

and emission reductions in that year alone. This number represents the long-term cost per ton of emissions reduced after all fixed costs of the program have been recovered by industry leaving only the variable costs of control. The cost per ton numbers include costs and emission reductions that would occur from the existing fleet (*i.e.*, those pieces of nonroad equipment that were sold into the market prior to the proposed emission standards). These results are shown in Table V.D-2. We did the cost analysis using a 3% discount rate. We will also be conducting a similar analysis using a 7% discount rate and including this information in the docket.

TABLE V.D-2—TOTAL PROPOSED FUEL AND ENGINE PROGRAM AGGREGATE COST PER TON AND LONG-TERM ANNUAL COST PER TON (\$2001)

| Pollutant | 2004–2036 Discounted lifetime cost per ton | Long-term cost per ton in 2036 |
|-----------------------------|--|--------------------------------|
| NO _x +NMHC | \$810 | \$530 |
| PM | 8,700 | 6,900 |
| SO _x | ^a 200 | 170 |

Notes:

^a This result does not match that in Table 8.4-2 because the nonroad portion of the fuel is reduced to 15 ppm and does not stay at 500 (locomotive and marine portions are kept at 500ppm). The costs to reduce fuel sulfur from uncontrolled to 15ppm were assigned 50/50 to NO_x+NMHC and PM for the reduction to 15 ppm is to enable aftertreatment technology.

5. Comparison With Other Means of Reducing Emissions

In comparison with other programs to control these pollutants, we believe that the proposed programs represent a cost effective strategy for generating substantial NO_x+NMHC, PM, and SO₂ reductions. This can be seen by comparing the 2007 fuel program (*i.e.*, a sulfur cap of 500 ppm) cost per ton and the total program cost per ton with a number of standards that EPA has adopted in the past. Table V.D-3 summarizes the cost per ton of several past EPA actions for NO_x+NMHC. Table V.D-4 summarizes the cost per ton of several past EPA actions for PM.

TABLE V.D-3—COST PER TON OF PREVIOUS MOBILE SOURCE PROGRAMS FOR NO_x + NMHC

| Program | \$/ton |
|--------------------------------------|-------------|
| Tier 2 Nonroad Diesel | 630 |
| Tier 3 Nonroad Diesel | 430 |
| Tier 2 vehicle/gasoline sulfur | 1,410–2,370 |

TABLE V.D-3—COST PER TON OF PREVIOUS MOBILE SOURCE PROGRAMS FOR NO_x + NMHC—Continued

| Program | \$/ton |
|------------------------------|-------------|
| 2007 Highway HD | 2,260 |
| 2004 Highway HD | 220–430 |
| Off-highway diesel engine .. | 450–710 |
| Tier 1 vehicle | 2,160–2,930 |
| NLEV | 2030 |
| Marine SI engines | 1,230–1,940 |
| On-board diagnostics | 2,430 |
| Marine CI engines | 30–190 |

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

TABLE V.D-4.—COST PER TON OF PREVIOUS MOBILE SOURCE PROGRAMS FOR PM

| Program | \$/ton |
|------------------------------------|---------------|
| Tier 1/Tier 2 Nonroad Diesel | 2,410 |
| 2007 Highway HD | 14,280 |
| Marine CI engines | 5,480–4,070 |
| 1996 urban bus | 12,870–20,590 |
| Urban bus retrofit/rebuild .. | 31,740 |
| 1994 highway HD diesel .. | 21,930–25,670 |

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

To compare the cost per ton of SO₂ emissions reduced, we looked at the cost per ton for the Title IV SO₂ trading programs. This information is found in EPA report 430/R-02-004, “Documentation of EPA Modeling Applications (V.2.1) Using the Integrated Planning Model”, in Figure 9.11 on page 9–14 (www.epa.gov/airmarkets/epa-ipm/index.html#documentation). The SO₂ cost per ton results of the proposed program presented in Table V.D-2 compare very favorably with the program shown in Table V.D-5.

TABLE V.D-5—COST PER TON OF SO₂ FROM EPA BASE CASE 2000 FOR THE TITLE IV SO₂ TRADING PROGRAMS

| Program | \$/ton |
|--|---------------------------------|
| Title IV SO ₂ Trading Programs. | \$490 in 2010 to \$610 in 2020. |

Note: Costs adjusted to 2001 dollars using the Producer Price Index for Total Manufacturing Industries.

E. Do the Benefits Outweigh the Costs of the Standards?

Our analysis of the health and welfare benefits to be expected from this proposal are presented in this section.

Briefly, the analysis projects major benefits throughout the period from initial implementation of the rule through 2030, the last year analyzed. As described below, thousands of deaths and other serious health effects would be prevented, yielding a net present value in 2004 of those benefits we could monetize of approximately \$550 billion dollars. These benefits exceed the net present value of the social cost of the proposal (\$17 billion) by a factor of over 30 to one.

1. What Were the Results of the Benefit-Cost Analysis?

Table V.E-1 presents the primary estimate of reduced incidence of PM-related health effects for the years 2020 and 2030. In interpreting the results, it is important to keep in mind the limited set of effects we are able to monetize. Specifically, the table lists the PM-related benefits associated with the reduction of several health effects.²⁹⁰ In 2030, we estimate that there will be 9,600 fewer fatalities per year associated with fine PM, and the rule will result in about 5,700 fewer cases of chronic bronchitis, 8,300 fewer hospitalizations (for respiratory and cardiovascular disease combined), and result in significant reductions in days of restricted activity due to respiratory illness (with an estimated 5.7 million fewer cases). We also estimate substantial health improvements for children from reduced upper and lower respiratory illness, acute bronchitis, and asthma attacks.²⁹¹

Table V.E-2 presents the total monetized benefits for the years 2020 and 2030. This table also indicates with a “B” those additional health and environmental effects which we were unable to quantify or monetize. These effects are additive to estimate of total benefits, and EPA believes there is

²⁹⁰ Based upon recent preliminary findings by the Health Effects Institute, the concentration-response functions used to estimate reductions in hospital admissions may over or underestimate the true concentration-response relationship. See letter from Dan Greenberg, President, Health Effects Institute, May 30, 2002, attached to letter from Dr. Hopke, dated August 8, 2002. Docket A-2000-01, Document IV-A-145.

²⁹¹ Our estimate incorporates significant reductions of 150,000 fewer cases of lower respiratory symptoms in children ages 7 to 14 each year, 110,000 fewer cases of upper respiratory symptoms (similar to cold symptoms) in asthmatic children each year, and 14,000 fewer cases of acute bronchitis in children ages 8 to 12 each year. In addition, we estimate that this rule will reduce almost 6,000 emergency room visits for asthma attacks in children each year from reduced exposure to particulates. Additional incidents would be avoided from reduced ozone exposures. Asthma is the most prevalent chronic disease among children and currently affects over seven percent of children under 18 years of age.