TP 13942E

Assessment of Low-Speed Electric Vehicles in Urban Communities

Pilot Project

Prepared for
Transportation Development Centre
Transport Canada

by
Centre for Electric Vehicle Experimentation in Quebec (CEVEQ)

April 2002

CEVEQ

Centre d'expérimentation des véhicules électriques du Québec

Centre for Electric Vehicle Experimentation in Québec

TP 13942E

Assessment of Low-Speed Electric Vehicles in Urban Communities: Pilot Project

by
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April 2002

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16. Abstract

This report presents the findings and recommendations resulting from a project assessing low-speed electric vehicles (LSVs) carried out in the City of St. Jérôme, Quebec, from August 10 to November 2, 2001. The project's main objective was to assess the integration of LSVs into urban traffic from the perspectives of safety and reliability.

To carry out the project, the Centre for Electric Vehicle Experimentation in Quebec (CEVEQ), the project proponent, requested the support of various partners and LSV manufacturers. A total of seven LSVs, provided by four manufacturers, were made available to 53 volunteers for testing purposes.

The volunteer LSV drivers were asked to drive the vehicles for a week on city streets with 50-km/h speed limits within the boundaries of the City of St. Jérôme, which covers an area of 89 km^2. At the end of this period, the LSV drivers had to fill out a detailed questionnaire and submit their comments. Another group consisting of 126 road users (pedestrians and motorists) were asked to give their impressions of how well they thought these vehicles integrated into urban traffic.

The project had a number of secondary objectives, including: conduct research with respect to a regulatory framework; assess interest in LSVs as a mode of urban transportation; support new less-energy-consuming and non-polluting modes of transportation; and promote vehicles that are consistent with the strategy to reduce greenhouse gas emissions.

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16. Résumé

Ce rapport présente les résultats et les recommandations émanant d'un projet d'évaluation de véhicules électriques à basse vitesse (VBV) tenu dans la ville de Saint-Jérôme, au Québec, du 10 août au 2 novembre 2001. Le principal objectif de ce projet consistait à évaluer l'intégration des VBV, sous l'angle de la sécurité et de la fiabilité dans le flot de la circulation urbaine.

Pour ce faire, le Centre d'expérimentation des véhicules électriques du Québec (CEVEQ), initiateur du projet, a sollicité l'appui de divers partenaires et manufacturiers de VBV. Au total, sept VBV de quatre manufacturiers ont été mis à la disposition de 53 volontaires pour en faire l'essai.

Les utilisateurs étaient invités à utiliser le véhicule pendant une semaine pour se déplacer en milieu urbain, sur les routes dont la limite de vitesse était fixée à 50 km/h, à l'intérieur de la ville de Saint-Jérôme couvrant une superficie de 89 km^2. À la fin de cette période, les utilisateurs devaient remplir un questionnaire détaillé et formuler leurs commentaires. Visant le même objectif, 126 autres personnes, piétons ou automobilistes usagers de la route ont également donné leurs impressions quant à l'intégration de ces véhicules sur les routes.

Le projet comportait un certain nombre d'objectifs secondaires, dont : la recherche d'un cadre réglementaire; l'évaluation de l'intérêt du VBV comme moyen de transport urbain; l'appui à l'émergence de moyens de transport moins énergivores et non polluants; la promotion de véhicules s'inscrivant dans la stratégie de réduction des GES.

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We would like to thank Bell Canada for kindly lending two neighbourhood electric vehicles (NEVs) from its car fleet to assist with the project.

We would also like to thank all of the LSV drivers for their diligent and very enthusiastic participation in this study, and all road users who kindly took the time to fill out our questionnaires.

We thank the City of St. Jérôme for its support in setting up the Assessment of Low-Speed Electric Vehicles in Urban Communities project.

Our thanks also go out to the MIRA Foundation for its interest and active participation in the project.

Lastly, we would like to thank Transport Quebec and Transport Canada's Transportation Development Centre (TDC) for their help and cooperation to ensure the project was carried out smoothly.

EXECUTIVE SUMMARY

Background

In response to increased pollution and road congestion throughout the world, a new concept in urban mobility seems to be developing that will make way for cleaner, less energy-consuming, smaller vehicles that are easy to drive and suited to urban communities.

Since 1998, the National Highway Traffic Safety Administration (NHTSA) has defined a low-speed vehicle (LSV) in the United States as "a 4-wheeled motor vehicle, other than a truck, whose attainable speed is more than 32 km/h (20 mph) and not more than 40 km/h (25 mph)." To date, about 30 American states have authorized the use of LSVs mostly on roads with speed limits of 56 km/h (35 mph). Thirteen of these states limit the on-road use of LSVs to electric LSVs exclusively. However, U.S. municipalities enjoy full latitude to restrict the on-road use of LSVs to certain areas of their jurisdictions.

In the summer of 2000, Transport Canada adopted regulations comparable to those in force in the United States, except that it authorized only completely non-polluting LSVs powered by electric motors. The provinces may eventually determine and adopt appropriate standards so that LSVs may be registered and authorized for use on some public thoroughfares.

Project

The main objective of the Assessment of Low-Speed Electric Vehicles in Urban Communities project, initiated and managed by the Centre for Electric Vehicle Experimentation in Quebec (CEVEQ), was to assess the integration of LSVs into urban traffic from the perspectives of safety and reliability.

The main organizing and funding partners of this project were Transport Quebec and Transport Canada's Transportation Development Centre (TDC). The City of St. Jérôme, Hydro-Québec Laurentians and official suppliers – Global Electric Motorcars, Bombardier Inc., Dynasty Motorcar Corporation and Feel Good Cars Inc. – also contributed to the project and ensured that it went smoothly.

During a 12-week period, seven LSVs provided by four manufacturers were driven in the City of St. Jérôme, which has a population of 60,764 and covers an area of 89.3 km^2. The vehicles were driven a total of 6,067 km. The study was used to gather public opinion on the risks related to using these vehicles in normal city traffic.

A total of 53 participants from various backgrounds drove the LSVs for one-week periods and filled out the evaluation questionnaire. In addition, 126 people, including police officers and taxi drivers, were given the opportunity to submit their impressions of how well these vehicles integrated into city traffic.

When the pilot project was set up, LSVs were completely unknown to the residents of St. Jérôme. Appropriate signage was erected and an information campaign promoting caution was launched to raise public awareness of this new class of vehicles.

Study Findings

The information collected from the questionnaires filled out by the drivers and road users was compiled and analysed. It was then discussed during a focus group meeting attended by representatives of the two groups and project partners.

Safety Aspects

The study showed that the level of safety felt by the drivers varied depending on the type of road and urban area. It was found that roads considered less safe for LSVs were those with 50-km/h speed limits where the actual speed of traffic was usually higher, and roads with single-lane traffic in areas where passing posed a greater risk. In all, 56 percent of the LSV drivers said they felt safe at all times while driving the vehicles.

When the findings were analysed, it was found that one third of the LSV drivers felt the vehicles should have doors so that they would have a greater feeling of protection in the event of a collision. In addition, 66 percent of the LSV drivers felt that identifying signage on the LSVs increased their feeling of safety on the road.

Moreover, 64 percent of the LSV drivers said that the LSVs did not go fast enough to keep up with the flow of traffic at all times. In more specific terms, 97 percent suggested that the top speed of the vehicles should be increased. However, 47 percent of the road users felt that 40 km/h was an appropriate speed in the city.

Technical Characteristics

A total of 77 percent of the LSV drivers were pleasantly surprised by these small cars. Acceleration, attractiveness and vehicle handling were seen as the main strong points. However, vehicle range was the most criticized aspect.

It was found that additional features would make the vehicles safer – doors, a reliable power gauge, defogging equipment, windshield washers and a positive locking system to prevent the wheels from moving when the vehicles are stopped.

Urban Transportation Mode

St. Jérôme residents were very attracted to the idea of small, clean, silent-operating vehicles. In fact, 83 percent of the LSV drivers and 89 percent of the road users felt that LSVs had their place in the city. However, representatives of the MIRA Foundation said that in order to take persons with visual impairments into account, LSVs could be equipped with an appropriate system to warn people of their approach.

In all, 64 percent of the LSV drivers were interested in buying an LSV, although one third of them said they would wait until some improvements were made.

Conclusions

We were aware by the end of the tests that the LSV drivers and the public liked the LSV concept. Because this vehicle is new on the market, it is important that its introduction to on-road use be accompanied by regulations, adequate safety measures and better matching of the product to consumer needs. LSVs designed for the lifestyles of American retirement and other “gated” communities do not always meet the requirements of working people who could use an LSV to replace the second family car.

We found that LSVs in their current configurations cannot be allowed unrestricted use in all municipalities nor on all road systems, even urban road systems. However, we believe that LSVs are vehicles that meet both individual and community needs, can be safely driven in traffic and have their place in urban communities.

Recommendations

The Assessment of Low-Speed Electric Vehicles in Urban Communities project enabled us to develop the following recommendations for various manufacturers and levels of government.

Federal Government

- Require that the vehicles be able to maintain a minimum speed (32 km/h) in hilly road conditions.
- Require that additional safety features, such as motor brake systems, windshield wipers and defogging systems, be installed on all LSVs equipped with doors.
- Conduct studies to assess the impact of increasing the top speed of LSVs to 50 km/h.

Provincial Government

- Authorize the use of LSVs in areas with 50-km/h and lower speed limits, except in areas where actual known speeds are higher than authorized speeds (e.g., major arterial roads).
- Have municipalities participate in each phase leading up to the government's possible authorization of LSV use on municipal roads.
- Prepare a guide for municipalities to help them facilitate the introduction of LSVs in municipal areas.
- Prohibit the use of LSVs in winter, except in cases where LSVs are adapted to winter conditions.
- Require the same driver's licence and minimum age requirement for LSVs as for passenger cars.
- Conduct a national awareness campaign focussing on safety and environmental benefits.

Municipal Authorities

- In accordance with a guide prepared by Transport Quebec, determine which roads are safe for LSVs before allowing their on-road use within municipal boundaries.
- Introduce various measures and incentives to promote the on-road use of LSVs.

Manufacturers

- Improve technical components to ensure greater safety, such as highly reliable power gauges, battery depletion threshold warning indicators and additional safety accessories.

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1 BACKGROUND

1.1 Introduction

In response to increased pollution and road congestion throughout the world, a new concept in urban mobility seems to be developing that will make way for cleaner, less energy-consuming, smaller vehicles that are easy to drive and suited to urban communities.

In retirement and other “gated” communities in the United States in the early 1990s, golf carts with speeds of no more than 20 km/h became increasingly popular for running short errands. However, in response to an increase in accidents caused by excessively low speeds[1] and to the attraction of this new mode of transportation for retirees, government authorities and U.S. manufacturers studied the issue to provide users with a safe product that met their needs.

In response to lobbying from Bombardier, which was manufacturing neighbourhood electric vehicles (NEVs) at the time, the United States adopted regulations in 1998 recognizing low-speed vehicles (LSVs) as full-fledged vehicles. LSVs are defined by the National Highway Traffic Safety Administration (NHTSA) as “a 4-wheeled motor vehicle, other than a truck, whose attainable speed is more than 32 km/h (20 mph) and not more than 40 km/h (25 mph)”. Thus far, about 30 American states authorize the unrestricted on-road use of LSVs on certain roads, most of them with speed limits not exceeding 56 km/h (35 mph). Of this number, 13 restrict the on-road use of LSVs to electric LSVs exclusively.[2]

In the summer of 2000, Transport Canada approved an amendment to the Canada Motor Vehicle Safety Act authorizing the sale of LSVs powered exclusively by electric motors. The provinces may eventually adopt and define appropriate standards so that LSVs can be registered and authorized for use on some public thoroughfares.

The Canadian Council of Motor Transport Administrators (CCMTA) has also set up a working committee to establish a framework for the on-road use of low-speed vehicles. However, many questions about requirements to be met need to be asked before LSVs can be introduced on our streets and highways.

Starting in 1998 and 1999, LSVs have been test-driven on some Quebec roads on a trial basis. However, earlier studies did not take into account certain parameters for assessing the actual on-road use of LSVs: unrestricted on-road testing of the vehicles in an average-sized city, at any time of the day or night, by a varied sample of people.

The Assessment of Low-Speed Electric Vehicles in Urban Communities project, initiated and managed by the Centre for Electric Vehicle Experimentation in Quebec (CEVEQ), involved the on-road use of seven LSVs in the City of St. Jérôme, which has a population of 60,764[3] and covers an area of 89.3 km^2, for a 12-week period (from August 10 to November 2, 2001).

