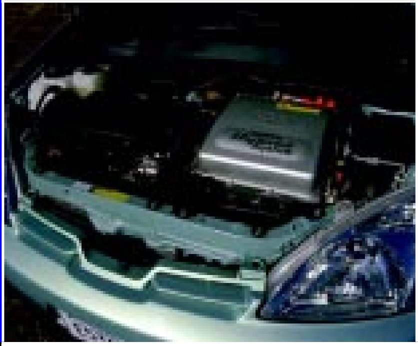
CLEAN CARS, CLEANER AIR



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HOW STRONG EMISSION STANDARDS CAN CUT AIRBORNE TOXIC POLLUTION IN NEW JERSEY

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Toxic air pollutants pose a major public health threat in New Jersey. The risk of contracting cancer from airborne toxics vastly exceeds established health guidelines for 95 percent of the state's residents.

Mobile sources – and particularly cars and trucks – are major contributors to the toxic air pollution problem in New Jersey. The U.S. Environmental Protection Agency estimates that mobile sources emit 41 percent of all air toxics by weight and that on-road vehicles are responsible for approximately half that amount. Mobile sources are also responsible for the majority of emissions of certain air toxics, such as benzene.

In 1999, the EPA and the state of California adopted separate standards to limit emissions from cars and light-duty trucks. Those standards were intended to address a variety of air pollution problems, including the emission of toxic chemicals into the air. The California standards, known as LEV II, are much stronger than those of the EPA, known as Tier 2. They also maintain California's long-standing commitment to ensuring that a certain percentage of cars sold in future years be clean, advanced technology vehicles.

Our analysis of the two programs shows that LEV II holds the potential for substantial environmental and public health benefits for New Jersey – over and above the benefits gained through Tier 2. Specifically, compared with the federal program, LEV II would result in:

- Significant reductions in emissions of toxic air pollutants, including many known and suspected carcinogens.
    - o By 2020, New Jersey's passenger cars, pickup trucks and SUVs would annually release about 23 percent less toxic pollution than under the federal program – despite projected increases in vehicle miles traveled over the next two decades.
    - o This emission reduction is the equivalent of taking nearly half a million (465,000) of today's cars off New Jersey's roads.
- Lower emissions of pollutants that contribute to asthma and other respiratory illness.
    - o By 2020, emissions of ozone-forming volatile organic compounds (VOCs) from cars, light trucks and SUVs would be approximately 19 percent less than under the federal program. Similar reductions would occur in ozone-forming nitrogen oxides. Most of New Jersey currently fails to attain federal health standards for ozone, the principal component of smog.
    - o The federal program would allow the dirtiest cars to pollute twice the amount of diesel particulates permitted by LEV II.
- A new generation of inherently cleaner cars.
    - o LEV II would replace approximately 300,000 polluting conventional vehicles with advanced technology hybrid-electric, electric, fuel cell and alternative fuel vehicles by 2020.
    - o More than 2 million vehicles by 2020 would be covered by extended, 150,000-mile warranties on their emission control systems, resulting in more durable and less-polluting cars that will benefit consumers.

State adoption of LEV II will come at some additional cost to automakers and consumers. However, those costs are minor when compared to other air pollution reduction programs and average vehicle costs. Moreover, the rules will result in a net economic gain for the state over the long term by reducing public health costs, enhancing the state's energy security, and encouraging the development of high-tech industry.

We recommend that the state of New Jersey adopt LEV II at the earliest opportunity. Further, we recommend that the state take additional actions to encourage the deployment of ZEVs and other ultra-clean vehicles, reducing the threat posed by motor vehicles to public health in the state.

1. INTRODUCTION

New Jersey has long been identified with the automobile. The New Jersey Turnpike and Garden State Parkway are not just highways; they are icons. The New York to Philadelphia corridor is one of the busiest in the nation, and much of the state's rural and suburban land has been reshaped by the automobile.

As a result of the high density of vehicle traffic throughout the state, much of New Jersey endures smog levels that rival those in cities like Los Angeles and Houston, putting the health of thousands of New Jersey residents at risk.

But smog isn't the only problem. Airborne toxic pollutants – like benzene, particulate matter and formaldehyde – also pose a significant public health threat, putting millions of New Jersey residents at increased risk of contracting cancer and respiratory ailments, and possibly leading to reproductive and developmental health effects as well.

Residents of every New Jersey county – from Cape May to Sussex – breathe levels of airborne toxic contaminants that pose an excessive cancer risk under the guidelines set by federal law. Mobile sources, and especially highway vehicles like cars and trucks, are a major source of that pollution.[1]

Over the past three decades, the federal government has adopted increasingly stronger standards to regulate emissions from motor vehicles. In 1999 it did so again, adopting "Tier 2" standards that will dramatically reduce emissions of a range of air pollutants.

But while the new standards will likely go far to address the region's smog problem, they may not be sufficient to protect New Jersey residents from exposure to air toxics.

Thankfully, there is an alternative. The state of California – long a leader in automobile emission reductions – has adopted a different set of emission standards that take an aggressive posture toward air toxics while also helping to combat the state's notorious smog problem. Those standards, called the Low-Emission Vehicle II (LEV II) rule, also include a cutting-edge requirement that automakers build significant numbers of zero-emission or near-zero emission vehicles in the near future. Recognizing the benefits of the California approach, three states – New York, Massachusetts and Vermont – have adopted California's air pollution and zero-emission vehicle standards for themselves.

Comparing the emission benefits of Tier 2 and LEV II leads to the conclusion that adopting the California standards would significantly reduce air toxics emissions in New Jersey over the next two decades while helping to encourage the development of technologies that could someday eliminate toxic emissions from automobiles altogether.

This approach will not be without short-term costs. But the long-term benefits – in improved public health, reduced environmental pollution and enhanced economic and energy security – are well worth the investment.

2. AIR TOXICS IN NEW JERSEY

The federal Environmental Protection Agency lists 188 chemicals as hazardous air pollutants (HAPs). Of those, EPA has identified 21 as coming primarily from "mobile sources" – cars, trucks and other non-stationary machinery. At least 10 of those are produced in significant quantities by light-duty cars and trucks:

- **Benzene**, which can cause leukemia and a variety of other cancers, as well as central nervous system depression at high levels of exposure. On-road vehicles produced an estimated 57 percent of all benzene emitted into New Jersey's air in 1996.[2]
- **1,3-Butadiene**, a probable human carcinogen, which is suspected of causing respiratory problems. On-road vehicles are responsible for 77 percent of emissions.
- **n-Hexane**, which is associated with neurotoxicity and whose links to cancer are unknown.
- **Formaldehyde**, a probable human carcinogen with respiratory effects. On-road vehicles are responsible for 39 percent of emissions.
- **Acetaldehyde**, a probable human carcinogen that has caused reproductive health effects in animal studies. On-road vehicles are responsible for 29 percent of emissions.
- **Acrolein**, a possible human carcinogen that can cause eye, nose and throat irritation. On-road vehicles are responsible for 34 percent of emissions.
- **Toluene**, a central nervous system depressant suspected of causing developmental problems in children whose mothers were exposed while pregnant. Its cancer links are unknown.
- **Ethylbenzene**, which has caused adverse fetal development effects in animal studies. Its cancer links are unknown.
- **Xylene**, a central nervous system depressant that has caused developmental and reproductive problems in animal studies.
- **Styrene**, a central nervous system depressant that is a possible human carcinogen.[3]

In addition, airborne **particulate matter** – the motor vehicle component of which comes largely from diesel-fueled vehicles – has also been recognized as a cause of lung cancer and respiratory problems, and is classified by California as a toxic air contaminant.

Mobile sources – which include cars, trucks and other highway and non-road motorized machinery – are major emitters of air toxics. EPA estimates that mobile sources emit 41 percent of all air toxics by weight and that on-road vehicles are responsible for approximately half that amount.[4] Several air toxics – such as benzene and toluene – are also hydrocarbons, which play an important role in the chemical reaction that creates smog.

In 1990, the U.S. Congress mandated that the EPA take steps to address emissions of airborne toxic chemicals. In the Clean Air Act amendments of that year, Congress set as a goal reducing the cancer risk from airborne toxins to one case of cancer for every one million residents. But twelve years later, New Jersey residents still face cancer risks from these and other air toxics that are well above the Clean Air Act goal.

In November 2001, NJPIRG Law & Policy Center completed a detailed study of the cancer risks posed by toxic air pollutants based on EPA modeling of 1996 data. Among the conclusions of that report:

- The average New Jersey resident breathed levels of air toxics in 1996 that were 1,600 times higher than the cancer risk goal of the Clean Air Act. Risk exceeded 820-in-one-million for 95 percent of the population of the state, and 3,500-in-one-million for the 5 percent of the population with the greatest exposure.

- Certain areas of New Jersey face extreme health threats from air toxics. Hudson, Camden, Bergen, and Essex counties have the highest average cancer risks, ranging from 1,800- to 3,600-in-one-million. Seventeen New Jersey counties ranked in the top 100 nationwide for cancer risk from airborne toxins.
- Five of the top eight toxic compounds for cancer risk in New Jersey come primarily from mobile sources. Mobile sources account for 88 percent of the cancer risk and 86 percent of the chronic respiratory hazards faced by New Jersey residents due to airborne toxics.
- If all eight million New Jersey residents were exposed to these levels of pollutants for 70 years, roughly 13,000 people would get cancer and possibly die, even in the absence of any other risk factors.[5]

Figure 1 represents the cancer risk from air toxics faced by the middle 90 percent of the population in each New Jersey county.

Air toxics are clearly a serious public health problem for New Jersey. But while that threat has gained increasing recognition in recent years, it has not been adequately addressed at the federal level.

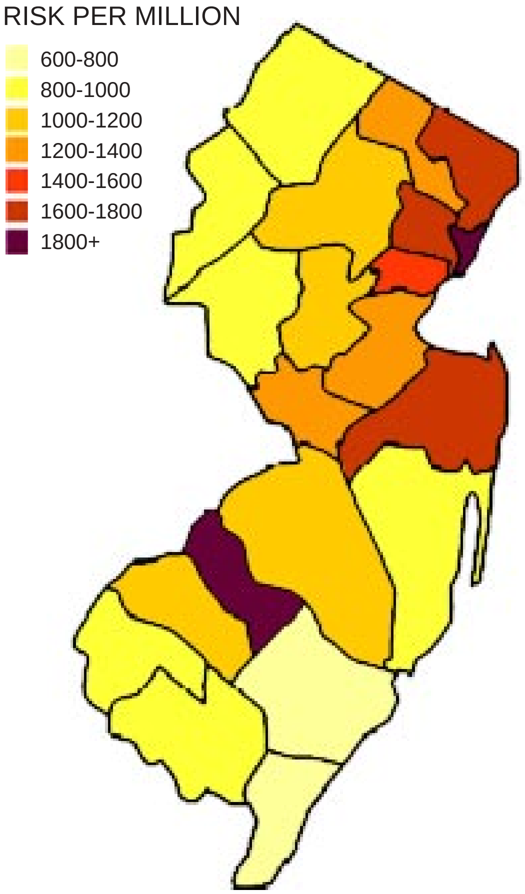
The 1970 Clean Air Act directed EPA to set health-based ambient air quality standards for six "criteria" pollutants – carbon monoxide, ground level ozone, lead, nitrogen oxide, particulate matter and sulfur dioxide. With the Clean Air Act amendments of 1990, Congress established the one-in-a-million cancer risk goal for toxic air contaminants and directed EPA to address emissions of three specific mobile source air toxics: benzene, formaldehyde and 1,3-butadiene.[6]

Despite a 54-month timeframe for developing regulations for those chemicals, it took the agency until 2001 to issue a mobile source air toxics rule – and even that rule did not take additional action to limit air toxic emissions from mobile sources. A group of environmentalists and states filed suit against the EPA in May 2001 to get the agency to fulfill the congressional mandate.[7]

Northeast States for Coordinated Air Use Management – a group representing six New England states, New York and New Jersey – contends that the implementation of all current and proposed federal regulations, including the Tier 2 standards discussed in this report, will not achieve the cancer risk reductions called for by the Clean Air Act.[8]

Achieving that goal – and protecting the health of New Jersey residents – will require additional action. The LEV II standards are the best option available to New Jersey to meet this threat.

