

# Regulatory Impact Analysis

## Control of Hazardous Air Pollutants from Mobile Sources

### Chapter 11 Cost per Ton of Emissions Reduced

Assessment and Standards Division  
Office of Transportation and Air Quality  
U.S. Environmental Protection Agency



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## **Chapter 11: Cost per Ton of Emissions Reduced**

We have calculated the cost per ton for the rule based on the net present value of all costs incurred and all emission reductions generated from 2009 out to 2030. The time window is meant to capture both the early period of the program when there are a small number of compliant vehicles and portable fuel containers (PFCs) in use, and the later period when there is nearly complete turnover to compliant vehicles and PFCs. For the fuel benzene standards, which begin in 2011, the cost per ton estimates include costs and emission reductions that will occur from all vehicles and nonroad engines fueled with gasoline, PFCs, and gasoline distribution. We have also calculated the cost per ton of emissions reduced in the year 2030 using the annual costs and emissions reductions in that year alone. This number represents the long-term cost per ton of emissions reduced. All costs are in 2003 dollars.

To calculate the cost per ton for each pollutant reduced under the program, we divided the net present value of the annual costs by the net present value of the annual emissions reductions. We have not attempted to apportion costs across these various pollutants for purposes of the cost per ton calculations since there is no distinction in the technologies, or associated costs, used to control the pollutants. Instead, we have calculated costs per ton by assigning all costs to each individual pollutant. If we apportioned costs among the pollutants, the costs per ton presented here would be proportionally lowered depending on what portion of costs were assigned to the various pollutants. Results are presented using both a 3 percent and 7 percent discount rate.

This analysis uses the aggregate costs presented in Chapters 8 through 10 for vehicles, fuels, and PFCs as well as the emissions reductions presented in Chapter 2. In Section 11.1 through 11.3 we present the cost per ton estimates for vehicles, fuels, and PFCs separately. In Section, 11.4, we present the cost per ton estimates for the combined rule.

### **11.1 Cost per Ton for Vehicle Standards**

We are establishing new cold temperature NMHC standards for light-duty vehicles, including medium-duty passenger vehicles. The new standard will be phased in from 2010 through 2015. As discussed in Chapter 8, we are projecting costs for R&D and facilities upgrades. For our cost estimates, we projected that these fixed costs would be recovered over the first five years of production for R&D and the first ten years of production for facilities upgrades. We are not projecting any variable costs, so after the first ten years of production, the overall annualized costs for the new standards are reduced to \$0. For vehicles, we are establishing NMHC standards which would also VOC-based toxics including benzene. We are also expecting direct PM reductions due to the new NMHC standards. We have estimated NMHC, total MSATs, benzene, and PM emissions reductions associated with the cold temperature NMHC standards, as provided in Chapter 2. We have interpolated to estimate the emissions reductions for intermediate years not modeled. The annualized costs and emissions reduction estimates in tons for 2009 through 2030 are provided in Table 11.1-1 below.

**Table 11.1-1 Aggregate Annualized Vehicle Costs and Emissions Reductions**

Calendar Year	Cost	NMHC Reduction (tons)	Benzene Reduction (tons)	MSAT Reduction (tons)	PM Reduction (tons)
2009	\$0	0	0	0	0
2010	\$11,118,971	151,748	7,939	51,987	1,414
2011	\$11,772,829	185,655	9,665	63,136	2,544
2012	\$12,535,232	219,562	11,391	74,285	3,675
2013	\$13,297,635	253,470	13,118	85,433	4,806
2014	\$13,406,181	287,377	14,844	96,582	5,937
2015	\$12,860,869	321,284	16,570	107,731	7,068
2016	\$12,207,011	362,900	18,675	121,586	7,984
2017	\$11,444,608	404,516	20,781	135,441	8,899
2018	\$10,682,205	446,131	22,886	149,297	9,815
2019	\$10,573,659	487,747	24,992	163,152	10,730
2020	\$0	529,363	27,097	177,007	11,646
2021	\$0	564,703	28,891	188,789	12,424
2022	\$0	600,043	30,685	200,570	13,201
2023	\$0	635,383	32,479	212,352	13,979
2024	\$0	670,723	34,273	224,134	14,756
2025	\$0	706,063	36,067	235,916	15,534
2026	\$0	741,402	37,861	247,697	16,311
2027	\$0	776,742	39,655	259,479	17,089
2028	\$0	812,082	41,449	271,261	17,866
2029	\$0	847,422	43,243	283,042	18,644
2030	\$0	882,762	45,037	294,824	19,421

We have calculated the costs per ton using the net present value of the annualized costs of the program from 2009 through 2030 and the net present value of the annual emission reductions through 2030. We have also calculated the cost per ton of emissions reduced in the year 2030 using the annual costs and emissions reductions in that year alone. This number represents the long-term cost per ton of emissions reduced. As noted above, we have calculated costs per ton by assigning all costs to each individual pollutant. The results for each pollutant are provided in Table 11.1-2.

