In-Use Off-road Diesel Vehicle Regulation Workgroup Meeting

June 18, 2007
Sacramento, California

Heavy-Duty Diesel In-Use Strategies Branch

California Environmental Protection Agency

Air Resources Board

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Outline

- Staff cost estimate
- Staff cost analysis and methodology
- Issues raised
- Construction industry estimate

PM Retrofit System

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Staff Cost Estimate

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Staff Cost Estimate

- Total cost of $3.0 - $3.4 billion
  - Range based on compliance actions chosen
- Cost-effectiveness
  - $37 - $43/lb PM
  - $2.1 - $2.5/lb NOx
- Health cost savings
  - $18 to $26 billion

PM retrofit in engine bay

Technical Support Document, page 173 (ARB, April 2007)

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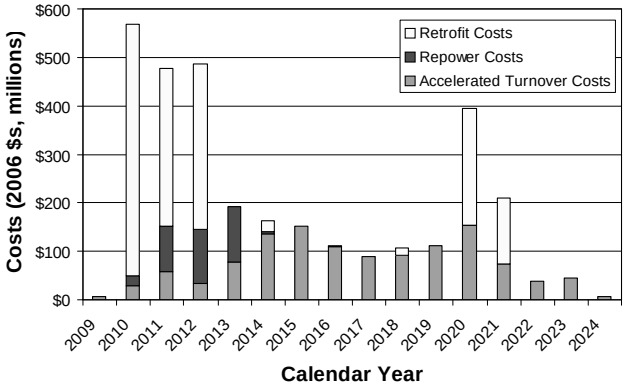
Annual Costs



Staff Report, page 40 (ARB, April 2007)

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Staff Cost Analysis and Methodology

DPF durability demonstration on concrete

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Modeling Based on Analysis of Individual Fleets

- Modeled actions for each fleet separately
  - Applied BACT until fleet average met
- Evaluated each year from 2009 to 2030
- Modeled actions required by regulation
  - Buy new, buy used, repower, and/or install exhaust retrofits
- Compared to baseline without regulation
- Did not model growth in individual fleet
- Scaled costs for individual fleets to match ARB emissions inventory for each year

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Individual Fleet Analysis Methodology Overview

- Determined fleet average age
- Estimated age of vehicle normally purchased
- Estimated normal turnover rates for each fleet
  - Based on fleet age
- Order of turnover by relative age
  - Ratio of vehicle age to useful life of the vehicle category

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200 Individual Fleets Analyzed

- From individual fleet owners, and industry associations and 2003 TIAX survey
- Total population = 10,152 vehicles
- Total hp = 2,163,669 hp

NOx/PM Retrofit System

Technical Support Document, page H-2 (ARB, April 2007)

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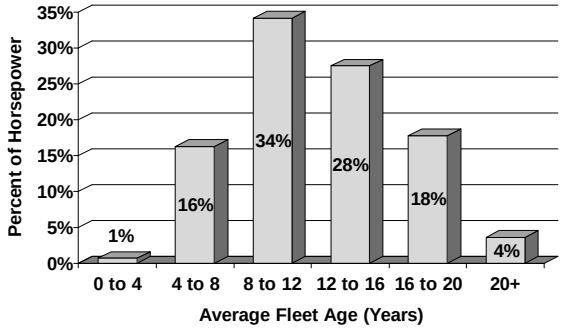
Summary Fleet Age Distribution



Technical Support Document, page 170 (ARB, April 2007)

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Age of Replacement Vehicles Modeled

Average Fleet Age	Replacement Age (years)	
	Baseline	Regulation
0 to 8 years	New	New
8 to 12 years	2	1
12 to 16 years	4	2
16 to 20 years	6	3
20 and greater	8	4

Technical Support Document pp. 161, 164, H-6 (ARB, April 2007)

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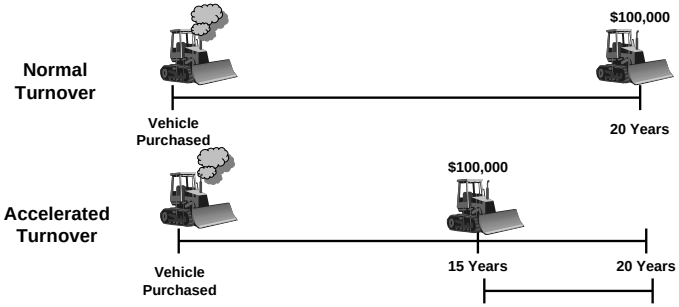
Accelerated Turnover Cost Example



Value at 15 Years = $5,000
Value at 20 Years = $3,000

Cost = ($100,000-$3,000) x (5/20) - $5,000 + $3,000 = $22,250

Technical Support Document, page 160 (ARB, April 2007)

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Accelerated Turnover Costs Data

- For sale prices collected for 19 equipment categories
- Over 2000 prices collected
- Curve fit by $/hp and vehicle age to represent typical price

Technical Support Document, page 162 (ARB, April 2007)

