions

How Heavy-Duty Trucks are Powered

- Conventional Fuels and Advanced Technologies

Type of Fuel Used by Cal HEAT Classifications

- Diesel fuel is the primary fuel for heavier trucks
- Gasoline is more relevant in the smaller class vehicles



Hybrids, Fuel Cell and Electric Technology in Heavy-Duty Vehicles

- Trucks are currently dominated by conventional fuels (ie. Diesel and gasoline)
- Significant progress in the development and penetration of alternative fuels for heavy-duty trucks is taking place in the marketplace
- Hybrids, Fuel Cell and Electric Vehicles can be effective in several vocations such as drayage, waste (refuse) and bus applications

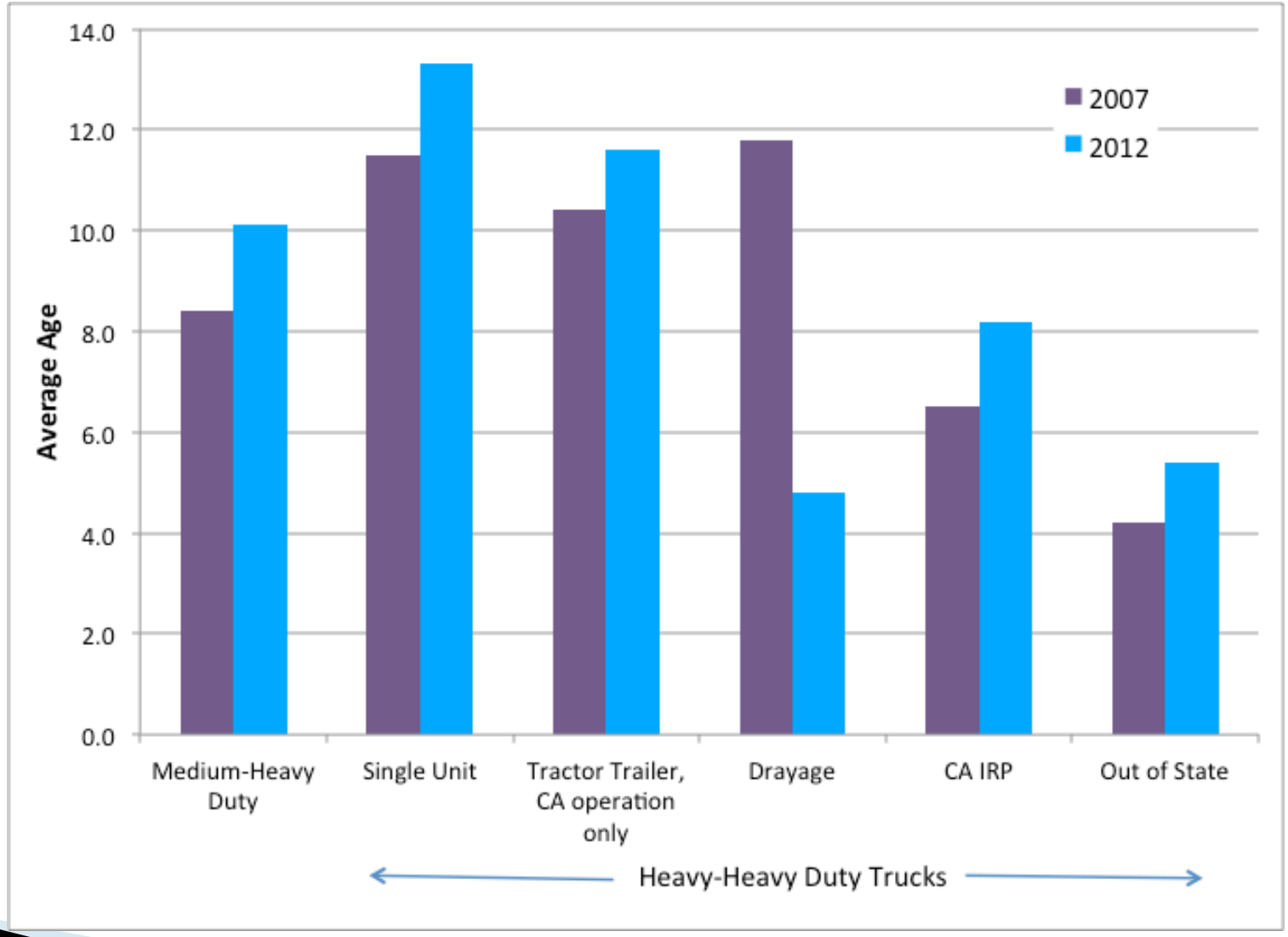
Truck Fleet Characteristics

- How Trucks are Purchased and Used

Truck Age Distribution and Function

- Truck have relatively long life spans with life spans over 20 years
- Trucks can travel more than a million miles over their lifetime
- California heavy-duty trucks are diverse and serve a variety of vocational applications from Agriculture, Construction to traditional long-haul trucking
- Trucks often have multiple lives; for example a Class 8 Over the Road vehicle is often sold used to perform the function of regional haul vehicle
- Fleets often have different age characteristics:
  - Fleets with 51 or more vehicles have an average age of 4.9 years
  - Fleets with less that 6 vehicles have an average age of 11 years

Average Vehicle Age for Different California Heavy-Heavy Duty Truck Classifications



Truck Age Distribution and Function

- *Over the Road* trucks tend to be predominately new trucks
- *Work Trucks-Urban, Work Site Support, Rural/Intracity* tend to be made of more even distributions of newer and older trucks.
- *Short Haul/Regional* trucks again tend to be weighted toward older trucks

Basic Drive Cycles for Truck Categories

- Drive cycle is highly driven by weight class, vocational and driving pattern for vehicles
- The effectiveness new technologies such as hybridization and electrification is highly dependent on duty cycle
- Duty cycle affects engine temperature, SCR, catalyst effectiveness, DPF region and much more

- Over the Road (OTR)–Class 7 and 8 trucks that travel high annual VMT at higher average speeds marked by mainly highway driving
