Appendix 5

Cost Effectiveness and Economic Impact

APPENDIX 5
Cost-effectiveness and Economic Impact

Introduction

In support of the proposed 2011 Amendments to the Regulation for Certification of Vapor Recovery Systems at Gasoline Dispensing Facilities (GDFs), California Air Resources Board (ARB or CARB) staff assessed the overall cost-effectiveness along with the economic and fiscal impacts of the proposed amendments. The proposed permeation standard for GDF hoses is the only item of this rulemaking that will have fiscal and economic impact. All other amendments being proposed are administrative in nature and should not impose any new costs.

The proposed permeation standard would be limited to hoses where liquid gasoline would be in contact with the outer wall of the hose. This means that hoses used with vacuum assist vapor recovery systems and conventional hoses[1] are subject to the proposal. Staff has determined the proposal will not impose a significant cost burden on retail businesses located in California or on implementing government agencies. Manufacturers, located outside California, are currently providing low-permeation hoses for other applications (e.g., small off-road engines) subject to similar performance standards.

Staff has determined that the total five-year cost of the proposed regulation for all affected GDF owners and operators within California will be approximately $1,445,000. California GDFs dispense about 14.8 billion gallons of gasoline per year. When compared to the cost of gasoline dispensed, compliance cost is negligible, and is expected to be passed on to consumers. However, low-permeation hoses will prevent dispensed fuel from evaporating, resulting in a five-year fuel savings to consumers of approximately $1,715,000. Therefore, the regulation will result in a net savings and has a cost-effectiveness of $0.09 saved per pound of ROG reduced. A summary table of these results can be found at the end of this document in Attachment 1. Further, all calculations for this appendix may be viewed online at ARB's website at: http://www.arb.ca.gov/vapor/gdfhe/low_permeation_gdf_hose_emissions_spreadsheet.xls

Methodology: Cost and Cost-effectiveness

To compare regulatory cost-effectiveness, ARB staff uses the measure of dollars per pound of emissions reduced ($/lb.). The following demonstrates the assumptions and calculations staff used to determine cost-effectiveness.

Hose-to-Fueling Point Ratio

For all of the calculations throughout this report staff assumes that gasoline is

[1] Conventional hoses are installed on GDFs that have been exempted from Phase II vapor recovery because the GDF refuels predominately vehicles that are equipped with onboard refueling vapor recovery or ORVR.

dispensed primarily with unihose dispenser or one hose per fueling point. There are some exceptions to this rule as with "six-pack" dispensers. Since the quantity of gasoline dispensed through "six-pack" dispenser are small, staff assumed the ratio of one hose per fueling point throughout this report.

Cost Increase of Low-permeation Hoses

Staff conducted a survey of hose manufacturers to determine the cost increase to GDF owners for low-permeation GDF hoses (CARB, 2010). The survey defined the hose permeation limit to be 5 grams per square meter per day (g/m^2/day) using CE-10 test fuel at a constant temperature of 104.0 °F (40.0 °C). The hose length was defined to be 10 feet. The responses to the survey indicated the upgrade cost to the end-user would be approximately $10 for either a vacuum assist or conventional GDF hose. Staff concludes these numbers are conservative, as the permeation standard that was proposed in the survey is more rigorous than what is now proposed (10.0 g/m^2/day using CE-10 test fuel at a constant temperature of 100.4 °F (38.0 °C)).

Average GDF Hose Life

Staff interviewed several GDF hose manufacturers and determined the average life of a GDF hose is approximately two years. Although there are many cases of hoses lasting longer than two years, damage from customer drive-offs and driving over hoses leads to a shorter hose life.

From this assumption, staff assumes that in any given year, on average, approximately half of the affected hoses would be replaced. Therefore, staff assumes that only 50 percent of the affected hoses will be replaced in 2013, the initial year that staff assumes when an ARB certified low-permeation hose would be available commercially. Similarly, the following year, staff projects that the remaining half of the affected hoses would be replaced, with 50 percent of the affected population being replaced every year thereafter.

This is a conservative assumption for the purpose of simplifying calculations within this paper. If hoses last longer than projected, then cost-effectiveness of the emission reductions in this regulation would improve due to reduced replacement costs.

