Destination – Safe, Resilient Transport and Smart Mobility services for passengers and goods

This Destination includes activities addressing safe and smart mobility services for passengers and goods.

Europe needs to manage the transformation of supply-based transport into safe, resilient and sustainable transport and demand-driven, smart mobility services for passengers and goods. Suitable research and innovation will enable significant safety, environmental, economic and social benefits by reducing accidents caused by human error, decreasing traffic congestion, reducing energy consumption and emissions of vehicles, increasing efficiency and productivity of freight transport operations. To succeed in this transformation, Europe's ageing (and not always sustainable) transport infrastructure needs to be prepared for enabling cleaner and smarter operations.

Europe needs also to maintain a high-level of transport safety for its citizens. Resilience should be built in the transport systems to prevent, mitigate and recover from disruptions. Research and innovation will underpin the three safety pillars: technologies, regulations and human factors.

This Destination contributes to the following Strategic Plan's **Key Strategic Orientations (KSO)**:

- *C: Making Europe the first digitally enabled circular, climate-neutral and sustainable economy through the transformation of its mobility, energy, construction and production systems;*

- *A: Promoting an open strategic autonomy*[291] *by leading the development of key digital, enabling and emerging technologies, sectors and value chains to accelerate and steer the digital and green transitions through human-centred technologies and innovations.*

It covers the following **impact areas**:

- Industrial leadership in key and emerging technologies that work for people;

- Smart and sustainable transport.

The **expected impact**, in line with the Strategic Plan, is to contribute to *"Safe, seamless, smart, inclusive, resilient and sustainable mobility systems for people and goods thanks to user-centric technologies and services including digital technologies and advanced satellite navigation services"*, notably through:

[291] *'Open strategic autonomy' refers to the term 'strategic autonomy while preserving an open economy', as reflected in the conclusions of the European Council 1 – 2 October 2020.*

- Accelerating the implementation of innovative **connected, cooperative and automated mobility (CCAM)** technologies and systems for passengers and goods (more detailed information below).

- Further developing a **multimodal transport system** through sustainable and smart long-haul and urban freight transport and **logistics**, upgraded and resilient physical and digital **infrastructures** for smarter vehicles and operations, for optimised system-wide network efficiency (more detailed information below).

- Drastically decreasing the number of **transport accidents, incidents and fatalities** towards the EU's long-term goal of moving close to zero fatalities and serious injuries by 2050 even in road transportation (Vision Zero) and increase the **resilience** of transport systems (more detailed information below).

Connected, Cooperative and Automated Mobility (CCAM)

Joint actions are foreseen between the "Cooperative Connected and Automated Mobility" (CCAM) partnership, the "2ZERO" Partnership and the Mission on "Climate Neutral and Smart Cities", in particular the Joint topic "Co-designed smart systems and services for user-centred shared zero-emission mobility of people and goods in urban areas (see work programme of the Cities' Mission 2023).

To test CCAM solutions, applicants can seek possibilities of involving the European Commission's Joint Research Centre (JRC) in order to valorise the relevant expertise and physical facilities of JRC in demonstrating and testing energy and mobility applications of the JRC Living Lab for Future Urban Ecosystems https://ec.europa.eu/jrc/en/research-facility/living-labs-at-the-jrc

Main expected impacts:

- Seamless, affordable and user oriented CCAM based solutions with particular focus on shared, smart and zero emission mobility and goods deliveries for all and high public buy-in of these solutions.

- Validated safety and security, improved robustness and resilience of CCAM technologies and systems.

- Vehicle technologies and solutions which optimise the on-board and off-board experience in terms of well-being, security and privacy.

- Comprehensive set of verification, validation and rating procedures of CCAM systems

- Secure and trustworthy interaction between road users, CCAM and "conventional" vehicles, physical and digital infrastructure and services to achieve safer and more efficient transport flows (people and goods) and better use of infrastructure capacity.

- Clear understanding of societal needs and impacts of CCAM (including ethics, employment, socio-economic impacts) at individual and collective level, to ensure a more tailored, resilient and sustainable deployment of CCAM solutions.

- Better coordination of public and private R&I actions, large-scale testing and implementation plans in Europe towards harmonisation and standardisation.

Multimodal and sustainable transport systems for passengers and goods

Main expected impacts:

- Upgraded and resilient physical and digital infrastructures for clean, accessible and affordable multimodal mobility.

- Sustainable and smart long-haul and regional (including links to urban) freight transport and logistics, through increased efficiency and improved interconnectivity.

- Reduced external costs (e.g. congestion, traffic jams, emissions, air and noise pollution, road collisions) of passenger mobility and freight transport, as well as optimised system-wide network efficiency and resilience.

- Enhanced local and/or regional capacity for governance and innovation in passenger mobility and freight transport.

Safety and resilience - per mode and across all transport modes

Main expected impacts:

Safety in Urban Areas / Road Transport Safety

- Drastic reduction in serious injuries and fatalities in road crashes by 2030 and establishing a framework to improve traffic safety culture in the EU.

- Avoiding risks, collisions and finding new ways of reducing long term consequences of road crashes.

- Minimising the effects of disruptive changes on transport safety and improving the resilience of transport systems by design.

- Better infrastructure safety on urban and secondary rural roads throughout a combination of adaptable monitoring and maintenance solutions.

Waterborne Safety and Resilience

- *Ensure safe and secure exploitation of technologies like digitalisation, Internet of Things, and sensors*

Aviation Safety and Resilience

- Ensure safety through aviation transformation (from green/digital technologies uptake up to independent certification).

