# Regulatory Impact Analysis

## Control of Hazardous Air Pollutants from Mobile Sources

## Chapter 10
## Portable Fuel Container Costs

Assessment and Standards Division
Office of Transportation and Air Quality
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EPA United States Environmental Protection Agency

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# CHAPTER 10: Portable Fuel Container Costs

This chapter presents a detailed analysis of the projected average portable fuel container (PFC) costs related to meeting new emissions standards, which would require the use of "best available controls." These costs have been developed based on industry information, discussions with manufacturers (including confidential business information concerning technology costs), and engineering judgment. These costs include variable costs for improved materials used in manufacturing PFCs (including improved spouts), and fixed costs for research and development, tooling, and certification. Finally, this chapter presents estimated fuel savings and aggregate nationwide costs for PFCs.

## 10.1 Methodology

The following technology characterization and cost figures reflect our current best judgment based on engineering analysis, information from manufacturers, and the published literature. The analysis includes manufacturer markups to the retail level.

Costs of control typically include variable costs (for incremental hardware costs, assembly costs, and associated markups) and fixed costs (for tooling, R&D, and certification). Variable costs are marked up at a rate of 29 percent to account for PFC manufacturers' overhead and profit.[1] To account for additional warranty costs associated with a change in technology, we have added 5 percent of the incremental variable cost. We estimated a range of costs for different size PFCs and also an average per container cost based on the approximate sales weighting of the three PFC sizes.[A] All costs are in 2003 dollars.

We are not projecting any additional R&D costs associated with the new EPA PFC standards. Manufacturers have developed and are continuing to develop control technologies in response to the California (and other state) programs. EPA's program is very similar to the California program and we believe the most likely approach for manufacturers will be to use the technologies developed for state programs nationwide. Manufacturers will incur the R&D costs even in the absence of EPA emissions standards. Further, the permeation barriers available are very well understood within the industry. Therefore, we believe manufacturers will use these same technologies for their nationwide product lines and will not incur significant new R&D costs due to an EPA program.

We estimate that tooling and certification costs will be incurred one year prior to production, on average. These fixed costs were increased by seven percent to reflect the time value of money over the one year period. The fixed costs then were recovered over the first five years of production at a rate of seven percent.

## 10.2 Costs for Permeation Control

*Multi-layered designs*

[A] PFC sales for 1,2, and 5 gallon containers are weighted at 33%, 33%, and 34% of total sales, respectively.

Manufacturers have indicated that most are likely to switch to multi-layer designs to meet permeation requirements. For this analysis, we considered a PFC design with a material composition of 3% ethylene vinyl alcohol (EVOH) at $3.50/lb, 4% adhesive layer at $1/lb and the remainder HDPE.[2] This resulted in materials costs ranging from $0.29 to $0.58 for 1 to 5 gallon containers, with an average materials cost of $0.41.[B]

In some cases, blow-molding machines can be retrofitted for multi-layer operation. The total cost of such a retrofit, including supporting equipment, would be about $1,000,000 per machine. In other cases, a new blow-molding machine would be required. A machine that could blow-mold multi-layer tanks would approximately double the price of the blow-molding machine. For this analysis, we use a machine cost increase of $2,000,000, including all molds and related set-up. For our analysis, we've projected that half the machines would be retrofit and half would be new, for an average cost of about $1,500,000 per machine. Our analysis uses an average total annual production of 350,000 blow-molded tanks per machine and an amortization of the capital costs over 5 years. This results in an average fixed cost per container of $1.12. Adding the fixed costs to the variable costs described above gives an average per container cost for multi-layered cans of about $1.53.

*Non-continuous Barrier Platelets*

Manufacturers may reduce permeation from blow-molded PFCs by blending in a low permeation material such as EVOH with the HDPE. This is typically known by its trade name, Selar. The EVOH in the plastic forms non-continuous barrier platelets in the PFC during blow-molding that make it harder for fuel to permeate through the walls of the tank. Using this approach, no changes should be necessary in the blow-molding equipment, so the costs are based on increased material costs. We used 10 percent EVOH, which costs about $3-4 per pound, and 90 percent HDPE, which costs about $0.65-0.75 per pound. This equates to a price increase of about $0.35 per pound. The increased cost for PFCs would range from $0.69 to $1.38, with an average cost increase of $1.00 per container.

