POLICY BRIEF

FAME: How Can Cooperative, Connected and Automated Mobility Contribute to Achieving Climate Neutrality in Europe by 2050?

This document is an output of FAME (Framework for coordination of Automated Mobility in Europe) project, funded through the Horizon Europe Programme, and serves as a summary of the analysis of testing procedures and administrative framework conditions on CCAM testing. The inputs of this brief are heavily based upon the work from FAME partners and the EU-wide Knowledge Base. This document is a straightforward and accessible policy brief for policymakers and other relevant stakeholders responsible for creating and influencing policy. The second version of the policy brief is planned for 2025 and will shed light on the recommendations for the European framework on testing on public roads.

Introduction

Through the Green Deal, the European Union (EU) is committing to achieve climate neutrality by 2050. According to the European Environment Agency, **transport alone is responsible for about one-quarter of the EU's total greenhouse gas emissions**. Connectivity and digitalisation are often mentioned when speaking of ways to make traffic more efficient. Automation is already recognised to have some positive impacts for transport on safety but the link between automated mobility and the environment remains uncertain[1]. Consequently, the EU is investing a lot through Horizon Europe to work on research and innovation in the field of cooperative, connected and automated mobility (CCAM) to tackle climate change.

As described in the Smart and Sustainable Mobility Strategy, **automated mobility should be deployed at a large scale by 2030** to have a 90% cut in transport-related greenhouse gas emissions by 2050. Automated vehicles (AVs) could make driving more energy efficient through, for instance, better routing, eco-driving, smoother driving, etc. However, deployment at the moment is very limited because the regulatory framework for testing is unclear. Local pilots are limited in time and space and concern mainly SAE level 3 vehicles (a driver is still required to intervene, even if the automated driving function takes over certain tasks).

This policy brief highlights the different ways in which CCAM can have a positive impact on the environment and also presents what the current regulatory framework for deployment looks like.

Potential positive impacts of CCAM on climate neutrality

[1] European Environmental Agency (2022). Transport and environment report 2022 – Digitalisation in the mobility system: challenges and opportunities [report]. Available here: https://www.eea.europa.eu/publications/transport-and-environment-report-2022/transport-and-environment-report

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CCAM solutions are expected to significantly contribute to the EU's goal of achieving climate neutrality by 2050. In general, three impacts arise when speaking of potential positive impacts – namely **emissions reduction, energy efficiency and modal shift**. Some examples can be found below on how CCAM can contribute to climate neutrality.

CCAM for passengers

AVs can be a game changer for urban mobility when deployed as part of **shared CCAM services** into an effective public transport network[2]. Such solutions concern:

- AVs used as **feeders to public transport** stations (first/last mile)
- Automated **on-demand shuttles**
- Automated **car-sharing** and a combination of **robo-taxis**
- **Area-based on-demand** automated mini-buses

It is worthwhile noting that there is a **risk that deploying CCAM for passengers increases travel** if not well managed. The cases of increased comfort and reduced fares of CCAM services are commonly used as examples of why people may choose to travel more frequently once these services are introduced[3]. There is also a risk of a 'reverse' modal shift, where people switch from active travel and high-capacity public transport to robo-taxis for example[4].

Many see a benefit of **integrating shared on-demand CCAM services in Mobility-as-a-Service through one central app**[5]. The public transport operator in Frankfurt RMV is working with EasyMile shuttles on this theme by connecting people from residential areas to local stores in Frankfurt (see Figure 1). By doing so, the company aspires to reduce car ownership in cities.

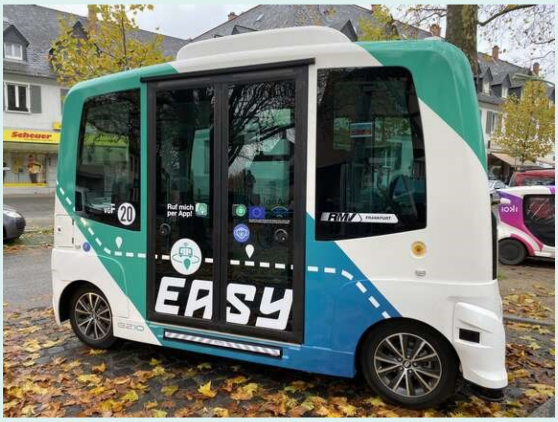

Figure 1: EasyMile shuttle running in Frankfurt for SHOW project ©Rhein-Main-Verkehrsverbund

CCAM for logistics

The demand for transport of goods has been increasing significantly along with the intensification of globalisation, especially due to e-commerce. Meeting the expectations of consumers to have their products delivered as fast as possible comes with high environmental (as well as social) costs. **Automated urban delivery solutions** (e.g., automated vans and delivery robots) are recognised by some to reduce costs (e.g., congestion and time)

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[2] UITP (2020). Autonomous Vehicles: A Potential Game Changer for Urban Mobility [Policy Brief], available at: https://cms.uitp.org/wp/wp-content/uploads/2020/06/Policy-Brief-Autonomous-Vehicles_2.4_LQ.pdf

[3] Lehtonen, E., Malin, F., Louw, T., Lee, Y. M., Itkonen, T., & Innamaa, S. (2022). Why would people want to travel more with automated cars?. Transportation research part F: traffic psychology and behaviour, 89, 143-154.