**Table 11.1-2. Vehicle Aggregate Cost per Ton and Long-Term Annual Cost Per Ton (\$2003)**

	<b>Discounted Lifetime Cost per ton at 3%</b>	<b>Discounted Lifetime Cost per ton at 7%</b>	<b>Long-Term Cost per Ton in 2030</b>
NMHC	\$14	\$18	\$0
Benzene	\$270	\$360	\$0
Total MSATs	\$42	\$54	\$0
Direct PM	\$650	\$870	\$0

## 11.2 Cost Per Ton for Fuel Benzene Standard

We are adopting a new benzene fuel content standard which will go into effect in 2011. We have estimated the costs and benzene reductions for the new standards, which are provided in Chapters 9 and 2, respectively. Table 11.2-1 provides the estimated annualized aggregate costs and emissions reductions associated with the standard through 2030. The cost per ton estimates include costs and emission reductions that will occur from all vehicles and nonroad engines fueled with gasoline, as well as reductions from PFCs and gasoline distribution.

**Table 11.2-1 Aggregate Annualized Fuels Costs and Benzene Reductions**

Calendar Year	Cost	Benzene Reduction (tons)
2011	\$354,384,659	18,095
2012	\$360,089,040	17,975
2013	\$365,080,373	17,855
2014	\$369,715,182	17,735
2015	\$374,349,992	17,615
2016	\$378,984,801	17,616
2017	\$383,619,610	17,616
2018	\$388,254,420	17,617
2019	\$393,245,753	17,617
2020	\$397,880,563	17,618
2021	\$402,158,848	17,821
2022	\$406,437,134	18,023
2023	\$410,358,896	18,226
2024	\$414,280,657	18,428
2025	\$418,558,943	18,631
2026	\$422,837,229	18,833
2027	\$427,472,038	19,036
2028	\$432,106,847	19,238
2029	\$436,385,133	19,441
2030	\$441,019,943	19,643

The cost per ton of benzene reductions for fuels are shown in Table 11.2-2 using this same methodology as noted above.

**Table 11.2-2. Fuel Benzene Aggregate Cost per Ton and Long-Term Annual Cost Per Ton (\$2003)**

	Discounted Lifetime Cost per ton at 3%	Discounted Lifetime Cost per ton at 7%	Long-Term Cost per Ton in 2030
Benzene	\$22,400	\$23,100	\$22,500

### 11.3 Cost Per Ton for PFCs

We are adopting an HC standard for PFCs that will go into effect beginning in 2009. The estimated costs for the standard, and gasoline fuel savings, are presented in Chapter 10 and the emissions reductions are provided in Chapter 2. The new HC standard will also reduce VOC-based toxics including benzene. The stream of annualized costs, gasoline fuel savings, and emissions reduction estimates in tons for HC, benzene, and total MSATs for PFCs are provided in Table 11.3-1.

**Table 11.3-1 Aggregate Annualized Portable Fuel Container Costs and Emissions Reductions**

Calendar Year	Cost	Fuel Savings	HC Reduction (tons)	Benzene Reduction (tons)	MSAT Reduction (tons)
2009	\$58,070,171	\$15,346,933	30,290	100	2,590
2010	\$58,674,056	\$30,693,867	60,580	200	5,179
2011	\$59,290,018	\$48,298,000	95,325	294	8,149
2012	\$59,918,300	\$65,901,627	130,069	389	11,120
2013	\$60,559,148	\$83,505,760	164,814	483	14,090
2014	\$33,336,886	\$101,109,387	199,558	578	17,060
2015	\$34,003,624	\$102,522,480	202,347	672	17,357
2016	\$34,683,696	\$103,935,898	205,137	681	17,596
2017	\$35,377,370	\$105,349,189	207,926	690	17,835
2018	\$36,084,918	\$106,762,481	210,715	700	18,075
2019	\$36,806,616	\$108,175,772	213,505	709	18,314
2020	\$37,542,748	\$109,589,064	216,294	718	18,553
2021	\$38,293,603	\$111,056,401	219,190	728	18,801
2022	\$39,059,475	\$112,523,738	222,086	737	19,050
2023	\$39,840,665	\$113,991,075	224,982	747	19,298
2024	\$40,637,478	\$115,458,412	227,878	756	19,546
2025	\$41,450,228	\$116,925,749	230,775	766	19,795
2026	\$42,279,232	\$118,393,086	233,671	776	20,043
2027	\$43,124,817	\$119,860,423	236,567	785	20,291
2028	\$43,987,313	\$121,327,760	239,463	795	20,539
2029	\$44,867,059	\$122,795,097	242,359	804	20,788
2030	\$45,764,401	\$124,262,434	245,255	814	21,036

Table 11.3-2 provides estimated cost per ton for both overall HC reductions, overall MSAT reductions, and for benzene reductions. As with vehicles, we have calculated costs per ton by assigning all costs to each individual pollutant. If we apportioned costs among the pollutants, the costs per ton presented here would be proportionally lowered depending on what portion of costs were assigned to the various pollutants. The cost per ton estimates are presented

with and without gasoline fuel savings. Where the fuel savings outweigh the costs, the table presents cost per ton as \$0, rather than calculating a negative value that has no clear meaning.