1.2 Mandate

CEVEQ’s mandate for this study consisted of the following :

- Determine the scope of the demonstration/assessment project with the partners;
- Look for LSV suppliers that comply with Transport Canada regulations;
- Consult key authorities (police forces and traffic officials) to plan, set up and carry out the project while giving priority to the safety of the operation;

1 National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, Federal Motor Vehicle Safety Standard No. 500, June 1998
2 National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, 49 CFR, 1998
3 Directory of Quebec Municipalities: see Web site of the Quebec Department of Municipal Affairs and Greater Montreal (MAMM)

- Determine the impact on the safety of LSV drivers and road users in an actual use context;
- Target potential users;
- Train and supervise drivers;
- Develop and propose promotional tools;
- Coordinate relations with the media;
- Design questionnaires and logbooks;
- Produce an assessment report based on data collected from questionnaires filled out by the participants;
- Manage the operation's budget.

1.3 Partners and Suppliers

1.3.1 CEVEQ: Project Proponent and Manager

CEVEQ, established in 1996, is a non-profit private corporation whose mission is to promote the use of electric vehicles (Evs) or hybrid vehicles from the perspective of environmental and economic benefits and of energy efficiency.

CEVEQ's mission consists of the following :

- Manage EV assessment and demonstration projects;
- Participate in industrial development projects;
- Test EVs and components in actual climate and on-road use conditions;
- Promote efficient, non-polluting modes of transportation;
- Develop EV maintenance expertise;
- Help develop technical training with specialized organizations.

1.3.2 Organizing and Funding Partners

The main organizing and funding partners for this study were Transport Quebec and Transport Canada's Transportation Development Centre (TDC).

Transport Quebec provided support for the project, which will be useful in the search for a regulatory framework that takes into account driver safety, LSV on-road use requirements and environmental concerns. Transport Quebec is firmly in step with government strategies to reduce greenhouse gas emissions (GGEs) and takes an active part in implementing the 2000-2002 Quebec Action Plan on Climate Change, which specifically promotes the use of more energy-efficient and environmentally friendly vehicles.

The Government of Canada is committed to promoting the development of alternative fuels and technologies in the urban transportation field in order to contribute to international efforts to reduce greenhouse gas emissions. TDC participated in the project because of its interest in fostering the development of clean, safe transportation systems and assessing the impact of LSV use on urban communities.

The other funding partners were the City of St. Jérôme, which is recognized as Quebec's host city for pilot projects involving the testing and assessment of electric vehicles and is intent on helping to develop and introduce non-polluting vehicles, and Hydro-Québec, which, as North America's leading electricity producer, is interested in developing an electrically powered transportation network.

1.3.3 Supplier Partners

Bombardier Inc.

Bombardier's Recreational Products Division began producing NEVs in 1997. A pioneer in this lucrative new market, Bombardier spearheaded the regulations in force in the United States. Although the NEVs were produced in Sherbrooke, they were intended primarily for distribution in the United States, mostly in California and Florida, which have large numbers of retirees and gated communities.

Global Electric Motorcars, LLC (GEM)

GEM, with operations in North Dakota in the United States, is a recognized leader in the manufacture of low-speed electric vehicles. GEM has manufactured over 7,000 LSVs since it was established in 1998 and is now part of the Daimler-Chrysler Group.

Dynasty Motorcar Corporation

Dynasty designs, manufactures and markets its line of LSVs for urban, recreational and commercial markets. Founded in 1998, the company has its head office and manufacturing plant in Kelowna, British Columbia. The company began selling its IT sedan in April 2001.

Feel Good Cars Inc.

A Canadian company founded in 2000 and located in Toronto, Feel Good Cars specializes in vehicle restoration and electrification. The company has just converted a small LSV-class vehicle from European manufacturer Microcar into a 100-percent electric vehicle. The company is planning to set up its production plant in the Laurentians area of Quebec.

1.4 Project Objectives

1.4.1 Overall Objectives

The project's objective was to assess the integration of low-speed electric vehicles into urban traffic.

A parallel objective was to promote "green" vehicles and make motorists and the general public more aware of the problems of greenhouse gas emissions and climate change.

1.4.2 Specific Objectives

For the public

- Assess LSV performance from the perspectives of safety and reliability.
- Make target clienteles (LSV drivers and road users) more aware of the impact of this new mode of transportation.
- Ascertain public interest in using the product for short-distance travel in urban areas.

For partners

- Promote the use of a less energy-consuming mode of transportation.
- Assess various types of products in terms of safety.
- Promote vehicles that fit in with the strategy to reduce GGEs.
- Carry out comparative tests and obtain statistics.
- Help conduct research to establish a regulatory framework based on actual tests.

1.5 Scope

It should first be explained that the study did not focus on LSV safety aspects such as traffic rules, risk exposure, accident and injury risks, protection of passengers, etc. Instead, the study sought to obtain public opinion regarding the risks related to using these vehicles in normal motor vehicle traffic in an urban centre such as St. Jérôme.

During the 12-week test period, seven LSVs were driven on St. Jérôme streets for test periods lasting from 2 to 12 weeks, depending on the availability of the loaned vehicles.

In all, 53 participants from various backgrounds drove LSVs for one-week periods and filled out evaluation questionnaires. About 50 other people tried out the vehicles during a one-day demonstration. There was also a group of 126 people, including police officers and taxi drivers, who gave their impressions of how well these vehicles integrated into city traffic.

Four companies provided LSVs, making it possible to test various types of LSVs. Two of these companies, GEM and Bombardier, had doorless models based on upgraded golf carts. The models of the other two companies, Dynasty and Feel Good Cars, resembled smaller conventional cars.

Table 1: LSV Delivery and Use

Manufacturer	Headquarters	Model	Quantity	Delivery Date	Date of Use in the Project	Test Period (weeks)
GEM	Fargo, U.S.	GEM	1	August 7	August 10	12
		GEM	2 *	August 21	August 24	10
Bombardier	Valcourt, QC	NEV	1	June 30	August 10	12
	Golf course Terrebonne, QC	NEV	1	September 18	September 28	5
	Bell Canada Montreal, QC	NEV	2 **	September 28	October 12	3
Dynasty	Toronto, ON	IT	1	October 9	October 12	3
Feel Good Cars	Toronto, ON	Zenn	1	October 12	October 19	2
	TOTAL		9			

* One of the vehicles could not be used because it did not meet the definition of an LSV as set out in the Transport Canada regulations. The vehicle's load platform dimensions put it into the truck category.

** One of the vehicles could not be used because of the poor condition and low range of the battery pack.

2 SITUATION OF LSVs AROUND THE WORLD

2.1 North America

Since the advent of LSVs as a mode of travel, the United States, followed by Canada, have developed regulations governing these small vehicles.

The objective of federal regulations drafted in the U.S. and Canada was to facilitate the marketing and possible on-road use of a new class of motor vehicles in retirement and other gated communities and in urban centres. The 40-km/h maximum speed limit imposed on this class of vehicle was established in accordance with the environments in which the LSVs would be used and on the basis of the LSVs' meeting minimum safety criteria.

2.1.1 U.S. Regulations

In the United States, LSVs have been defined by the NHTSA since 1998 as vehicles subject to Federal Motor Vehicle Safety Standard (FMVSS) No. 500. While low-speed vehicle (LSV) is the correct technical term, neighbourhood electric vehicle (NEV) is the term used by manufacturers.

They are defined in this standard as follows: "A low-speed vehicle is a 4-wheeled motor vehicle, other than a truck, whose attainable speed is more than 32 km/h (20 mph) and not more than 40 km/h (25 mph)."

In addition, LSVs must have the following minimum safety equipment: headlights; seat belts; a windshield; a vehicle identification number; front and rear turn signals; stop lights; and reflex reflectors (one red reflector on each side as far to the rear as practicable, and one red reflector on the rear to make the vehicle easier to see at night[4]). LSVs do not have to meet requirements related to anti-collision standards.

These regulations respond to the growing interest in using golf carts for short trips, shopping and recreational activities in U.S. retirement and other gated communities.

The NHTSA is currently updating the regulations in response to the representations of U.S. automobile manufacturers and other stakeholders. Some of the points raised concern vehicle visibility (lighting, reflectors and signalling), exclusion of commercial models, performance of certain components such as brakes and seat belts, and the minimum speed standard.

2.1.2 Development and Introduction of LSVs in the United States

In the 1990s, several states from California to Florida allowed the use of golf carts at speeds not exceeding 24 km/h (15 mph) on some roads, mainly in retirement and other gated communities. However, most of these states made it a requirement that additional safety equipment be installed on conventional golf carts.[5]

These states ushered in the use of vehicles that were faster than golf carts. They amended the definition of the golf cart category to include vehicles with top speeds of 40 km/h (25 mph) or established a new vehicle class – NEVs – also with top speeds of 40 km/h (25 mph).

It was found that the growing number of these vehicles moving at various speeds on roads had led to an increase in accidents. Between 1993 and 1997, they were involved in fatal accidents (16 deaths) and accidents involving injury (an average of 222 per year in the same period).[6]

4 NHTSA, U.S. Department of Transportation, Federal Motor Vehicle Safety Standard No. 500, Low Speed Vehicle, 1998
5 NHTSA, U.S. Department of Transportation, 49 CFR, 1998
6 NHTSA, U.S. Department of Transportation, Technical Report, August 1998

Meanwhile, Bombardier requested that a new vehicle class be introduced for slow, economically priced vehicles intended for short-distance travel.

In Bombardier's case, restricting the top speed of its vehicle (the NEV) to 32 km/h (20 mph) would compromise the NEV's ability to manoeuvre in traffic on public streets that it had to share with bigger, faster vehicles as well as shrink the market for NEVs.[7] This request for a review was supported by numerous petitions and conclusive trials and tests with Japanese and French golf carts that were carried out to assess the LSV's stability on public thoroughfares, its safety potential, stopping distances, acceleration, etc.

In 1998, the United States adopted regulations that designated LSVs as a new vehicle class and thus excluded them from the passenger vehicle class.

Unfortunately, no data on accident rates appears to have been published since the introduction of these regulations. However, it may be assumed that the number of accidents has fallen because golf carts with speeds under 32 km/h (20 mph) have been banned for on-road use.

To date, 35 American states (see Appendix 1) have authorized the use of LSVs on roads with speed limits of 56 km/h (35 mph) and 13 of them have authorized the on-road use of LSVs equipped with electric motors, as defined in Canada Motor Vehicle Safety Standard (CMVSS) No. 500. However, municipalities are completely free to restrict the on-road use of LSVs to certain areas within their boundaries.

Since then, LSVs have quickly become popular with the public, particularly for short neighbourhood trips (driving children to school, shopping, etc.), and in private and public-sector vehicle fleets (military bases, parks, airports, municipal utilities, etc.).

In addition, the Zero Emission Vehicle (ZEV) Program was set up in 1990 by the California Air Resources Board (CARB) to promote the marketing of electric vehicles and reduce pollution rates. The Program requirement for 2003 is that 10 percent of new vehicles sold should be ZEVs or Low Emission Vehicles (LEVs). In return, automobile manufacturers receive credits for each electric vehicle sold. Consequently, Daimler-Chrysler has purchased GEM, while Ford has acquired a small Norwegian company, PIVCO, to market a line of electric vehicles, including the LSV Th!nk Neighbor.

Table 2 is a partial list of American LSV manufacturers.

Table 2: Partial List of American LSV Manufacturers

Manufacturer[8]	Product
• Global Electric Motorcars • Dynasty Motocar Corporation • Ford TH!NK Mobility • Columbia ParCar Corp. • Frazier Nash Corp. • Lido Motors USA	• GEM • IT • TH!NK NEIGHBOR • COLUMBIA PARCAR • FRAZIER NASH NEV • LIDO NEV

It is estimated that between 10,000 and 20,000 LSVs will be sold every year over the next few years.[9] At least ten new manufacturers are expected to enter the LSV market. Some projections go so far as to say that governments will be among the major users. Interest is also evident in new residential developments where spaces with recharging outlets are reserved for these vehicles.

7 NHTSA, U.S. Department of Transportation, 49 CFR, 1998
8 Presentation by Barry L. Good (Dynasty), *Business Opportunity with Electric Cleanair Vehicles*, 1999
9 Presentation by Barry L. Good (Dynasty), *Business Opportunity with Electric Cleanair Vehicles*, 1999

2.1.3 Projects and Studies in the United States

Studies and projects have been carried out in recent years with a view to introducing LSVs into vehicle fleets and curtailing greenhouse gases resulting from city congestion and pollution problems.

