TRANSPORTING QUÉBEC TOWARDS MODERNITY

SUSTAINABLE MOBILITY POLICY – 2030

Road Safety Intervention Framework

Québec

This publication was prepared by the Direction générale de la Politique de mobilité durable et de l'Électrification and edited by the Direction des communications of the ministère des Transports.

The content of this publication can be found on the Ministère's website at the following address: **www.transports.gouv.qc.ca**.

Cette publication est également disponible en français sous le titre
Politique de mobilité durable – 2030 - *Cadre d'intervention en sécurité routière*.

For more information, you can:

• dial 511 (in Québec) or 1-888-355-0511 (elsewhere in North America)

• visit the website of the ministère des Transports at **www.transports.gouv.qc.ca**.

• write to: Direction des communications
Ministère des Transports
500, boul. René-Lévesque Ouest, bureau 4.010
Montréal (Québec) H2Z 1W7

ISBN 978-2-550-83417-5 (PDF)

(Original edition: ISBN 978-2-550-81197-8 [PDF])

Legal deposit – 2019
Bibliothèque et Archives nationales du Québec

Road and Off-Road Safety in Québec

This document is an integral part of the Sustainable Mobility Policy to 2030. It presents an overall portrait of road and off-road safety in Québec, its issues and all measures related to the 2018–2023 Road and Off-Road Safety Action Plan. The most promising and cross-sectional measures in this sectoral action plan also appear in the Sustainable Mobility Policy Comprehensive Action Plan.

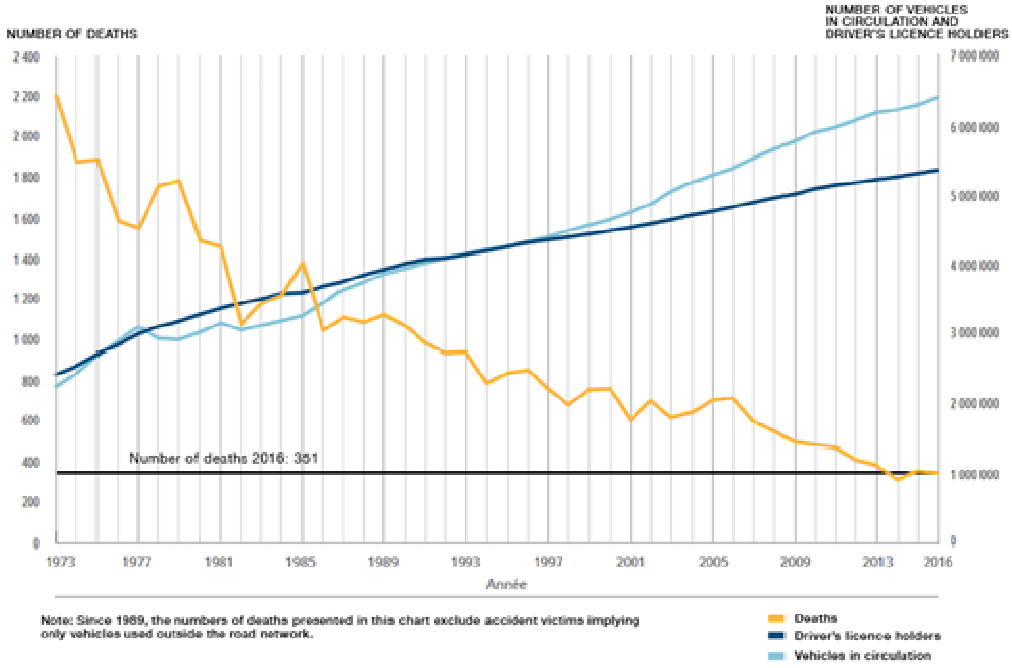
The Road Safety Intervention Framework is a key component of the Sustainable Mobility Policy vision: In 2030, Québec will be a North American leader in 21st-century sustainable and integrated mobility. In a territory planned with a view to sustainable mobility, it will have a high-performance, safe, connected and low-carbon transport ecosystem that contributes to Québec's prosperity and meets the needs of people and businesses.

Current Situation

Road safety

Since the 1970s, Québec has seen an improvement in its road safety record. Despite the constant increase in the number of vehicles in circulation, the increase in the number of driver's licence holders and the growing diversity of means of transportation, the number of deaths has decreased significantly (Figure 1).

Figure 1: Change in the number of deaths, the number of vehicles in circulation and the number of driver's licence holders, 1973 to 2016



Source: Société de l'assurance automobile du Québec

In 43 years, the number of deaths related to road collisions has dropped by nearly 80%, from 2,209 in 1973 to 351 in 2016.

This improvement is due to numerous factors, including the construction of safer road infrastructures, the design and manufacture of safer vehicles combined with strict oversight of vehicles allowed on the public roads, the implementation of new legislative and regulatory measures, increased police presence, sensitization of road users and an improvement in health services, including ambulance interventions and hospital services.

Despite this improvement, further advancements have been more difficult in the last five years, as has also been the case in other Western countries. However, Québec has a higher death rate per capita than its neighbouring province, Ontario, and those of many comparable countries, including Sweden and the Netherlands[1].

