Report to Congress

Operation of Neighborhood Electric Vehicles (NEVs) on Roadways with a Maximum Speed Limit of 40 mph (64 kph): Fuel Consumption Savings and Safety Ramifications

Office of the Secretary

U.S. Department of Transportation

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Table of Contents

Exhibits

EXECUTIVE SUMMARY

This report responds to a request, through the Conference Report accompanying the FY 2009 Omnibus Appropriations Act (PL 111-8), for the Secretary of Transportation, in consultation with the National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration (FHWA), to evaluate the fuel consumption and safety ramifications associated with expanded use of Neighborhood Electric Vehicles (NEVs) on roadways with a maximum speed limit up to 40 miles per hour (64 kilometers per hour).

NEVs are currently regulated by Federal motor vehicle safety standard (FMVSS) No. 500; *Low-speed vehicles*,[1] which establishes a minimum level of required safety equipment for NEVs. In adopting these minimal requirements, NHTSA cited the 25 mph (40 kph) maximum speed of these vehicles under the standard, as well as their intended limited use in controlled driving environments. Since then, more than half of the states have permitted the operation of NEVs on roadways with speed limits up to 35 mph (56 kph).

This Congressional request focuses on two key elements of the Department of Transportation's mission, reducing national fuel consumption and assuring the safety of the motoring public. Any reduction in the nation's fuel consumption is desirable, no matter the size. The Department therefore welcomes expanded use of NEVs in appropriate circumstances. However, the Department cannot encourage NEV use on mixed traffic roads with vehicles heavier than NEVs that travel at speeds above the maximum speed of NEVs, at least not while only minimal safety requirements apply to NEVs.

On several occasions, both prior to and since taking office, President Obama has announced this Administration's goal of putting one million advanced technology vehicles, including electric vehicles, on the road by 2015. Increasing the use of NEVs under conditions where they can operate safely can be a step, albeit a small one, toward meeting that goal.

Key Findings

A Substantial Increase in the Number of NEVs in Use and Their Annual Miles Driven is Needed Before Significant Additional Fuel Consumption Savings Would Occur – Data on NEV use, such as average annual vehicle miles driven per NEV, is limited. The U.S. Department of Energy estimates there are approximately 45,000 NEVs in use in the United States. Estimates of annual average fuel consumption savings depend on estimates of annual NEV miles traveled, gasoline saved per NEV mile driven, and the percentage of NEV miles that are assumed to replace gasoline vehicle miles. Because of the significant range for each of these variables, we put the current annual fuel consumption savings from NEV use at

[1] As used in this report, the term "neighborhood electric vehicle" ("NEV") and the term "low speed vehicle" ("LSV") are very similar terms. The terms differ only in that not all low speed vehicles are electric. This issue is explained further in the background section of the report. NEVs should not be confused with larger, higher speed electric vehicles (EVs) or hybrid electric vehicles (HEVs), which must comply with all applicable FMVSSs.

between 1.4 million and 7.6 million gallons. We calculated projected fuel consumption savings under several scenarios involving increases in NEVs in use and increases in the average annual miles driven by NEVs. Even in a scenario of 1 million NEVs in use with each driving an average of 10,000 miles annually, the estimated gasoline saved would be less than half of one percent of the approximate current total annual U.S. gasoline consumption.

We also note that the estimates above do not account for energy consumed by NEVs. Accounting for that energy in the form of equivalent gallons of gasoline substantially reduces the estimated fuel consumption savings resulting from NEV use. To realize significant fuel consumption savings, drastic increases would need to occur in both the number of NEVs in use and the average annual miles driven per NEV, currently at between 1,000 and 3,500 miles per year based on available information.

Federal Motor Vehicle Safety Standards That Do Not Apply to NEVs Account for a Significant Number of Lives Saved in Crashes on Roads With Speed Limits Up to 40 mph – While NEV-specific crash data is limited, we note that overall crash data indicate a significant percentage of deaths and injuries occur in crashes on roads with speed limits up to and including 40 mph (64 kph). Between 2005 and 2009, an annual average of 3,931 people were killed on roads with posted speed limits of 30 mph (48 kph) or less, and an annual average of 6,778 were killed in crashes on roads with posted speed limits of 35 or 40 mph (56 or 64 kph). A NHTSA analysis of crashes on similar roads indicates that a substantial number of lives have been saved as a result of equipment on conventional passenger motor vehicles that is required by the FMVSSs that do not apply to NEVs. NHTSA estimates that in 2005 on roads posted at 35 mph (56 kph) or lower, 1,921 crash victims survived because the vehicles were compliant with all FMVSSs; including 278 lives saved by air bags. In crashes that year on roads posted at 45 mph (72 kph) or lower, NHTSA estimates that 3,163 lives were saved because the vehicles involved were compliant with all FMVSSs. Of those, 414 were saved by air bags.

Crash Tests Show NEV Occupants at Elevated Risk of Injury or Death in Crashes – While the U.S. government has not conducted crash tests on NEVs, we note that the Insurance Institute for Highway Safety (IIHS) and the Canadian government have done so. IIHS conducted two different side crash tests on LSVs at 31 mph (50 kph), with results suggesting serious or fatal injury for occupants of the NEVs tested. In July 2008, the Canadian government released video of two crash tests it conducted on NEVs, one a frontal crash into a rigid barrier at 40 kph (25 mph), the other a crash of a "microcar" into the side of an LSV at 50 kph (31 mph). It found projected elevated injury risk for occupants of NEVs similar to what was found by IIHS.

The Reduced Safety Requirements that Currently Apply to NEVs May Need to be Upgraded Substantially if Additional NEVs are Operated on Mixed Use (Up to 40 mph) Roads – Based on our review of the available data and the rationale cited for not requiring

NEVs to meet the full set of FMVSSs, including those involving occupant crash protection, we believe the current requirements in FMVSS No. 500 are insufficient for vehicles operating on mixed use roadways with speed limits up to 40 mph (64 kph). Therefore, in order to safely account for expanded use of NEVs, it likely would be necessary to require these vehicles to meet a larger number, or the entire set of FMVSSs, including those that involve crash performance.

SECTION I BACKGROUND

In the Conference Report accompanying the FY 2009 Omnibus Appropriations Act (PL 111-8), the Secretary of Transportation was directed as follows:

> "The Secretary in consultation with the Federal Highway Administration and National Highway Traffic Safety Administration shall conduct a study of the fuel consumption savings and safety ramifications generated by the expanded use of Neighborhood Electric Vehicles, as defined by Federal Motor Vehicle Safety Standard No. 500 (49 CFR 571.500), on roadways with a maximum speed limit of 40 miles per hour."

As directed by Congress, the Federal Highway Administration (FHWA) and the National Highway Traffic Safety Administration (NHTSA) were consulted in developing this response to Congress.

NHTSA's mission is to save lives, prevent injuries, and reduce economic costs due to road traffic crashes through education, research, safety standards and enforcement activity. NHTSA is responsible for establishing and enforcing Federal motor vehicle safety standards (FMVSS), including FMVSS No. 500, which applies to Neighborhood Electric Vehicles (NEVs). NHTSA also establishes and enforces the Corporate Average Fuel Economy (CAFE) standards for passenger cars and light trucks under the Energy Policy and Conservation Act of 1975 (EPCA), as amended by the Energy Independence and Security Act of 2007 (EISA). The overarching purpose of EPCA/EISA is to conserve energy by reducing fuel consumption.

FHWA's mission is to improve mobility on our Nation's highways through national leadership, innovation, and program delivery. FHWA is active in safety areas of interest relative to NEVs, including roadway design and usage.

Regulatory Status of Neighborhood Electric Vehicles (NEVs)

FMVSS No. 500 establishes a category of vehicles known as low speed vehicles (LSVs), which are defined as follows:

> Low-speed vehicle (LSV) means a motor vehicle,
>
> (1) That is 4-wheeled,
>
> (2) Whose speed attainable in 1.6 km (1 mile) is more than 32

kilometers per hour (20 miles per hour) and not more than 40 kilometers per hour (25 miles per hour) on a paved level surface, and
(3) Whose GVWR is less than 1,361 kilograms (3,000 pounds).[2]

NEVs are not defined. However, the preamble to the final rule[3] establishing FMVSS No. 500 contains a glossary with the following two definitions:

> "Neighborhood electric vehicle" means any 4-wheeled electric vehicle whose top speed is not greater than 25 miles per hour. Some of these vehicles look more like a passenger car than a conventional golf car.
>
> "Low-speed vehicle" means any 4-wheeled motor vehicle whose top speed is greater than 20 miles per hour, but not greater than 25 miles per hour. This group includes neighborhood electric vehicles, and speed-modified golf cars, whose top speed is greater than 20 miles per hour, but not greater than 25 miles per hour.

These definitions make clear that NEVs are a type of LSV, and are thus regulated by FMVSS No. 500.

Requirements of FMVSS No. 500

FMVSS No. 500, a complete copy of which is provided in Appendix A, establishes a minimum set of safety requirements for LSVs (including NEVs) that is substantially below what is required of conventional passenger motor vehicles. NEVs are thus required to have the following:

(1) Headlamps,

(2) Front and rear turn signal lamps,

(3) Taillamps,

(4) Stop lamps,

(5) Reflex reflectors: one red on each side as far to the rear as practicable, and one red on the rear,

(6) An exterior mirror mounted on the driver's side of the vehicle and either an exterior mirror mounted on the passenger's side of the vehicle or an interior mirror,

(7) A parking brake,

(8) A windshield that conforms to the Federal motor vehicle safety standard on glazing materials (49 CFR 571.205).

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[2] 49 CFR 571.3(b)
[3] 63 FR 33194

(9) A VIN that conforms to the requirements of part 565 *Vehicle Identification Number* of this chapter, and

(10) A Type 1 or Type 2 seat belt assembly conforming to Sec. 571.209 of this part, Federal Motor Vehicle Safety Standard No. 209, *Seat belt assemblies,* installed at each designated seating position.

Among the many FMVSSs that apply to conventional passenger motor vehicles, but not to NEVs, are FMVSS No. 208; *Occupant crash protection* and FMVSS No. 214; *Side impact protection.* Both require that conventional passenger motor vehicles meet certain performance criteria when the vehicles are crashed according to specified test procedures. No crash testing is currently required of NEVs. Other FMVSSs assure a level of protection for drivers and occupants of conventional passenger motor vehicles when those vehicles are struck from the rear or when they are involved in a rollover crash. Likewise, NEVs are not subject to a recently issued final rule on ejection mitigation.

The Rationale for FMVSS No. 500

From the January 8, 1997 notice[4] that first proposed a separate FMVSS for LSVs to a September 26, 2008 denial of a petition[5] to create another class of vehicles that would have been known as "medium speed vehicles" and in several related notices in between, NHTSA has been consistent in its rationale for FMVSS No. 500. The two primary and unique aspects of NEVs that support separate treatment under FMVSSs are the fact that they cannot achieve speeds in excess of 25 mph (40 kph) and they operate primarily in carefully controlled environments with low posted speed limits (i.e., 25 miles per hour or less) rather than in mixed traffic encountered on public streets, roads, and highways or in higher speed traffic. NHTSA has also previously stated that even under these circumstances, should data or anecdotal information arise that suggests that there is a safety issue relating to the operation of NEVs, NHTSA would take steps to issue additional requirements to improve the safety of these vehicles. This would include possibly making LSVs subject to the same FMVSSs that apply to conventional passenger motor vehicles. A thorough discussion of NHTSA's previous comments in this area during the process of adopting FMVSS No. 500 appears later in this report in "Section III Safety Ramifications."

State Laws Related to NEV Use on Higher Speed Limit Roads

The Congressional request to the Secretary implies that allowing NEVs to operate on roadways with a maximum speed limit of 40 mph (64 kph) would encourage the use of NEVs on longer, but still local trips. For example, in addition to using an NEV to get to the golf course or pool in a retirement community, an individual might also use his or her NEV to travel to a nearby shopping center outside of the retirement community to do grocery or other shopping. A user might also travel several miles to another part of the municipality or even to a different municipality to visit a friend.

[4] 62 FR 1077
[5] 73 FR 55804

The request also suggests a potential change involving expanded operation of NEVs on roadways with a speed limit above NEVs' 25 mph (40 kph) maximum speed, which we note is outside the conditions envisioned by NHTSA in adopting minimal safety requirements for these vehicles.

Speed limits and other conditions under which vehicles are permitted to operate on public roads are the jurisdiction of the states and localities in which those roads are located. A chart prepared by the Insurance Institute for Highway Safety (IIHS) and posted on the institute's web site[6] indicates:

- four states allow NEVs to operate on roads with speed limits up to 30 mph (48 kph);
- 33 states already allow NEVs to operate on roads with speed limits up to 35 mph (56 kph) and Nebraska passed similar legislation[7] earlier this year;
- Texas allows NEV operation on roads with speed limits up to 45 mpg (72 kph);
- two states and the District of Columbia allow the operation of NEVs on roads on which a low speed vehicle would not impede the normal and reasonable movement of traffic; and
- four states have no state law on the subject.

The various approaches in the remaining five states are:

- allowing NEVs on roads with a posted speed limit of 25 mph (40 kph) or less with a state commissioner empowered to permit use on specified roads with a posted speed limit between 25 mph (40kph) and 35 mph (56 kph);
- limiting NEV use to 25 mph (40 kph) roads on a specific island from 6:00 a.m. to 6:00 p.m.;
- permitting NEV use on 25 mph (40 kph) or less roads within the corporate limits of a municipality;
- allowing local ordinances to permit NEV use on roads with a posted speed limit of 35 mph (56 kph) or less;
- allowing NEV use on non-interstate highways on which the NEV can achieve the maximum speed limit of the highway; and

In many states, therefore, NEV users are permitted to venture further from the low speed, controlled environments envisioned by NHTSA in its LSV rulemakings as being appropriate for NEV operation and in which, in fact, most NEVs seem to usually operate. While there are a limited number of states in which it is possible to operate NEVs on roads with speed limits of 40 mph or higher, there are many states in which the operation of NEVs on roads with a 35 mph speed limit is allowed. It can be assumed that most 35 mph roads have some degree of mixed

[6] www.iihs.org/laws/LowSpeedVehicles.aspx
[7] www.legislature.ne.gov

traffic. As will be discussed later in this report, there is no evidence that NEVs are being operated to any great degree on roads with speed limits of 35 mph.

