FLEET Calculator for Onroad & Nonroad Heavy Duty Diesel Vehicles

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Highlights of FLEET Calculator

- FLeet Emission Estimation Tool 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, NOx, SOx, 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	\checkmark	✓

Software structure



E	, FLEET Calculator							
ł	File Language Help							
ſ	On-Roa	d Fleet		Non	-Road Fleet		Reductions & C	ost Effectiveness
Stop 1	Elect Information		, <u></u>					
Step	Sub-Fleet Name	I Engine Manufacturer	Mo	odel Year E	ngine Family	GVWR (ka)	HP ♯ofV	ehicles Mileage (km/vr)
	HDDV8-97	Cummins	▼ 19	997 - N	/CE359D6DAAA	15,000 - 27,272	▼ 215 12	10000
	Bus	Caternillar		1996		School Bus	195	2 30000
	HDDV8-02	Cummins		2002	201403020ANK	11 818 - 15 000	240	5 15000
	HDDV8-96	Cummins		1996	CE505D6DAAA	15,000 - 27,272	300	11 20000
	HDDV8-97	Cummins		1997 \	/CE359D6DAAA	15,000 - 27,272	215	12 10000
	HDDV8-99	Caterpillar		1999 >	KCPXH0729ERK	15,000 - 27,272	315	8 18000
	,							
Stop 2								
	Emission Reduct	tion Strategies						
	Fuels Improvements		Engine	e/Vehicle	Replacements	Retr	ofit Controls	
	🛛 🔽 1. Detergent & Cetar	ne Additives	🔽 1.Ne	ewer Diese	el Engine	V 1	. Diesel Oxidation C	atalyst (DOC)
	2. Biodiesel B20		🗖 2. D)iesel-Elect	ric Hybrid	2	. DOC & Crankcase	Filter
	IV 3. Fuel / Water Emu	lsion		ING Engine	3	I ∨ 3	. Flow I hrough Filte Discal Particulate I	(Filter (D.D.E.)
			 ♥ 4. II	IFDI		I V 4	. Dieser Faiticulater	
	Economio Doto							
Step 3								
		Fuels Im	provements		Engine/Vehicle	Replacements	Retrofit Con	trols
		Price	Consumption		Capital Cost M (Musicia) (4	faintenance Cost	Capital Cost (* Austrials)	Maintenance Cost
		(\$/L)	(L7100Kill)		(\$7Venicie) (a	p/venicie /yrj	(\$7Venicie)	(\$7Venicie7yi)
	Base Case	0.86	35.69					
	Detergent & Cetane Add	litives 0.865	34.98					
	Biodiesel B20 Evol 707/atox Econolation	0.858	36.05					
	New Diesel Engine	0.93	41.04		45000			
	Diesel-Electric Hubrid	0.86	32.12		45000	J		
	CNG Engine	0.00	42.83		55000	1		
	HPDI	0.5	36.76		30000	<u>,</u>		
	Diesel Oxidation Catalys	t internet	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
						1.1		
		Add Sub-Fleet	HDDV8-97	•	Delete Sub-Fle	et Update Sub-F	leet Cancel	

Onroad: Input Fleet Information & Select Options

	Step 1 - Inp Engine ma Model yea Engine fat Gross Vel Power	OUT: anufacturer ar mily hicle Weight	t Rating			Step 2 - emissic each su	 Select one or more on reduction options for ubfleet. 						
	 Number o Mileage 	f Vehicles											
File	e Language Help												
	On-Roa	d Fleet	, r		No	on-Road Fleet		Υ	Re	ductions	: & Cost Effe	ctiveness	
	- Fleet Information Sub-Fleet Name	n Engine Manufacti	urer	Mo	del Yea	r Engine Family		GVWR (kg)		HP ‡	‡ of Vehicles M	ileage (km/y	уг)
	HDDV8-97	Cummins		▼ 19	97 💌	VCE359D6DAA		15,000 - 27,27	⁷ 2 <u>-</u>	215	12 1	0000	
	Bus	Caterpillar			1996	5 TCP403DZDAR	K	School Bus		185	2	30000	
	HDDV8-02	Cummins			2002	2 2CEXH0505CA()	11,818 - 15,0	00	240	5	15000	
	HDDV8-96	Cummins			1996	6 TCE505D6DAA	۱	15,000 - 27,2	72	300	11	20000	
	HDDV8-97	Cummins			1997	VCE359D6DAA	<u> </u>	15,000 - 27,2	72	215	12	10000	
	HDDV8-99	Caterpillar			1999	JXCPXH0729ER	<u> </u>	15,000 - 27,2	72	315	8	18000	
	-Emission Reduc	tion Strategi	es										
	Fuels Improvements	;		Engine	Nehic	le Replacemen	ts		Retrofit	Controls	:		
	🔽 1. Detergent & Ceta	ne Additives		🔽 1.Ne	ewer Die	esel Engine			🔽 1. Die	esel Oxidat	ion Catalyst (DI	OC)	
	2. Biodiesel B20			📃 2. D	iesel-Ele	ectric Hybrid			🔽 2. DO	IC & Crank	case Filter		
	J 3. Fuel / Water Emu	ulsion		□ 3. C ■ 4. H	NG Eng PDI	ine			 ☑ 3. Flo ☑ 4. Die 	w Through esel Particu	n Filter ulate Filter (DPF	-)	