The following call(s) in this work programme contribute to this destination:

Call	Budgets (EUR million)		Deadline(s)
	2023	2024	
HORIZON-CL5-2023-D6-01	108.50		05 Sep 2023
HORIZON-CL5-2024-D6-01		122.50	05 Sep 2024
Overall indicative budget	108.50	122.50	

Call - Safe, Resilient Transport and Smart Mobility services for passengers and goods

HORIZON-CL5-2023-D6-01

Conditions for the Call

Indicative budget(s)[292]

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR million)[293]	Indicative number of projects expected to be funded
		2023		
Opening: 04 May 2023 Deadline(s): 05 Sep 2023				
HORIZON-CL5-2023-D6-01-01	RIA	8.00	Around 4.00	2
HORIZON-CL5-2023-D6-01-02	RIA	20.00	Around 20.00	1
HORIZON-CL5-2023-D6-01-03	IA	12.00	Around 6.00	2
HORIZON-CL5-2023-D6-01-04	RIA	8.00	3.00 to 4.00	2
HORIZON-CL5-2023-D6-01-05	RIA	2.00	Around 2.00	1
HORIZON-CL5-2023-D6-01-06	RIA	6.00	Around 3.00	2
HORIZON-CL5-2023-D6-01-07	RIA	8.00	Around 4.00	2
HORIZON-CL5-2023-D6-01-08	CSA	3.00	Around 3.00	1
HORIZON-CL5-2023-D6-01-09	IA	14.00	Around 7.00	2
HORIZON-CL5-2023-D6-01-10	RIA	10.00	Around 5.00	2
HORIZON-CL5-2023-D6-01-11	RIA	8.00	Around 4.00	2

[292] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
The Director-General responsible may delay the deadline(s) by up to two months.
All deadlines are at 17.00.00 Brussels local time.
The budget amounts are subject to the availability of the appropriations provided for in the general budget of the Union for years 2023 and 2024.

[293] Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.

HORIZON-CL5-2023-D6-01-12	RIA	8.00	Around 4.00	2
HORIZON-CL5-2023-D6-01-13	CSA	1.50	Around 1.50	1
Overall indicative budget		108.50		

General conditions relating to this call	
Admissibility conditions	The conditions are described in General Annex A.
Eligibility conditions	The conditions are described in General Annex B.
Financial and operational capacity and exclusion	The criteria are described in General Annex C.
Award criteria	The criteria are described in General Annex D.
Documents	The documents are described in General Annex E.
Procedure	The procedure is described in General Annex F.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G.

Connected, Cooperative and Automated Mobility (CCAM)

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D6-01-01: User-centric development of vehicle technologies and solutions to optimise the on-board experience and ensure inclusiveness (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions

Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Project results are expected to contribute to all of the following outcomes:

1. Advanced vehicle technologies and solutions which optimise usability, perception and experience on-board, and when boarding/off-boarding, in terms of security, privacy, well-being, health and assistance.

2. Enhanced inclusiveness and trust in the interaction between users and new automated modes of road transport and mobility services in the transition from human-driven to automated vehicles.

3. Safety and security of vehicle occupants in all circumstances even when the vehicle is driverless by helping to prevent dangerous and inconvenient situations, also when boarding/off-boarding.

4. Strengthened cooperation between users, vehicle manufacturers, suppliers, researchers and other stakeholders to co-design vehicles with solutions that optimise the on-board experience.

5. Better understanding of the benefits of new vehicle technologies and solutions in terms of on-board experience, inclusiveness and trust to enable wider user acceptability and hence contribute to the creation of future standards.

6. Full exploitation of the new opportunities offered by automated vehicles to provide user-centric, accessible and inclusive mobility for all.

Scope: In the transition from human-driven to automated vehicles, optimising the on-board experience and overall satisfaction of users is paramount for high social buy-in and widespread adoption of CCAM-based mobility solutions. This can be achieved through the development, integration and validation of advanced vehicle technologies and solutions that serve to optimise the usability, perception and experience on-board and when boarding/off-boarding. Such solutions should be designed holistically by adopting a universal design approach from an inclusive, user-centric perspective. All users will demand vehicles that allow and facilitate relaxing, social or work-related activities within a space designed for health and well-being and that are responsive to individual needs (depending on gender, age, disability, size, weight etc.), while ensuring privacy for social interaction. Hence, a wide range of different user groups are expected to be involved early in the development phase to

have their specific needs understood, in order to develop technologies and solutions for individual and shared automated vehicles that meet the demands of all.

To achieve these objectives, it is expected that activities will focus on the development and validation of a range of new, advanced technologies and solutions that leverage the latest advances in technologies and know-how in terms of ensuring a seamless interaction between the vehicle and its occupants that are also fully aligned with safety requirements (and future standards), including at least the following aspects:

- Perception-focused solutions and features (e.g. temperature, lighting, sound/acoustics, vibration, seating, posture), aimed at enhancing the sense of safety, privacy, and well-being while eliminating stress, including personalisation, addressing the specific needs of individuals from diverse user groups (e.g. elderly, disabled, tourists).
- Alternative, flexible and automated interior configurations to better suit occupants' needs.
- Solutions that further advance the state-of-the-art with respect to tackling motion sickness.
- Adaptive systems that can also transfer preferred personal settings between vehicles to increase the user acceptability of shared vehicles.
- New mobility services also for users with special needs (e.g. elderly and disabled), which take into account the heterogeneous requirements and preferences of different target groups.
- Technologies to ensure the security of the occupants, which monitor inside and outside the vehicle to reduce the risk of its misuse and counteracting dangerous situations (e.g. assaults, vandalism, thefts, etc.).

It will be necessary, also based on feedback from user groups, to assess how the technologies and services developed benefit on-board experience and inclusiveness.

This topic requires the effective contribution of SSH disciplines including ethics and gender and the involvement of SSH experts, institutions as well as the inclusion of relevant SSH expertise, in order to produce meaningful and significant effects enhancing the societal impact of the related research activities.

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D6-01-02: Generation of scenarios for development, training, virtual testing and validation of CCAM systems (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 20.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 20.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Project results are expected to contribute to all of the following expected outcomes:

1. Improved validation of CCAM systems enabled by real and synthetic test scenarios, with the widest possible coverage of traffic situations CCAM systems can encounter on European roads.
2. Efficient provision of relevant test scenarios in a permanently updated and therefore dynamic EU wide database.
3. Accelerated AI development and training making use of the dynamic scenario database.
4. Use of the most appropriate approaches (e.g. vehicle-based versus (quasi-)stationary sensor units) to record relevant traffic data, as a basis for the derivation of test scenarios, in different traffic environments according to extending ODDs.
5. Commitment from key stakeholders to the validation methodology, the scenario database and its usage and to the provision of significant volumes of raw data and/or scenarios extracted from such data.

Scope: Higher levels of CCAM require validation methodologies making use of scenario-based physical and virtual testing, thereby complementing real-world test drives on public roads, audits and in-use reporting. Scenario-based testing is necessary as conventional testing and validation approaches would require driving hundreds of millions of test kilometres

before new CCAM systems or system updates can be deployed. The development of common scenario-based validation methodologies is the subject of HORIZON-CL5-2021-D6-01-02[294] and should be based on the results of the HEADSTART project[295]. To enable these common validation methodologies to be widely used, relevant test scenarios need to be provided. These scenarios can partly be defined based on expert knowledge, which, however, needs to be complemented by the extraction of test scenarios from real traffic data[296], from collision data and in the future, from advanced traffic simulations. The aim of this call topic is to generate a wide range of test scenarios for the training, testing and validation of CCAM systems with a focus on urban and rural traffic, for which there is significantly less knowledge on relevant scenarios than for motorway driving.