Fig. 1: Cancer Risk from Air Toxics for Middle 90 Percent of Population



3. AUTO EMISSION STANDARDS

A common theme runs through the history of automobile emission standards in the United States. Whenever the time has come to take action to protect the environment and public health from vehicle emissions, California has led the rest of the nation.

That should be no surprise. With its automobile-centered culture and smog-conducive climate, California has typically felt the negative effects of vehicle emissions earlier and with greater severity than elsewhere in the country.

In 1961, California required installation of the first automobile emission control device in the country. In 1966, it was the first state to adopt tailpipe emission standards for specific pollutants. Three years later, the state issued the first set of pollutant-specific air quality standards. In the latter two cases, the federal government followed suit within two years with similar regulations.

In 1970, the federal government took a major step forward with the passage of the original Clean Air Act, which called for the first national tailpipe emission standards and set the overall framework that has governed automobile emission regulation since.[9] The 1970s and 1980s saw the progressive tightening of existing air quality standards, the installation of new pollution control equipment, and the elimination of leaded gasoline – all of which led to significant reductions in automobile emissions.

But even as federal air pollution rules grew more stringent, federal law preserved a special place for California. From the very early days of air pollution regulation, California has been empowered to issue its own vehicle emission standards because of the state's urgent air pollution problems.

With the Clean Air Act of 1990, the federal government further tightened emission standards at the federal level. The law also required the EPA to reassess the need for even tighter standards for the 2004 model year and beyond.

The 1990 act also preserved the right of states to adopt more protective emission standards based on those adopted in California. By the mid-1990s, New York and Massachusetts had adopted the California rules, with Vermont and Maine following suit later.[10] States were barred from issuing standards that differed from the federal or California rules – a provision intended to prevent automakers from being forced to market 50 different cars in 50 states.

While Congress was acting to tighten air pollution standards at the national level, California was not sitting still. In 1990, the state adopted its low-emission vehicle (LEV) and zero-emission vehicle (ZEV) standards. The LEV standards, which were far tighter than the prevailing federal standards at the time, allowed manufacturers to certify vehicles to a series of emissions "bins," provided that their fleets met an overall average standard for non-methane organic gas (NMOG) – a class of pollutants that includes many air toxics and smog precursors – that declined over time. The law also required automakers to manufacture a certain percentage of ZEVs, beginning with 2 percent in 1998 and increasing to 10 percent by 2003.[11]

In 1994, following up on the 1990 Clean Air Act Amendments, the U.S. EPA issued its Tier 1 rule, which phased in tighter emission standards for cars and some light trucks. Several years later, in an effort to stave off the implementation of the ZEV requirement by other states, the auto industry and federal government agreed to a new National Low Emission Vehicle (NLEV) program that went into effect in the northeastern states in 1999 and nationwide in 2001. The NLEV standards include further reductions in tailpipe emissions, mirroring the reductions included in California's original LEV standards.

In 1999, both California and the federal government adopted tough new standards designed to limit air pollution emissions from a wide range of motor vehicles beginning in the 2004 model year. The California program was called LEV II; the federal program, Tier 2.

There are many similarities between the two programs. In fact, they have more in common than not.

Both adopted the "bin" system pioneered in California's 1990 LEV I standards. The system gives manufacturers the flexibility to produce a mix of higher- and lower-polluting vehicles as long as their entire fleet meets overall emission reduction targets. Both programs also eliminated the "SUV loophole" that exempted many light trucks from the tough emission standards in place for passenger cars (although a similar loophole still exists in federal fuel efficiency standards). And both established tighter emission levels for vehicles regardless of the type of fuel they use. [12]

But there are several key differences between the two programs. Among these are:

- The two programs measure compliance against different benchmark pollutants.
- There is significant difference in the reductions required for "evaporative emissions" – those emissions that come from sources other than vehicle exhaust.
- The federal standards do not require the production and sale of advanced technology vehicles.

How Standards Are Enforced

For both the California LEV II and the federal Tier 2 programs, the amount of emissions permitted for a vehicle depends on its vehicle class and weight. With the 1999 changes, the Tier 2 and LEV II programs have adopted a generally similar set of classifications for passenger cars (known as PCs or LDVs) and light trucks (LDTs). (See Table 1.)

To determine if vehicles are in compliance with clean air standards, vehicles are tested according to standardized test procedures, with their engines aged to simulate conditions at their "full useful life," which is currently defined as 120,000 miles under both California and federal standards. In certain cases, regulations also stipulate "intermediate life" standards, which are measured at 50,000 miles.

For the sake of clarity, this report will refer to vehicles by their federal classifications. Occasionally, we will refer to "heavy" and "light" light-duty trucks. Heavy light-duty trucks (or HLDTs) comprise the LDT3 and LDT4 categories in the federal classifications, while light light-duty trucks (LLDTs) represent the LDT1 and LDT2 categories. Further, whenever standards are mentioned, they should be assumed to be for the full (120,000 mile) useful life, unless otherwise stated.

Table 1: Federal and California Light-Duty Vehicle Classes[13]

CA Vehicle Class	Weight	US Vehicle Class	Weight
PC	All passenger cars	LDV	All passenger cars
LDT1	0-3,750 lbs. LVW	LDT1	0-6,000 lbs. GVW 0-3,750 lbs. LVW
LDT2	3,751 lbs. LVW-8,500 lbs. GVW	LDT2	0-6,000 lbs. GVW 3,751-5,750 lbs. LVW
		LDT3	6,001-8,500 lbs. GVW 0-5,750 lbs. ALVW
		LDT4	6,001-8,500 lbs. GVW 5,751-8,500 lbs. ALVW

LVW: Loaded Vehicle Weight=actual vehicle weight plus 300 lbs.

GVW: Gross Vehicle Weight=maximum design loaded weight

ALVW: Adjusted Loaded Vehicle Weight=average of GVW and actual vehicle weight

NMOG, NMHC and VOCs

Historically, federal and California regulations have used a variety of measures to gauge the release of toxic and smog-forming pollutants from motor vehicles. The Tier 2 and LEV II rules both measure tailpipe emissions of non-methane organic gases (NMOG), a class of pollutants that includes hydrocarbons (except methane) and various other reactive organic substances such as alcohols, ketones, aldehydes and ethers. Some previous standards have been communicated in terms of non-methane hydrocarbons (NMHC), which do not include non-hydrocarbon reactive gases. Still other standards are communicated in terms of volatile organic compounds (VOCs), which include all the components of NMOG but exempt some non-reactive hydrocarbons. All three measures include a variety of air toxics, but not necessarily the same ones.

The three measures yield roughly equivalent amounts of motor vehicle emissions and are often used interchangeably. In this report, overall tailpipe and evaporative emissions reductions are presented in terms of NMHC. These values were then converted to NMOG to analyze emissions of specific air toxics and VOCs. For a more detailed discussion of this topic, see Appendix A.

Tailpipe Emission Standards

Federal Tier 2 Rule

The foundation of the Tier 2 rule is a fleet average emission standard for nitrogen oxides (NOx) – a key precursor of smog – of 0.07 grams/mile, a significant reduction from earlier federal standards. The NOx standard is to be phased in for cars and LLDTs beginning in 2004, with the standards to be fully phased in for the 2007 model year. HLDTs and medium-duty passenger vehicles (MDPVs, a class of larger passenger vehicles that includes conversion vans) will be subject to interim standards, which will be phased in beginning in 2004, and the full Tier 2 standards, which will be phased in beginning in 2008. All vehicles will comply with the new standards beginning in 2009.[14]

The new rules also give manufacturers an incentive to certify their vehicles to Tier 2 standards ahead of schedule, by allowing

Table 2: Tier 2 Tailpipe Emission Standards (grams/mile)[15]

Bin No.	NOx	NMOG	CO	Formaldehyde	PM	Notes
11	0.9	0.280	7.3	0.032	0.12	a,c
10	0.6	0.156/0.230	4.2/6.4	0.018/0.027	0.08	a,b,d
9	0.3	0.09/0.18	4.2	0.018	0.06	a,b,e
8	0.2	0.125/0.156	4.2	0.018	0.02	b,f
7	0.15	0.09	4.2	0.018	0.02	
6	0.1	0.09	4.2	0.018	0.01	
5	0.07	0.09	4.2	0.018	0.01	
4	0.04	0.07	2.1	0.011	0.01	
3	0.03	0.055	2.1	0.011	0.01	
2	0.02	0.01	2.1	0.004	0.01	
1	0	0	0	0	0	

Notes:

a) This bin is deleted at the end of the 2006 model year (end of 2008 model year for LDT3-4 and MDPVs).
b) Higher NMOG, CO and formaldehyde values apply for LDT3-4 and MDPVs only.
c) This bin is only for MDPVs.
d) Optional NMOG standard of 0.280 g/mi applies for qualifying LDT4s and qualifying MDPVs only.
e) Optional NMOG standard of 0.130 g/mi applies for qualifying LDT2s only.
f) Higher NMOG standard deleted at end of 2008 model year.

them to bank credits toward future compliance with the rules.

Manufacturers will have the flexibility to certify their vehicles to one of a number of "bins," provided that their fleets meet the 0.07 g/mi average NOx requirement. In practice, the bins will allow manufacturers to produce some vehicles that emit more than 0.07 g/mi of NOx, as long as they also manufacture vehicles certified to bins with tighter NOx requirements.

The bins are structured to ensure that emissions of other air pollutants – including NMOG (which includes many air toxics), carbon monoxide (CO), formaldehyde, and particulate matter for diesel vehicles (PM) – are reduced along with NOx.

The Tier 2 standards guarantee that, at full phase-in, light-duty cars and trucks will emit no more than 0.09 g/mi of NMOG – the highest level allowed in any permanent bin. In fact, emissions will likely be less, as automakers certify some vehicles to bins 1 through 4 in an effort to balance out higher NOx-emitting vehicles in their fleets.