- Short Haul/Regional–Class 7 and 8 trucks that mainly drive between cities
- Urban–Class 3–8 trucks that have a lower VMT and average speed with significant stop and start activities
- Rural/Intracity–Class 3–8 high VMT with higher average speed marked by a combination of urban and highway traffic
- Work Site Support– Class 3–8 utility trucks which have significant idle times and PTO use

Used Truck Purchasing Patterns in California

- Heavily influenced by the national fleet
  - One million interstate trucks operate in CA
  - More than half of California's in-state heavy trucks were originally purchased outside of California
- Needs additional control
  - California will not attain ozone standards without additional reductions from the heavy-duty sector
  - A California standard will not by itself impact enough trucks to meet attainment
- A strengthened national standard is crucial to meet California's air quality goals

Heavy-Duty Truck Manufacturing

- Tractor, Trailer, Engine, Chassis, and Body Manufacturers

Characteristics of Truck Manufacturing

- Truck manufacturing as a whole is marked by a lack of vertical integration
- Class 8 trucks are broken into manufacturers that build the tractor, engine, powertrain (including transmission) and an industry that manufacturers the trailer
- Class 4-7 vocational trucks are predominately manufactured in two steps: a chassis manufacturer builds the chassis and then a body builder builds the remainder of the vehicle

Class 7 and 8 Tractor Manufacturing

- Over 60% of Class 7 and 8 vehicles in use in 2002 were manufactured by 5 truck manufacturers: Freightliner, Kenworth, International, Mack and Peterbuilt
- These same 5 companies accounted for nearly 80% of new manufacturing in 2005.
- Unlike in light duty vehicles, tractor manufacturers often interchange engine manufacturers and/or powertrain manufacturers (i.e. transmission)
- Over 90% Class 8 tuck engines in 2005 were manufactured by 8 companies: Caterpillar, Cummins, Detroit Diesel, Mack, and Volvo
- US DOE Supertruck program is attempting to encourage a holistic look at Class 8 trucks/trailers with the goal of achieving higher fuel economy