To maximise the outcomes, proposed actions should demonstrate upfront commitment from key stakeholders to the validation methodologies, as developed and used in HEADSTART, in a project to be funded under HORIZON-CL5-2021-D6-01-02[297], in L3Pilot and in Hi-Drive, either by providing significant volumes of raw data or by providing scenarios extracted from such data making use of the automated processing chain. Furthermore, stakeholders should dedicate resources to ensure that the scenarios are developed in a manner that maximises their utility also to other entities and their successful integration in their future (virtual) development and testing processes. Proposed actions are expected to share scenarios in an openly accessible EU wide database, which should be established by a project to be funded under HORIZON-CL5-2021-D6-01-02[298].

Scenarios and other data shared by stakeholders and existing data made available by national and by other EU-funded projects can be complemented by new data recorded in this action, to provide a realistic set of scenarios with EU-wide coverage.

The proposed actions are expected to address all of the following aspects:

1. AI based tools to transform raw traffic data into reliable, plausibility-proofed data as well as tools for automatic scenario identification and extraction from that data, including the detection of edge cases - the relatively rare, but particularly challenging traffic situations.

2. Generation of variations of scenarios (starting from those based on real traffic data and creating synthetic entries to the scenario database) with a focus on extending ODDs (including adverse weather conditions).

3. Integration of the above in an automatic processing chain with standardised, open interfaces to enable the efficient and seamless use of data from different sources. The processing chain is expected to comply with the FAIR principles, should be agnostic to

294 "Common approaches for the safety validation of CCAM systems"
295 https://www.headstart-project.eu/
296 Traffic data in this context refers to microscopic traffic data that describes a driving situation, incl. road layout, road users with their dynamic behaviour, other objects and environmental conditions.
297 Ibid.
298 Ibid.

sensor technologies, data providers and traffic environments, and it should provide for the data management and quality assurance through the whole process.

4. Ensuring reliable merging of scenarios from different data sources (different projects, different vehicles and stationary units, different perspectives etc.).

5. Feeding the resulting scenarios in an openly accessible dynamic scenario database, which can be used for the development, training, virtual testing and type approval validation of CCAM systems, and which should be connected to or integrate existing national databases as far as possible.

6. Quality assurance of the database: Defining approaches and methods to handle uncertainty and the possibility of errors that might propagate in the assessment, including algorithms for their quantification.

7. Demonstration, assessment of the potential and upscaling of (quasi-)stationary sensor units to record high quality big traffic data in various environments, as well as under various environmental conditions and to identify relevant scenarios making use of the processing chain. The focus of recording such data from a "helicopter" perspective - as an alternative to the use of vehicle-based sensors - should be on the provision of suitable data in a cost-efficient way particularly in urban areas. This includes the fusion of data from different sensors. Upscaling requires amongst others the definition of hardware and software requirements for such measuring and recording systems. When recording traffic data in urban areas, proposed action should aim at:

    - high geographic coverage,

    - high seasonal coverage including adverse environmental conditions (e.g. extreme weather conditions) and their synchronized recording and

    - coverage of complex traffic environments including the interaction with other road users (e.g. pedestrians, bicyclists, users of personal mobility devices).

8. Evaluating different approaches to identify relevant scenarios on rural roads based on the developed processing chain and on traffic data to be recorded on various types of rural roads. This includes the fusion of data from different sensors. When recording traffic data on rural roads, roads with low traffic density should be covered in addition to addressing the coverage issues above.

9. Exploring the potential of complementing scenarios extracted from real traffic data with scenarios extracted from validated, highly detailed traffic simulations, including the use of AI to generate edge cases and other adversarial driving conditions in such simulations.

10. Development of a mechanism for the continuous generation of updates of the dynamic scenario database, including an arrangement for the organisational set-up, governance and financial management of the required activities and resources.

The research will require due consideration of cyber security and both personal and non-personal data protection issues, including GDPR. The cyber security of the developed processing chain should be demonstrated for training, virtual testing and validation of CCAM systems.

Proposed actions are expected to develop recommendations for harmonisation and standardisation and to feed into on-going discussions regarding EU type vehicle approval rules as well as in the framework of the UNECE.

In order to achieve the expected outcomes, international cooperation is encouraged in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D6-01-03: Infrastructure-enabled solutions for improving the continuity or extension of Operational Design Domains (ODDs) (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 6.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 12.00 million.
Type of Action	Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 6-7 by the end of the project – see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: The funding rate is 60% of the eligible costs, except for non-profit legal entities where the funding rate is up to 100% of the total eligible

	costs.

Expected Outcome: Project results are expected to contribute to all of the following outcomes:

1. Infrastructure-enabled solutions improving the continuity of or extending the Operational Design Domains (ODDs).
2. System, data and service architectures for Digital Twins [299] for road transport infrastructure developed and feasibility proven.
3. Input to standardisation, also legal, trust and data security aspects as well as business and governance models (including organisational processes and right of use of data) for Digital Twins.
4. Advanced cooperation of CCAM actors in a robust and functionally safe manner for reasons of ODD continuity/extension, enhancing the readiness of CCAM services and their future extendibility.

Scope: Operational Design Domains (ODDs) of automated vehicle functions are currently limited (e.g. motorways up to 60 km/h). Infrastructure-enabled or -supported solutions can help automated vehicles to overcome the limitation and fragmentation of ODDs. Several Horizon 2020 projects (e.g. INFRAMIX [300], TransAID [301], MAVEN [302]) have delivered promising concepts on how infrastructure and vehicles can work together. Projects addressing the first Horizon Europe calls of the CCAM Partnership (most notably HORIZON-CL5-2021-D6-01-03 [303] and HORIZON-CL5-2022-D6-01-01 [304]) are expected to expand on this promising ground [305]. Directions for improving the continuity of or extending the ODDs comprise mechanisms such as extended perception and decision-making delegation, supporting the real time knowledge about conditions in the "electronic horizon", the centimetric accuracy of the positioning signal, the ability of CCAM enabled vehicles to navigate through road works and incident sites.