California LEV II Rule

In contrast to the federal rules based on NOx, the California LEV II standards are based on fleet average emissions of non-methane organic gases (NMOG) – which include some smog precursors as well as many air toxics.

The LEV II standards require all cars and light-duty trucks to meet a steadily declining fleet average NMOG requirement beginning in 2004. In the first year, LDT1s must meet a fleet average of 0.053 g/mi NMOG when tested at 50,000 miles intermediate life, while LDT2-4s must meet a fleet average of 0.085 g/mi. Those averages gradually decline to 0.035 g/mi for cars and LDT1s and 0.043 for LDT2-4s by 2010. (See Table 3.)

Table 3: LEV II Fleet Average NMOG Standards for Light-Duty Vehicle Classes (grams/mile)[16]

Model Year	All PCs; LDTs 0-3,750 lbs. LVW	LDTs 3,751 lbs. LVW-8,500 lbs. GVW
2004	0.053	0.085
2005	0.049	0.076
2006	0.046	0.062
2007	0.043	0.055
2008	0.040	0.050
2009	0.038	0.047
2010+	0.035	0.043

As is the case in Tier 2, manufacturers can certify their cars to any one of a number of emissions "bins"– as long as their fleet average emissions of NMOG meet the standards. The declining NMOG fleet averages will result in manufacturers certifying a greater proportion of their cars to cleaner bins as the years go by.

In the early years of LEV II, manufacturers can still certify a portion of their vehicles to the earlier LEV I standards, but the fleet averages in LEV II still apply. After 2006, the following emissions bins apply. (See Table 4.)

It must be noted both federal and California standards also impose new limits on emissions from medium-duty passenger vehicles (e.g. large passenger vans). Because medium-duty vehicles make up only a small

Table 4: LEV II Light-Duty Emission Bins at Intermediate and Full Useful Life (grams/mile)[17]

Bin	NMOG	CO	NOx	Formaldehyde	PM
LEV[18]	0.075/0.09	3.4/4.2	0.05/0.07	0.015/0.018	NA/0.01
ULEV	0.04/0.055	1.7/2.1	0.05/0.07	0.008/0.011	NA/0.01
SULEV	NA/0.01	NA/1.0	NA/0.02	NA/0.004	NA/0.01
ZEV	0	0	0	0	0

LEV=low-emission vehicle, ULEV=ultra low-emission vehicle, SULEV=super low-emission vehicle portion of the U.S. vehicle fleet, this analysis focuses primarily on light-duty vehicles, which make up 90 percent of all vehicle miles traveled in the U.S.[19]

Evaporative Emission Standards

While many think of pollution as primarily coming from a vehicle's tailpipe, there are other sources as well. Approximately half of all hydrocarbon emissions from vehicles come from evaporative emissions – those emissions that emanate from engines, fuel systems and other parts of the vehicle both while it is running and while it is sitting still.[20]

Those emissions include:

- **Running losses** (about 47 percent of evaporative emissions) – Running losses include leakage from the fuel and exhaust systems as the car is being driven.
- **Hot soak emissions** (about 38 percent) – Hot soak emissions include releases from the carburetor or fuel injector that occur when a car is cooling off following a trip.
- **Diurnal emissions** (about 10 percent) – Emissions that take place due to "breathing" of the gas tank caused by changes in ambient temperature (i.e. the car being heated and cooled by the sun).
- **Resting losses** (about 4 percent) – Leakage from a car while it is resting.[21]

Both the Tier 2 and LEV II standards include new rules to limit evaporative emissions. Both rules keep in place limits on running loss emissions that are the same for California and the rest of the nation. The main difference is in limits on diurnal and hot-soak emissions. Those emissions are measured by two sets of tests. The three-day diurnal-plus-hot-soak test measures the evaporative emissions produced during a set of vehicle operations. The two-day test is a supplemental testing procedure designed to ensure adequate purging of the emission control canister during vehicle operation.[22] (See Table 5.)

Table 5: Evaporative Emission Standards for Three-Day Diurnal Plus Hot Soak Test (in grams/test)

Class	California	Federal
Passenger cars	0.5	0.95
Light-duty trucks <6,000 lbs. GVW	0.65	0.95
Light-duty trucks 6,000-8,500 lbs. GVW	0.9	1.2

How They Stack Up

Although both the LEV II and Tier 2 programs will result in substantial reductions in emissions, a direct comparison between the programs shows that LEV II is much stronger:

- **The LEV II program will lead to greater tailpipe emissions reductions upon full phase-in**. As noted above, the federal Tier 2 program will result in maximum fleet-average NMOG emissions of 0.09 grams/mile. Vehicles certified to Tier 2 standards will likely have somewhat lower emissions of NMOG than the 0.09 g/mi upper limit, as manufacturers certify their vehicles to cleaner bins in order to meet the fleet-average NOx requirement. The declining fleet average NMOG standard in LEV II, however, ensures that California cars will eventually release significantly less NMOG – and, therefore, fewer air toxics – than cars certified under Tier 2. An analysis of the potential reduction in air toxics in New Jersey that would result from adoption of LEV II follows in the next chapter.

  A similar situation is likely to occur for the two chemical precursors of smog: volatile organic compounds and nitrogen oxides. Because VOC emissions are closely tied to emissions of NMOG, New Jersey will experience a significant decline in VOC releases as the LEV II program progresses. (See next chapter for a more detailed analysis.)

Reductions in NOx emissions are expected to be similar for the early years of both the Tier 2 and LEV II programs. However, as California's fleet-average standard for NMOG tightens, more super-low-emission and zero-emission vehicles will be required to meet the standards, driving down NOx emissions significantly.

Detailed analysis conducted by the Massachusetts Department of Environmental Protection and the New York State Department of Environmental Conservation confirms the long-term NOx reduction benefits of LEV II. The Massachusetts DEP estimated that adoption of LEV II would result in a 19 percent reduction in NOx emissions compared to Tier 2 levels by 2020.[23] New York's DEC estimated that LEV II would attain a fleet average for NOx that is nearly 29 percent lower than the final fleet average attained by Tier 2 upon full implementation of both programs.[24]

- **Tier 2 could allow for continued use of dirtier vehicles.** Even at full phase-in, the Tier 2 program preserves the use of two bins – Bin 6 and Bin 7 – that permit greater emissions of certain pollutants than the LEV II standards.

  Use of the higher NOx emission levels in Bins 6 and 7 would require manufacturers to also certify some vehicles to cleaner bins in order to meet the federal fleet average requirement for NOx. The more significant difference, however, is in Bin 7's standard for particulate matter, which is double that of the highest LEV II bin. Some analysts suggest that such an approach would open the door for greater sales of diesel vehicles, which are a major source of particulate pollution.[25]

- **LEV II will generate greater reductions in evaporative emissions than Tier 2.** The California standards represent a nearly 80 percent reduction in evaporative emissions from previous standards, while the federal Tier 2 standards represent only a 50 percent reduction.[26]

4. EMISSION REDUCTIONS IN NEW JERSEY

Air Toxics Reductions Under LEV II

To develop estimates of the emission reductions that would result from LEV II, this study relies on grams-per-mile emission factors for the year 2020 developed for the Massachusetts Department of Environmental Protection in its 1999 study of the impacts of LEV II. Those emission factors were then applied to a projection of vehicle use and fleet composition for the year 2020 that is based largely on data used by EPA and the California Air Resources Board. For more detail on how the estimates that follow were derived, please see Appendix A.

Tailpipe NMHC Emission Benefits

By the year 2020, state adoption of LEV II would result in a reduction of about 5.2 million pounds – or 28 percent – of annual tailpipe non-methane hydrocarbon (NMHC) emissions in New Jersey when compared to Tier 2 standards. (See Table 6.) NMHC emissions are closely related to emissions of NMOG, which includes the bulk of EPA-regulated mobile source air toxics.

Table 6: Estimated New Jersey Tailpipe NMHC Emissions in 2020 Under Tier 2 and LEV II (in thousand pounds)

Vehicle Class	Tier 2	LEV II	Difference	Pct. Difference
LDV	6,074	3,695	2,380	39%
LDT 1/2	7,850	5,576	2,274	29%
LDT 3/4	5,062	4,486	576	11%
TOTAL	**18,987**	**13,757**	**5,230**	**28%**

Table 7: Light-Duty Evaporative NMHC Emissions in 2020 Under Tier 2/LEV II (in thousand pounds)

Vehicle Class	Tier 2	LEV II	Difference	Pct. Difference
LDV	7,452	6,388	1,065	14%
LDT 1/2	8,071	7,263	807	10%
LDT 3/4	3,167	2,903	264	8%
TOTAL	**18,689**	**16,554**	**2,136**	**11%**

Most of the difference between the two standards comes from passenger cars and light light-duty trucks. These vehicles were already subject to stringent emission limits before Tier 2 and LEV II, meaning that older LDVs and LLDTs still on the road in 2020 will make up a smaller percentage of the pollution from vehicles in those weight classes than will older HLDTs. Moreover, the high percentage reduction under LEV II reflects the program's phase-in of more stringent limits on NMOG releases from LDVs and LDT1s over time – an aggressive posture not found in Tier 2.

Evaporative NMHC Emission Benefits

The LEV II program would also bring about significant reductions in evaporative NMHC emissions – the source of about half of all NMHC released into the air from motor vehicles.

By 2020, light-duty vehicles in New Jersey would release about 2.1 million fewer pounds of NMHC – or about 11 percent – under LEV II evaporative emission standards as opposed to those in Tier 2. (See Table 7.)

Total NMHC Reductions

Combining the tailpipe and evaporative emission benefits of LEV II leads to the conclusion that total light-duty NMHC emissions would be about 7.4 million pounds per year less in New Jersey by 2020 – or 20 percent – under LEV II as opposed to Tier 2. (See Table 8.)

Table 8: Total NMHC Emissions from Light-Duty Vehicles in 2020 under Tier 2/LEV II (in thousand pounds)

	NMHC Emissions
LEV II	30,311
Tier 2	37,676
Total Reduction	**7,365**
Pct. Reduction	**20%**

Reductions in Specific Air Toxics

The EPA regulates 21 mobile source air toxics (see Appendix C), of which a smaller number, approximately 10, are present in detectable levels in light-duty vehicle exhaust and evaporative emissions. With the exception of diesel particulate matter, which is addressed in the next section, the NMOG category of emissions includes the bulk of EPA-regulated mobile source air toxics from light-duty vehicles.

These specific chemicals are not measured individually. But chemical speciation profiles, which detail the chemical composition of NMOG, allow us to determine the potential reductions in emissions of particular air toxics.

