Autonomous vehicles: what role do they have in the mobility transition?

 Finished research

Begin: 01 February 2020
End: 01 March 2021

At a time when companies and governments are focusing all their energy on innovation, autonomous vehicles seem to embody the quintessential breakthrough that promises to revolutionize the future of automobility. Throughout the world, all eyes are on the activities of Google and Uber and the announcements of American, European and Asian manufacturers, attracting great attention from the media. In this context, the Mobile Lives Forum commissioned the French think tank La Fabrique Écologique to carry out a study aimed at determining the degree to which autonomous vehicles (excluding the transport of goods) could potentially contribute to the transition to a more sustainable world.

Research participants

LA FABRIQUE ÉCOLOGIQUE

Contact: Anne Fuzier

The object of the study

For several years now, autonomous vehicles have generated great enthusiasm. They’re presented as the future of motor terms of safety, services or ecology, and they seem to challenge the relevance of traditional public transport. Yet many questions: Are autonomous vehicles? What are their possible uses? What is required for their functioning? Who are the stakeholders in their development? And above all, to what extent and under what conditions can they contribute, in France, to the ecological transport sector by 2050? The methodology of the study led by La Fabrique Écologique is based on a review of both gray (technical and theoretical) and white literature on autonomous vehicles, as well as on nine semi-structured interviews with stakeholders involved in the construction and deployment: national politicians, executives from the automobile industry, researchers involved in related research, etc. The purpose of these interviews was to gather knowledge from the stakeholders on the advances made in the field and to understand the worldviews which drive these choices. This study only covers passenger transport, thereby excluding goods.

The results

A term that covers a complex and polymorphic reality

An autonomous road vehicle can be an individual or shared vehicle (car-sharing service, robotaxi, self-driving shuttle). Autonomous vehicles have been assumed to be electric due to the synchronicity between these two innovations. But thermal or electric motor, nor do they require certain types of energy in particular (natural gas, hydrogen, etc.). There are many kinds of engines and energy sources they will be able to use. An autonomous vehicle doesn’t refer to a stable continuum of incremental improvements on the traditional car. Autonomy is segmented into 5 levels, the first two of which are assistance systems that are already widely available in the current market. It’s only from level 3 that we can truly speak of autonomy which is still a way off, designated complete autonomy in all circumstances.
Autonomous vehicles are characterized by technologies that enable their functioning without human intervention. Such technologies allow for the analysis of the environment and the generation of gigantic amounts of data, which are then processed by artificial intelligence to control the driving process. These sensors have to work together in order to record every event, regardless of the circumstances. This designates complete autonomy in all circumstances.
conditions. There are therefore many different technologies in use: 3D cameras, radars, lidars (that measure distance with real-time maps which can supplement the data recorded by the sensors. The generated data is then processed by the AI which transforms it into trajectory or speed instructions. This data is also communicated to other autonomous vehicles systems to increase the quantity of information and therefore its reliability. This information redundancy is the necessary driving, and as it requires a high level of connectivity, it will probably be dependent upon the mass deployment of 5G.

Massive investments

Such technological demands require colossal investments, first and foremost in research and development. An international Institution estimates that between 2015 and 2017, 80 billion dollars were invested in autonomous vehicles, mainly in R&D; these investments come from private parties, the cost of deploying the necessary infrastructure to allow autonomous driving, and as it requires a high level of connectivity, it will probably be dependent upon the mass deployment of 5G.

A global competition

Research and development on autonomous vehicles has been driven by intense global competition between different players in the automotive industry, manufacturers (Renault and Peugeot in France) and their equipment manufacturers see it as an opportunity to sell their systems to a car system by selling vehicles equipped with even more features. The big tech companies (Google, Uber, etc.) are aiming to control the production and circulation of data. By freeing up time for drivers, autonomous vehicles would allow them to reduce operating costs by eliminating or relocating need for drivers, the cost of service could be reduced by 60% to 70%. Finally, states have also embarked on the international competitive race. autonomous vehicles, with the United States and China currently ahead of the pack. The challenge for Europe is to strengthen its position in this race.

Potentially catastrophic ecological consequences

Three scenarios are currently considered for the development of autonomous vehicles: first, individual mobility with autonomous vehicles, mainly controlled by car manufacturers; second, on-demand mobility based on fleets of robotaxis, supported by digital technology player companies; and third, mobility with autonomous shuttles, supported by public actors (local authorities and transport operators).

- First scenario: the individual autonomous vehicle

In addition to the considerable environmental impacts linked to the mass development of high-tech vehicles, as well as the cost of acquiring an autonomous vehicle, the “individual mobility scenario” could lead to significant rebound effects, which are common to the first and second scenarios and which have been highlighted by num ecological consequences of deploying autonomous vehicles, could lead to significant rebound effects, which are common to the first and second scenarios and which have been highlighted by numerous studies. Freed from the task of driving, motorists could develop other onboard activities, resulting in new daily schedules and prerequisites areas, with longer and more frequent trips as they are less constraining. This would increase the number of vehicles on the road and the need for vehicle production and energy to power them.

