IDDRI

POLICY BRIEF

N°02/18 APRIL 2018

A dashboard for sustainable autonomous mobility

Mathieu Saujot, Laura Brimont, Oliver Sartor (IDDRI)

Autonomous vehicles are currently the object of intensive innovation. This technology race is accompanied by a disruptive narrative delivered by its advocates: autonomy will transform mobility and provide many benefits. The future of autonomous mobility therefore appears to be mapped out. But it is in fact highly uncertain: several autonomous mobility models are possible depending on the powers that organise its development, and these different models entail risks but also opportunities for sustainable mobility. In this context, public actors in France and in other countries have an important role to play in steering its deployment. If we do not reaffirm the policy issues that should guide autonomous mobility, especially in terms of sustainability, there is a risk that the development of this technology will be dominated by economic and commercial interests. In order to develop a sustainable autonomous mobility strategy, it is essential to answer two questions: how does autonomy alter the traditional challenges of sustainable mobility? And how should mobility policies evolve to seize the opportunities provided by this technology?

This *Policy Brief* provides some answers to these questions based on the findings of a prospective study on potential scenarios for deploying autonomous vehicles.

This *Policy Brief* has received financial support from the French government in the framework of the "Investissements d'avenir" programme managed by ANR (the French National Research Agency) under the reference ANR-10-LABX-01. It is based on the "Autonomous mobility, sustainable mobility?" project conducted by IDDRI in partnership with the European Climate Foundation, Renault, Vinci and GRDF.

KEY MESSAGES

- **Autonomous vehicles are far from being a magic bullet for sustainable mobility.** They fail to resolve a number of existing problems – for example, it is uncertain whether autonomous vehicles will foster carpooling or accelerate transport sector decarbonisation in the short term – and generate new challenges: the quantity of data produced by automation could increase vehicle energy consumption; autonomy could accentuate inequalities of access to mobility, both economically and geographically; it could also reduce the opportunity cost of travel time, and thereby encourage an increase in travel and urban sprawl. Nevertheless, autonomous mobility also presents long-term opportunities under certain conditions (extending the scope of public transport coverage, improving access to mobility for people without driving licences, sharing vehicles, etc.).
- **In order to limit these risks and to make the most of the opportunities provided by autonomous mobility, local and national public actors need to guide its development.** The collective mobility model currently based on public transport is the matrix most likely to yield sustainable autonomous mobility. Moreover, the public authorities have tools for action: they need to take advantage of the immaturity of this technology to impose their own agenda and to steer future offerings according to their priorities, using their competence in terms of road system planning and regulation (dedicated lanes, priority, speed, operating licences). Moreover, cities and their coalitions can influence industrial strategies by acting now to develop roadmaps and calls for tenders on mobility issues.

www.iddri.org

Institut du développement durable
et des relations internationales
27, rue Saint-Guillaume
75337 Paris cedex 07 France

SciencesPo

A PROSPECTIVE STUDY ON AUTONOMOUS MOBILITY

Autonomy in itself is not transformative: it is a compromise between technological and service-based possibilities, individual uses and collective demands that truly produces change. This is the principle underpinning the prospective study conducted by IDDRI, which assumes that different compromises are possible, leading in the long-term to different mobility models.

From this analysis we draw three scenarios based on three "organisational models", in other words modes of transport that organise mobility, in terms of not only infrastructure and spatial organisation, but also regulation, social expectations and visions, which are associated with different ecosystems of actors: **scenario 1** involves private, individual autonomous mobility backed by car manufacturers; **scenario 2** is based on collective, shared autonomous mobility backed by local authorities and public transport operators to consolidate public transport services; and **scenario 3** concerns private on-demand robo-taxi services provided by digital actors.

These scenarios also differ in terms of the types of vehicles and the status of individuals (car buyer, local public service user or client of a private company). They are deliberately contrasting and simplified – the actual model will inevitably be a hybrid version – in order to reveal the consequences and challenges of each scenario and to show what room for manoeuvre the public authorities have.

ANALYSIS

Autonomous mobility can take different development pathways that vary considerably in terms of the risks and opportunities for sustainable mobility.

