

FLEET Calculator
for
Onroad & Nonroad Heavy Duty Diesel Vehicles

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Highlights of FLEET Calculator

- **F**L**e**e**t** **E**mission **E**stimation **T**ool for On-Road and Non-Road Heavy Duty Diesel Vehicles
- Target audience consists primarily fleet managers and staff with government agencies
- Simplicity and user friendliness were key design requirements
- Analysis tool for estimating baseline emissions and emission reductions along with cost effectiveness of the selected control options



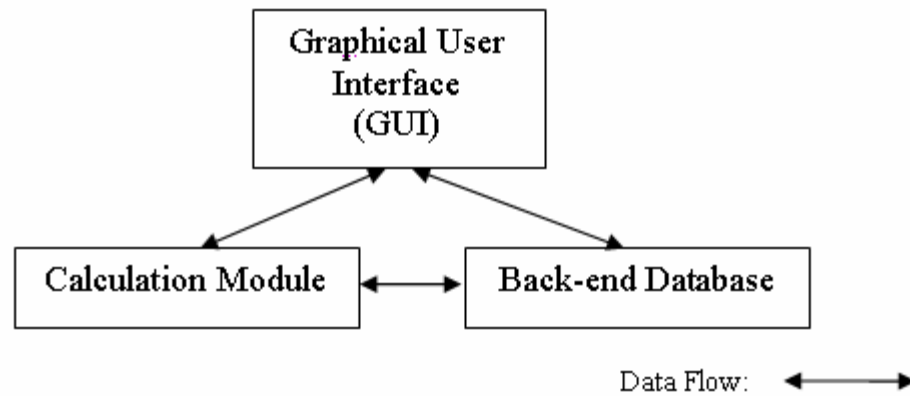
Capabilities of the FLEET Calculator

- **Output:**
 - Baseline emissions of PM, NO_x, SO_x, VOC, CO, and CO₂ (tonnes/year).
 - Emission reductions from fuel improvements, newer diesel engines and retrofit control technologies (tonnes/year).
 - Cost effectiveness of each control technology (\$/tonne reduced).
- **Types of diesel vehicles included:**
 - Onroad: > 8501 pounds or 3856 kg GVW – trucks and buses.
 - Nonroad: Any wheeled or tracked vehicles designed for off-road use.

Emission Reduction Options in FLEET

Option	Onroad	Nonroad
Ultra low sulphur diesel		✓
Detergent & cetane additives	✓	
Biodiesel (B20)	✓	✓
Diesel/water emulsion	✓	
Newer diesel engine	✓	✓
Diesel-electric hybrid drive	✓	
Compressed natural gas	✓	
High pressure direct injection natural gas	✓	
Diesel oxidation catalyst	✓	✓
Diesel oxidation catalyst & crankcase filter	✓	
Flow through filter	✓	✓
Diesel particulate filter	✓	✓

Software structure



FLEET Calculator
File Language Help

On-Road Fleet **Non-Road Fleet** **Reductions & Cost Effectiveness**

Fleet Information

Sub-Fleet Name	Engine Manufacturer	Model Year	Engine Family	GVWR (kg)	HP	# of Vehicles	Mileage (km/yr)
HDDV8-97	Cummins	1997	VCE359D6DAAA	15,000 - 27,272	215	12	10000
Bus	Caterpillar	1996	TCP403DZDARK	School Bus	185	2	30000
HDDV8-02	Cummins	2002	2CEXH0505CAQ	11,818 - 15,000	240	5	15000
HDDV8-96	Cummins	1996	TCE505D6DAAA	15,000 - 27,272	300	11	20000
HDDV8-97	Cummins	1997	VCE359D6DAAA	15,000 - 27,272	215	12	10000
HDDV8-99	Caterpillar	1999	XCPXH0729ERK	15,000 - 27,272	315	8	18000

Emission Reduction Strategies

Fuels Improvements

- 1. Detergent & Cetane Additives
- 2. Biodiesel B20
- 3. Fuel / Water Emulsion

Engine/Vehicle Replacements

- 1. Newer Diesel Engine
- 2. Diesel-Electric Hybrid
- 3. CNG Engine
- 4. HPDI

Retrofit Controls

- 1. Diesel Oxidation Catalyst (DOC)
- 2. DOC & Crankcase Filter
- 3. Flow Through Filter
- 4. Diesel Particulate Filter (DPF)

