Regulatory Impact Analysis

Control of Hazardous Air Pollutants from Mobile Sources

Chapter 8
Impact of New Requirements on Vehicle Costs

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U.S. Environmental Protection Agency

United States
Environmental Protection
Agency

EPA420-R-07-002
February 2007

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Chapter 8: Impact of New Requirements on Vehicle Costs

Chapter 5 on vehicle feasibility describes the changes to Tier 2 vehicles we believe will be needed to meet new cold temperature NMHC standards and new evaporative emissions standards. This section presents our analysis of the average vehicle-related costs associated with those changes.[A] For our analysis, we considered incremental hardware costs and up-front costs for research and development (R&D), tooling, certification, and facilities. This section includes both per vehicle and nationwide aggregate cost estimates. All costs are in 2003 dollars.

8.1 Costs Associated with a New Cold Temperature Standard

8.1.1 Hardware Costs

As described in Chapter 5, we are not expecting hardware changes to Tier 2 vehicles in response to new cold temperature standards. Tier 2 vehicles are already being equipped with very sophisticated emissions control systems. We expect manufacturers to use these systems to minimize emissions at cold temperatures. We were able to demonstrate significant emissions reductions from a Tier 2 vehicle through recalibration alone. In addition, a standard based on averaging allows some vehicles to be above the numeric standard as long as those excess emissions are offset by vehicles below the standard. Averaging would help manufacturers in cases where they are not able to achieve the numeric standard for a particular vehicle group, thus helping manufacturers avoid costly hardware changes. The phase-in of standards and emissions credits provisions also help manufacturers avoid situations where expensive vehicle modifications would be needed to meet a new cold temperature NMHC standard. Therefore, we are not projecting hardware costs or additional assembly costs associated with meeting new cold temperature NMHC emissions standards.

8.1.2 Development and Capital Costs

Manufacturers would incur research and development costs associated with a new cold temperature standard and some may also need to upgrade testing facilities to handle increased number of cold tests during vehicle development.

R&D

Manufacturers currently have detailed vehicle development processes designed to ensure Tier 2 vehicles meet all applicable emissions standards throughout the useful life. These processes include cold temperature development and testing for the cold CO standard. New NMHC standards would add engineering effort and emissions testing to the Tier 2 vehicle development cycle for each vehicle durability group. Manufacturers would need to calibrate emissions controls to optimize emissions performance and potentially refine those calibrations to ensure acceptable vehicle performance. Based on discussions with manufacturers and our

[A] This chapter discusses costs for Tier 2 vehicles. We believe the costs would be the same or lower for California certified LEV-II vehicles. Tier 2 and LEV-II must meet very similar emissions standards. LEV-II vehicles, however, must currently meet a 50°F standard which may reduce the costs associated with meeting a 20°F.

feasibility testing described in Chapter 5, we are projecting an average increase of 160 hours of engineering staff time and 10 additional cold temperature development tests for each durability group.[B] The level of effort is likely to vary somewhat by durability group and also by manufacturer, depending on their engines and emissions control systems. However, we believe our estimate is conservatively high based on our test program. We were able with less than 80 hours of engineering effort to significantly reduce emissions from a heavier test weight vehicle with relatively high emissions to levels well below the 0.5 g/mile fleet average standard level. We understand that additional engineering time may be needed as the vehicles proceed through their development cycle so we have doubled the hours needed to 160 hours. We also believe that the average R&D costs are likely conservatively high because the projection ignores the carryover of knowledge from the first vehicle groups designed to meet the new standard to others phased-in later.

We estimate that the R&D costs would be incurred on average three years prior to production. We increased the R&D costs by seven percent each year prior to introduction to account for time value of money. This resulted in an average R&D cost per durability group of about $42,400. To determine a per vehicle cost, we divided total annual vehicle sales by the number of durability groups certified by manufacturers (16,948,000 vehicles sold divided by 295 durability groups) to determine an estimate of average number of vehicles sold per durability group (about 57,500 vehicles/durability group). [1,2] Finally, for the cost analysis, the fixed R&D costs were recovered over five years of production at a rate of seven percent.

Test Facility Upgrades

Manufacturers currently have testing facilities capable of cold temperature testing due to the cold CO standard and also for vehicle development. We are anticipating additional vehicle development testing due to the new cold temperature NMHC standard. During discussions with manufacturers, manufacturers expressed a wide range of concern regarding their testing capabilities. Some manufacturers will likely be able to absorb this additional testing with their current facilities. Other manufacturers expressed the need to upgrade facilities to handle the additional volume of testing. We believe that the proposed phase-in of the standards helps to minimize the number of additional tests that will be needed in any given year and that major new facilities will not be needed. However, we recognize that facility upgrades may be needed in some cases to handle additional test volumes. For our cost analysis, we are including an average facilities cost of $10 million for each of the six largest manufacturers which make up about 88 percent of the vehicles sold. This is based on discussions with manufacturers and our general experiences with testing facilities costs. We believe the remaining manufacturers have limited product lines with relatively few durability groups and will either be able to cover the additional testing with their current facilities or by contracting out a small number of tests as needed.