Scenario 1 could increase the kilometres travelled due to urban sprawl, to the rebound effect linked to greater comfort (which encourages people to spend more time in their vehicles) and to the possibility of deadheading. Efforts to encourage journey sharing and electrification will continue to face some of the obstacles existing today. Moreover, the prospect of a mass market would increase the environmental impact generated by the production of digital material.

Scenario 2 would help to extend the advantages of public transport to autonomous mobility, but nevertheless raises questions concerning the relevant geographical coverage (e.g. economic viability in less populated areas), as well as the capacity of the actors concerned to implement autonomous mobility innovations.

Scenario 3 presents the opportunity to reduce the number of vehicles and to significantly step up sharing thanks to optimisation solutions. A robo-taxi manager would also be encouraged to decarbonise its fleet and to improve its energy efficiency. However the private pricing model could be detrimental to equity of access to the service, and the management of these new actors raises questions regarding the local governance of mobility.

In general, scenarios 1 and 3 present the greatest risks for sustainable mobility, whereas scenario 2, based on collective mobility, is the matrix most likely to yield sustainable autonomous mobility. Table 1 summarises the main risks identified in our scenarios and suggests possible solutions to address these risks.

TOOLS FOR ACTION FOR SUSTAINABLE AUTONOMOUS MOBILITY

Autonomy is thus far from being a magic bullet for sustainable mobility. Local and national public actors need to steer the development of autonomy and must not allow the terms of the "negotiation" on the future autonomous mobility model to be imposed on them, especially by scenarios 1 and 3. As far as possible, this mobility model must be organised by public transport (scenario 2), the model around which other hybrid forms of autonomous mobility will emerge.

To achieve this, the public authorities have some real tools for action: they need to take advantage of the immaturity of this technology to impose their own agenda and to use their competence in terms of road system planning and regulation (dedicated lanes, priority, speed, operating licences) in order to foster technology uses that are the most consistent with a sustainable mobility strategy. For example, developing connected infrastructures and making them available to autonomous mobility providers would make it easier for the public authorities to impose smart regulation and data exchange.

The local public authorities also have some real opportunities to influence industrial strategies. Indeed, mobility actors are mindful of the consequences of regulations already in force or soon to be established in cities: some are planning, for example, to ban diesel vehicles in the medium term; the German courts recently ruled that cities have the right to ban diesel vehicles following a case brought by an association; and the C40 cities group has stated its intention to ban fossil fuels. The local public authorities therefore have a key role to play in imposing their priorities and their vision in terms of mobility and giving a competitive advantage to the private actors that develop suitable offerings. For example, they could launch a call for tenders for autonomous mobility manufacturers and operators to provide

Table 1. Autonomy and sustainable mobility: risks and possible solutions

6 MAJOR CHALLENGES	NUMEROUS RISKS FOR SUSTAINABLE MOBILITY	POSSIBLE SOLUTIONS
Managing urban form and demand for mobility	Increasing demand and suburbanisation. In the long term, the number of kilometres travelled, especially for high-income households, could increase (urban growth, deadheading).	Reducing the speed limit to prevent urban sprawl (travel time planning). Regulations to limit the possibility of deadheading.
Ensuring access to mobility	New inequalities of access to mobility could emerge (more expensive individual mobility, unsuitable infrastructures/ limited robo-taxi services in some areas, lanes reserved for autonomous vehicle owners, etc.). Different winners/losers depending on the scenario.	Anticipating the adaptation of mobility taxation linked to electrification and automation (e.g. distance-based pricing). At the same time, rethinking the mobility equalisation model in order to improve autonomous mobility service provision in less populated areas.
Improving sharing and energy efficiency per km	Journey sharing is not a matter of course and should be strongly encouraged to overcome current obstacles, whether for individual mobility or robo-taxis. Energy efficiency gains linked to autonomy should be put into perspective.	Reinforcing support policies for short distance ridesharing. Testing shared autonomous vehicle services. Reducing the speed limit and fostering a regulatory approach based on guaranteed travel time.
Decarbonising the energy source	Despite its long-term promise, autonomous mobility does not preclude the need to act now on transport decarbonisation.	Reinforcing existing support policies for low-emission vehicles. Promoting fleet operation service models, which are more likely to adopt these vehicles.
Allocating urban space to different uses	Autonomous mobility could further complicate road sharing between different users (pedestrians, cyclists, etc.) and the management of dedicated lanes.	Testing different road sharing configurations to find the best compromise between traffic flow, incentives to share journeys (dedicated lanes for ridesharing) and the safety of active modes.
Managing resource consumption	Additional energy and resource consumption linked to data and to digital material manufacturing is to be expected.	Evaluating the lifecycle and energy consumption footprint of vehicles and digital infrastructures. Developing a "digital responsibility" label for autonomous vehicles. Building a recycling chain for digital material.