In a U.S. Department of Energy (DOE) report, published in July 2001, on the assessment of 348 LSVs and their introduction into 15 vehicle fleets in the United States, it was reported that 32 percent of the LSVs were used on public thoroughfares and that 12 percent had been used on both public and private thoroughfares.[10] According to the report, these LSVs travelled a distance of 1.9 million km (1.2 million miles) per year or 5,454 km (3,409 miles) per vehicle.

The use of these LSVs generated significant benefits in terms of energy efficiency and a cleaner environment. Per year, they prevented the consumption of 110,514 L (29,195 gal.) of gasoline, which equals 329 L (87 gal.) per LSV, and consequently the emission of 570 t of GGE.

Another project, the San Jose Electric Vehicle Demonstration Project, supported by the California Energy Commission, was set up in July 2001 for a one-year period in the City of San Jose, California. Four low-speed GEM vehicles were made available to the public in order to raise public awareness of the use of non-polluting modes of urban transportation. Interested participants had to be 25 years old or older and meet good driving record criteria. For about $25 per week, San Jose residents were able to drive LSVs for their personal use.

In the City of Anaheim, California, a recent pilot project funded by the California Energy Commission made it possible to provide 10 low-speed vehicles for public use. A special feature of the program was to introduce the use of these vehicles into underprivileged neighbourhoods undergoing revitalization and give low-income residents opportunities to use the vehicle for local trips (driving children to school, grocery shopping, trips to the bank, etc.). This project was consistent with the purposes of reducing greenhouse gas emissions and raising awareness of non-polluting vehicles.

2.1.4 Canadian Regulations

In Canada, LSVs are currently authorized for sale but still banned from public thoroughfares. However, the CCMTA has set up a working committee to draw up measures for on-road use of these vehicles.

In July 2000, in accordance with CMVSS No. 500, Canada adopted regulations introducing a new vehicle class – low-speed vehicles. However, this standard, very similar to the American standard, specifies that LSVs must be powered exclusively by electric motors (see SOR/DORS/2000-304 on the web site http://canada.gc.ca/gazette/part2/pdf/g2-13417.pdf).

According to the Regulations Amending the Motor Vehicle Safety Regulations (Low-speed Vehicles) published in the Canada Gazette Part II, “low-speed vehicle” means a vehicle, other than an all-terrain vehicle, a truck or a vehicle imported temporarily for special purposes, that:

- is powered by an electric motor,
- produces no emissions,
- is designed to travel on four wheels and has an attainable speed in 1.6 km of more than 32 km/h but not more than 40 km/h, on a paved level surface.

These Regulations also set out requirements whereby all LSVs should be equipped with the following:

- Headlamps
- Front and rear turn signal lamps
- Taillamps
- Stop lamps

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10 U.S. Department of Energy – *Field Operation Program for Neighborhood Electric Vehicle Fleet Use*, 2001

- Red reflex reflectors: one red on each side as far to the rear as practicable, and one on the rear
- 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
- A parking brake
- An AS-1 or AS-5 windshield
- A Vehicle Identification Number (VIN)
- A Type 1 or Type 2 seat belt assembly installed at each designated seating position

In Canada, the introduction into the market of non-polluting low-speed vehicles partly meets Canada's commitment under the Kyoto Protocol to tackle the problem of global warming and reduce polluting emissions. Insofar as these non-polluting vehicles replace conventional vehicles powered by internal combustion engines, they will help reduce hydrocarbon, nitrogen oxide and CO_2 emissions, and noise.

These Canadian regulations governing LSVs have been studied in public consultations with vehicle manufacturers and representatives of provinces and municipalities. The comments received focussed on perceived risks to LSV driver safety and the safety of other vehicle drivers on public thoroughfares,[11] which suggests that their use may be considered for designated areas such as airports, tourism parks and recreational areas. These regulations allow provinces and territories to authorize or prohibit the on-road use of LSVs or to require that additional safety equipment be installed.

2.1.5 Demonstration Projects in Quebec

In recent years, a few LSV testing projects have been carried out in Quebec.

In the summer of 1997, CEVEQ tested four Bombardier NEVs intended for tourist use at Mont Tremblant and gathered information on the general public's assessment of these vehicles. In all, 480 people drove an NEV for approximately one hour each. They were only allowed to drive on a predetermined route over roads with 50-km/h or lower speed limits. Tourists were very attracted to this new type of vehicle, which could be driven freely without harming the environment. No accidents were reported during the test period.

In the summer of 1998, the Montreal Urban Community Police Department acquired three NEVs, for which a dispensation was granted by the *Société de l'assurance automobile du Québec* (SAAQ) allowing them to be driven on certain Montreal streets. Two of the vehicles were intended for parks monitoring and the other for use downtown. The NEVs made it easier for police officers to carry out monitoring activities, respond quickly and safely and, owing to the nature of the vehicles, be more visible. No accidents were reported during the testing. The NEVs are still being used in the summer.

From May to November 1999 and in two consecutive years, eight NEVs were driven as part of a demonstration project authorized by the SAAQ that was held in Valcourt, home to a Bombardier plant. Valcourt is a small town of 2,450 residents[12] covering an area of 5.17 km^2. Use of the NEVs was authorized on roads with speed limits below 50 km/h. No accidents were reported.

2.2 Europe

A low-speed vehicle known as a light quadricycle has been used in France since the 1970s. Starting in 1997, the quadricycle became a European product subject to European Economic Community regulations.[13] Unlike in North America, these vehicles are most often diesel-powered and have higher speeds.

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11 Canada Gazette, Part II, Vol. 134, No. 17
12 Valcourt Town Hall, January 2002
13 European Association of Quadricycle Manufacturers and Importers (AFQUAD)

2.2.1 European Regulations

A light quadricycle has the following characteristics:

- Equipped with four wheels;
- Maximum speed of 45 km/h;
- Power of less than 4 kW or 50 cm^3;
- Net weight of less than 350 kg.

In France, light quadricycles are included in the scooter category. They can be driven without a driver's licence by persons over the age of 16 on roads with 90-km/h or lower speed limits. However, they must meet safety standards similar to those for passenger cars, such as front and side collision tests.

2.2.2 Growth and Popularity of Quadricycles in Europe

Most quadricycle users are people without driver's licences – particularly women, seniors and low-income earners.

Although opposed for many years by motorists, light quadricycles have gained popularity because of a low accident rate mainly attributable to their low speed, according to the European Association of Quadricyle Manufacturers and Importers (AFQUAD).

Close to 200,000 of the vehicles are in circulation on urban and semi-urban thoroughfares of European Economic Community countries, except in Germany[14] temporarily.

There are 11 manufacturers of light quadricycles in Europe, the main ones being Microcar, Aixam and Ligier.

[14] www.micro-vehicules.com/pages/P6-Les_produits.html

3 SPECIFIC CHARACTERISTICS OF TESTED LSVs

GEM™
Global Electric Motorcars, LLC

Max. speed	40 km/h
Motor	electric, 2.6 kW
Batteries	6 lead-acid batteries
Recharging time	8 hours (110 V)
Range	40 km
Dimensions	320 cm L x 140 cm W x 180 cm H
Weight	581 kg (1,280 lb.)
Max. load	372 kg (820 lb.)
Body	thermoplastic
Front/rear brakes	drum
Passengers	4
Price range	C$12,000

Tested models	Year	Quantity
GEM 4-seater, blue	2000	1
GEM 2-seater, yellow with small trailer	2001	1

Bombardier NV
It'll drive you happy

Max. speed	40 km/h
Motor	electric
Acceleration	0 to 33 km/h in 4.5 s
Batteries	6 lead-acid batteries
Recharging time	8 hours (110 V)
Range	40 km to 50 km
Dimensions	254 cm L x 140 cm W x 158 cm H
Weight	561 kg (1,237 lb.)
Max. load	205 kg (450 lb.)
Body	PVC plastic (polyvinyl chloride)
Front/rear brakes	electromagnetic drum
Passengers	2
Price range	C$10,000

Tested models	Year	Quantity
White and green NEV	2000	1
White and green NEV	1998	1
NEV in Bell Canada colours	1998	1

IS ELECTRIC!

Max. speed	40 km/h
Motor	72 VDC, 5 HP/3.7 kW electric motor
Batteries	6 lead-acid batteries 1 accessory 12-V battery
Recharging time	8 hours (110 V)
Range	40 km to 50 km
Dimensions	355 cm L x 152 cm W x 160 cm H
Weight	653 kg (1,450 lb.)
Body	Fiberglass
Front/rear brakes	Front disc brakes, rear drum brakes
Passengers	4
Price range	C$16,000

Tested model	Year	Quantity
White 5-door It sedan	2001	1

ZENN

Max. speed	40 km/h
Motor	48 VDC/4 kW electric, automatic transmission
Batteries	4 lead-acid batteries 12 VDC high density, maintenance free
Recharging time	8 hours (110 V)
Range	45 km
Gradability	35%
Dimensions	258 cm L x 138 cm W x 139 cm H
Weight	450 kg
Max. load	350 kg
Body	reinforced polyester
Front/rear brakes	disc (172 mm), drum (160 mm)
Suspension	independent front, rear semi-rigid axle
Passengers	2+2
Price range	C$15,000 to C$18,000

Tested model	Year	Quantity
Grey ZENN	2002	1

4 METHODOLOGY

4.1 Project Implementation

When the pilot project was set up, LSVs were totally unknown to the residents of St. Jérôme. The partners consulted one another periodically to make all necessary arrangements for increasing safety relative to these new vehicles. Additional signage was erected along streets and placed on the vehicles to increase visibility and safety (see section 4.5).

CEVEQ also informed the St. Jérôme Police Department that people would be driving a new class of vehicle during a trial period. It was jointly agreed with the authorities that the area in which these low-speed vehicles could be driven would be restricted to streets with 50-km/h or lower speed limits.

An extensive information campaign was carried out in the vehicle-testing area to raise public awareness of this new class of vehicle and recommend to the general public that it watch for and show courtesy toward these slower vehicles.

Moreover, since the main objective was to carefully assess the impact of LSVs on urban traffic flow and whether they could fit in compatibly and safely in 50-km/h and lower speed zones, it was necessary to gather information not only on the LSV drivers' impressions, but also those of road users.

The first group, the ***LSV drivers***, consisted of all those persons who had driven an LSV for a seven-day period and filled out the appropriate questionnaire.

The second group, the ***road users***, consisted of all those persons who had seen or followed an LSV on the streets and been approached by the interviewers during the test phase. The road users could be pedestrians or motorists.

4.2 Target Clientele

To obtain a good sample of project participants, we arranged for announcements on the radio and notices in newspapers to target drivers who met the following criteria:

- Were over 20 years old;
- Had a valid driver's licence (Class 5);
- Lived in St. Jérôme and would drive the vehicle locally;
- Would use the vehicle every day (about 30 km/day);
- Were prepared to fill out an evaluation questionnaire;
- Could plug in their vehicle at night.

Within a week, about 100 people expressed interest in test-driving an LSV and filled out the short application questionnaire. We then selected 50 people of all ages and backgrounds while giving special priority to people with environmental and technology concerns, and to people in certain occupations (teachers, journalists, postal workers, local business people, police officers, road maintenance employees and parking ticket officers). Checks were made with the SAAQ to make sure that each person's driver's licence was valid.

Participants attended training and information meetings with regard to their responsibilities and were encouraged to drive with caution.

4.2.1 Training and Information Meetings

Three group meetings at three-week intervals were held for the selected participants. Each meeting dealt with the following: CEVEQ's role, project objectives, regulations, the LSVs, each driver's commitment, safety concepts, insurance, the loan contract and dates for picking up the vehicles.

Designated drivers also went to CEVEQ every Friday to pick up their vehicles and receive individual technical training. Vehicle operation and driving and safety rules were explained and test drives were arranged with a trainer. Loan contracts had to be signed with photocopies of each driver's licence appended.

4.3 Data Gathering

The data-gathering method consisted of compiling data obtained from the answers provided by LSV drivers and road users in the questionnaires drawn up by CEVEQ. The questionnaires had been developed in collaboration with TDC to place special emphasis on safety concepts.

The questionnaires were used to gather relevant information from LSV drivers and from road users such as motorists, pedestrians and cyclists, to assess how well these small, low-speed vehicles shared the road with conventional vehicles.

4.3.1 Questionnaires

All of the questionnaire answers were entered in two databases: one for the LSV drivers, which faithfully reproduced the profile of each LSV driver's questionnaire, and the other for the road users, which similarly reproduced the profile of each road user's questionnaire. A request generator was used to prepare all of the analysis results and a spreadsheet program was used to produce tables and graphs.