Another issue addressed by state laws is whether or not NEVs are allowed to cross roads with higher speeds. Thirty states allow NEVs to cross roads with higher speeds with most requiring that they cross at intersections.[8]

NEVs Currently in Use in the United States

A report by the U.S. Department of Energy (DOE) released in April 2010 estimated the total number of low speed electric vehicles (in essence, NEVs) in use in the United States at 44,842 as of 2008. According to the DOE report, this represents 99.8 percent of the low speed vehicles (LSVs) currently in use, which means that virtually all LSVs in the United States are NEVs.[9]

(While most references in this report are to NEVs, we note that in some instances we refer to LSVs as this term is consistent with the regulatory language used in FMVSS No. 500, the Federal motor vehicle safety standard that applies to NEVs, and related public notices.)

Increased NEV Use: How Much, How Soon?

Growth in the number of NEVs in use in the United States has been steady, but slow.

The DOE reports that the number of vehicles using electricity as their power source, which includes NEVs, grew from 1,607 in 1992 to 56,901 in 2008.[10] Most of the 56,901 electric vehicles in 2008 were NEVs (44,842).

If the ratio of NEVs to the total number of electric vehicles has been essentially the same from 1992-2008, then the growth in the number of NEVs in use has been slow and steady, but not dramatic. This is supported by the growth in the number of electric vehicles in just the years 2004-2008. The number of electric vehicles in use in those years was 49,536 (2004), 51,398 (2005), 53,526 (2006), 55,730 (2007), and 56,901 (2008), which again reflects slow and steady growth.

[8] For detailed discussions of state laws relating to NEVs, See "OLR Research Report No. 2008-R-0432, Low Speed Electric Vehicles," by James J. Fazzalaro, August 8, 2008 at http://www.cga.ct.gov/2008/rpt/2008-R-0432.htm and "Impacts of Low-Speed Vehicles on Transportation Infrastructure and Safety," Oregon Transportation Research and Education Consortium, OTREC-RR-10-19, December, 2010 at http://www.trb.org/Main/Blurbs/Impacts_of_LowSpeed_Vehicles_on_Transportation_Inf_164695.aspx?utm_medium=etmail&utm_source=Transportation%20Research%20Board&utm_campaign=TRB+E-Newsletter+-+02-01-2011&utm_content=Customer&utm_term=

[9] See "Alternatives to Traditional Transportation Fuels 2008," April 2010, U.S. Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, U. S. Department of Energy, Table V5: Estimated Number of Alternative Fueled Vehicles in Use, by Weight Class, Vehicle Type and Fuel Type, 2008, at: http://www.eia.doe.gov/cneaf/alternate/page/atftables/attf_v5.pdf

[10] See U.S. Department of Energy, Annual Energy Review 2009, Table 10.5 - Estimated Number of Alternative-Fueled Vehicles in Use and Fuel Consumption, 1992-2008, at http://www.eia.doe.gov/aer/pdf/aer.pdf, Page 295.

In its most recent press releases, Global Electric Motorcar (GEM), a wholly owned subsidiary of Chrysler Group LLC, describes itself as "the market leader in the low-speed, Neighborhood Electric Vehicle (NEV) industry," and says there are 45,000 of its vehicles on the road. The company notes that "the 2011 model marks our 14th year of designing and distributing 100 percent battery-electric GEM vehicles." According to the company, its calculations to determine that there are currently about 45,000 vehicles on the road assumes that each vehicle has a 10 year life,[11] which means that some of the vehicles produced by GEM in the 13 full years in which it has been in the business are not in the 45,000 figure. Even allowing for the vehicles that are now out of service, GEM's total output over the 13 completed years it has been producing NEVs is relatively modest and suggests that what growth there has been in the total number of GEM vehicles on the road or GEM's annual production is on the same order as what has occurred with respect to electric vehicles in the United States as a whole as reflected in the DOE figures previously cited. When specifically asked, the company indicated that it estimates that the total fleet of NEVs in the United States (all manufacturers) grows at a rate of about 1,000 vehicles a year.[12]

Growth in the use of NEVs seems to have been, and for the foreseeable future will likely be the result of several factors. One is growth in the number of planned communities, especially retirement communities as baby boomers retire. These communities are especially amenable to the use of NEVs. A retirement community in Florida called The Villages is an example of a community that was built with NEV use in mind. In Coronado, California, NEV use has expanded rapidly and significantly.[13]

Another factor is the extent to which existing communities make modifications to their roadways and transportation systems to accommodate the use of NEVs. Lincoln, California, which is discussed in more detail elsewhere in this report, is an example of a community making various adjustments to its roadways to allow for and encourage NEV use.

Yet another factor is the fact the NEVs are well suited for use in other environments like those cited by GEM on its web site. The company states, "GEM cars are used by local, state and national government agencies, resorts, master-planned communities, universities, medical and corporate campuses, as well as by sports teams, taxi-shuttle services and individual consumers." These are the kinds of settings NHTSA envisioned NEVs being operated in when it created FMVSS No. 500 with its reduced safety equipment requirements for NEVs. To the extent that there remain settings of this type or new settings of this type that will be developed, it would seem that NEV use will continue to expand at least at the pace of the last 10 to 15 years.

[11] February 8, 2011 phone conversation with GEM executives.
[12] February 14, 2011 email exchange.
[13] See "Coronado's electric cars enjoying life in the fast lane," by Janine Zúñiga, San Diego Times Union, May 29, 2007 at http://www.signonsandiego.com/uniontrib/20070529/news_1n29ecars.html

Finally, there are policies at all levels of government – Federal, state, and local – aimed at encouraging the use of electric vehicles, which includes NEVs.

Federal Policies

Among the Federal policies with the potential to encourage or that specifically encourage NEV use are:

Administration's Commitment to One Million Electric Vehicles by 2015: In 2008, prior to his election, President Obama announced an ambitious goal of putting one million advanced technology vehicles on the road by 2015. The President has repeated this goal on several subsequent occasions, including in the State of the Union address in January 2011. In order to help achieve this goal, the Administrations is proposing a $7500 rebate at the point of sale for the purchase of electric vehicles; research and development investments in electric drive, batteries and energy storage technologies; and a new competitive grant program for local communities to invest in recharging infrastructure and to remove regulatory barriers for electric vehicles. All of these programs may encourage increased use of NEVs, as well as other electric vehicles.

Partnership for Sustainable Communities: On June 16, 2009, U.S. Secretary of Transportation Ray LaHood, U.S. Secretary of Housing and Urban Development Shaun Donovan, and U.S. Environmental Protection Agency Administrator Lisa P. Jackson, announced an interagency Partnership for Sustainable Communities to help improve access to affordable housing, more transportation options, and lower transportation costs while protecting the environment in communities nationwide. First among the principles announced as guiding this partnership is "Provide more transportation choices: Develop safe, reliable and economical transportation choices to decrease household transportation costs, reduce our Nation's dependence on foreign oil, improve air quality, reduce greenhouse gas emissions and promote public health." As of October 2010, $409.5 million in grants to various local communities have been awarded as a result of this initiative.

Tax Credit Under American Recovery and Reinvestment Act of 2009: Under the American Recovery and Reinvestment Act of 2009, a tax credit equal to 10 percent of the vehicle cost up to $7,500, depending on battery capacity, is available to purchasers of plug-in electric vehicles, including NEVs, for vehicles bought between February 17, 2009 and December 31, 2011.

Clean Cities: A part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy's Vehicle Technologies Program, the Clean Cities program strives to advance the Nation's economic, environmental, and energy security by supporting local decisions to adopt practices that contribute to the reduction of petroleum consumption. Clean Cities has a network of nearly 100 volunteer coalitions, which develop partnerships in the public and private sectors to promote alternative and renewable fuels, fuel economy measures, idle reduction technologies, and new technologies as they emerge.

State Policies

Allowing NEV Use on Public Roadways: As indicated in the "State Laws Related to NEV Use on Higher Speed Limit Roads" section of this report, 46 states and the District of Columbia have enacted laws that permit the use of NEVs on public roadways with speed limits above the maximum 25 mph speed of NEVs. While there is little evidence to suggest that these laws have resulted in widespread use of these vehicles on public roadways, this key policy development of allowing NEV use on higher speed roadways, is in place in these jurisdictions should other factors, such as public acceptance of NEV use on higher speed roadways take hold.

California

The State of California has been the most notably active in promoting the use of electric vehicles. Policies the state has adopted with respect to the broad category of alternative fuel or otherwise environmentally advantageous vehicles include incentives for NEV use. This is reflected in the 30,242 electric vehicles, which includes NEVs, in use in California in 2008. Other states lag behind California's numbers. The state with the second highest total of electric vehicles in 2008 was New York with 8,094. Other states with more than 1,000 electric vehicles in use in 2008 are: Arizona (3,821), Georgia (1,018), Massachusetts (2,477), Michigan (1,919), Oregon (1,889), and Texas (1,096). Despite its large population of retirees, Florida in 2008 had only 431 electric vehicles in use.[14][15]

Among California's policies that provide incentives for electric vehicles including NEVs are:

Zero Emission Vehicle (ZEV) Program: Since 1990, California has had in place a regulation under which manufacturers selling light vehicles in California must assure that a percentage of those vehicles are zero emission vehicles, although alternative approaches involving reduced emission vehicles are available to manufacturers for complying with the regulation. NEVs are considered ZEVs under the California regulation. NEVs sold by GEM in California, for example, assist GEM's parent company, Chrysler Group, LLC, in complying with the ZEV regulation.

Plug-In Hybrid and Zero Emission Light-Duty Vehicle Rebates: Rebates are available through the Clean Vehicle Rebate Project (CVRP) for the purchase or lease of qualified vehicles. The rebates offer up to $5,000 for light-duty zero emission and plug-in hybrid vehicles and up to $20,000 for zero emission commercial vehicles that the California Air Resources Board (ARB) has approved or certified. The rebates are available on a first-come, first-served basis to individuals, business owners, and government entities in California that purchase or lease new eligible vehicles on or after March 15, 2010. Eligible vehicles are electric drive cars, trucks, commercial medium- and heavy-duty vehicles, motorcycles, or neighborhood electric vehicles. Manufacturers of zero emission vehicles must apply to ARB to have their vehicles included in

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[14] "Alternatives to Traditional Transportation Fuels 2008," op. cit., Table V3. Estimated Number of Alternative Fueled Vehicles in Use, by State and,Fuel Type, 2008.

[15] Golf carts are not included in these figures.

CVRP. The ARB determines annual funding amounts for CVRP, which is expected to be effective through 2015.

Legislation Permitting Localities to Develop NEV Transportation Plans: The California state legislature passed legislation that enables several specific communities to develop NEV Transportation Plans that are, when implemented, intended to foster the use of NEVs. This development is discussed at greater length in the "Local Policies" section below.

Other States

The DOE's Office of Energy Efficiency and Renewable Energy maintains an Alternative Fuels and Advanced Vehicles Data Center on its web site, which includes information on federal and state incentives and state laws relating to a number of issues, including NEVs. The state incentives for NEV use found here were limited in number and scope in comparison to those in California.

Hawaii EV Ready Rebate Program: Under this program, qualified Hawaii residents, businesses, government agencies, and non-profit agencies may apply for rebates for the price of electric vehicles (EV) and electric vehicle supply equipment (ESVE). Rebates are 20% of the vehicle purchase price, up to $4,500, and are restricted to one EV per applicant. To be eligible, the Internal Revenue Service must have approved the EV for the Qualified Plug-in Electric Drive Motor Vehicle Credit[16], and the vehicle must be purchased in Hawaii on or after August 1, 2010. EVSE rebates are in the amount of 30% of the charging system cost including installation, up to $500. EVSE must be purchased on or before August 1, 2010, and installed before the rebate program ends; EVSE product and installation requirements apply. Rebates are issued on a first come, first served basis. The Hawaii EV Ready Rebate Program will continue until September 30, 2011, or until funds are exhausted.

New Jersey Zero Emissions Vehicle (ZEV) Tax Exemption: ZEVs sold, rented, or leased in New Jersey are exempt from state sales and use tax. This exemption does not apply to partial zero emission vehicles, including hybrid electric vehicles. ZEVs are defined as vehicles that the California Air Resources Board has certified as such. A list of qualifying ZEVs on the New Jersey Department of the Treasury web site includes NEVs.

Oklahoma Electric Vehicle (EV) Manufacturing Tax Credit: Vehicle manufacturers are eligible for a tax credit for EVs. Four-wheeled low-speed EVs are eligible for a $500 credit per vehicle. Tax credits may be carried forward for up to five years.

Georgia has a tax credit for ZEVs, but specifically exempts low-speed vehicles from this credit.

Maryland's Electric Vehicle (EV) Tax Credit applies only to vehicles that can achieve a maximum speed of at least 55 miles per hour.

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[16] NEVs are approved.

Local Policies

California also seems to be the leading state in local level activities aimed at stimulating the use of NEVs, with state legislation authorizing the creation of local transportation plans in various communities, first for golf carts and later for NEVs.

When NHTSA first considered creating FMVSS No. 500, it examined the experience of two municipalities – Palm Desert, California and Sun City, Arizona – with the use of golf carts[17] on city streets. NHTSA held a public meeting on July 18, 1996 in Palm Desert during which state, county, and local officials from California and Arizona, among others, presented comments. The State of California had in 1992 amended its Streets and Highways Code (CSHC) to establish a Golf Cart Transportation Pilot Program for the City of Palm Desert, which resulted in a Golf Cart Transportation Plan for that city. The CSHC was ultimately amended to allow any city or county in California to establish a Golf Cart Transportation Plan.[18]

Traditionally, golf carts have been defined as having a maximum speed of 15 mph (24 kph) and as being used primarily on golf courses.[19] If they meet these two criteria, they are not regulated by NHTSA. At about the time it enabled the creation of a Golf Cart Transportation Pilot Program for the City of Palm Desert, California defined golf carts as having a maximum speed of 25 mph (40 kph). The current California definition of golf cart also limits occupancy to two persons plus golf equipment, limits the vehicle's unladen weight to 1,300 pounds, and requires that the vehicle have "not less than three wheels" touching the ground.[20] Thus, the Golf Cart Transportation Plan in effect in Palm Desert when NHTSA was considering the adoption of FMVSS No. 500 envisioned the use of vehicles similar to NEVs in that their maximum speed is 25 mph.

In Palm Desert, the plan[21] adopted by the city created two types of dedicated lanes for golf carts – one in which only bicycles and golf carts could operate, and another shared by golf carts with automobile traffic at speeds up to 25 mph (40 kph).