[4] Lang N, Rübmann M, Mei-Pochtler A, Dauner T, Komiya S,Mosquet X, et al. (2016). Self-Driving Vehicles, Robo-Taxis, and the Urban Mobility Revolution. Boston Consulting Group Report. Available from: https://www.bcg.com/pt-br/publications/2016/automotive-public-sector-self-drivingvehicles-robo-taxis-urban-mobilityrevolution.aspx

[5] SHOW -Shared automation Operating models for Worldwide adoption (H-2020 ART 2019, 2020-2023): https://cordis.europa.eu/project/id/875530

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through eco-driving, better route planning, vehicle-to-everything (V2X) communication and platooning[6]. Moreover, several industry players have started to put in place fully automated last-mile e-deliveries to tackle the issues related to traffic and congestion in urban areas (see Figure 2).

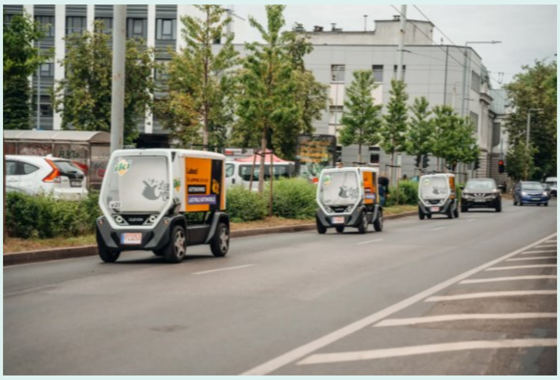

Figure 2: Autonomous robot carriers in Vilnius, Lithuania @Clevon

Compared to the use of automated mobility services for passengers, AVs are already commonly used in ports and logistic hubs. **Applying CAD to road freight transport** to maximise fuel efficiency can support the EU in achieving its climate objectives. Platooning (having groups of vehicles drive in tight single file) and efficient driving have the potential to substantially reduce energy consumption[7]. The ENSEMBLE project[8] was born to demonstrate that multi-brand truck platooning in Europe can reduce energy consumption and increase traffic safety (see Figure 3).

Figure 3: Final demonstration in real life for the ENSEMBLE project

As described in the 'Guide for Advancing Towards Zero-Emission Logistics by 2023', deploying **CCAM for hub-to-hub transport** can have environmental benefits in some specific cases[9]. The LEVITATE project investigated the long-term impacts of CCAM on freight transport and concluded that the contribution to climate neutrality is mainly due to the shift of freight traffic towards the night – leading to less congestion and accidents[10]. Highway automation and assisted corridors can also represent an opportunity to increase fuel efficiency for hub-to-hub truck operations – but also for passenger cars. For the vehicle to be guided by the road (and not the driver), the automated vehicle should be cooperative and connected with the intelligent transport systems.

Existing regulatory framework around CCAM solutions

Overall, it seems that certain CCAM solutions can represent an answer when it comes to limiting the effects transport has on the

[6] Backhaus, W., Rupprecht, S., & Franco, D. (2019). Practitioner Briefing: Road vehicle automation in sustainable urban mobility planning. by Rupprecht Consult–Research & Consulting. https://www. eltis. org/sites/default/files/road_vehicle_automation_in_sustainable_urban_mobility_planning_0. pdf (14/5/2020).

[7] Wadud, Z., MacKenzie, D., & Leiby, P. (2016). Help or hindrance? The travel, energy and carbon impacts of highly automated vehicles. *Transportation Research Part A: Policy and Practice*, *86*, 1-18.

[8] ENSEMBLE (2021). D5.6: Public Demonstration Report. Deliverable of the Horizon-2020 ENSEMBLE project, Grant Agreement No. 769115.

[9] ALICE-ETP & POLIS (2021). Cities-Regions and companies working together. Guide for advancing towards zero-emission urban logistics by 2030. Available here: https://www.etp-logistics.eu/wp-content/uploads/2021/12/POLIS_ALICE_Guide-Zero-Emission-Urban-Logistics_Dec2021-low.pdf

[10] LEVITATE (2022). D7.4: Long-term impacts of cooperative, connected, and automated mobility on freight transport. Deliverable of the Horizon-2020 LEVITATE project, Grant Agreement No. 824361.