Applying EPA-generated speciation profiles to the LEV II-generated NMHC emission reductions detailed above yields a projected annual reduction of 1.8 million pounds – or approximately 23 percent – of the 10 air toxics listed in Table 9 under LEV II.[27]

Estimating that the average car on the road today in New Jersey produces approximately 3.9 pounds of air toxics per year, the additional emissions reductions under LEV II compared with Tier 2 would be equivalent to taking approximately 465,000 of today's cars off the road by 2020.[28]

Reductions in Volatile Organic Compounds

As noted above, the declining NMOG certification standards in LEV II will eventually force automakers to certify increasing numbers of cars to cleaner emission "bins" – a move that will lead to long-term reductions in emissions of NOx, an important ozone precursor.

However, those declining standards will also lead to reductions in the other main precursor of smog: volatile organic compounds, or VOCs.

Table 9: Air Toxics Emissions by Light-Duty Fleet Under Tier 2/LEV II, 2020 (in thousand pounds)

	Tier 2	LEV II	Difference
1,3- BUTADIENE	113	82	31
N-HEXANE	609	514	95
FORMALDEHYDE	249	180	69
ACETALDEHYDE	113	82	31
ACROLEIN	14	10	4
BENZENE	1,303	1,005	299
TOLUENE	3,149	2,410	739
ETHYLBENZENE	481	372	109
XYLENE	1,756	1,341	414
STYRENE	77	56	21
TOTAL AIR TOXICS	**7,864**	**6,052**	**1,812**
PCT. REDUCTION			**23%**

Table 10: VOC Emissions Under LEV II vs. Tier 2, 2020 (thousand pounds)

	Tier 2	LEV II	Difference	Pct. Difference
Exhaust VOC	18,928	13,714	5,214	28%
Evaporative VOC	19,247	17,048	2,199	11%
Total VOC	**38,176**	**30,762**	**7,413**	**19%**

In addition to containing a variety of toxic substances, the NMOG category of emissions also includes many volatile compounds that react with sunlight and NOx in the atmosphere to form smog. By reducing NMOG emissions through LEV II, New Jersey can enjoy commensurate reductions in VOCs. By 2020, adoption of the LEV II standards would result in a reduction of 7.4 million pounds of VOC emissions – or 19 percent – when compared to Tier 2. (See Table 10.)

The Impact of Diesel

No discussion of mobile-source air toxics would be complete without referencing one of the most dangerous pollutants: diesel particulate matter (PM).

Currently, light-duty vehicles are responsible for only a small portion of the particulate matter emitted into the nation's air. The EPA estimates that even without the Tier 2 standards emissions from light-duty vehicles would make up only 1.4 percent of all emissions of PM by 2007.

However, there is little certainty as to what portion of light-duty vehicles will run on diesel fuel in the years to come. In making its Tier 2 rule, the EPA posited a scenario in which as many as 9 percent of all passenger cars and 24 percent of light trucks sold in 2020 are running on diesel.[29]

As noted above, the Tier 2 rule allows some greater flexibility for manufacturers to produce diesel-fueled vehicles because of more lenient particulate matter standards. In one bin, PM standards are double the maximum level allowed in any bin under LEV II. Manufacturers might be tempted to take advantage of that leniency due to the greater fuel efficiency of diesel engines.

The EPA projects that tighter limits on sulfur in gasoline (enacted at the same time as Tier 2) will offset the increased production of light-duty diesel vehicles, such that its Tier 2 standards will result in total light-duty PM emissions remaining roughly the same in 2020 as today.[30]

In contrast, California's LEV II emissions standards would not make room for the widespread introduction of light-duty diesel vehicles to the marketplace. Combined with standards that reduce the sulfur content of gasoline, California's standards will lead to steep reductions in light-duty PM emissions.

Cost

Adopting the LEV II standards will not be without costs to automakers or consumers. However, those costs appear minor when compared to the price of an average vehicle or to the economic benefits that will result from improved public health.

The best gauge of the added cost of LEV II versus Tier 2 comes from a cost analysis by the California Air Resources Board (CARB). This analysis projected the additional cost of upgrading a 2003 model year vehicle certified to the ULEV bin in the original LEV I standards to a ULEV or SULEV under LEV II. The LEV I ULEV bin includes NMOG emission levels that are roughly comparable to the final Tier 2 standards, but NOx levels that are between four and twelve times higher than Tier 2. Thus, CARB's estimate – while the best available – likely overstates the additional cost of upgrading Tier 2 vehicles to meet the LEV II standards.[31]

Table 11: Incremental Per Vehicle Cost of LEV II ULEVs and SULEVs Versus LEV I ULEVs

	LEV II ULEV	LEV II SULEV
LDV	$96	$156
LDT1	$71	$130
LDT2-4	$209	$304

CARB estimated that the incremental per-vehicle cost of LEV II would range from as little as $71 to upgrade an LDT1 to meet the LEV II ULEV standard to $304 to upgrade a heavy light-duty truck to meet the LEV II SULEV standard.[32] These figures include CARB's $25 per vehicle estimated cost of complying with LEV II's evaporative emission standards. (See Table 11.)

The LEV II emission standards also appear to be cost-effective when compared to other means of reducing pollution from mobile sources. CARB estimated that the additional cost would translate to approximately $1.00 for every pound of pollution reduced, compared to $5.00 per pound for other mobile source reduction programs and $10.00 per pound for many stationary source programs.[33]

The increase in cost under the LEV II emission standards also appears small when compared to the average cost of a new motor vehicle, currently about $24,800.[34] The cost of adopting the standards, then, translates to less than one percent of vehicle price in almost all cases.

Unfortunately, CARB did not go on to estimate the societal benefits – in reduced public health costs, averted sick days, and the like – that would result from adoption of LEV II. However, EPA did conduct such an analysis for its adoption of Tier 2 standards.

EPA estimated that its Tier 2 standards will lead to the annual avoidance of 4,300 premature deaths nationwide, 2,300 cases of bronchitis, and numerous lost work days, hospital visits and other costs.[35] The net economic benefit of the policy to society at full implementation in 2030, EPA estimated, would be between $8.5 billion and $20 billion.[36]

Because the marginal cost of eliminating pollution increases as pollution controls tighten, it would be improper to extrapolate the potential societal benefit of the LEV II program from the EPA analysis. If, however, LEV II were to reduce air toxics concentrations in New Jersey – and the risks of cancer and other health problems that they pose – it is reasonable to assume that the program would result in a net economic benefit to the state.

5. PROMOTING ADVANCED TECHNOLOGY VEHICLES

The zero-emission vehicle (ZEV) requirement in the LEV II standards makes possible much of the emission reductions gained through the program, while promoting the development and use of advanced technology cars that could lead to further emission reductions in the future.

The ZEV requirement – as it has developed in California and been adopted by other states – is a evolving program. It has also had a tortuous history, thanks in large part to the consistent and vehement opposition of the automobile and oil industries, which have employed litigation, lobbying and public relations strategies to undo the program and prevent its spread.

Yet California's experience with the ZEV program to date has already spurred innovation in a wide range of zero-emission and low-emission vehicle technologies, from traditional electric cars to new options such as fuel-cell and hybrid-electric vehicles.

The History of the Zero-Emission Vehicle Program

The original zero-emission vehicle program was unveiled as part of California's Low-Emission Vehicle program in 1990. As originally constructed, the plan was to have required that two percent of cars sold in California would be ZEVs by 1998, five percent by 2001, and ten percent by 2003.

In 1996, the California Air Resources Board amended the ZEV regulations in keeping with a memorandum of agreement it negotiated with seven major auto manufacturers. The agreement called for the lifting of all ZEV requirements prior to 2003 in exchange for automakers' pledge to produce for sale between 1,250 and 3,750 advanced battery electric vehicles between 1998 and 2000.[37]

In 1998, the board again amended the ZEV program, creating partial ZEV (PZEV) credits for vehicles that achieve near-zero emissions (commensurate with the SULEV emission standard) and have zero evaporative emissions. The credits served to reduce the number of "pure ZEVs" that would have to be sold by manufacturers in 2003, while increasing the overall number of cleaner vehicles on the road.

As California was adjusting its ZEV rules, a set of eastern states were positioning themselves to adopt the LEV standards and the ZEV rules that come with them. By 1996, four eastern states – New York, Massachusetts, Maine and Vermont – had adopted some or all of the LEV/ZEV program.

In the early 1990s, it looked for a time as though the LEV and ZEV programs would take hold throughout the northeast. Acting as the Ozone Transport Commission (OTC – a body created under the 1990 Clean Air Act), the northeastern states petitioned EPA to mandate adoption of the LEV program from Maine to Virginia.

The OTC's petition was later thrown out in one of many legal actions filed by automakers against the LEV program in the northeast. However, the EPA and automakers negotiated to develop a voluntary program that could supplant LEV/ZEV in the northeastern states that hadn't already adopted it.

In 1998, that voluntary program – the National Low-Emission Vehicle (NLEV) program – took effect, requiring automakers to sell cars meeting roughly the same standards as the original LEV program across the country by 2001. However, the program did not include the ZEV requirement. And it came with a promise from the northeastern states that hadn't already adopted LEV that they would not adopt California standards that would take effect before the 2006 model year.

In 2001, CARB again altered the ZEV program, reducing the percentage of pure ZEVs required in the initial years of the program to two percent and allowing manufacturers to claim additional ZEV credits. Those changes are now making their way through the regulatory process.

In the northeastern states that had adopted the ZEV program, meanwhile, state officials have proposed an alternative compliance strategy that would delay the introduction of pure ZEVs, while encouraging the early introduction of vehicles meeting PZEV criteria.[38] The plan is still under consideration as this report goes to press.

In its short history, then, the ZEV program has been through several incarnations, weathered many political and legal battles, and remains in flux even now.

For the purpose of this report, we will assume that the version of the ZEV program that would be considered for adoption by New Jersey is the version that was adopted by CARB in 2001.[39]

How It Works

The percentages of ZEV and near-ZEV vehicles called for under California's ZEV program do not represent actual percentages of cars sold. Rather, automakers have many opportunities to earn credits toward the ZEV requirements that reduce the actual number of ZEVs they must produce.

In recent years, CARB has moved toward policies that reduce the number of pure ZEVs required of automakers, while increasing the number of extremely clean vehicles eligible for partial ZEV (or PZEV) credits.

The complexity of California's credit scheme makes it impossible to predict how many of each type of ZEV or PZEV vehicle will be on the road by 2020. Moreover, rapid changes in technology could render even CARB's initial assumptions invalid.