The State of California has since taken the approach it used with respect to golf carts and applied it to NEVs. In January 2005, the California State Legislature enacted a law that enabled the cities of Lincoln and Rocklin, in Placer County, to create their own Neighborhood Electric Vehicle Transportation Plans under which NEVs would be allowed to operate on certain designated city roadways[22]. The definition of a NEV under California law is essentially identical

[17] While most often referred to as a "golf cart," a vehicle for carrying golfers at low speeds on a golf course may also be referred to as a "golf car." In fact, the national association of manufacturers of these vehicles is called the National Golf Car Manufacturers Association.
[18] California Streets and Highway Code, Sections 1950-1961.
[19] See posting by National Golf Car Manufacturers Association at http://www.ngcma.org/standards.aspx
[20] California Streets and Highway Code, Section 1951(b).
[21] The agency's review and analysis of the Palm Desert plan is discussed in "Section III Safety Ramifications."
[22] California Streets and Highway Code, Sections 1963-1963.10.

to the definition of a LSV under FMVSS No. 500.[23] Lincoln published its plan in June of 2006.[24] In January 2008, the two cities submitted a report[25] on the implementation of their plans ("the first major citywide NEV transportation project in the State of California") to the California legislature as required by the implementing legislation.[26] As of the January 2008 report, Lincoln indicated that much of the plan had not yet been implemented, particularly signage and lane striping and markings to indicate NEV lanes. It further noted that, as of the time of the report, "only a fraction of total lane miles in the NEV Transportation Plan are located on higher-speed facilities..."

The plans for the cities of Lincoln and Rocklin envision three levels of NEV routes: Class I NEV routes that would provide a completely separate right-of-way for the exclusive use of NEVs, pedestrians and bikes with cross-flow minimized; Class II NEV Routes designated as a separate striped lane adjacent to traffic; and Class III NEV Routes that allow for shared use with automobile traffic on streets with a posted speed limit of 35 mph or less. Some streets that are posted 35 mph may be designated as not appropriate for NEV use.[27]

There are a variety of subjects discussed in the report to the California legislature, one of which is a survey of NEV users regarding their perception of the relative safety of various conditions under which NEVs operate or might operate. The NEV users surveyed felt most safe on "paths restricted only to NEVs" (almost 90% of respondents) or on "roads with separate lanes for NEVs and autos" (almost 70 percent of respondents). Complete results of the survey relating to NEV users' perceptions of the safety of various conditions are presented in Appendix B. NEV users' perception of the safety of the conditions under which they operate NEVs may play a part in whether or not the efforts of communities to expand NEV use are successful. The attitudes regarding the safe operation of NEVs reflected in this survey may be widespread and may account, at least in part, for why no evidence was found to suggest that NEVs are used extensively on public roads with speed limits above the 25 mph maximum speed of NEVs.

At this point, the important thing to note is that the January 2008 report of the City of Lincoln, California on the implementation of its NEV Transportation Plan recommended that NEV Transportation Plans should be continued in the cities of Lincoln and Rocklin and that such plans could be "successfully implemented statewide," although it also recommended "that a more

[23] California Vehicle Code, Section 385.5.
[24] See "City of Lincoln: NEV Transportation Plan" at http://www.ci.lincoln.ca.us/pagedownloads/NEV%20Transportation%20Plan-Aug2006.pdf
[25] The findings of this report are discussed later in "Section III Safety Ramifications.".
[26] "A Report to the California State Legislature *as required by* Assembly Bill 2353 (Chapter 422, Section 1. Chapter 7) Neighborhood Electric Vehicle Transportation Plan Evaluation," prepared by Kevan Shafizadeh, Ph.D., P.E., PTOE, and Kimberly Fox, California State University, Sacramento, and John E. Pedri, P.E., Director of Public Works/City Engineer, The City of Lincoln, January 1, 2008. Report may be found at: http://www.dot.ca.gov/hq/traffops/signtech/newtech/reports/LincolnNEVEvaulationReportrev-Jan2008.pdf
[27] "City of Lincoln: NEV Transportation Plan," op. cit.

comprehensive analysis be conducted when more of the approved NEV Transportation Plan has been implemented."

The City of Lincoln's report also noted, "There are several communities throughout the state that are currently pursuing drafting legislation to allow them to stripe NEV lanes on roadways with speed limits above 35 mph...If a statewide NEV policy is implemented, it could include the standardization of signage, striping, and design specifications, all of which could help Caltrans and federal transportation agencies expedite the approval process while helping to ensure consistency among local jurisdictions throughout the state." It stated, "To encourage statewide implementation of NEVs, the Cities of Lincoln and Rocklin may want to develop a statewide task force to coordinate efforts with other cities that are interested in similar NEV Transportation Plans." The report also recommended that the Cities of Lincoln and Rocklin continue to work with the state legislature to coordinate these efforts.

The State of California has, in fact, passed additional legislation allowing the City of Fresno[28], the "Ranch Plan Planned Community" in Orange County[29], and the cities of Jackson, Sutter Creek, and Amador City in Amador County[30] to develop NEV Transportation Plans.

While proceeding slowly for now, these efforts by California to first incorporate golf carts and now NEVs into local community transportation options are likely to expand, both in California and perhaps other areas of the country as well.

The Possible Impact of Electric Cars on NEV Use

In his State of the Union speech on January 25, 2011, President Obama called for 1 million plug-in electric cars to be on the road within 4 years. The president's call, coupled with the introduction of such vehicles as the all electric Nissan Leaf and the electric/gas Chevrolet Volt into the United States market, suggests the beginning of a new era in electric powered conventional passenger vehicle transportation. This could be a major factor in the next 10 to 15 years as efforts to grow NEV use continue. Fully or partially electric vehicles were not part of the mix during the last 10 to 15 years of slow and steady growth in NEV use. We feel that an analysis of the potential ways in which the possible proliferation of electric cars will impact growth in the use of NEVs (and therefore their ability to contribute to further national fuel consumption savings) is beyond the scope of this report. We simply observe that the success in the marketplace of electric cars that meet all applicable FMVSSs is a factor that may impact the degree to which NEV use will grow and therefore be able to make additional significant contributions to fuel consumption savings.

[28] California Streets and Highway Code, Sections 1964-1964.8.
[29] California Streets and Highway Code, Chapter 8, Sections 1965-1964.7.
[30] California Streets and Highway Code, Chapter 8.1, Sections 1966-1966.7.

SECTION II FUEL CONSUMPTION SAVINGS

Estimating the fuel consumption savings that could result from the expanded use of NEVs requires knowing the gas saved per NEV mile driven and the average annual number of miles driven per NEV. There are very few sources of information, much less hard data, available for determining these figures. We identified the limited sources available and used these sources to make estimates.

Estimates of Gas Saved by NEVs per Mile Driven

Global Electric Motorcars (GEM)

Global Electric Motorcars (GEM), a wholly owned subsidiary of Chrysler Group LLC and one of the principal players in the NEV industry estimates that since it began producing NEVs its vehicles have driven some 450,000,000 miles saving 20,000,000 gallons of gasoline.[31] Using these figures, NHTSA calculated that a NEV saves 0.044 gallons of gasoline per mile driven. This was calculated as follows:

$$\frac{20{,}000{,}000 \text{ gallons of gasoline saved}}{450{,}000{,}000 \text{ miles driven}} = 0.044 \text{ gallons of gas saved per NEV mile driven}$$

The GEM figures indicate that the typical vehicle whose miles are replaced by NEV miles gets 22.73 miles per gallon (1 mile/0.44 gallons saved per mile = 22.73 miles per gallon). These figures also imply that NEVs have no impact on fuel consumption as a result of recharging. Since NEVs are battery powered, they, in fact, use no gasoline, although they still consume energy when their batteries are recharged.

According to the Department's Research and Innovative Technology Administration's Bureau of Transportation Statistics (RITA-BTS), as of 2008, the average fuel efficiency of all United States passenger cars was 22.6 miles per gallon while the average fuel efficiency of "other 2-axle 4-tire" vehicles was 18.1 miles per gallon.[32] Also as of 2008, RITA-BTS reported that there were 137,079,843 passenger cars and 101,234,849 "other 2-axle 4-tire" vehicles in the United States.[33] We assumed that all of the vehicles in the latter category are passenger vehicles of the sort whose miles might be replaced by miles driven by NEVs.[34] Using these figures, we calculated the average fuel efficiency for the 2008 passenger vehicle fleet as follows:

[31] In a February 8, 2011 phone call, GEM executives indicated that these figures are based on an estimated 1,500 miles driven by each NEV annually. They said these figures also assume that the life of a vehicle is 10 years so not all NEVs manufactured over the 13 years involved are included in the 45,000 NEVs still on the road.

[32] See National Transportation Statistics, Table 4-23: Average Fuel Efficiency of U.S. Passenger Cars and Light Trucks at http://www.bts.gov/publications/national_transportation_statistics/html/table_04_23.html

[33] See http://www.bts.gov/publications/national_transportation_statistics/html/table_01_11.html

[34] According to the U.S. Department of Transportation's Federal Highway Administration, these vehicles include vans, pickup trucks, and sport/utility vehicles. (See footnote 3 at http://www.fhwa.dot.gov/policyinformation/statistics/2008/vm1.cfm). Other materials in this section suggest that it

(22.6 x 137,079,843) + (18.1 x 101,234,849) / 238,314,692 = 20.7 average miles per gallon

The gasoline saved per mile driven per NEV using this, the current average fuel efficiency of the passenger vehicle fleet, increases to 0.048 gallons per mile driven (1 mile / X gallons saved per mile driven = 20.7 miles per gallon. X= 0.048).

California Energy Commission 2002 Study

On July 1, 2002, the California Energy Commission issued "Demonstration of Neighborhood Electric Vehicles (NEVs)"[35] in which it reported the results of demonstration projects it funded at four sites, each with different characteristics. A total of 42 vehicles were located at the study sites. The ways in which the vehicles were used were surveyed. Forty of the vehicles involved were NEVs. The remaining two were electric vehicles capable of achieving speeds up to 35 mph. The study involved a total of 6,281 days of use. The vehicles involved in the study traveled 22,494 miles and saved an estimated 818 gallons of gasoline, according to the report.

Using these figures, and assuming that the two vehicles capable of achieving speeds up to 35 mph did not significantly skew the results, the gas saving per mile driven in this study is 0.036 gallons saved per mile driven (818 gallons/22,494 miles = 0.036 gallons saved/mile).

U.S. Department of Energy Study

A July 2001 U.S. Department of Energy report titled, "Field Operations Program: Neighborhood Electric Vehicle Use," provides results of a study of 15 automotive fleets that operate NEVs in the United States. The 15 fleets operated a total of 348 NEVs for a variety of purposes in fleet sizes from 2 to 82 NEVs. Fifty-six percent of the NEVs were used on private roads, 32 percent on public roads, and 12 percent on both private and public roads. The report estimated that these vehicles were driven a total of about 1.2 million miles annually or about 3,409 miles per year per NEV. This equates to 87 gallons of petroleum use avoided per NEV per year, according to the report. Based on these figures, the annual gas saving per NEV in this study would be 0.026 gallons saved per mile driven (87 gallons/3,409 miles per year = 0.026).

This study emphasized that it "was not intended as a scientific sample, rather, as an informal analysis of NEV use and experience." Among the factors that could affect the above gas saving per NEV mile driven figure is the fact that the 348 vehicles in the study included four Nissan Hyperminis, which are not NEVs and are capable of speeds closer to conventional passenger motor vehicles. Also, the report assumed that the fuel efficiency of the vehicles whose trips the NEV trips replaced was 39 mpg. This value was based on the Honda Civic, which the report indicates was listed in the 2000 EPA Fuel Economy Guide as having the highest mileage of all gasoline vehicles. A more realistic assumption as to the fuel efficiency of the vehicles whose

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is not only passenger vehicles whose trips are replaced by NEVs. For example, on a college campus, a pickup truck might have previously been used by maintenance people to get around campus. A NEV might be used instead.

[35] "Demonstration of Neighborhood Electric Vehicles (NEVs)," Consultant Report, California Energy Commission, July 1, 2002, P600-02-020F. at http://www.energy.ca.gov/reports/2002-08-28_600-02-020F.PDF

trips were replaced by NEVs brings the gasoline saved per mile driven figure more into line with the other figures above. Using the RITA-BTS figure of 20.7 miles per gallon as the fuel efficiency for all passenger vehicles on the road in 2008, the amount of gas saved by the total of the NEVs in the study would be 1,087 (22,494 total miles/20.7 miles per gallon = 1,087 gallons) for a total gas saving of 0.048 gallons per mile driven (1,087gallons/22,494 total miles = 0.048).

Annual Miles Traveled Per NEV

As with determining estimates of gas saved by NEVs per mile driven, there are limited sources for estimating this and each source provides a different number.

2003 Green Car Institute Study

In July 2003, the Green Car Institute[36] reported on a phone survey of 260 NEV owners/users randomly selected from a database of what were then almost 10,000 GEM vehicles in California. The vehicles represented those used by individuals and those used in fleets. The estimated average annual number of miles traveled by NEVs owned by households was 1,095 while the estimated average annual number of miles traveled by NEVs used in fleets was 1,533. The average annual miles traveled for the total sample was 1,258.

GEM Figures

GEM indicates that it used a figure of 1,500 average annual miles traveled per NEV to calculate the 2011 press release figures referenced earlier in this report.[37] This figure is derived from the Green Car Institute study (GEM was a contributor to the Green Car Institute study). The figures in GEM's 2011 press releases are also based on the assumption that the life of a GEM NEV is 10 years.

Lincoln, California Survey

The City of Lincoln, California has conducted two surveys, one in 2003[38] before the adoption of its NEV Transportation Plan and another in the summer of 2007, after the plan was adopted and its implementation begun.[39] The first, which sent surveys to NEV owners in Lincoln and got 35 responses, indicated that 70 percent of the respondents drive their NEVs more than 500 miles per year and 23 percent drive their NEVs more than 1,000 miles per year. The second produced a total of 148 respondents, 94 of which were NEV users. The 94 NEV users indicated they take almost 15 one-way NEV trips per week and average a little less than 4.5 miles per trip. This

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[36] "Study of NEV User Behavior in California," Green Car Institute, July 2003 available at http://www.greencars.org/pdf/Study%20of%20NEV%20User%20Behavior%20in%20California.pdf

[37] February 8, 2011 phone conversation with GEM executives.

