United States
Environmental Protection
Agency

Air Programs Branch
Region IV
Atlanta, Georgia 30308

EPA-904/9-79-039
April 1979

Air

EPA

An Analysis of Inspection-Maintenance Program Options for Jefferson County, Kentucky

Executive Summary

AN ANALYSIS OF
INSPECTION-MAINTENANCE PROGRAM OPTIONS
FOR JEFFERSON COUNTY, KENTUCKY

EXECUTIVE SUMMARY

Submitted to

Jefferson County, Kentucky
Air Pollution Control District

Prepared by

Engineering-Science
7903 Westpark Drive
McLean, Virginia 22102

April 1979

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION I

INTRODUCTION

OVERVIEW

Engineering-Science (ES) was engaged by the U. S. Environmental Protection Agency, Region IV, Atlanta, Georgia (EPA) in July 1978 under Contract No. 68-02-2869 to assist the Jefferson County, Kentucky, Air Pollution Control District (APCD) in the evaluation of motor vehicle emissions inspection-maintenance (I/M) programs. This effort was intended to provide comparative cost/benefit analyses which could be used by a joint city-county-state task force as the basis for selection of a preferred option, there being many ways to administer and conduct inspection-maintenance programs. It was expected that the task force would report their preference to the City of Louisville Board of Aldermen and the Jefferson County Fiscal Court and suggest an ordinance which would establish an I/M program.

I/M has been found to be an effective means of identifying cars which need remedial maintenance or adjustment and requiring the necessary repairs. Tests have shown that hydrocarbon and carbon monoxide emissions of in-use vehicles are much higher than expected under the Federal motor vehicle emission control program, partly because of malfunctions that went undetected, partly because of too infrequent a maintenance schedule, and partly because of tampering with the emission control devices. I/M programs in several states and municipalities show that when vehicle exhaust emissions are measured at least once a year and high emitters are required to have their vehicles repaired, the repaired vehicles' emissions conform to the rates projected by EPA. Deterioration in the intervening year appears to be less than the improvement realized so that there is an increasing benefit over the years.

Mandatory inspection-maintenance programs not only reduce emissions of hydrocarbons and carbon monoxide to the level projected by the Federal motor vehicle control program, they also result in a standardized baseline that

will permit accurate assessment of the impact of transportation control measures, such as carpool/vanpool programs. The emission reduction will have a beneficial effect on human health and reduce the damage to agricultural products as well. It should result in improved visibility, giving a clearer, brighter visual aspect to the entire community. Finally, improved maintenance should lead to improved fuel economy. Estimates presented in this report (page II-25, Phase I) suggest a saving of 40 gallons of gasoline per year for the average repaired vehicle. This not only defrays the cost of repairs but promotes national energy conservation goals.

ES provided the necessary comparative cost-benefit analyses of sixteen available emissions inspection options and issued a final report on the first phase of this effort in early December 1978. Then, the task force in a series of meetings selected two preferred options: a centralized idle mode inspection managed for the county by a private contractor and a centralized idle mode inspection managed by local government. These were the two low-cost options when total program costs were considered. However, they present local government with various financial requirements. The task force proposed presenting both options to the City Board of Aldermen and the County Fiscal Court with task force endorsement. Selection of a single option is expected to be made by the legislators primarily on the basis of financial determinants. The ordinance which establishes the program and its funding would be passed by both bodies.

In February 1979 EPA requested ES to continue its support to the APCD and prepare supplementary cost analyses for the two preferred options. These analyses are sufficiently detailed and pertinent to local circumstances to provide the legislators the basis for selection between the options and the basis for the financial planning associated with the I/M ordinance. This was considered Phase II of this effort, and the detailed cost analyses of the two preferred options are appended to the basic report.

STATUTORY CONSIDERATIONS

The Clean Air Act Amendments of 1977 (CAA) require each state which has areas within it which are not attaining the National Ambient Air Quality Standards (NAAQS) for any pollutant, as designated by the state and confirmed by

EPA, to submit a revision to their State Implementation Plan (SIP) which will outline the strategy by which the NAAQS will be attained as expeditiously as practicable. Standards are to be attained no later than the end of 1982 except in the case where a state can show that even with the application of all reasonably available control measures the carbon monoxide and/or the ozone standards cannot be attained by 1982. The statutory limit may be extended through 1987 provided the state implements transportation control planning and a motor vehicle emissions inspection program with mandatory maintenance of failed vehicles.