*Fluorination*

We have also estimated costs for fluorination since some PFC manufacturers have used this approach to meet current California standards. Our surface treatment cost estimates are based on price quotes from a company that specializes in this fluorination.[3] We estimate that PFC costs would range from $0.86 to $3.30, with an average cost of $1.84. These prices do not include the cost of transporting the PFCs; we estimated that shipping, handling and overhead costs would be an additional $0.30 per PFC.[4]

## 10.3 Spout Costs

Manufacturers will need to move from a simple pouring spout to an automatic closing spout in order to meet evaporative emissions standards. The automatic closing spouts would include a spring closing mechanism. For this analysis, we estimated an average variable cost

[B] This analysis was done using container weights of 1.5, 2.0, and 3.0 pounds for 1,2, and 5 gallon containers, respectively.

increase for spouts of about $0.85 including assembly costs, based on discussions with PFC manufacturers. We have also estimated $200,000 for tooling per 1 million spouts. This results in a fixed cost for tooling of about $0.05 per spout, for a total spout cost of $0.90. The spout costs would not likely vary by PFC size.

## 10.4 Certification Costs

Manufacturers will need to integrate the emission control technology into their designs and there will be some engineering and clerical effort needed to submit the required information for certification. We expect that in the early years, PFC manufacturers will perform durability and permeation testing for certification. They will be able to carry over this data in future years and to PFCs that are made of similar materials and have the same permeation control strategy regardless of PFC size.

Manufacturers will need to run certification testing for their PFCs and then submit the data and supporting information to EPA for certification. Based on the current approach used by manufacturers, we've estimated that each manufacturer will contract out testing at a cost of about $7,500 per manufacturer. We've included an additional cost of $5,000 for staff time for the certification process, for a total certification cost of $12,500 per manufacturer.

To calculate a per PFC certification cost, we calculated a total industry cost for certification of $125,000 and spread this cost over industry-wide sales of 26,000,000 units. As with other fixed costs, we amortized the cost over five years of sales to calculate per unit certification costs. Due to the large sales volumes, the analysis results in an average per can cost for certification of less than one cent.

## 10.5 Per Container Total Costs

We based our cost analysis on costs associated with multi-layer PFCs. We believe most manufacturers will continue down the path of using this technology since it is robust, has well-understood emissions performance, and appears to have the lowest cost once the capital costs are recovered. Other options for permeation barriers have similar overall costs, especially in the near term. If manufacturers select a different permeation barrier approach such as non-continuous barrier platelets or fluorination, tooling costs would be lower, but would be offset by higher variable costs. Our estimated per container costs are shown in Table 10.5-1. The weighted average costs would be $2.69. These costs are similar to cost data shared with us by manufacturers on a confidential basis.

**Table 10.5-1. Costs per PFC**

| | 1 gallon | 2 gallon | 5 gallon |
|---|---|---|---|
| Variable costs<br>- Permeation Barrier<br>- Spout | <br>$0.22<br>$0.85 | <br>$0.28<br>$0.85 | <br>$0.44<br>$0.85 |
| Total Variable Costs | $1.07 | $1.13 | $1.29 |
| Total Variable costs w/ OEM Mark-up and warranty | $1.40 | $1.48 | $1.69 |
| Tooling | $1.17 | $1.17 | $1.17 |
| Certification | Less than $0.01 | Less than $0.01 | Less than $0.01 |
| Total | $2.57 | $2.65 | $2.86 |

Costs are well understood due to the experience manufacturers have had previously with permeation emissions control technologies and with the California PFC program. We are estimating costs based on the likely technology path manufacturers will take to meet the standards. Costs could be somewhat higher or lower if manufacturers use a different mix of control technologies or use multiple technologies across their product lines. Other sources of potential uncertainty include whether costs might be lower on a nationwide basis due to economies of scale or due to additional learning by the manufacturers.