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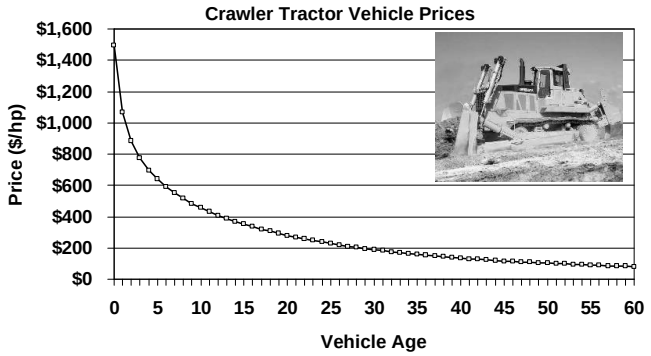
Example Vehicle Cost Inputs



Workshop Presentation (ARB, December 2006)

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Repower Cost

- Average repower cost $270/hp
  - Tier 0 to Tier 2 or Tier 3
  - From Justice and Associates
- Modeled on engines over 250 hp
  - Only if 10 years before end of useful life
- Not presumed to occur at time of rebuild
- No salvage value attributed to replaced engine
- About 2% of engines estimated to be repowered

Technical Support Document page 161, 164, H-6 (ARB, April 2007)

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Estimated PM Retrofit Costs

Engine Size	Total Price
Less than 50 hp	$8,000
50 to 175 hp	$12,000
175 to 300 hp	$18,000
Greater than 300 hp	$30,000

Represent mix of active and passive systems

Technical Support Document, page 164 (April 2007)

Actual Price Quotes for Huss Active System (spring, '07)

Engine Size	Number of Quotes	Median Price
Less than 50 hp	0	NA
50 to 175 hp	94	$13,928
175 to 390 hp	15	$19,512
394 hp	1	$48,858

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Other Costs Included

- Increased costs for Tier 4 vehicles
  - Equivalent to price of DPF
- Reduced value of Tier 0 vehicles
- Fuel economy losses
  - 2% loss associated with PM filters
- Filter regeneration and maintenance costs
- Reporting costs

NOx/PM Retrofit System

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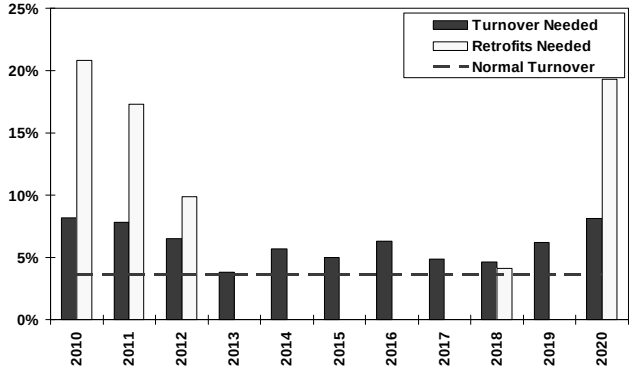
Technical Support Document pp.165-166, 173 (ARB, April 2007)

Compliance Path Example Fleet 1 Average Age 13.4 Years



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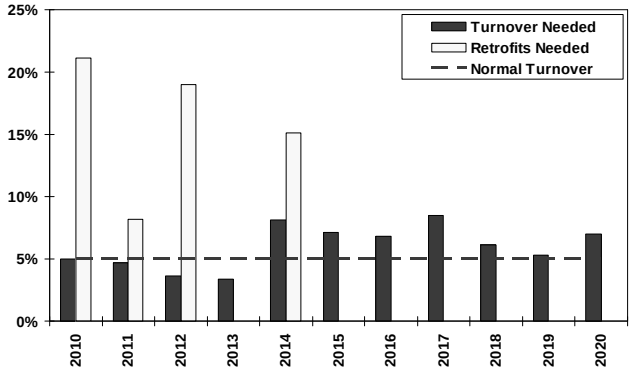
Technical Support Document, page 167-169 (ARB, April 2007)

Compliance Path Example Fleet 2 Average Age 8.9 Years



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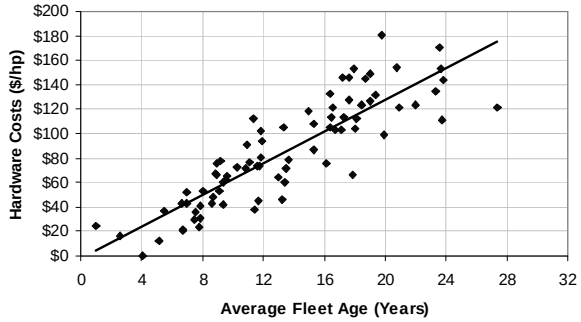
Technical Support Document, page 167-169 (ARB, April 2007)