LSV driver and road user data were compared as part of the operations carried out. The comparison was used to assess various impacts, including those regarding safety, the primary objective of this study.

LSV Drivers' Questionnaire

The questionnaire given to the LSV drivers when they picked up the vehicles included a total of 47 open-ended and closed-ended questions grouped into four sections covering the following topics:

- Driver profile (5 questions);
- Technical aspects (4 questions);
- LSV and safety (26 questions);
- Overall assessment (12 questions).

Most of the questions had a choice of objective Yes/No answers and a section for comments.

Road Users' Questionnaire

The road users' survey was conducted at the end of the project. The questionnaire included 30 questions and was divided into four parts:

- General profile (5 questions);
- Motorist section (11 questions);
- Pedestrian or cyclist section (4 questions);
- General section (10 questions).

The questionnaires were filled out by people who had often seen LSVs or had driven in proximity to an LSV more than once. Half of the respondents (48 percent) had seen an LSV in the city between 2 and 5 times, 23 percent had seen them over 10 times, 12 percent only once, 10 percent often and 8 percent between 6 and 10 times.

4.4 Focus Group Meeting

At the end of the project, a focus group meeting was held to debate some of the outstanding issues and consolidate the mixed results.

When follow-up telephone calls were made, it was found that many people were interested in participating in the focus group meeting, but few were available to attend. The meeting held on December 19, 2001, was attended by seven people, including five LSV drivers, one of them a police officer, and two road users, one of them also a police officer.

The questionnaire findings were presented to the participants and certain issues relative to speed, safety, use of certain roads, traffic density, LSV ergonomics and signage were debated. The valuable exchanges in the focus group meeting and the participants' input helped to more effectively identify public requirements, reservations and expectations.

The information collected at the focus group meeting was used to clarify the data obtained in the analysis of the questionnaires (see section 5).

4.5 Communication Strategy

The objective of the communication tools was to give the project visibility and thus draw the attention of motorists, pedestrians and the general public to the use of low-speed vehicles in their community. By investing in visibility, we made an investment in safety and caution.

Several tools were used to ensure a safe framework for the on-road use of the new vehicles.

Other tools were part of a communications component that included advertisements in local newspapers, posters put up in various locations, an open house for the public and press briefings. However, the best awareness tool of all was the LSVs, which attracted attention and questions from everyone.

4.5.1 Safety-Enhancement Tools

Vehicle Identification

To guarantee greater safety, it was essential that the LSVs be clearly identified. Three messages in highly visible blue lettering were applied to the backs of these vehicles to announce that they were low-speed electric vehicles, had a maximum speed of 40 km/h and were part of a pilot project. The messages informed motorists and pedestrians that these were not conventional vehicles. As an additional safety precaution, yellow pennants were affixed to the vehicles to make them visible from a distance (see photos on p. 16).

Billboards

Four billboards measuring 2.5 m x 1.2 m were erected in various strategic locations, particularly on main streets leading into the city, to inform the public that they were entering a low-speed electric vehicle test area and should exercise caution.

Radio Announcements

The main radio station chosen was CIME-FM Laurentides, which reaches over 50,000 listeners in the area extending from St. Eustache to Mont Tremblant.

In the radio messages, we advised the public that small electric vehicles with maximum speeds of 40 km/h would be driving on the streets of St. Jérôme for a three-month test period and asked listeners to exercise caution and be courteous.

Over 100 radio messages were broadcast during the first month of the tests. Interviews and special features were also broadcast throughout the project.

4.5.2 Promotional Tools

Brochures

A total of 2,000 four-page brochures on glossy stock paper were distributed to partners, resource people, drivers, residents and the media.

Posters

In all, 200 posters were put up in strategic locations in St. Jérôme (tourist booths, city hall, shopping malls, etc.).

Newspaper Advertisements

A few advertisements were placed in local newspapers to recruit drivers and inform the public of the project.

Internet Site

In keeping with the visuals in the project brochure, we created three Web pages in French and in English, which could be accessed from the CEVEQ site (www.ceveq.qc.ca) and the City of St. Jérôme site (www.ville.saint-jerome.qc.ca).

Demonstration Day

A demonstration day featuring three LSVs was held on Saturday, September 15, 2001. Members of the general public were offered free 15-minute test drives on the vehicles accompanied by a CEVEQ employee. The demonstration day helped to further raise local residents' awareness of LSVs (see photo).

Press Conferences

A press briefing for representatives of regional newspapers was held on August 6, 2001. A national press conference was held on October 17 for media representatives, partners and guests.

5 ASSESSMENT RESULTS

5.1 General

It should be mentioned that these results reflect a particular testing framework and are only valid in that context (seven vehicles put into service in St. Jérôme for a 12-week period).

This section highlights the results of the questionnaires for LSV drivers and road users and, in certain cases, information obtained in the focus group meeting.

5.1.1 Distances Driven

During the tests, the LSVs were driven a total of 6,067 km on the streets of St. Jérôme and its outlying areas, for an average of 114 km and seven trips[15] per LSV per test week. The first two weeks were a breaking-in period for the vehicles. They were then test-driven for 12 consecutive weeks by 53 assigned drivers.

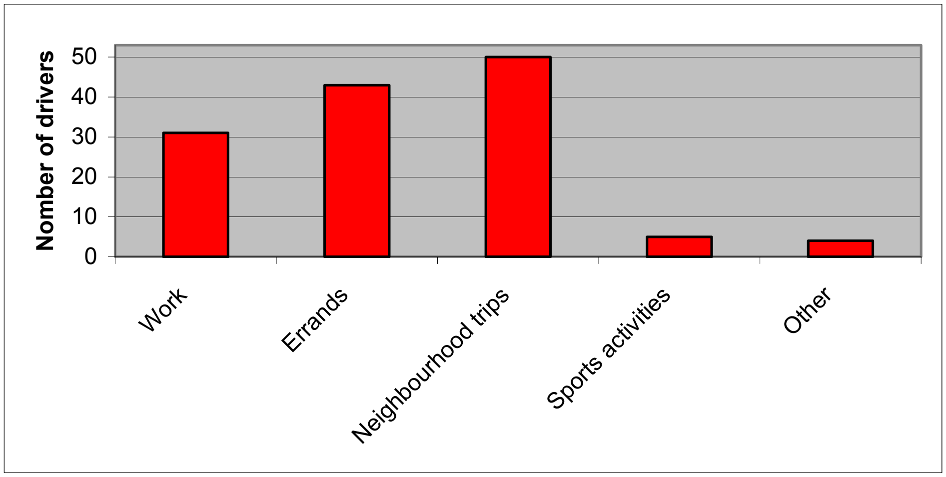
Table 3: Summary of Distance Driven per Week per Vehicle

Week	Date	LSV 1 (2000 NEV)		LSV 2 (GEM 4-seater)		LSV 3 (GEM commercial)		LSV 4 (1997 NEV)		LSV 5 (1998 Bell)		LSV 6 (Dynasty It)		LSV 7 (ZENN)	
		Km	No of Trips	Km	No of Trips	Km	No of Trips	Km	No of Trips	Km	No of Trips	Km	No of Trips	Km	No of Trips
1	July 27 to Aug 2	54	2	58	3										
2	Aug 3 to 9	143	6	182	7										
3	Aug 10 to 16	244	10	201	13										
4	Aug 17 to 23	145	8	150	9										
5	Aug 24 to 30	113	7	145	11	146	8								
6	Aug 31 to Sept 6	240	13	130	9	171	8								
7	Sept 7 to 13	277	12	143	7	185	10								
8	Sept 14 to 20	117	10	98	7	137	7								
9	Sept 21 to 27	73	8	113	8	42	5	50	7						
10	Sept 28 to Oct 4	116	5	177	8	124	7	100	7						
11	Oct 5 to 11	112	9	114	8	29	4	60	4						
12	Oct 12 to 18	131	10	111	11	79	6	45	3	179	7	45	6		
13	Oct 19 to 25	205	9	71	5	138	7			69	9	34	6	75	5
14	Oct 26 to Nov 2			171	9	180	10			165	9	59	8	121	7
Total		**1,970**	**109**	**1,864**	**115**	**1,231**	**72**	**255**	**21**	**413**	**25**	**138**	**20**	**196**	**12**

The maximum requirement imposed on the selected LSV drivers was to use the LSVs for travel in the city. Most of the drivers used the LSVs to drive to places in their neighbourhoods, do errands, go to work, drive children to school, go to sports activities or drive to places in connection with their work.

[15] Trips were calculated on a daily basis. If the number of trips was higher than the number of days of vehicle use (7), it meant that the vehicle was recharged twice in the same day.

Figure 1: Circumstances of LSV Use



5.1.2 Respondent Profile

LSV Drivers

Of the 53 questionnaires collected at the end of the tests, 70 percent were completed by men and 30 percent by women.

Since the number of applications received far exceeded the number of places available in the tests, we were able to select a better sample of participants from all age categories.

Table 4: Breakdown of LSV Drivers by Age Group and Sex

	20-35 years	36-45 years	46-60 years	Over 60 years	Total
Men	23%	17%	24%	6%	**70%**
Women	13%	8%	9%	0%	**30%**
Total	**36%**	**25%**	**33%**	**6%**	**100%**

Road Users

We surveyed 126 road users. Table 4 shows that, when broken down by age and sex, there were fairly similar percentages of road users between the ages of 20 and 60.

Table 5: Breakdown of Road Users by Age Group and Sex

	20-35 years	36-45 years	46-60 years	Over 60 years	No answer	Total
Men	19%	19%	18%	1%	2%	**59%**
Women	10%	15%	12%	3%	1%	**41%**
Total	**29%**	**34%**	**30%**	**4%**	**3%**	**100%**

We targeted the following groups of people :

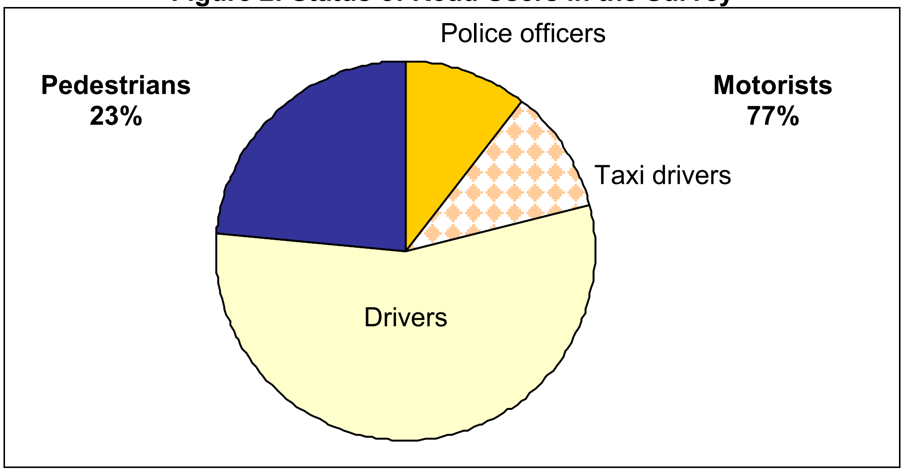
- St. Jérôme taxi drivers,
- St. Jérôme police officers,
- Other motorists in general,
- Pedestrians,
- Cyclists.

The pedestrian group (i.e., persons on foot when they saw an LSV) accounted for 23 percent of the sample.

The motorist group (i.e., persons driving their cars when they saw an LSV, including police officers and taxi drivers) accounted for 77 percent of the sample.

Figure 2 shows the percentages of road users in each category.

Figure 2: Status of Road Users in the Survey



Of the 126 people surveyed, half saw an LSV on the road between 2 and 5 times, 7 percent saw an LSV between 6 and 10 times, 23 percent saw one more than 10 times and 10 percent saw LSVs often.

Most of the road users encountered an LSV downtown (62 percent) or in a residential area (44 percent). Very few encountered them on secondary roads (4 percent). Most of them had followed an LSV on a street with two-way, double-lane traffic (54 percent) or a street with two-way, single-lane traffic (43 percent), and some had encountered an LSV at an intersection (12 percent). The traffic was usually moving (85 percent).

5.1.3 Usual Modes of Transportation

Most of the LSV drivers (79 percent) usually used conventional motor vehicles to commute to work and do errands in the city. Of these drivers, 33 (62 percent) lived within 10 km or less of their workplaces.

LSVs were a fairly satisfactory mode of transportation for drivers who drove to outlying areas of the city every day. This explained why a large number of the drivers (84 percent) thought that an LSV could replace their usual mode of transportation in the city or, in some cases, replace a second car.