We estimate that the facility costs will be incurred on average three years prior to the start of the program because the facilities will be needed during vehicle development. As with R&D costs, we increased the facilities costs by seven percent each year prior to introduction to account for time value of money. This resulted in an overall facility cost industry-wide of about $73,500,000. We projected that the facilities costs will be recovered over 10 years of production

[B] We estimated costs using $60 per engineering hour and $2,500 per test.

at a seven percent rate of return. To determine an average per vehicle cost, we divided the annualized cost by annual sales.

Certification Costs

We are not projecting an increase in certification costs. Manufacturers are currently required to measure HC when running the cold CO test procedure during certification.[3] We do not believe the standard adds significantly to manufacturers' current certification process. Development testing is included in the estimated R&D costs described above.

8.1.3 Total Per Vehicle Costs

Our estimated per vehicle cost increase due to the new standards is relatively small because we are projecting no hardware costs, tooling costs, or certification costs, and fixed costs for R&D and facilities are recovered over large unit sales volumes. We estimate the average per vehicle cost will be about $0.62 due to both the R&D and facilities costs during the first five years of the program. The costs would be reduced to $0.44 after the five year recovery period for R&D costs.

As discussed above, we believe the cold temperature standards are feasible for Tier 2 vehicles. We are also including other program provisions such as lead time, phase-in, averaging, and early emissions credits that would help ease the transition to the new standards and avoid costly vehicle redesign and new hardware. Costs associated with the new standard are fixed costs for facilities upgrades and vehicle development. We are projecting average vehicle development costs for vehicle recalibration and software design for cold temperature emissions control. The costs associated with facilities are well understood based on past experience with testing facilities and will vary depending on the current facilities of each manufacturer. The development costs will also vary due to the wide variety of vehicles and the averaging program. Costs could be higher if vehicles not yet phased in to the Tier 2 fleet are more difficult to control than anticipated relative to those already phased in to the Tier 2 program. Costs may be lower because the above analysis does not consider manufacturers being able to transfer knowledge and experience from one vehicle family to the next. However, we do not expect the average per vehicle cost to be considerably higher or lower than the costs projected. These fixed costs are recovered over a large number of vehicles. Although we don't believe we have significantly over or underestimated costs, even if the costs are twice those projected here, the per vehicle costs would remain under $1.30 per vehicle.

We received comments from one limited product line manufacturer that it believes it will be unable to meet the new standard without additional hardware "such as a secondary air injection system or hydrocarbon trap or significantly alter our United States fleet mix to 100% expensive SULEV certified vehicles." The commenter did not provide cost information in their comments. Other manufacturers' comments supported our leadtime, phase-in, and other transitional provisions as providing the flexibility needed to meet the standards with Tier 2 vehicle hardware. We continue to believe that manufacturers will be able to meet the standards through vehicle development without additional hardware. However, we conducted a sensitivity analysis in response to this comment, assuming the commenter would use new hardware to meet

the cold temperature standard. The commenter's sales represent about 1% of US light-duty vehicle sales. If one percent of new vehicles required additional hardware costing $100 - $200 per vehicle, the average cost would increase from $0.62 to the range of $1.60 - $2.60 per vehicle. We used this relatively large range of cost because it is not clear what new hardware or combination of hardware the commenter might use on its vehicles. Also, we believe there will be significant incentive for manufacturers to find alternative to using additional hardware in order to remain competitive, considering that other manufacturers are unlikely to be making hardware changes. Additional discussion of the comments received on the vehicle cold temperature standard is provided in Chapter 3 of the Summary and Analysis of Comments for this rule.

8.1.4 Annual Total Nationwide Costs

To estimate annual costs, we distributed the R&D costs over the phase-in schedule shown below in Table 8.1-1 and amortized the costs over a five-year time period after vehicle introduction using a seven percent discount rate. Based on certification data, we estimated that about 14% (42 out of 295) of durability groups are HLDT/MDPV durability groups. The phase-in schedule is needed to reasonably account for the timing of the R&D investment.