Emissions Reductions and Gasoline Savings

As discussed in detail in Appendix 4 of this report, staff determined that the unregulated average year round vacuum-assist and conventional GDF hose permeation rate of 74.8 g/m^2/day leads to an average uncontrolled annual emissions of 1.00 tons per day (tpd). Further, staff demonstrated that the proposed GDF hose permeation limit of 10 g/m2/day at 38 °C would control 0.957 tpd of these emissions. These controlled emissions result directly in gasoline savings, as the gasoline is not allowed to permeate through the hose and evaporate into the environment.

From this, staff determined the average amount of gasoline saved per hose per year (1.68 gallons) by applying the emission reductions of the regulation (0.957 tpd) by the gallons per ton conversion factor for gasoline (320) over the affected hose population (66,430).

365 days per year × 0.957 tons per day × 320 gallons per ton / 66430 hoses
= 1.68 gallons per hose per year

Compliance Cost (Cost of Purchasing Low-permeation Hoses)
Staff determined the annual cost of compliance by multiplying the amortized upgrade cost of an average individual low-permeation hose across the affected hose population.

To determine the amortized upgrade cost of the hose ($5.38), staff multiplied the standard factor for two-year capital recovery (0.5378) by the upgrade cost of a hose from the manufacturer's survey ($10).

0.5378 × $10 per hose = $5.38 per hose

Multiplying this result across the affected population of conventional and vacuum assist hoses (66,430), yields the undiscounted annual compliance cost ($357,000).

$5.38 per hose × 66,430 hoses ≅ $357,000*

**After rounding for significant figures.*

As discussed earlier, in 2013 (the first year when an ARB certified low-permeation hose would be available commercially) only half of the current hose population will be replaced with new low-permeation hoses due to the average two-year hose life expectancy. Therefore, the cost impact for the first year of the analysis will only be half of the annual compliance cost ($179,000)

Staff then calculated the present value of compliance costs over the five-year lifetime of the regulation[2], applying a 5% discount rate to annual compliance costs per the following formula:

$$y_n = x_n / (1 + 0.05)^{(t_n - t)}$$

where;
y_n is the present value of the cost of the regulation over year n,
x_n is the annual cost of the regulation over year n,
t is the year the regulation took effect,
t_n is the particular year being evaluated

Staff summed annual subtotals of the above calculation for the years 2013 to 2017 to estimate the total discounted cost of the regulation ($1,445,000), in today's dollars. (See Attachment 1)

Staff then levelized annual compliance cost for the regulation ($334,000), by multiplying the total discounted cost of the regulation ($1,445,000) by the standard five-year amortization factor (0.231).

[2] Where the lifetime of compliance equipment is less than five years, ARB estimates economic impact on the basis of a five-year regulatory lifetime.

$1,445,000 per 5 years × 0.231 = $334,000*

**After rounding for significant figures.*

Compliance Cost Savings (Value of the Fuel Saved)
Because this regulation will result in cost savings to California consumers in the form of gasoline savings, it is appropriate to offset the upgrade costs of these hoses with gasoline savings. Staff determined the annual value of statewide fueling savings due to low-permeation hoses by multiplying the annual gasoline savings of the affected hose population by the average value per gallon of gasoline saved.

Staff applied a projected gasoline value for 2017, the year when all GDFs must be in compliance with the low permeation hose standard (assuming that low permeation hoses would be available commercially in 2013)[3]. Staff estimates that the value of gasoline saved in 2017 will be $3.80 per gallon in today's dollars. This is based upon averaging high ($4.42/gal) and low ($3.17/gal) projections for the retail prices of 2017 California reformulated gasoline (CaRFG) from the California Energy Commission (CEC, 2010).

As discussed earlier, staff determined the annual amount of gasoline saved per hose to be 1.68 gallons. Staff then applied this to the 2017 value per gallon of gasoline ($3.80) to determine the annual value of gasoline savings per hose ($6.38).

$3.80 per gallon × 1.68 gallons per hose per year = $6.38 per hose per year

By applying the per-hose gasoline savings across the affected hose population, staff estimated the regulation's statewide annual gasoline cost savings to be $424,000.