Class 8 Tractor Manufacturers 2008–2012

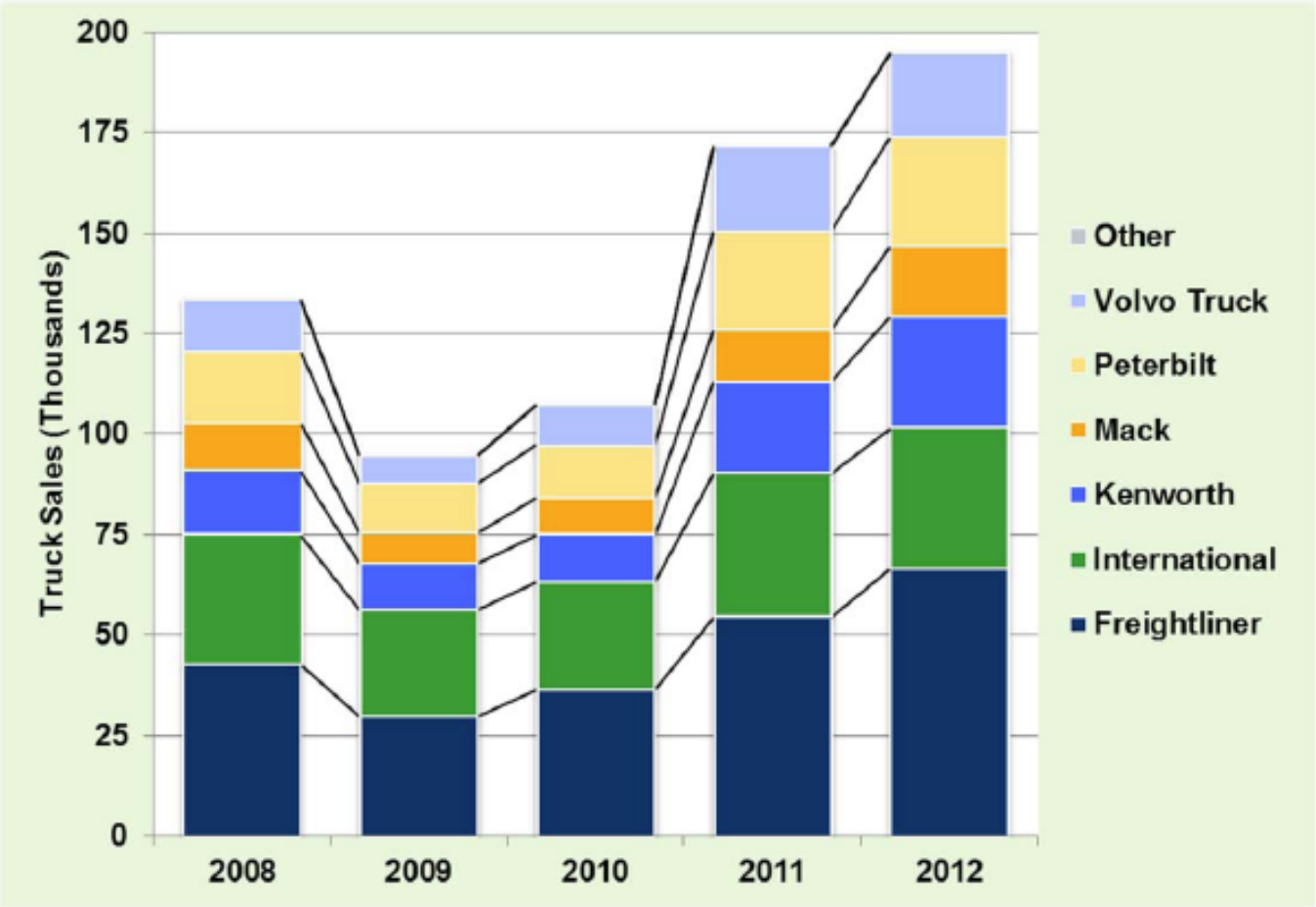