Digital Twins can improve the real-time availability of information, especially on information that stems from road authorities and road operators. Digital Twins also serve as a data source for prescriptive analytics and simulation environments, in order to improve the efficiency of (virtual) testing and pro-active traffic management. Moreover, Digital Twins play an important role for asset management. The scope includes technology requirements, coherence

299 A digital twin is a virtual representation that serves as the real-time digital counterpart of a physical object or process, in the context here a virtual representation of road transport infrastructure.
300 https://www.inframix.eu/
301 https://www.transaid.eu/
302 http://www.maven-its.eu/
303 "Physical and Digital Infrastructure (PDI), connectivity and cooperation enabling and supporting CCAM"
304 "European demonstrators for integrated shared automated mobility solutions for people and goods"
305 CCAM Partnership, Strategic Research and Innovation Agenda 2021-2027, December 2021, https://www.ccam.eu/, Lessons Learned from completed projects: https://connectedautomateddriving.eu/ projects/lessons-learned/, Horizon Europe Work Programme 2021-2022, Climate, Energy and Mobility, *European Commission Decision C(2021)4200 of 15 June 2021*.

with proven physical and digital infrastructure support concepts, using Digital Twins for true redundancy and operation in different weather conditions.

As close cross-sectoral collaboration will be necessary, social innovation [306] should be considered to support the actions under this topic, thereby empowering different stakeholders and communities in the design, development and implementation of innovative ideas that are in line with societal needs.

Proposed actions for this topic are expected to address all of the following aspects:

- Improve the availability of real-time information beyond the reach of vehicle on-board sensors by developing and demonstrating system, data and service architectures for Digital Twins for road transport infrastructure.

- Remove the discontinuity of the GNSS positioning signal in challenging road environments such as urban canyons and canopies, tunnels, mountainous areas and northern latitudes. Actions should develop approaches to improve the robustness and reliability of the positioning information by local positioning services, landmarks, modules, new procedures and redundancy processes etc.

- Develop novel solutions for the management of and navigation through road works and incident sites for CCAM enabled vehicles, making such high-risk zones much safer for road users (including vulnerable road users), but also for road workers and rescue organisation personnel. Advancing CCAM from information only to services with automated actions requires cooperation in higher classes ("agreement seeking" according to SAE J 3216[307]). Safe and secure communication, transfer learning, distributed data processing as well as tools and enablers for improving the vehicles' capabilities of coping with infrastructure imperfections (such as sub-standard infrastructure maintenance) are expected to be addressed. Furthermore, harmonised local traffic management measures at road works and incident sites to support their safe navigation should also be addressed.

Proposed actions should advance the infrastructure-enabled solutions for ODD continuity and/or extension to TRL 6/7 on the way towards (pre-)deployment as an important contribution to large-scale demonstration actions[308]. EU-wide/global harmonisation is key in this action, enabling broad uptake of services in the common single market and paving the way towards coordinated deployment of necessary infrastructure support for CCAM. Potential needs for standardisation or input for future regulatory action should be identified. Proposed actions should build on NAP (National Access Points) and a Common European Mobility Dataspace to ensure alignment with existing framework.

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306 Social innovation concerns the development of new products, methods, and services for and with society to meet societal needs involving citizens, public authorities, business and industry, social partners and academia—the "Quadruple Helix"—in their design, development, and implementation to drive social change and market uptake.

307 https://www.sae.org/standards/content/j3216_202107

308 Published impact evaluation methodologies such as the EU-CEM should be used to evaluate the impact of the solutions as appropriate.

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D6-01-04: Integrating European diversity in the design, development and implementation of CCAM solutions to support mobility equity (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of between EUR 3.00 and 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).

Expected Outcome: Projects results are expected to contribute to all of the following outcomes:

1. Increased knowledge about the influence of geographical and cultural dimensions on the societal acceptability, uptake and use of CCAM.

2. Integration of geographical and cultural factors in the planning, design, development and implementation of CCAM solutions by CCAM developers and implementers (including decision-makers).

3. A strategy to support the fair deployment of CCAM systems and services, adapted to local contexts and cultures, leading to enhanced acceptability and willingness to use CCAM in Europe, thereby contributing to CCAM's expected societal benefits.

4. Increased transferability of solutions, experiences, knowledge and lessons learnt between European cities, regions and projects that integrate geographical and cultural diversities in the development and deployment of CCAM.

Scope: Research on the societal implications and deployment of CCAM systems and services has mostly been "geography- and culture-agnostic", focusing instead on mobility behaviours at demographic level and prioritising factors like age and gender. However, European countries encompass multiple cultures, historical heritage, administrative structures, and public policy approaches (e.g. on climate change, digitalisation, and road safety) which may influence the uptake and use of CCAM. The range of cultural, geographical and policy diversities need to be integrated into the design, development and deployment of CCAM solutions. Such diversities can include infrastructure (certain regions have dedicated lanes for alternative mobility solutions, strong bike cultures), specific geographical dispositions (mountains, harsh weather conditions leading to car-captivity or a centralisation of mobility services), or cultural norms and working conditions (e.g. remote working or diverging innovation-friendly or privacy-centric cultures). Furthermore, there are also regional regulatory, policy and governance structures that influence the development and implementation of CCAM or other innovative services.

Adapting to and building on these European differences and similarities will ensure a more tailored, resilient and sustainable match between CCAM solutions, people and societal needs, thereby leading to higher public buy-in and societal benefits. R&I actions will therefore provide a geographical and cultural understanding of CCAM uptake and use, with the aim of contributing to a more integrated, diverse and people centric approach to the design, development and implementation of CCAM supporting mobility equity. Intersecting social factors, such as gender, age, social origin and income level should nevertheless be taken into account, where relevant.

The proposed actions are expected to address all of the following aspects:

1. Evaluate how cultural and regional particularities have led to different transport infrastructure, societal settings, travel needs and behaviours.

2. Develop methodologies that take into account the impact of cultural and regional diversities on attitudes, demand, uptake, and implementation of CCAM solutions, early in the design and development phase. In particular, these methodologies should combine this range of diversities and be based on:

    - Aggregation of results from existing studies and pilots that have investigated isolated diversity aspects in automated mobility contexts.

    - A systems perspective, with specific attention on the impact of CCAM on digital equity (e.g. methods for service payment and information, access to CCAM services, avoiding the negative equity effects of CCAM services without a human driver).

3. Develop principles, criteria and recommendations for the developers and implementers of CCAM systems and services (including local decision-makers and policy makers) that foster the integration of geographical and cultural factors in the planning, design, development and implementation of CCAM through proactive and corrective measures.