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environment. Nonetheless, these services have difficulties in being tested all over Europe due to a complex regulatory framework. Testing also facilitates developing coherent evaluation frameworks that include the key performance indicators most suitable to maximise the environmental benefits of CCAM. Contributing to this, **FAME is developing a common evaluation methodology** (CEM) that provides guidance on how to set up and carry out an evaluation or assessment of direct and indirect impacts directed to different user groups.

EU level

European regulations use the United Nations Economic Commission of Europe (UNECE) regulation requirements as a basis to develop the legal EU framework for automated vehicles, such as:

UN Regulation No.155 for cybersecurity and cybersecurity management systems setting the technical requirements and provisions for the approval of vehicles equipped with automated driving systems (ADS) for levels 3 to 5 automation.

UN Regulation No.157 for automated lane-keeping systems (ALKS) which gives a legal framework, to a certain extent, for Level 3 systems (conditionally automated driving) that perform automated lane-keeping at low speed on motorways.

The EU often references the UNECE Regulation for type approval when implementing its legislation, especially when it comes to the Union's **type-approval framework**[11] and the **General Safety Regulation**[12]. The Implementing Regulation (EU) 2022/1426 – laying down rules for the application of the General Safety Regulation for uniform procedures and technical specifications for the type-approval of the automated driving system (ADS) of fully automated vehicles – is currently limited to three use cases (i.e., hub-to-hub, automated valet parking and predefined area in an urban or suburban environment).

The **EU CAM strategy**[13], published in 2018, sets the vision for connected and automated mobility. It emphasizes the importance of a harmonised approach for CCAM across member states. It is worthwhile noting that the EU legislation does not cover testing in real life currently.

Moreover, CCAM testing and deployment must be done in alignment with the European clean transports' objectives. For instance, CCAM solutions on the road will have to conform to new CO_2 emissions standards (for light-duty and heavy-duty vehicles) and more charging points will become available with the

[11] Regulation No (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, amending Regulations (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0858

[12] Regulation (EU) 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles and their trailers, and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users, amending Regulation (EU) 2018/858 of the European Parliament and of the Council and repealing Regulations (EC) No 78/2009, (EC) No 79/2009 and (EC) No 661/2009 of the European Parliament and of the Council and Commission Regulations (EC) No 631/2009, (EU) No 406/2010, (EU) No 672/2010, (EU) No 1003/2010, (EU) No 1005/2010, (EU) No 1008/2010, (EU) No 1009/2010, (EU) No 19/2011, (EU) No 109/2011, (EU) No 458/2011, (EU) No 65/2012, (EU) No 130/2012, (EU) No 347/2012, (EU) No 351/2012, (EU) No 1230/2012 and (EU) 2015/166. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R2144-20220905

[13] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions On the road to automated mobility: An EU strategy for mobility of the future. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0283

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latest alternative fuel infrastructure regulation[14].

National level

As highlighted in the portal of Connected Automated Driving Europe (EUCAD), each country has its specific regulatory framework for automated driving (AD) – especially when it comes to testing[15]. Most European countries have dedicated frameworks to allow for Level 3 and Level 4 automated vehicles in regular services (see **Table 1**).

Table 1: Categorisation of countries by legislative bases for CCAM testing[16]

Legislative bases for CCAM testing	Countries
Countries with national legislation dedicated to automated driving	Austria, Denmark, France, Germany, Greece, Norway, Slovakia, Spain, Sweden
Countries where CCAM testing is possible based on existing national acts	Belgium, Czech Republic, Finland, Hungary, Italy, Lithuania, Luxemburg, Poland, Slovenia, Switzerland
Countries oriented towards European regulations for CCAM testing	Netherlands
Countries with guidelines or a code of practice for CCAM testing	Latvia, United Kingdom
Countries where operating or testing AVs on public roads is not possible	Bulgaria, Croatia, Cyprus, Estonia, Ireland, Malta, Portugal, Romania

However, the **roles of the different authorities involved in the approval process at the national level in Europe are not harmonised**. There is no clear communication path between the higher and lower levels of governance at the European level and a step-by-step description of the process that applicants need to follow. It is worthwhile noting that, although the legislative landscape for testing automated vehicles varies between the countries, a lot of commonalities have already been found – such as the **requirement for the presence of safety mechanisms** (safety driver or remote safety operator) and the **handling of personal data** (e.g., the difficulty of collecting data while following GDPR).

FAME findings already highlight the need to harmonise requirements between the EU member states for data management, and ethical, technical and administrative considerations. **Specific recommendations will be shared in the second FAME policy brief**.