Onroad – Input cost data

Step 3 – Input Cost Data or Use Default Values

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

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

Nonroad – Input Fleet Information & Select Options

Step 1 - Input: Source category Model year Power Number of vehicles Hours	S ei ei	tep 2 - Selo mission re ach subfle	ect one ductio et.	e or more on options for	•
🐂 FLEET Calculator					
File Language Help					
On-Road Fleet	Non-Road	Fleet	Redu	uctions & Cost Effectiven	ess
Fleet Information Sub-Fleet Name Source Cate Forklifts1 Diesel Fork Loaders1 Diesel Rub Rubber tired crane Diesel Crar	gory M fts 1 ifts per Tire Loaders es	odel Year Average HP 998 240 1998 1996 2000	# of 9 4 240 285 600	Sources Operating Hours 2400 4 2400 5 1000 3 2400	
Emission Reduction Strategies – Fuels Improvements 1. Ultra Low Sulphur Diesel (15 ppm) 2. Biodiesel B20	Engine/Vehicle Rep	p lacements gine (Tier 3)	Retrofit Cont	t rois xidation Catalyst (DOC)	
			 3. Diesel Pa 	articulate Filter (DPF)	

Ĺ	On-Roa	ad Fleet			N	on-Road Fl	eet		Reduc	ctions & Co	st Effective
5 4	-Economic Defa Weighting Fac	ult Data — tors for emiss	sion red	uction :	Ir	nterest Rate	:	E	conomic L	.ife Time (Yea	ar) :
ulte	NOx VOC	SOx CC 3 0	D F 1143 2	РМ 25	[0	.05		1	0		
	-Baseline Emiss	ions (Tonr	nes/Ye	ar) —							
	SubEleatName	Category	1	- 50.0	NOS	00	VO	- -	PM	Weighted	
	Bus	OnBoad		0.001	0.534	0.123	0.119	3	0.010	0.922	62
	HDDV8-02	OnRoad		0.001	0.442	0.105	0.01	5	0.009	0.698	64
	HDDV8-96	OnRoad		0.002	1.835	0.379	0.07	6	0.031	2.755	214
	HDDV8-97	OnRoad		0.001	0.989	0.393	0.06	5	0.015	1.500	117
	HDDV8-99	OnRoad		0.001	0.897	0.237	0.05	9	0.018	1.446	140
	Total Emissions for th	ne whole Fleet:		0.006	4.697	1.237	0.333		0.084	7.321	598
	Total Emissions for th	e whole Fleet:	nes/Ye	0.006	4.697	1.237	0.333) ———	0.084	7.321	598
	Total Emissions for th Emission Redu e SubElectName	ne whole Fleet: ction (Tonr	nes/Ye	0.006 ear) with	4.697	1.237 ctiveness	0.333 (\$/Tonne) PM	0.084	7.321	598
	Total Emissions for the Control Emission Reduced SubFleetName Bus	te whole Fleet: ction (Tonr Category OnRoad	nes/Ye	0.006 ear) with SOx	4.697 cost effe	1.237 ctiveness C0 0.049	0.333 (\$/Tonne VOC 0.083) PM 0.004	0.084	7.321	598 CE 2.443
	Total Emissions for the Control Emission Reduced SubFleetName Bus Bus	ction (Tonr Category OnRoad OnRoad	nes/Ye R_ID R1 F2	0.006 ear) with SOx 0 0.000	4.697 cost effe <u>NOx</u> 0 -0.011	1.237 ctiveness C0 0.049 0.013	0.333 (\$/Tonne VOC 0.083 0.024	PM 0.004 0.001	0.084	7.321 CO2	598 CE 2,443 3,721
	Total Emissions for the Emission Redu SubFleetName Bus Bus Bus	ction (Tonr Category OnRoad OnRoad	nes/Ye R_ID R1 F2 R2	0.006 ear) with SOx 0 0.000	4.697 cost effe N0x 0 -0.011 0	1.237 ctiveness CO 0.049 0.013 0.049	0.333 (\$/Tonne VOC 0.083 0.024 0.083	PM 0.004 0.001 0.004	0.084	7.321 CO2 0 11 0 0	598 CE 2,443 3,721 3,918
	Total Emissions for the	ction (Tonr Category OnRoad OnRoad OnRoad OnRoad	R_ID R1 F2 R2 F1	0.006 ear) with SOx 0 0.000 0 0.000	4.697 cost effe NOx 0 -0.011 0 0.013	1.237 ctiveness CO 0.049 0.013 0.049 0.005	0.333 (\$/Tonne VOC 0.083 0.024 0.083 0.002	PM 0.004 0.001 0.004 0.001	0.084	7.321 1 CO2 2 O 1 1 0 O 1 1 0 O 1 1 0 O	598 CE 2,443 3,721 3,918 -8,904