$6.38 per hose per year × 66,430 hoses = $424,000* per year

**After rounding for significant figures.*

As discussed earlier, in 2013 only half of the existing hose population would be replaced with new low-permeation hoses due to the average two-year hose life expectancy. Therefore, gasoline savings for that year would only be half of the annual gasoline savings ($212,000).

Staff then calculated the present value of cost savings over the five-year lifetime of the regulation by applying a 5% discount rate to annual gasoline cost savings, and summing, as above. The discounted value of the regulation's gasoline savings for the years 2013 to 2017 is $1,715,000. (See Attachment 1, "Total Present Value of Regulatory Compliance Cost.")

Staff then levelized annual cost savings for the regulation ($396,000), by multiplying the discounted value of regulatory fuel savings ($1,715,000) by the five-year

[3] See other parts of proposal for discussion regarding the "four year clock" for new vapor recovery performance standards.

amortization factor (0.231).

$1,715,000 per 5 years × 0.231 = $396,000* per year

**After rounding for significant figures.*

Net Annual Compliance cost
Staff determined the net annual levelized cost of the regulation (-$62,000) by subtracting the levelized annual savings ($396,000) from the levelized annual cost ($334,000) from the above sections. Note that the negative sign indicates a net savings.

$334,000 per year - $396,000 per year = -$62,000 per year

Cost-effectiveness of Low-permeation GDF Hoses
To compare regulations on a cost effective basis, ARB staff uses the measure of dollars spent per pound of emissions reduced ($/lb.). To determine this, staff divided the net annual statewide cost of the regulation (-$62,000 per year) by the annual emissions reductions of the regulation.

The average year-round statewide emissions reductions of 0.957 TPD for low-permeation hoses converts to 699,000 pounds per year. From this, staff estimates the cost-effectiveness of the regulation, with respect to low-permeation hoses, to be -0.09/lb. Note that the negative sign indicates a cost savings.

(-$62,000 per year) / 699,000 lb. ROG per year = -$0.09* per lb. of ROG

**After rounding.*

Economic Impact

This section addresses estimated private sector impacts, estimated costs, estimated benefits, and alternatives of the proposed regulation used to satisfy the requirements of the accompanying economic impact statement. As demonstrated above, the estimated net five-year cost of the proposed regulation to affected California stakeholders is less than $10 million, and so does not constitute a major regulation. Staff has determined that this regulation will not lead to the elimination or creation of jobs within California, as the actual cost impact to any one GDF is very small. The proposed regulation will not affect the competitiveness of California businesses because the impacts on any one California business are expected to be minor. GDF hose manufactures affected by the proposed regulation are headquartered outside California.

Estimate of Small Businesses Affected
Staff is unaware of any credible sources identifying the number of GDFs classified as small businesses. Small businesses are defined in California Government Code Section 11342.610. GDFs are in the retail trade sector, and the applicable part of the code excludes businesses with gross annual receipts exceeding two million dollars.

Staff initially assumed that an average number of fueling points at a small GDF is three. Further, staff assumed that the average number of fueling events per fueling point per day is approximately 65. Staff also assumed that the average amount of fuel dispensed per fueling event is 10 gallons. Given these assumptions, and the $3.80 per gallon fuel price, staff calculates that the average annual gross receipts for gasoline for a GDF with three hoses is approximately $2,700,000.

365 day per year × 3 hoses × 65 fueling events per day ×
10 gallons per fueling event × $3.80 per gallon ≅ $2,700,000* per year

**After rounding.*

This clearly exceeds the legal threshold for a small business. Further, many GDFs also sell other merchandise and services. Therefore, it is staff's estimation that very few GDFs could qualify as a small business. For the purposes of this report, staff estimates that less than ten percent of GDFs are small businesses. Further, as demonstrated above, small business GDFs would necessarily have no more than two fueling points.

Estimate Private vs. Public Portion of Affected Population

The proposed regulation is expected to have statewide impacts on GDF owners. Staff expects these impacts to affect approximately 7,110 privately owned GDFs. This number was determined this by applying the percent of private California GDFs (91.8) to the combined vacuum assist and conventional GDF population affected by the regulation (7,742) (CARB, 2011a).