Table 1: Number of deaths per year, by user category

User category	Number of deaths per year							2011–2016 % of all deaths	Change in % 2016–2011 to 2015
	2011	2012	2013	2014	2015	2016	2011–2016		
Occupant of a car or light truck	315	276	236	194	238	193	1,452	62.7%	–23.4%
Occupant of a heavy truck or semi-trailer truck	7	6	13	4	6	7	43	1.9%	–2.8%
Occupant of a motorcycle	40	45	46	40	50	54	275	11.9 %	22.2 %
Occupant of a bicycle	17	14	20	11	9	8	79	3.4%	–43.7%
Pedestrian	75	55	65	50	45	63	353	15.2%	8.6 %
Other (1)*	21	21	12	19	14	26	113	4.9%	49.4%
TOTAL	**475**	**417**	**392**	**318**	**362**	**351**	**2,315**	**100%**	**–10.6%**

(*) The "Other" category includes victims whose category was not determined and victims travelling in the following types of vehicles: bus, school bus, taxi, scooter, equipment vehicle, tool vehicle, agricultural vehicle and all vehicles that generally drive off of the road network.

Source: 2016 Road Safety Report (SAAQ) and special compilation of SAAQ data

Table 2: Number of serious injuries per year, by user category

User category	Number of serious injuries per year							2011–2016 % of all deaths	Change in % 2016–2011 to 2015
	2011	2012	2013	2014	2015	2016	2011–2016		
Occupant of a car or light truck	1,253	1,155	990	885	841	811	5,935	57.5%	–20.9%
Occupant of a heavy truck or semi-trailer truck	29	26	28	22	25	31	161	1.6%	19.2%
Occupant of a motorcycle	216	240	201	233	243	230	1,363	13.2%	1.5%
Occupant of a bicycle	106	88	113	88	113	96	604	5.9%	– 5.5%
Pedestrian	314	323	296	263	272	242	1,710	16.6%	–17.6%
Other (1)*	102	123	97	80	78	66	546	5.3%	–31.3%
TOTAL	**2,020**	**1,955**	**1,725**	**1,571**	**1,572**	**1,476**	**10,319**	**100%**	**–16.5%**

(*) The "Other" category includes victims whose category was not determined and victims travelling in the following types of vehicles: bus, school bus, taxi, scooter, equipment vehicle, tool vehicle, agricultural vehicle and all vehicles that generally drive off of the road network.

Source: 2016 Road Safety Report (SAAQ) and special compilation of SAAQ data

[1] Société de l'assurance automobile du Québec (2016). *La sécurité routière, ça nous concerne tous.* Public consultation document.

Table 3: Number of minor injuries per year, by user category

User category	Number of minor injuries per year							2011–2016 % of all deaths	Change in % 2016–2011 to 2015
	2011	2012	2013	2014	2015	2016	2011–2016		
Occupant of a car or light truck	30,829	28,651	28,067	26,980	27,719	28,054	170,300	78.1%	–1.4%
Occupant of a heavy truck or semi-trailer truck	487	505	456	454	455	437	2,794	1.3%	–7.3%
Occupant of a motorcycle	1,590	1,574	1,577	1,481	1,576	1,730	9,528	4.4%	10.9%
Occupant of a bicycle	1,795	1,910	1,772	1,630	1,773	1,710	10,590	4.9%	–3.7%
Pedestrian	2,848	2,598	2,539	2,335	2,518	2,489	15,327	7.0%	–3.1%
Other (1)*	1,852	1,867	1,563	1,418	1,379	1,404	9,483	4.3%	–13.1%
TOTAL	**39,401**	**37,105**	**35,974**	**34,298**	**35,420**	**35,824**	**218,022**	**100%**	**–1.7%**

(*) The "Other" category includes victims whose category was not determined and victims travelling in the following types of vehicles: bus, school bus, taxi, moped, equipment vehicle, tool vehicle, agricultural vehicle and all vehicles that generally drive off of the road network.

Source: 2016 Road Safety Report (SAAQ) and special compilation of SAAQ data

According to the data from the Société de l'assurance automobile du Québec (SAAQ), for the period from 2011 to 2016, there were a total of 230,656 road accident victims in Québec, minor and serious injuries and deaths combined (Figure 2). This report provides only a partial portrait, however, especially concerning vulnerable users. The data from the SAAQ files are taken from accident reports produced by officers of the peace involving a moving motorized vehicle. They do not include pedestrian accidents (including users of motorized or non-motorized mobility aids[22]) with a non-motorized vehicle, such as a bicycle. Cycling accidents attributable, for example, to falls (e.g., icy surface, pothole, intoxication, etc.) or to collision with a fixed object or other non-motorized users, are not compiled. Finally, many accidents are never documented, because the victims suffer minor injuries and do not necessarily go to the hospital. We can therefore assume that the number of accident victims, particularly among cyclists and pedestrians, is higher than revealed by the road safety report.

The SAAQ data also tell us that 2,315 people died in road accidents from 2011 to 2016. Even though fatal accidents involving an occupant of a car or light truck represent nearly two-thirds (63%) of all fatal accidents that occurred between 2011 and 2016, the vulnerability of some other users is still a concern, especially in the context of sustainable mobility.

Currently, we do not have accurate data about the number of Québecers who travel by foot, by bicycle or using a mobility aid, nor do we know about the distances covered using these modes of transportation. For this reason, it is hard to estimate the accident risk related to these modes of transportation in comparison with the risk associated with car travel, for example.

It is clear, however, that nearly one-third of the people killed on Québec's roads are pedestrians, including those using mobility aids, motorcyclists and cyclists: 15% of the fatal accidents between 2011 and 2016 involved a pedestrian (with or without a mobility aid), 12% involved a motorcyclist and 3% involved a cyclist.

[2] Examples: crutches, walkers, manual or motorized wheel chairs, three-wheel scooter, four-wheel scooter.