## 10.6 Costs for PFCs Complying with State Programs

The above costs are for currently uncontrolled PFCs. Some states have adopted PFC programs, based on the original California program which took effect in 2001.[C] The original California program contained permeation requirements that would be significantly less stringent than the standards considered in this cost analysis (about a 50 percent emission reduction compared to an 80 to 90 percent emission reduction). Because the standards considered in this cost analysis are more stringent than those currently in place in states with programs, we have estimated costs associated with the difference. For purposes of the cost analysis, we have estimated that the costs associated with meeting the state programs would be half those for the permeation requirements considered here, resulting in a cost difference of $0.77 per container.

Although there technically is a difference in stringency between current state programs and the potential EPA requirements and we are including costs associated with the difference, it is unlikely that these costs would be realized. California has adopted revised program requirements that are essentially equivalent to those being considered by EPA. Manufacturers are in the process of incorporating more robust permeation controls in response to the new California program. Manufacturers would want to avoid carrying two different products and would likely use the more robust permeation controls in all states with programs. Also, in the absence of an EPA program, states would likely adopt the new California requirements eventually.

[C] Delaware, Maine, Maryland, Pennsylvania, New York, Connecticut, Massachusetts, New Jersey, Rhode Island, Vermont, Virginia, Washington DC, Ohio, New Hampshire, and Texas

## 10.7 Gasoline Savings

The emissions reductions due to reduced evaporative losses and reduced spills from PFCs filled with gasoline translate into gasoline savings. As described in Chapter 2, we have estimated the annual HC reductions due to new standards. By dividing the tons reduced by the number of PFCs in use with gasoline we can estimate the annual tons reduction per PFC. In 2015, after the program is fully implemented, we estimated that there would be 88,023,896 PFCs in use with gasoline nationwide and that those cans would be responsible for about 202,347 tons of HC reduction. We can then translate the tons reduction per can per year (0.002 tons, or 4.1 pounds) to gallons using a fuel density of six lbs/gallon (for lighter hydrocarbons which evaporate first). We used an average life of five years for PFCs and used a discount rate of seven percent to estimate total average undiscounted and discounted fuel savings per PFC, provided below. We calculated the savings using $1.52 per gallon of gasoline.[5] These savings would offset the cost of the PFC controls.

**Table 10.7-1. Average Gasoline Savings Over Life of PFC**

| | |
|---|---|
| HC reduced (pounds) | 20.5 |
| Fuel Savings (gallons) | 3.4 |
| Undiscounted Savings | $5.17 |
| Discounted Savings | $4.24 |

## 10.8 Annual Total Nationwide Costs and Fuel Savings

The above analyses provide incremental per unit PFC cost estimates. Using these per unit costs and projections of future annual sales, we have estimated total aggregate annual costs. The aggregate costs are presented on a cash flow basis, with hardware and fixed costs incurred in the year the PFCs are sold and fuel savings occurring over the life of the PFC. To project annual sales into the future, we started with an estimated 26 million PFCs sold nationwide in 2002 and then grew sales by two percent per year.[6,7] The resulting sales estimates for select years are shown in Table 10.8-1 below. To estimate sales in states with and without existing PFC programs, we projected that 39 percent of overall sales would be in states with existing PFC programs. This estimate is based on current estimated PFC populations by state provided in Chapter 2 of the RIA.

**Table 10.8-1. Projected Annual PFC Sales**

| | 2009 | 2015 | 2020 | 2030 |
|---|---|---|---|---|
| Projected sales | 29,866,000 | 33,634,000 | 37,134,000 | 45,267,000 |

For total fuel savings, we used the nationwide HC reductions estimated in Chapter 2 of the RIA and the methodology described above to convert to gallons of fuel saved nationwide, and then to savings in dollars. We estimate that fuel savings ramp up as new PFCs replace old ones and would more than offset the aggregate costs in the long term, for an overall savings. Table 10.8-2 presents the results of this analysis. As shown in the table, aggregate costs start out at about $58 million and then drop to $33 million in 2014 when the fixed costs have been recovered. Fuel savings start out at about $15 million per year and reach $101 million in 2014. After 2014, increases in costs and savings are due to PFC sales and population growth.

As noted above, fixed costs due to certification and tooling are expected to actually be incurred on average one year prior to the start of the program. We estimate that the total fixed costs in that year would be about $107 million.