The key elements of the program are as follows:

- **Partial ZEV (PZEV) credits** – The California law requires 10 percent of all cars sold to be zero-emission vehicles. However, manufacturers can meet up to 6 percent of the 10 percent ZEV requirement by marketing cars that meet 150,000 mile SULEV emission standards and the state's zero evaporative emission criteria. These cars, which can be powered by internal combustion engines, are eligible for partial credit toward the ZEV requirement. Under the 2001 rules, their introduction will be phased in between 2003 and 2006.
- **Advanced technology PZEVs (AT-PZEVs)** – Manufacturers will be allowed to satisfy up to two percent of the 10 percent ZEV requirement by marketing AT-PZEVs powered by compressed natural gas, hybrid-electric motors, methanol fuel cells, or other very clean means. Such vehicles must meet the strict SULEV emissions standards, have "zero" evaporative emissions, and have their emissions control systems under warranty for 150,000 miles.[40] Current hybrid-electric vehicles such as the Toyota Prius do not yet meet those standards, but there is no technological reason why they cannot. If manufacturers fail to fulfill the two percent allocated to AT-PZEVs, they must sell pure ZEVs instead.
- **Pure ZEVs** – The California rules require that two percent of the cars sold by large volume manufacturers by 2003 be "pure ZEVs"; those with no tailpipe or fuel-related evaporative emissions. Currently, that means electric cars, but it is expected that this will soon lead to commercial introduction of hydrogen fuel cells. In early years of the program, manufacturers can meet the requirement either with "full function" ZEVs, or with "city" or "neighborhood" electric vehicles that have a smaller range and travel at lower speeds. Credits for neighborhood electric vehicles are scheduled to decrease over time, so that by 2006 they will count for only 0.15 of a full-function ZEV.[41]
- **Other credits** – Automakers can also receive additional credits for early introduction of ZEVs or for including technologies

Table 12: ZEV Percentage Requirement[42]

Model Years	Minimum ZEV Requirement
2003-2008	10 percent
2009-2011	11 percent
2012-2014	12 percent
2015-2017	14 percent
2018+	16 percent

that enhance vehicle performance, such as fast recharging, extended range, and extended warranties on batteries or fuel cells.

- **Scope** – In the initial years of the program, the ZEV requirement applies only to passenger cars and light trucks in the LDT1 category. Beginning in 2007, heavier sport utility vehicles, pickup trucks and vans will be phased into the sales figures used to calculate the ZEV requirement.

Another important change adopted by CARB in 2001 is a gradual ratcheting up of the ZEV requirement from 10 percent to 16 percent over the next two decades as shown in Table 12.

However, the ample opportunities for additional credits and multipliers available to manufacturers will significantly reduce the amount of vehicles that must be sold – particularly in the early years of the program.

Assuming that New Jersey implements the LEV II requirement beginning in 2006 – and that implementation takes place in a similar fashion as it is expected to in California – approximately 1.8 million PZEVs would be on the road in New Jersey in 2020, along with approximately 246,000 AT-PZEVs and 45,000 pure ZEVs, based on a CARB projection of how automakers will satisfy the ZEV requirement over the next 20 years.[43] (See Table 13.)

Even with the small number of pure ZEVs required by the new version of the California standards, the overall ZEV program has the potential to bring two major benefits to New Jersey. It makes possible the impressive reductions in air toxics and other pollutants called for by LEV II and it fosters the development of new technologies that can make automobiles much cleaner in the years to come.

Emission Benefits

As noted above, the ZEV requirement is separate from the overall fleet-average emissions goals set out by the LEV II standards. In other words, automakers must meet the LEV II emission targets, regardless of how many, or what type, of ZEVs they put on the road. However, LEV II's increasingly strong emissions requirements become more attainable for the rest of the vehicle fleet because of the significant number of ultra-clean cars required under the ZEV program. Between the 2004 and 2010 model years, California's fleet-average standard for non-methane organic gases is scheduled to be reduced by 34 percent for cars and LDT1s and 50 percent for LDT2-4s. Coincidentally, these are the same years when the ZEV requirement is in the process of phase-in.

Using CARB's predictions of how automakers will comply with the ZEV rule, and applying them to New Jersey, the tailpipe NMOG emissions of ZEV, PZEV and AT-PZEV vehicles on the road in the state in 2020 would be approximately 597,000 pounds, provided that all ZEV and PZEV vehicles adhere to applicable emission standards for their entire lives. The same number of vehicles meeting the anticipated fleet average for NMOG under Tier 2 would emit 4.9 million pounds.[44]

As stated in the previous section, the LEV II standards would result in a reduction of

Table 13: Estimated ZEVs and PZEVs in Use in New Jersey: 2020

	Cars	Percentage of light-duty fleet
ZEVs	45,000	0.7%
AT-PZEVs	246,000	3.9%
PZEVs	1,787,000	28.4%

7.4 million pounds of NMHC in 2020 when compared to Tier 2. ***Thus, more than half of the NMHC emissions savings gained under LEV II versus Tier 2 can be attributed to vehicles manufactured to fulfill the ZEV requirement.*** (See Table 14.)

The above analysis understates the role the ZEV requirement plays in realizing emission reductions under LEV II. First, the ZEV program's requirements for PZEVs and AT-PZEVs require that automakers certify those vehicles to the ultra-low SULEV emissions bin for 150,000 miles useful life, not 120,000. Because emission control systems degrade over time and with wear, the emission reductions generated by vehicles covered by the ZEV mandate will persist for a longer period of time than even conventional cars certified to LEV II standards.

Second, those rules also require PZEVs and AT-PZEVs to have zero fuel-related evaporative emissions, reducing diurnal-plus-hot-soak NMOG emissions by 30 percent for passenger cars and 17 to 23 percent for light-duty trucks from the levels in the LEV II standards.

In sum, the ZEV requirement, by requiring the sale of significant numbers of ultra-clean vehicles, brings the aggressive emission-reduction goals of the LEV II program within closer technological reach for the rest of the vehicle fleet. And its own particular rules for useful life and evaporative emissions result in emission reductions that would not occur were it not for the ZEV requirement.

Table 14: NMHC Emissions of Vehicles Used to Comply with ZEV Requirement vs. Comparable Tier 2 Vehicles, 2020 (in thousand pounds)[45]

	NMHC (thousand lbs.)
ZEV, PZEV, AT-PZEV emissions	597
Tier 2 vehicle emissions	4,884
Difference	4,288
Total emissions savings LEV II vs. Tier 2	7,365
Pct. of savings due to vehicles covered by ZEV requirement	**58%**

Air Toxic Pollution Associated With Zero-Emission Vehicles

One argument often lodged against ZEVs – and electric vehicles in particular – is that they create pollution upstream at power plants that use coal, oil, natural gas or nuclear fuel to generate the electricity to move the vehicles.

This argument sets up an unfair comparison with conventional vehicles. The "upstream" pollution caused by petroleum extraction, refining, storage and distribution is rarely factored into the analysis of emissions from internal combustion vehicles. Including oil spills, leaking underground storage tanks, and air emissions from refineries into a calculation of the environmental impacts of internal combustion engines would only serve to underscore the urgency of moving away from fossil fuels for transportation.

Even though electric vehicles will be partially reliant on power generated from fossil fuels, the upstream impacts they cause in New Jersey will be significantly less than those caused by even the cleanest internal combustion vehicles.

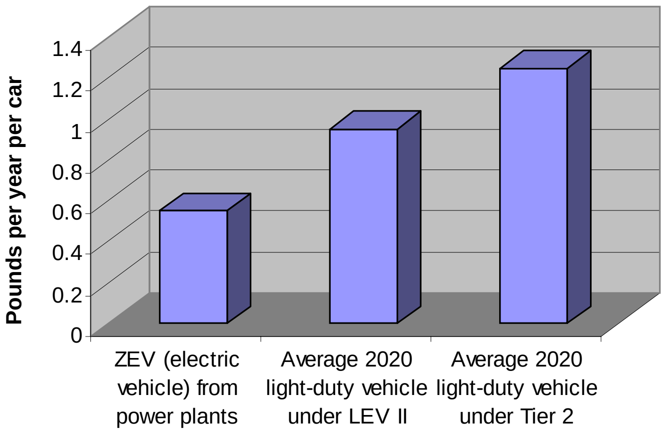
Taking the example of air toxics releases, the ZEV requirement will result in only marginal pollution from power plants. Currently, the only automobiles that are true ZEVs are powered by electricity. The ZEV standards, however, allow automakers to take "partial ZEV credits" for extremely clean vehicles powered by other technologies, including compressed natural gas, hybrid-electric motors, and methanol fuel cells. Within the near future, automakers could also be manufacturing hydrogen fuel cell vehicles that could also be considered "pure" ZEVs.

To the extent that alternate-technology vehicles release pollutants into the air as a result of combustion or chemical reactions, those emissions are regulated under LEV II. To qualify for a partial ZEV credit, vehicles using alternate technologies must certify as SULEVs and have "zero" evaporative emissions.[46]

Assuming that full-function ZEVs in New Jersey are rolled out in the state on the same schedule as in California, only three years later – and that all 45,000 of those ZEVs are powered by electricity – New Jersey would see a 0.3 percent increase in annual electricity production to power them by 2020, based on 1999 electricity sales figures and fuel consumption estimates made by the California Air Resources Board.[47]

That increase would lead to a corresponding increase of 24,700 pounds of emissions of 18 toxic chemicals into the air – a tiny fraction of the 7.8 million pounds of air toxics emitted by power plants in New Jersey in 1999. On a per-vehicle basis, using the above figures, ZEVs would be responsible for an average of 0.55 pounds of power plant-related air toxic pollution per year, versus an average of 0.95 pounds per year of air toxics emissions in 2020 for light-duty cars and trucks under the LEV II standard and 1.25 pounds under Tier 2. (See Figure 2.) For specific air toxics, the benefits are even more pronounced. ZEVs would be responsible for power plant-related emissions of 0.004 pounds per year of toluene, versus 0.38 pounds per year for the average vehicle on the road in 2020 under LEV II.

Fig. 2: Projected Air Toxics Releases Per Car in New Jersey, 2020[48]



One area of somewhat legitimate concern, however, is the possibility of an increase in emissions of particulate matter from power plants. As noted above, light-duty vehicles currently represent only a small percentage of particulate matter emissions, largely because so few of them run on diesel fuel. Coal- and oil-fired power plants, however, are significant emitters of particulate matter, and increasing demand for electricity could lead to increased emissions from those sources.

In at least two respects, however, concerns about air toxics and particulate matter releases attributable to ZEVs are likely to be overstated. First, the imposition of tougher air pollution standards, the continued shift toward natural gas for electric generation, and the potential for widespread adoption of renewable energy sources – such as solar and wind – promise to make electric power plants cleaner on a per-kilowatt-hour basis in 2020 than they are today. Second, there is growing belief that hydrogen fuel cell vehicles – not electric vehicles – will become the "pure" ZEVs of choice within the next two decades. If that were to be the case, the need for off-site generation of electricity to power vehicles would be eliminated entirely (although some electricity would be needed to produce hydrogen for vehicles).

Even in the worst case scenario, therefore, New Jersey can rest assured that the ZEV program will not simply result in the shifting of pollution from one venue to another, but rather will guarantee tangible reductions in air toxics and other pollutants.

Stimulating Technology

One of the most important benefits of the ZEV program has little to do with reducing emissions in the near term. In its 12 years in existence in California, the ZEV program has proven to be a catalyst for the development of new technologies that could make automobiles even cleaner in the years to come.