The portrait is even more worrisome for accidents causing serious injuries. Occupants of cars or light trucks are the main victims (58%), but vulnerable users are still highly represented. Over this period, 17% of accidents causing serious injuries involved a pedestrian, 13% a motorcyclist and 6% a cyclist.

Off-road safety

The safety of drivers and passengers using off-road vehicles (ORV), a vehicle category that includes snowmobiles and all-terrain vehicles (ATV), that is, quads, recreational off-road vehicles (ROV) and all-terrain motorcycles, is also of concern to the government.

ORVs were initially designed for utilitarian purposes and are still used for this purpose, mainly by farmers and entrepreneurs. But for the majority of users, ORV are recreational[3]. In Québec, snowmobiles are recognized as one of the four tourism products included in the 2014–2020 Winter Tourism Development Plan[4].

Furthermore, in communities that are not connected to the highway network, particularly in the regions of Nord-du-Québec and Basse-Côte-Nord, the use of ORV is comparable to car use. These vehicles are essentially the main means of transportation for passengers and goods. In indigenous communities, information concerning the number of vehicles in use, the number of accidents and the trends concerning ORV use are incomplete.

As Figure 3 shows, between 2011 and 2016, there was a 7% increase in the number of ORV in use, based on the number of registered ORV.

Table 4: Number of registered off-road vehicles (ORV), 2011 to 2016

Year	Snowmobile	Change %	All-terrain vehicle (ATV)	Change %	All OVR	Change %
2011	172,938	−1.22%	364,236	−1.57%	537,174	−1.45%
2012	176,564	2.10%	362,595	–0.40%	539,159	0.37%
2013	184,908	4.73%	382,434	5.47%	567,342	5.23%
2014	182,991	−1.04%	384,459	0.53%	567,450	0.02%
2015	181,010	−1.08%	386,445	0.52%	567,455	0.00%
2016	185,285	2.36 %	389,741	0.85%	575,026	1.33%
TOTAL		**7.14 %**		**7.00%**		**7.05 %**

Source: SAAQ

Despite the presence of a 60,000-km trail network and many measures to safeguard ORV users, there are a great number of on- and off-trail accidents every year.

From September 1, 2010, to December 31, 2016 (Figure 4), there were 334 deaths involving an ORV. The number of snowmobile deaths peaked in 2014–2015, with 35 deaths, while for ATV the deadliest year between 2011 and 2016 was 2011, with 33 deaths, followed by 2016, with 31.

[3] Institut national de santé publique du Québec (2006). *Mémoire déposé à la Commission parlementaire sur les transports et l'environnement lors des consultations particulières et audiences publiques dans le cadre du document d'orientation sur les véhicules hors route présenté par la ministre déléguée aux Transports*, p. 4.

[4] Tourisme Québec (2014). *Stratégie de mise en valeur du tourisme hivernal 2014-2020 et plan d'action 2014-2017*.

Table 5: Number of snowmobile-related deaths and injuries, winters 2010–2011 to 2015–2016

Type of accident	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	TOTAL
Deaths	26	22	26	22	35	25	156
Serious injuries	287	232	278	340	308	230*	1,675
TOTAL	313	254	304	362	343	255	1,831

*Provisional data

Source: Bureau du coroner, INSPQ

Table 6: Number of ATV-related deaths and injuries, 2011 to 2016

Type of accident	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	TOTAL
Deaths	33	28	28	29	29	31	178
Serious injuries	588	665	617	580	606	623	3,679
TOTAL	621	693	645	609	635	654	3,857

Source: Bureau du coroner, INSPQ

Furthermore, for this same period, we can add 5,354 serious injuries (snowmobile and quad only) for the period from September 1, 2010, to December 31, 2016.

Québec has over 33,000 km of marked snowmobile trails and over 27,000 ATV trails. Based on the geolocation of accidents by the ministère des Transports, de la Mobilité durable et de l'Électrification des transports (MTMDET) using SAAQ data, there was a clear increase in snowmobile accidents on marked trails in winters 2013–2014, 2014–2015 and 2015–2016, with 45 of the 80 deaths occurring on the trails, a proportion of 56%. As for ATV, 81 of the 94 fatal accidents in the 2014 to 2016 seasons took place off the trails, or 86% of the deaths in that three-year period.

In summary, the number of accidents leading to death or serious injury has been stable, despite the money invested over the years by the MTMDET, mainly through financial assistance programs.

The importance of road and off-road safety for sustainable mobility in Québec

Mobility is not sustainable without user safety, which is an essential factor that gauges the applicability of the other Sustainable Mobility Policy measures. It would be counterproductive to promote an action that would endanger users,especially since the cost of road and off-road accidents is a heavy burden for Québec on the human, social and economic fronts[5]. Furthermore, lack of safety, both real and perceived, on the public roads and in the built environment presents a serious drawback for encouraging people to adopt means of transportation other than the private car.

Finally, investing in road safety will allow some vulnerable users, including the elderly and people with reduced mobility, not to restrict their movements due to infrastructures that are unsafe or ill-suited to their specific needs, thereby expanding the scope of the inclusive approach within sustainable mobility.

[5] Parachute (2015). The Cost in Injury in Canada.

The role of the Québec government

The government, and particularly the MTMDET, plays an active role in road and off-road safety in Québec.

With regard to road safety, the MTMDET is responsible for both the management of the highways and the regulation and legislation that applies to the whole of Québec. This responsibility is shared by the MTMDET and the municipalities, which manage their own road networks, in compliance with the rules set out in the Highway Safety Code[6].