[38] See "City of Lincon: NEV Transportation Plan" prepared by MHM Engineers & Surveyors, June 2006 at http://www.ci.lincoln.ca.us/pagedownloads/NEV%20Transportation%20Plan-Aug2006.pdf

[39] See "A Report to the California State Legislature *as required by* Assembly Bill 2353 (Chapter 422, Section 1. Chapter 7) - Neighborhood Electric Vehicle Transportation Plan Evaluation" by Kevan Shafizadeh, Kimberly Fox, John E. Pedri, January 1, 2008, page 18 at http://www.dot.ca.gov/hq/traffops/signtech/newtech/reports/LincolnNEVEvaulationReportrev-Jan2008.pdf

translates to an average annual NEV usage for these 94 NEV users of almost 3,500 miles per year, what the City of Lincoln noted as "over three and a half times higher than previous estimates." The City of Lincoln seemed surprised by this result and noted, "The amount of travel and potential benefits associated with NEV use is an area in need of future research." It added, "It is clear that this study did not capture a representative sample of Lincoln residents and should not be used for generalizations beyond this evaluation." Notwithstanding this statement, this report uses these survey results because it may well be that NEV use rises dramatically in communities where the vehicles are already in use and the community makes an effort to promote their use, and if that is true, it seems useful to illustrate the fuel-saving impact of that scenario.

California Energy Commission 2002 Study

In addition to 22,494 miles driven by NEVs and an estimated 818 gallons of gasoline saved, the 2002 California Energy Commission study discussed in the "Estimates of Gas Saved by NEVs per Mile Driven" section above involved 6,281 days of use. This translates to an average of 3.58 miles driven per day or 1,307 miles driven annually if the vehicle is used 365 days a year, or 934 miles driven annually if the vehicle were used on weekdays only (261 days a year).

U.S. Department of Energy Study

As indicated earlier in the "Estimates of Gas Saved by NEVs per Mile Driven" section above, the July 2001 DOE study of 15 automotive fleets that operate NEVs in the United States found the average annual miles driven per NEV in these fleets to be an estimated 3,409.

Estimated Fuel Consumption Savings from Current and Expanded NEV Use

National fuel consumption savings from NEV use are dependent on three variables – the number of NEVs in use, the total number of miles driven by these NEVs, and the number of gallons saved per NEV mile driven. The last variable is the product of another variable – the relative fuel efficiency of the vehicles that would otherwise have been used for trips taken by NEVs.

As indicated in the previous sections, other than the number of NEVs in use in 2008, there are no precise, clear-cut answers as to what numbers should be used for each of the variables involved in calculating fuel consumption savings from NEV use. We will therefore present several scenarios that are representative of the numbers identified in the various sources cited above and calculate the fuel consumption savings that would result.

At Current Use Levels

Using Gas Saved and Annual Miles Estimates

The chart that follows reflects the estimated fuel consumption savings that are currently being achieved based on various numbers derived from the information presented in the "Estimates of Gas Saved by NEVs per Mile Driven" and "Annual Miles Traveled Per NEV" sections above. The numbers have been rounded to simplify calculations.

The July 2003 Green Car Institute report, "Study of NEV User Behavior in California," found that NEV users replaced trips taken in their personal or company-provided internal combustion engine vehicles with NEVs for 64.7 percent of their trips. Therefore, the chart presents fuel consumption savings that assume that every mile driven by a NEV replaces a mile that would have otherwise been driven by a gasoline powered motor vehicle as well as the fuel consumption savings that would result if only 65 percent of the NEV miles driven replace miles that would otherwise have been driven by gasoline power motor vehicles.

The two levels of gallons saved per NEV mile traveled used in the calculations are 0.036, and 0.048, which are the low and high numbers reported in the "Estimates of Gas Saved by NEVs per Mile Driven" section of this report. The 1,300 miles/NEV/year figure is rounded up from the 1,258 annual average miles based on household and fleet NEV use found in the Green Car Institute Study. The 3,500 miles/NEV/year is rounded up from the 3,409 miles found in the DOE's "Field Operations Program: Neighborhood Electric Vehicle Use" report.

An example of the basic calculation used in determining the numbers in the chart is as follows:

> 45,000 U.S. NEVs x 1,300 miles per NEV per year = 58,500,000 U.S. NEV vehicle miles traveled by per year
>
> 58,500,000 NEV vehicle miles traveled per year x 0.036 gallons saved per NEV per mile traveled = 2,106,000 gallons saved per year.

Exhibit 1: Estimated Fuel Consumption Savings Under Current NEV Use Levels & Several Assumptions

# of NEVs	Miles/NEV/Yr.	Total NEV Miles	Gallons Saved/ NEV Mile	Projected Total Gallons Saved /Year at 100% Gasoline Vehicle Replacement	Projected Total Gallons Saved /Year at 65% Gasoline Vehicle Replacement
45,000	1,300	58,500,000	0.036	2,106,000	1,368,900
45,000	3,500	157,500,000	0.036	5,670,000	3,685,500
45,000	1,300	58,500,000	0.048	2,808,000	1,825,200
45,000	3,500	157,500,000	0.048	7,560,000	4,914,000

Using U.S. Department of Energy Calculation Methodology

The DOE has a Petroleum Reduction Calculation Methodology on its website.[40] Using this tool, the estimates of current annual gasoline savings in the chart below were calculated using the same number of NEVs and annual miles driver per NEV as were used in Exhibit 1.

[40] See Energy Efficiency and Renewable Energy, Alternative Fuels and Advanced Vehicles Data Center, Petroleum Reduction Planning Tool, at https://www.afdc.energy.gov/afdc/prep/methodology.html#table1

Exhibit 2: Estimated Fuel Consumption Savings Under Current NEV Use Levels Using DOE Methodology

# of NEVs	Miles/NEV/Yr.	Projected Total Gallons Saved /Year at 100% Gasoline Vehicle Replacement	Projected Total Gallons Saved /Year at 65% Gasoline Vehicle Replacement
45,000	1,300	2,826,087	1,836,957
45,000	3,500	7,608,696	4,945,652

At Various Levels of Possible Expanded NEV Use

Using Gas Saved and Annual Miles Estimates

This report does not make any assumptions as to whether or not expanded use of NEVs will occur, or if it does, that it will result from allowing these vehicles to operate on roadways with a maximum speed limit of 40 mph (64 kph). This report simply presents estimates, based on the assumptions reflected in the chart below, of the fuel consumption savings that would occur at various levels of expanded NEV use, whatever the reason or reasons.

According to the U.S. Energy Information Administration, in 2008 the United States consumed about 137.93 billion gallons of gasoline, about 3 percent less than the record high of about 142.35 billion gallons consumed in 2007.[41]

Using the figures of 0.036 and 0.048 gallons saved/per NEV mile traveled as reported earlier in this report and used in calculations in the previous section, NHTSA calculated the fuel consumption savings based on various assumptions regarding increased numbers of NEVs in use, miles/NEV traveled each year, and total annual NEV miles traveled that would result. We found no publicly available projections as to the future use of NEVs, either the number that will be in use or the average annual number of miles that each NEV will drive. Therefore, we used the available current values to demonstrate what gasoline savings would result if the expanded NEV use reflected in the assumptions were to occur. Exhibit 3 reflects estimated fuel consumption savings that would result under various assumptions.

[41] See http://www.eia.doe.gov/tools/faqs/faq.cfm?id=23&t=10

Exhibit 3: Estimated Fuel Consumption Savings Under Expanded NEV Use Scenarios

Assumed # of NEVs in Use	Assumed Miles/ NEV/ Year	Assumed Total NEV Miles/ Year	Gallons Saved/ LSV/ Mile	Total Gallons Saved/Year at 100% Gasoline Vehicle Replacement	% of 2008 Gasoline Consumption At 100% Gasoline Vehicle Replacement
50,000	2,500	125,000,000	0.036	4,500,000	0.0033
			0.048	6,000,000	0.0044
100,000	5,000	500,000,000	0.036	18,000,000	0.013
			0.048	24,000,000	0.017
1,000,000	10,000	10,000,000,000	0.036	360,000,000	0.26
			0.048	480,000,000	0.35

The first assumption in the above chart is currently realistic. It would require only a modest increase in the current number of NEVs in use as of 2008 and the Miles/NEV/Year is within the range found in the various estimates examined above. The second assumption may be possible, but is probably still a long way off. The total number of electric vehicles in the United States, most of which as of 2008 were NEVs, grew from 49,536 in 2004 to 56,901 from 2004 to 2008. That is a growth rate of about 13 percent for that five year period. A 13 percent growth in the approximately 45,000 NEVs in the United States in 2008 during the five years from 2009 to 2013 would result in only 50,850 NEVs in use in the United States. Another five year period of 13 percent growth would result in 64,298 NEVs in use in the United States. Reaching the level of 100,000 NEVs in use would require two five year periods of a total of 50 percent growth in each of the two periods. This would result in 101,250 NEVs on the road. The last assumption at this point seems unrealistic for the foreseeable future. (As indicated earlier in this report, GEM executives estimate that the total fleet of NEVs in the United States [all manufacturers] grows at a rate of about 1,000 vehicles a year.) The last assumption is provided to illustrate that even at this unrealistically high level of NEV use and using the assumption that every NEV mile replaces a mile of a gasoline powered vehicle, the percentage reduction of gasoline use is still very small, only 0.35 percent of the 2008 national gasoline consumption total.

Using U.S. Department of Energy Calculation Methodology

The assumed number of NEVs in use and annual miles driven per NEV reflected in Exhibit 3 were used in the DOE calculation methodology to yield the following projected gasoline savings.

Exhibit 4: Estimated Fuel Consumption Savings Under Expanded Use Scenarios Using DOE Methodology

Assumed # of NEVs in Use	Assumed Miles/ NEV/ Year	Assumed Total NEV Miles/ Year	Total Gallons Saved/Year at 100% Gasoline Vehicle Replacement	% of 2008 Gasoline Consumption At 100% Gasoline Vehicle Replacement (Based on Gallons Saved Rounded to Nearest Million)
50,000	2,500	125,000,000	6,038,647	.0044
100,000	5,000	500,000,000	24,154,589	.017
1,000,000	10,000	10,000,000,000	483,091,787	.35

Other Factors Relating to Fuel Consumption Savings from NEV Use

The Offsetting Impact of NEV Energy Consumption

Included in the DOE Petroleum Reduction Calculation Methodology is a way to assign to alternative fuel vehicles, like NEVs, a gasoline equivalent of the energy they consume, in the case of NEVs the energy used to recharge the vehicle and later expended as the vehicle is driven. Exhibit 5 below indicates both the gasoline savings as calculated above using the DOE methodology, the offsetting alternative fuel energy consumption using the DOE methodology, and the net gasoline savings that result from NEVs under the various scenarios presented.

Exhibit 5: Net Equivalent of Gasoline Gallons Saved Using DOE Methodology

Assumed # of NEVs in Use	Assumed Miles/ NEV/ Year	Assumed Total NEV Miles/ Year	Total Gallons Saved/Year at 100% Gasoline Vehicle Replacement	Total Alternative Fuel Consumed in Equivalent Gallons of Gasoline	Net Gallons of Equivalent Gasoline Saved at 100% Gasoline Vehicle Replacment (%2008 Gasoline Consumption)
45,000	1,300	58,500,000	2,826,087	2,573,850	252,237(<.001)
45,000	3,500	157,500,000	7,608,696	6,929,595	679,100(<.001)
50,000	2,500	125,000,000	6,038,647	5,499,679	538,969(<.001)
100,000	5,000	500,000,000	24,154,589	21,998,715	2,155,874 (.00156)
1,000,000	10,000	10,000,000,000	483,091,787	439,974,306	43,117,481 (.031)

The Potential Impact of Overall Increases in Fuel Efficiency

This paper does not contain an analysis of how the fuel consumption savings, expressed as either a percentage of national gasoline consumption or as the number of gallons of gasoline saved, might be affected by future changes in vehicle fuel efficiency. It should be noted, however, that as the impact of increases in the fuel efficiency requirements of CAFE take hold and the fuel efficiency of the Nation's light passenger vehicle fleet increases, there will be a significant downward impact on the calculation of fuel consumption savings resulting from NEV use because the gallons of gasoline saved per mile will decrease.

As an example, if a NEV travels 1,500 miles in a year and each mile replaces a mile that would have been driven by a gasoline powered vehicle that gets 20.7 mpg, the average light vehicle fuel economy in 2008, the calculation of one NEV's annual fuel consumption savings would be approximately 72.5 gallons of gasoline (1,500 miles/20.7 miles per gallon = 72.5 gallons). If the light vehicle average fuel economy in the fleet were 22 mpg, however, just a little more than 1 mpg in increased fuel efficiency, the gasoline saved by one NEV for the same 1,500 miles would be about 68 gallons (1,500 miles/22 miles per gallon = 68 gallons).

If increases in fuel efficiency drive down national gasoline consumption figures, this could increase the percentage of relative national gasoline consumption saved by NEV use since the gallons of gasoline saved as a result of NEV use would be divided by a smaller overall gasoline consumption denominator.

There are many other factors that can affect the two basic scenarios described above. They include:

- An increase in gas consumption due to an increase in longer trips as improved fuel efficiency drives trip costs down;
- Fluctuations in the price of gasoline and the resulting impact on the amount of driving that occurs;
- Steady population increases and resulting increases in the number of light passenger vehicles on the road, which sustains demand for gasoline and the resulting annual level of national gasoline consumption in spite of improvements in fuel efficiency; and
- The extent to which other alternative fuel vehicles succeed in the marketplace at the expense of NEVs.

Consideration of the details of possible long term scenarios involving these variables requires detailed economic analysis that is beyond the scope of this report.

Electric Vehicles That Comply with FMVSSs May Affect NEV Use

Certainly any fuel consumption savings that result from the use of NEVs contribute to the reduction in the nation's reliance on fossil fuels. However, the current actual fuel consumption savings and those projected under scenarios in which there would be expanded use of NEVs represent percentage reductions that are small. As suggested earlier in this report, significant fuel consumption savings from expanded NEV use could possibly be complicated by the fact that electric conventional passenger motor vehicles that meet the full set of FMVSSs have begun to appear in the marketplace, which could limit the future market for NEVs. These electric conventional passenger motor vehicles are generally capable of traveling longer distances per battery charge than NEVs, which will make them useful for a variety of types of local travel both in a person's immediate community and beyond, such as for commuting. If these vehicles have a similar level of success in the marketplace as that of hybrid vehicles to date, the potential fuel consumption savings would likely be far greater than that represented by any current scenario of expanded NEV use and what has until now been slow NEV market growth. The FMVSSs with which these electric conventional passenger motor vehicles comply include those relating to a vehicle's crashworthiness. Therefore, these vehicles are significantly safer than NEVs if they are involved in a crash. At the very least, it would seem that any significant growth in the market for electric vehicles that comply with the full set of FMVSSs would result in NEVs continuing to be used primarily in highly controlled settings, rather than expanding their use to replace more trips currently made by conventional passenger vehicles on higher-speed roads.

SECTION III SAFETY RAMIFICATIONS

Regulatory Background

NHTSA has, in several public notices conveying regulatory decisions, addressed the safety issues inherent in expanding the use of NEVs on roadways with a maximum speed limit of up to 40 mph (64 kph).