The enactment of the original ZEV program in California in 1990 led to an almost immediate spike in interest among automakers in advancing electric vehicle technology. A study conducted for CARB by researchers from the University of California-Davis found that patent applications for electric vehicle-related technologies skyrocketed beginning in 1993 after a long decline during the 1980s and early 1990s.[49] The researchers also found that spending on joint federal government/industry electric vehicle programs increased from $18 million in 1990 to $100 million in 2000.[50]

The renewed research effort had a major impact on the state of electric vehicle technology. Between 1996 and 2000, as a result of California's memorandum of agreement with the automakers, approximately 2,300 electric vehicles of seven different models took the road in California, demonstrating their viability as a transportation alternative.[51]

Other alternative technologies advanced as well. In 1999, Honda offered the first hybrid-electric vehicle, the Insight, for sale in the U.S. The "Big 3" American automakers have been working in conjunction with the federal government on a research effort to develop their own market-ready hybrids by 2003.[52] In 2001, the gasoline-powered California version of the Nissan Sentra became the first vehicle to qualify for PZEV credit. Honda's natural gas powered Civic GX has since become the first car certified for AT-PZEV credit. Other vehicles – such as the Honda Accord and Toyota Prius – have achieved SULEV status, one of the main criteria for qualifying for PZEV credit.

Hydrogen fuel cells are another technology that has recently made significant advances. Fuel cells use hydrogen to create a chemical reaction that generates electricity to power a vehicle. Fuels such as gasoline and methanol can be used to generate the hydrogen needed, or hydrogen itself can be used as a fuel. When hydrogen is used, the only "emissions" from the fuel cell are water and heat. Other base fuels generate small amounts of hydrocarbon emissions (and are thus not eligible for credit as pure ZEVs), but produce far less pollution than conventional vehicles because of their superior efficiency.

Until recent years, fuel cells have been mainly used in specialized applications such as space travel. But over the last several years, public-private partnerships at the federal level and in California have worked to bring fuel-cell vehicles to the demonstration stage. The California program, the California Fuel Cell Partnership, aims to demonstrate more than 70 fuel cell-powered cars and buses in the state by 2003.[53]

Automakers are already working toward the introduction of fuel-cell vehicles into their fleets, with Ford planning to market such a vehicle beginning in 2004, and other manufacturers planning to follow suit.[54]

The technological state of the art with regard to ZEVs and near-ZEVs is clearly far advanced from where it was when California adopted the ZEV requirement in 1990. Electric vehicles have moved from car-show concepts to daily reality for more than 2,000 Californians. Hybrid and fuel-cell vehicles have gone from the drawing board to concept development to, in the case of hybrids, mass production. California's ZEV requirement has clearly played a role in driving those technological developments.

However the California experience has not only demonstrated the effectiveness of the ZEV requirement in spurring technological innovation, it has also proven the reverse – that without a specific requirement in effect, progress toward advanced technology vehicles will languish.

In 1996, California and the seven major automakers reached an agreement that would lift the ZEV percentage requirement until 2003 in exchange for a commitment by manufacturers to produce a certain number of electric vehicles. The agreement was billed as a way to guarantee that electric cars would make their way onto California's roadways quickly, with the hope that, once established, the vehicles would gain a foothold.

What state officials did not anticipate, however, is that once the agreement expired, automakers would quickly cease producing electric cars – despite evidence of continuing consumer demand.

The decision of the automakers to stop manufacturing electric cars in the absence of a specific government mandate was a setback to the long-term success of the ZEV program. "(C)ontinuity of ZEV production is critical. Market acceptance cannot build, and volume production cannot be achieved, if ZEVs continue to be available only in boom and bust cycles," wrote CARB in a 2000 report.[55] Had CARB maintained some form of ZEV mandate for 1998 through 2003, instead of reaching a voluntary agreement with the automakers, chances are that such a "boom and bust" cycle could have been avoided.

Whether the issue is safety, the adoption of emission control technologies, or the development of advanced technology vehicles, the automobile industry has proven time and time again that it requires a strong push from state and federal agencies before it adopts practices to protect public health and safety. The ZEV requirement, then, is a necessary step to hasten the development of technologies that will make New Jersey's air cleaner for decades to come.

An Investment Worth Making

The primary argument against the ZEV requirement is that it costs too much. Automakers must spend millions to develop new technologies. And the cars that result are much more expensive than the average consumer can afford.

Because few ZEV or near-ZEV cars have yet made it into general production, there is some truth to this argument. CARB estimates that incremental costs for pure ZEVs in 2003 will range from $7,500 for city electric vehicles to more than $20,000 for freeway-capable vehicles with advanced batteries.[56] However, CARB noted that if existing electric vehicles were to be produced in volume and if gasoline prices should increase significantly (to $1.75 per gallon), the life-cycle cost of a freeway-capable electric car would begin to approach that of a conventional car.[57]

For the majority of ZEV-compliant vehicles, however, the cost picture is much better. CARB anticipates that the incremental cost of conventional PZEVs will be approximately $200, while hybrid-electric vehicles certified to AT-PZEV standards will likely cost an additional $3,200 to manufacture.[58]

To help with the purchase of ZEVs during the term of the memorandum of agreement, California provided $5,000 per car subsidies to automakers, which then applied the subsidy to their ZEV lease or deducted it from the sticker price.[59] In 2000, California passed a new law under which consumers will be eligible for grants of up to $9,000 toward the purchase of a new ZEV.[60] Consumers are also eligible for federal tax breaks that help offset the cost of purchasing alternative fuel vehicles.

There are other costs associated with ZEVs as well. Widespread use of electric vehicles will require some public charging infrastructure to augment charging stations in homes and in offices. Fuel cells that rely on hydrogen as a base fuel will require the availability of hydrogen fueling stations.

But the infrastructure costs – and vehicle costs as well – are offset by the profound environmental and economic benefits that come from a reduced dependence on fossil fuels for transportation use. Subsidizing the development and deployment of advanced technology vehicles is a sound long-term investment to reduce future costs from public health and environmental damage.

Environmentally, in addition to the reductions in emissions noted above, ZEV and near-ZEV vehicles can play a major role in reducing the incentive to drill for oil in sensitive natural areas and eliminate many of the negative "upstream" impacts of oil production, from oil spills to pollution from refineries to leaking underground storage tanks. In addition, the ZEV requirement provides incentives for manufacturers to meet higher energy-efficiency standards for zero-emission vehicles and AT-PZEVs, which can not only ease demand for oil or electricity but can also reduce emissions of greenhouse gases responsible for global warming.

The global warming benefits of the ZEV program alone make it worth consideration. An analysis produced for CARB's 2000 biennial review of the ZEV program found that electric and hybrid-electric vehicles produced the lowest emissions of carbon dioxide among seven vehicle-fuel combinations studied.[61] Hydrogen fuel cells, which were not studied, have the potential for even greater reductions in carbon dioxide emissions, provided that the hydrogen extraction process is highly energy efficient or powered with renewable energy. With the number of vehicle miles traveled expected to increase in New Jersey and elsewhere over the next two decades, the introduction of significant numbers of electric, fuel cell or extremely efficient internal combustion engines (such as hybrid electrics) will be needed to prevent further increases in carbon emissions from the light-duty fleet.

Economically, the introduction of ZEVs would cushion the economy from the impact of intermittent oil-price shocks, reduce dependence on foreign oil, and safeguard New Jersey from severe social disruption should the oil supply become significantly strained within the next two decades, as some experts predict. The development and production of ZEVs can also help spur the economy, provided that the United States acts aggressively to take leadership in this emerging market.

New Jersey is in a strong position to take economic advantage of the shift to cleaner transportation technologies. The state Department of Transportation, in partnership with local educational institutions and businesses, has helped forward fuel-cell technology through the development of two prototype fuel-cell vehicles, the New Jersey Venturer and New Jersey Genesis. Several businesses with operations in New Jersey are working to develop fuel cells for automotive and stationary applications. One of those companies, Eatontown-based Millennium Cell, recently demonstrated its unique fuel-cell system – which generates hydrogen from a chemical derived from borax – in a DaimlerChrysler minivan at an electric vehicle show in California.[62]

Finally, the adoption of the ZEV requirement can help hasten the development of alternative fuel sources for other uses – from home heating to manufacturing – bringing added stability and efficiency to those sectors as well.

A Role for New Jersey

New Jersey's adoption of LEV II and the ZEV requirement would not, in and of itself, bring about the massive technological shift described above. However, the state has a key role to play in making such a shift happen.

New Jersey is home to 3.5 percent of all passenger cars and 2.4 percent of all trucks registered in the U.S.[63] Were it to join the other states that have already adopted the ZEV requirement, the program would affect states with more than 20 percent of the nation's passenger cars.

Moreover, with New York, Massachusetts and Vermont already on board, New Jersey could help form a core northeastern block of states committed to ZEV technology. That could create a powerful incentive for other nearby states to join the program.

Finally, New Jersey has traditionally been looked toward as a national leader in dealing with environmental challenges such as water pollution and toxic chemical discharges. Adopting the ZEV requirement would reaffirm New Jersey's reputation as an environmental trend-setter, and further encourage the spread of ZEV elsewhere.

In short, because of its location, size, density and reputation for environmental leadership, New Jersey is uniquely situated to adopt a policy that would not only reap major benefits for its own citizens, but help build the solid, sustainable base of demand that will be required for ZEVs to become an economically viable alternative in the years to come.

6. POLICY RECOMMENDATIONS

New Jersey should join Massachusetts, New York and Vermont in adopting the California Low-Emission Vehicle II standards.

Adoption of the California LEV II standards and the ZEV requirement is one of the most effective steps New Jersey can take to protect citizens from the health dangers posed by air toxics, reduce the emission of smog-forming pollutants, and strengthen the state's long-term economic and environmental security.

Northeast States for Coordinated Air Use Management (NESCAUM) has estimated the changes in ambient air toxics concentrations for the northeastern states that would take place under all current and proposed federal mobile source regulations – including Tier 2. NESCAUM concluded that all those regulations, combined, would fail to meet standards for cancer risk set out by the Clean Air Act by 2030.

Adoption of the LEV II standards is a straightforward and effective way that New Jersey can move itself closer to the goal of reducing the cancer threats posed by air toxics.

New Jersey should consider other incentives for ZEV development and use.

Even under the LEV II program, it will be several years before New Jersey residents have the opportunity to purchase or own a ZEV or near-ZEV vehicle. There are several ways the state can encourage the speedy introduction of ultra-clean vehicles.

- Direct subsidies or tax credits for consumers, financed by a small surcharge on motor vehicle registrations.
- Requirements that government or public agencies purchase zero emission and alternative fuel vehicles for appropriate uses.
- Encouragement of voluntary labeling systems (such as one in Maine) that can help environmentally conscious consumers identify the cleanest cars.

We acknowledge that it may be politically difficult with the recent economic downturn to create new incentives such as direct subsidies. But it is important for state officials to realize that a thoughtful and effective approach to the introduction of ZEVs will require carrots as well as sticks. The experience of California and other states should help state officials decide what works and what doesn't in encouraging ZEV use.

Conclusion

The debate over the LEV program in New Jersey is not new. In the early 1990s, the state considered adopting it and the ZEV requirement, only to step back. The state decided to adopt LEV only if neighboring states did so, which they ultimately did not.