91.8% (private GDFs) × 7,742 GDFs = 7,110* GDFs

**After rounding for significant figures.*

Similarly, the regulation is expected to affect 550 (7.1 percent) GDFs operated by local government entities, 70 (0.90 percent) GDFs operated by State government entities and 15 (0.20 percent) GDFs operated by federal government entities. All together the affected government facilities add up to 635 GDFs (8.2 percent). (CARB, 2011a)

Estimate of Hoses per GDF by GDF Type

For most applications, staff estimates that Government GDFs (635) generally have two fueling points. From this staff estimates that there are 1,270 hoses at GDFs operated by government entities.

2 hoses per GDF × 635 GDFs = 1,270 hoses

Further, as discussed previously, staff estimates that small businesses have an average of no more than two fueling points and account for no more than 10 percent of the affected privately operated population (711). From this staff estimates that there are 1,422 hoses at GDFs operated by small business entities.

2 hoses per GDF × 711 GDFs = 1,422 hoses

Staff determined the statewide number of hoses (63,740) employed at affected privately operated GDFs that are not considered small businesses by subtracting the number of government and small business hoses from the total number of affected hoses (66,430) (CARB 2011a).

66,430 hoses - 1,270 hoses - 1,422 hoses = 63,740* hoses

**After rounding for significant figures.*

Staff further determined that there are approximately 6,400 affected privately operated GDFs that are not considered small businesses by subtracting the number of small business GDFs (711) from the total number of affected privately operated GDFs (7,110).

7,110 GDFs - 711 GDFs = 6,400* GDFs

**After rounding for significant figures.*

From this, staff determined that an average of 10.0 hoses is employed at privately operated GDFs that are not considered small businesses by dividing the number of hoses at these GDFs by the number of these GDFs.

63740 hoses / 6400 GDFs = 10.0 hoses per GDF

Subtracting the number of hoses at affected government operated GDFs (1,270) from the total affected hose population (66,430) yields the total number of hoses at privately operated GDFs (65,160). This is 98.1 percent of the affected hose population.

66,430 hoses - 1,270 hoses = 65,160 hoses

Estimate of Total Economic Impact

The gross statewide five-year cost impact of the regulation is the five-year present value cost of the regulation ($1,445,000). This was determined earlier in the Cost and Cost-effectiveness Section.

The gross statewide five-year gasoline savings impact of the regulation is the five-year present value of the regulation's gasoline savings ($1,715,000). This was also determined earlier in the Cost and Cost-effectiveness Section.

The net statewide five-year economic impact of the regulation is a cost savings of $270,000. This is determined by subtracting the regulation's five-year present value of gasoline savings ($1,715,000) from the regulation's five-year present value cost ($1,445,000). Note that the negative sign indicates a net savings.

$1,445,000 - $1,715,000 = -$270,000

Estimate of Costs for a Typical Private GDF
Staff estimated the initial-year cost to a typical GDF ($50) by multiplying unamortized per-hose costs ($10) by the number of hoses expected to be purchased in the first year of the regulation (five). The same approach was applied to estimating initial-year cost for a typical small business ($10). These initial-year cost estimates represent the capital investment regulated entities are expected to make to comply with the proposed rule.

To calculate annual ongoing costs of compliance for typical and small businesses staff multiplied the annual amortized upgrade cost for the two-year life of the hose, ($5.38), by the number of hoses per GDF, (10 for typical, two for small), and by the annual hose turnover factor (0.50). See results in Table 1, below. As discussed previously, due to the two-year life of a hose only half of the hoses are expected to be replaced in the first year of the regulation. For example:

$5.38 per hose per year × 2 years × 10 hoses ×
50% (annual hose replacement factor) ≅ $54*

**After rounding.*

Table 1, Annual Ongoing Costs for Typical and Small GDFs

	Average Number of Hoses per GDF	Annual Amortized Cost per Hose	Annual Costs
Small Business	2.0	$5.38	$11
Typical Business	10.0	$5.38	$54

Estimate of Benefits and Gasoline Savings
The proposed regulation will reduce approximately one tpd of reactive organic gases (ROG). These emission reductions benefit citizens of the State of California by contributing to cleaner air and the associated health benefits. It is difficult to assign a dollar value to the health benefit of ROG emission reductions. The proposed regulation is consistent with the State Implementation Plan (CARB, 2007).