**Table 10.8-2. Annual Nationwide PFC Costs and Fuel Savings**

| Calendar Year | Variable Costs | Fixed Costs | Total Costs | Fuel Savings | Net Cost |
|---|---|---|---|---|---|
| 2008 | 0 | 0 | 0 | 0 | 0 |
| 2009 | $ 30,194,245 | $ 27,875,926 | $58,070,171 | $15,346,933 | $42,723,237 |
| 2010 | $ 30,798,130 | $ 27,875,926 | $58,674,056 | $30,693,867 | $27,980,189 |
| 2011 | $ 31,414,092 | $ 27,875,926 | $59,290,018 | $48,298,000 | $10,992,018 |
| 2012 | $ 32,042,374 | $ 27,875,926 | $59,918,300 | $65,901,627 | -$5,983,327 |
| 2013 | $ 32,683,222 | $ 27,875,926 | $60,559,148 | $83,505,760 | -$22,946,612 |
| 2014 | $ 33,336,886 | $ - | $33,336,886 | $101,109,387 | -$67,772,501 |
| 2015 | $ 34,003,624 | | $34,003,624 | $102,522,480 | -$68,518,856 |
| 2016 | $ 34,683,696 | | $34,683,696 | $103,935,898 | -$69,252,201 |
| 2017 | $ 35,377,370 | | $35,377,370 | $105,349,189 | -$69,971,819 |
| 2018 | $ 36,084,918 | | $36,084,918 | $106,762,481 | -$70,677,563 |
| 2019 | $ 36,806,616 | | $36,806,616 | $108,175,772 | -$71,369,156 |
| 2020 | $ 37,542,748 | | $37,542,748 | $109,589,064 | -$72,046,316 |
| 2021 | $ 38,293,603 | | $38,293,603 | $111,056,401 | -$72,762,798 |
| 2022 | $ 39,059,475 | | $39,059,475 | $112,523,738 | -$73,464,263 |
| 2023 | $ 39,840,665 | | $39,840,665 | $113,991,075 | -$74,150,410 |
| 2024 | $ 40,637,478 | | $40,637,478 | $115,458,412 | -$74,820,934 |
| 2025 | $ 41,450,228 | | $41,450,228 | $116,925,749 | -$75,475,522 |
| 2026 | $ 42,279,232 | | $42,279,232 | $118,393,086 | -$76,113,854 |
| 2027 | $ 43,124,817 | | $43,124,817 | $119,860,423 | -$76,735,606 |
| 2028 | $ 43,987,313 | | $43,987,313 | $121,327,760 | -$77,340,447 |
| 2029 | $ 44,867,059 | | $44,867,059 | $122,795,097 | -$77,928,038 |
| 2030 | $ 45,764,401 | | $45,764,401 | $124,262,434 | -$78,498,034 |
| 2031 | $ 46,679,689 | | $46,679,689 | $125,675,726 | -$78,996,037 |
| 2032 | $ 47,613,282 | | $47,613,282 | $127,089,018 | -$79,475,735 |
| 2033 | $ 48,565,548 | | $48,565,548 | $128,502,309 | -$79,936,761 |
| 2034 | $ 49,536,859 | | $49,536,859 | $129,915,601 | -$80,378,742 |
| 2035 | $ 50,527,596 | | $50,527,596 | $131,328,892 | -$80,801,296 |

**References for Chapter 10**

[1] ."Update of EPA's Motor Vehicle Emission Control Equipment Retail Price Equivalent (RPE) Calculation Formula," Jack Faucett Associates, Report No. JACKFAU-85-322-3, September 1985.

[2]"Plastic News," Resin Pricing for November 8, 2004, www.plasticsnews.com.

[3] "Information on Costs and Effectiveness of Fluorination Received from Fluoroseal," Memorandum from Mike Samulski to Docket A-2000-1, March 27, 2002.

[4]"Shipping Costs," Memorandum from Glenn Passavant, U.S. EPA to Docket A-2000-01, March 27, 2002.

[5] Energy Information Administration, Annual Energy Outlook 2005, Table 12, Petroleum Product Prices, January 2005, DOE/EIA-0383(2005). EIA projected average post-tax gasoline costs for 2010.

[6] "Characterizing Gas Can Markets: A Profile," RTI International, Final Report, August 2004.

[7] "Gas Can Industry Profile Updates", Memorandum from RTI to EPA, January 4, 2007.