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Chapter 7: Truck Costs and Costs per Ton of GHG

7.1 Costs Associated with the Proposed Program

In this section, EPA presents our estimate of the costs associated with the proposed program. The presentation here summarizes the costs associated with new technology expected to be added to meet the new GHG and fuel consumption standards, including hardware costs to comply with the A/C credit program. The analysis summarized here provides our estimate of incremental costs on a per truck basis and on an annual total basis.

The presentation here summarizes the best estimate by EPA and NHTSA staff as to the technology mix expected to be employed for compliance. For details behind the cost estimates associated with individual technologies, the reader is directed to Section III of the preamble and to Chapter 2 of the draft RIA.

With respect to the cost estimates presented here, the agencies note that, because these estimates relate to technologies which are in most cases already available, these cost estimates are technically robust.

7.1.1 Technology Costs per Truck

For the Class 2b and 3 trucks, the agencies have used a methodology consistent with that used for our recent light-duty joint rulemaking since most of the technologies expected for Class 2b and 3 trucks is consistent with that expected for the larger light-duty trucks. The cost estimates presented in the recent light-duty joint rulemaking were then scaled upward to account for the larger weight, towing capacity, and work demands of the trucks in these heavier classes. For details on that scaling process and the resultant costs for individual technologies, the reader is directed to Section III of the preamble and to Chapter 2 of the draft RIA. Note also that all cost estimates have been updated to 2008 dollars for this analysis while the recent light-duty joint rulemaking was presented in 2007 dollars.

For the heavy-duty gasoline and the light heavy-duty diesel engines, we have used engine-related costs from the Class 2b and 3 truck estimates since the light heavy-duty engines are essentially the same engines as those sold into the Class 2b and 3 truck market.

For medium and heavy heavy-duty engines, the agencies have estimated costs using a different methodology than that employed in the recent light-duty joint rulemaking. In the recent light-duty joint rulemaking, the fixed costs were included in the hardware costs via an indirect cost multiplier. As such, the hardware costs presented in that analysis, and in the cost estimates for Class 2b and 3 trucks and the light HD diesel and HD gasoline engines, included both the actual hardware and the associated fixed costs. For this analysis, some of the fixed costs are estimated separately for medium and heavy HD engines and are presented separately from the technology costs. These fixed costs are referred to as “Other Engineering Costs” as shown in

Table 7-2 and described in the text surrounding that table. For details, the reader is directed to Chapter 2 of the draft RIA. Importantly, once totaled both methodologies account for all the costs associated with the proposal. As noted above, all costs are presented in 2008 dollars.

The estimates of vehicle compliance costs cover the years leading up to – 2012 and 2013 – and including implementation of the program – 2014 through 2018. Also presented are costs for the years following implementation to shed light on the long term (2022 and later) cost impacts of the program. The year 2022 was chosen here consistent with the recent light-duty joint rulemaking. That year was considered long term in that analysis because the short-term and long-term markup factors described shortly below are applied in five year increments with the 2012 through 2016 implementation span and the 2017 through 2021 span both representing the short-term. Since many of the costs used in this analysis are based on costs in the recent light-duty joint rulemaking analysis, consistency with that analysis seems appropriate.

Individual technology cost estimates are presented in Chapter 2 of this draft RIA, and account for both the direct and indirect costs incurred. As described fully in Chapter 2 of this draft RIA, the agencies have also considered the impacts of manufacturer learning on the technology cost estimates.

The technology cost estimates discussed in Section III of the preamble and detailed in Chapter 2 of the draft RIA are used to build up technology package cost estimates. For each engine and truck class, a single package for each was developed capable of complying with the proposed standards and the costs for each package was generated. The technology packages and package costs are discussed in more detail in Chapter 2 of the draft RIA. The compliance cost estimates take into account all credits and trading programs and include costs associated with air conditioning controls. Table Table 7-1 presents the average incremental costs per truck for this proposal. For Class 2b and 3, costs increase as the standards become more stringent in 2014 through 2018. Following 2018, costs then decrease going forward as learning effects result in decreased costs for individual technologies. By 2022, the long term ICMs take effect and costs decrease yet again. For vocational trucks, cost trends are more difficult to discern as diesel engines begin adding technology in 2014, gasoline engines begin adding technology in 2016, and the trucks themselves begin adding technology in 2014. With learning effects the costs, in general, decrease each year except for the heavy-duty gasoline engine changes in 2016. Long term ICMs take effect in 2022 to provide more cost reductions. For combination tractors, costs generally decrease each year due to learning effects with the exception of 2017 when the engines placed in sleeper cab tractors add turbo compounding. Following that, learning impacts result in cost reductions and the long term ICMs take effect in 2022 for further cost reductions. By 2030 and later, cost per truck estimates remain constant for all classes. Regarding the long term ICMs taking effect in 2022, the agencies consider this the point at which some indirect costs decrease or are no longer considered attributable to the program (e.g., warranty costs go down). Costs per truck remain essentially constant thereafter.