As previously discussed, staff estimates the annual gasoline saved per hose to be about 1.68 gallons. Further, staff estimates the 2017 value for a gallon of gasoline to be $3.80. The average annual gross value of gasoline saved per fueling point is approximately $6.38. It is important to note that these gasoline savings are realized directly by the consumer and not the GDF owner, as the gasoline is saved in the hose, after the dispenser where the gasoline dispensed is actually metered. However, staff assumes that the increased cost of the hoses will be passed along to the consumer through the cost of gasoline.

By subtracting the annual amortized upgrade cost of a hose ($5.38) from the annual fuel savings of a hose ($6.38), the consumers will realize a net annual savings of $1.00 per hose.

$6.38 per hose per year - $5.38 per hose per year = $1.00 per hose per year

As mentioned in the introduction, this translates into a negligible cost savings to individual consumers of less than one cent per gallon.

It should be noted that in the special cases where the GDF and the fleet being fueled are owned by the same entity then those operations will experience a net annual savings of $1.00 per fueling point. Examples of such special operations include rental car fleet facilities and government fleet facilities, among others.

The proposed regulation will amend current enhanced vapor recovery (EVR) requirements to require low-permeation hoses. There are no proposed compliance tests of the hose after it has been ARB certified. Therefore, staff has determined that there will be no significant compliance reporting costs associated with the proposed regulation.

Alternatives to the Regulation

The economic and fiscal impact of the alternatives considered include no action by ARB and requiring balance EVR hoses to incorporate low-permeation technology in addition to the other hoses covered in the current proposal.

Alternative 1: No Action

There currently exists no state or federal regulation designed to reduce emissions from GDF hoses. Therefore, if no action is taken by ARB, then no improvement in air quality would likely occur. This would mean the emissions reduction from GDF hose permeation will have to be obtained from sources, which may be more expensive than controlling GDF hose permeation. As discussed earlier, $396,000 is the statewide levelized annual value of gasoline that will be lost when there is no permeation standard for GDF hoses. Therefore, staff rejected this alternative as it does not produce air quality benefits and leads to a waste of gasoline.

Alternative 2: Require Low-permeation for Balance Hoses in Addition to the Current Proposal

Staff has considered requiring balance EVR hoses to incorporate low-permeation technology in addition to the other hoses covered in the current proposal. However, staff rejected this strategy because of concerns over technological feasibility and the increased mitigation of permeation emissions from balance hoses by the continued increase of ORVR vehicles within California's vehicle population.

Staff's concerns over technological feasibility on balance hoses stems from manufacturers failure to produce a prototype for ARB staff to test, and the fact that the estimated increased hose cost for a low-permeation hose would be approximately 3 times that of vacuum assist and conventional hoses (CARB, 2010). Staff believes that

the difficulty stems from fact that low-permeation hose technologies observed by staff have multiple layers that are derived from an extrusion process. Permeation is reduced by one of these layers specifically chosen for its permeation reducing qualities. However, the outer hose of a balance GDF hose assembly encompasses a metal helix causing the hose to have a corrugated shape (Figure 1). This current design complicates the extrusion process for applying a barrier material.