the robo-taxis or shuttles that are most suited to urban mobility and the most energy- and resource-efficient.

RECOMMENDATIONS

The local public authorities have an important role to play, not only in terms of regulation (environmental stickers, tolls, management of parking spaces and road systems), but also as mobility service providers. Moreover, they are a key actor in defining the autonomous mobility of the future, and it is essential that the government includes them in the design of national experiments and policies. From this perspective, we can now put forward a number of recommendations:

- **Experiments must not test only technological aspects,** but also economic and service-based possibilities (profitability) and the way in which the service proposed is in line with individual uses (preferences in terms of the number of passengers per shuttle, for example) and collective policy demands (integration into the urban planning process for the territory, for example). In order to better connect the development of autonomy with the strategic efforts of the government to decarbonise the transport[1] sector1, these experiments must contribute to developing sustainable autonomous mobility indicators.
- **To prepare sustainable autonomous mobility, experiments must evaluate the lifecycle and energy consumption footprint** of vehicles and their digital components (including data management). Such evaluations will also be useful in anticipating regulations on the energy efficiency of digital material in order to develop a true digital responsibility approach in this new autonomous mobility, including extending the lifetime of equipment and setting up reconditioning and recycling chains.
- **The public authorities should not wait for autonomy before facilitating shared mobility.** Supporting short distance ridesharing today is a guarantee of success for shared autonomous

1. Especially within the framework of monitoring of the implementation of the national low-carbon strategy (SNBC), which sets out measures and tools for implementing the French Climate Plan (https://www.ecologique-solidaire.gouv.fr/strategie-nationale-bas-carbone).

mobility tomorrow. Support policies can be implemented as of now: individual incentives, support for actors in the sector and infrastructures (dedicated lanes). At the same time, it is important that experiments test shared autonomous mobility services in order to firmly implant the image of collective, shared autonomous mobility in the collective imagination. It is also necessary to encourage and accompany private hire vehicle operators and taxis in developing shared offerings (like the services provided by UberPool) in the context of the emerging exchanges between these actors and cities in order to acquire experience and especially to accustom users to journey sharing.

- **The public authorities must be careful to avoid creating new inequalities between users.** Indeed, autonomy backers could request that autonomous vehicles are separated from other traffic (dedicated lanes) to facilitate their movement and support their development. Such choices would be detrimental to other users, but also to other public policy goals that could also benefit from dedicated lanes (support for ridesharing and cycling, incentives for low-emission vehicles). Moreover, the development of a collective autonomous mobility model in urban centres should avoid increasing territorial divides with suburban areas, where individual mobility will remain dominant.
- **Autonomous mobility encourages going beyond regulation through speed limits.** A lower speed limit would have many positive effects on autonomous driving: easier implementation, a reduction in computing capacity requirements, an increase in energy efficiency and security, and better coexistence with active modes, etc. Autonomous, connected mobility also enables a shift from an approach based on regulation through speed limits to an approach based on regulation through guaranteed travel time.
- **Autonomous mobility implies inventing a new form of mobility governance.** Mobility based solely on public transport will not meet all mobility requirements. Other offerings will be necessary, such as robo-taxis or individual vehicles. Moreover, autonomous mobility will blur the boundaries between individual mobility and mobility services, a trend already initiated with ridesharing, carpooling and bikesharing services. The authorities that organise mobility thus need to evolve towards a coordination role for the different services provided by private operators, and must therefore go beyond simply managing public transport. This coordination will imply investing in new knowledge specific to digital tools.

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