Consultation with the Department for Natural Resources and Environmental Protection (DNREP) in Frankfort, Kentucky, has indicated that Jefferson County is designated nonattainment for both ozone and carbon monoxide. Even though the ozone standard has recently been raised from 0.08 ppm to 0.12 ppm, the possibility does not exist that the ozone standard may be achieved by 1982. Further, the SIP will show that despite the application of all reasonably available control measures the ozone and carbon monoxide standards cannot be achieved by 1982. Thus inspection-maintenance in Jefferson County will become a statutory requirement of the responsible governmental agency.

A House committee of the 1978 Legislature of the Commonwealth of Kentucky briefly considered and declined to pass on the floor of the General Assembly legislation which would specifically require I/M programs where needed. However, the legislature did enact Home Rule legislation, KRS 67.083, as amended, which could be used as local enabling legislation. In an opinion dated August 18, 1978, the Attorney General concluded that KRS 67.083, as amended, specifically authorizes the fiscal court of Jefferson County to enact an ordinance establishing a mandatory motor vehicle emisison inspection/maintenance program. Through the mechanism of KRS 77, Louisville and Jefferson County already jointly fund a local air pollution control board capable of administering a city-county inspection program.

PUBLIC PERCEPTION OF I/M

In October 1976 the Urban Studies Center, University of Louisville published in Community Priorities and Evaluations the results of a public opinion survey on I/M. It showed that the public identifies cars and trucks as primary sources of air pollution. A majority (68%) favor mandatory I/M in Jefferson

County. Those who were opposed were primarily concerned about the proper administration or effectiveness of the program.

These observations, made during late summer when half the days had air pollution alerts, were closely repeated in early February when snow and cold weather prevailed. In the March 1979 issue of the same publication a majority almost as great (62%) indicated it favored mandatory I/M. The percentage of support in both surveys is especially significant since the answers were given in response to a question that made clear that vehicle inspections would cost $3 to $5 and require maintenance and retest of those cars failing the test.

PHASE I RESULTS

Sixteen options were considered in Phase I with different approaches to the problem, different ways of administering the program or different types of inspection procedure. A cost analysis approach was used which considered the cost of all I/M activities generated by the program to be borne by the motorist/taxpayer. The most cost effective program was found to be the centralized idle mode test administered by government. A close second was a centralized mode test run by a contractor. Decentralized inspection, conducted by independent private garages, though less expensive when cost to government alone was considered, comprised the most expensive options when total cost to the taxpaying motorist was considered. This was primarily due to the large staff that would be required for quality assurance and because of the large expenditures for equipment required for most of the options.

The potential for reducing emissions seemed to be independent of the option selected, provided the standards were stringent enough and inspection was made at least annually. When an initial failure rate of 35% was considered, annual I/M had the potential to reduce hydrocarbon emissions in the Louisville SMSA by 32% and carbon monoxide emissions by 41% by 1987, when compared with annual emissions that would be expected in the absence of such a program. In addition, some test results have indicated that fuel economy as a result of maintenance would defray much of the cost of repairs. To achieve this additional benefit right away, however, it appears necessary to have a mechanics' training program before inspection-maintenance is implemented.

PHASE II OBJECTIVES AND LIMITATIONS

It was the objective of the Phase II analysis to present a fiscal basis for deciding between a contractor-run or a government-run inspection-maintenance program. It was further the intent that this analysis provide a basis for establishing the funding requirements of this activity whichever option shall be selected.

The analysis required first a detailed definition of the program. However, some decisions made for this analysis may be altered when the program is actually implemented. For example, 35% stringency may be judged to be inappropriate at some later stage. In addition, certain assumptions were made in drawing up cost figures which may prove to be inaccurate. For example, land availability in certain zoning categories and locations could not be firmly ascertained and assumptions made in this connection may have been reasonable but change before the time of implementation. Finally, growth rates, failure rates, cost of capital and other variables may prove to have different values from those assumed here because of their stochastic nature. For these reasons the costs estimated here must be considered approximate, and for planning purposes only.

SECTION II

PROGRAM DEFINITION AND ASSUMPTIONS

The basis for cost analysis of the programs, which is presented in Section III, must be derived from operational and administrative parameters. This was established in Chapter II of Phase I. The particular parameters presented below were reviewed by the JAPCD and represent their tentative program parameters. They apply whether the contractor-run lanes or government-run lanes option is implemented.