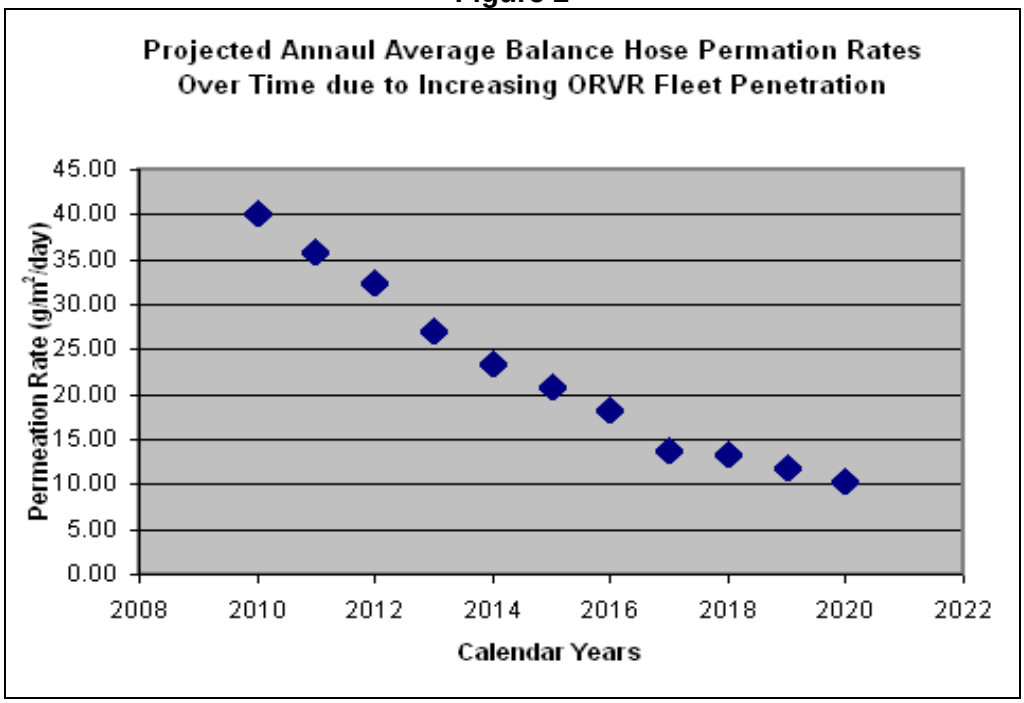
Figure 1 - Cutaway of A Balance GDF Hose Showing Vapor and Liquid Paths

Staff has further observed that when fueling vehicles equipped with ORVR, balance hoses return very little gasoline vapor while sucking in outside air through the vapor return path (CARB, 2011b). This decrease in vapor quality within the vapor path of the balance hose causes permeation to decrease. This decrease in vapor quality is exacerbated with consecutive fueling of vehicles equipped with ORVR. Because ORVR technology on cars is required by both ARB and federal regulations, ORVR equipped vehicles are expected to increase every year as a percent California's vehicle population to 94 percent by the year 2020. Therefore, staff expects this trend to reduce most of the emissions which would be caused by permeation from balance GDF hoses (Figure 2).

To estimate the five-year economic impacts of this alternative to the proposed regulation, staff employed the same methodology to balance hoses as was used to evaluate the current proposal, and then added the results to those of the current proposal. Details of this analysis can be found in a spreadsheet posted at: http://www.arb.ca.gov/vapor/gdfhe/low_permeation_gdf_hose_emissions_spreadsheet.xls

There is one key methodological difference in performing the five-year economic impact analysis for low-permeation balance hoses, and that stems from the changing permeation rate of balance hoses over time as ORVR equipped vehicles dominate the vehicle population. Staff dealt with this by taking emissions from the 2013 estimated annual average permeation rate (27.0 g/m^2/day) and the 2017 estimated annual average permeation rate (13.9 g/m^2/day) (CARB, 2011b) and averaging those emissions (0.224 tpd) resulting approximately 368 tons of ROG over five years.

Figure 2



Data taken from ARB's 2011 analysis of GDF balance hose vapor quality (CARB, 2011b)

Staff determined the gross statewide five-year cost impact of low-permeation balance hoses would be $1,874,000. Further, staff determined the gross statewide five-year gasoline savings impact of low-permeation balance hoses would be $401,000. Therefore the five-year economic impact of regulating low-permeation balance hoses is a net cost of $1,536,000 (See Attachment 2)

Staff determined the statewide net amortized five-year cost of this alternative to the regulation for GDF owners and operators within California will be approximately $3,320,000, by combining the five-year cost impact of the regulation ($1,445,000) and the five-year cost impact of low-permeation balance hoses ($1,874,000).

