

Stationary Compression Ignition Internal Combustion Engines

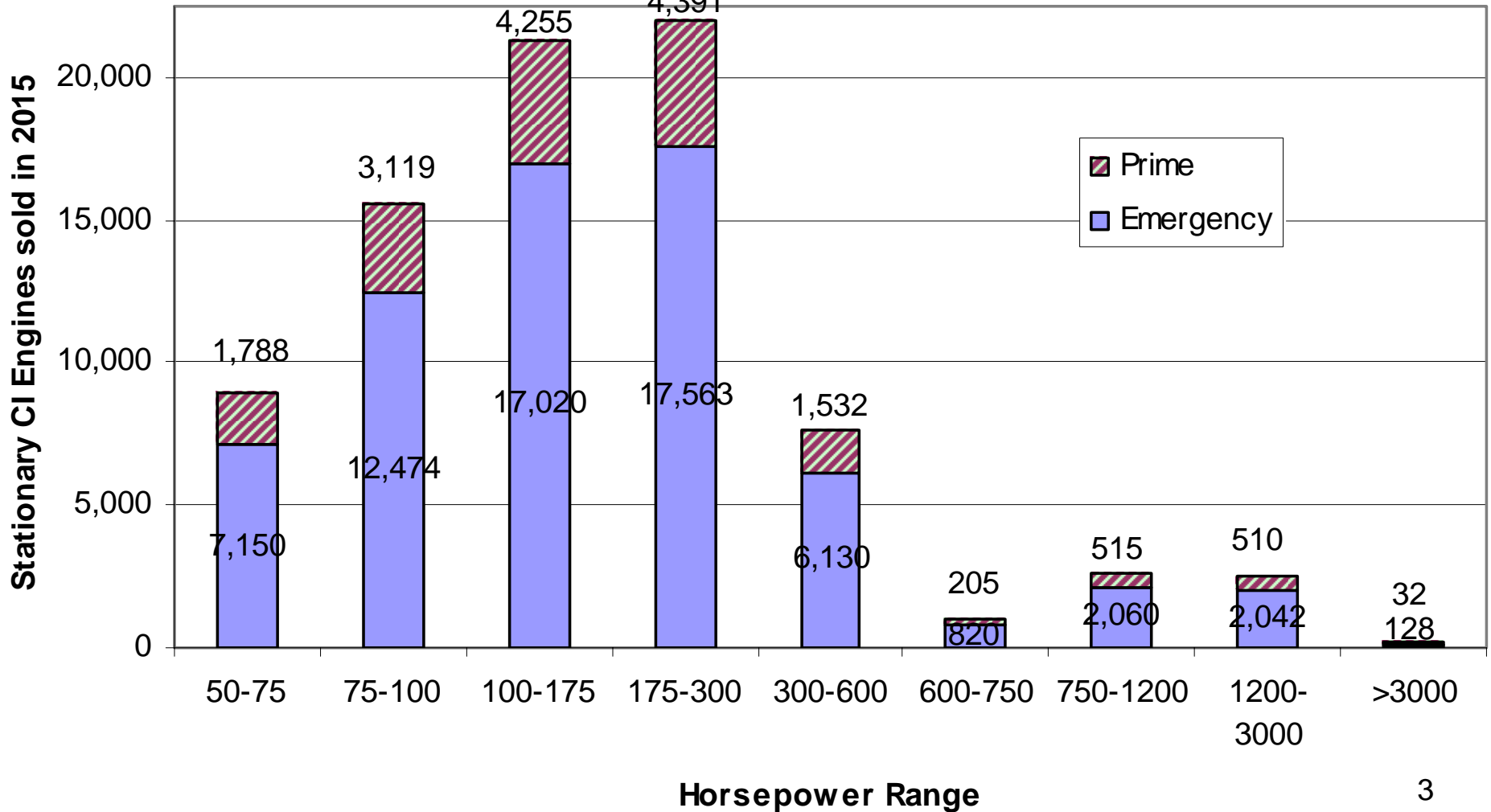
New Source Performance Standards

September 16, 2005

Status

- Stationary diesel engine NSPS proposal published in FR - July 11, 2005
- End of comment period - September 9, 2005
- Estimated final rule published in FR - July 2006