For off-road safety, the MTMDET exercises constant leadership, taking into account the changes in issues and problems related to ORV traffic. It is responsible for the *Act Respecting Off-Highway Vehicles* (AROHV)[7] and its related regulations. Furthermore, it maintains the Route Blanche, a winter ORV trail 525 km long that serves the people of Basse-Côte-Nord. Finally, the MTMDET manage three financial assistance programs related to ORV: the Programme d'aide financière aux véhicules tout-terrain du Québec (ATV financial assistance program), the Programme d'aide financiaire aux clubs de motoneigistes du Québec (Québec'snowmobile clubs financial assistance program), and the Programme d'aide financière aux véhicules hors route – Infrastructures et protection de la faune (off-road vehicle financial assistance program for infrastructures and wildlife protection).

The MTMDET also serves as an intermediary for various groups concerned about road and off-road safety, such as the trucking industry[8], cyclists[9] and federations that promote the use of ORV.

This connection to the public and its needs then leads to laws, regulations, policies and MTMDET action plans. This role, in connection with scientific monitoring and recognized expertise, allows the MTMDET to anticipate and accompany changes that may influence safety, such as the introduction of autonomous vehicles.

To achieve this mission, the government relies on the MTMDET and the SAAQ which, in terms of road safety, is particularly involved in promoting good behaviours, vehicle equipment and road control. Furthermore, the MTMDET can count on the cooperation of other federations that oversee snowmobiling and ATV activities.

Trends and outlook to 2030

The road environment plays a decisive role for user safety, and the cohabitation of ORV with car drivers raises its own set of issues.

With regard to improvements in car safety over the years, such as the addition of seat belts and air bags, the year-over-year gains are gradual and marginal.

The progress is the result of technological change and the needs or requirements of the public. In this sense, the current modernization of vehicles, such as progressive automation, is still responding to these two dynamics.

The construction of safe infrastructures, such as the new types of surfaces or signalling, will become a bigger priority for the government, given the trends that are revealed in this regard.

[6] SAAQ. Highway Safety Code: http://legisquebec.gouv.qc.ca/en/pdf/cs/C-24.2.pdf.
[7] *Op. cit.*
[8] All matters involving heavy vehicle safety and related to rad sharing issues are included in the Road Freight Transportation Intervention Framework.
[9] All matters involving active transportation and related road sharing issues are included in the Active Transportation Framework

The advancement of road safety must be conceived based on the changes in Québec's population, a demographically influenced shift that will change the way the government and the municipalities will have to design and manage their road networks in the future.

ORV practices are also changing. It is important to improve knowledge about new products and the environment in which ORV users are driving. This environment includes marked trails, lumber roads and the entire off-road area, which is attracting more and more fans.

Trend 1: Demographic and behavioural trends of Québecers

Ageing and changing values and behaviours are both transportation planning issues that the government is facing, and they will become even more important in the next two decades.

> Ageing population

The baby-boom phenomenon is especially pronounced in Québec. By 2030, the demographic weight of people over 65 will represent about 25% of the total population[10] In terms of road safety, it is important to consider that older people's perception of the environment may be altered due to the weakening of their visual, cognitive and motor capacities.

In general, older drivers adapt their driving habits (speed, time of driving, behaviour at stop signs, etc.), which will influence the very design of these networks[11].

We can also anticipate that an ageing population will lead to a change in modes of transportation. For example, initially, people suffering a loss of autonomy will move to public transit or opt for shared drives. Likewise, more people will replace their private car with a motorized mobility aid (MMA) or simply walk. This makes them vulnerable users, because they are unprotected and have to deal with reduced visual or physical capacities.

For the period from 2012 to 2016, according to SAAQ statistics, people aged 65 and over represented 45% of the pedestrians killed in road accidents. They are at the greatest risk of being involved in an accident as pedestrians[12].

> A new multimodal generation

At the same time, there has been a change in the transportation choices of young Québecers, particularly "millennials" (Generation Y, born between about 1982 and 2000). For them, private cars are less important, as is also true elsewhere in North America. This phenomenon creates an increased interest in more traditional active travel (bicycles, bike-sharing, electric bicycles, etc.) and for the use of multimodal transportation and new, ecological and connected modes of transportation[13].

Although the behaviour of the generation born in the 2000s is as yet unknown, it is likely that it will be more connected and interested in shared mobility, the most convenient possible without the burden of car ownership[14].

---

[10] Institut national de santé publique du Québec (2017). Population aged 65 and over. Santéscope.

[11] Fonds de recherche Nature et technologie (2016). Évaluation des chaînes de déplacements du conducteur âgé et typologie des collisions en régions urbaines

[12] Société de l'assurance automobile du Québec (2016). Profil détaillé des faits et des statistiques touchant les piétons.

[13] Corwin, S., Vitale, J., Kelly, E., & Cathles, E. (2015). *The future of mobility. How transportation technology and social trends are creating a new business ecosystem.* Dutzik, T., Inglis, J. & Baxandall, P. (2014). *Millennials in Motion: Changing Travel Habits of Young Americans and the Implications for Public Policy.* US PIRG Education Fund Frontier Group. Larochelle, S. (2016). Les jeunes Québécois délaissent-ils la voiture? *La Presse*. March 16, 2016. René, C. (2017). Les milléniaux de moins en moins intéressés par la possession d'une auto. *La Presse.* October 17, 2017.