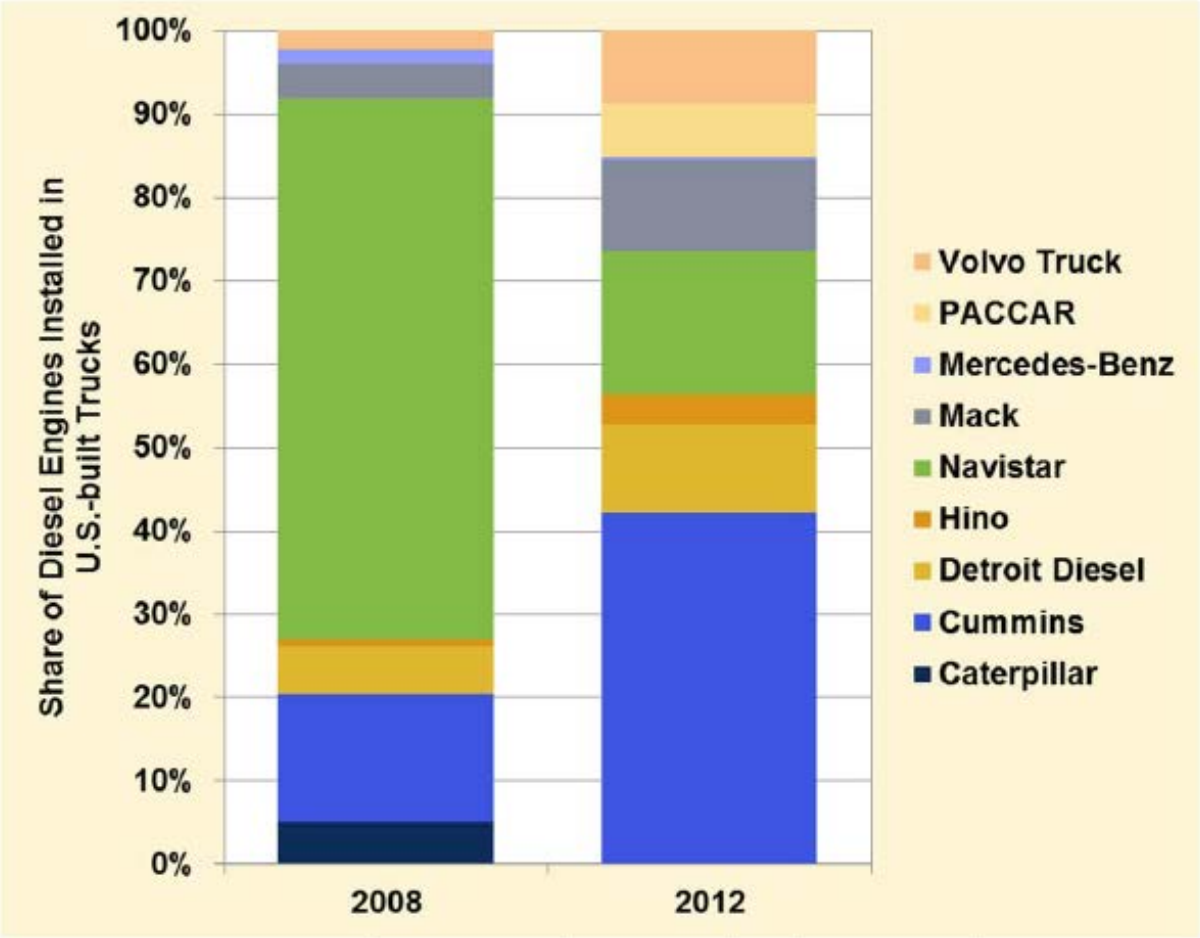