Number of Stationary CI Engines sold in the year 2015
 (note this is not cumulative sales, this is sales in 2015 only)



Emission Standards Overview

- Manufacturers indicate that virtually all engine families that are manufactured for nonroad use are also used in stationary applications.
 - OTAQ certifies over 600 nonroad CI engine families each model year, of which approximately 200 have stationary engines also.)
- The NSPS is modeled after the standards for nonroad CI engines:
 - For pre-2007 Model Year (MY) engines, owners/operators must purchase engines that achieve limits based on Tier 1 nonroad standards
 - Manufacturers must certify engines beginning with the 2007 MY
 - 2007-2010 MY – on-engine controls
 - 2011 MY non-emergency engines – after treatment controls using catalyzed diesel particulate filters (CDPF) and NOx adsorbers
- Engine manufacturers must follow the certification procedures and must meet the warranty, maintenance, installation, and labeling requirements as specified in the Nonroad Engine Rule
- There are a few exceptions to modeling the rule after the Nonroad Engine Rule.

Exceptions to the Nonroad Rule

- >3000 HP and <10 liters/cylinder displacement must meet Tier 1 in 2007 and Tier 4 beginning in 2011 (Tier 2 is not required)
- ≥ 10 liters/cylinder and < 30 liters/cylinder displacement must meet Tier 1 and 2 standards for marine engines
- ≥ 30 liters/cylinder displacement must reduce NO_x by at least 90% or limit NO_x emissions to 0.40 g/kW-hr (0.30 g/hp-hr). Also must reduce PM by at least 60% or limit PM emissions to 0.12 g/kW-hr (0.09 g/hp-hr)
- Emergency engines must meet the corresponding Nonroad standards based on on-engine controls, but not the add-on controls in Tier 4
- Fire pump engines:
 - Meet Tier 1, then meet Tier 3 standards beginning 2-3 years after Tier 3 starts

Engine	Timeline for Stationary CI NSPS Proposal		
	Proposal (7/11/05)-2006 Model Year	2007-2010 Model Year	2011 Model Year ^a and Later
Prime	<u>Manufacturer:</u> <ul style="list-style-type: none"> •No requirements 	<u>Manufacturer:</u> <ul style="list-style-type: none"> • Certify engine to applicable Tier standard •Best on-engine controls 	<u>Manufacturer:</u> <ul style="list-style-type: none"> •Certify engine to applicable Tier standard •Level necessitates add-on control <u>Owner/Operator:</u> <ul style="list-style-type: none"> •Purchase certified engine •Operate engine (and controls) properly
Emergency	<u>Owner/Operator:</u> <ul style="list-style-type: none"> •Demonstrate that engine meets limits (based on best on-engine controls) •Operate engine (and controls) properly 	<u>Owner/Operator:</u> <ul style="list-style-type: none"> •Purchase certified engine •Operate engine (and controls) properly 	<u>Manufacturer:</u> <ul style="list-style-type: none"> •Certify engine to applicable Tier that does not necessitate add-on controls •Level based on best on-engine control <u>Owner/Operator:</u> <ul style="list-style-type: none"> •Purchase certified engine •Operate engine (and controls) properly

^a This is the earliest model year that standards that necessitate the use of add-on controls become effective, however, the model year varies based on the engine power and ranges from the 2011-2015 model year.

Ultra-Low Sulfur Fuel Availability

- CDPF and NOx adsorbers, which will be used to meet Tier 4 levels for stationary CI non-emergency engines, rely on the use of ultra low sulfur diesel (ULSD) fuel.
- New stationary non-emergency CI engines affected by the NSPS would need less than 900 million gallons of ULSD fuel in the year 2011, resulting in an increased demand of ULSD of less than 2 percent.
- The fuel availability analysis indicates that sufficient quantities of ULSD will be available for new stationary CI non-emergency engines affected by the NSPS.
- We proposed to require:
 - Low sulfur fuel (500 ppm) beginning October 1, 2007
 - ULSD (15 ppm) beginning October 1, 2010.