Creation of "Low Speed Vehicle" Class and FMVSS No. 500

In a September 26, 2008 Federal Register notice[42] denying rulemaking petitions to establish a class of vehicles that would have been known as "medium speed vehicles," the agency provided a summary of the background of the creation of the low speed vehicle class of vehicles and FMVSS No. 500. This background information remains relevant for purposes of this report and is repeated essentially verbatim below, except for a small amount of material relating to state laws that has been deleted because it is out of date.

> "In 1998, NHTSA established Federal Motor Vehicle Safety Standard (FMVSS) No. 500, 'Low speed vehicles,' in response to growing interest in using golf cars and other similar-sized, 4-wheeled vehicles, including Neighborhood Electric Vehicles (NEVs), to make short trips for shopping, social, and recreational purposes primarily within retirement or other planned communities with golf courses. *See* 63 FR 33194. The definition of LSV established in that rulemaking was, 'a 4-wheeled motor vehicle, other than a truck, whose speed attainable in 1.6 km (1 mile) is more than 32 kilometers per hour (20 miles per hour) and not more than 40 kilometers per hour (25 miles per hour) on a paved level surface.'
>
> "In 2005, NHTSA published a final rule amending the definition of LSVs by removing the restriction on trucks, and instead establishing a 2,500 pound maximum GVWR. *See* 70 FR 48313. This allowed small vehicles designed for work-related applications within the intended communities, such as landscaping or delivery purposes, to be included within the definition of an LSV, without opening the category to unintended vehicles, such as street sweepers or speed-modified passenger cars. Additionally, in 2006, in response to petitions for reconsideration from Dynasty Electric Car Corporation and Global Electric Motorcars (GEM), both manufacturers of electric LSVs, NHTSA increased the maximum GVWR for LSVs to 3,000 pounds. This was done, in part, to 'level the playing field' between electric and gasoline-powered LSVs, by allowing for the additional weight in batteries required by electric vehicles. *See* 71 FR 20026.
>
> "In conceiving the concept of the LSV as a small vehicle that would not be subject to the same stringent safety criteria as other vehicles, a critical concept was that it would not

[42] 73 FR 55804.

ordinarily mix with other traffic. In our 1998 rule establishing the category of LSVs, NHTSA explained in the summary that the rule:

> '[R]esponds to a growing public interest in using golf cars and other similar-sized, 4-wheeled vehicles to make short trips for shopping, social and recreational purposes *primarily within retirement or other planned communities with golf courses.* [emphasis added]'

NHTSA's detailed analysis, as explained in the preamble of the 1998 final rule, recognized the importance of the fact that under most conditions, LSVs would not intermingle with regular automobile traffic, and the occasions where they would mix would be in controlled, low-speed environments. NHTSA stated that:

> 'NHTSA has carefully reviewed their argument about the effects of this rulemaking. LSV safety, and thus the need for FMVSSs for LSVs, will be determined by the combination of three factors: vehicle design and performance; operator training and ability; and the operating environment. The agency believes that Standard No. 500, in combination with a limited operating environment and appropriate operator training and ability, will appropriately address the safety needs of LSV users.'

"Additionally, in the 1998 final rule, NHTSA analyzed the Fatal Analysis Reporting System (FARS) data regarding fatalities involving golf cars. It was found that of the nine reported fatalities, eight of them involved a collision with a car or truck. This further underscored the importance of driving environment.

"In the 1998 final rule, the agency studied the use of LSVs in various municipalities that permitted them to travel on public roads. In that notice, we stated that 'the driving environment [of LSVs] should be appropriate to the vehicle and its characteristics. Limiting LSV use to low-speed city and suburban streets is necessary, but does not eliminate the safety risks.'[43]...

"One portion of the analysis discussed possible reasons for the disparity of fatalities between Sun City (which had four NEV fatalities) and the City of Palm Desert (which had zero). We noted that:

> 'The City of Palm Desert has a more controlled environment than Sun City for golf car use. The City of Palm Desert permits on-road use of golf cars in the same lanes as passenger cars and other larger motor vehicles in speed zones posted for speeds up to 25 miles per hour. In speed zones posted for speeds over 25 miles per hour, golf cars may be operated on-road only if there is a lane designated for

[43] 63 FR 33208

their use and if the golf car is, in fact, operated within that lane. By contrast, NHTSA understands that Sun City, under state law, allows golf cars to operate in the same lanes as larger traffic on any road with a maximum speed of 35 miles per hour.'

"Based in part on this analysis, as well as our other observations, we concluded that operating environment played an important role in determining the benefits of establishing the LSV classification, as well as determining what safety standards should apply to that class. While NHTSA does not regulate the driving environment (such decisions are at the discretion of State governments), it did recommend that LSVs be licensed only for use in environments with very limited traffic. Specifically, we stated:

"NHTSA recognizes that not all operating environments may be as controlled as that of the City of Palm Desert. The agency encourages other states and municipalities to study the features of the City of Palm Desert's plan and adopt those features to the extent practicable.[44]"

Denial of Request to Increase LSV GVWR to 4,000 lbs.

As indicated at the beginning of the previous section, on September 26, 2008, NHTSA denied a petition requesting that the GVWR limit for LSVs be raised to 4,000 lbs.[45] It gave two reasons for its decision. One was its belief that vehicles over 3,000 pounds GVWR are capable of complying with the full requirements of FMVSSs that apply to conventional passenger motor vehicles. The second was its belief that increasing the GVWR limit would encourage the use of LSVs in circumstances that could pose an unreasonable risk to safety.

Denial of Petitions for Medium Speed Vehicle Class

In 2008, NHTSA was petitioned by three companies – Environmental Motors, Mirox Corporation, and Porteon Electric Vehicles, Inc. – to create a new class of motor vehicles called "medium speed vehicles," which would have a maximum speed of 35 mph (56 kph).[46] While the petitions differed in various respects – the level of detail as to the safety equipment that would be required for the proposed class of vehicles, for example – the underlying thrust of each of the petitions was the same. The petitioners' wanted NHTSA to establish a class of motor vehicles, known as "medium speed vehicles," to meet the environmental objective of having more fuel efficient vehicles on more roads to provide transportation for relatively short trips. The petitioners contemplated that these vehicles would be subject to a set of safety standards greater than those that apply to low speed vehicles but still substantially less than the full set of safety standards that apply to other light vehicles such as passenger cars.

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[44] 63 FR 33208
[45] 73 FR 55801
[46] See Docket No. NHTSA-2008-0154.

On September 28, 2008, NHTSA denied the petitions[47] citing concerns about the safety of those who would operate the proposed medium speed vehicles in the kinds of situations envisioned by the petitioners. It cited death and injury data relating to roads with speed limits of 35 mph (56 kph) and 45 mph (72 kph), the type of roads on which it felt vehicles in the proposed vehicle class would likely operate. NHTSA said,

> "For this traffic environment, the need for the safety features required in FMVSS No. 208, air bags, are far more important than for lower speed crashes, as frontal crashes become a more prominent part of the overall crash picture.
>
> "The total number of occupants killed annually in crashes is 37,314 (2002–2006 average, Fatality Analysis Reporting System). Of these occupant fatalities, 6,319 were killed on roads with posted speed limits of 35 mph or less, and 13,493 are killed in crashes on roads with posted speed limits of 45 mph or less.... It is important to note that those numbers reflect vehicles that were certified to comply with the Federal motor vehicle safety standards.
>
> "We estimate that in 2005, on roads posted at 35 mph or lower, 1,921 crash victims lived because the vehicles were compliant with all FMVSSs, including 278 saved by air bags. In crashes on roads posted at 45 mph or lower, 3,163 lives were saved because the vehicles involved were compliant with all FMVSSs. Of those, 414 were saved by air bags.[48]
>
> "Given these statistics, we believe the full set of Federal motor vehicle safety standards is needed for vehicles traveling in the traffic environment in which MSVs would likely travel, including, e.g., urban roads with speed limits of 35 mph or 45 mph.
>
> "Finally, as noted above, a number of the crash test requirements included in our safety standards simulate crashes in this environment. For example, our highest speed crash test in FMVSS No. 208 (vehicle compliance is currently phasing in) simulates a 35 mph frontal crash between the tested vehicle and a vehicle like itself. Our crash test in FMVSS No. 214 that helps ensure thoracic protection simulates a crash in which the tested vehicle traveling at 15 mph is struck in the side by a light vehicle traveling at 30 mph."

It added,

> "NHTSA also considers fuel conservation an important goal. However, we believe that it is neither necessary nor appropriate to significantly increase the risk of deaths and serious injuries to save fuel. Fuel conservation can be accomplished by means that are not

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[47] 73 FR 55804

[48] Using the methodology of "Lives Saved by the Federal Motor Vehicle Safety Standards and Other Vehicle Technologies, 1960-2002" DOT HS 809-833.

inconsistent with the need for safety. Significant innovation is currently underway in fuel economy, gas-electric hybrid engine technology, and continued development of fully electric vehicles…"[49]

NHTSA also cited its then proposed increased fuel economy – Corporate Average Fuel Economy (CAFE) – standards for new passenger cars and light trucks that have since been finalized.

More recent data relating to injuries and deaths and the speed limits for the roads on which the crashes involved occurred appears in the chart below.

Exhibit 6: Persons Killed or Injured in Crashes, by Speed Limit

	2005	2006	2007	2008	2009
PERSONS KILLED					
30 mph (48 kph) or less	4,132	4,100	4,068	3,909	3,445
35 or 40 mph (56 or 64 kph)	7,330	7,330	6,861	6,512	5,858
45 or 50 mph (72 or 80 kph)	8,035	7,971	7,795	6,954	6,579
55 mph (89 kph)	13,220	12,673	12,226	10,836	9,838
60 mph (97 kph) or higher	9,454	9,139	8,883	7,956	7,076
No Statutory Limit	126	109	127	139	121
Unknown	1,146	1,320	1,099	955	891
Total	43,443	42,642	41,059	37,261	33,808
PERSONS INJURED					
30 mph (48 kph) or less	517,000	473,000	486,000	463,000	443,000
35 or 40 mph (56 or 64 kph)	953,000	896,000	826,000	804,000	753,000
45 or 50 mph (72 or 80 kph)	569,000	594,000	569,000	511,000	497,000
55 mph (89 kph)	376,000	349,000	327,000	314,000	279,000
60 mph (97 kph) or higher	272,000	254,000	265,000	229,000	227,000
No Statutory Limit	11,000	9,000	18,000	26,000	18,000
Total	2,699,000	2,575,000	2,491,000	2,346,000	2,217,000

Source: Traffic Safety Facts 2005 – 2008 and 2009 Early Edition

[49] at 73 CFR 55809

From the years 2005 to 2009, crashes on roads with speed limits of 40 mph (64 kph) or less have consistently resulted in more than 25 percent of all traffic crash fatalities and more than 50 percent of all traffic crash injuries. It is important to note that these death and injury numbers relate to crashes involving vehicles that were certified to comply with FMVSSs.

Little Evidence to Suggest NEV Use on Higher Speed Roads Is Occurring

In spite of the large number of states that allow for the operation of NEVs on roads with speed limits in excess of 25 mph (40 kph), there is little evidence to suggest that the operation of these vehicles on these roads is widespread. The Department would expect to find a clearly identifiable number of crashes involving NEVs if there was widespread use of these vehicles on roads with speed limits up to 35 mph (56 kph) or higher. The Department did not find many instances of such crashes. This suggests that NEVs are not being used on roads with speed limits up to 35 mph (56 kph) or higher even though such use is permitted in many states. In the case of conventional passenger motor vehicles, data reflecting total crashes, deaths, and injuries as well as certain key ratios, such as deaths per 100 million vehicle miles traveled, are readily available. Comparable data for NEVs do not exist. Even finding individual crashes involving NEVs in the NHTSA's large data sources is difficult. Only a small number of such crashes have been located. They are discussed in more detail in the section of this report titled, "Data Sources Examined," which immediately follows this section.

The Department believes there are several possible explanations for why there is not more data on the safety performance of NEVs. They include:

- There are still only a small number of NEVs in use and the number of miles traveled per NEV per year is relatively small. As indicated earlier, the U.S. Department of Energy recently estimated the total number of alternative fuel LSVs in use at 44,934, some 44,842 of which are NEVs.[50] Because of the low number of NEVs in use and the low miles traveled by these vehicles, there are relatively few deaths and injuries involving these vehicles. Those that have occurred are hard to find.
- Even in states where operation of LSVs on roads with speed limits above 25 mph (40 kph) is permitted, local communities may have enacted laws that carefully prescribe the use of NEVs to designated lanes on roads appropriate for their use and the safety performance of LSVs in these situations is relatively good as a result. Or, as seems to be the case in California, some form of state legislative action is required before use of NEVs on higher speed limit roadways within a community is permitted, as in the case of the City of Lincoln.

[50] See "Alternatives to Traditional Transportation Fuels 2008," April 2010, U.S. Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, U. S. Department of Energy, op.cit., Table V5: Estimated Number of Alternative Fueled Vehicles in Use by Weight Class, Vehicle Type and Fuel Type, 2008.

- Operators of NEVs may not feel safe driving such vehicles in mixed traffic conditions with posted speeds above 25 mph (40 kph) and therefore refrain from doing so. As mentioned in a discussion of local NEV policies earlier in this report, the City of Lincoln, CA surveyed NEV users regarding their perception of the relative safety of various conditions under which NEVs operate or might operate. The NEV users surveyed felt most safe on "paths restricted only to NEVs" [almost 90% of respondents] or on "roads with separate lanes for NEVs and autos" [almost 70 percent of respondents].[51] Complete results of the survey relating to NEV users perceptions of the safety of various conditions are presented in Appendix B. In the Green Car Institute study[52], the top five reasons survey respondents gave for why they perceived their communities as being safe for NEV use were: 35 mph or less streets (70%), short distances between destinations (76.54%), fair weather (60.38%), dedicated roads for low speed vehicles (30.38%), and parking privileges for electric vehicles and NEVs (24.23%).