4. Propose indicators and approaches to enable a fair integration of cultural and regional factors in CCAM impact evaluation frameworks to better reflect the need for CCAM to support mobility equity.

5. Develop mechanisms to transfer knowledge, e.g. maps, matrices or other instruments, to capture patterns and recurring typologies of settlements, infrastructure and travel indicators in Europe to foster dissemination of people-centric and sustainable CCAM solutions. Include documentation of lessons learnt and approaches for an iterative and long-term evolution and update of the mechanism (until 2030).

6. Demonstrate the developed recommendations and the knowledge transfer mechanism by applying them in at least four pilot activities for CCAM systems and/or services. The majority of pilots should be about shared services and should cover passenger and goods mobility, although a primary focus on either people or goods mobility is possible. The pilots can be local, regional or national but are expected to represent cultural and geographical diversity in at least four European countries.

Projects should make use of the CCAM Knowledge Base[309] to support their findings and to share research outputs.

This topic requires the effective contribution of SSH disciplines including ethics and the involvement of SSH experts, institutions as well as the inclusion of relevant SSH expertise, in order to produce meaningful and significant effects enhancing the societal impact of the related research activities. Projects should also ground their work in participatory processes to support their findings.

In order to achieve the expected outcomes, international cooperation is encouraged in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on ‘Connected, Cooperative and Automated Mobility’ (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Connected, Cooperative and Automated Mobility’ (CCAM) in support of the monitoring of its KPIs.

309 https://www.connectedautomateddriving.eu/

HORIZON-CL5-2023-D6-01-05: CCAM effects on jobs and education, plans for skills that match the CCAM development, and prerequisites for employment growth (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 2.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 2.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).

Expected Outcome: Project results are expected to contribute to all of the following outcomes:

1. Improved understanding of the short-, medium- and long-term employment effects (e.g. working conditions, shifts in responsibilities, future roles and driver's skills depreciation) and wider socio-economic effects (income segregation, geographic dispersion, availability of entry level jobs) resulting from CCAM deployment, taking into account the full range of professions associated with CCAM services for the movement of people and goods. This includes insight on the demand of new and updated skills, as well as plans to develop and enhance these skills in order to realise new opportunities and future needs arising from CCAM deployment.

2. High awareness within the stakeholder community about the effects of CCAM on jobs, along the entire CCAM value chain, and recommendations on how to address those effects.

3. Prerequisites for job creation and job growth through strategies that aim to boost innovation capabilities and develop competitive CCAM solutions and associated businesses.

4. Support the development of educational plans and activities (e.g. for curricula, Lifelong learning initiatives) as well as reskilling efforts to develop human capital in innovative mobility systems and services through education and training, thereby realising the benefits of a large deployment of CCAM solutions.

Scope: In order to make the socio-economic transition to CCAM fair for all, it is important to anticipate and mitigate potential job losses and job relocations due to CCAM deployment (including shared services) by ensuring that necessary skills are available and up scaled across a wide range of fields (along the entire CCAM value chain, from mobility operators, IT staff, drivers and non-drivers, to administration and management in transport). While concerns and future needs regarding the impact of automation on the transport sector have been identified and investigated[310,311], the potential for CCAM solutions to lead to job creation and job growth remains strong.

H2020 projects[312] and studies[313] have investigated the socio-economic impacts of automation across different transport modes (air, rail, road, waterborne) in order to provide policy recommendations that keep pace of this rapidly developing mobility transition.

Building upon the findings of these projects, the proposed action will aim to further anticipate and mitigate the impacts and rebound effects on jobs due to the deployment of road based CCAM systems and services, as well as boost innovation capabilities through the availability and upscaling of CCAM-specific professional skills. A wide range of professions and fields has to be considered. In addition, proposed actions should raise the awareness of the stakeholder community to better understand and anticipate upcoming socio-economic needs and requirements (especially in terms of employment opportunities and skills) and provide support through proactive planning.

The proposed actions are expected to address all of the following aspects:

- Develop a roadmap to support the socio-economic transition to CCAM and provide prerequisites for job growth, strengthened innovation capabilities, and short- and long-term demands for skills. Future spatial mismatches in labour demand identified by existing studies[314] should be taken into account. This roadmap should consider a wide range of CCAM-related professions, especially service related, and highlight any particularities between the transport of persons and of goods.

- Define and assess how expectations for job growth enabled by CCAM development and deployment can be achieved. Identify mechanisms and options to enhance innovation capabilities to develop competitive solutions. Social innovation[315] is encouraged.

- Analyse socio-economic and employment effects of CCAM across the full value-chain, such as income segregation, geographic dispersion, workforce overcapacity/shortages,

310 ECORYS: Study on exploring the possible employment implications of connected and automated driving. Final Report. Rotterdam, October 2020.

311 European Commission: Study on the social dimension of the transition to automation and digitalisation in transport focusing on the labour force. Final report. Brussels, 2021.

312 WETRANSFORM, SKILLFULL, Pascal.

313 In particular, work within the Wise-ACT COST project.

314 ECORYS: ibid.

315 Social innovation concerns the development of new products, methods, and services for and with society to meet societal needs involving citizens, public authorities, business and industry, social partners and academia—the "Quadruple Helix"—in their design, development, and implementation to drive social change and market uptake.

considering various penetration degrees of mobility solutions with automation levels 3-5, taking into account:

  - Different operations in the transportation of people and freight.
  - Aspects induced by new emerging business models such as sharing schemes, e-commerce.
  - The role of road transport as an entry point into work-life and the effect of CCAM on the availability of entry-level jobs.

- Identify and assess short to long-term demands for updated skills (as well as skills and gender gaps) and enhanced knowledge regarding the full range of CCAM-related professions along its entire value chain, both for the mobility of persons and delivery of goods. This goes beyond jobs directly involved with vehicles (manufacturing, driving and operating) and should also include services (e.g. boarding assistance at travel end-points such as hospitals). This should include the development of educational plans and trainings[316].
- Design schemes for the development and enhancement of skills to support future CCAM jobs and innovations. This is to be done throughout educational chains by looking at different use cases, paying particular attention to potential mismatches in skills and spatial demand and supply. Consider at least three use-cases for groups of people that are directly or indirectly involved in the provision of CCAM services. A variety of angles should be covered, including young persons, gender, private and public sector, passenger mobility and freight.

