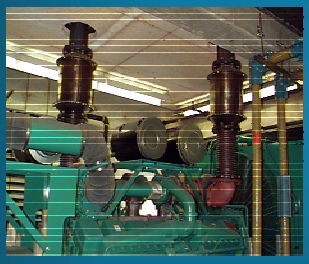
PUBLIC CONSULTATION MEETING TO DISCUSS REGULATORY APPROACHES TO REDUCE EMISSIONS FROM STATIONARY DIESEL-FUELED ENGINES

Presentation of the Methods and Key Assumptions for Estimating the Costs for In-Use Stationary Engines



March 6, 2003

California Environmental Protection Agency

Air Resources Board

Analysis Overview

- Approach
- Estimated costs associated with controls
- Key assumptions
- Preliminary results

Approach

- Identified representative sample
  - Emergency Standby Engines - survey data
  - Prime Engines - Diesel Risk Reduction Plan - survey pending
- Determined level of control to comply with ATCM
  - Annual hourly use
  - Estimated PM emission rate - Offroad Model
  - 25% of engine owners will reduce hours to meet the next lower hourly use limit

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Approach continued

- Determined capital, installation and O&M costs per engine
- Annualized cost based on expected life of control equipment
- Determined emission reductions with reduced hours and installed control equipment
- Calculated cost effectiveness
  - $/lb. PM reduced
  - $/Reduction in risk at PMI

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Estimated Costs Associated with Emission Control System: Capital Costs

- DPFs (Active and Passive)
  - Considered actual costs for 11 installations in CA (includes installation and cost of equipment) and estimated costs quoted by control manufacturers
  - Used this data to estimate a range of cost in $/hp
- DOCs
  - Estimated costs based on quotes by manufacturers
- New Engines
  - Considered actual costs for five installations in CA
  - Contacted engine manufacturer for quotes on various size new diesel generators

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Estimated Costs Associated with Emission Control System: O&M Costs

- DPFs (Active and Passive)
  - Estimated cleaning cost ~ once every 300 - 2000 hours
  - Estimated reporting cost
- DOCs
  - Estimated reporting cost
- Emulsions
  - Estimated increased fuel cost ~ $0.30/gallon
  - Estimated decrease in power or fuel economy ~ 15%

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Actual Costs for Diesel Particulate Filters Installed in California

Facility Type	Engine	Model	HP	Date	DPF
Public Works	Caterpillar	3516B	2848	2001	$ 76,000
Medical Center	Caterpillar		2680	2001	$ 156,750
Food Processing	Caterpillar	3516 B	2680	2001	$ 121,500
Data	Cummins	KTTA50-G2	2220	1997	$ 24,000
Food Processing	Caterpillar	3412 DISTA	1100	1999	$ 20,000
Data	Caterpillar		1072	2001	$ 90,000
Communications	Caterpillar	3412C	896	2000	$ 30,000
Data	Caterpillar		536	2001	$ 35,000
Medical Center	Caterpillar	3406	519	2002	$ 26,000
Communications	Caterpillar	3406	449	2000	$ 23,600
Hotel	Caterpillar		175	Soon	$ 8,500

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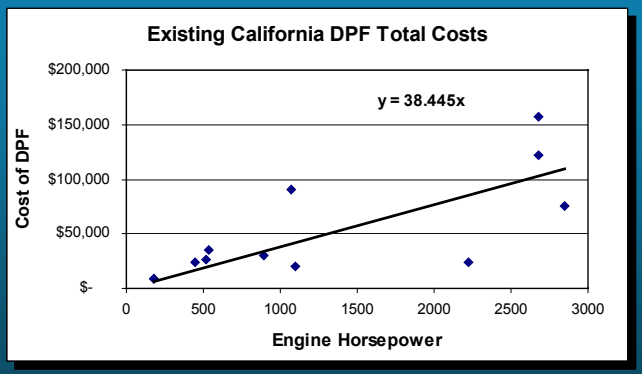
Actual Cost for Diesel Particulate Filters Installed in California



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Manufacturers Estimated Retrofit Costs for DOCs and DPFs

Applications to CEC/ARB Demonstration Project

Control Technology	Costs for Typical Engine (500 kW 670 hp) Design	Capital	Installation	Total
DOC	$ 575	$ 4,000	$ 800	$ 5,375
DOC	$ 2,000	$ 1,200	$ 300	$ 3,500
DOC & FBC	$ 500	$ 7,500	$ 4,000	$ 12,000
DPF, Active	$ 2,000	$ 6,000	$ 2,000	$ 10,000
DPF, Active	$ 5,360	$16,750	$ 2,680	$ 24,790
DPF, Active	included	$24,000	$ 3,500	$ 27,500
DPF, Passive	$ 1,200	$19,000	$ 2,200	$ 22,400
DPF, Passive	$ 1,000	$36,000	$ 2,500	$ 39,500
DPF, Passive	included	$18,000	$ 3,000	$ 21,000
DPF, Passive	$ 6,700	$ 5,500	$ 500	$ 12,700
DPF, Passive	$ 670	$ 6,700	$ 1,340	$ 8,710