INSPECTION OPERATIONS

o Program initiation date is January 1, 1981.

o An idle mode test will be given which would measure CO and HC concentrations in the exhaust.

o Affected vehicles are light-duty, gasoline-powered automobiles and trucks registered in Jefferson County with gross vehicle weight (GVW) less than 8,500 pounds. Excluded are motorcycles, new vehicles, vehicles more than 14 years old, diesel powered vehicles, and vehicles with GVW >8,500 pounds. Special exemption is given owners if estimated repair costs exceed 10% of vehicle worth.

o The number of affected vehicles in 1981 will be 444,387 and this will require 631,030 inspections assuming 35% fail the first test and 20% of these fail the retest. If these rates were constant and vehicle registration increased by 2% per year, then in the fifth year there would be 490,639 vehicles requiring 696,708 inspections.

o Personnel requirements will be specified in Section II of this report. Classification has been varied slightly to conform to the City of Louisville Civil Service specifications. Thus it is additionally assumed that the City of Louisville will have fiscal responsibility for any joint city-county inspection program which may result, although the fiscal agent could just as well be the county.

o Inspections will be performed in facilities providing two inspection lanes. Inspection rates will average 40,000 per year assuming a 40-hour work week. Thus 16 lanes, or 8 two-lane facilities, will be required initially. With no new building assumed, the work week would have to increase to 44 hours/week during the fifth year.

o One exhaust gas analyzer will be provided for each lane (Tachometer/CO/HC); eighteen total including two spares. Testing and recording of results would be automated.

o Data recorded will be vehicle specifications, registration details, test circumstances, test results including pass/fail decision, repairs performed, cost of repairs, retest circumstances, and results.

o A government-operated challenge facility is necessary under the contractor-run lanes program.

PROGRAM ADMINISTRATION

o Land purchased for the network is zoned industrial. Minimal facilities will be constructed thereon to protect equipment and supplies from weather and theft. OSHA requirements will be met.

o Mechanics may be certified upon successful completion of an approved short course (8 hrs.); garages to be licensed must have a certified mechanic on duty and approved emission analysis equipment. These actions are voluntary.

o Vehicle emission inspectors must successfully complete an approved short course (40 hrs.).

o Maintenance of exhaust analyzers will generally be performed by program personnel.

o A vigorous consumer protection program will be maintained to guard against unnecessary repair or overcharge and to hear complaints.

o A vigorous quality assurance program will be maintained to guarantee frequent calibration of instruments, linearity of response, and integrity of calibration gases.

o A vigorous public relations program will be maintained with frequent reporting of all aspects of the program.

o Necessary training can be provided by the county vocational-technical schools for the estimated 500 mechanics and 35 inspectors to be certified in the first year. Thereafter, a monthly offering for mechanics is assumed adequate.

SECTION III

COST ANALYSIS OF PREFERRED OPTIONS

In this section we consider the capital costs, those initial outlays necessary to establish the program, and the operating costs, those expenditures required for its continued operation. Then annual costs are estimated which are simply the sum of the operating costs plus the amortization of the capital costs. In the government-run lanes option, an alternate is considered in which capital costs are paid in the first year and an equipment recovery fund is established. First year and stable annual costs of this alternate are also provided. Those initial costs which are necessary to the programs success, but which do not produce tangible assets, such as inspectors training, are not capitalized when made by government. The recovery of these costs by the contractor, however, is allowed.

The two programs are costed separately. They are identified by the short titles: Government-Run Lanes and Contractor-Run Lanes. In this analysis costs are estimated in 1979 dollars; salaries are computed at entry level; and no allowance is made for construction contingencies. This establishes baseline costs with a minimum of speculation. In Section V, when funding is discussed, the effect of inflation, promotion, and construction contingencies are considered. All costs are estimated to the nearest hundred dollars.

GOVERNMENT-RUN LANES

Capital Costs

Capital cost (Table 1) items include real and personal property. The cost of land, 8 one-third acre sites, is estimated to be $82,500. The eight buildings required for each site total $193,600. This is an average of $24,200 for each building, including site preparation and utility hookup. Equipment costs include $102,600 for the exhaust gas analyzers; $250,000 for data processing equipment (comparable to IBM System One); and $42,700 for support furnishings, office equipment, and vehicles. The total estimated capital cost is $671,400.