FIGURE 75. Class 8 Truck Sales by Manufacturer, 2008-2012

Heavy Duty Diesel Engine Market by Manufacturer Class 4-8

- Class 4-8 Engine Manufacturing is dominated by 8 companies

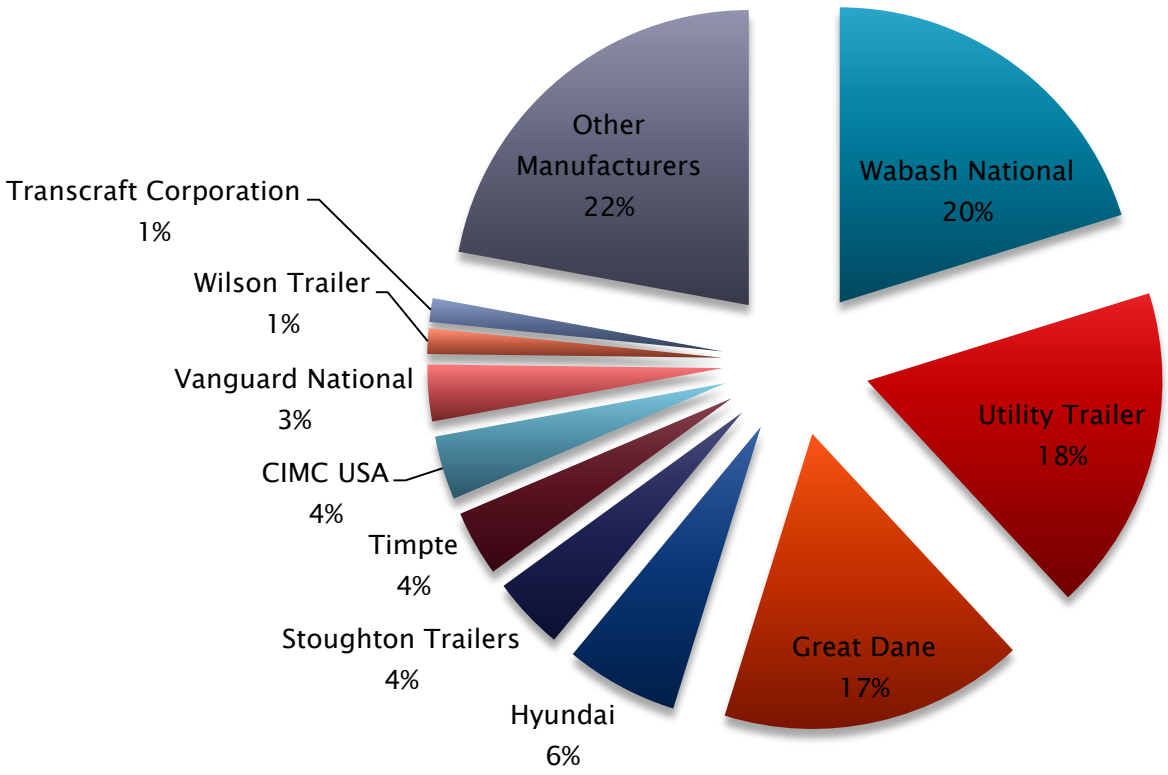


Trailer Manufacturing

- Trailer manufacturing is largely separated from tractor manufacturing
- The Top 10 manufacturers of trailers comprise 77.9% of the market share
- These manufacturers are:
  - Wabash, Utility Trailer, Great Dane, Hyundai, Stoughton Trailers, Timpte, CIMC USA, Vanguard National, Wilson Trailer
- Trailers range in function from van, refrigerated van, flatbed, tank, container, grain to a variety of more specialized function trailers
- Dry Vans dominate the type of trailers manufactured