Economic Data

	Fuels Improvements		Engine/Vehicle Replacements		Retrofit Controls	
	Price (\$/L)	Consumption (L/100km)	Capital Cost (\$/vehicle)	Maintenance Cost (\$/vehicle /yr)	Capital Cost (\$/vehicle)	Maintenance Cost (\$/vehicle/yr)
Base Case	0.86	35.69				
Detergent & Cetane Additives	0.865	34.98				
Biodiesel B20	0.858	36.05				
Fuel / Water Emulsion	0.93	41.04				
New Diesel Engine	0.86	32.12	45000	0		
Diesel-Electric Hybrid	0.86	24.98	250000	0		
CNG Engine	0.5	42.83	55000	0		
HPDI	0.47	36.76	30000	0		
Diesel Oxidation Catalyst		35.69			1743	0
DOC & Crankcase Filter		35.69			2943	0
Flow Through Filter		35.69			4450	0
Diesel Particulate Filter		36.05			6600	50

Add Sub-Fleet **HDDV8-97** Delete Sub-Fleet Update Sub-Fleet Cancel

Step 1

Step 2

Step 3

Onroad: Input Fleet Information & Select Options

Step 1 - Input:

- Engine manufacturer
- Model year
- Engine family
- Gross Vehicle Weight Rating
- Power
- Number of Vehicles
- Mileage

Step 2 - Select one or more emission reduction options for each subfleet.

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On-Road Fleet Non-Road Fleet Reductions & Cost Effectiveness

Fleet Information

Sub-Fleet Name	Engine Manufacturer	Model Year	Engine Family	GVWR (kg)	HP	# of Vehicles	Mileage (km/yr)
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HDDV8-02	Cummins	2002	2CEXH0505CA0	11,818 - 15,000	240	5	15000
HDDV8-96	Cummins	1996	TCE505D6DAAA	15,000 - 27,272	300	11	20000
HDDV8-97	Cummins	1997	VCE359D6DAAA	15,000 - 27,272	215	12	10000
HDDV8-99	Caterpillar	1999	XCPXH0729ERK	15,000 - 27,272	315	8	18000

Emission Reduction Strategies

<p>Fuels Improvements</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 1. Detergent & Cetane Additives <input checked="" type="checkbox"/> 2. Biodiesel B20 <input checked="" type="checkbox"/> 3. Fuel / Water Emulsion 	<p>Engine/Vehicle Replacements</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 1. Newer Diesel Engine <input type="checkbox"/> 2. Diesel-Electric Hybrid <input type="checkbox"/> 3. CNG Engine <input checked="" type="checkbox"/> 4. HPDI 	<p>Retrofit Controls</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 1. Diesel Oxidation Catalyst (DOC) <input checked="" type="checkbox"/> 2. DOC & Crankcase Filter <input checked="" type="checkbox"/> 3. Flow Through Filter <input checked="" type="checkbox"/> 4. Diesel Particulate Filter (DPF)
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Onroad – Input cost data

Step 3 – Input Cost Data or Use Default Values

- Fuel prices
- Fuel consumption
- Capital and operating costs for control options



Economic Data						
	Fuels Improvements		Engine/Vehicle Replacements		Retrofit Controls	
	Price (\$/L)	Consumption (L/100km)	Capital Cost (\$/vehicle)	Maintenance Cost (\$/vehicle /yr)	Capital Cost (\$/vehicle)	Maintenance Cost (\$/vehicle/yr)
Base Case	0.86	35.69				
Detergent & Cetane Additives	0.865	34.98				
Biodiesel B20	0.858	36.05				
Fuel / Water Emulsion	0.93	41.04				
New Diesel Engine	0.86	32.12	45000	0		
Diesel-Electric Hybrid	0.86	24.98	250000	0		
CNG Engine	0.5	42.83	55000	0		
HPDI	0.47	36.76	30000	0		
Diesel Oxidation Catalyst		35.69			1743	0
DOC & Crankcase Filter		35.69			2943	0
Flow Through Filter		35.69			4450	0
Diesel Particulate Filter		36.05			6600	50

Nonroad – Input Fleet Information & Select Options

Step 1 - Input:

- Source category
- Model year
- Power
- Number of vehicles
- Hours

Step 2 - Select one or more emission reduction options for each subfleet.