TABLE 1

CAPITAL COSTS (GOVERNMENT-RUN LANES)
(1979 dollars)

PROPERTY				COST
Land				$ 82,500
Buildings, including site preparation				193,600
Equipment and furniture				395,300
Inspection equipment		$102,600		
Data Processing Equipment				
Hardware		200,000		
Software		50,000		
Office Equipment		6,200		
Furniture		19,000		
Vehicles		17,500		
	Subtotal	$395,300		
			Total	$671,400

Operating Costs

Operating costs (Table 2) total $714,800 of which $482,000 is required for program operations and $232,600 is required for program administration. Seventy-eight percent of the operations budget and 66% of the administration budget are personnel salaries and benefits. Public relations, maintenance of equipment and supplies are the only other major costs and they are estimated at $137,700.

Annual Costs

Calculated annual costs are given in Table 3. Real property is amortized over 10 years at 8 1/2% interest; equipment is amortized over 5 years at 10% interest. The annualized capital costs are seen to total $146,400. When added to annual operating costs, the total annual cost of the county-run lanes option is obtained: $861,200. With a vehicle fleet of approximately 444,000 this amounts to $1.94 per vehicle. An alternative means of financing is considered in Note 3: capital costs are paid outright and and an equipment recovery fund is established. This results in first year per vehicle costs of $3.36 and stable annual costs of $1.85.

Additional Implementation Costs

Table 4 contains a summary of first year costs that were not capitalized. Start-up costs, figured on the basis of a six-month uniform buildup of personnel and property as one-quarter's annual costs, amount to almost 64% of the $315,700 total. Other significant items are a vigorous public relations campaign ($50,000), which is believed to be vital to the success of the program gram on the basis of results in other programs; and procurement costs ($55,200), calculated as 15% of the cost of equipment, which is an estimated cost of purchasing by bid. Minor items include: mechanics' training ($5,300), inspectors' training ($1,700), and a voluntary garage certification or licensing program ($2,500). These additional costs add $0.71 per vehicle the first year.

CONTRACTOR-RUN LANES

Capital Costs

Property costs for the contractor (Table 5) are essentially the same as reported for government in the previous option, $678,000. However, the front-

TABLE 2

OPERATING COSTS (GOVERNMENT-RUN LANES)
(1979 dollars)

OPERATIONS		ANNUAL COST
Operations		
Personnel salaries and benefits		$374,900
Uniforms		2,200
Gas supplies		44,000
Equipment repair and replacement		43,700
Travel (local)		1,400
Miscellaneous (utilities, etc.)		16,000
	Subtotal	$482,200
Administration		
Personnel salaries and benefits		$153,200
Public Relations		50,000
Office supplies		10,000
Travel (local)		3,200
Rent		6,000
Uniforms		200
Miscellaneous (utilities, accounting services, etc.)		10,000
	Subtotal	$232,600
	Total	$714,800

TABLE 3(3)

ANNUAL COSTS (GOVERNMENT-RUN LANES)
(1979 dollars)

COSTS	TERMS		ANNUAL COST
Capital Costs			
Land and buildings	$276,100 for 10 yrs. @ 8 1/2%(1)		$ 42,100
Equipment	$395,300 for 5 yrs. @ 10% (2)		104,300
		Subtotal	$146,400
Operating Costs			
Operations			$482,200
Administration			232,600
		Subtotal	$714,800
		Total	$861,200
Annual Cost/Vehicle	861,200/444,000		$ 1.94

(1) $F = i(1 + i)^n/(1 + i)^m - 1$ = amortization factor, where i is the interest rate and n is the number of years. This factor applied to the principal yields the annual payment. For i = 0.185 and n = 10, F = 0.1524.

(2) For i = 0.10 and n = 5, F = 0.2638.