Data Sources Examined

NHTSA examined a number of sources of data to see if it could identify crashes involving NEVs, particularly on roads with speed limits above 25 mph (40 kph). The sources examined were:

- *Fatality Analysis Reporting System (FARS)* – Through a cooperative agreement with an agency in each state, NHTSA receives information in a standard format on fatal crashes from which it creates a nationwide census of fatal injuries suffered in motor vehicle traffic crashes.
- *State Data System (SDS)* – The State Data System consists of accident information derived from police accident reports. This information is provided to NHTSA by the 32 states currently participating in the SDS program.
- *National Automotive Sampling System (NASS)* – NASS is composed of two systems – the Crashworthiness Data System (CDS) and the General Estimates System (GES). These are based on cases selected from a sample of police crash reports. CDS data focus on passenger vehicle crashes and are used to investigate injury mechanisms to identify potential improvements in vehicle design. GES data focus on the larger overall crash picture and are used for problem size assessments and tracking trends.
- *Special Crash Investigations (SCI)* – About 200 cases a year are selected to be investigated in detail by professional NHTSA crash investigators. Matters of particular interest can include new emerging technologies, including the safety performance of alternative fueled vehicles, child safety restraints, adapted vehicles, safety belts, vehicle-pedestrian interactions, and potential safety defects. Cases of interest are located from an extensive and diverse network of sources, including NHTSA's Auto Safety Hotline, the

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[51] "A Report to the California State Legislature *as required by* Assembly Bill 2353 (Chapter 422, Section 1. Chapter 7) Neighborhood Electric Vehicle Transportation Plan Evaluation," op. cit.
[52] "Study of NEV User Behavior in California," Green Car Institute, July 2003, op.cit.

Department of Transportation's National Crash Alert System, NHTSA's regional offices, automotive manufacturers, other government agencies, law enforcement agencies, engineers, and medical personnel.

- *Not-in-Traffic Surveillance (NiTS)* - Not-in-Traffic Surveillance incidents can fall into a variety of categories. Some are crashes (which occur in private driveways) and some are incidents (occupant getting caught in a power window, hyper/hypothermia, etc.). NHTSA is actively pursuing NiTS crashes from its network of sources to provide in-depth information on the particulars of the incident or crash.
- *National Electronic Injury Surveillance System (NEISS)* – NEISS is a national probability sample of hospitals in the United States and its territories. It is operated by the U.S. Consumer Product Safety Commission. Patient information is collected from each NEISS hospital for every emergency visit involving an injury associated with consumer products. From this sample, the total number of product-related injuries treated in hospital emergency rooms nationwide can be estimated. Although the system focuses primarily on consumer products, there are some codes used in the system that could be applied to NEVs.

A detailed description of NHTSA's examination of these sources appears in Appendix C. Limited information on LSV crashes was found. NHTSA's efforts included:

- *Searching FARS cases from 2007* using codes for body type, make, and other variables that could have been applied to NEVs. None of the total of 64 cases identified involved an NEV.
- *Searching FARS cases from 2005 through 2008* using identifiers in the Vehicle Identification Number (VIN) that denoted a manufacturer of NEVs. One vehicle was identified as an LSV. It was involved in a fatal crash in 2008. That vehicle had originally been sold as a golf cart and had been modified to be a LSV. Much of the safety equipment required of NEVs by FMVSS No. 500 was not on the vehicle.
- *State Data System (SDS).* NHTSA searched the five most recent years of Florida data files (2003-2007) and found 942 police-reported crashes in which an LSV might have been involved. (Currently Florida is the only state among the 32 participating in the SDS that has a body type code for LSV on its state Police Accident Report [PAR]. California has LSV as a body type on the PAR for the California Highway Patrol but not on the PAR used by local police jurisdictions.) A closer review of these cases using VINs and vehicle make indicated that many of the vehicles in the 942 cases were actually golf carts, not LSVs. In total, NHTSA has identified 21 cases involving an LSV. The breakdown of the 21 vehicles is as follows:
    - 13 Global Electric Motorcars (GEM)
    - 6 Barton Investment Group
    - 1 LA Concept Cars
    - 1 Western Golf Car Manufacturing Company

There were a total of 37 occupants in these 21 LSVs. The injuries they sustained are as follows:

- 19 No Injuries
- 1 Possible Injury
- 10 Non-incapacitating Injuries
- 3 Incapacitating Injuries
- 4 Injuries, Severity Unknown

While the above injury distribution provides evidence that a large percentage of LSV occupants are injured in police reported crashes, it is difficult to know how many other LSVs may be involved in crashes. The operation of LSVs on public roads is limited. Under these circumstances, it is not uncommon for data to be recorded in ways that make it difficult to locate incidents involving LSVs in large databases. NHTSA will continue to explore the files in the SDS for ways to better identify and collect information about crashes involving LSVs.

- *National Automotive Sampling Systems (NASS).* Starting in 2009, NHTSA notified 24 NASS teams, located throughout the United States, of NHTSA's interest in LSV crashes. These teams conduct normal sampling activities and frequent tow and salvage yards. As of June 2010, one LSV crash (involving a 2002 Ford Think) had been submitted by the NASS teams.
- *Special Crash Investigations (SCI).* SCI teams have identified one LSV crash and have pursued additional information on three others that were classified as LSVs. The LSV crash occurred in a parking lot, involved only minor damage, and resulted in no injuries to the occupant of the LSV. The subsequent cases contained a vehicle that was identified as a LSV, but was later determined to be a golf cart or modified electric vehicle.
- *Not-in-Traffic Surveillance (NiTS).* NHTSA also examined its growing database of these types of crashes to see if it contained any LSV crashes. None were found.
- *National Electronic Injury Surveillance System (NEISS)* – Searches of 2008 and 2009 data were conducted using codes with possible application to NEVs. These codes covered motorized vehicles with 3 or more wheels, various types of all terrain vehicles, and utility vehicles. No incidents involving NEVs were found.

Applying Conventional Passenger Motor Vehicle Data to NEVs

Data on motor vehicle crash fatalities, and injuries from 2005-2009 that occurred on roads with a speed limit of 30 mph or less and on roads with a speed limit of 35 or 40 mph is presented in Exhibit 4 below. The data is broken down by year and the speed limit of the roads on which the crashes occurred.

Exhibit 7: Fatal and Injury Crashes on 30 mph or Less and 35 or 40 mph or Less Roads

	2005	2006	2007	2008	2009
FATAL CRASHES					
30 mph (48 kph) or less	3,920	3,864	3,842	3,705	3,277
35 or 40 mph (56 or 64 kph)	6,910	6,881	6,431	6,115	5,516
PERSONS KILLED					
30 mph (48 kph) or less	4,132	4,100	4,068	3,909	3,445
35 or 40 mph (56 or 64 kph)	7,330	7,330	6,861	6,512	5,858
INJURY CRASHES					
30 mph (48 kph) or less	373,000	347,000	359,000	350,000	323,000
35 or 40 mph (56 or 64 kph)	633,000	596,000	560,000	549,000	511,000
PERSONS INJURED					
30 mph (48 kph) or less	517,000	473,000	486,000	463,000	443,000
35 or 40 mph (56 or 64 kph)	953,000	896,000	826,000	804,000	753,000

Source: Traffic Safety Facts 2005 – 2008 and 2009 Early Edition

What is apparent from this data is the fact that the number of injury and fatality crashes, fatalities, and injuries on roads with a speed limit of 35 or 40 mph (56 or 64 kph) has consistently been significantly higher than the number of similar incidents on roads with a speed limit of 30 mph (48 kph) or less. If there were "expanded use" of NEVs on roads with a maximum speed limit of 40 mph (64 kph), a significant portion of the additional miles traveled by NEVs would likely occur on roads with a speed limit of 35 mph or 40 mph (56 or 64 kph). If significant numbers of NEVs were to use 35 mph or 40 mph (56 or 64 kph) roads, some of them would be involved in crashes on these roads, given the number of crashes that already occur. The Department would expect that deaths and serious injuries would occur at a higher rate (in terms of crashes per miles traveled, for example) for drivers and occupants of NEVs because those vehicles lack the full range of protections afforded by FMVSSs to drivers and passengers in conventional passenger motor vehicles.

The vehicles for which these statistics have been gathered are all required to comply with the full range of applicable FMVSSs. This includes those FMVSSs that require crash tests, which are typically conducted between 30 and 35 mph (48 and 56 kph). NEVs, which weigh less than conventional passenger motor vehicles and are not required to meet crash tests, will very likely perform significantly more poorly in crashes at these speeds than vehicles designed to meet those tests.

Safety Concerns

Currently, available crash, death, and injury data relating to the current use of NEVs is limited. While the available data do not seem to indicate a significant number of instances involving crashes of these vehicles, The Department believes this is related to the relatively low number of NEVs currently in use, the current conditions under which these vehicles tend to operate, and the low level of miles traveled annually. Based on the issues discussed below and given current NEV design, we believe there would be significant risk of serious injury to NEV occupants if their use is expanded to mixed traffic roadways with speeds up to 40 mph (64 kph).

Crash Energy

As indicated earlier, NHTSA and FHWA believe that NEV use outside controlled, low-speed environments may be limited by the fact that occupants do not want to travel in such vehicles at 25 mph (40 kph) in mixed traffic. NHTSA and FHWA strongly believe that the use of NEVs on roads with speed limits in excess of 25 mph (40 kph) represents a very likely safety risk. This is primarily because of engineering considerations. Even on roads with speed limits of 25 mph (40 kph), another vehicle that a NEV might encounter in a crash will likely be significantly heavier than the NEV. NEVs are equipped with only minimal safety equipment, nearly all of which is aimed at helping the NEV driver avoid crashes, and none of which is aimed at enhancing the crashworthiness of the vehicle. In addition, many NEVs are open on the side, making occupants of those vehicles particularly vulnerable to injury in a side crash or to being ejected from the vehicle.

On roads with speed limits greater than 25 mph (40 kph), the situation gets worse rapidly. Exhibit 8 below is based on a conventional passenger motor vehicle with an average curb weight striking an NEV with an average curb weight, with the motor vehicle traveling at the posted speed limit and the NEV traveling at 25 mph (40 kph). The average curb weight in the case of conventional passenger motor vehicles is based on 3,877 vehicles that have been rated under NHTSA's New Car Assessment Program since the early 1990s. The average curb weight for NEVs is based on an examination of information relating to vehicles manufactured by companies listed on the web site of the Electric Auto Association and for which curb weights were provided on the companies' web sites. A total of 22 vehicles were used to determine the average NEV curb weight. Each average NEV curb weight has been increased by 150 lbs. to account for the vehicle driver while no such adjustment has been made to account for occupants of conventional passenger motor vehicles. Values in the chart are based on the formula: Kinetic Energy = ½ Mass x Velocity^2. Miles per hour and pounds have been converted to metric units and the resulting calculation divided by 1,000 to get a calculation in Kilojoules.

Exhibit 8: Energy in Conventional Passenger Motor Vehicles and NEVs at Selected Speeds

Assumed speed of other vehicle	Kinetic Energy (Kilojoules) Average Motor Vehicle @ 3,749 lbs.	Kinetic Energy (Kilojoules) Average NEV @ 1,605 lbs.	Difference in Kinetic Energy Compared to NEV
25 mph (40 kph)	106.2	45.5	2.3 times higher
30 mph (48 kph)	152.9	45.5	3.4 times higher
35 mph (56 kph)	208.1	45.5	4.6 times higher
40 mph (64 kph)	271.9	45.5	6 times higher

Exhibit 8 demonstrates that there is a difference in kinetic energy between a conventional passenger motor vehicle with an average curb weight and a NEV with an average curb weight when both vehicles are traveling at 25 mph (40 kph). This difference in kinetic energy increases dramatically as the speed of the conventional passenger motor vehicle increases, until at 40 mph (64 kph) the kinetic energy is three times that of the NEV traveling at 25 mph (40 kph). Thus, occupants of an NEV hit by an average sized conventional passenger motor vehicle going 40 mph (64 kph) will be exposed to significantly more energy and have an increased risk of injury as compared to the occupants of the conventional passenger motor vehicle.

How the energy difference between an average conventional passenger motor vehicle traveling at 40 mph (64 kph) and an average NEV traveling at 25 mph (40 kph) will be dealt with in an actual crash will vary according to the circumstances of the crash. However, the disparity in energy between an average conventional passenger motor vehicle traveling at speeds between 25 and 40 mph (40 and 64 kph) and an average NEV travelling at 25 mph (40 kph) is such that the risk of injury to occupants of the NEV will be greater. This risk of injury to the NEV occupants is exacerbated by the fact that the NEV is not required to comply with the full set of safety requirements with which the faster moving conventional passenger motor vehicle must comply.

In addition to the concern over the disparity between the kinetic energy of an NEV and that of a conventional passenger motor vehicle at various speeds, there are two other engineering related safety concerns the Department has. One is the relative ability of an NEV to avoid a crash in faster moving traffic. The other is the ability of NEVs to resist rolling over.

Disadvantages of a Slower Moving NEV in a Potential Crash Situation

A vehicle with a maximum speed of 25 mph (40 kph) mixed in with vehicles traveling at up to 40 mph (64 kph) will be at a decided disadvantage in two ways. First, it will have substantially reduced ability to get out of the way of a faster moving vehicle because of its lower maximum speed and its reduced ability to accelerate. Second, it will be more vulnerable to crashes with faster moving vehicles if the driver of a faster moving vehicle believes a NEV is traveling at a rate consistent with the posted speed limit, but it is not since a NEV's maximum speed is 25 mph.

NEVs Have Poor Rollover Resistance

With a top speed of 25 mph (40 kph), NEVs may be less likely to end up in situations in which a single vehicle rollover crash might occur. However, NEVs' rollover properties are such that even at 25 mph (40 kph) the rollover risk for NEVs is greater than that for most conventional passenger motor vehicles.

NHTSA evaluated the safety aspects of two NEVs and a golf cart leading up to the 1998 final rule establishing FMVSS No. 500. The vehicles evaluated were what were then referred to as the Bombardier and the GEM (acronym for Global Electric Motorcars, the company that made the vehicle), and a Yamaha gasoline powered golf cart. The Bombardier is no longer manufactured while GEM (a wholly owned subsidiary of Chrysler Group LLC) has gone on to manufacture several other models.

Among the items evaluated was the Static Stability Factor (SSF) of the vehicles. For motor vehicles, SSF provides a measure of how likely a vehicle is to roll over if it is involved in a single vehicle crash and is used as a factor in rollover resistance ratings in NHTSA's New Car Assessment Program (NCAP). A vehicle's SSF is determined using the formula SSF= ½ Track Width x Height of Center of Gravity, where the track width of a vehicle is the measurement from the center of one tire to the center of the opposite tire on the same axle. The height of a vehicle's center of gravity is measured using a very expensive and sophisticated piece of equipment.

NHTSA found the following:

> The Bombardier, with an unloaded/loaded SSF of 1.4/1.2, indicated good stability even when loaded. The GEM and Yamaha had good SSFs when unloaded (1.0 and 1.3 respectively) but when ballasted to the equivalent of two adult male passengers these values dropped to a level that indicated a degree of instability and a tendency to roll (0.86 and 0.88, respectively).[53]

Conventional passenger motor vehicles are routinely measured for their SSF and dynamically tested to determine a rollover resistance rating from one to five stars as part of NCAP.

