The Jerusalem Institute for Israel Studies
The Center for Environmental Policy
Established by the Charles H. Revson Foundation

Insuring the Effectiveness of Catalytic Converters to Prevent Air Pollution from Transportation in Israel

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2005

The Center for Environmental Policy Studies Series no. 20

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The author gratefully acknowledges the support of the GM Foundation, Rishon Lezion, Israel, in preparing this study. Valuable comments on an earlier draft were received from Malcolm Ferguson of the Institute for European Environmental Policy in London.

This publication was made possible through funding by the Charles H. Revson Foundation.

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Introduction

There are more than fifteen times the number of cars, trucks and buses on the planet today than there were fifty years ago, with the number soon to reach one billion vehicles (UNEP, 1999). While this phenomenon has revolutionized mobility for much of the world's population, it has also significantly impaired the quality of its air, particularly in cities. The dominant contribution of mobile source air pollutants to overall ambient air pollution concentrations in diverse urban areas, as shown in Table 1 (which compares emissions in cities with populations comparable in size to Israel's), indicates the pervasiveness of the dynamic. The Israeli air pollution profile is certainly no different. Israel's Ministry of Environment monitoring suggests that transportation is the dominant source of general emissions and the single greatest contributor to chronic ambient air standard exceedances in cities such as Tel Aviv, Jerusalem and Haifa (Israel Ministry of Environment, 2003).

Table 1:
Percentage of Vehicle Contribution to Total Air Pollutants by Country

CITY	YEAR	CO	HC	NOx	SO_2	PM
Beijing	1989	39	75	46	NA	NA
	2000	84	NA	73	NA	NA
Mumbai	1992	NA	NA	52	5	24
Budapest	1987	81	75	57	12	NA
Cochin	1993	70	95	77	NA	NA
Delhi	1987	90	85	59	3	37
Lagos	1988	91	20	62	27	69
Mexico City	1990	97	99	53	33	75
	1996	77	22	21	35	26
Santiago	1993	95	92	69	46	85
	1997	71	14	15	11	86
Sao Paulo	1990	94	89	92	64	39
ISRAEL	1999	98	62	45	NA	>50

Source: World Council for Sustainable Development, 2002; Gabbay, 2002

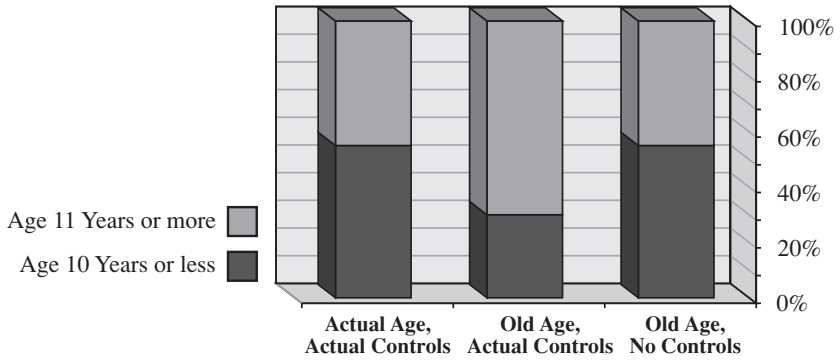
Since the mid-1970s, the conventional technology for reducing emissions from vehicles has been catalytic converters. Some commentators are critical that government policies spawned a diffusion of catalytic converter technology rather than more fundamental innovations, such as a "zero emissions" alternative to the internal combustion engine (Bunke, 1997). Yet, catalytic converters are a case where "end of the pipe" technologies are potentially capable of eliminating much of the world's mobile source — air pollution emissions. In the U.S. alone, converters are attributed with reducing over 1.5 billion tons of air pollution. Originally designed for cars, catalytic converters are now available for use on buses, trucks, motorcycles, construction equipment, lawnmowers and non-road engines (MECA, 2003).