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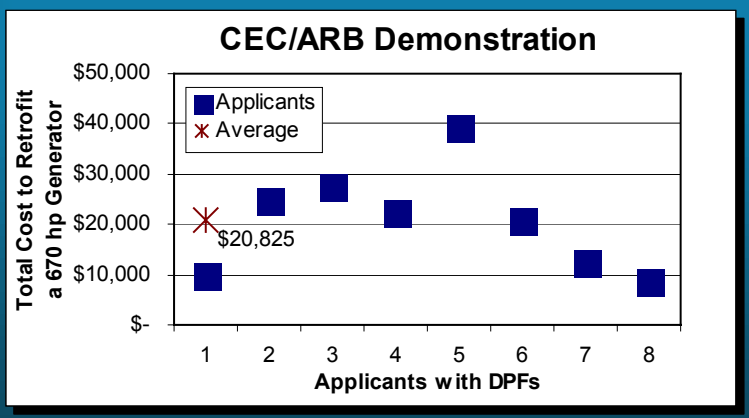
Manufacturers Estimated Retrofit Total Costs for DPFs



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New Diesel Gensets Cost in California Recently Purchased and Dealership Data

Manufacturer	kW	HP	Price
Cummins	100	147	$ 16,000
Cummins	150	221	$ 20,000
Cummins	200	295	$ 28,000
Cummins	250	368	$ 33,000
Caterpillar	335	493	$ 50,000
Cummins	500	736	$ 62,000
Caterpillar	600	884	$ 90,000
Cummins	750	1104	$ 93,000
Cummins	1000	1473	$ 115,000
Cummins	1500	2209	$ 183,000
Cummins	2000	2945	$ 248,000
Caterpillar	2000	2945	$ 288,000
Caterpillar	2000	2945	$ 311,380

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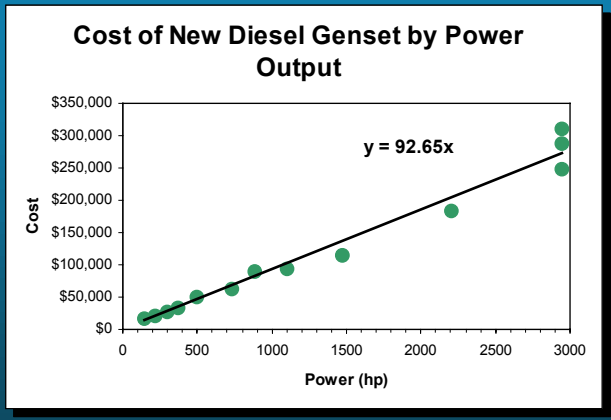
New Diesel Engine Cost in California Recently Purchased and Dealership Data



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Estimated Retrofit: Capital Cost

- Retrofit control technologies and total retrofit costs
  - Operational limits = $0
  - DOCs ~ $10/hp
  - Active and Passive DPFs ~ $31/hp to $38/hp
  - New Engine + DPF ~ $124/hp to $131/hp

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Estimated Retrofit: O&M Costs

- Retrofit control technologies O&M costs
  - Operational limits = $0
  - Emulsified Fuel = $0.017/hp-hr
  - DOCs ~ $46/yr reporting and cleaning
  - DPFs ~ $46/yr reporting and cleaning
  - New Engine + DPF ~ $46/yr reporting and cleaning

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Key Assumptions

- Retrofit control technologies and cost
  - Operational limits = $0
  - DOCs ~ $10/hp
  - Active and Passive DPFs ~ $31 - $38/hp
  - New Engine + DPF ~ $124 - $131/hp
- PM emission rates based on the OFFROAD Model
- 25% of engine owners will reduce hours to meet the next lower hourly use limit
- Sample is representative ~ 21% of the CA population
- Hours of operation are represented in the survey
- Cost amortized over 10 years at 7% interest rate

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Presentation of the Methods and Key Assumptions for Estimating the Costs for In-Use Stationary Engines

Anticipated Compliance Approach and Estimated Emissions Reductions

- Emergency standby engines
  - Operating limits ~ 83% (9,460 engines)
  - Emulsified Fuel ~ 7.9% (890 engines)
  - Retrofit with a DOC ~ 2.7% (310 engines)
  - Retrofit with a DPF ~ 4.8% (540 engines)
  - New engine+DPF ~ 1.3% (150 engines @100+ hours)
  - Estimated annual PM emissions reduction ~ 4600 lbs. ~ 40%
- Prime engines
  - Retrofit with a DPF - 100% (1,360 engines)
  - Estimated annual PM emissions reduction ~ 50,700 lbs. ~ 85%