Table 8.1-1. Phase-in Schedule Used in Cost Analysis

Vehicle GVWR (Category)	2010	2011	2012	2013	2014	2015
≤ 6000 lbs (LDV/LLDT)	25%	50%	75%	100%		
> 6000lbs (HLDT/MDPV)			25%	50%	75%	100%

For the facilities cost, we projected that all facility modifications would occur prior to the start of the program and would be amortized over a ten-year time period. We do not expect the phase-in schedule to impact the timing of facilities upgrades. Manufacturers will likely upgrade facilities prior to the first year of the phase-in. Table 8.1-2 provides annual nationwide cost estimates. Table 8.1-3 provides non-annualized aggregate costs.

Table 8.1-2. Annual Nationwide Vehicle Costs

Calendar Year	LDV/LLDT Cost	HLDT/MDPV Cost	Facilities Cost	Total cost
2009	0	0	0	0
2010	653,858	0	10,465,114	11,118,971
2011	1,307,715	0	10,465,114	11,772,829
2012	1,961,573	108,546	10,465,114	12,535,232
2013	2,615,430	217,091	10,465,114	13,297,635
2014	2,615,430	325,637	10,465,114	13,406,181
2015	1,961,573	434,182	10,465,114	12,860,869
2016	1,307,715	434,182	10,465,114	12,207,011
2017	653,858	325,637	10,465,114	11,444,608
2018	0	217,091	10,465,114	10,682,205
2019	0	108,546	10,465,114	10,573,659
2020	0	0	0	0
2021	0	0	0	0
2022	0	0	0	0
2023	0	0	0	0
2024	0	0	0	0
2025	0	0	0	0
2026	0	0	0	0
2027	0	0	0	0
2028	0	0	0	0
2029	0	0	0	0
2030	0	0	0	0
2031	0	0	0	0
2032	0	0	0	0
2033	0	0	0	0
2034	0	0	0	0

Table 8.1-3. Non-Annualized Nationwide Vehicle Costs

Calendar Year	LDV/LLDT Cost	HLDT/MDPV Cost	Facilities Cost	Total cost
2006	0	0	0	0
2007	2,188,450	0	60,000,000	62,188,450
2008	2,188,450	0	0	2,188,450
2009	2,188,450	363,300	0	2,551,750
2010	2,188,450	363,300	0	2,551,750
2011	0	363,300	0	363,300
2012	0	363,300	0	363,300
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0
2018	0	0	0	0
2019	0	0	0	0
2020	0	0	0	0
2021	0	0	0	0
2022	0	0	0	0
2023	0	0	0	0
2024	0	0	0	0
2025	0	0	0	0
2026	0	0	0	0
2027	0	0	0	0
2028	0	0	0	0
2029	0	0	0	0
2030	0	0	0	0
2031	0	0	0	0
2032	0	0	0	0
2033	0	0	0	0
2034	0	0	0	0

8.2 Costs Associated with Evaporative Standards

The standards for evaporative emissions, which are equivalent to the California LEV II standards, are technologically feasible now. As discussed earlier in Chapter 5, the California LEV II program contains numerically more stringent evaporative emissions standards compared to existing EPA Tier 2 standards, but because of differences in testing requirements, we believe the programs are essentially equivalent. This view is supported by manufacturers and current industry practices. (See section V.C.5 of today's rule for further discussion of such test differences -- e.g., test temperatures and fuel volatilities.) A review of recent model year certification results indicates that essentially all manufacturers certify 50-state evaporative emission systems.[4] Based on this understanding, we do not expect additional costs since we expect that manufacturers will continue to produce 50-state evaporative systems that meet LEV II standards.

As discussed in the section V.C.3 of final rule, some manufacturers are still developing flex fuel vehicles (FFVs) and the evaporative control systems in some cases have not been fully field tested and certified on the non-gasoline fuel (for example E-85, which consists of 85 percent ethanol and 15 percent gasoline). Only a few FFV systems have been certified thus far to California LEV-II standards on the non-gasoline fuel. It is likely, however, that other vehicles will be certified to LEV-II standards in the future so that the vehicles can be offered for sale in California as FFVs. We are providing more lead time to manufacturers to certify to the new evaporative standards on the non-gasoline fuel. At this time, however, we do not expect significant hardware changes to these evaporative control systems or a significant increase in the average costs for vehicles due to the new standards. The few systems already on the market available in California are not significantly different from the systems used on current Tier 2-certified FFVs.

References for Chapter 8

[1] Ward's Automotive Yearbook 2006, Calendar Year 2005 Light-duty Vehicle Sales.

[2] Certification data for the 2005 model year.

[3] 40 CFR Subpart C.

[4] Update for FRM: U.S. EPA, Evaporative Emission Certification Results for Model Years 2004 to 2007, Memorandum to Docket EPA-HQ-OAR-2005-0036 from Bryan Manning, January 4, 2007.