This topic requires the effective contribution of SSH disciplines including ethics, gender and the involvement of SSH experts, institutions as well as the inclusion of relevant SSH expertise, in order to produce meaningful and significant effects enhancing the societal impact of the related research activities. Involvement of labour market competencies is encouraged. Social innovation should also be considered to support the actions under this topic in order to match innovative ideas with social needs.

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on ‘Connected, Cooperative and Automated Mobility’ (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Connected, Cooperative and Automated Mobility’ (CCAM) in support of the monitoring of its KPIs.

316 In this respect it would be advisable to establish, as appropriate, a link to project FAME funded under CL5-2021-D6-01-06 and to the future project funded under topic HORIZON-CL5-2024-D6-01-05 that are developing the EU- Common Evaluation Methodology (EU-CEM).

Multimodal transport, infrastructure and logistics

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D6-01-06: Zero-emission e-commerce and freight delivery and return choices by retailers, consumers and local authorities

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 3.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 6.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Projects are expected to contribute to all of the following outcomes:

- Better understanding of customers' willingness and motivations to choose more sustainable delivery and return options, possibly including also social sustainability (e.g. adequate working conditions for drivers/delivery personnel).
- Retailers and logistics operators support relevant processes by providing information on the implications of delivery solutions.
- Consumers are aware and committed in using delivery and return strategies to reduce emissions and traffic congestion.
- Information on environmental footprint of deliveries and returns are provided transparently and in an understandable way by the retailers (in collaboration with logistics operators and transport system providers) to consumers.
- A wider range of zero-emission delivery and return options and related incentive schemes (at least comparable to the existing ones e.g. in terms of price and convenience) are co-designed with customers and proposed by retailers, incentivised by customers' growing demand for greener choices and cities' regulations.

- At least 50% of the delivery and return options/processes adopted by the retailers and logistics operators involved in the action and available to their customers are zero-emissions.

- Better understanding of local authorities' ability to influence greener choices of delivery and return options by consumers.

- Recommendations proposed to local authorities and the EU on the impact of relevant policy levers and possible regulations to influence greener choices of delivery and return options.

Scope: To support changing retailers and customers' behaviours towards zero-emission freight delivery and return choices, the research actions will have to develop co-created actions able to increase transparency and consumers' awareness of greenhouse gas emissions and other impacts (considering also socio-economic ones) of e-commerce, deliveries and returns. They will have also to propose zero-emission delivery solutions and develop supporting incentive schemes to encourage customers to make sustainable choices, still in accordance with their preferences and in combination with competitive and sustainable retail value propositions. The research actions will have to take into account and build on existing methods and standards to compare the emission in the transport value chain of B2C e-commerce, and to be developed in line with the Commission's initiative on EU framework for harmonised measurement of transport and logistics emissions – 'CountEmissions EU'[317].

Proposals will have to address all of the following points:

- Taking stock of existing studies, assess which conditions would make zero-emission delivery and return options attractive to consumers and which motivations and options would incentivise consumers to change their behaviour towards greener choices. Integrate an intersectional analysis of consumers' gender, age, and socioeconomic status to account better for the customers' variety of expectations and motivations and develop solutions which cater for all social groups.

- Co-designing with and engaging consumers and retailers, and taking into account the assessed motivations and incentives, develop a set of zero-emission delivery and return options, which are at least comparable with existing delivery offering and account for the different consumer groups' needs and motivations to change their behaviour. Identify which options would be more suitable to the customers' group or groups more motivated to change their behaviours and act as frontrunners, thus leading to a more rapid adoption.

- Actively involve consumers (e.g. through consumer organisations) and retailers in the development of guidelines and best practices for retailers to raise awareness and communicate transparently and in an understandable way on the greenhouse gas emission footprint of deliveries and returns' modes and options.

[317] Commission's CountEmissions EU initiative (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13217-Count-your-transport-emissions-%E2%80%98Coun tEmissions-EU%E2%80%99_en –

- Define scalable and generic processes and requirements for the retailers to adopt the zero-emission logistics processes in practice.
- Develop and analyse different scenarios that implement measures towards both more transparent communication and implementation of cleaner and zero-emission e-commerce last mile deliveries to assess reduction of greenhouse gas emissions and air pollution.
- Test with selected retailers and representative customers, and in collaboration with relevant local authorities, the proposed guidelines to visualise the advanced information on emissions and the zero-emission delivery and return options towards consumers. Assess their attractiveness to consumers, the potential impact on consumers' behaviours (including e.g. same-day delivery, returns and physical store pick up options) and their possible buy-in into more sustainable offering. In an iterative process develop and implement recommendations for improvement.
- Demonstrate solutions and propose recommendations to support and incentivise the uptake of greener choices by consumers and retailers.
- Define indicators to measure and evaluate the successful communication and the implementation by the retailers as well as the adoption by the consumers of zero-emission delivery and return options.
- Develop recommendations and a toolset with and for local authorities to accelerate the adoption of zero-emission delivery and return options and choices.
- Strengthen the coordination and collaboration between e-commerce companies, industrial logistics stakeholders and cities, companies, research and civil society, in Europe and internationally, to give input to the project as well as disseminate and exploit results.
- Cooperation with the network of cities CIVITAS[318] should be planned as appropriate.

If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries are expected to clearly describe if and how the use of Copernicus and/or Galileo/EGNOS are incorporated in the proposed solutions. In addition, if the activities proposed involve the use and/or development of AI-based systems and/or techniques, the technical and social robustness of the proposed systems has to be described in the proposal.

HORIZON-CL5-2023-D6-01-07: Operational automation to support multimodal freight transport

Specific conditions

[318] https://civitas.eu/

Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Projects are expected to contribute to all of the following outcomes:

- Better definition of the operational automation requirements for seamless multimodal automatic freight transport.
- Clearly assessed benefits, in terms of reduced social and environmental impacts (e.g. GHG, congestion, working conditions, employment rate and safety) and reduced logistics and freight transport costs, as well as technological gaps of hubs' automation.
- Strategies to reduce the investment cost in this sector and support the implementation of automated solutions for logistics and multimodal freight transport are proposed.
- Recommendations for possible regulatory and policy actions.
- Synergies are established among rail, road, aviation, waterborne and alternative innovative modes of transport research actions on automation relevant for freight transport (e.g. links to CCAM [319] and Zero Emission Waterborne Transport Partnerships[320], and EU Rail JU Flagship Areas 1, 2 and 5[321]).