Local level

CCAM is least likely to deliver sustainable and equitable outcomes in cities if the appropriate policy and regulatory framework are not there. Local administrations play a significant role in testing in real life as they are responsible, among other things, for **road categorisation, curb-side management, road space allocation, speed regimes** and **access regulations**.

As urban areas are increasingly challenged with new mobility initiatives, **cities will need to**

[14] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R1804

[15] For further information, see here: https://www.connectedautomateddriving.eu/regulation-and-policies/national-level/

[16] FAME (2023). D5.1: Analysis of testing procedures and administrative framework conditions on CCAM testing. Deliverable of the Horizon-2020 FAME project, Grant Agreement No. 101069898.

prepare for automation and steer implementation in the direction of sustainable urban mobility (SUM) goals. In the context of the H2020 SHOW project, a set of recommendations has been put forward for local decision-makers to prepare cities ahead of shared CCAM services deployment[17]. At the testing phase, local authorities can:

Mandate accessibility of shared CCAM services

Put in place vehicle requirements (e.g., vehicle weight, dimension, etc.)

Collect public feedback on the performance of the vehicles and services

Hence, integrating CCAM as part of the local system can have wide benefits in gathering useful data for the authorities. **Some cities have included automated mobility as part of their solutions in their Sustainable Urban Mobility Plans** (SUMPs) - to deal with transport-related issues in urban areas. For instance, Tampere recognised AVs as part of their feeder traffic (with other modes) in their SUMP to increase the use of public transport in the city and enable sustainable travel chains[18].

Shared automated mobility needs to be integrated efficiently with public transport in the future to avoid a modal shift from public transport[19]. In Greece, local administrations have a greater role in approving the operations of automated vehicles – of urban bus type – on public roads, as long as the operation of the vehicle is carried out as part of municipal transport. Cities provide testing grounds and will have a major role in guiding the sustainable deployment of CCAM solutions – by including environmental criteria in public tendering processes, and by applying soft regulation to commercially operated CCAM services.

The 2023 EUCAD conference emphasised the importance of **co-creating the use cases with the local municipalities** to respond at best to the residents' needs. Co-creation is not only relevant for working on use cases to achieve climate neutrality, but it also contributes to making CCAM more inclusive by facilitating discussions around future technologies with various vulnerable groups through participatory processes[20]. Here, city authorities can also have a role in stimulating collaboration between universities, residents and companies.

Conclusion and considerations

In conclusion, the **potential contributions of automated mobility to climate neutrality are significant**, offering promising paths for sustainable urban transportation and freight logistics. Shared CCAM services, when effectively managed by local authorities, can complement public transport, easing urban congestion and reducing emissions. Automated urban delivery solutions demonstrate the potential to enhance eco-driving, optimize route planning, and minimise congestion through innovative technologies such as V2X communication and platooning. Moreover, the shift of freight traffic towards night time with hub-to-hub automated transport presents a crucial opportunity to

[17] SHOW (2023). D3.3: Recommendations for Adapting Regulatory and Operational Strategies for CCAV deployment at Local and Regional Level. Deliverable of the Horizon-2020 SHOW project, Grant Agreement No. 875530.

[18] City of Tampere (2021). Sustainable Urban Mobility Plan SUMP, available at: https://www.tampere.fi/sites/default/files/2022-05/SUMP_taitto2021_englanti.p%C3%A4ivitetty.pdf

[19] LEVITATE (2022). D6.3: The medium-term impacts of cooperative, connected, and automated mobility on passenger transport. Deliverable of the H2020 LEVITATE project, Grant Agreement No. 824361.

[20] Flores, C. C., Vanongeval, F., & Steenberghen, T. (2023). Identification of older adults' needs as future users of autonomous shuttles: A serious game co-creation approach for inclusiveness. *Transactions on Transport Sciences*, *14*(1), 14–23. https://doi.org/10.5507/tots.2022.024

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align transportation practices with climate neutrality goals. While testing of AVs is needed to confirm this, a set of challenges arise in Europe at different levels:

EU

- Absence of **legislation covering real-life testing.**
- Alignment of CCAM deployment with **EU's clean transport objectives.**

National

- **Lack of harmonisation in the roles of authorities** involved in the approval process.
- **Variations in the legislative landcape** for automated vehicle testing across countries.

Local

- **Cities need to prepare for automation** and steer implementation in the direction of the SUM goals.
- **Engaging local administration early in testing** through approval procedures and co-creating use cases.

Addressing the challenging complexity of testing these technologies throughout the continent will enable Europe to lead in the deployment of CCAM – advancing both mobility and sustainability objectives.

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