Table 7-1 Estimated Hardware Cost per Truck (2008 dollars)

YEAR	CLASS 2B&3	VOCATIONAL	CLASS 7&8
2014	$233	$362	$6,828
2015	$302	$356	$6,638

2016	$587	$389	$6,358
2017	$877	$382	$6,668
2018	$1,458	$349	$6,403
2020	$1,454	$333	$6,144
2030	$1,375	$272	$5,081
2040	$1,375	$267	$5,081
2050	$1,375	$267	$5,081

As noted above, the fixed costs were estimated separately from the hardware costs for the medium and heavy HD engines that are placed in Vocational and Combination trucks/tractors. Those fixed costs are not included in Table Table 7-1. The agencies have estimated the R&D costs at $6.75 million per manufacturer per year for five years and the new test cell costs (to accommodate measurement of N_2O emissions) at $100,000 per manufacturer. These costs apply individually for medium and heavy HD engines. Given the 11 manufacturers impacted by the proposed standards, each of which are estimated to sell both medium and heavy HD engines, we have estimated a five year annual R&D cost of $148.5 million dollars (2 x 11 x $6.75 million for each year 2012-2016) and a one-time test cell cost of $1.1 million dollars (2 x 11 x $100,000 in 2013). Estimating annual sales of medium and heavy HD engines at roughly 280,000 units results in roughly $530 per engine per year for five years beginning in 2012 and ending in 2016. Again, these costs are not reflected in Table Table 7-1, but are included in Table Table 7-2 as "Other Engineering Costs".

7.1.2 Annual Costs of the Proposal

The costs presented here represent the incremental costs for newly added technology to comply with the proposal. Together with the projected increases in truck sales, the increases in per-truck average costs shown in Table Table 7-1 above result in the total annual costs presented in Table Table 7-2 below. Note that the costs presented in Table Table 7-2 do not include the savings that would occur as a result of the improvements to fuel consumption. Those impacts are presented in Section 0.

Table 7-2 Annual Costs Associated with the Proposal ($Millions of 2008 dollars)

YEAR	CLASS 2B&3	VOCATIONAL	CLASS 7&8	OTHER ENGINEERING COSTS[A]	ANNUAL COSTS
2012	$0	$0	$0	$149	$149
2013	$0	$0	$0	$151	$151
2014	$183	$202	$834	$149	$1,367
2015	$221	$205	$825	$149	$1,399
2016	$418	$231	$804	$149	$1,602
2017	$622	$234	$859	$0	$1,714
2018	$1,045	$220	$843	$0	$2,108

2020	$1,004	$222	$844	$0	$2,070
2030	$980	$234	$805	$0	$2,019
2040	$1,057	$322	$921	$0	$2,300
2050	$1,140	$423	$1,065	$0	$2,627
NPV, 3%	$19,240	$5,561	$18,261	$692	$43,755
NPV, 7%	$9,923	$2,891	$10,009	$632	$23,456

[A] "Other Engineering Costs" are described in Section 7.1.1. These costs represent fixed costs for medium heavy and heavy heavy engines placed in vocational trucks and combination trucks/tractors.

7.2 Cost per Ton of GHG Emissions Reduced

The agencies have calculated the cost per ton of GHG (CO_2-equivalent, or CO_2e) reductions associated with this rule using the above costs and the GHG emissions reductions described in Chapter 5. The cost per metric ton of GHG emissions reductions has been calculated in the years 2020, 2030, 2040, and 2050 using the annual vehicle compliance costs and emission reductions for each of those years. The value in 2050 represents the long-term cost per ton of the emissions reduced. The agencies have also calculated the cost per metric ton of GHG emission reductions including the savings associated with reduced fuel consumption (presented below in Section **Error! Reference source not found.**7.3). This latter calculation does not include the other benefits associated with this proposal such as those associated with criteria pollutant reductions or energy security benefits (discussed in Chapter 9). By including the fuel savings in the cost estimates, the cost per ton is less than $0 since the estimated value of fuel savings outweighs the program costs. Also of interest is the cumulative cost per ton of cumulative CO_2e reductions. These values are shown in Table 7-4 both with and without cumulative fuel savings.