**Table 11.3-2. PFC Aggregate Cost per Ton and Long-Term Annual Cost Per Ton (\$2003)**

	<b>Discounted Lifetime Cost per ton at 3%</b>	<b>Discounted Lifetime Cost per ton at 7%</b>	<b>Long-Term Cost per Ton in 2030</b>
HC without fuel savings	\$240	\$270	\$190
HC with fuel savings	\$0	\$0	\$0
Total MSATs without fuel savings	\$2,800	\$3,100	\$2,200
Total MSATs with fuel savings	\$0	\$0	\$0
Benzene without fuel savings	\$74,500	\$82,900	\$56,200
Benzene with fuel saving	\$0	\$0	\$0

## 11.4 Cost Per Ton for the Overall Proposal

The cost per ton estimates for each individual program are presented separately in the sections and tables above, and are part of the justification for each of the programs. For informational purposes, we also present below the cost per ton for the three programs combined. For MSATs and benzene, we have estimated overall costs by summing the cost shown above for fuels, vehicles, and PFCs, including gasoline fuel savings. For MSAT and benzene reductions, we have accounted for the interaction between reduced fuel benzene content due to the new standard and the reductions in benzene that are provided by the vehicle and PFC standards. These emissions reduction estimates are provided in Chapter 2. For HC, we have added the costs and HC reductions shown above for vehicles and PFCs, including fuel savings. Tables 11.4-1 and 11.4-2 provide the streams of costs and emissions reductions in tons for benzene and HC, respectively.



**Table 11.4-1 Aggregate Annualized Overall Costs, and Benzene and MSAT Emissions Reductions\***

Calendar Year	Cost Including Fuel Savings	Benzene Reduction (tons)	MSAT Reduction (tons)
2009	\$42,723,237	100	2590
2010	\$39,099,160	8,139	57,166
2011	\$377,149,506	26,708	88,034
2012	\$366,640,945	28,327	101,951
2013	\$355,431,396	29,946	115,869
2014	\$315,348,863	31,565	129,786
2015	\$318,692,004	33,206	140,837
2016	\$321,939,611	35,117	154,730
2017	\$325,092,399	37,028	168,623
2018	\$328,259,062	38,938	182,517
2019	\$332,450,256	40,849	196,410
2020	\$325,834,247	42,760	210,303
2021	\$329,396,050	44,588	234,411
2022	\$332,972,871	46,415	234,613
2023	\$336,208,485	48,243	246,667
2024	\$339,459,723	50,070	258,721
2025	\$343,083,421	51,898	270,775
2026	\$346,723,375	53,725	282,828
2027	\$350,736,432	55,553	294,882
2028	\$354,766,400	57,380	306,936
2029	\$358,457,095	59,208	318,990
2030	\$362,521,909	61,035	330,844

\* includes fuels, vehicles, and portable fuel containers

**Table 11.4-2 Aggregate Annualized Overall Costs and HC Emissions Reductions\***

Calendar Year	Cost Including Fuel Savings	HC Reduction
2009	\$42,723,237	30,290
2010	\$39,099,160	212,328
2011	\$22,764,847	280,980
2012	\$6,551,906	349,631
2013	-\$9,648,977	418,284
2014	-\$54,366,320	486,935
2015	-\$55,657,987	523,631
2016	-\$57,045,190	568,036
2017	-\$58,527,211	612,442
2018	-\$59,995,358	656,847
2019	-\$60,795,497	701,252
2020	-\$72,046,316	745,657
2021	-\$72,762,798	783,893
2022	-\$73,464,263	822,129
2023	-\$74,150,410	860,365
2024	-\$74,820,934	898,601
2025	-\$75,475,522	936,837
2026	-\$76,113,854	975,073
2027	-\$76,735,606	1,013,309
2028	-\$77,340,447	1,051,545
2029	-\$77,928,038	1,089,781
2030	-\$78,498,034	1,128,017

\* includes vehicles and gas cans

Table 11.4-3 provides the estimated combined cost per ton estimates for benzene, MSATs and HC. The HC estimates are reported as \$0 because the gasoline fuel savings from PFCs offsets the combined costs of the vehicle and PFC programs.

**Table 11.4-3. Overall Aggregate Cost per Ton and Long-Term Annual Cost Per Ton (\$2003)**

	<b>Discounted Lifetime Cost per ton at 3%</b>	<b>Discounted Lifetime Cost per ton at 7%</b>	<b>Long-Term Cost per Ton in 2030</b>
Benzene for fuels, vehicles, and PFCs combined	\$8,200	\$8,600	\$5,900
Total MSATs for fuels, vehicles, and PFCs combined	\$1,700	\$1,800	\$1,100
HC for vehicles and PFCs combined	\$0	\$0	\$0