Scope: Automated vehicles, rolling stock and vessels, as well as related transhipment automated processes, are developed independently within the various transport modes and sectors. This creates gaps and disconnections in the actual use within the logistics operations, missing concrete new operational models and opportunities for end-to-end logistics, which may support adoption and contributing to system integration and decarbonisation.

319 https://www.ccam.eu/
320 https://www.waterborne.eu/partnership/partnership
321 See draft EU-Rail Multi Annual Work programme at https://shift2rail.org/wp-content/uploads/2021/12/20211222_mawp_v1_agreed-in-principle_clean.pdf

Automation will change the way goods flow across all modes (possibly encouraging modal shifts to coastal shipping modes/smaller vessel fleets, inland waterways transport, railway transport, or alternative road transport usages) and is not well explored in terms of opportunities for the logistics supply chains and enabling increased usage of vehicles and infrastructures. A high level of operational automation can be reached in terminals and hubs (e.g. node-to-node operations undertaken in inland hubs, multimodal depots, logistics terminals, freight consolidation facilities), which offer controlled environments and repeatable processes but also in the operational domain of processes occurring in those places.

To ensure operational efficiency and support multimodal transport, proposals should address all the following points:

- Identify gaps in automated transport technologies and logistics operations between modes and hubs.
- Assess benefits of autonomous vehicles, rolling stock and vessels to multimodal logistics and the role/benefits of seamless multimodal automatic cargo transport across transport modes (rail, road, waterborne, aviation, alternative innovative modes of transport).
- Investigate the requirements and define concrete benefits of seamless and automated logistics operations, particularly in multimodal terminals and hubs, linking e.g. rail, road and inland waterways with a focus on intra-European freight flows. Consider interoperability and cybersecurity issues.
- With the support of e.g. machine learning, digital twins, robotic process automation and AI, and using historical operational data, compare and demonstrate (through simulation) benefits of operational automation to current standard flows and operations in all modes. Synergies for rail will need to be sought with the EU-Rail Programme projects implementing the Flagship Areas 1, 2 and Destination 5[322].
- Design, analyse and evaluate business and governance models as well as organisational change issues and incentives to reduce the investment costs and support the implementation of automated solutions for logistics and multimodal freight transport.
- Develop and propose recommendations for possible regulatory and policy actions supporting the adoption of automated solutions for logistics and multimodal freight transport.

If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries are expected to clearly describe if and how the use of Copernicus and/or Galileo/EGNOS are incorporated in the proposed solutions. In addition, if the activities proposed involve the use and/or development of AI-based systems and/or techniques, the technical and social robustness of the proposed systems has to be described in the proposal.

[322] See draft EU-Rail Multi Annual Work programme at https://shift2rail.org/wp-content/uploads/2021/12/20211222_mawp_v1_agreed-in-principle_clean.pdf

HORIZON-CL5-2023-D6-01-08: Future-proof GHG and environmental emissions factors for accounting emissions from transport and logistics operations

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 3.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Coordination and Support Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025). [323].

Expected Outcome: Projects are expected to contribute to all of the following outcomes:

- Establish a comprehensive set of harmonised GHG emission factors, for transport and logistics operations;
- Explore synergies and establish horizontal cooperation among various organisational structures developing GHG emission factors for transport and logistics.

Scope: Proposals should develop a comprehensive set of harmonised emission factors for the transport sector (freight and passenger), covering GHG emissions (CO2 equivalent) of transport and logistics operations. Proposals should address values for the entire transport/logistics chain and take up the full energy lifecycle (Well-To-Wheel/Wake).

[323] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

Emission factors that relate the amount of GHG emission to the unit of energy consumed (for an energy-based calculation), or to the amount of GHG activity (for an activity-based calculation) are the basis of any GHG calculation. The increased efforts for measuring effects of climate change in various segments of the transport sector resulted in a range of values developed within the organisational structures of different transport modes, research entities and countries. Some of this work led to legitimate testing and development of the methodologies for the calculation and use of emission factors, or the generation of values that represent fuel specifications for given applications. However, much of it has merely resulted in a proliferation of apparently similar values creating confusion in the marketplace and bearing the risk of selection of sources/values purely on the basis of what is beneficial to the individual entity rather than what is correct.

This problem becomes more important in conjunction with the development of a wide set of technical solutions combating climate change, particularly the new and increasingly complex zero and low carbon energy mixes, including e- and biofuels. These solutions are deployed in the market very often with the support of dedicated financial mechanisms and programs, based on the estimated GHG emission reduction associated with the specific fuel technologies. Not only is it important for the climate impact that the emission calculations are 'correct'[324], but when dealing with large amounts of transport energy even a small difference over an emission factor value can lead to a significant difference in the associated financial transaction. Without an agreed and validated set of default emission factors for a wide range of the most common energy sources and a mechanism whereby legitimate variations or new energy carriers can be regularly updated, many actions based on calculating GHG emission reduction can be considered to be a risk of conflict and associated legal dispute.

Proposals will have to address <u>all</u> of the following points:

- Review the existing emission factors derived from the key global sources, duly reflecting the scientific state of the art and ensuring the coverage of new and conventional fuels.
- Perform the gap analysis and develop emission factors for categories not yet covered, both for upstream and downstream emissions, taking into due consideration new production pathways, and addressing in particular the uncertainty and variation in the well to tank factors to be applied to the new fuels.
- Establish a clearer set of rules regarding:
    1. Methodology – to ensure that the basis and legitimate use of the two fundamental methodology types (consequential and attributional) are properly understood and applied appropriately.
    2. Boundaries of calculation – to ensure that boundaries are not accidentally or deliberately set in order to favour particular outcomes.

[324] There may be no such thing as a 100% correct value, but it is essential there is a consensus and linked convention based around values within an agreed, small uncertainty threshold.

3. Common sets of fuel / energy specifications – to ensure that data labels and associated values are truly aligned between sources.

4. Assumptions about input parameters that can result in variations in output values based on local circumstances for specific production.

5. The basis for new energy carriers to be calculated quickly and consistently in order to avoid delaying the deployment of new, beneficial solutions.

Establish a simple guidance to the transport sector as to which emission factors are the agreed defaults, and why; under what circumstances an alternative can legitimately be used.

The project's main governance (e.g. Steering Group, Advisory Board) is expected to provide for direct involvement of all relevant stakeholders, as well as relevant European Commission services.