(3) If capital costs were paid in the first year from other sources and an equipment recovery fund were established to provide for extended operations without refinancing, then first year and stable annual costs would be computed as follows:

Capital Costs	First Year	Other Years
Land and buildings	$276,100	
Equipment	395,300	
Operating Costs		
Operations	482,200	482,200
Administration	232,600	232,600
Equipment Recovery Fund	104,300	104,300
Subtotal	819,100	819,100
Total	$1,490,500	$819,100
Annual Cost/Vehicle	$3.36	$1.85

TABLE 4

ADDITIONAL IMPLEMENTATION COSTS[1]
(1979 dollars)

Mechanics training and certification	$ 5,300
Inspector training and certification	1,700
Garage certification or licensing	2,500
Public relations campaign	50,000
Procurement costs	55,200
Start-up costs	201,000
	$315,700

(1) These implementation costs add $0.71 per vehicle to the first year costs computed in Table 3, note 3. If they could be amortized over 5 years at 10%, then they would amount to $83,300 annually or $0.19 per vehicle.

TABLE 5

CAPITAL COSTS (CONTRACTOR-RUN LANES)
(1979 dollars)

		COST TO CONTRACTOR	COST TO GOVERNMENT
Property			
Land		$ 82,500	$10,000
Buildings		201,100	24,200
Equipment and furniture		394,400	57,600
Inspection Equipment		(102,600)	(27,200)
Data Processing Equipment			
Hardware		(200,000)	
Software		(50,000)	
Office Equipment		(5,300)	(4,400)
Furniture		(19,000)	(8,500)
Vehicles		(17,500)	(17,500)
	Subtotal	$678,000	$91,800
Implementation Costs			
Mechanics Training and Certification			$ 5,300
Inspector's Training and Certification		$ 1,700	600
Garage Certification or Licensing			2,500
Public Relations Campaign			50,000
Procurement Costs			8,200
Start-up Costs		$199,300	$ 54,200
	Subtotal	$201,000	$120,800
	Total	$879,000	$212,600

end cost of training inspectors ($1,700) and the start-up costs ($199,300), calculated as before, one-quarter's annual cost, are included as capital costs and may be recovered by the contractor. Together they bring the capital cost to the contractor to $879,000, a 31% increase over the government-run lanes option.

Also in this option, government would have the capital costs associated with the establishment of a challenge lane, for consumer protection, and a quality control unit. The total property cost to government is estimated at $91,800 and this is amortized later. Listed in Table 5, however, are the first year costs to government which do not produce tangible assets and are not amortized later. These total $120,800 figured on the same basis.

Operating Costs

Operating costs for this option are given in Table 6. They total $842,400 compared with $714,800 for the previous option. Efficiencies of management do not compensate for profit taken. Again, the dominant cost items are for personnel: 80% of the cost of operating and 84% of the administrative costs. The ratio of the contractor's operating costs to administration costs is 4.68; in the government-run option this ratio was 2.64. The contractor's personnel costs are figured 20% greater than comparable civil service grades and benefits are calculated at 12% instead of 16%.

Government operating costs, also in Table 5, total $247,300; $60,900 for operations and $186,400 for administration of the program. The necessary governmental functions provided for include: program direction, program evaluation, quality control, consumer protection, clerical support, mechanic training, and garage licensing. A vigorous public relations program is the largest item except for salaries.

Annual Costs

The annual costs for this option are presented in Table 7. Again, real property is amortized over 10 years at 8 1/2%; equipment and the contractor's implementation costs are amortized over 5 years at 10%. The contractor's annualized capital costs are $200,200; government's annualized capital costs, which do not include intangible first year costs, are $20,400. When these are added to operating costs of $842,400 and $247,300 to contractor and government, respectively, the total annual cost for this option is $1,310,300. For a vehicle fleet of approximately 444,000, this amounts to $2.95 per vehicle.

TABLE 6

OPERATING COSTS (CONTRACTOR-RUN LANES)
(1979 dollars)

		COST TO CONTRACTOR	COST TO GOVERNMENT
Operations			
Personnel Salaries and Benefits		$434,300	$ 45,900
Uniforms		2,200	300
Gas Supplies		44,000	400
Equipment Repair and Replacement		43,500	10,900
Travel (local)		1,400	1,400
Taxes		3,900	
Miscellaneous (Utilities)		16,000	2,000
	Subtotal	$545,300	$ 60,900
Administration			
Personnel Salaries and Benefits		$ 97,400	$120,200
Public Relations			50,000
Office Supplies		5,000	5,000
Travel (local)		3,200	3,200
Rent			3,000
Miscellaneous (Utilities,etc.)		10,000	5,000
	Subtotal	$115,600	$186,400
Profit			
15% x Capital Costs		$131,900	
7.5% x Operating Costs		49,600	
	Subtotal	$181,500	
	Total	$842,400	$247,300