Compliance Costs by Fleet Age for Medium and Large Fleets



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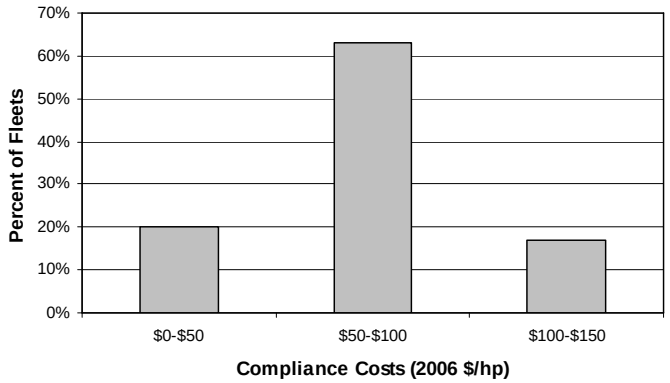
Technical Support Document, page 171 (ARB, April 2007)

Total Fleet Compliance Costs Vary



Technical Support Document, page 171 (ARB, April 2007)

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Issues Raised by Stakeholders and Staff Response

Fuel Burner PM Retrofit System

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Issue Raised by Stakeholders

- Vehicle inventory underestimated
- Baseline/normal turnover rate too high
- Results skewed by public fleet data
- Cost estimates sensitive to input assumptions
- Insufficient number of used vehicles available
- Impact on jobs underestimated
- Industry published estimate much higher

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Inventory Update Process

- ARB held 6 workgroup meetings with stakeholders to gather input and data
  - From December, 2004 through July, 2006
- In July 2006, the inventory was updated based on:
  - MacKay & Co. Construction Universe Study (2003)
  - TIAX Public Fleet Survey (2003)
  - Yengst equipment analysis reports (2005)
  - ARB Off-road Equipment Survey (2005)
  - ARB Off-road Mini Survey (2006)
  - Input from stakeholders
- OFFROAD2007 Model incorporated this updated diesel inventory in November 2006

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Normal Fleet Turnover Rate

- Statewide average vehicle attrition rate from ARB inventory about 5% per year
- Industry used 3% per year referencing US EPA
- EPA NONROAD model show 7% per year attrition rate

PM Retrofit Systems at LAX

USEPA NONROAD Model

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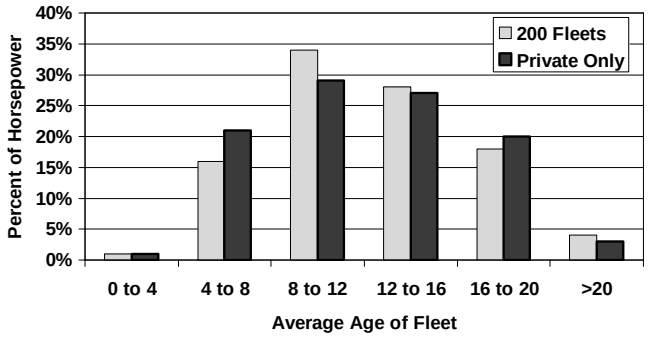
Public Fleets Did Not Skew Age Distribution (77% of horsepower from private fleets)



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Sensitivity Analysis of ARB Model

Factor Evaluated for Sensitivity	Potential Change (billions)
Tier 0 completely devalued	+ $0.4
Double PM retrofit costs for high hp	+ $0.2
Wide utilization of early credit	- $0.2
Public fleets excluded	No Change
Increase new vehicle prices 60%	+ $0.1
More small fleet and fewer large	- $0.02
Repair savings from newer vehicles	Under review

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Availability of Used Vehicles

- At most increase in demand for used vehicles is 5400 per year (2010 to 2015)
- Over 80,000 vehicles for sale in one day on two websites
  - Ritchie Brothers, 2007
  - Machinery Trader, 2007
- Over 30,000 were 2003 model year or newer (likely Tier 2 or better).

Technical Support Document, page 178 (ARB, April 2007)

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Impact on Jobs

- ARB staff used peer-reviewed UC Berkeley model EDRAM
  - Model also used by California Energy Commission and Department of Finance
- Estimated jobs lost throughout entire statewide economy
- Would reduce California employment by approximately 1,000 jobs (< 0.01% of total jobs)

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Construction Industry Estimate

PM filter on small engine skid steer

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Staff Comments on $13 Billion Industry Cost Estimate

- Incorrectly assumed all fleets must do maximum turnover and retrofitting every year
- Only modeled purchase of new (no used) vehicles
- Applied inflated PM retrofit costs to small vehicles
- Arbitrarily assumed PM retrofits would not be used on engines greater than 150 hp
- Inappropriately turned over engines to reduce PM
  - Regulation would not require any action to reduce PM if VDEC not available

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Cost Impact in Industry Model

Assumptions Made in Industry Analysis	Effect in Industry Model
Vehicle attrition rate for oldest vehicle category applied to all vehicles	$2.3 billion
Assumed no fleets would meet the fleet averages (always maximum turnover and PM retrofits)	$1.5 billion
New vehicle prices assumed to be 60% higher	$4.3 billion
Assumed engine turnover to reduce PM rather than use exhaust retrofits (engines >150 hp)	Not quantified
Assumed purchasing of only new vehicles rather than a mix of new and used	Not quantified
Total	$8.1 Billion

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