But catalytic converters do not last forever. As environmental managers grapple for solutions to mounting air pollution problems around the world, a common characteristic of most urban air quality profiles has become increasingly salient: older vehicles are consistently dirtier. In the U.S., for example, a recent U.S. National Academy of Science report estimated that less than 10 percent of the vehicle fleet contributes more than 50 percent of any given pollutant (U.S. National Academy of Science, 2001). Earlier studies showed that cars over twenty years old constituted 3.4 percent of total auto registrations and only 1.7 percent of total miles driven. Yet they produced 7.5 percent of HC and 7.6 percent of CO. California reported even more dramatic contributions, with old vehicles driving only 3 percent of the total miles but producing 15 percent of the CO and 22 percent of the hydrocarbons (U.S. Office of Technology Assessment, 1992). Israeli figures suggest that catalytic converters leave new cars with one-seventh of the pollution emissions of 10-year-old vehicles (Gabbay, 2002). Figure 1 offers a graphic description of the phenomenon based on studies in Taiwan.

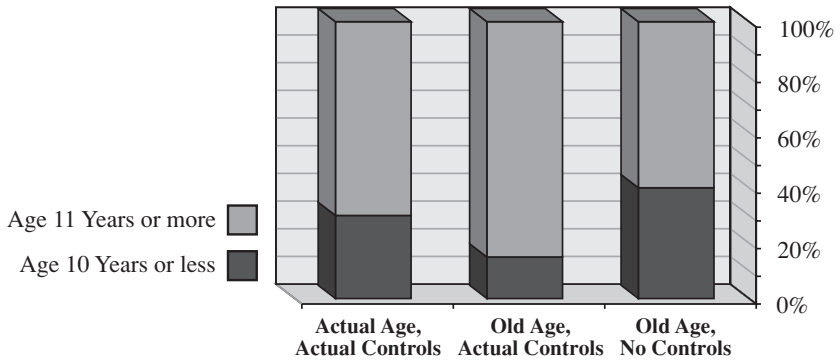
The measurable mechanical attrition at the fleet level turns scores of old individual vehicles into chronic air pollution violators. In Israel, this phenomenon is well documented. A Technion research team estimated that some 50 percent of older vehicles failed to meet the country's fairly modest emission standards (Gutman, 1998). A more recent evaluation by the country's licensed garages for vehicle inspections estimates that 25 percent of pre-1995 cars fail the annual inspection tests as opposed to a trivial number of new vehicles (Tal, 2002). Clearly, if progress is to be made in improving air quality in Israel, policies need to focus on lowering

Figure 1:
Impact of Vehicle Age Distribution on Emissions of NOx, CO and HC

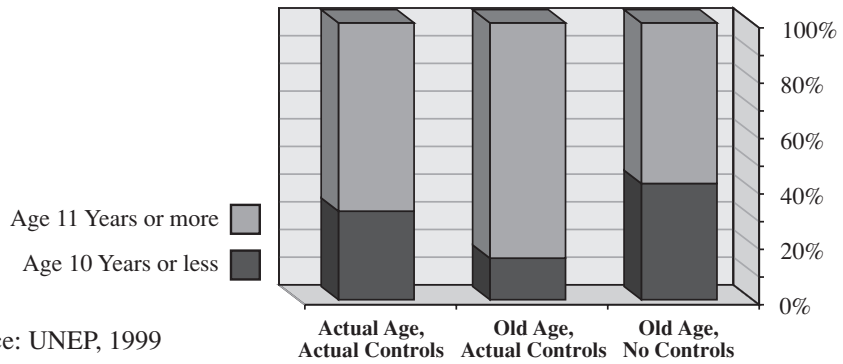
Nitrogen Oxides – NOx



Carbon Monoxide – CO



Hydrocarbons – HC



Source: UNEP, 1999

emission levels among the older vehicles in the fleet. By definition, this means extending the effective performance of catalytic converters or ensuring that they are promptly replaced when they cease to reduce emissions sufficiently.

Several policy options have been suggested by the United Nations to address the older vehicle emissions syndrome (UNEP, 1999). They include:

- Use of Alternative Fuels to remove pollutants from the potential emission streams;
- Inspection and Maintenance (I&M) Programs to ensure ongoing emission performance levels;
- Retrofitting old vehicles, which includes various incentives and requirements for replacing catalytic converters. Alternatively, accelerated retirement or "scrappage" incentives could be used to get old vehicles off the road; and
- Limiting "Used Imports" to prevent the dumping of "dirty vehicles" onto local markets.