TABLE 7

ANNUAL COSTS (CONTRACTOR-RUN LANES)
(1979 dollars)

CAPITAL COSTS	TERMS		ANNUAL COST
To Contractor:			
Land and Buildings	$283,600 for 10 yrs. @ 8 1/2%(1)		$ 43,200
Equipment	$394,400 for 5 yrs. @ 10%(2)		104,000
Implementation (Start-up) Costs	$201,000 for 5 yrs. @ 10%		53,000
		Subtotal	$200,200
To Government:			
Land and Buildings	$34,200 for 10 yrs. @ 8 1/2%(1)		$ 5,200
Equipment	$57,600 for 5 yrs. @ 10%		15,200
		Subtotal	$ 20,400
OPERATING COSTS			
To Contractor:			
Operations			$545,300
Administration			115,600
Profit			181,500
		Subtotal	$842,400
To Government:			
Operations			60,900
Administration			186,400
		Subtotal	$247,300
		Total	$1,310,300
ANNUAL COST/VEHICLE	1,310,300/444,000 = $2.95		

(1) $F = i\,(1 + i)^n/(1 + i)^n - 1$ = amortization factor, where i is the interest rate and n is the number of years. This factor applied to the principal yields the annual payment. For i = 0.85 and n = 10, F = 0.1524.

(2) For i = 0.10 and n = 5, F = 0.2638.

Additional Implementation Costs to Government

The same cost items appear here as before: mechanics training, inspectors training, garage certification, public relations campaign, procurement costs and start-up costs. These costs are given in Table 8 and are seen to be much smaller than in the previous option because the government is less involved. The cost of public relations and garage and mechanic certification are unchanged, however. The estimate for the total amount of first year costs to government is $120,800. These additional costs would add $0.27 per vehicle to first year costs. If amortized over five years at 10% they would add $0.07 per vehicle annually.

TABLE 8

ADDITIONAL IMPLEMENTATION COSTS TO GOVERNMENT[1]
(1979 dollars)

ITEM	COST
Mechanic's Training and Certification	$ 5,300
Inspector's Training and Certification	600
Garage Certification or Licensing	2,500
Public Relations Campaign	50,000
Procurement Costs	8,200
Start-up Costs	54,200
Total	$120,800

(1) These implementation costs add $0.27 per vehicle to the first year costs. If they could be amortized over 5 years at 10%, then they would amount to $31,900 annually or $0.07 per vehicle.

SECTION IV

EXPECTED VEHICLE REPAIR COSTS

Mandatory inspection-maintenance programs have been in existence at various locations in the country for several years. Some of the agencies, those with centralized inspection programs, have maintained and published records of the associated repair costs. Table 9, taken from a report by EPA's Chief of Mobile Source Enforcement Division[1] shows the associated costs for vehicles tested by the Portland, Oregon, New Jersey, and Arizona I/M programs through early 1976. These data show that repairs needed are mainly of the carburetor adjustment and tune-up category. Over 70% of the repairs in Oregon cost less than $10.00; in New Jersey 55% of the repairs cost less than $25.00; and in Arizona 66% of the repairs cost less than $25. These figures, however, do not reflect 1979 dollar costs, nor do they reflect the repair costs for cars built after 1975, the first catalyst equipped model year.

Data have recently become available for six months of 1978 in Portland, Oregon[2], which are more representative of current costs and current models. Their findings are presented in Table 10 and may be summarized as follows:

> "The average cost of repair was $24 for newer cars and $35 for older cars. Fifty percent of all failed cars had repair costs of $14 or less."

---

(1) The Need For and Benefits of Inspection and Maintenance of In Use Motor Vehicles, by Michael P. Walsh, E.P.A. Mobile Source Enforcement Division, November, 1976.

(2) Portland Study Interim Analysis: Observations on Six Months of Vehicle Operation, I/M Staff, Emission Control Technology Division, Office of Mobile Source Air Pollution Control, U.S. EPA, January 1979.