Emission Standards for Pre-2007 MY Engines

- To allow manufacturers to use up existing stock, owners/operators of pre-2007 MY engines manufactured on or after April 1, 2006 must meet emission standards that are based on the Tier 1 nonroad CI engine standards.
- Standards do not apply to fire pump engines manufactured before July 1, 2006.
- Engines ordered after the proposal date with a displacement ≥ 30 liters/cylinder must immediately comply at promulgation or startup, whichever is later, with the NO_x and PM standards (this applies for all model years).

Compliance - Certified Engines

- Owners/Operators must purchase certified engines
- All engines and control devices must be operated according to manufacturer's recommended operating procedures.
- Certified engines are assumed to be in compliance with the emission standards throughout the useful life of the engine.
- Engines with a CDPF must have a backpressure monitor.
 - Already installed with CDPF
 - Used to determine condition of the CDPF

Compliance - Pre-2007 MY Engines

- Compliance for pre-2007 MY engines can be demonstrated by purchasing a certified nonroad engine.
- Owners/operators that have pre-2007 MY stationary CI engines that are not certified to the appropriate standard for the MY must keep records on site of one of the following to demonstrate compliance:
 - Engine manufacturer's data for that engine family,
 - Control device vendor data for that engine and control device,
 - Emission test data from a similar engine, or
 - Source test information from the immediate engine.

Compliance - Emergency Engines

- Engines must be operated according to manufacturer's recommended operating procedures
- Engines must have a non-resettable hour meter
 - Already installed on engines
 - Will be used to monitor non-emergency use

Notification, Reporting, Recordkeeping, and Testing

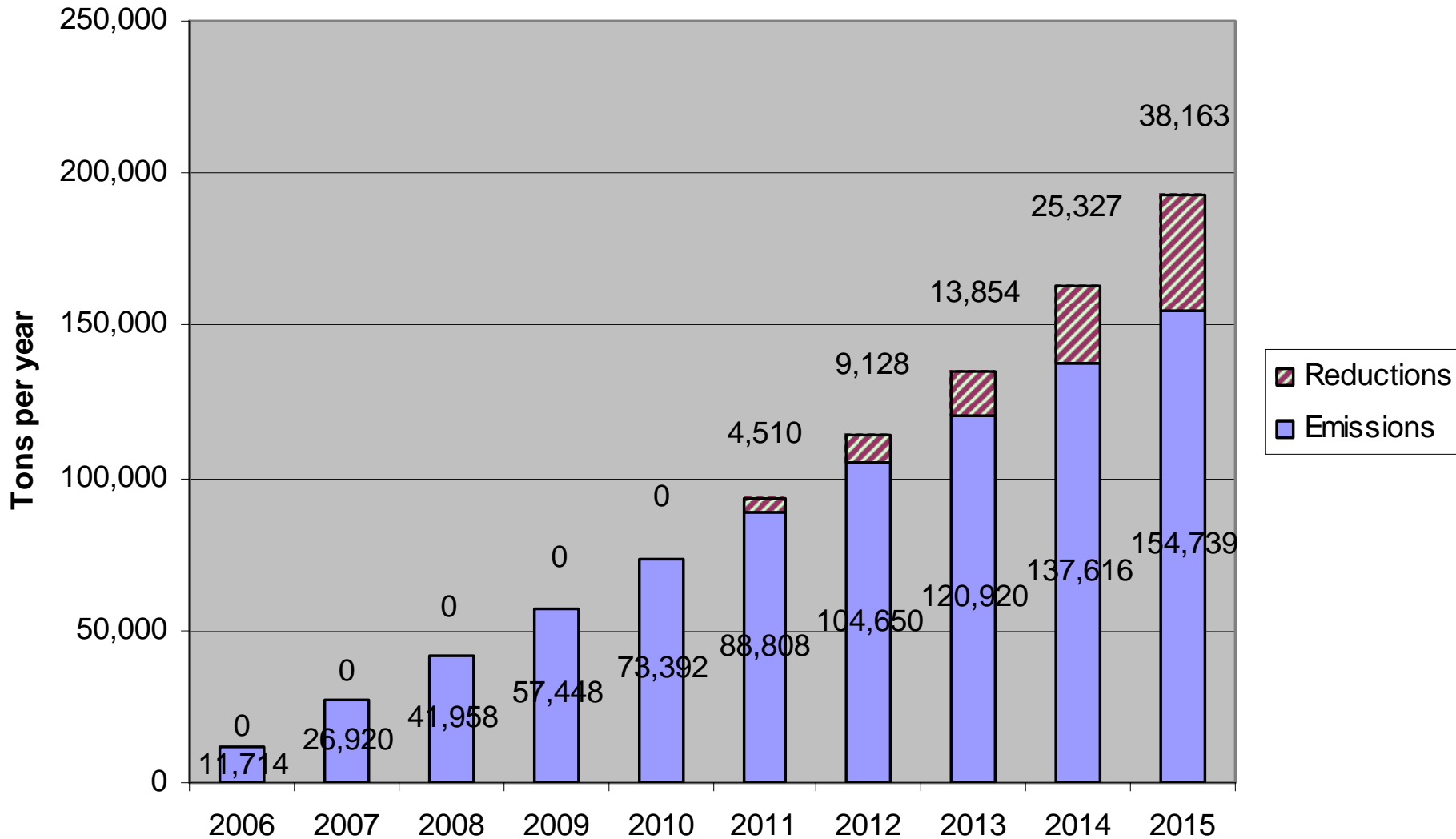
- Tried to minimize burden by requiring engine certification.
- Initial notification required for only the largest certified engines – (>3000HP, >10 liter/cylinder displacement), and for engines that are not certified – (>175HP)
- Minimal recordkeeping required for certified engines.
- Normal NSPS General Provisions requirements for >30 liter/cylinder engines