[14] Baker, E. (2015). Generation Z is a threat to the car industry. *The Telegraph.* September 5, 2015.

Trend 2: Innovation and advancement of road vehicles

For a few decades now, the emergence of integrated technologies in cars has been increasing exponentially. These innovations (cruise control, assisted braking and parking, lane-departure warning, collision alert system, blindspot monitor, etc.) have led to improvements in driving safety.

The ongoing automation of vehicles adds to the number of existing safety systems, but is also changing the very concept of driver, as drivers become increasingly secondary or passive with regard to their driving environment. The objective, or at least the argument, of the designers of these technologies is to reduce human error in order to improve road safety.

Autonomous vehicles may also offer a response to the safety of the most vulnerable users and become an alternative to traditional public transit such as buses or paratransit systems.

Whatever results, the purpose of autonomous vehicles is to reduce or control the risks related to driving. One of the collateral consequences of this technological advancement is that it is less and less socially acceptable for people to die during transportation, with absolutely safe slowly becoming a priority in the design of modern vehicles and leading to an obligation of results for road network managers.

> Connectivity

Along with the trend toward vehicle automation, there has been a development in the capacity of vehicles to communicate with each other and their environment. We can anticipate that cars will be connected to each other and to infrastructures. Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) Communications may revolutionize road safety by automatically accommodating real or sudden environmental conditions (e.g., presence of road works, obstacles, condition of the pavement).

Many tests on environmental detection systems (cameras, driving assistance, etc.), particularly for buses and heavy vehicles, are already underway in Québec. Furthermore, some international companies have designed systems that allow a series of interconnected trucks (*platooning*) to drive with an active driver only in the first truck, thus reducing risks related to human error[15].

> Cybersecurity

Vehicle automation and connectivity will lead to new road safety risks, particularly concerning cybersecurity. The possibility that someone other than the user could take control of the vehicle and change its trajectory will increase with technological advancement[16].

> New vehicles on the market and new safety challenges

The presence of motorized personal mobility devices (MPMD) on the market is another trend that will affect road safety. MPMD are constantly evolving in technology and they include devices similar to traditional means of transportation, such as bicycles, scooters, skateboards and gyropodes, that are propelled by an electric motor.

Other more innovative types of vehicles have arrived, such as the Twizy, in France (which qualifies as a low-speed vehicle under Transport Canada rules but not Québec's), the Slingshot, in Minnesota (a three-wheel vehicle), the EHang 184, in China (a kind of drone taxi), the Kitty Hawk Flyer, in California (a cross

[15] European Truck Platooning (2016). *Truck platooning: Safety first*.
[16] US Department of Homeland Security (2017). *Future Environnement net assessment. Autonomous Vehicles*.

between a motorcycle, a drone and a hydroplane) or the Liberty, a flying car, the stuff of 1960s science-fiction but now available for pre-sale in 2018 by Pal-V in the Netherlands.

This race toward new motilities, by whatever means used, will have consequences for the way networks are designed but also, and perhaps especially, for the new prospective concerning road safety gains and losses.

> **Urban sprawl and increased congestion**

In Québec, traffic management is challenged by two linked trends: urban sprawl and increased congestion. The advent of autonomous or connected vehicles will not counter these trends if their use is not structured and optimal to avoid individual rather than shared travel, because by making car travel accessible to people who were formerly deprived of it, autonomous cars could increase congestion.

The infrastructures themselves will have to evolve, both to adapt to changing vehicles, by being connected with them for example, and so the effects of their development will be countered, particularly concerning urban sprawl and increased congestion.

> **Climate change**

At the same time, climate change may have an influence on the way road safety is designed. For example, freeze-thaw cycles will be more frequent during the winter season, and there may be more floods. Furthermore, the erosion of banks is already affecting many regions of Québec, and the thawing of the permafrost poses a significant challenge for communities in northern Québec, where off-road vehicles are often used as a means of transport.

Trend 3: Technological ORV trends

Snowmobile technology is constantly evolving with the arrival of so-called “hybrid” snowmobiles, which are built to be as easy to manoeuvre on- and off-trail and designed to move powerfully through powder snow. Furthermore, in the new models, the engine has been repositioned so the driver has more room to handle the vehicle easily. The manufacturers are also concerned about greenhouse gas emissions and are working to make snowmobiles quieter to meet the rules concerning less polluting, less noisy ORV by January 1, 2020.

While manoeuvrability, comfort and the environment seem to influence the development of new technologies, snowmobile users’ interests are focused on better performance and more power. According to an analysis conducted by the INSPQ for the winters from 2009–2010 to 2015–2016 on 172 deaths that were subject to investigation by the coroner’s office, for 70 deceased people, or 41% of all the deaths, excessive speed was a contributing factor in the accident[17].

It is important to add that ATV have also been subject to new technological trends, and engine power is also an important target for the industry, which wants to meet the demands of consumers, more and more of whom are using quads, off-trail and in the snow. The trend is toward recreational off-highway vehicles (ROV), also called “side-by-sides,” where the driver and passenger are seated next to each other. For ATV users, the INSPQ reports that from 2010 to 2016, 49 deaths of a total 181 were related to excessive speed, or 27% of all deaths during that period[18].

[17] These data do not represent all snowmobile deaths during this period, because it takes several months after a death for the coroner’s office to complete its investigation. These figures were reported by the INSPQ on November 20, 2017.