Trailer Manufacturing

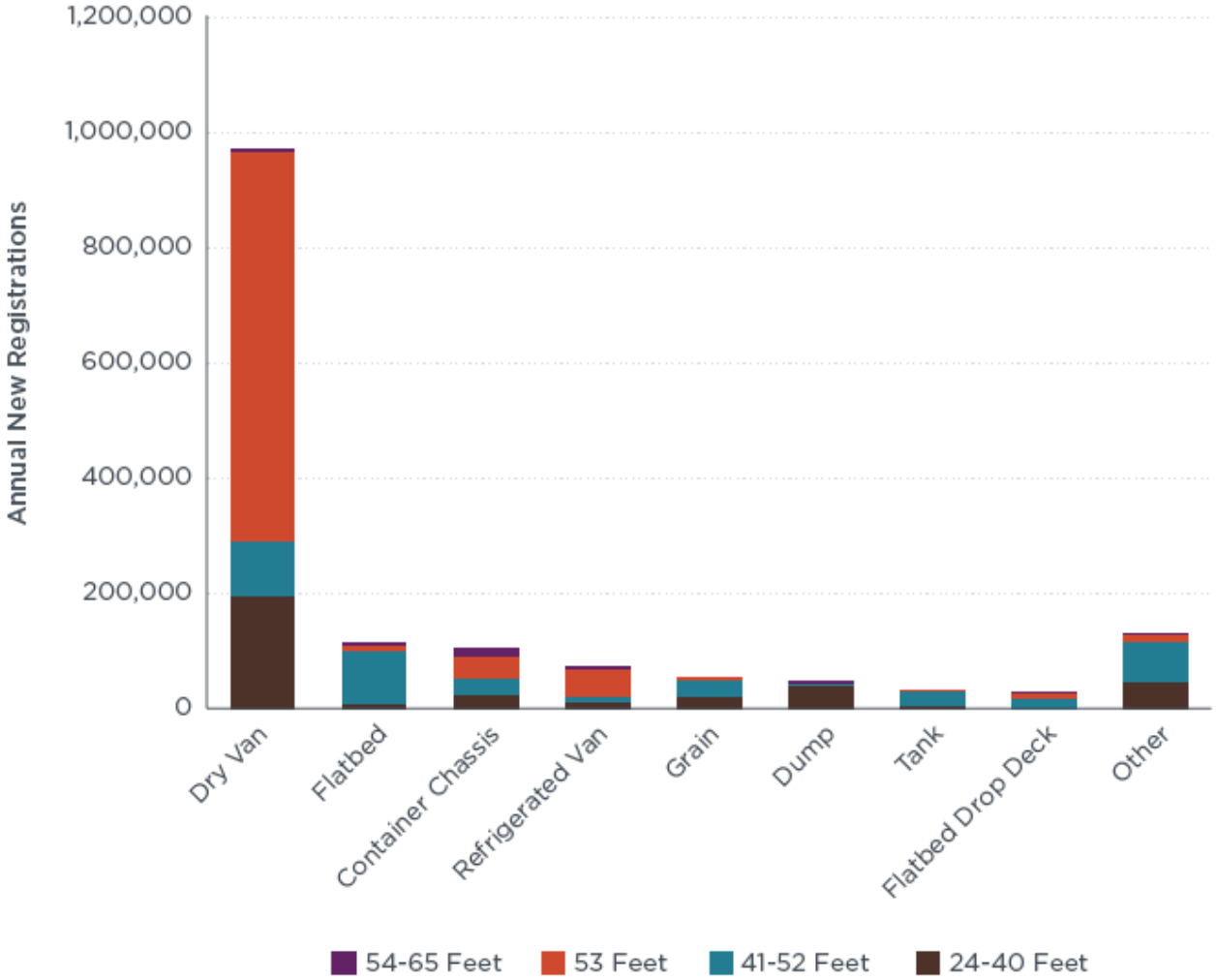
Major Trailer Manufacturers by Market Share 2008-2011



Trailer Ownership and Use

- Trailers are predominately owned by either private companies that transport their own goods or for-hire carriers which transport freight for a fee
- The effective lifespan of a trailer is 30+ years
- New trailer registrations are at a 1.17 to 2.18 ratio to new tractors
- Dominated by dry vans

Trailer Types by Annual New Registrations



*Trailer Technologies for Increased Heavy-Duty Vehicle Efficiency, ICCT June 2013

Vocational Truck Manufacturing Class 4-7

- Vocational truck manufacturing is not vertically integrated.
- Rather, a group of manufacturers produce a chassis which is then equipped with a body by body builder manufacturer
- Chassis manufacturing is fairly consolidated while there are numerous body builder manufacturers
- Engine manufacturing is dominated by the same manufacturers as those for Class 8