Reduction from 2005 Baseline

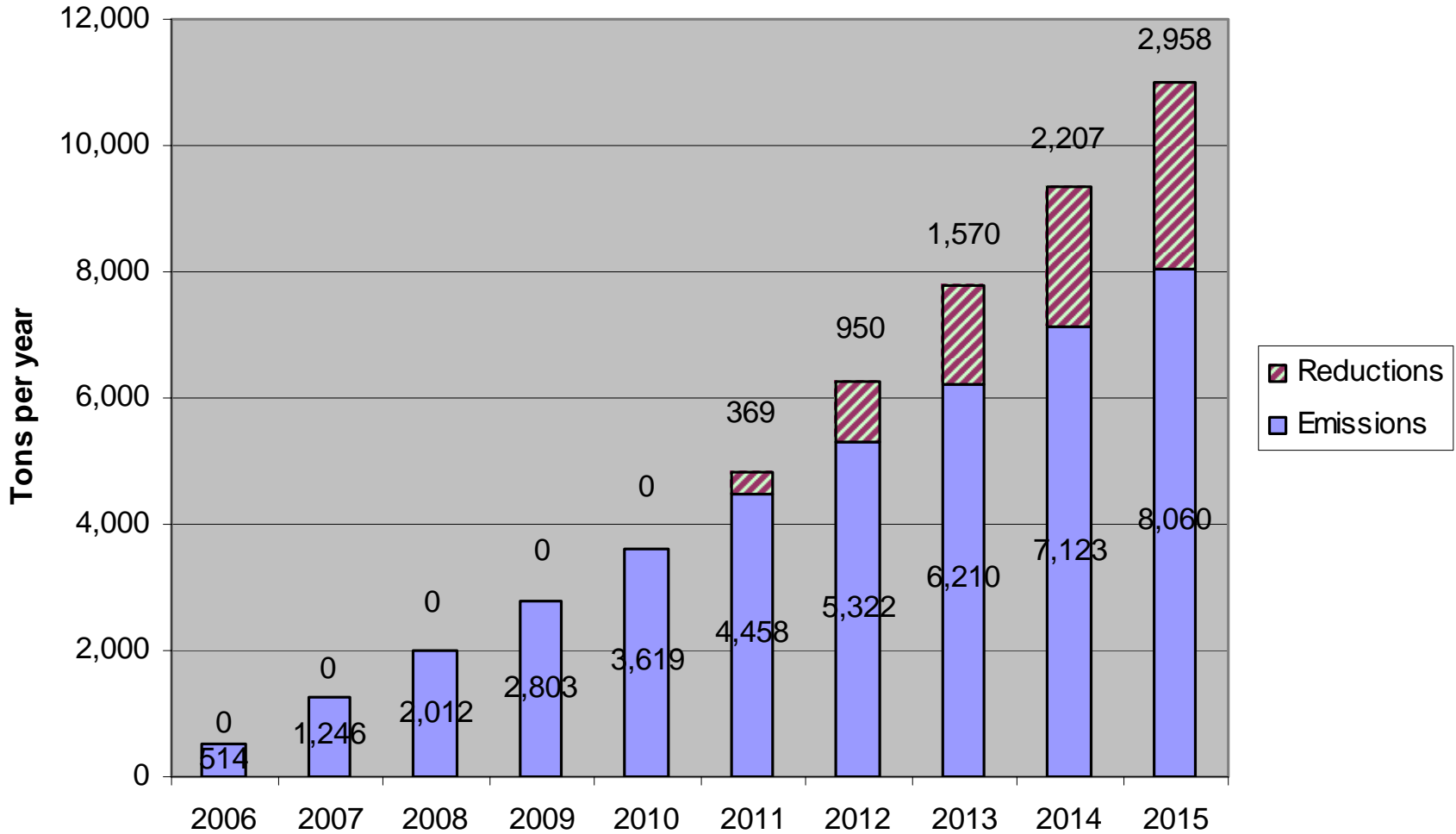
Engine Model Year	PM		NOx	
	Standard for 500 HP Engine g/kW-hr (g/hp-hr)	% Reduction from 2005 Level	Standard for 500 HP Engine g/kW-hr (g/hp-hr)	% Reduction from 2005 Level
2006	0.54 (0.4)	---	9.2 (6.9)	---
2007	0.20 (0.15)	63%	3.7 (2.8)*	60%
2011	0.02 (0.015)	96%	0.40 (0.30)	96%

*Limit for 2007 engines is 4.0 g/kW-hr (3.0 g/hp-hr) NMHC+NOx, so this number is an estimate of the NOx portion of the emissions.

Total NOx Emissions and Reductions from New Stationary CI Engines 2006-2015 (w/o taking credit for Tier 2/Tier 3)



**Total PM Emissions and Reductions from New Stationary CI Engines 2006-2015
(w/o taking credit for Tier 2/Tier 3)**



Projected Emission Reductions from 2006-2015 (w/o taking credit for Tier 2/Tier 3)

Emission Reductions from the NSPS (tons/year)										
Pollutant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
NOx	0	0	0	0	0	4,510	9,128	13,854	25,327	38,163
PM	0	0	0	0	0	369	950	1,570	2,207	2,958
NMHC	0	0	0	0	0	0	6	9	164	602
CO	0	0	0	0	0	2,573	6,249	10,028	14,168	18,419
SO ²	0	0	0	143		4,973	5,909	6,886	7,889	8,917

- Note: HAP emissions from stationary CI engines will be reduced by an estimated 93 tons in the year 2015. These reductions will result from applying add-on controls –CDPF – to stationary CI engines

Costs and Benefits

- Capital cost of rule is \$67 million in the year 2015
- Annual cost of rule is \$57 million in the year 2015
- Annual cost per ton of rule (includes cost for control, recordkeeping, reporting, certification program)/ton of pollutant reduced:
 - PM - \$11,780/ton
 - NO_x+NMHC - \$575/ton
- Benefits for this proposal likely to exceed costs due to relatively high direct PM 2.5 reductions

Potential Changes To Proposal

- We have not had time to review the comments we have received since the comment period closed on September 9th.
- We have discussed making changes for two area's.
 - Number of hours emergency engines can operate for maintenance and testing purposes, and
 - Not requiring the use of low sulfur fuel in rural Alaska until the ULSD fuel is required