[18] *Ditto.*

2. Sustainable Mobility Issues Related to Road and Off-Road Safety

The impact of road and off-road accidents on the health and wellbeing of Québecers

Every accident, on or off the roads, has impacts on the human, social and economic scale. The consequences are significant, for both the victims and the government[19]. Nevertheless, in terms of road safety, it is appropriate to focus on the ultimate goal of the interventions: protecting people by saving lives and reducing serious injuries. By pursuing this goal, all the other advantages of investing in road safety will benefit from the efforts made.

The challenge in pursuing the measures deployed to further reduce on- and off-road accidents in Québec can be seen in the following issues:

Issue 1: Governance of road and off-road safety

Most sustainable development and health policies, strategies and action plans in effect target road safety as an intrinsic component of success. This perspective illustrates, however, that the approach to road safety in Québec is highly segmented. For example, we could draw attention to the 2015–2025 National Public Health Program[20], the 2008–2020 Bicycle Policy[21], the government guidelines on land-use planning or the ministerial action plans on road safety, which, in whole or in part, address the importance of road safety.

These documents reveal some consistency in the intentions or interventions proposed. The best road safety practices are known or at least hinted at by all stakeholders. What is lacking, however, is a single reference point, a unifying concept that can advance, for every ministerial or municipal intervention, the same direction, the same intention, and give shared meaning to the various actions.

As concerns ORV governance, the Act Respecting Off-Highway Vehicles (AROHV) and its regulations need to be updated, as some of their provisions refer to off-road vehicle and equipment manufacturing technologies that have advanced toward an offer that is increasingly respectful to the environment and people who live around ORV trails.

The AROHV's field of application needs to be realigned based on the types of ORV and trail maintenance vehicles, not based on where they are being driven. Some provisions of the AROHV and the Highway Safety Code also require harmonization. Authorizations to build ORV trails on public land must be part of a collaborative approach between the government ministries and the organizations in question. Furthermore, they must be understandable for ORV club members, and the handling of complaints based on neighbourhood annoyances requires improvement, particularly for complaints that are not eligible for the mediation and arbitration process. These are some examples that argue in favour of a review of all the related legislation.

[19] Parachute (2015). *The Cost of Injury in Canada*.
[20] MSSS (2015). *Programme national de santé publique 2015-2015*. http://publications.msss.gouv.qc.ca/msss/fichiers/2015/15-216-01W.pdf
[21] MTQ (2008). Bicylce Policy. http://bv.transports.gouv.qc.ca/mono/0979376.pdf.

Issue 2: Interventions tailored to target users

Infrastructure design, especially for new road infrastructures, and interventions carried out on existing infrastructures must seek to reduce or eliminate deaths and serious injuries.

More specifically, the need to design road environments tailored to the needs of all road users, including vulnerable users such as pedestrians, cyclists, motorcyclists, people with reduced mobility and disabled people, is widely recognized. Where appropriate, the design of these environments should take into account the principles of inclusive approach and universal accessibility. We should point out, in this regard, that vulnerable road users were involved in nearly 35% of fatal and serious accidents from 2011 to 2016. During the same period, there were fewer improvements for this group than for all road users. This vulnerability, aggravated by the ageing of the population, calls for concrete interventions that require a new approach to designing infrastructures to make active transportation safer.

The rules of the Highway Safety Code (HSC) allow the movement of different road users to be regulated in a way that avoids conflicts and reduces the risk of collisions. To be effective and credible, the legislative framework must reflect the realities of travel and traffic. Rules concerning pedestrian and cyclist travel were added to the HSC at a time when the use of means of transportation other than the car was marginal, so some of these should be reviewed to ensure safe, fair sharing of the public roads.

For ORV, the interventions cannot focus solely on the infrastructures. There is also an opportunity to reinforce oversight where there are safety and cohabitation problems, especially as this activity is increasingly likely to be practised off-trail.

Issue 3: Harmonious and safe introduction of autonomous and connected vehicles

Most large car manufacturers and high-tech businesses have made a commitment to design automated driving systems that, by 2020, will allow drivers to completely cede control of the vehicle under certain situations. This means that even before we achieve level-5 automation (completely autonomous vehicle with no driver), in the lower levels (levels 3, conditional automation, and 4, no driver in some situations), we can anticipate safety benefits.

The reduction of accidents due to human error, through the automation of driving, is nevertheless accompanied by legal framework issues for these vehicles. These technologies raise questions about the reliability of the vehicles, the infrastructures required for them to function properly, the certification of the vehicles and the users, the liability and indemnification rules that would apply in the event of an accident, the vigilance that automated driving requires and the related ethical aspects. To this we must add issues about communication with other road users and infrastructures, as well as data sharing matters.

Another major challenge, especially during the transition period of the next few decades as autonomous cars emerge, will be the safe cohabitation with traditional vehicles and the public, especially vulnerable road users.

It is also important for the government to make provisions to encourage the shared use of autonomous vehicles (e.g., car sharing) and their use for public transit (shuttle, minibus, etc.) and for merchandise delivery in urban areas and cargo (e.g., *platooning*). Without these incentives, these technologies may actually increase the number of private vehicles on public roads.

Issue 4: Emergence of new means of transportation

There are many innovative transportation devices, such as gyropodes and electric scooters, that are currently poorly or not targeted by existing legislation but that may meet mobility needs, especially in urban areas. In addition to a lack of rules governing where and how these devices are used, they are generally not held up to any safety standards before they are manufactured or sold in Québec.

But these new vehicles are increasingly common on the market, posing many challenges in terms of road safety. Beyond the need for the legislation to be adjusted, they raise the important issue of cohabitation with the more traditional means of transportation, including walking, cycling and driving. In light of their growing popularity, this issue will be increasingly important in the future.