FLEET Calculator
File Language Help

On-Road Fleet **Non-Road Fleet** Reductions & Cost Effectiveness

Fleet Information

Sub-Fleet Name	Source Category	Model Year	Average HP	# of Sources	Operating Hours
Forklifts1	Diesel Forklifts	1998	240	4	2400
Forklifts1	Diesel Forklifts	1998	240	4	2400
Loaders1	Diesel Rubber Tire Loaders	1996	285	5	1000
Rubber tired crane	Diesel Cranes	2000	600	3	2400

Emission Reduction Strategies

Fuels Improvements	Engine/Vehicle Replacements	Retrofit Controls
<input type="checkbox"/> 1. Ultra Low Sulphur Diesel (15 ppm)	<input type="checkbox"/> 1. Newer Diesel Engine (Tier 3)	<input checked="" type="checkbox"/> 1. Diesel Oxidation Catalyst (DOC)
<input checked="" type="checkbox"/> 2. Biodiesel B20		<input checked="" type="checkbox"/> 2. Flow Through Filter
		<input checked="" type="checkbox"/> 3. Diesel Particulate Filter (DPF)



Step 4

Results

On-Road Fleet		Non-Road Fleet		Reductions & Cost Effectiveness						
Economic Default Data										
Weighting Factors for emission reduction :				Interest Rate :	Economic Life Time (Year) :					
NOx	VOC	SOx	CO	PM						
<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="3"/>	<input type="text" value="0.143"/>	<input type="text" value="25"/>	<input type="text" value="0.05"/>					
<input type="text" value="10"/>										
Baseline Emissions (Tonnes/Year)										
SubFleetName	Category	SOx	NOx	CO	VOC	PM	Weighted	CO2		
Bus	OnRoad	0.001	0.534	0.123	0.118	0.010	0.922	62		
HDDV8-02	OnRoad	0.001	0.442	0.105	0.015	0.009	0.698	64		
HDDV8-96	OnRoad	0.002	1.835	0.379	0.076	0.031	2.755	214		
HDDV8-97	OnRoad	0.001	0.989	0.393	0.065	0.015	1.500	117		
HDDV8-99	OnRoad	0.001	0.897	0.237	0.059	0.018	1.446	140		
Total Emissions for the whole Fleet:		<input type="text" value="0.006"/>	<input type="text" value="4.697"/>	<input type="text" value="1.237"/>	<input type="text" value="0.333"/>	<input type="text" value="0.084"/>	<input type="text" value="7.321"/>	<input type="text" value="598"/>		
Emission Reduction (Tonnes/Year) with cost effectiveness (\$/Tonne)										
SubFleetName	Category	R_ID	SOx	NOx	CO	VOC	PM	Weighted	CO2	CE
Bus	OnRoad	R1	0	0	0.049	0.083	0.004	0.177	0	2,443
Bus	OnRoad	F2	0.000	-0.011	0.013	0.024	0.001	0.040	11	3,721
Bus	OnRoad	R2	0	0	0.049	0.083	0.004	0.190	0	3,918
HDDV8-02	OnRoad	F1	0.000	0.013	0.005	0.002	0.001	0.032	1	-8,904
HDDV8-02	OnRoad	F3	0	0.049	0	-0.017	0.005	0.155	0	986
HDDV8-02	OnRoad	F2	0.000	-0.009	0.012	0.003	0.001	0.019	12	8,201
HDDV8-02	OnRoad	R1	0	0	0.042	0.011	0.003	0.095	0	12,254
HDDV8-02	OnRoad	R2	0	0	0.042	0.011	0.004	0.106	0	18,280
HDDV8-02	OnRoad	R3	0	0	0.063	0.012	0.005	0.155	0	20,678
HDDV8-02	OnRoad	E4	0.001	0.199	0.095	0.012	0.008	0.438	10	24,244
HDDV8-02	OnRoad	R4	0.000	0	0.079	0.013	0.008	0.214	-1	24,303
HDDV8-96	OnRoad	F1	0.000	0.055	0.019	0.011	0.002	0.124	4	-7,725
Show		<input type="radio"/> Both OnRoad and NonRoad <input checked="" type="radio"/> OnRoad only <input type="radio"/> NonRoad only		<input type="button" value="Calculate / Update"/>						

Calculation Methodology

➤ On-Road:

- ❑ Use of Emission Factors based on EPA Engine Certification Data.

➤ Non-Road:

- ❑ Use of Emission Factors and calculation methods based on 2005 EPA NONROAD model.

➤ Cost Effectiveness:

- ❑
$$CostEffectiveness = \sum \left[\frac{(\Delta FuelCost + \Delta MaintenanceCost + \Delta CapitalCost)}{WeightedEmission\ Reduction_{(tonnes/yr)}} \right]$$



Special Input and Output Features

- Data input:
 - ❑ Fleet data can be imported from an Excel file, simplifying data entry for large fleets.
- Output:
 - ❑ All input data and results can be exported to an Excel file for record keeping, printing, further analysis and creating graphs.



Conclusions

- Simple tool designed to assist fleet managers to assess the best emission reduction options for on-road and non-road heavy duty diesel vehicles
- User-friendly stand alone application to run on a desktop PC – does not require the knowledge of Microsoft Excel or Access software
- Can generate the baseline emission inventories and carry out the cost effectiveness analysis for the fleet facility



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