Of the LSV drivers, 57 percent had at least two gasoline-powered vehicles, 60 percent had a mid-range car, 40 percent a compact car and 32 percent a van or four-wheel drive vehicle.

5.2 LSV Safety Aspects

5.2.1 General

First, we wanted to know whether LSVs were easy to drive in all 50 km/h zones as well as in downtown areas and on major arterial roads. We also wanted to know whether traffic density had an impact on passenger safety.

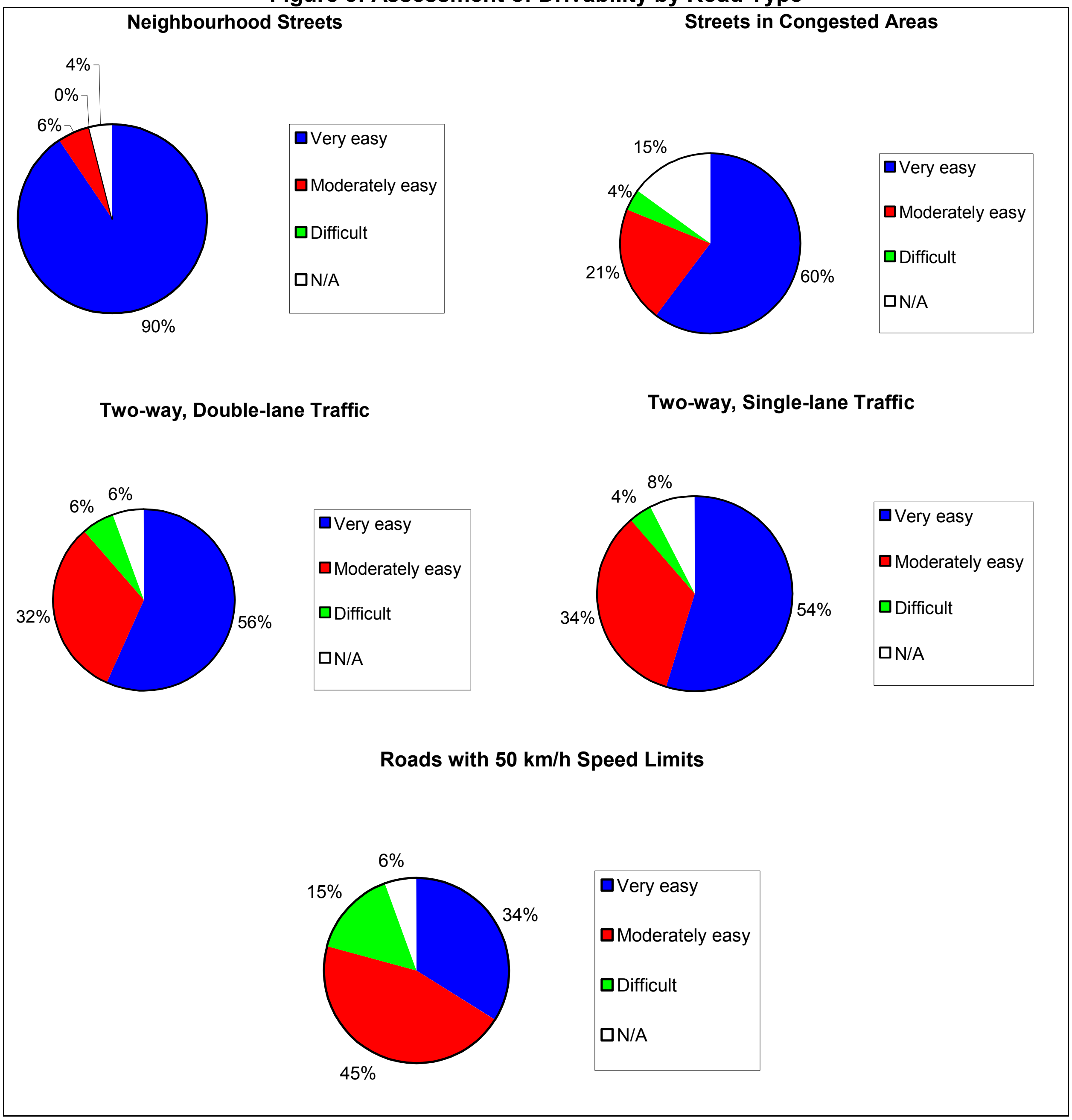
Second, we wanted to know how road users would react and whether LSVs, because of their low speed, would interfere with and possibly disrupt road traffic and endanger the safety of nearby motorists.

5.2.2 Roads Used

Figure 3 shows estimates of the amount of travel carried out by LSV drivers in various areas:

- neighbourhoods,
- congested or higher-density urban areas,
- streets with two-way, single-lane or two-way, double-lane traffic,
- major arterial roads with 50-km/h speed limits often in outlying urban areas.

Figure 3: Assessment of Drivability by Road Type



Residential areas have lighter traffic and many stop signs, which slow down motorists considerably. In these areas, LSVs are an ideal way to get around.

With regard to **higher-density urban areas**, 60 percent of the respondents thought that LSVs were easy to drive because traffic moved slowly. Other respondents (21 percent) did not feel safe because of the proximity of other vehicles and the fact that most of the LSVs were doorless.

We did not find any difference between the respondents' reactions to **streets with two-way, double-lane traffic** and **streets with two-way, single-lane traffic**. Half of them felt they were very easy to drive on, while a third found the driving moderately easy. A few drivers said, "When we drove on streets with two-way, single-lane traffic, we felt we had to move over to the side and get out of the way of vehicles behind us." In the case of streets with two-way, double-lane traffic, some respondents said it was fairly difficult to change lanes (to make a left turn, for example) when the traffic was too heavy.

According to the focus group participants, streets with two-way, single-lane traffic were more difficult to drive on than streets with two-way, double-lane traffic. In the case of streets with two-way, single-lane traffic, the LSV drivers felt pressured by the motorists behind them who were having a harder time trying to pass them. In these situations, they felt they should move over to the right, which was potentially hazardous. However, the same drivers also said that streets with two-way, single-lane traffic in residential neighbourhoods and streets with traffic lights at short intervals were not a problem.

On major arterial roads with 50-km/h speed limits, 45 percent of the respondents found the LSVs moderately easy to drive and 15 percent found them difficult to drive because the actual speed of surrounding traffic was 60 to 70 km/h. The speed of other motorists made the LSV drivers feel unsafe. They not only felt they were disrupting traffic, but they also felt at risk (little protection) if a collision occurred.

The focus group participants' comments corresponded to the results outlined above. They felt that the LSVs did not go fast enough to keep up with the flow of traffic. However, they did not agree with the idea of possibly prohibiting LSVs in certain lanes in 50-km/h zones.

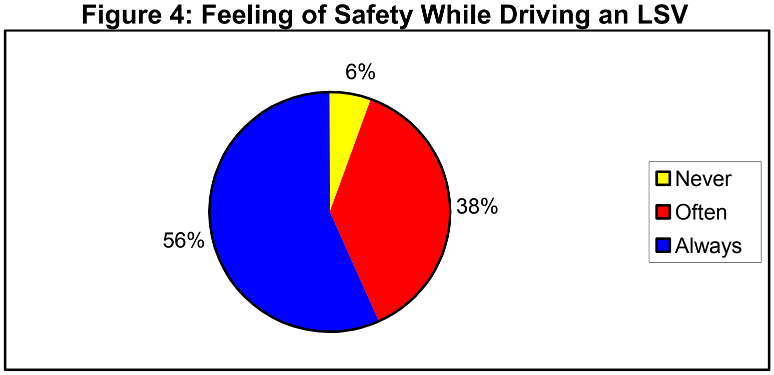
The road users had seen LSVs downtown, on streets with two-way, single-lane or two-way, double-lane traffic or in residential areas – streets more conducive to LSVs, in other words – rather than on major arterial roads (3 percent). In the vast majority of cases (84 percent), they had seen the LSVs when traffic was moving, which explains why 70 percent of the road users did not feel bothered by LSVs and thought their use in the city was justified.

5.2.3 Are LSVs Completely Safe to Drive?

As we saw above, the LSV drivers found that the driveability of the vehicles varied, depending on the type of road and city area.

Nonetheless, Figure 4 shows that most of the LSV drivers always or often felt safe when driving the LSVs.

Figure 4: Feeling of Safety While Driving an LSV



We found that 6 percent, or three LSV drivers, never felt safe while driving an LSV. We understood from their comments that they did not feel safe because the vehicles were doorless and there was a lack of protection for passengers in case of collision. It should also be mentioned that 33 percent of the LSV drivers felt vulnerable and sometimes even unsafe in a doorless vehicle.

We also asked the LSV drivers whether they had been in critical situations while driving the vehicles. Half of them said yes and mentioned the following problems:

- Battery range
  - fear of a breakdown
  - drop in vehicle speed caused concern when the battery was at half charge
  - vehicle ran out of power

- Speed
  - on major thoroughfares,
  - when traffic was moving at a fast rate,
  - on hills where vehicles slowed down to speeds in the range of 20 to 30 km/h.

All of the focus group participants said that these two situations were not the reason for feelings of reduced safety The group did confirm, however, that the lack of speed on major thoroughfares and slowness on uphill grades were causes for concern. It was also noted that Bombardier NEVs had not been found to lose speed on uphill grades.

The focus group also suggested that the best way to drive an LSV on a street with two-way, single-lane traffic was to drive in the centre of the lane, as a motorcycle driver would.

5.2.4 LSV Signage

The vehicles were clearly identified to inform drivers behind them (lettering on the back saying “low-speed electric vehicle” and “40 km/h maximum speed”) and others (orange pennants) that they were low-speed vehicles with top speeds of 40 km/h. For this reason and also because of the popularity of the pilot project in St. Jérôme, motorists were very courteous to the LSV drivers. If they honked their horns at the LSVs, it was only in support. Nonetheless, we took note of two people who lost patience while behind an LSV and insulted the driver.

According to 66 percent of the LSV drivers, the identifying markings on the LSVs increased their feeling of safety on the road. We collected 16 comments to the effect that “people have a better understanding of why I am driving slowly and are more sympathetic.”

According to only 45 percent of the road users, the orange pennants were necessary so that people could identify the vehicles from a distance. However, 82 percent thought it was necessary to clearly identify low-speed vehicles because they did not have the same on-road performance as other passenger cars. People would tend to be more forgiving, courteous and patient as a result.

Consequently, both LSV drivers and road users felt it was important to indicate on the backs of the vehicles that their top speeds were 40 km/h.

Participants in the focus group did not think that pennants were necessary. However, they thought that the low speeds of the vehicles should be indicated on the backs of the vehicles. It was suggested that a fluorescent logo similar to the triangles identifying slow-moving vehicles but with a more positive, environmental connotation be placed on the vehicles.

5.2.5 Maximum Speed of 40 km/h

In addition to their small size, the slower speeds of LSVs make them different from other vehicles. They fall into a new class that requires that their speed be restricted to 40 km/h.

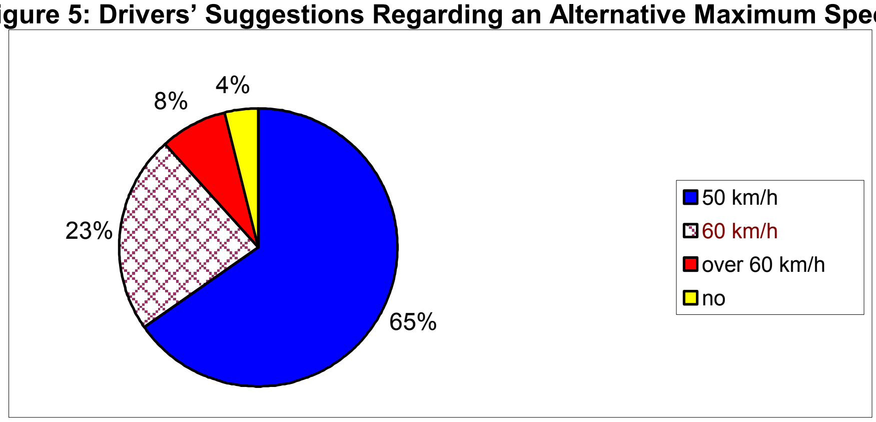
An LSV with very good acceleration can reach its cruising speed in a few seconds and usually maintain it all times. The question posed in the study was whether LSVs were fast enough to avoid disrupting the flow of traffic.

According to 64 percent of the LSV drivers, the LSVs were not fast enough to keep up with the flow of traffic at all times. As we saw above, some types of roads were more critical for LSVs, such as major arterial roads, streets with two-way, single-lane traffic on which traffic is moving, and uphill grades.