Next Steps

- Review and reply to comments
- Develop final rule package
- Review and approval by EPA and Federal Agencies
- Administrator Signature by end of June 2006

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Appendix

Emission Standards for Pre-2007 MY Stationary CI Engines with a Displacement <10 Liters/Cylinder and 2007-2010 MY Stationary CI Engines >3,000 hp with a Displacement <10 Liters/Cylinder

kW (hp)	Emission Standards in g/kW-hr (g/hp-hr)				
	NMHC + NOx	HC	NOx	CO	PM
<8 (<11)	10.5 (7.8)	-	-	8.0 (6.0)	1.0 (0.75)
8-19 (11-25)	9.5 (7.1)	-	-	6.6 (4.9)	0.80 (0.60)
19-37 (25-50)		-	-	5.5 (4.1)	
37-56 (50-75)	-	-	9.2 (6.9)	-	-
56-75 (75-100)	-	-		-	-
75-130 (100-175)	-	-		-	-
130-225 (175-300)	-	1.3 (1.0)		11.4 (8.5)	0.54 (0.40)
225-450 (300-600)	-				
450-560 (600-750)	-				
>560 (>750)	-				

Table values are based on the nonroad CI engine Tier 1 emission standards.

Standards for 2007 MY and Later Non-Emergency Engines ≤3,000 hp with a Displacement <10 Liters/Cylinder and 2011 MY and Later Non-Emergency Engines >3,000 hp with a Displacement <10 Liters/Cylinder

kW (hp)	MY	Emission Standards in g/kW-hr (g/hp-hr)					
		NMHC + NOx	NMHC	NOx	CO	PM	
<8 (<11)	2007	7.5 (5.6)	-	-	8.0 (6.0)	0.80 (0.60)	
	2008+					0.40 (0.30)	
8-19 (11-25)	2007				6.6 (4.9)	0.80 (0.60)	
	2008+					0.40 (0.30)	
19-37 (25-50)	2007	7.5 (5.6)	-	-	5.5 (4.1)	0.60 (0.45)	
	2008-2012					0.30 (0.22)	
	2013+					0.03 (0.02)	
37-56 (50-75)	2007	7.5 (5.6)	-	-	5.0 (3.7)	0.40 (0.30)	
	2008-2012					0.30 (0.22) ^a	
	2013+					0.03 (0.02)	
56-75 (75-100)	2007	7.5 (5.6)	-	-	5.0 (3.7)	0.40 (0.30)	
	2008-2011					4.7 (3.5)	
	2012-2013	-				0.19 (0.14) ^a	0.40 (0.30) ^b
	2014+					0.19 (0.14)	0.40 (0.30)

^a A manufacturer has the option of skipping the 0.30 g/kW-hr PM standard for all 37-56 kW engines. The 0.03 g/kW-hr standard would then take effect one year earlier for all 37-56 kW engines, in 2012. The Tier 3 standard of 0.40 g/kW-hr would be in effect until 2012.

^b 50 percent of the engines produced have to meet the NOx + NMHC standard and 50 percent have to meet the separate NOx and NMHC limits.

Standards for 2007 MY and Later Non-Emergency Engines (Cont'd)