	Total Emissions for the Emission Reduced SubFleetName Bus Bus Bus HDDV8-02 HDDV8-02	ction (Tonr Category OnRoad OnRoad OnRoad OnRoad OnRoad	R_ID R1 F2 R2 F1 F3	0.006 ear) with SOx 0 0.000 0 0.000	4.697 cost effe NOx 0 -0.011 0 0.013 0.049	1.237 ctiveness CO 0.049 0.013 0.049 0.005 0	0.333 (\$/Tonne VOC 0.083 0.024 0.083 0.002 -0.017	PM 0.004 0.001 0.001 0.001 0.005	0.084	7.321 CO2 CO2 CO2 CO2 CO2 CO2 CO2 CO2	598 CE 2,443 3,721 3,918 -8,904 986
	Total Emissions for the Emission Reduces SubFleetName Bus Bus Bus HDDV8-02 HDDV8-02 HDDV8-02	ction (Tonr Category OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad	nes/Ye R_ID R1 F2 R2 F1 F3 F3 F2	0.006 ear) with SOx 0 0.000 0 0.000 0 0.000	4.697 cost effe NOx 0 -0.011 0 0.013 0.049 -0.009	1.237 ctiveness CO 0.049 0.013 0.049 0.005 0 0.005 0 0.012		PM 0.004 0.001 0.001 0.005 0.001	0.084	7.321 CO2 CO2 10 11 0 0 11 0 0 12 12	598 CE 2,443 3,721 3,918 -8,904 986 8,201
	Total Emissions for the Emission Reduced SubFleetName Bus Bus Bus HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02	ction (Tonr Category OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad	R_ID R1 F2 R2 F1 F3 F2 F1 F3 F2 R1	0.006 ear) with SOx 0 0.000 0 0.000 0 0.000 0 0.000	4.697 cost effe NOx 0 -0.011 0 0.013 0.049 -0.009 0	1.237 ctiveness CO 0.049 0.013 0.049 0.005 0 0.005 0 0.012 0.042	0.333 (\$/Tonne VOC 0.083 0.024 0.083 0.002 -0.017 0.003 0.001	PM 0.004 0.001 0.001 0.005 0.001 0.005	0.084 Weighted 0.177 0.040 0.190 0.032 0.155 0.019 0.095	7.321 CO2 CO2 0 11 0 0 11 0 0 12 0 0 0 0 0 0 0 0 0 0 0 0 0	598 CE 2,443 3,721 3,918 -8,904 986 8,201 12,254
	Total Emissions for the SubFleetName Bus Bus HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02	ction (Tonr Category OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad	R_ID R1 F2 R2 F1 F3 F3 F2 R1 R2 R1 R2	0.006 ear) with SOx 0 0.000 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	4.697 cost effe NOx 0 -0.011 0 0.013 0.049 -0.009 0 0 0 0 0 0 0 0 0 0 0 0 0	1.237 ctiveness CO 0.049 0.013 0.049 0.049 0.005 0 0.005 0 0.012 0.042 0.042 0.042	0.333 (\$/Tonne VOC 0.083 0.024 0.083 0.002 -0.017 0.003 0.011 0.011	PM 0.004 0.001 0.001 0.001 0.005 0.001 0.003 0.003	0.084 Weighted 0.177 0.040 0.190 0.032 0.019 0.019 0.095 0.106	7.321 7.321 0 0 11 0 0 11 0 0 12 0 0 0 12 0 0 0 0	598 CE 2,443 3,721 3,918 -8,904 986 8,201 12,254 18,280
	Total Emissions for the Emission Reduce SubFleetName Bus Bus Bus HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02 HDDV8-02	ction (Tonr Category OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad OnRoad	R_ID R1 F2 R2 F1 F3 F3 F3 F2 R1 R2 R1 R2 R3	0.006 ear) with SOx 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0	4.697 cost effe NOx 0 -0.011 0 0.013 0.049 -0.009 0 0 0 0 0 0 0 0 0 0 0 0 0	1.237 Ctiveness CO 0.049 0.013 0.049 0.005 0 0.005 0 0.012 0.042 0.042 0.042 0.042 0.042 0.043	Comparent of the second state of the seco	PM 0.004 0.001 0.001 0.005 0.001 0.005 0.001 0.003 0.004 0.003	0.084 Weighted 0.177 0.040 0.190 0.032 0.155 0.019 0.095 0.106 0.155	7.321 7.321 7 0 0 111 0 0 112 0 0 12 0 0 0 0 0 0 0 0	598 CE 2,443 3,721 3,918 -8,904 986 8,201 12,254 18,280 20,678
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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:



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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