In the Israeli context, the first three options are the most likely candidates for adoption by decision makers. The high price of new vehicles due to import taxes undermines most incentives for early retirement of vehicles. For many Israelis it is simply too expensive to upgrade regularly. Similarly, the importation of used vehicles is not a serious phenomenon in Israel, primarily because neighboring countries are disinclined to export and import taxes make used cars from Europe prohibitively costly. Nonetheless, these policies will be considered briefly in the report in order to offer a complete picture. While alternative fuels may become available in Israel in the long run, present efforts focus on cleaning up conventional fuels.

Upgrading the quality of existing fuel sources in Israel could indeed play an important role in improving catalytic converter performance, especially among older vehicles. This, in addition to the last two categories (I&M and converter replacement), is particularly germane for Israel in its efforts to prolong the life span and effectiveness of catalytic converters in Israel. The international experience in these areas is at the heart of the present analysis.

If high-performance catalytic converters are going to be central to any strategy for reduced air emissions among older vehicles, an effective policy must address the "causes" of the defunct converter conundrum. The drop in effectiveness among old converters is caused and exacerbated by numerous factors:

- *inhibition by inappropriate fuels;*
- *improper maintenance regimes; and*
- *unwillingness to replace converters when they are irreversibly damaged.*

These three factors can be linked to the specific policy areas that will be considered in the present analysis.

The study begins its review of the subject by considering the physical characteristics of catalytic converters and factors that reduce their life expectancy. Present Israeli policies that affect catalytic converters are then discussed, with an eye to appropriate junctures for future intervention to promote converter longevity. A number of policies from around the world that were designed to address different aspects of faulty catalytic converter performance in older vehicles are then be detailed. As catalytic converters are presently installed only on *gasoline*-powered vehicles in Israel, the report is limited to this segment of the fleet; for now they are the only group where a converter "aging" problem needs to be confronted.

Conclusions and Recommendations

The pollution profile among Israeli vehicles is no different than that of other industrialized countries. Older vehicles (especially diesels) contribute an inordinate percentage of the pollution burden. With full introduction of catalytic converters into the Israeli fleet reaching its tenth anniversary, it is time that the country began to consider converter longevity and replacement in its overall air quality strategy.

In theory, the country's current programs and policies offer a strong regulatory infrastructure for implementing such a policy. For instance, the annual vehicle registration test is professionally implemented with oversight improving, standards for replacement converters are in place, etc. Yet, this potential goes unexploited,

for a variety of reasons. Chief among them is a poor diagnostic standard in annual testing for evaluating catalytic converter performance and the insufficient frequency of testing among older vehicles. A new emissions standard is critical as a basis for identifying damaged converters, prohibiting "tampering" with converters and for better directing garages to make real repairs on polluting vehicles.

While today's fuel standards, especially sulfur concentrations and lead, are at long last adequate for meeting the present generation's needs of emission control equipment, further reductions will be necessary. Presumably, the current linkage to Europe's fuel standards, if honored, will be sufficient for the future. Retrofitting of older fleets, especially particulate traps among diesel vehicles, appears to be a cost-effective initiative. The government should identify high-polluting groups and assess the potential for cost-sharing initiatives. Already, the present analysis suggests that an accelerated vehicle retirement program would reduce emissions sufficiently to justify the cost of a tax reduction or other form of incentive.

Because weaker socio-economic groups tend to have older vehicles, there may be "societal" and equity implications associated with a more focused catalytic converter longevity program. Yet, international experience suggests ways to ease such a burden.

Surveys with garage owners and mechanics confirm that they are hardly the "partners' required for a national catalytic converter policy. A broad program that includes detailed directives for the maintenance of exhaust systems in older vehicles, stringent supervision of garage repairs for violating vehicles, alongside education and training could be important for recruiting this crucial cohort into a national initiative. At the same time, the general public remains generally unaware of motor vehicles' dominant role in air pollution-related health problems, much less the role of catalytic converter protection and automotive maintenance. Educational campaigns have the potential of influencing them and the other government bodies that need to be committed to reducing air pollution in older vehicles.