The last decade has only served to heighten the awareness of the dangers of air toxics, which threaten the health of millions of New Jersey residents. It has also demonstrated the viability of tight automobile emission standards and seen significant technological advances in the development of ultra-low-emission and zero-emission vehicles.

New Jersey now finds itself at a critical juncture. The state, like others that supported the NLEV program, will be eligible to adopt California emissions standards again beginning with the 2006 model year. In order to give manufacturers the necessary lead time to meet those standards, policy-makers will need to take action soon.

Now is the time for New Jersey to demonstrate leadership, as it has so often in the past on environmental issues ranging from water pollution to toxic emissions. To protect the health of its citizens, ensure long-term energy stability, and encourage a broader shift to a clean energy future, New Jersey should adopt LEV II.

APPENDIX A: METHODOLOGY AND SOURCES

Assumptions

This report is intended to calculate an estimate of anticipated reductions in toxic air pollution that would take place annually in New Jersey beginning in 2020 under the LEV II standards as opposed to federal Tier 2 emission controls. Estimates of these relative benefits – as well as other conclusions reached by this report – were derived using a simplified methodology that does not reflect all local factors that can influence vehicle emissions. It is intended as a measure of the relative policy implications of the LEV II and Tier 2 standards, not a projection of future toxic pollution in New Jersey.

Two assumptions underlie this analysis:

- **This study focused on emissions from light-duty vehicles only.** New standards for medium-duty passenger vehicles are part of the updated Tier 2 and LEV II rules. However, the rules still primarily focus on light-duty vehicles, which make up the vast majority of vehicle miles traveled in the U.S. As a result, this analysis understates the relative emissions benefits of both the Tier 2 and LEV II programs.
- **This study assumes that no light-duty vehicles are powered by diesel.** This assumption is largely true at present, because diesel-powered vehicles make up less than one percent of overall car and light truck sales. However, as noted earlier, the EPA projects that light-duty diesel vehicles could increase to as much as 9 percent of all new car sales and 24 percent of all light truck sales by 2015 under one scenario.

  Because these projections of future diesel penetration of the light-duty fleet are highly speculative – and because the use of diesel fuel results in a different mix of air toxics emissions than gasoline, introducing a complicating factor to the analysis – this study assumed that the light-duty fleet on the road in 2020 will continue to be gasoline-powered vehicles.

Emissions Estimation

Overall NMHC Emissions

Estimates of relative reductions in non-methane hydrocarbon (NMHC) emissions are based on emissions factors calculated by Cambridge Systematics in their analysis for the Massachusetts DEP, which were in turn derived from EPA's Tier 2 and MOBILE5b models. This method has the limitation of being based on climactic and driving patterns that differ slightly from those in New Jersey. It is also based on the assumptions (true in Massachusetts) a) that LEV II standards will be implemented beginning in 2004, not 2006 as would be the case in New Jersey, and b) that the LEV I program, rather than the NLEV and Tier 1 programs, was in effect for vehicles sold prior to the 2004 model year. Because light-duty vehicles manufactured prior to 2006 are anticipated to represent only about 5 percent of vehicle-miles traveled in 2020, the impact of these assumptions was deemed to be small, but they will tend to slightly exaggerate the differences between LEV II and Tier 2 when applied to New Jersey. Finally, EPA has recently issued a new emissions modeling program – MOBILE6 – that supersedes MOBILE5b and the Tier 2 model. Time and resource limitations prevented the inclusion of MOBILE6 in this analysis.

Overall emissions were calculated by multiplying the total light-duty VMT projected for 2020 for each vehicle class (as derived below) by the applicable emission factor for that class.

Air Toxics

Estimated emissions of individual air toxics were calculated by converting total estimated NMHC emissions into estimated NMOG emissions, then multiplying by speciation percentages in EPA's Speciate database. The speciation profiles chosen were profile #1313 for tailpipe emissions and profile #1305 for evaporative emissions. Both profiles are based on 1990 baseline gasoline. No attempt was made to account for differences in speciation profiles based on the use of oxygenated or reformulated gasoline.

In both profiles, the total organic gas (TOG) percentages in the EPA's speciation model were converted to NMOG by eliminating the methane portion of the profile. In addition, the profiles were used to estimate an NMHC to NMOG conversion factor based on the percentage of TOG represented by non-hydrocarbon organic gases (alcohols, ethers, ketones and aldehydes). This factor was 1.027 for exhaust and 1.030 for evaporative emissions. NMHC emissions were multiplied by the conversion factor, and then by the percentages in the NMOG portion of the speciation profile to derive individual air toxics emissions.

Volatile Organic Chemicals

Speciation profiles were also employed to derive a NMOG to VOC conversion factor, by calculating the percentage of NMOG represented by compounds exempted by the EPA from its definition of VOCs per Code of Federal Regulations 40 CFR 51.100(s)(1). This factor was found to be 0.971 for exhaust and 1.0 for evaporative emissions. The factor was then multiplied by total NMOG emissions to derive total VOC emissions.

Number of Cars Taken Off the Road

An estimate was made of the number of vehicles on the road in 2000 that would be taken off the road to equal the additional air toxics pollution reductions in LEV II over Tier 2. The "car" used for this comparison is an average light-duty passenger car on the road in 2000 with emissions equivalent to the emission factors for the 2000 fleet in Cambridge Systematics' analysis. The per-mile emission levels were then multiplied by the estimated number of vehicle-miles traveled by a light-duty car in 2020 per the methodology below, and then the chemical speciation profiles listed above, to arrive at a per-car amount of air toxics emissions. The total air toxics reductions under LEV II were then divided by this per-car amount to arrive at the number of cars that would be taken off the road.

Fleet Characteristics and Vehicle Miles Traveled

Unless otherwise noted, fleet and vehicle miles traveled data attributed to the EPA are from "Fleet Characterization Data for MOBILE6: Development and Use of Age Distributions, Average Annual Mileage Accumulation Rates and Projected Vehicle Counts for Use in MOBILE6," published April 1999.

The total number of light-duty vehicles in use in 2020 in the state was determined by taking the national in-use vehicle fleet estimates from EPA and multiplying them by the percentage of U.S. cars and trucks registered in New Jersey in 2000 per Ward's Automotive Yearbook 2001. The number of light-duty trucks in each class was determined by multiplying the total number of light-duty trucks by ratios of truck classes established by EPA for MOBILE6.

Vehicle counts were further broken down by model year using age distribution percentages for each vehicle class established by EPA.

Vehicle miles traveled data are based on the estimate of 47-state VMT for 2020 prepared by EPA corrected to take account for VMT in Alaska, California and Hawaii. Total VMT was then disaggregated into VMT by vehicle subgroupings (LDV, LDT1/2 and LDT3/4) using ratios in worksheet T2MODAQA of EPA's Tier 2 model, and further broken down into individual vehicle classes using the vehicle stock splits in EPA's MOBILE6 fleet characterization data.

Two correction factors were applied to determine what portion of VMT should be applied to vehicles of each model year and to account for different driving habits at the state versus national level.

A vehicle age factor was applied consisting of the vehicle mileage accumulation rates developed by EPA divided by the average VMT per vehicle for 1996 per Ward's Automotive Yearbook 2001.

A state correction factor was applied consisting of the average VMT per vehicle for the state in 1999 divided by the national average VMT for 1999 (per Ward's and the "Highway Statistics 1999" published by the U.S. Department of Transportation).

The result was a state-specific estimate of the number of miles traveled per vehicle by vehicles in each class and each model year for the year 2020. This number was then multiplied by the estimated fleet composition numbers to arrive at the total number of VMT traveled by vehicles in each class and each model year during 2020.

ZEV Program Analysis

Because the emission factors generated from the Massachusetts DEP modeling encompass the overall impact of the LEV II rules, a separate model was constructed to estimate the relative impact of the ZEV requirement within the LEV II program. This model was used to project the contribution made by the ZEV program to overall LEV II emissions reductions, the amount of air toxics released by power plants to fuel ZEVs, and the additional evaporative emissions benefits of the "zero" evaporative emission standard in the ZEV program.

Estimates of tailpipe emissions for ZEV-compliant vehicles were obtained by multiplying the estimated VMT of vehicles in each model year and class in 2020 by the applicable standard. A similar calculation was performed for Tier 2 vehicles, multiplying VMT by Cambridge Systematics' inference of grams/mile NMOG emissions based on 120,000 miles useful life, in its analysis for the Massachusetts DEP. This method will tend to underestimate emissions from both ZEV-compliant and Tier 2 vehicles.

Estimates of the amount of electric power needed to operate ZEVs were derived by multiplying the average VMT per LDV in 2020 by the number of ZEVs on the road that year (as calculated based on CARB's projection of how automakers will implement the ZEV requirement) and an estimated average energy efficiency of 0.5 kW per mile per CARB's 2000 ZEV biennial review. Per-kilowatt-hour toxic emissions levels were derived by taking the total toxic emissions for electric power plants in the state from the 1999 EPA Toxics Release Inventory and dividing that number by the number of kilowatt-hours of electricity sold in the state in 1999 per the Energy Information Administration's Annual Electric Utility Report. Total electricity consumption of ZEVs on the road in the state in 2020 was then multiplied by the per-kilowatt-hour toxic emissions data to arrive at the amount of toxic pollution from power plants resulting from ZEVs.

APPENDIX B: GLOSSARY OF ABBREVIATIONS

ALVW – Adjusted loaded vehicle weight (average of gross vehicle weight and actual vehicle weight).

AT-PZEV – Advanced technology partial zero-emission vehicle. Class of ultra-clean vehicles under California standards that run on alternative fuels.

CARB – California Air Resources Board.

CO – Carbon monoxide.

GVW – Gross vehicle weight (maximum design loaded weight).

HAP – Hazardous air pollutant. Also known as air toxics.

HLDT – Heavy light-duty truck.

I/M – Inspection and maintenance programs.

LDV – Light-duty vehicle (i.e. passenger car).

LDT – Light-duty truck.

LEV – Low-Emission Vehicle program adopted in California in 1990. Also, the dirtiest bin to which vehicles may be certified under the LEV II standards.

LEV II – Low-Emission Vehicle program adopted in California in 1999.

LLDT – Light light-duty truck.

LVW – Loaded vehicle weight (vehicle weight plus 300 pounds).

MDPV – Medium-duty passenger vehicle.

NLEV – National Low-Emission Vehicle program adopted as a result of voluntary agreement between automakers, state governments and the EPA.

NMHC – Non-methane hydrocarbons. Category of emissions that includes many air toxics. Includes most of the NMOG category, but not aldehydes, ketones, alcohols and ethers

NMOG – Non-methane organic gas. Category of emissions that includes many air toxics. Includes non-methane hydrocarbons and other organic gases such as aldehydes, ketones alcohols and ethers.

NOx – Nitrogen oxides, a major precursor of smog.

OTC – Ozone Transport Commission. A group of northeastern states formed by Clean Air Act of 1990 to promote coordinated smog-reduction policies.