3. 2018–2023 Road and Off-Road Safety Action Plan

Issue 1: Governance of road and off-road safety

INTERVENTION PRIORITY 1.1: STRENGTHEN THE GOVERNANCE OF ROAD AND OFF-ROAD SAFETY

Measure 1: Integration of Vision Zero as the reference strategy of road safety in Québec

Under this policy, the MTMDET will define its own road safety intervention strategy based on the Vision Zero in order to respond to the issue represented by deaths and serious injuries on Québec's roads.

This new vision will allow road safety to be more easily integrated in various public plans, reinforcing the role that this concern should play in fields such as the environment, land-use planning, health and, primarily, transportation.

Indicator: Intervention strategy
Target 1: Development of the strategy by 2019
Target 2: Launch and communication of the strategy by 2020

Measure 2: Review the governance of photo radar to facilitate future deployment phases and extend its use to the various municipalities and regions of Québec

The current governance model is centred in government organizations. The government guideline to give greater autonomy to municipalities and the municipal cooperation pilot project argue in favour of a new governance model.

The MTMDET intends to pursue the deployment of photo radar by installing new automated devices in the regions, RCMs and municipalities other than those that already participate.

Currently, there are 53 devices. It is expected that this number will at least double in the coming years. A minimum of 100 devices can be expected.

Indicator: Number of devices used
Target: 100 devices by 2023
Budget: $15 million over five years (funds already planned)

Measure 3: Improve the off-road safety record by updating the legislative and regulatory framework

Many provisions of the Act Respecting Off-Highway Vehicles (AROHV) and its regulations need to be reviewed to improve safety and enforce application, because questions related to safety, the environment and the cohabitation of ORV users with neighbours are constantly changing.

Indicator: Bill and regulations adopted
Target 1: Table a bill to be adopted by January 1, 2020
Target 2: Regulations overhauled by 2021

Issue 2: Interventions tailored to different road users

INTERVENTION PRIORITY 2.1: IMPROVE USER SAFETY ON THE HIGHWAY NETWORK

Measure 4: Implementation of means of action for safer roads and roadsides

As a sustainable mobility leader, the MTMDET plans to invest over $600 million annually in road safety projects that contribute to Québec's sustainable development.

Improving road safety is a priority for the MTMDET. It is well known that some types of collisions are more likely to lead to deaths or serious injuries. Head-on collisions, collisions resulting from roadway departure and right-angle collisions at intersections are some of these. To help reduce the number of deaths and serious injuries on its road network, the MTMDET intends to correct sites where these types of collisions occur, focusing on measures that meet the Vision Zero objectives.

Based on these objectives, the interventions will mainly involve:

- a new approach to screening the most promising sites for potential reductions in deaths and serious injuries;
- the analysis and correction of potentially improvable sites using a progressive approach with the goal of correcting ten sites per year.

To this end, of the annual $600-million envelope mentioned above, the sum of $100 million will be dedicated to projects that respond to this vision.

Furthermore, in addition to interventions related to Vision Zero and in keeping with the road safety action plan, the MTMDET will continue to deploy measures recognized for road safety effectiveness, such as paving shoulders and maintaining the road marking compliance rate in the spring time.

Indicator: Interventions and investments made annually
Target: To be determined by an implementation plan
Budget: $100 million over five years

Measure 5: Revision of the Highway Safety Code to improve the safety of the most vulnerable users

Although certain provisions of the HSC outline the priorities on the road network and others penalize behaviours that could endanger life or safety, the message is not explicit enough to change road sharing habits toward more cooperative, responsible social dynamics advocate increased caution, especially toward the most vulnerable road users. It would be useful to add a duty of care principle to this law.

In conjunction, for the HSC to reflect this duty of care principle, a review of some driving rules is in order, especially those related to right-of-way.

Indicator: Bills adopted
Target 1: Duty of care principle added to HSC by 2018
Target 2: Review of HSC driving rules, particularly those concerning vulnerable users, in conjunction with the duty of care principle, by 2023

INTERVENTION PRIORITY 2.2: IMPROVE THE SAFETY OF VULNERABLE USERS ON MUNICIPAL ROADS

Measure 6: Implementation of an initiative concerning the emergence the Vision Zero in Québec

To further reduce the number of deaths and serious injuries on Québec's roads, road network managers need to review the way they design transportation systems, particularly by optimizing infrastructures for vulnerable users. This need affects municipalities and cities in particular, as they are most likely to have vulnerable users on their road networks. Municipalities do not all have the same resources or expertise to make the changes required to adopt this vision, however.

This initiative will allow the MTMDET and the municipalities to establish a shared understanding of the Vision Zero, design and release tools that will help the municipalities make decisions consistent with the vision and facilitate the achievement of its objectives.

Indicator: Implementation of the initiative and number of meetings
Target: Development of an implementation guide for the Vision Zero in the municipal environment, by 2020

INTERVENTION PRIORITY 2.3: IMPROVE THE SAFETY OF ORV USERS

Measure 7: Draw up an agreement with the police forces in question to assign patrols to target areas

Officers of the peace enforce the AROHV and its regulations. Oversight is also provided by officers accredited by snowmobile and ATV federations. Nevertheless, the extent of the network, at over 60,000 km, its remote location and a worrisome safety record in terms of deaths and serious injuries demand increased safety on the trails.