As indicated in Figure 5, 97 percent of our 53 participants suggested that the top speed of the LSVs be increased to a level that, in their opinion, would be more suitable for keeping up with the flow of city traffic. Most of the LSV drivers (65 percent) wanted a speed of 50 km/h.

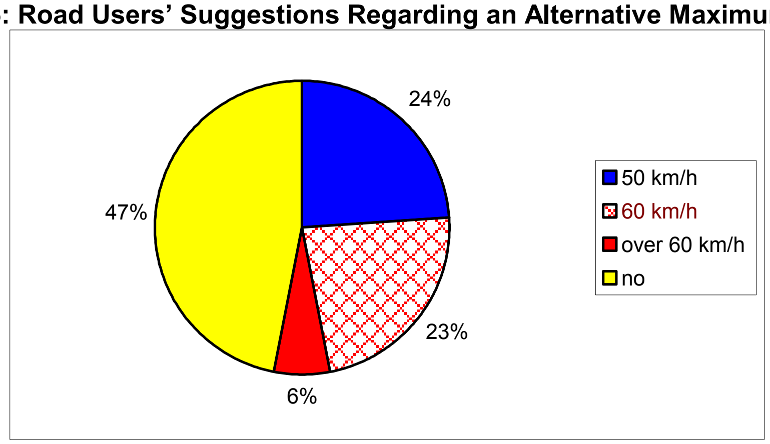
They gave various reasons to support their suggested speed increase: “it would avoid the risks of dangerous passing”; “40 km/h is fast enough in a residential area, but not fast enough on busier streets”; “the vehicle is safe enough to be driven at city speed limits”; “it’s the usual speed limit in the city”; “it would enable the vehicles to keep up with traffic better”; “other drivers following us at 40 km/h when the speed limit is 50 km/h are sometimes impatient”.

Figure 5: Drivers’ Suggestions Regarding an Alternative Maximum Speed



We also asked the road users whether they thought the LSVs were too slow. Figure 6 shows that close to half of them thought the LSV speeds were appropriate, while 24 percent thought these vehicles could be driven at 50 km/h or, for that matter, at 60 km/h.

Figure 6: Road Users’ Suggestions Regarding an Alternative Maximum Speed



We found a notable difference between the two surveyed groups who gave their opinions on the speeds of the LSVs. Almost all of the LSV drivers wanted to increase the speed, whereas half of the road users did not find LSVs to be overly slow vehicles that were disruptive. The differences of opinion gave rise to the following questions:

- Is there a clearer perception of speed on board the vehicle than there is from outside?
- Is fear of being a nuisance to other vehicles the reason the LSV drivers felt unsafe when driving at 40 km/h?

The LSV drivers who attended the focus group meeting said that the different perceptions between LSV drivers and road users were simply a result of the number of LSVs in circulation. In cases where there were not very many of them on the streets (as was true during the project), their presence on the streets was not felt to be a problem. However, if their number were to grow, it could possibly lead to intolerant attitudes on the part of road users, if not cases of road rage, particularly during rush hour. Nevertheless, if there were enough of the vehicles to create a critical mass, people would become familiar with them and accept them in the same way as bicycles.

The same people also said that the vehicles should be able to reach 40 km/h at all times, whether they were driven on level surfaces or on hills.

5.2.6 LSVs in Rainy Conditions

Of the four models we tested, two were doorless vehicles equipped with windshield wipers.

A total of 32 participants drove the LSVs in rainy conditions. They did not find that the LSVs performed less well in the rain: 96 percent did not feel that the vehicles lost any traction and 84 percent did not feel unsafe when braking.

However, in the case of the doorless vehicles, the drivers clearly felt uncomfortable because the rain splashed into the cab. As well, when vinyl doors were fitted to the vehicles, the windows fogged over very quickly because the vehicles had no defogging equipment. The safety of passengers in the vehicles could therefore be at risk.

5.3 Technical Performance of Tested LSVs

5.3.1 General

Participants were asked to assess the overall performance of the LSVs and, based on their judgment, to rate the performance from mediocre to excellent. Ratings were absolute, not comparative, because each driver only tested one model.

5.3.2 GEM

In all, 28 people drove GEMs for one-week periods.

Suggested Technical Improvements

Several LSV drivers made the following suggestions to improve parts of the vehicle and make it safer.

- Dashboard
  - Install a mechanism to automatically stop the blinker after the steering wheel is turned.
  - Improve the console (separate indicators for speed, kilometres and battery charge).
  - Install a warning indicator for the last 5 km of available charge.

- Body
  - Add doors or bars for side protection.

- Comfort
  - Improve the suspension.

- Mechanisms
  - Improve the brake pedal, which is too stiff and positioned too high.
  - Install a positive wheel-lock to keep the vehicle from moving backward on hills.

- Accessories
  - Install bigger rearview mirrors.
  - Add a windshield-washer system.

Table 6: Drivers' "Excellent" or "Good" Assessments of GEM Technical Performance

Attractiveness Vehicle is user-friendly and pleasant to drive, particularly in warm weather.	**100%**
Acceleration	**96%**
Vehicle handling (stability, control) Very stable, easy to drive, had firm control of the vehicle.	**86%**
Drivability (steering wheel) Even without power steering, the steering wheel handles easily, Because LSVs are small, they are easy to steer and manoeuvre in traffic.	**82%**
Comfort The fact that the vehicle has no doors makes some people feel uncomfortable, particularly when it is raining.	**64%**
Recharging time	**61%**
Accessories	**39%**
Speed The fact that the vehicle does not go faster than 40 km/h, if even 37 km/h, is a drawback for many drivers.	**32%**
Braking The stiffness and raised position of the pedal makes braking difficult. However, the quality of the brakes is good.	**32%**
Suspension	**29%**
Power on hills The speed dropped by 50 percent on steep hills, making the vehicle fairly annoying.	**25%**
Battery range The range was too short (30 km). The power gauge was not reliable. At the 30 percent mark, the vehicle had already depleted its charge. The battery also lost half its charge in low temperatures (between 0°C and 10°C). A small reserve battery would be appreciated.	**7%**

5.3.3 NEV

A total of 20 people drove NEVs for one-week periods.

Suggested Technical Improvements

- Body
  - Add doors.

- Comfort
  - Improve the suspension.
  - Install adjustable seats.
  - Install adjustable seatbelts.

- Mechanism
  - Position the brake pedal farther away from the accelerator.
  - Install a positive wheel-lock to keep the vehicle from moving backward on hills.

- Accessories
  - Add a windshield-washer system.

Table 7: Drivers' "Excellent" or "Good" Assessments of NEV Technical Performance

Acceleration The NEV has very quick acceleration on both level surfaces and uphill grades.	**100%**
Attractiveness	**90%**
Vehicle handling (stability, control) Good overall stability; some models are more stable than others.	**80%**
Power on hills The NEV is surprising on hills. It climbs easily without losing its cruising speed. However, when it starts off on a hill, it tends to back up a little before going forward (the accelerator takes a few seconds to respond).	**80%**
Braking	**75%**
Drivability (steering wheel) Easy to manoeuvre in general. Depending on the model, the steering wheel could be stiffer.	**70%**
Recharging time	**65%**
Speed	**60%**
Suspension	**50%**
Comfort	**45%**
Accessories	**40%**
Battery range The vehicle's short range (30 km) restricts travel and increases driver worries of a breakdown.	**30%**

5.3.4 DYNASTY IT

Because the vehicle arrived very late, only three drivers were able to test it for one-week periods. This vehicle was a prototype and its cab was only partly finished.

It was difficult to compile statistics owing to the small number of drivers. However, compared with the other vehicles, we noticed that it had a lower top speed (35 km/h), more sluggish acceleration, a steering wheel that was difficult to handle, and very little comfort, which made the vehicle unpleasant to drive. The vehicle was very attractive, but its performance had to be improved.

Suggested Technical Improvements

- Make the vehicle more comfortable (better insulation, better interior styling and more comfortable seats).
- Adjust the top speed to 40 km/h.
- Provide faster acceleration.

5.3.5 ZENN

This vehicle was a prototype that had been recently converted into an electrically powered vehicle. It required further improvements before being marketed.

The ZENN's interior resembled that of a conventional car with all of the usual comforts (doors; adjustable, comfortable seats; attractive styling; radio; windshield defogging system; etc.). The two drivers who drove the vehicle for a week and many other people who drove the vehicle a few kilometres liked its styling.

The vehicle's only drawbacks were its speed on hills and battery range. Its acceleration and top speed could be slightly improved. We also found that the ZENN had trouble starting in cold weather (-5°C).

One driver, who had test-driven an NEV for a week and a ZENN several times, suggested that a combination of the two vehicles would make the perfect LSV for use in the city. The positive aspects of the NEV were its body and comfort and those of the ZENN were its speed and acceleration.

5.3.6 Highlights

After comparing Tables 5 and 6, we found that acceleration, attractiveness and vehicle handling were perceived as the strong points of the GEM and NEV vehicles. In addition, the NEV was surprising in terms of its power on hills, compared with the GEM, which had greater difficulty maintaining its cruising speed. The drivers also seemed less dissatisfied with the NEV's speed than with that of the GEM, the reason being that the NEV's speed was slightly higher than 40 km/h (i.e., 43 km/h, measured by radar), which clearly made a difference.

On the whole, many of the LSV drivers (77 percent) were surprised in a positive way by these small cars. Most of them (64 percent) liked the prompt acceleration, which was similar to that of a conventional automobile and thus did not disrupt traffic at intersections and start-offs (from lights, stop signs, etc.). The drivers were surprised by other aspects including:

- Drivability;
- Parkability;
- Manoeuvrability in traffic;
- Good cruising speed (NEV);
- Corner handling;
- Speed comparable to a gasoline-powered car.

5.3.7 Observations of Focus Group Participants

Drivers who participated in the focus group mentioned the following aspects of the vehicles' technical performance:

- A vehicle body with doors made drivers feel more comfortable and increased their feeling of safety while driving. They suggested that the LSVs be equipped with "real" removable doors because fabric doors impaired visibility and reduced comfort.
- Windshield defogging systems should be mandatory for LSVs with doors (even plastic doors).
- The power gauge should be reliable and the vehicle's actual range should be the range specified by the manufacturer so that the driver has trust in the vehicle.
- Mirrors of sufficient size on each side of the vehicle would provide greater visibility.
- Fluorescent strips should be placed on the LSVs.
- The vehicles should be able to maintain their minimum speeds at all times (on both hills and level surfaces).
- The hand brake should not be in the way of the clutch.

5.4 LSVs as a Mode of Urban Transportation

5.4.1 Place of LSVs in Urban Communities

Opinions of Motorist Road Users

A large majority (89 percent) of road users felt that LSVs had their place in urban communities. The main reason given by the 11 percent of road users who responded negatively was that they moved too slowly to keep up with traffic. However, 5 percent of the road users who responded positively qualified their answers with the comment "if the vehicle went a little faster".

As well, a similar proportion of people (88 percent) thought these vehicles were the vehicles of the future and designed for the city, although some wondered how safe they would be in collisions. Others thought they should be adapted to the Quebec climate (enclosed cabs and heating).

Opinions of Pedestrian Road Users

LSVs are essentially electric vehicles and thus operate silently. In the city, pedestrians often rely on the sounds of engines to know that gasoline-powered vehicles are approaching. We therefore wanted to know whether pedestrians found the silent operation of the vehicles problematic.

Of the 29 pedestrians surveyed, none felt in harm's way at the approach of the small silent-operating vehicle. Only three said they did not see or hear the vehicle approach. However, none had to get out of its way at the last minute.

Only two people thought the LSVs did not belong in an urban community because of their slowness. The other surveyed pedestrians found that the vehicle was designed for the city (silent-operating, non-polluting and low-speed) and perfect for downtown or on less travelled secondary roads.

Opinions of LSV Drivers

In the opinion of 83 percent of the drivers, LSVs were vehicles suited to the city. The most positive respondents in this group said that "this vehicle is perfect for a city like St. Jérôme"; "the speed is fine because the distances between traffic lights and stop signs are very short"; and "they manoeuvre well". However, one quarter of the respondents qualified their positive answers with the condition that "the speed be increased".

In the opinion of 15 percent of the respondents, the LSVs were not yet perfected. Two people found "they needed to be safer in order to be driven in traffic with conventional vehicles", while five said their excessively low speed made them annoying.