TABLE 9

REPAIR COSTS FOR EXISTING PROGRAMS

New Jersey (flunk rate = 12%)

less than $10	29.7%
$10 to $25	26.4%
$25 to $50	22.1%
$50 to $100	16.1%
more than $100	5.6%

N = 16,000
Avg. Repair Cost = $32.97
Median: 50% of repairs cost less than $21
65% of repairs cost less than average

Oregon (flunk rate = 35%)

No cost	32%
less than $10	40%
$10 to $30	15%
$30 to $50	6%
$50 to $75	3%
$75 to $100	2%
more than $100	2%

N = 6,527 (primarily new cars)
Avg. Repair Cost - $18.86
Median: 50% of repairs cost less than $6
79% of repairs cost less than average

Arizona (flunk rate = 47%)

less than $5	24%
$5 to $10	17%
$10 to $25	25%
$25 to $50	20%
$50 to $100	11%
more than $100	3%

N = 4000 (does not include those who performed their ownn repairs)
Avg. Repair cost = $25.42
Median: 50% of repairs cost less than $15
67% of repairs cost less than average

Source: Walsh, Need for I/M, 1976 op.cit.

TABLE 10

RECENT REPAIR COSTS

REPAIR COSTS					
		PERCENTILES			
MODEL YEARS	SAMPLE MEAN	25	50	75	90
1972-74	$34.97	$5	$11	$41	$78
1975-77	$24.46	$7	$14	$37	$59
1972-77	$29.47	$6	$14	$38	$70

Source: Portland Study, U.S. EPA, January, 1979.

There is no data to indicate what maintenance costs would normally have been incurred and what costs may be specifically due to I/M. However, such figures would show that the cost of I/M repairs indicated above are actually less than reported.

All programs show that the well-maintained vehicle should be expected to pass. Most of the repairs needed are minor, but the cumulative result is substantially reduced emissions.

SECTION V

FUNDING

REQUIREMENTS

The annual costs of I/M and the additional, first year, implementation costs to government must be provided for before an I/M program can be promulgated. Baseline estimates of these costs have been presented in Section III. For funding purposes, some consideration of contingencies and cost escalation due to inflation and pay increases should be given. This is done in Table 11.

The contingency allowance for construction imponderables adds $12,600 and $14,600, respectively, to the 1979 annual costs. Adjusting salaries to the mid-range adds to the baseline $102,000 and $124,100, respectively, and increasing the cost of operations 10% adds to the baseline $48,200 and $60,200, respectively. The inflation factors are 1.166 from 1979 to 1981 and 1.469 from 1981 to 1985. Annual costs of the two options in the fifth year become $1,754,900 ($3.65/vehicle) for government-run and $2,492,300 ($5.18/vehicle) for contractor-run lanes.

The funding requirements are two: (1) provide for the escalating annual costs by a mechanism that generates the requisite amount on an annual basis, and (2) provide for the first year costs to government from funds-in-being or grants.

FUNDING OPPORTUNITIES

Inspection Fee

The most obvious way to provide for the annual costs is by inspection fee. Then the motorist bears the cost of the pollution control program. Using average values for the cost per vehicle over the first five year period, the minimum fees would be $2.98 for the government-run lanes option; $4.30 for the contractor-run lanes option.[1] The cost, under this plan, would have to be increased every five years to allow for promotion and inflation. In addition, refinancing would be necessary when equipment needed replacement.

---

(1) $\frac{\$2.30/\text{vehicle} + \$3.65/\text{vehicle}}{2} = \$2.98$

$\frac{\$3.43/\text{vehicle} + \$5.18/\text{vehicle}}{2} = \$4.30$

TABLE 11

FUNDING REQUIREMENTS[1]

	GOVERNMENT-RUN LANES	CONTRACTOR-RUN LANES
Annual cost in 1981,[2] baseline estimate	$1,004,500 ($2.26/vehicle)	$1,506,400 ($3.39/vehicle)
Annual cost in 1981, with contingencies[2,3]	$1,019,200 ($2.30/vehicle)	$1,523,400 ($3.43/vehicle)
Annual cost with contingencies in 5th year of program[2,4]	$1,754,900 ($3.65/vehicle)	$2,492,300 ($5.18/vehicle)
Implementation costs to government[2]	$ 368,200 ($0.83/vehicle)	$ 140,900 ($0.32/vehicle)

(1) 1979 dollars are inflated to the year of reference. Analysis assumes amortization of capital costs (land, buildings, and equipment) from operating revenues rather than lump sum payment in first year from other sources (see Table 3, note 3). Under this assumption equipment would have to be refinanced when replaced.