$1,445,000 + $1,874,000 = $3,320,000*

**After rounding.*

Staff determined the statewide net amortized five-year gasoline savings of this alternative to the regulation for GDF owners and operators within California will be approximately $2,120,000, by combining the five-year gasoline savings impact of the regulation ($1,715,000) and the five-year impact of low-permeation balance hoses ($401,000).

$1,715,000 + $401,000 = $2,120,000*

**After rounding.*

Further, because of the mitigating effects of ORVR, the savings to consumers would

gradually decrease to the baseline five-year savings of the proposed regulation of approximately $1,715,000 while the costs would remain constant.

Due to the increased cost of the regulation with only minimal extra reductions in emissions and uncertainty of the feasibility of low-permeation balance hose technology, staff rejected this alternative to the current proposal.

Fiscal Impact

This section addresses the estimated fiscal effect on local and State government. Government-operated GDFs will realize annual cost savings of $1.00 per hose because these facilities fuel government fleet vehicles and will therefore realize the gasoline savings that would otherwise be realized by GDF customers.

As discussed earlier, by subtracting the annual amortized upgrade cost of a hose ($5.38) from the annual fuel savings of a hose ($6.38), these government facilities will realize a net annual savings of $1.00 per hose.

Fiscal Effect on Local Government

The statewide total savings to local agencies, such as schools and fire districts that operate affected GDFs to fuel their fleets will be approximately $1,100.

As discussed earlier, local government has approximately 550 affected GDFs with approximately 2 hoses each. When applying this number across the total population of local government hoses, local government is expected to save $1,100 annually statewide.

Fiscal Effect on State Government

The statewide total savings to state agencies that operate affected GDFs to fuel their fleets will be approximately $140.

As discussed earlier, state government has approximately 70 affected GDFs with approximately 2 hoses each. When applying this number across the total population of state government hoses, state government is expected to save $140 annually statewide.

Staff has determined that ARB will not incur any additional operating costs in the implementation of this regulation.

Fiscal Effect on Federal Government

The statewide total savings to federal agencies that operate affected GDFs to fuel their fleets will be approximately $30.

As discussed earlier, federal government has approximately 15 affected GDFs with approximately 2 hoses each. When applying this number across the total population of local government hoses, local government is expected to save $30 annually statewide.

Staff does not believe this regulation will have any effect on federal funding of state

programs as no fiscal impact exists because this regulation will not affect any federally funded State agency or program.

Conclusion

Staff has determined that the proposed regulation will not have a significant impact on the private sector or the government. Staff has also determined that the total statewide five-year cost of the proposed regulation for GDF owners and operators within California will be approximately $1,445,000. Further, because this regulation results in a five-year fuel savings valued of approximately $1,715,000, the regulation will result in a net savings to consumers. The result is a cost-effectiveness of $0.09 savings per pound of ROG reduced.

References

CARB. (2007). Air Resources Board's Proposed State Strategy for California's 2007 State Implementation Plan (SIP). Sacramento: California Air Resources Board. <http://arb.ca.gov/planning/sip/2007sip/apr07draft/sipback.pdf>

CARB. (2010). Gasoline Dispensing Facility (GDF) Low Permeation Hose Upgrade Cost Report. Sacramento: California Air Resources Board. <http://www.arb.ca.gov/vapor/gdfhe/ARB_GDF_hose_upgrade_cost_report_07-07-10.pdf>

CARB. (2011a). Gasoline Dispensing Facility (GDF) Fueling Point Population Report. Sacramento: California Air Resources Board. <http://www.arb.ca.gov/vapor/gdfhe/gdf_fueling_point_population_report.pdf>

CARB. (2011b). Gasoline Dispensing Facility (GDF) Balance Hose Vapor Quality and Permeation Analysis. Sacramento: California Air Resources Board. <http://www.arb.ca.gov/vapor/gdfhe/hose_quality_and_perm_2011.pdf>

CEC, (2010). Final Staff Report: TRANSPORTATION ENERGY FORECASTS AND ANALYSES FOR THE *2009 INTEGRATED ENERGY POLICY REPORT*. Sacramento: California Energy Commission <http://www.energy.ca.gov/2010publications/CEC-600-2010-002/CEC-600-2010-002-SF.PDF>.