The method by which the SSF of the NEVs and the golf cart was determined when they were evaluated is different than that used by NCAP in that the SSF was measured with the NEV/golf cart empty and with the equivalent of two passengers in each of the vehicles. Nonetheless, the

[53] "Inspection and Testing of Low Speed Vehicles," National Highway Traffic Safety Administration, Vehicle Research and Test Center, August 1998, Technical Summary at page vii. Complete report may be seen at: http://www.nhtsa.gov/DOT/NHTSA/NRD/Multimedia/PDFs/VRTC/cw/lospeedveh.pdf

SSF values for the GEM and golf cart loaded with two passengers gives NHTSA concern for two reasons. First, the difference between the SSF of the unloaded and loaded vehicles was significant. In the case of conventional passenger motor vehicles, the difference between the SSFs of vehicles measured with the driver only and those measured loaded with the equivalent of five occupants is usually only several hundredths, which indicates that the stability of the vehicle is relatively unchanged by a substantial increase in the loading. In the case of the GEM and golf cart as well as the Bombardier, the difference between the SSF of the vehicle unloaded and loaded with two passengers was greater than a tenth, indicating that the stability of the vehicle changed markedly as a result of loading the vehicle with two passengers.

The second reason is that the SSFs of the GEM and golf cart are extremely low in comparison to the many conventional passenger motor vehicle SSFs that have been measured, which indicates a substantial risk of rollover. The lowest SSF ever recorded in the NCAP for a vehicle and driver was 0.92. This measurement was so low that it was off the statistical chart for determining a vehicle's risk of rolling over in a single vehicle crash. The vehicle was given a one star rating along with a footnote that explained that the risk of rollover over if the vehicle were involved in single vehicle crash was "greater than 65%."

Crash Tests Indicate Vulnerability of LSVs

While NHTSA has not conducted crash tests on LSVs to date, we note that other organizations have done so. The Insurance Institute for Highway Safety (IIHS)[54] recently conducted several crash tests of LSVs to demonstrate their vulnerability in impacts with vehicles weighing more than LSVs and traveling at speeds greater than a LSV's maximum speed of 25 mph (40 kph). The results of these tests were made public in a May 20, 2010 news release titled, "Low-speed vehicles and minitrucks shouldn't share busy public roads with regular traffic."[55]

The IIHS tested three small vehicles including two GEM e2 electric vehicles. The third vehicle tested was a 2008 Tiger Star minitruck. It is marketed as an off-road utility vehicle and is not certified as a LSV. The results of that crash test are therefore not reported here.

In the first GEM test, a moving barrier representing a pickup or SUV crashed into a GEM vehicle at 31 mph (50 kph). According to the IIHS release, "Dummy measures suggest severe or fatal injury to a real person." The IIHS noted that in the same barrier test of a Smart vehicle, the smallest passenger car on United States roads that complies with the full set of FMVSSs, the Smart's airbags and safety cage protected the test dummy from serious injury.

A second side crash test of a GEM vehicle was run with a Smart car crashing into a stationary GEM at 31 mph (50 kph). "The Smart's front intruded into the GEM's side so much that the

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[54] IIHS conducts a program under which it crash tests vehicles and issues safety ratings based on the results of those crash tests. The crash tests of LSVs referenced here were not conducted as part of the IIHS safety ratings program, but rather to provide consumers and others with information about LSVs.

[55] The release and video of IIHS crash tests of LSVs may be seen at: http://www.iihs.org/news/rss/pr052010.html.

belted dummy's head came close to hitting the Smart's windshield. The GEM dummy had injury measures indicating serious or fatal injury for real occupants," IIHS said.

Exhibit 9: A Smart Car Impacting the Side of a GEM e2 Vehicle at 31 mph

(INSURANCE INSTITUTE FOR HIGHWAY SAFETY PHOTO)

Transport Canada has also crash tested LSVs and in July 2008 released video of the crash tests it had conducted. In releasing the videos, Transport Canada expressed concerns similar to those expressed by IIHS. Two tests were conducted. One involved the frontal crash of an LSV into a rigid barrier at 40 kph (25 mph). In the other, a "mircocar" crashed into the side of an LSV at 50 kph (31 mph). "The test results to date confirm that low-speed vehicles provide a substantially lower level of occupant protection than conventional passenger cars and that the injury risk in these vehicles is disproportionate to the severity of crash."[56]

Recent Developments: NEV Transportation Plans in California

The record of the Department's examination of the experience with golf carts in Palm Desert, CA and Sun City, AZ has been described previously in the "Regulatory Background" section above. It will not be revisited here other than to note again that four fatalities involving golf cart operation in Sun City over the period of their being operated there were identified by NHTSA when it was considering adoption of FMVSS No. 500 while none were found in Palm Desert. NHTSA offered two possible explanations then for the disparity in the safety records of the two

[56] Statements regarding the safety of LSVs as well as video of LSV crash tests conducted by Transport Canada may be seen at: http://www.tc.gc.ca/eng/roadsafety/tp-tp2436-rs200803-menu-374.htm. There is no report of Transport Canada's testing of LSVs. The action taken by Transport Canada, based on information on its web site, seems to have been limited to release of footage of the crash tests conducted along with statements regarding the relative safety of these vehicles.

cities. The first was the drastic difference in the number of golf carts then in use in the two communities (250 in Palm Desert and 6,000 in Sun City). The second was the existence in Palm Desert of that city's Golf Cart Transportation Plan in which golf carts are permitted in lanes limited to bicycles and golf carts and to designated lanes shared with other vehicles whose speed is limited to 25 mph (40 kph). NHTSA noted, "By contrast, NHTSA understands that Sun City, under state law, allows golf cars to operate in the same lanes as larger traffic on any road with a maximum speed limit of 35 miles per hour." This information is consistent with two points made in this report. The first is that as NEV use on roads with speed limits above 25 mph (40 kph) increases, the number of crashes involving injuries or deaths is likely to increase. The second is that when NEV use is permitted on roadways with other traffic, the conditions under which this is allowed should be carefully considered.

As has been stated earlier, when NHTSA first created FMVSS No. 500, it envisioned that NEVs would be used primarily in settings other than on public roadways, such as in retirement communities, and on college, corporate, and medical campuses, and the like. NHTSA was aware of the Golf Cart Transportation Plan in Palm Desert and the fact that it allowed for the operation of golf carts with a maximum speed of 25 mph (40 kph) on public roadways in designated lanes. NHTSA stated at the time that, "The agency encourages other states and municipalities to study the features of the City of Palm Desert's plan, and to adopt those features to the extent practicable."

While encouraged by the experience of Palm Desert and the extent to which that city had established a seemingly adequately controlled environment for the operation of golf carts in designated lanes and on public roads with speed limits up to 25 mph (40 kph), NHTSA believed then and does now that the conditions that were created by Palm Desert's Golf Cart Transportation Plan represent a kind of outer limit beyond which NHTSA is less confident about the safety of NEV occupants.

With the creation of the NEV Transportation Plan in Lincoln, CA, as described earlier in this report, and what could be a model for other communities to follow, the question for NHTSA and others concerned about vehicle safety is: Will expanded use of NEVs, which involves the operation of NEVs on roadways with speed limits above the 25 mph (40 kph) maximum speed of NEVs in what will likely be steadily increasing numbers represent too great a departure from the conditions under which NHTSA envisioned these vehicles operating when it specified only a very minimal level of required safety equipment and performance for these vehicles? NHTSA is particularly concerned by the fact that the Lincoln NEV Transportation Plan envisions a category of roads (Class III) that allows for shared use with automobile traffic on streets with a posted speed limit of 35 mph or less. Operation of NEVs on 35 mph roads shared with automobiles is clearly beyond what NHTSA envisioned when it created the limited safety requirements for NEVs in FMVSS No. 500.

NHTSA notes that as of the date of the Lincoln report to the California legislature there were no safety related incidents involving NEVs in areas where the plan had been implemented, according to the report. However, the City of Lincoln's NEV Transportation Plan was far short of being fully implemented as of the date of the report.

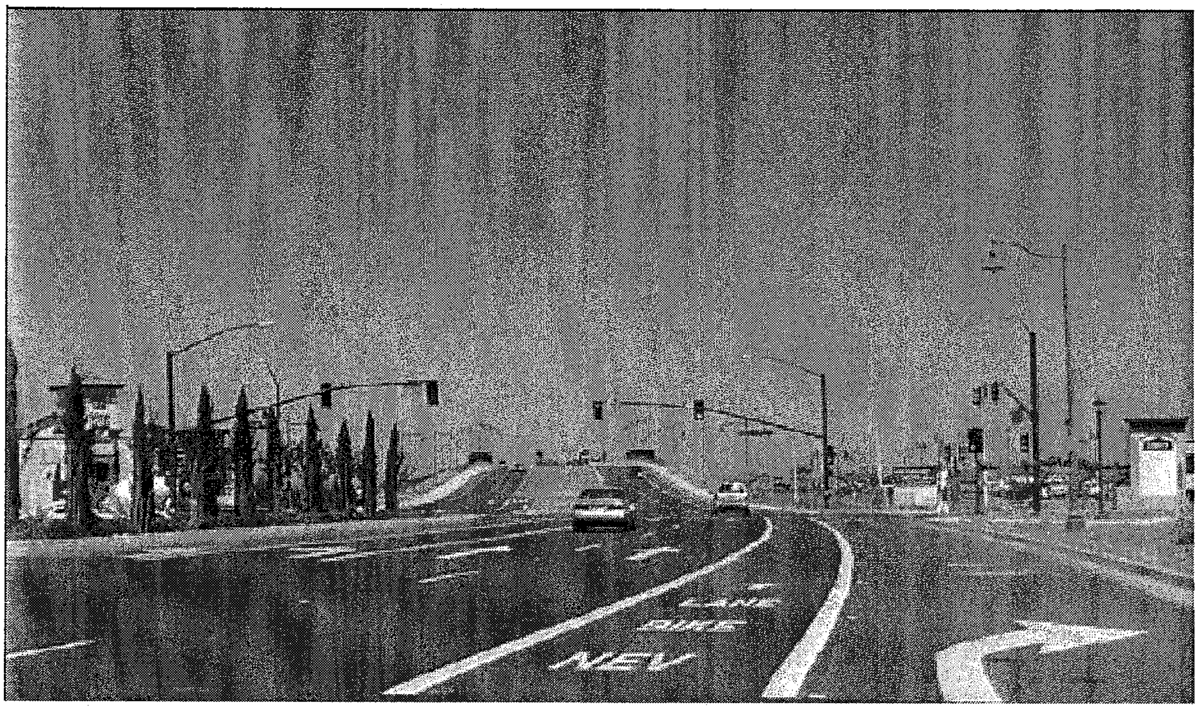

Exhibit 10: Roadway in Lincoln, CA Marked for NEV Use

The picture above is taken from the City of Lincoln's 2008 status report to the California legislature referenced earlier. It appears to be what would be categorized as Class II in the Lincoln NEV Transportation Plan. Class II NEV routes are designated as a separate striped lane adjacent to traffic. Even this Class II route raises concern. The NEV/Bike Lane, as indicated by the markings on the pavement, is the far right lane of what appears to be a total of five lanes of traffic, including the NEV/Bike lane. While the existence of an NEV/bike lane may help to assure that NEVs will not be operating in mixed traffic, it is clear from this photograph that they will be operating very near to mixed traffic. Beyond that, at this point in the roadway there is an exit lane, presumably for all traffic, which is to the right of the NEV/bike lane. This means that at some point prior to the point reflected in the photograph, mixed traffic will be crossing the NEV/bike lane to get to the exit lane. As this picture indicates, it is also likely that bicyclists could be exposed to both mixed traffic with NEVs in the same lane as well as conventional passenger vehicles attempting to cross their lane to make a right turn at the intersection. This may result in significant safety risk to bicyclists, as well as NEV occupants, due to the mixed-use nature and design of the lanes leading to the intersection. Therefore, the Department believes there may be unintended consequences regarding safety impact on bicyclists that should be considered as part of the development of NEV transportation plans.

Like the conditions created by the Palm Desert Golf Cart Transportation Plan, the Lincoln NEV Transportation Plan may minimize the exposure of NEV drivers and passengers to serious crashes. On the other hand, those conditions may expose NEV drivers and passengers to greater risks because of their proximity to mixed traffic. It is for this reason that NHTSA, as it indicated throughout the development of FMVSS No. 500 and subsequent decisions relating to it, will continue to monitor the safety record of NEVs. Should there be any suggestion that these vehicles are being operated under conditions that are resulting in increased safety concerns, NHTSA will look at increasing the safety requirements of these vehicles, including possibly requiring that these vehicles comply with a higher number and possibly all of the safety standards that apply to conventional passenger motor vehicles.

SECTION IV CONCLUSION

Fuel consumption savings that occur as a result of NEV operation represent a positive contribution to reducing the nation's dependence on fossil fuels. Our analysis here, however, suggests that the fuel consumption savings that currently occur as the result of NEV operation are negligible and those that would result from expanded use of NEVs are very limited. Even if NEV use expands to a level far above the current level of usage the projected fuel savings would still not exceed one half of one percent of annual United States gasoline consumption. In the mean time, other developments, such as electric vehicles that comply with all relevant Federal motor vehicle safety standards and further expansion of the market for hybrid vehicles, may make more rapid and significant contributions to fuel consumption savings.

In denying a September 28, 2008 petition to establish a class of vehicles that would have been called medium speed vehicles, NHTSA said, "NHTSA also considers fuel conservation an important goal. However, we believe that it is neither necessary nor appropriate to significantly increase the risk of deaths and serious injuries to save fuel." The Department, with safety as its highest priority, continues to believe this statement to be true.

When NHTSA created FMVSS No. 500 in 1998 as the sole Federal motor vehicle safety standard applicable to low speed vehicles, nearly all of which are Neighborhood Electric Vehicles (NEVs), it did so in the firm belief that these vehicles would be restricted to operation in controlled, low speed environments, not in mixed traffic found on roadways used for normal vehicle traffic. Limiting the safety equipment required on NEVs was supported by the evidence then which indicated these vehicles were being operated predominantly in such environments. Even under the conditions that existed in 1998, NHTSA recognized the importance of monitoring sources of data and anecdotal information for indications of a NEV safety problem.