kW (hp)	MY	Emission Standards in g/kW-hr (g/hp-hr)				
		NMHC + NOx	NMHC	NOx	CO	PM
75-130 (100-175)	2007	4.0 (3.0)	-	-	5.0 (3.7)	0.30 (0.22)
	2008-2011					
	2012-2013	-	0.19 (0.14) ^a	0.40 (0.30) ^a		0.02 (0.01)
	2014+		0.19 (0.14)	0.40 (0.30)		
130-560 (175-750)	2007-2010	4.0 (3.0)	-	-	3.5 (2.6)	0.20 (0.15)
	2011-2013	-	0.19 (0.14) ^a	0.40 (0.30) ^a		0.02 (0.01)
	2014+		0.19 (0.14)	0.40 (0.30)		
>560 ^b (>750)	2007-2010	6.4 (4.8)	-	-	3.5 (2.6)	0.20 (0.15)
	2011-2014	-	0.40 (0.30)	3.5 (2.6)		0.10 (0.075)
	2015+		0.19 (0.14)			0.04 (0.03)
560-900 ^c (750-1200)	2007-2010	6.4 (4.8)	-	-	3.5 (2.6)	0.20 (0.15)
	2011-2014	-	0.40 (0.30)	3.5 (2.6)		0.10 (0.075)
	2015+		0.19 (0.14)	0.67 (0.50)		0.03 (0.02)
>900 ^c (>1200)	2007-2010	6.4 (4.8)	-	-	3.5 (2.6)	0.20 (0.15)
	2011-2014	-	0.40 (0.30)	0.67 (0.50)		0.10 (0.075)
	2015+		0.19 (0.14)			0.03 (0.02)

^a 50 percent of the engines produced have to meet the NOx + NMHC standard and 50 percent have to meet the separate NOx and NMHC limits.

^b Except generator sets.

^c Generator sets.

Standards for Stationary CI Engines with a Displacement ≥ 10 and < 30 Liters/Cylinder

- Standard for pre-2007 MY engines is for NO_x only. The standard is 17.0 g/kW-hr (12.7 g/hp-hr) when the maximum test speed is less than 130 revolutions per minute (rpm); $45.0 \times N^{-0.20}$ when maximum test speed is at least 130 but less than 2000 rpm, where N is the maximum test speed of the engine in rpm; and 9.8 g/kW-hr (7.3 g/hp-hr) when maximum test speed is 2000 rpm or more.

Standards for 2007 MY and Later Engines				
Engine Size (liters/cylinder)	Engine Power	THC+NO _x	CO	PM
$5.0 \leq \text{displacement} < 15.0$	all power levels	7.8	5.0	0.27
$15.0 \leq \text{displacement} < 20.0$	$< 3,300$ kW	8.7		0.50
$15.0 \leq \text{displacement} < 20.0$	$\geq 3,300$ kW	9.8		
$20.0 \leq \text{displacement} < 25.0$	all power levels			
$25.0 \leq \text{displacement} < 30.0$	all power levels	11.0		

Projected Emission Reductions from 2006-2015 (claiming credit for Tier 2/Tier 3)

Emission Reductions from the NSPS (tons/year)										
Pollutant	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
NOx	4,913	12,588	21,142	29,956	39,027	53,722	68,805	84,278	106,779	130,925
PM	56	110	153	203	248	662	1,290	1,956	2,640	3,439
NMHC	246	660	1,158	1,673	2,205	2,554	2,916	3,295	3,823	4,655
CO	0	0	0	0	0	2,573	6,249	10,028	14,168	18,419
SO2				143		4,973	5,909	6,886	7,889	8,917

- The reductions presented above represent the reductions from the 2005 baseline for stationary CI engines subject to the NSPS
- In the timeframe of 2006 to 2010, a significant portion of the reductions would have occurred even in the absence of the CI NSPS because many of the same engines are used for both stationary and nonroad applications
- Emissions from stationary engines would decrease due to engine design modifications that were done to meet the limits for nonroad engines.
- We estimate that the CI NSPS would account for possibly 20% of the emissions reductions in that time period.
- For new CI engines in 2011 and thereafter the CI NSPS would account for all of the emission reductions.
- Note: HAP emissions from stationary CI engines will be reduced by an estimated 93 tons in the year 2015. These reductions will result from applying add-on controls –CDPF – to stationary CI engines

Stationary CI Engine Population

Projected Number of Stationary CI Engines Sold in the Year 2015 (note this is not cumulative sales, this is sales in 2015 only)		
HP Range	# Prime	# Emergency
50-75	1,788	7,150
75-100	3,119	12,474
100-175	4,255	17,020
175-300	4,391	17,563
300-600	1,532	6,130
600-750	205	820
750-1200	515	2,060
1200-3000	510	2,042
>3000	32	128
Total	16,347	65,387