Quite clearly, nearly all of the LSV drivers (97 percent) enjoyed their experience and liked driving these small vehicles. Their reported comments included the following: "they're fun"; "they give me a feeling of freedom and being on vacation"; "the ideal vehicle in hot weather"; "I liked the fact it was non-polluting"; and "it was magical to see how the people we met were attracted to it and how it got smiles from children on the sidewalks".

Opinions of Focus Group Participants

Although LSVs were ideal vehicles for the city because they were practical and economical, the fact that they were currently designed to drive at speeds lower than permitted speed limits was an obstacle to their introduction to on-road use and acceptance by other road users.

However, if the speed of LSVs could not be increased to 50 km/h for technical reasons, the focus group participants thought it might be imperative that a national public awareness campaign be launched. It was recommended that an investment be made in an overall environmental approach promoting the purchase and introduction of these small non-polluting vehicles in the long term.

The participants felt that the key issue relative to promoting the introduction of LSVs was to raise the tolerance threshold of other motorists with regard to slower vehicles. The only potentially justifiable approach would be to promote the environmental benefits arising from greater on-road use of these LSVs.

According to the participants, LSVs had their place in urban communities, but their place still had to be defined. They felt it would be more reasonable to build bypass lanes on streets with faster traffic than to ban LSVs from some streets. They thought that priority should be given to information and signage.

Opinions of the MIRA Foundation for Persons with Visual Impairments

Although the silent operation of electric vehicles may be an advantage for most people, it can be a major disadvantage for others.

As recommended by the Road Safety branch of the Quebec Department of Transport, CEVEQ representatives met with MIRA Foundation representatives to inform them of the project and allow the Foundation to help assess the impact of electric vehicles on the ability of persons with visual impairments to walk the streets safely.

A person who was blind from birth participated in the tests as a pedestrian to assess the possible dangers arising from silent vehicles.

In the city, persons with visual impairments can only go by the noise of motor vehicles to ascertain whether they can cross the street at a controlled intersection (traffic light or stop sign). The blind person found that the GEM did not emit any audible signal when it passed by. There was no auditory reference point to indicate the presence of a car and the person was thus unaware of any danger.

According to this participant, it would be a good idea for electric vehicles to emit a faint (pleasant) sound and that this sound be activated when the vehicles moved at low speeds or stopped. The sound would therefore be detectable by visually impaired persons crossing at intersections or walking through parking lots. A car horn sound would not be effective because visually impaired persons would not know whether the audible signal was intended for them.

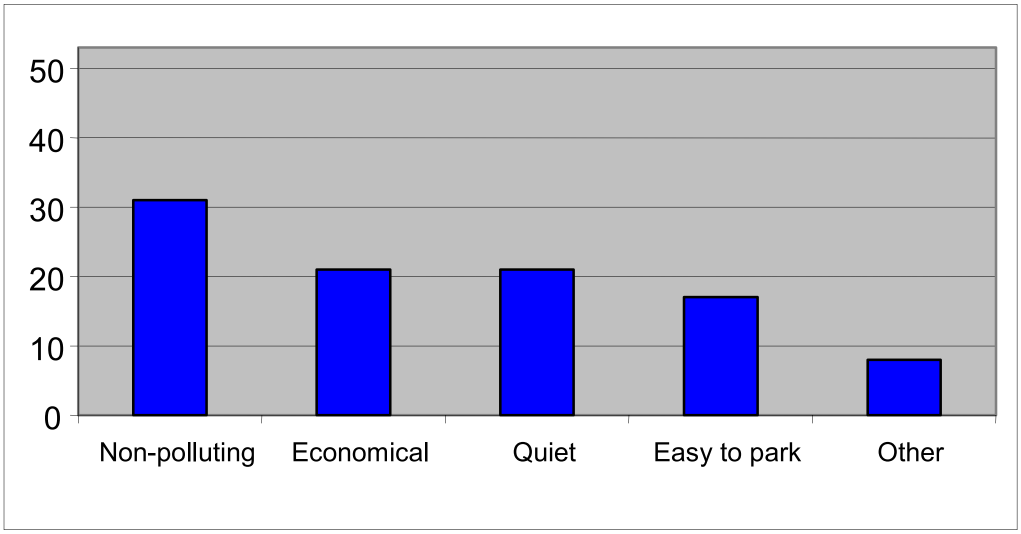
The MIRA Foundation was very pleased to have been contacted and hoped to work together with manufacturers so that the introduction of electric vehicles would be to the full benefit of persons with visual impairments.

5.4.2 Advantages of LSVs in the City

Figure 7 shows the most often cited advantages based on our LSV drivers' answers.

The primary advantage, in the opinion of over half of the LSV drivers, was that the vehicles did not pollute. Although the participants in the electric vehicle tests were probably more aware of environmental protection, people nonetheless want to do their share for the environment and the fact that electric vehicles do not pollute (neither emissions nor odours) encourages them to drive "clean" vehicles. For the purposes of this project, the LSV fleet was driven a total of 6,067 km. The amount of avoided CO_2 emissions was 1.8 t. It can therefore be imagined what the environmental impact will be if this type of vehicle replaces gasoline-powered vehicles. An LSV driven about 200 km per week could generate three fewer tonnes of GGEs per year if driven year round.

Figure 7: Advantages of LSVs in the City



The second advantage of an LSV was its economy in terms of purchase price (an estimated $10,000) and operating cost because, according to Bombardier, it only costs $0.40 to give the vehicle a full electrical charge for a range of 30 km, compared with $2.70[16] in gasoline for the same distance (6.7 times more). The $16 saving generated in a week would add up to $832 if the vehicle were driven year-round.

The third advantage was the noiselessness of the vehicles which, in addition to reducing external noise pollution, reduces stress on drivers.

The fourth advantage was parkability. LSVs are small vehicles that take up small amounts of space and handle very well, which makes them easier to park in the city.

The other advantages were related to the functional and user-friendly aspects of the vehicles:

- "small; they don't take up much room in traffic"
- "pleasant and easy to drive"
- "very easy to handle; greater mobility in the city"
- "greater harmony with pedestrians and cyclists"
- "complies with speed limits"
- "slows down urban traffic"

5.4.3 Disadvantages of LSVs in the City

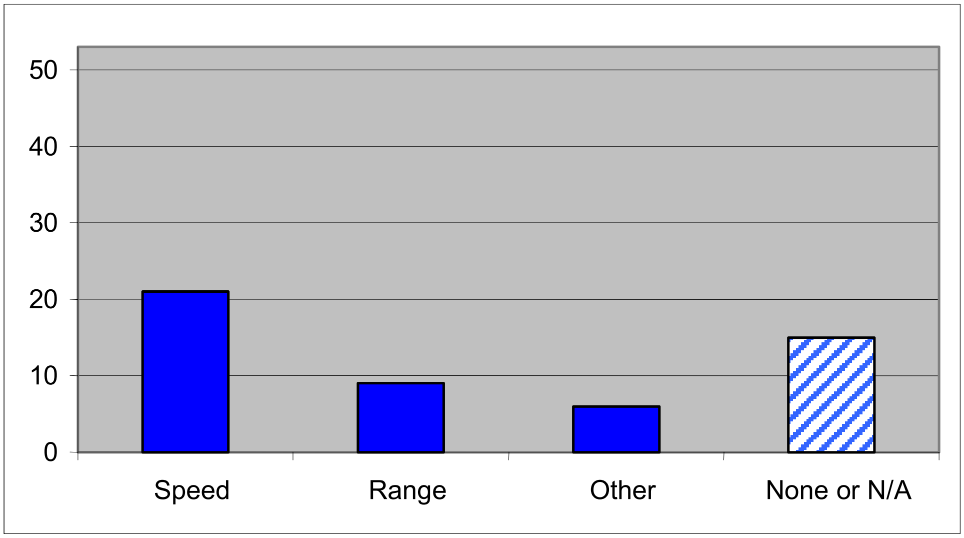
Figure 8 shows the most often cited disadvantages based on our LSV drivers' answers.

We found that 15 people, or almost a third of the LSV drivers, did not see any disadvantage with this type of vehicle being used in the city.

The major disadvantage reported by the LSV drivers was the vehicles' slow speed. As we saw above, many drivers felt that a top speed of 40 km/h was too slow for them to feel completely at ease in all traffic situations.

[16] Based on city-driving consumption of 15 L/100 km

Figure 8: Disadvantages of LSVs in the City



The second disadvantage was the short range. The distance that an LSV could travel before recharging was 30 km. Many LSV drivers wanted to travel farther, but ran out of power. Those who could partly recharged the vehicles at their places of work, at the homes of friends, at the hairdresser's, etc., to increase their daily range. However, it should be noted that some vehicles had been equipped with used batteries, which impaired their performance.

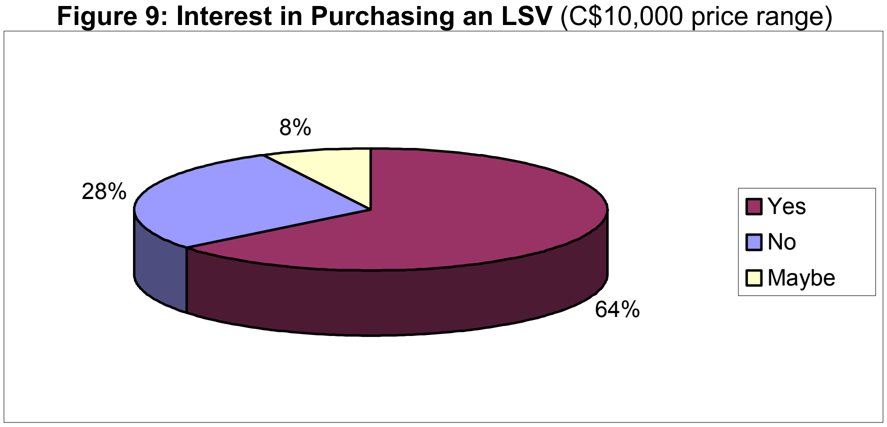
Noteworthy among the other cited disadvantages was the absence of doors, which made some passengers feel unsafe, and the absence of a positive wheel-lock (park system) to prevent the vehicles from moving when stopped. The absence of such devices can be very dangerous if the handbrake were disengaged (by a child, for example) because the vehicle could then roll downhill by itself.

5.4.4 Interest in Purchasing an LSV

That 64 percent of the LSV drivers were prepared to purchase an LSV suggests that LSVs are a mode of transportation that should not be ignored.

Nevertheless, one third of the LSV drivers wanted to see the above-mentioned disadvantages corrected before they bought an LSV. The others would be interested in an LSV as a second car for going to work and doing errands in the city. The potential buyers were couples who lived and worked in outlying areas of the city and already regularly commuted to work by car.

Figure 9: Interest in Purchasing an LSV (C$10,000 price range)



5.4.5 Role of Municipalities

The use of LSVs is strictly limited to urban communities because they cannot be authorized for use on roads with speed limits above 50 km/h. Under these circumstances, individual municipalities could eventually promote the use and purchase of LSVs based on their environmental priorities. In the questionnaires, the LSV drivers put forward interesting suggestions for promoting the introduction and unrestricted on-road use of LSVs in the city.

Incentives

A total of 28 percent of the LSV drivers suggested that free, reserved parking should be provided for clean vehicles in strategic places such as shopping malls and downtown areas, and that pay-per-use battery recharging outlets be installed in these parking areas.

In all, 18 percent of the LSV drivers suggested that LSVs be promoted not only by holding test-drive sessions open to the general public or in schools, but also by setting an example by having these types of vehicles purchased for people who work in the city, such as municipal utility employees, parking ticket officers and postal employees.

Other suggestions included the following: “set up lanes and reserved areas to encourage their use”; “put together a fleet and make them available for rental”; and “set up a grant and tax credit system to make them easier to purchase”.

Billboards

Because LSVs were still unknown to the residents of St. Jérôme, special attention was given to safety in the Assessment of Low-Speed Electric Vehicles in Urban Communities project by having billboards erected in four strategic locations along streets leading into the city to tell people that they might encounter these small low-speed vehicles on the streets. Many St. Jérôme residents and tourists saw these billboards.

In addition, 74 percent of the LSV drivers were in favour of this initiative, which they believed would help raise public awareness, inform people and promote caution. This measure also provided visibility for “clean vehicles” and the city, which promotes environmentally friendly policies.

Opinions were divided among the road users: 49 percent felt that the billboards were important, while the rest thought the vehicles were fairly visible and integrated well into traffic without their presence having to be emphasized.

6 RESULTS ANALYSIS

6.1 Safety Aspect

The Assessment of Low-Speed Electric Vehicles in Urban Communities project highlighted the following aspects.