Indicator: Number of interventions carried out annually
Target: Number of interventions to be determined by an implementation plan

Issue 3: Harmonious and safe introduction of autonomous and connected vehicles

INTERVENTION PRIORITY 3.1: SAFELY REGULATE THE INTRODUCTION OF CONNECTED AND AUTONOMOUS VEHICLES

Given the imperfect coverage of the current HSC, a legislative and regulatory framework capable of guiding the introduction of autonomous vehicles is required.

The MTMDET must also determine the infrastructures required to allow for the safe use of autonomous and connected vehicles in the future.

If the government appropriately oversees the arrival of connected and autonomous vehicles, the automation of transportation could lead to changes in transportation habits. The MTMDET must therefore support the shift to these new technologies for purposes other than individual use, particularly by encouraging shared use, connections with the existing major transportation systems ("first mile, last mile" approach) and improved freight transportation, for example.

Measure 8: Adapt the legal and regulatory interventions required for the emergence of autonomous vehicles

The SAAQ and the MTMDET share responsibility for road safety. Striking a committee will ensure a safe introduction of autonomous vehicles while fostering innovation, economic development and sustainable mobility. The committee could also explore various avenues to smooth the transition to new solutions, such as mobility as a service.

The ultimate goal of the committee's efforts would be to adequately oversee the arrival of autonomous vehicles in Québec to ensure their safe introduction on public roads in the medium term. To do this, changes will be required in the HSC, to take the new reality associated with these vehicles into account. In the meanwhile, the MTMDET is planning to conduct pilot projects to allow autonomous vehicles to drive on the public road network.

Indicator: Number of pilot projects in place
Target 1: Three pilot projects launched by 2021
Target 2: First legislative or regulatory changes by 2021

Issue 4: Emergence of new modes of transportation

INTERVENTION PRIORITY 4.1: REGULATE THE EMERGENCE OF NEW MODES OF TRANSPORTATION

The arrival of motorized personal mobility devices (MPMD) and other "hybrid" vehicles, generally electric, offers interesting personal mobility options that will reduce road congestion and increase trips made using means of transportation other than the car. Currently, these new devices are not regulated by the HSC and, in most cases, there are no safety standards that must be met in their manufacture.

It is therefore important to regulate these new means of transportation in order to give Québecers alternatives to the car that are safe, economical and ecological, which can be safely introduced to our roads.

Measure 9: Establish a legislative and regulatory framework for the use of MPMD on public roads

A working group will assess the possibility of testing the use of some MPMD in pilot projects and establish the applicable testing conditions.

Indicator: Number of pilot projects to test the use of MPMDs
Target: Three pilot projects by 2023

SUMMARY TABLE

Road Safety Intervention Framework Issues, Intervention Priorities and Measures	Indicator	Target	Contribution to aspects of the Sustainable Mobility Policy					
			SMP aspect 1	SMP aspect 2	SMP aspect 3	SMP aspect 4	SMP aspect 5	Winning conditions
ISSUE 1: Governance of road and off-road safety								
Intervention priority 1.1: Strengthen the governance of road and off-road safety								
Measure 1: Integration of Vision Zero as the reference strategy of road safety in Québec (MTMDET)	Intervention strategy	Target 1: Development by 2019 Target 2: Launch and communication of the strategy by 2020			X			
Measure 2: Review the governance of photo radar to facilitate future deployment phases and extend its use to the various municipalities and regions of Québec (MTMDET)	Number of devices used	100 devices by 2023			X			
Measure 3: Improve the off-road safety record by updating the legislative and regulatory framework (MTMDET)	Bill and regulation adopted	Table a bill by 2020 and a regulation by 2021			X			
ISSUE 2: Interventions tailored to different road users								
Intervention priority 2.1: Improve user safety on the highway network								
Measure 4: Implementation of means of action for safer roads and roadsides (MTMDET)	Interventions and investments made annually	To be determined by an implementation plan			X			
Measure 5: Revision of the Highway Safety Code to improve the safety of the most vulnerable users (MTMDET)	Bills adopted	Target 1: Introduction of caution principle by 2018 Target 2: Review of rules in keeping with caution principle by 2023			X			

Road Safety Intervention Framework Issues, Intervention Priorities and Measures	Indicator	Target	Contribution to aspects of the Sustainable Mobility Policy					
			SMP aspect 1	SMP aspect 2	SMP aspect 3	SMP aspect 4	SMP aspect 5	Winning conditions
Intervention priority 2.2: Improve the safety of vulnerable users on municipal roads								
Measure 6: Implementation of an initiative concerning the emergence of the Vision Zero in Québec (MTMDET and municipalities)	Implementation of an initiative with the municipal sector	Development of an implementation plan			X			
Measure 7: Draw up an agreement with the Sûreté du Québec to assign patrols to target areas (MTMDET and SQ)	Number of interventions carried out annually	To be determined by an implementation plan			X			
ISSUE 3: Harmonious and safe introduction of autonomous and connected vehicles								
Intervention Priority 3.1: Safely regulate the introduction of connected and autonomous vehicles								
Measure 8: Adapt the legal and regulatory interventions required for the emergence of autonomous vehicles (MTMDET, SAAQ and MESI)	Number of pilot projects	3 pilot projects by 2021, first legislative or regulatory changes by 2021			X			
ISSUE 4: Emergence of new modes of transportation								
Intervention Priority 4.1: Regulate the emergence of new modes of transportation								
Measure 9: Establish a legislative and regulatory framework for the use of MPMD on public roads (MTMDET)	Number of pilot projects	3 pilot projects by 2023			X			