Among the factors that concern the Department and require that NEVs be operated only in carefully controlled low speed environments are:

- The kinetic energy produced by a conventional passenger motor vehicle, which weighs appreciably more than the typical NEV and is capable of travelling at speeds higher than a NEV, is considerably higher than that produced by a NEV at speeds between 25 mph (40kph) and 40 mph (64 kph). This means that in a crash between a conventional passenger motor vehicle and a NEV, the occupants of the NEV will be at greater risk of serious or fatal injury.
- Conventional passenger motor vehicles comply with all applicable Federal motor vehicle safety standards, which include those aimed at protecting vehicle occupants during a crash. NEVs currently do not. These standards save lives. NHTSA estimates that in 2005, on roads posted at 35 mph (56 kph) or lower, 1,921 crash victims survived because the vehicles were compliant with all FMVSSs, including 278 saved by air bags. In crashes on roads posted at 45 mph (72 kph) or lower, 3,163 lives were saved because the

vehicles involved were compliant with all FMVSSs. Of those, 414 were saved by air bags.

- National crash data make clear that the number of crashes, fatalities, and injuries on roads with a speed limit of 35 or 40 mph (56 or 64 kph) has been consistently and significantly higher than the number of similar incidents on roads with a speed limit of 30 mph (48 kph) or less. If NEV use were to expand considerably because of additional NEVs operating on or near roadways with a maximum speed limit of 40 mph (64 kph), the Department is concerned that additional NEVs would begin showing up in the statistics for crashes on these roads. While NHTSA has not crash tested NEVs to date, based on test results from the Insurance Institute for Highway Safety and Transport Canada, it is apparent there is significant risk for serious injury to NEV occupants at speeds above 25 mph (40 kph).

As we have since FMVSS No. 500 was adopted, we will continue to monitor data and anecdotal information for any signs of a developing NEV safety problem. If it determines a safety problem exists, NHTSA, to fulfill its mission to reduce deaths and injuries resulting from traffic crashes, would consider increasing the safety requirements for NEVs, including possibly requiring that they meet the same Federal motor vehicle safety standards as conventional passenger motor vehicles.

APPENDICES

Appendix A: FMVSS No. 500

Title 49: Transportation
PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS
Subpart B—Federal Motor Vehicle Safety Standards

§ 571.500 Standard No. 500; Low-speed vehicles.

S1. *Scope.* This standard specifies requirements for low-speed vehicles.

S2. *Purpose.* The purpose of this standard is to ensure that low-speed vehicles operated on the public streets, roads, and highways are equipped with the minimum motor vehicle equipment appropriate for motor vehicle safety.

S3. *Applicability.* This standard applies to low-speed vehicles.

S4. [Reserved.]

S5. *Requirements.*

(a) When tested in accordance with test conditions in S6 and test procedures in S7, the maximum speed attainable in 1.6 km (1 mile) by each low-speed vehicle shall not more than 40 kilometers per hour (25 miles per hour).

(b) Each low-speed vehicle shall be equipped with:

(1) Headlamps,

(2) Front and rear turn signal lamps,

(3) Taillamps,

(4) Stop lamps,

(5) Reflex reflectors: one red on each side as far to the rear as practicable, and one red on the rear,

(6) An exterior mirror mounted on the driver's side of the vehicle and either an exterior mirror mounted on the passenger's side of the vehicle or an interior mirror,

(7) A parking brake,

(8) A windshield that conforms to the Federal motor vehicle safety standard on glazing materials (49 CFR 571.205).

(9) A VIN that conforms to the requirements of part 565 *Vehicle Identification Number* of this chapter, and

(10) A Type 1 or Type 2 seat belt assembly conforming to Sec. 571.209 of this part, Federal Motor Vehicle Safety Standard No. 209, *Seat belt assemblies,* installed at each designated seating position.

S6. *General test conditions.* Each vehicle must meet the performance limit specified in S5(a) under the following test conditions.

S6.1. *Ambient conditions.*

S6.1.1. *Ambient temperature.* The ambient temperature is any temperature between 0 °C (32 °F) and 40 °C (104 °F).

S6.1.2. *Wind speed.* The wind speed is not greater than 5 m/s (11.2 mph).

S6.2. *Road test surface.*

S6.2.1. *Pavement friction.* Unless otherwise specified, the road test surface produces a peak friction coefficient (PFC) of 0.9 when measured using a standard reference test tire that meets the specifications of American Society for Testing and Materials (ASTM) E1136, "Standard Specification for A Radial Standard Reference Test Tire," in accordance with ASTM Method E 1337–90, "Standard Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire," at a speed of 64.4 km/h (40.0 mph), without water delivery (incorporated by reference; see 49 CFR 571.5).

S6.2.2. *Gradient.* The test surface has not more than a 1 percent gradient in the direction of testing and not more than a 2 percent gradient perpendicular to the direction of testing.

S6.2.3. *Lane width.* The lane width is not less than 3.5 m (11.5 ft).

S6.3. *Vehicle conditions.*

S6.3.1. The test weight for maximum speed is unloaded vehicle weight plus a mass of 78 kg (170 pounds), including driver and instrumentation.

S6.3.2. No adjustment, repair or replacement of any component is allowed after the start of the first performance test.

S6.3.3. *Tire inflation pressure.* Cold inflation pressure is not more than the maximum permissible pressure molded on the tire sidewall.

S6.3.4. *Break-in.* The vehicle completes the manufacturer's recommended break-in agenda as a minimum condition prior to beginning the performance tests.

S6.3.5. *Vehicle openings.* All vehicle openings (doors, windows, hood, trunk, convertible top, cargo doors, etc.) are closed except as required for instrumentation purposes.

S6.3.6. *Battery powered vehicles.* Prior to beginning the performance tests, propulsion batteries are at the state of charge recommended by the manufacturer or, if the manufacturer has made no recommendation, at a state of charge of not less than 95 percent. No further charging of any propulsion battery is permissible.

S7. *Test procedure.* Each vehicle must meet the performance limit specified in S5(a) under the following test procedure. The maximum speed performance is determined by measuring the maximum attainable vehicle speed at any point in a distance of 1.6 km (1.0 mile) from a standing start and repeated in the opposite direction within 30 minutes.

[63 FR 33216, June 17, 1998, as amended at 68 FR 43972, July 25, 2003]

Appendix B: Highlights Relating to Perceived Safety of NEV Operating Conditions from 2007 Survey by City of Lincoln, CA[57]

In presenting results of its survey, the City of Lincoln commented, "it is clear that this study did not capture a representative sample of Lincoln residents and should not be used for generalizations beyond this evaluation."

Survey Respondent Summary Statistics

	148 respondents, 94 of which operated NEVs
Gender	63% Male / 37% Female
Average Age	63 years
Martial Status	82% Married / 14% Single
Employment Status	75% retired / 12% part-time / 10% full-time
Avg. Number of Workers in Household	0.4 persons
Avg. Annual Household Income (approx)	$84,000
Avg. Auto Ownership (not including NEVs)	1.7 vehicles

Perceived Safety of NEV Facilities by NEV Users

	Roads with *shared* lanes for NEVs and autos	Roads with *separate* lanes for NEVs and autos	Paths restricted only to NEVs
Very Safe (5)	13 (16.67%)	54 (69.23%)	70 (89.74%)
Somewhat Safe (4)	32 (41.03%)	22 (28.21%)	3 (3.85%)
Neither Safe nor Unsafe (3)	11 (14.10%)	0 (0%)	0 (0%)
Somewhat Unsafe (2)	16 (20.51%)	1 (1.28%)	0 (0%)
Very Unsafe (1)	3 (3.85%)	0 (0%)	0 (0%)
No Basis to Judge	3 (3.85%)	1 (1.28%)	5 (6.41%)
Mean	3.48	4.68	4.96

[57] These survey results are contained in "A Report to the California State Legislature *as required by* Assembly Bill 2353 (Chapter 422, Section 1. Chapter 7) Neighborhood Electric Vehicle Transportation Plan Evaluation," prepared by Kevan Shafizadeh, Ph.D., P.E., PTOE, and Kimberly Fox, California State University, Sacramento, and John E. Pedri, P.E., Director of Public Works/City Engineer, The City of Lincoln, January 1, 2008.

Appendix C: Data Sources Generally Have Little or No LSV Information

NHTSA's Crash Investigations Division (CID), Special Crash Investigations Section (SCI)

In mid-2009, the Special Crash Investigations (SCI) section of NHTSA's Crash Investigations Division (CID) was asked to track Low Speed Vehicle (LSV) crashes. SCI initiated a three-phase plan: 1) Analyze 64 police reports (calendar year 2007) provided by NHTSA's Fatality Analysis Reporting System (FARS); 2) encourage the 24 Crashworthiness Data System (CDS) teams in the National Automotive Sampling System (NASS) to look for LSV crashes in their primary sampling jurisdictions; 3) utilize the resources of the three SCI teams to identify LSV crashes within their assigned regions. The results of these efforts are summarized below.

Analysis of FARS reports

CID requested police accident reports (PARs) from four states (AZ, CA, FL and TX) that were thought likely to have more LSVs on the road. The cases were identified using vehicle body type and make information in the 2007 FARS data file. Under current FARS coding rules, LSVs would have a body type of "other." Therefore, the 15 cases of vehicles in fatal crashes listed as an "other" body type were selected. This search identified seven golf carts, three go karts, two all terrain vehicles, a dune buggy, a street sweeper, and a boom lift, but no LSVs.

The search was expanded to other categories in case an LSV had been assigned a body type code besides "other." The search included passenger (light duty) vehicles with a vehicle make of "other" or "unknown," construction equipment, vehicles with an unknown body type but a known make, and cases of unknown make and unknown body type. (Records for hit-and-run vehicles were excluded.) This produced an additional 49 cases for analysis. After reviewing these reports, none of the identified vehicles was an LSV.

In addition to the analysis of FARS PARs, NHTSA's Mathematical Analysis Division (MAD) searched the 2005 through 2008 FARS files for Vehicle Identification Numbers (VINs) that matched a World Manufacturer Identifier (WMI) for manufacturers of LSVs. One vehicle was identified as an LSV in a fatal crash in Arizona in 2008. SCI obtained the PAR in April 2010. Preliminary review indicates that the vehicle was originally sold as a golf cart, was modified to be an LSV, but that the owner removed much of the safety equipment required by FMVSS No. 500.

NASS System

In 2009 the 24 NASS CDS teams were notified of NHTSA's interest in LSV crashes. These teams are geographically located throughout the country and it was supposed that through the teams' normal sampling activities and their weekly visits to tow and salvage yards, LSV crashes, if they were occurring frequently, would be identified. As of June 2010, only one LSV crash has been identified by the NASS system.

The crash occurred in Ann Arbor, Michigan and was selected for follow-up research by the team in that locale. The crash involved a 2002 Ford Think that impacted a utility pole with its front left corner. The impact fractured the front left wheel from the axle and resulted in minor surface damage to the fender and adjoining areas of the vehicle. The two occupants who were seated in the front seats were using their lap and shoulder safety belts. Despite the restraint use, the driver, a 53-year-old female (5'0 feet tall and 115 lbs in weight), contacted the steering wheel rim and sustained a fracture of the left aspect of her maxilla, as well as multiple soft tissue contusions to her face. She was transported to a local hospital for treatment and released the same day. The front right passenger, a 19-year-old female (4'9" tall and 80 pounds in weight), was uninjured.

SCI Teams

The SCI program has identified one LSV crash and is pursuing additional information on several other potential LSV crashes that were later deemed to be golf carts. The LSV crash occurred in Ohio and involved a 2005 GEM that sustained minor damage in a low-speed parking lot crash with a 2008 Toyota Camry. Since the damage was minor, the crash occurred on private property, and the occupant of the LSV sustained no injuries, SCI did not pursue the case further. Three subsequent crashes where the vehicle was identified as an LSV turned out to be golf carts or modified electric vehicles.

The main obstacle SCI has faced in identifying LSV crashes has been the lack of available data. SCI has attempted to use existing resources, principally the on-site field personnel, to search for data on LSV crashes, but as of June 2010, only one LVS crash has surfaced. Further ancillary methods were employed such as monitoring the websites of national salvage facilities (IAA, CoPart, etc.); however, these methods also failed to produce any LSV crashes. SCI will continue to use these methods and will, when opportunities arise, communicate directly with police jurisdictions in areas where LSV usage is likely to be higher (i.e., warmer weather regions).

Low Speed Vehicles in NHTSA's State Data System

In addition to searching for fatal crashes involving LSVs in FARS, NHTSA also has begun to research its State Data System to identify crashes involving these vehicles. The State Data System is a collection of computerized crash data files provided by 32 participating States. Currently Florida is the only participating state that has a body type code for Low Speed Vehicle on its State Police Accident Report. (California has Low Speed Vehicle as a body type on the PAR for the CA Highway Patrol but not on the PAR used by local police jurisdictions.) A search of the five most recent years of Florida data files (2003 – 2007) indicated a possible 942 LSVs in police-reported crashes with varying degrees of severity. However, comparison of the LSVs identified using the vehicle type code with the Vehicle Identification Number (VIN) and the police-reported vehicle make indicated that many of the vehicles were actually golf carts and not LSVs even though the FL PAR instruction manual specifically states that a golf cart is not an LSV and golf carts should be consider an "other" vehicle type. To attempt to verify the accuracy of the police-reported body type, NHTSA turned to the vehicle identification numbers. NHTSA compiled a list of the World Manufacturer Identifiers (WMIs) for all of the known LSV manufacturers and compared this list to the VINs recorded by the police. In 243 cases, the police did not record a VIN. In another 391 cases, the entry in the VIN field did not have enough characters to be a full VIN. Upon further investigation, many of these 391 entries contained patterns consistent with the serial numbers for popular golf cart manufacturers. Based upon the VIN pattern of the remaining 308 vehicles, only 21 vehicles matched VIN patterns for LSVs. The breakdown of these 21 vehicles is as follows:

13 Global Electric Motorcars (GEM)

6 Barton Investment Group

1 LA Concept Cars

1 Western Golf Car Manufacturing Company

The injury distribution for the 37 occupants of these 21 LSVs in police reported crashes is as follows:

19 No Injuries

1 Possible Injury

10 Non-incapacitating Injuries

3 Incapacitating Injuries

4 Injuries Severity Unknown

While the above distribution provides evidence that a large percentage of LSV occupants is injured in police report crashes, it is difficult to know how many other LSVs may be involved in crashes. It is possible the police did not copy the VIN, copied the VIN incorrectly, or selected the wrong body type for the LSV. NHTSA will continue to explore the files in the State Data System for ways to better identify and collect information about crashes involving LSVs.

Not-in-Traffic Crashes

NHTSA also examined its growing database of not-in-traffic crashes to see if it contained any LSV crashes. None were found.