PC – Passenger car.

PM – Particulate matter, a toxic air pollutant.

PZEV – Partial zero-emission vehicle. Class of ultra-clean vehicles under California standards that may include vehicles run by internal combustion or other engines.

SULEV – Super low-emission vehicle. A certification bin under the LEV II standards that is cleaner than ULEV but not as clean as ZEV. AT-PZEVs and PZEVs must meet SULEV emission standards.

ULEV – Ultra-low-emission vehicle. A certification bin under the LEV II standards that is cleaner than LEV but not as clean as SULEV.

VOC – Volatile organic compounds. Organic compounds that evaporate into the air. Includes many air toxics.

VMT – Vehicle miles traveled.

ZEV – Zero-emission vehicle.

APPENDIX C: EPA LIST OF REGULATED MOBILE SOURCE AIR TOXICS

Acetaldehyde
MTBE
Acrolein
Ethylbenzene
Naphthalene
Arsenic Compounds
Formaldehyde
Nickel Compounds
Benzene
n-Hexane
Polycyclic Organic Matter[i]
1,3-Butadiene
Lead Compounds
Styrene
Chromium Compounds
Manganese Compounds
Toluene
Dioxin/Furans
Mercury Compounds
Xylene

[i] Polycyclic Organic Matter includes organic compounds with more than one benzene ring, and which have a boiling point greater than or equal to 100 degrees centigrade. A group of seven polynuclear aromatic hydrocarbons, which have been identified by EPA as probable human carcinogens.

Source: Federal Register: March 29, 2001 (Volume 66, Number 61), pages 17229-17273.

APPENDIX D: EMISSION FACTORS FOR TAILPIPE AND EVAPORATIVE NMHC EMISSIONS

Cumulative fleet emission factors for tailpipe and evaporative NMHC emissions in 2020 in grams/mile.

	Tier 2		LEV II	
	Tailpipe	Evaporative	Tailpipe	Evaporative
LDV	0.097	0.119	0.059	0.102
LDT 1/2	0.107	0.110	0.076	0.099
LDT 3/4	0.211	0.132	0.180	0.121

Source: "Background Document and Technical Support for Public Hearings on the Proposed Amendments to the State Implementation Plan for Ozone and Public Hearing and Findings Under the Massachusetts Low Emission Vehicle Statute," Massachusetts Department of Environmental Protection, October 1999.

NOTES

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2. Based on draft 1996 data from U.S. Environmental Protection Agency, National-Scale Air Toxics Assessment, downloaded from http://www.epa.gov/ttn/atw/nata/pdf/nj_emis.pdf, 27 December 2001.
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6. Michelle Toering and Rob Sargent, "Every Breath We Take: How Motor Vehicles Contribute to High Levels of Toxic Air Pollution in Massachusetts," MASSPIRG Education Fund, 8 July 1999.
7. "Coalition of Environmental Organizations and States Sue EPA on Inadequate Mobile Source Toxics Rule," press release, 24 May 2001. Downloaded from www.nescaum.org.
8. Madsen and Vasavada, 32.
9. U.S. Environmental Protection Agency , "Milestones in Auto Emissions Control," Fact Sheet OMS-12, August 1994; U.S. Environmental Protection Agency, "The History of Reducing Tailpipe Emissions," publication EPA420-F-99-017, May 1999; California Air Resources Board, "California's Air Quality History – Key Events," downloaded from http://www.arb.ca.gov/html/brochure/history.htm, updated 21 April 2000.
10. Maine adopted the LEV program, but has since repealed the ZEV requirement.
11. Michael Walsh, "California's Low Emission Vehicle Program Compared to U.S. EPA's Tier 2 Program," 20 January 2000, 1.
12. Anne G. Dillenbeck, "Driving Clean Transportation: LEVII: A Policy that Works," INFORM, 2000, 8.
13. U.S. Environmental Protection Agency, "Tier 2 Study White Paper," April 1997, downloaded from http://www.epa.gov/oms/t2paper.htm; Walsh, 4.
14. Walsh, 28-29.
15. Federal Register, Vol. 65, No. 28, 10 February 2000, 6855.
16. Walsh, 9. The LEV II NMOG fleet averages are measured at 50,000 miles rather than 120,000 miles useful life.
17. Walsh, 7.
18. LEV II allows manufacturers to certify up to four percent of their LDT2-4 fleet to a higher NOx standard of 0.10 g/mi.
19. From VMT fractions included in EPA's Tier 2 model, spreadsheet T2MODAQA.XLS.
20. New York State Department of Environmental Conservation, "Federally Mandated Emissions Test Begins Jan. 2 Upstate," press release, 11 December 1997.
21. Dr. John Holtzclaw, "Traffic Calming Cleans," Sierra Club, downloaded from http://www.sierraclub.org/sprawl/articles/hwyemis.asp, 6 September 2001. Based on CARB data; Great Lakes Commission, "Scope Study for Expanding the Great Lakes Toxic Emission Regional Inventory to Include Estimated Emissions from Mobile Sources," Chapter 4-1, downloaded from http://www.glc.org/air/scope/scope006.htm, 5 September 2001.
22. Walsh, 18.
23. Massachusetts Department of Environmental Protection, "Background Document and Technical Support for Public Hearings on the Proposed Amendments to the State Implementation Plan for Ozone and Public Hearing and Findings Under the Massachusetts Low Emission Vehicle Statute," October 1999.
24. New York State Department of Environmental Conservation, "Regulatory Impact Statement Summary," Amendments to 6 NYCRR Part 218, 2000, 4.
25. Walsh, 37.

26. Walsh, 18, 31.

27. The chemical composition of vehicle exhaust varies greatly depending on the vehicle and the type of fuel used. The speciation profiles used in this analysis are based on 1990 baseline gasoline and do not account for the use of oxygenated or reformulated gasoline. The results presented here are intended to be suggestive of the air toxics reductions that could be expected under LEV II.

28. Estimate of "average car" toxic emissions based on applying speciation profile to a typical light-duty vehicle on the road in 2000 whose emissions were calculated using 2020 vehicle-miles traveled projections.

29. U.S. Environmental Protection Agency, "Tier 2/Sulfur Regulatory Impact Analysis," December 1999, III-36.

30. U.S. Environmental Protection Agency, "Tier 2/Sulfur Regulatory Impact Analysis," December 1999, III-39.

31. The NMOG standards for the ULEV bin under LEV I are 0.055 g/mi for LDVs and LDT1s; 0.07 for LDT2s; 0.143 for LDT3s; and 0.167 for LDT4s, compared to an anticipated fleet average under Tier 2 of 0.09 g/mi. The NOx standards are 0.3 g/mi for LDVs and LDT1s; 0.5 for LDT2s; 0.6 for LDT3s; and 0.9 for LDT4s, compared with the 0.07 g/mi fleet average standard under Tier 2. From Walsh, 5-6.

32. California Air Resources Board, "Staff Report: Initial Statement of Reasons: Proposed Amendments to California Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles," 18 September 2001, II-55.

33. California Air Resources Board, "Staff Report: Initial Statement of Reasons: Proposed Amendments to California Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles," 18 September 2001, II-54.

34. Csaba Csere, "10 Best Cars," *Car and Driver*, January 2001.

35. U.S. Environmental Protection Agency, "Tier 2/Sulfur Regulatory Impact Analysis," December 1999, Executive Summary, v.

36. ibid, vii.

37. Walsh, 13.

38. State of New York, "Governor: Regulation to Reduce Harmful Vehicle Emissions," press release, 4 January 2002.

39. The emissions model used to calculate the air toxics reductions in this report is based on the former version of the California ZEV requirement. In adopting the 2001 amendments, CARB determined that the two sets of standards have an equivalent impact on emissions. Source: California Air Resources Board, "Summary of Board Meeting, January 25, 2001."

40. In this case, "zero" evaporative emissions refers to emissions from fuel. Hydrocarbon evaporative emissions also come from other sources, including paint, adhesives, air conditioning refrigerants, vinyl, tires, etc. Passenger cars releasing less than 0.35 grams/test, LLDTs releasing less than 0.65 grams/test, and HLDTs releasing less than 0.9 grams/test in evaporative emissions meet the "zero" evaporative emission requirement under California standards. Sources: California Air Resources Board, "California Evaporative Emission Test Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles," I.E.1(2), adopted 5 August 1999. Harold M. Haskew et al, "Running Loss Emissions from In-Use Vehicles," Coordinating Research Council, February 1999, 3.

41. California Air Resources Board, "Zero Emission Vehicle Program Changes," Fact Sheet, 23 February 2001.

42. ibid

43. Based on California Air Resources Board, "Fleet Implementation Schedule," downloaded from http://www.arb.ca.gov/regact/zev2001/zev2001.htm, 27 December 2001. Percentages of ZEV, AT-PZEV and PZEV vehicles in use for each model year based on CARB's estimate of total number of ZEV-compliant vehicles sold in each model year divided by total sales base covered by the ZEV requirement in each model year. This percentage is then applied to the fleet composition projection derived from the methodology outlined in Appendix A. Note: CARB assumes that even though LDT2-4s are counted toward the ZEV requirement beginning in 2007, manufacturers will choose to comply with the requirement by selling additional numbers of ZEV-compliant LDVs and LDT1s. The remainder of this section reflects this assumption.

44. The model used to calculate emissions from ZEV program-compliant and Tier 2 vehicles differs from the model used in the rest of this report in that it is based on compliance with emission standards and not the results of emission factor modeling. Because a large proportion of real-world hydrocarbon emissions come from vehicles that, due to age or malfunction, do not meet established standards, this method will tend to significantly underestimate actual emissions from both ZEV-compliant and Tier 2 vehicles. However, because ZEV-compliant vehicles must have their emissions certified for a longer useful life (150,000 miles as opposed to 120,000 miles under Tier 2), and because a significant number of those vehicles will likely be powered by fuel sources (such as electricity and fuel cells) that are not subject to the effects of fuel or emission system degradation, it is more likely that ZEV-compliant vehicles will comply with emission standards over the long haul. Thus, this method likely provides a fair portrayal of the role of the ZEV program in overall emission reductions under LEV II, and may even underestimate that role. Note: because this analysis is based on certification standards communicated in NMOG, that measure is used here and subsequently in this section of the report.

45. Values of ZEV and Tier 2 emissions calculated in terms of NMOG.

46. California Air Resources Board, "ARB Fact Sheet: Zero Emission Vehicle Program Changes," 23 February 2001.

47. In its 2000 biennial review, CARB estimated the typical efficiency of current battery electric vehicles at 400 to 500 Watts/hour. This analysis uses the high end of that range.

48. Comparisons of the quantity of air toxics released by different modes of power generation provide only a very limited picture of their relative impact on the environment. Coal and oil-fired power plants and gasoline-powered vehicles produce vastly different mixes of toxic chemicals, the health impacts of which cannot be easily compared.

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56. ibid

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63. Ward's Communication, "Ward's Automotive Yearbook 2001," 286, 287.