The results for CO_2e costs per ton under the proposal are shown in Table Table 7-3.

Table 7-3 Annual Cost per Metric Ton of CO_2e Reduced (2008 dollars)

YEAR	PROGRAM COST	FUEL SAVINGS (POST-TAX)	CO_2E REDUCED	COST PER TON (WITHOUT	COST PER TON (WITH FUEL
2020	$2,100	$9,300	36	$60	-$200
2030	$2,000	$21,100	73	$30	-$260
2040	$2,300	$30,700	94	$20	-$300
2050	$2,600	$38,200	114	$20	-$310

Table 7-4 Cumulative Cost per Cumulative Metric Ton of CO_2e Reduced (2008 dollars)

YEAR	PROGRAM COST	FUEL SAVINGS (POST-TAX)	CO_2E REDUCED	COST PER TON (WITHOUT	COST PER TON (WITH FUEL
2020	$12,600	$32,100	136	$90	-$140
2030	$32,700	$196,500	716	$50	-$230
2040	$54,400	$460,600	1,567	$30	-$260

2050	$79,200	$808,300	2,619	$30	-$280

7.3 Impacts of Reduction in Fuel Consumption

7.3.1 Gallons Reduced under the Proposal

The new CO_2 standards will result in significant improvements in the fuel efficiency of affected trucks. Drivers of those trucks will see corresponding savings associated with reduced fuel expenditures. The agencies have estimated the impacts on fuel consumption for the tailpipe CO_2 standards. To do this, fuel consumption is calculated using both current CO_2 emission levels and the new CO_2 standards. The difference between these estimates represents the net savings from the CO_2 standards. Note that the total number of miles that vehicles are driven each year is different under each of the control case scenarios than in the reference case due to the "rebound effect," which is discussed in Chapter 9. EPA also notes that drivers who drive more than our average estimates for vehicle miles traveled (VMT) will experience more fuel savings; drivers who drive less than our average VMT estimates will experience less fuel savings.

The expected impacts on fuel consumption are shown in Table Table 7-5. The gallons shown in the tables reflect impacts from the new CO_2 standards and include increased consumption resulting from the rebound effect.

Table 7-5 Fuel Consumption Reductions of the Proposal (Million gallons)

	GASOLINE				DIESEL			
YEAR	CLASS 2B&3	VOC	COMB	TOTAL	CLASS 2B&3	VOC	COMB	TOTAL
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	1.7	0.0	0.0	1.7	5.0	48	264	316
2015	4.9	0.0	0.0	4.9	12	93	519	624
2016	14	5.2	0.0	19	30	136	765	931
2017	29	10	0.0	39	57	221	1,115	1,393
2018	56	15	0.0	71	106	301	1,454	1,861
2020	108	24	0.0	132	199	445	2,079	2,723
2030	293	60	0.0	352	529	953	3,930	5,412
2040	397	71	0.0	468	715	1,483	4,805	7,004
2050	478	91	0.0	569	862	2,008	5,583	8,453

7.3.2 Monetized Fuel Savings

Using the fuel consumption estimates presented above, the agencies can calculate the monetized fuel savings associated with the proposed standards. To do this, reduced fuel consumption is multiplied in each year by the corresponding estimated average fuel price in that year, using the reference case taken from the AEO 2010. These estimates do not account for the significant uncertainty in future fuel prices; the monetized fuel savings will be understated if

actual fuel prices are higher (or overstated if fuel prices are lower) than estimated. AEO is a standard reference used by NHTSA and EPA and many other government agencies to estimate the projected price of fuel. This has been done using both the pre-tax and post-tax fuel prices. Since the post-tax fuel prices are the prices paid at fuel pumps, the fuel savings calculated using these prices represent the savings consumers would see. The pre-tax fuel savings are those savings that society would see. These results are shown in Table 7-6. Note that in Chapter 9, the overall benefits and- costs of the rule are presented and, for that reason, only the pre-tax fuel savings are presented there.

Table 7-6 Estimated Monetized Fuel Savings ($Millions of 2008 dollars)

Year	Fuel Savings (pre-tax)	Fuel Savings (post-tax)
2014	$700	$800
2015	$1,400	$1,700
2016	$2,200	$2,700
2017	$3,600	$4,200
2018	$5,000	$5,900
2020	$8,000	$9,300
2030	$18,900	$21,100
2040	$28,000	$30,700
2050	$35,200	$38,200
NPV, 3%	$351,100	$389,900
NPV, 7%	$152,100	$170,100

References