- Second scenario: fleets of robotaxis

The main players in this scenario, in which drivers aren’t needed on board anymore, are the tech giants. The “on-demand mobility scenario” could also increase social and territorial inequalities (private pricing; uneven deployment based on territorial profitability, thus uneven need for infrastructure); as well as road congestion if it just adds to existing road traffic.

These rebound effects, which are common to the first and second scenarios and which have been highlighted by numerous studies, could lead to significant rebound effects, which are common to the first and second scenarios and which have been highlighted by numerous studies. Freed from the task of driving, motorists could develop other onboard activities, resulting in new daily schedules and travel patterns. This would increase the number of vehicles on the road and the need for vehicle production and energy to power them.

- Third scenario: autonomous shuttles

The third scenario, that projects the development of autonomous shuttles for collective passenger transport, brings together

3D cameras, radars, lidars (that measure distance with real-time maps which can supplement the data recorded by the sensors. The generated data is then processed by the AI which transforms it into trajectory or speed instructions. This data is also communicated to other autonomous vehicles systems to increase the quantity of information and therefore its reliability. This information redundancy is the necessary driving, and as it requires a high level of connectivity, it will probably be dependent upon the mass deployment of 5G.

Massive investments

Such technological demands require colossal investments, first and foremost in research and development. An international Institution estimates that between 2015 and 2017, 80 billion dollars were invested in autonomous vehicles, mainly in R&D; these investments come from private parties, the cost of deploying the necessary infrastructure to allow autonomous driving, and as it requires a high level of connectivity, it will probably be dependent upon the mass deployment of 5G.

A global competition

Research and development on autonomous vehicles has been driven by intense global competition between different players in the automotive industry, manufacturers (Renault and Peugeot in France) and their equipment manufacturers see it as an opportunity to sell their systems to a car system by selling vehicles equipped with even more features. The big tech companies (Google, Uber, etc.) are aiming to control the production and circulation of data. By freeing up time for drivers, autonomous vehicles would allow them to reduce operating costs by eliminating or relocating need for drivers, the cost of service could be reduced by 60% to 70%. Finally, states have also embarked on the international competitive race. autonomous vehicles, with the United States and China currently ahead of the pack. The challenge for Europe is to strengthen its position in this race.

Potentially catastrophic ecological consequences

Three scenarios are currently considered for the development of autonomous vehicles: first, individual mobility with autonomous vehicles, mainly controlled by car manufacturers; second, on-demand mobility based on fleets of robotaxis, supported by digital technology player companies; and third, mobility with autonomous shuttles, supported by public actors (local authorities and transport operators).

- First scenario: the individual autonomous vehicle

In addition to the considerable environmental impacts linked to the mass development of high-tech vehicles, as well as the cost of acquiring an autonomous vehicle, the “individual mobility scenario” could lead to significant rebound effects, which are common to the first and second scenarios and which have been highlighted by numerous studies. Freed from the task of driving, motorists could develop other onboard activities, resulting in new daily schedules and travel patterns. This would increase the number of vehicles on the road and the need for vehicle production and energy to power them.

- Second scenario: fleets of robotaxis

The main players in this scenario, in which drivers aren’t needed on board anymore, are the tech giants. The “on-demand mobility scenario” could also increase social and territorial inequalities (private pricing; uneven deployment based on territorial profitability, thus uneven need for infrastructure); as well as road congestion if it just adds to existing road traffic.

These rebound effects, which are common to the first and second scenarios and which have been highlighted by numerous studies, could lead to significant rebound effects, which are common to the first and second scenarios and which have been highlighted by numerous studies. Freed from the task of driving, motorists could develop other onboard activities, resulting in new daily schedules and travel patterns. This would increase the number of vehicles on the road and the need for vehicle production and energy to power them.

- Third scenario: autonomous shuttles

The third scenario, that projects the development of autonomous shuttles for collective passenger transport, brings together...
6 applications of collective, autonomous transport for different uses

4 applications use small self-driving vehicles (shuttles, minibuses), which optimise operating costs of the service and maintain an acceptable revenue/expenses ratio, allowing a low number of passengers per vehicle.

- **Internal transportation service for large establishments**
  Vehicle providing internal transportation within large establishments (factories, hospitals, university campuses, etc.)

- **Last-mile shuttles**
  A service enabling people to reach a large transport hub (or to connect from there) in a scarcely populated area.

- **The periurban minibus**
  A minibus providing the internal transport within periurban residential areas, with a fixed route or dynamically adapting to demand.

- **The interstitial shuttle**
  A small collective vehicle that contributes to public transport for intra-neighborhood connections, supplements local transport solutions, and can lower costs all the while extending the operating hours.