(2) 8% per year inflation rate is applied to baseline values in 1979 dollars (Tables 1 through 8). Implementation costs to Government appearing on last line are not included in other estimates.

(3) 30% of costs of land and construction added before amortizing.

(4) 8% per year inflation assumed (factor of 1.4693); salaries first adjusted to mid-range and cost of operations increased by 10% to allow for growth of fleet.

Grants

The Jefferson County Air Pollution Control District has been awarded a special grant for the purpose of assisting in the implementation of an I/M program. This is in the amount of $300,000. The grant may be used for the purposes considered here to be implementation costs. With a $300,000 grant, implementation costs to government would be completely covered if the contractor-run lanes option were selected. If the government-run lanes option were selected, an additional $68,200 would be required, presumably from local funds.

SECTION VI

BENEFITS OF INSPECTION-MAINTENANCE

The benefits of I/M are realized primarily in the reduction of air pollution. Periodic inspection and maintenance ensures that factory-installed emission control devices and the general repair of the vehicle contribute to, rather than inhibit, pollution control. Furthermore, it establishes a valid baseline emission level which is necessary if the impact of transportation control measures, such as carpool/vanpool programs is to be accurately assessed.

The average reduction noted upon retest after repair has been found to be quite significant, on the order of 70% reduction for both CO and HC emissions. However, the real measure comes from modeling the annual emissions from the Jefferson County fleet of vehicles with their typical travel characteristics, and to follow this change over the years after I/M is installed. This was done in the course of this study with the following results:

- the program proposed should reduce Louisville HC emissions by 7% and CO emissions by 9% in 1982;
- by 1987 the annual reduction is expected to be 32% for HC and 41% for CO.

Reduction of CO levels must enhance human health since it is toxic and the affinity of blood hemoglobin to CO is much greater than to oxygen. Hydrocarbons are precursors to ozone and feature prominently in the reactions leading to the formation of secondary particulates. Thus reduction of HC emissions will reduce the incidence and intensity of eye-irritating smog. Damage to agricultural crops and gardens will be reduced and the hazy skies will be less dominant due to the reduction of secondary particles.

Studies of on-going I/M programs have also shown improved fuel economy as a side benefit of I/M. In Chapter II, Phase I the fuel savings was estimated to be about $26 per repaired vehicle. As the cost of gasoline increases this savings would increase too. This data must be viewed with cautious optimism, however. The most recent Portland study shows little change in fuel economy due to I/M. However, there was no mechanics training program there and EPA authorities hold that to be the important missing factor. EPA is convinced there is a positive fuel economy factor for a good I/M program

with trained mechanics. This leads not only to individual savings but furthers national energy conservation goals.

Finally, there is every reason to believe that a well-maintained machine will function better for a longer period. Certainly some preventive maintenance will be done and this will reduce the number of breakdowns on the road. Excessive wear associated with break down and malfunction will be avoided to some degree. Improved, trouble-free operation and longer life for the vehicle has not yet been established by hard data, but they ought to be expected.

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-904/9-79-039		

4. TITLE AND SUBTITLE
An Analysis of Inspection-Maintenance Program Options for Jefferson County, Kentucky

5. REPORT DATE
April 1979

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Alvan Bruch

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Engineering-Science
7903 Westpark Drive
McLean, Virginia 22102

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.
68-02-2869

12. SPONSORING AGENCY NAME AND ADDRESS
U.S. Environmental Protection Agency
Region IV
345 Courtland Street
Atlanta, Georgia 30308

13. TYPE OF REPORT AND PERIOD COVERED
Final Report

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Inspection-maintenance program options differing according to concept, management and type of inspection were identified, scaled to Jefferson County and comparative costed using a modular approach. Total costs were considered, including repair of vehicles, without regard for whom would meet these costs. Upon consideration of these comparative costs, and comparative benefits as well, the two low-cost options were selected for fuller consideration. These options, government-run and contractor-run central lanes, were then subjected to a more detailed and conventional cost analysis: capital costs; operating costs; annual costs; and first-year implementation costs to government. Finally, funding requirements and opportunities were considered.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Motor Vehicle Emissions Control Inspection-Maintenance	Carbon Monoxide Hydrocarbons Cost-Benefit Analysis Louisville	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release Unlimited	Unclassified	203
	20. SECURITY CLASS (This page)	22. PRICE
	Unclassified	

EPA Form 2220-1 (9-73)