Truck Sector Overview Technology Assessment

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California Environmental Protection Agency



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



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





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 heavyduty 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

- <u>Over the Road (OTR)</u>-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
- <u>Urban</u>-Class 3-8 trucks that have a lower VMT and average speed with significant stop and start activities
- <u>Rural/Intracity</u>-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

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