6.1.1 Speed

Most of the LSV drivers thought that the LSVs would integrate more efficiently into the traffic flow if they could be driven at 50 km/h.

If the top speed of the LSVs were increased to 50 km/h, they would integrate more easily into the traffic flow on streets with 50-km/h speed limits. They would also share the road more harmoniously with conventional vehicles and the risks of unsafe passing by other vehicles would be reduced. Throughout the study, it also appeared that a 50-km/h top speed would promote sales of the vehicles to the general public.

However, federal regulations currently limit the speed of LSVs to 40 km/h and the project objective was not to reopen the debate on LSV speeds. In addition, the safety of LSVs moving at 50 km/h and the risks inherent to this speed increase have never been assessed. Nonetheless, we may assume that an increase in speed would require the installation of additional safety features, which could increase vehicle costs substantially and depress the LSV market. However, we feel that a technical study of the speed increase could address this issue constructively.

The study also revealed that the speed of some LSV models could drop by half on uphill grades and present a safety risk. We therefore believe the vehicles should be able to maintain a minimum speed at all times, even on hills.

6.1.2 Types of Roads and City Areas

The study showed that the level of safety felt by the LSV drivers varied according to the types of roads and city areas where they were driving. The following types of roads were found to be less safe for LSVs:

- Roads with 50-km/h speed limits on which people usually drive at speeds higher than the authorized speed;
- Roads with single-lane traffic in areas where passing is more hazardous.

The LSV drivers' perceptions seemed legitimate to us and led us to believe that there could be potential risks in these areas. Therefore, in areas where actual speeds clearly exceed the authorized speeds, the on-road use of LSVs should not be authorized.

6.1.3 Vehicle Safety Aspects

The project showed that one third of the LSV drivers thought that the vehicles should have doors so that they would feel more protected in the event of a collision. We believe that the final decision to choose a vehicle with or without doors is up to the buyers, who can assess the potential risks, as they would in the case of motorcycles, bicycles and inline skates.

It was reported to us that removable plastic doors impaired the drivers' visibility because, with the lack of air circulation, the windshields quickly fogged. We think that all LSVs equipped with doors should have defogging systems to prevent windshield fogging.

The tests also revealed that, for obvious safety reasons, the clutch should lock as soon as the vehicle comes to a stop even if the hand brake is released. This would prevent the vehicle from moving on its own on a hilly street in the event of a child or ill-intentioned person releasing the hand brake.

After the meeting with the MIRA Foundation representatives, it was suggested that LSVs be equipped with auditory signals that would activate when the vehicles moved at slow speeds (under 20 km/h, for example) so as not to endanger persons with visual impairments at intersections.

6.1.4 Range

The results showed that the range of the tested LSVs was a problem and that gauges were not very reliable.

It is important that the actual range of the vehicles correspond to manufacturers' stated specifications. Charge indicators should also be more reliable to ensure driver trust in this new technology.

6.2 City Vehicles

The concept of small, silent, "clean" vehicles appealed to St. Jérôme residents.

The LSVs proved to be ideal vehicles for travelling short distances. People found they were quick to get around in and pleasant to drive. The LSV drivers were pleased to find them easy to operate: they could be plugged in at night to be ready for use in the morning and they cost less. The small size of the vehicles also made parking easier and greatly enhanced their handling capability.

The 30-km range of most of the LSVs was not always enough to meet driver needs. When power reserves quickly dwindled, drivers were haunted by thoughts of running out of power. To remedy this situation, it was suggested that municipalities could provide recharging facilities close to downtown areas and parking lots to enable drivers to partly recharge their vehicles while they did their errands. It was reported to us that most drivers were able to plug in their vehicles during their work hours.

The approximate C$10,000 cost of an LSV was seen as a positive factor that would promote its introduction. Because they were not only less expensive to buy than a gasoline-powered vehicle, but also less expensive in terms of maintenance and fuel consumption, they caught the interest of most people who participated in the study.

7 CONCLUSIONS

It was clear to us at the end of the tests that the LSV drivers and the public were pleased with the LSV concept.

Because the vehicles are new on the market, their introduction to on-road use should be accompanied by regulations, adequate safety measures and better matching of consumer needs with the product. LSVs intended for the lifestyles of American gated communities do not always meet the needs of working people, who could use them in place of a second family car.

If LSVs are a solution for increased urban pollution, congestion and excessive speed, it is imperative that government and municipal authorities provide support for their introduction and acceptance by the public. Consumers are already prepared to accept technological innovations that help prevent the deterioration of their living environments.

We find that the unrestricted use of LSVs, as currently designed, cannot be permitted in all municipalities or on all road networks, even urban road networks. However, we believe that LSVs are vehicles that meet both individual and community needs, that they can be integrated into traffic safely and that they have their place in urban communities.

In the case study, it was found that LSVs could be considered for on-road use in St. Jérôme, provided their use is prohibited on major arterial roads where the actual speeds of vehicles exceed the 50-km/h speed limits.

8 RECOMMENDATIONS

As a result of the Assessment of Low-Speed Electric Vehicles in Urban Communities project, we have drawn up the following recommendations for various levels of government and manufacturers.

8.1 Recommendations to Government Authorities

8.1.1 Federal Government

- Require that LSVs be able to maintain a minimum speed (32 km/h) in hilly conditions.
- Require that a positive wheel-lock (park system) be installed in LSVs to prevent the wheels from turning when the vehicle is stopped.
- Require that windshield wipers be installed on LSVs.
- Require that LSVs with doors (even removable, plastic doors) be equipped with adequate ventilation and defogging systems.
- Conduct studies to assess the impact of increasing the top speed of LSVs to 50 km/h.

8.1.2 Provincial Government

- Authorize the on-road use of LSVs in zones with 50-km/h or lower speed limits, except in areas where actual known speeds of traffic are higher than authorized speeds (e.g., major arterial roads).
- Include municipalities in each step leading up to the authorization of LSV use on municipal road networks.
- Prepare a guide for municipalities to help them facilitate the introduction of LSVs in municipal areas (general information on LSVs, introduction criteria and signage).
- Prohibit the use of LSVs in winter, except in cases where LSVs are adapted to winter conditions (defrosters, windshield washers, winter tires, heaters, battery insulation, etc.).
- Require the same driver's licence and minimum age for LSVs as for passenger vehicles (Class 5).
- Conduct a national awareness campaign focussing on safety and environmental benefits.

To make it easier to introduce LSVs, we also recommend that governments assess the possibilities of introducing tax incentives, such as lower registration fees and taxes, and promoting the implementation of a public battery-recharging infrastructure.

8.1.3 Municipal Authorities

- Determine which streets are safe in accordance with a guide prepared by Transport Quebec before allowing the on-road use of LSVs on municipal territory.
- Allocate reserved parking spaces for environmentally friendly vehicles.
- Allow free parking for LSVs in all city pay-parking lots.
- Set up battery-recharging facilities in strategic locations (downtown areas, shopping malls, etc.).
- Inform the public of the presence of LSVs in urban areas by erecting billboards that have been pre-standardized by provincial authorities.

These measures will help municipalities promote their images as cities providing better environments and will show recognition for residents who wish to use non-polluting modes of transportation.

8.2 Recommendations to Manufacturers

The following are a few suggested measures for manufacturers that are intended not only to harmonize supply and demand but also increase LSV safety. However, these recommendations concerning technical aspects are based on driver perceptions and cannot supersede technical studies intended to improve vehicle safety.

- The dashboard should be very legible and include an accurate, reliable power gauge with a blinking light to indicate the last 5 km of charge.
- There should be a warning light to indicate the battery depletion threshold and inform the driver of the vehicle’s reduced power status.
- Good-sized rearview mirrors should be attached on each side of the vehicle.
- Windshield-washer systems would be a good idea.
- The vehicles should be able to maintain a minimum top speed, even on hills.
- The manufacturer’s stated range for the vehicle should be the same in actual use conditions.
- A positive wheel-lock (park system) that engages when the motor stops should be a priority.
- Fluorescent strips would increase vehicle safety at night.
- Discussions should be continued with the MIRA Foundation.

Manufacturers should also be able to provide a variety of battery technologies. Consumers could pay for them based on the range that suits them.

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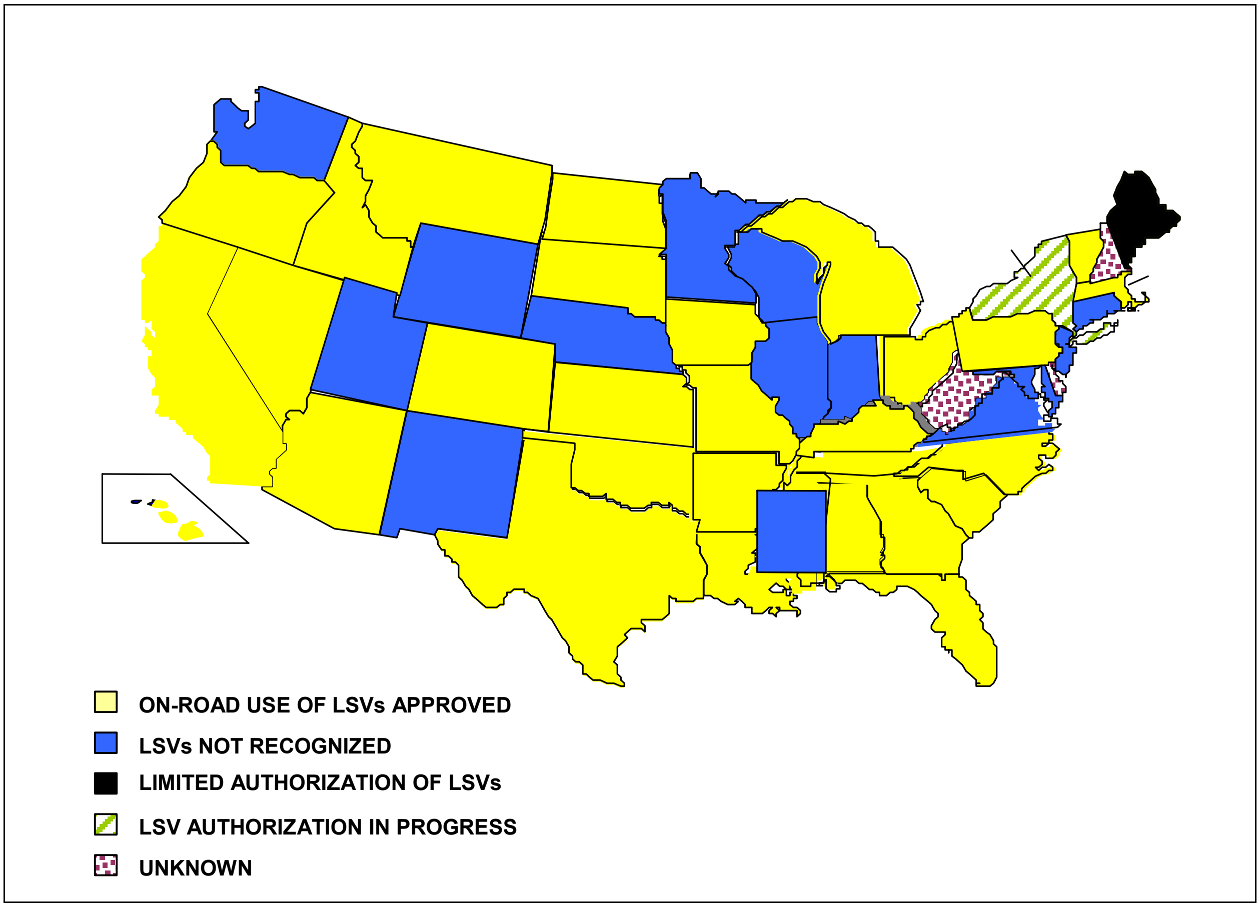
APPENDIX 1
UNITED STATES REGULATORY FRAMEWORK FOR LSVs BY STATE



- LSVs have been introduced and their on-road use recognized in more than 30 states.
- These states require that LSVs be driven on roads with speed limits no higher than 56 km/h (35 mph).
- Some states allow unrestricted on-road use in designated urban areas, while others allow restricted on-road use (to and from golf courses, for example).
- Some states without specific legislation for LSVs allow them to be used.
- The 13 states that have recognized LSVs require them to be electric vehicles.
- All of the states require LSV drivers to have valid driver's licences.
- Some states require safety equipment in addition to that required by the NHTSA (e.g., slow vehicle triangle symbol and window defrosters).
- Municipalities can restrict the on-road use of LSVs to certain areas.

Source: Electric Vehicle Association of America, August 2001