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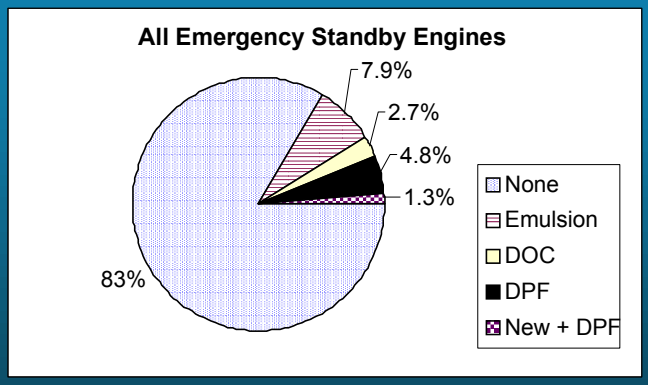
Anticipated Compliance Approach Of Standby Diesel Engines



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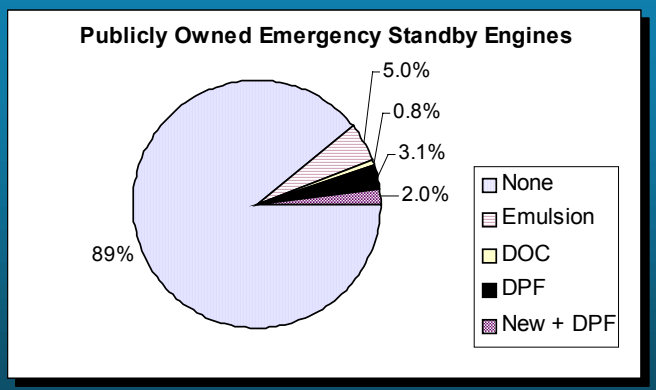
Anticipated Compliance Approach Of Standby Diesel Engines



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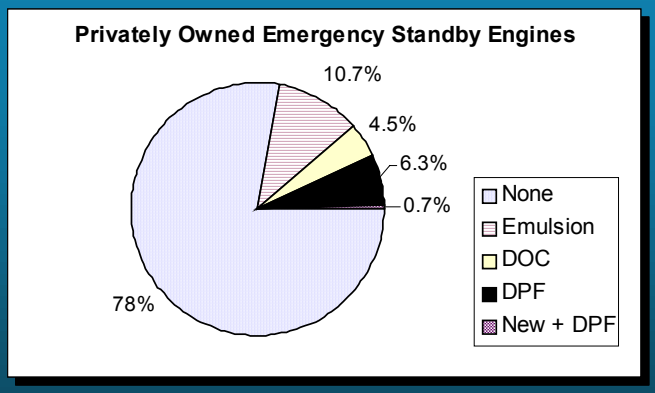
Anticipated Compliance Approach Of Standby Diesel Engines



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Presentation of the Methods and Key Assumptions for Estimating the Costs for In-Use Stationary Engines

Preliminary Estimates of Cost per Engine

- **Emergency standby engine**
  - Average total capital cost per engine
    - Emulsion ~ $0 (890 engines)
    - DOC ~ $6,200 (300 engines)
    - DPF ~ $28,500 (540 engines)
    - New Engine + DPF ~ $69,500 (150 engines)
  - Average annualized capital cost (10 yrs, 7%) + O&M per engine
    - Emulsion ~ $70
    - DOC ~ $920
    - DPF ~ $4,100
    - New Engine + DPF ~ $9,900
- **Prime engine**
  - Average capital cost per engine ~ $19,400
  - Average annualized capital cost (10 yrs, 7%) + O&M per engine ~ $2,700

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Presentation of the Methods and Key Assumptions for Estimating the Costs for In-Use Stationary Engines

Preliminary Estimates of Total Cost and Cost Effectiveness

- **Total Costs**
  - Emergency standby engine
    - Total capital and O&M cost ~ $ 27 - $ 30 million
  - Prime engine
    - Total capital and O&M cost ~ $ 22 - $ 27 million
- **Cost Effectiveness**
  - Emergency standby engines
    - Cost per pound PM reduced ~ 55 to 60 ($/lb)
    - Cost per change in risk @PMI ~ 45 to 50 ($/ delta risk)
  - Prime engine
    - Cost per pound PM reduced ~ 60 to 70 ($/lb)
    - Cost per change in risk @PMI ~ 30 to 35 ($/ delta risk)

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Cost Effectiveness Comparison to Other ATCMs

	Lifetime Cost Effectiveness ($/lb)	Potency Weighted Costs per Pound *
Backup Generators	55 - 60	55 - 60
Prime Engines	60 - 70	60 - 70
Benzene	64	662
Chrome Plating	340	0.68
Metal Melting	30	30.2

Note * Potency Weighted Cost per Pound =
[Cost Effectiveness * (diesel unit risk factor / unit risk factor)]

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