Attachment 1
Five-Year GDF Hose Regulatory Cost Table

Conventional and Vacuum Assist

2-yr Capital Recovery Factor	0.537805
Per-Hose Cost in Current $	$10.00
5-year Amortization Factor	0.231
Annual ROG Emissions Controlled lb./year	698610
5-year ROG Emissions Controlled (tons)	1572

Year of Reg	# Compliant GDF Hoses Sold annually	$10 price increase amortized over 2-year life of hose	Compliant GDF Hoses Providing Benefits in any given year	Annual Cost of Regulatory Compliance	Present Value of Regulatory Compliance Cost (discounted @ 5%)	Levelized Annual Compliance Cost (for Cost-effectiveness Calc)	Annual Fuel Savings from Regulatory Compliance	Present Value of Regulatory Fuel savings (discounted @ 5%)	Levelized (Average) Annual Fuel Savings	Annual Cost of Reductions (Net of Fuel Savings)
2013	33215	$5.38	33215	$178,632	$178,632	$333,759	$212,000	$212,000	$396,122	-$62,363
2014	33215	$5.38	66430	$357,264	$340,251	$333,759	$424,000	$403,810	$396,122	-$62,363
2015	33215	$5.38	66430	$357,264	$324,049	$333,759	$424,000	$384,580	$396,122	-$62,363
2016	33215	$5.38	66430	$357,264	$308,618	$333,759	$424,000	$366,267	$396,122	-$62,363
2017	33215	$5.38	66430	$357,264	$293,922	$333,759	$424,000	$348,826	$396,122	-$62,363

Total Present Value of Regulatory Compliance Cost	**$1,445,000**
Total Present Value of Regulatory Fuel Savings	**$1,715,000**
Net Total 5-year Cost of Regulation	**-$270,000**
Net Annualized Statewide Cost	-$62,000
Cost-effectiveness (per lb.)	-$0.089
Cost-effectiveness (per ton)	-$177.00

Attachment 2
Five-year GDF Balance Hose Cost Table[4]

Balance

2-yr Capital Recovery Factor	0.537805
Per-Hose Cost in Current $	$29.00
5-year Amortization Factor	0.231
Annual ROG Emissions Controlled lb./year	137970
5-year ROG Emissions Controlled (tons)	310

Year of Reg	# Compliant GDF Hoses Sold annually	$10 price increase amortized over 2-year life of hose	Compliant GDF Hoses Providing Benefits in any given year	Annual Cost of Regulatory Compliance	Present Value of Regulatory Compliance Cost (discounted @ 5%)	Levelized Annual Compliance Cost (for Cost-effectiveness Calc)	Annual Fuel Savings from Regulatory Compliance	Present Value of Regulatory Fuel savings (discounted @ 5%)	Levelized (Average) Annual Fuel Savings	Annual Cost of Reductions (Net of Fuel Savings)
2013	14850	$15.60	14850	$231,606	$231,606	$432,847	$49,500	$49,500	$92,621	$340,226
2014	14850	$15.60	29700	$463,211	$441,154	$432,847	$99,000	$94,286	$92,621	$340,226
2015	14850	$15.60	29700	$463,211	$420,146	$432,847	$99,000	$89,796	$92,621	$340,226
2016	14850	$15.60	29700	$463,211	$400,139	$432,847	$99,000	$85,520	$92,621	$340,226
2017	14850	$15.60	29700	$463,211	$381,085	$432,847	$99,000	$81,448	$92,621	$340,226

Total Present Value of Regulatory Compliance Cost	**$1,874,000**
Total Present Value of Regulatory Fuel savings	**$401,000**
Net Total 5-year Cost of Regulation	**$1,473,000**
Net Annualized Statewide Cost	$340,000
Cost-effectiveness (per lb.)	$2.46
Cost-effectiveness (per ton)	$4,930.00

[4] For purposes of estimating the costs of regulatory alternative 2: *Require Low-permeation for Balance Hoses in Addition to the Current Proposal.* See p.9, above.