- **An application using self-driving buses to help strengthen the supply at a constant cost, on routes where there is high potential for modal shift.**

- **Reinforcing the urban routes**
  Automating a pre-existing bus route can increase the service frequency and operating hours, and attract non-captive riders.

- **The strong autonomous route**
  Automating a main public transport route: collective reserved-lane transport

These shuttles could have a positive impact, but their deployment (developing the technology, creating the infrastructure, etc.) for the mass development of less positive uses. In order to restrict the development of autonomous vehicles to their most useful applications, public authorities would need to implement very strong regulations, yet at the moment they are neglecting the issue. For example, in France, of the 16 experiments carried out under the national EVRA project (Expérimentation du Véhicule Routier Routier Road Vehicle Experimentation), only two focused on collective mobility in rural areas, despite such territories being present both from an ecological standpoint (limiting solo driving) and from a social one (connecting isolated areas that are poorly served).
A deployment that is out of step with the climate emergency

Elon Musk, the CEO of Tesla, has promised to deliver an autonomous vehicle capable of driving in all conditions - rain, territories and in the presence of pedestrians and cyclists, by the end of 2021. However, international legislation adopted including France came into force in January 2021, imposing traffic conditions on the use of level 3 autonomous vehicles that are far more restrictive than what Musk is announcing. Such vehicles will only be allowed to travel with a seated driver, at speeds not exceeding 60 km/h and only on roads where the opposing traffic is separated by a physical barrier and from cyclists are absent. It remains to be seen under what conditions level 4 and 5 vehicles will be allowed to travel. In any case, whether researchers (CNRS) or public authorities (Idrac report), don’t expect to see the mass deployment of fully autonomous vehicles that is to say after the deadline set by the National Low Carbon Strategy (SNBC, Stratégie Nationale Bas Carbone) to achieve carbon neutrality in 2050. Consequently, autonomous vehicles clearly can’t make a valid contribution to the race against climate change, to which targets in 2030 and 2050.

Directing investments towards truly ecological solutions

While the development of autonomous vehicles and of the necessary infrastructures for their operation requires considerable investments - private and, in the future, increasingly public (development, adapting existing infrastructures, etc.) - the report by La Fabrique Écologique Mobile Lives Forum shows that autonomous vehicles can, at best, only contribute marginally to the decarbonization of transport, in particular resulting from this new subset of vehicles (increased travel distances, competition from public transport, mass production of vehicles, electronic equipment and infrastructure, as well as from the colossal amount of greenhouse gas emissions). This reveals a kind of schizophrenia among public authorities that seem unable to coordinate economic, social and ecological policies. An interdisciplinary approach spanning all relevant departments would allow the challenges relating to mobility to be understood.

In the near future, a working group made up of scientists, civil society representatives, and environmental or sustainable development experts will be set up and led by La Fabrique Écologique and the Mobile Lives Forum to focus on low-tech vehicles in order to propose recommendations.

Download the full report (in French only)
Notes

1 The following individuals were interviewed: Vincent Abadie, senior expert on ADAS and autonomous vehicles at PSA/ head of autonomous vehicles; Jean-Bernard Constant, digital manager for the Coeur de Brenne community of cities; Msupervisor in law, deputy director of the Accident Mechanisms Laboratory (Laboratoire Mécanisme d’accidents), Transp Department, Gustave Eifel University (formerly Ifsttar); François Jarrige, lecturer in contemporary history at the Université Lagache, Hervé Philippe and Arantxa Julien, DGITM (General Directorate for Transport, Infrastructure and the Sea), in th digital technology and territories; Florent Laroche, transport economist at LAET CNRS; Christian Long, mobility assessor Rabatel, CEO of VedecomTech.


3 As a connected vehicle could produce up to 1 GB per second, a French person could produce an average 1.3 million C

4 There are now 5 levels of autonomy, the first two of which are driver-assistance systems. Real autonomy occurs (in c 3, with level 5 designating full autonomy in all conditions.

5 The European Union pledged in December 2020 to reduce its global CO2 emissions by at least 55% by 2030.

Mobility

For the Mobile Lives Forum, mobility is understood as the process of how individuals travel across distances in ord and space the activities that make up their lifestyles. These travel practices are embedded in socio-technical syste and communication industries and techniques, and by normative discourses on these practices, with considerab spatial impacts.

More

----------------------------------------------------------------------------------------------------------------------

Keywords : Voiture autonome; mobilité durable; mobilité du futur; transition; automobile
Disciplines : Social sciences, Urban studies, Prospective studies
Transport mode(s) : Automobile

----------------------------------------------------------------------------------------------------------------------

1 mailto:anne.fuzier@sncf.fr
2 https://en.forumviesmobiles.org/marks/mobility-450
4 https://en.forumviesmobiles.org/disciplines/sciences-sociales