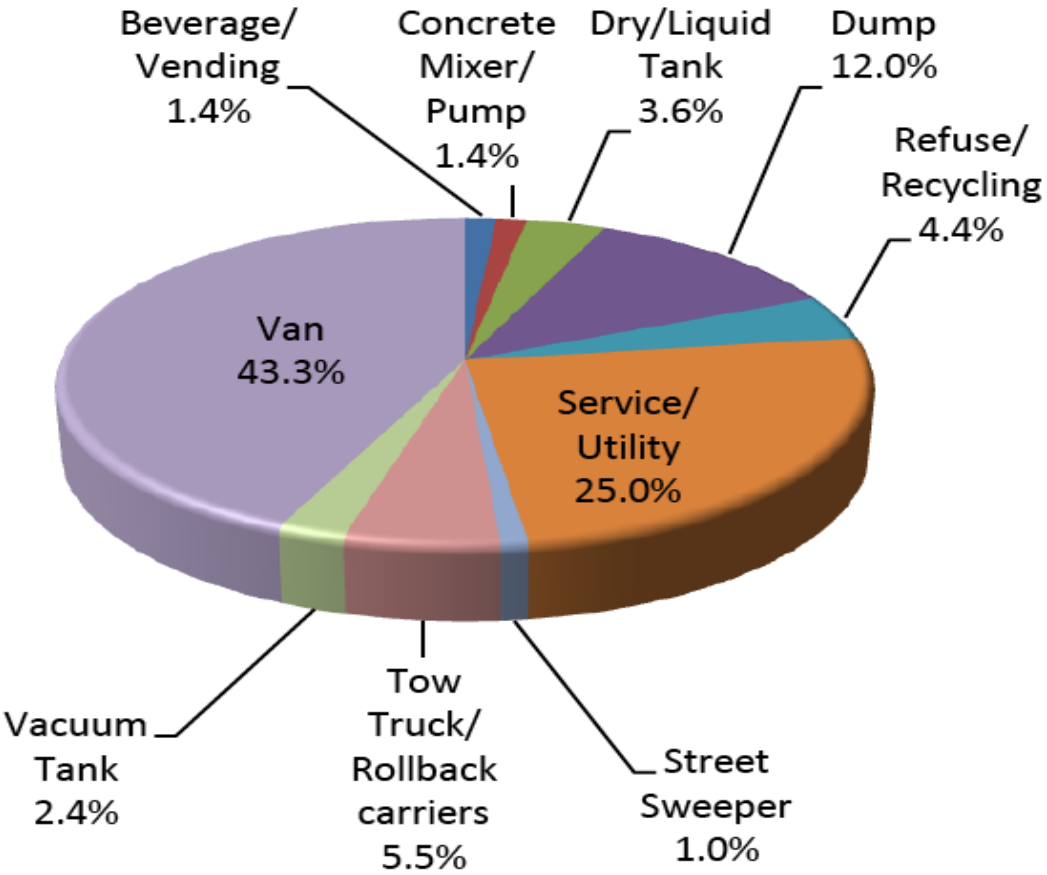
Chassis and Powertrain Manufacturers for Medium- and Heavy-Duty Trucks

- 18 Major Vocational Chassis Manufacturers:
  - Bluebird, Ford, Freightliner, Custom Chassis,Gilig, GM, Hino, IC Bus, International, Isuzu, Kenworth/Peterbilt, Mack/Volvo, Mitsubushi, Fuso, NABI, New Flyer, Nova Bus, Ram, Spartan, Thomas, Western Star/Freightliner
- 16 Major Powertrain (including Transmission) Manufacturers:
  - Aisin, Allison, Altec, ArvinMeritor, BAE, Boulder Electric, Crosspoing Kinetics, Dana, Eaton, Lightning Hybrids, Motive Power Systems, Odyne, Parker Hannifin, VIA Motors, Voith, ZF

Vocational Body Manufacturing

- Over 200+ vocational body builders across North America
- Major Categories of Vocational Body Builders:
  - Beverage and Vending
  - Concrete Mixers and Pumps
  - Dry and Liquid Tankers
  - Dump
  - Refuse and Recycling
  - Service and Utility
  - Street Sweepers
  - Tow Trucks and Rollback Carriers
  - Vacuum tank

Truck Bodies: All
Unit Share by Product Type



Time to Market

- For new truck and engine technologies

Time to Market

- Section 202(a) of the federal Clean Air Act requires 4 years lead time and 3 years stability for engine standards
- Typically takes ~2 years for regulatory development
- Seeking manufacturer input on production development times including beta engine development, fleet testing, and production site tooling
- Typically, industry looks to 18 month payback for fuel economy technologies in respect to long-haul fleets but these technologies have lasting benefits for the vehicle

Contacts

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- Submit comments by Oct. 1 to: http://www.arb.ca.gov/msprog/tech/comments.htm