The proposal should build on the existing and emerging EU regulatory frameworks (including Commission's proposal for the Fit-for-55 package and the new initiative on harmonised measurement of transport and logistics emissions – 'CountEmissions EU'), GHG emissions accounting standardisation activities (such as the future ISO standard 14083) and other relevant initiatives and projects. Given that emission factors are applied in a global transport market, efforts need to be made to ensure that internationally relevant bodies such as IMO or ICAO are involved alongside prominent European stakeholders.

HORIZON-CL5-2023-D6-01-09: Climate resilient and safe maritime ports

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 7.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 14.00 million.
Type of Action	Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 7 by the end of the project – see General Annex B.

Expected Outcome: Projects are expected to contribute to ALL of the following outcomes (with a clear baseline for each use case):

- Ensure resilience of infrastructure of a) seaports, b) connected inland waterways infrastructure c) connected hinterland land infrastructure, to extreme weather events by assuring at least 80% operability during the disruptions.
- Contribute with at least 20% increase in modal shift of port hinterland connections towards zero- and low-emission transport systems.
- Ensure safe port access and port operations by avoiding extra accidents as a consequence of disruptions caused by a changing climate.
- Minimise environmental impact (e.g. emissions, soil/water pollution, degradation of ecosystems and fragmentation of habitats and biodiversity loss, as foreseen in the EU Biodiversity Strategy 2030 [325]) during construction, maintenance, operation and decommissioning of the infrastructure by going beyond the EU environmental legislation.
- Present guidelines describing measures (structural, operational and institutional) to address climate risks and hazards, and provide guidance on how to screen and evaluate options.

Scope: Research is needed in order to limit transport infrastructure vulnerability to climate change and other natural or human caused disruptions. Making infrastructures more resilient to climate change should focus on improving the ability of the transport infrastructure network to withstand disruption, adapt to changing conditions under extreme circumstances while maintaining its performance. The goal is to strengthen infrastructure reliability, improve its performance under extreme circumstances thus increasing the resilience of the whole transport system.

Sea ports and waterways around the world are experiencing air and water temperature increases, rising sea levels, changes in seasonal precipitation and wind and wave conditions. Many are also seeing more frequent and severe extreme events such as storms, flash floods, prolonged heatwaves and droughts. Climate change represents a significant risk to business, operations, safety and infrastructure – and hence to local, national and European economies.

Extreme weather events affect transport infrastructures and their management. Even if infrastructures are designed to cope with various stresses along their life, the increase of frequency and severity of extreme weather events will, increase their deterioration pace and increase possibility of accidents that may become more frequent due to adverse weather conditions. Sea ports and connected inland waterways are particularly exposed to extreme weather events and are very important for the local and global economy, since nearly 80% of world freight is transported by ship. Seaports of Europe are gateways to other continents. 74% of extra-EU goods are shipped through ports. They are also important for intra-European

[325] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1590574123338&uri=CELEX:52020DC0380

trade: 37% of the intra-EU freight traffic and 385 million passengers pass by ports every year. A 50% growth of cargo handled in EU ports is predicted by 2030[326]

Port and waterway operators need to take urgent action to strengthen resilience and adapt. As costal structures, seaports and connected inland waterways are exposed to storm surges and sea level rise and are vulnerable to flooding. Climate change is expected to have more severe impacts in northern Europe, where Europe's top 20 cargo seaports are located. In total, 852 ports face the risk of inundation in 2080 and the number of seaports to be exposed to inundation levels higher than 1m is projected to increase by 80% from 2030 to 2080. The number of ports that face the risk of inundation is expected to increase by more than 50% from 2030 to 2080. This trend is even stronger on the North Sea coast, where according to the GISCO database over 500 ports are located with traffic accounting for up to 15% of the world's cargo transport (EUCC-D, 2013). In total, 852 important ports face the risk of inundation by the end of the century is 852[327].

At the same time when focusing at a resilient and performing transport infrastructure, its environmental footprint, resource and material consumption and habitat fragmentation and biodiversity degradation should be reduced to a minimum. The goal is smart, green, sustainable, climate-resilient and biodiversity friendly infrastructure.

Proposals will develop and validate new solutions to increase resilience, efficiency, inter-modality and safety of the transport system, for passengers and freight.

Proposals will have to address all the following points:

- Develop solutions for ensuring the performance and safety of a) seaports, b) connected inland waterways infrastructure c) connected hinterland land infrastructure, during periods of extreme weather events.

- Develop strategies minimising capacity loss of infrastructures during disruptive events, securing infrastructure assets or delivering the necessary redundancy or adaptive capacity when at the same time avoiding over-designing, adopting an inappropriate or irreversible design, based on vulnerability analysis and risk assessment.

- Demonstrate solutions to interconnect infrastructure health monitoring, traffic management and emergency management systems to support informed decision making during and after these events, also supporting possible redistribution of freight and passengers flows to complementary infrastructures. Solutions for rail to be harmonised with EU-Rail Programme projects implementing the Flagship Area 5[328].

326 https://ec.europa.eu/commission/presscorner/detail/en/MEMO_13_448
327 https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108865/jrc108865_final.pdf
328 See EU-Rail Multi Annual Work programme at https://shift2rail.org/wp-content/uploads/2022/03/EURAIL_MAWP_final.pdf

- Build on innovative solutions for surveillance and prediction of climate change effects, such as the Destination Earth digital twins[329], and for identification of infrastructure points particularly vulnerable to climate change. Proposals should develop cross-modal strategies to upgrade (including physical upgrade) existing infrastructures and reduce their vulnerability, while using sustainable materials and construction techniques.

- Develop novel and improved governance models that enable cooperation across institutional, modal and national boundaries to cope with large-scale shocks and disruptions.

- Develop standard procedures and methodologies to foster the implementation of measures (structural, operational, institutional and social) to address climate risks and hazards. Include at least three pilot demonstrations of the proposed solutions in operational environment (minimum at TRL7) for three seaports with connected inland waterways infrastructure on CEF corridors. The pilots should select the most effective measures and combinations of measures and determine how and when they can best be implemented over time as conditions change.

- Evaluate the qualitative and quantitative impact of the proposed measures with a clear baseline for each pilot demonstration.

- Innovative infrastructure solutions should contribute to lowering the environmental footprint, resources and material consumption. Exploring Nature-based solutions (NBS) is an opportunity for creating sustainable, climate-resilient European transport infrastructure in a cost-effective manner, while producing substantial social, economic, and environmental co-benefits. The goal is smart, green, sustainable and climate-resilient infrastructure, planned in a way that maximises positive impact on economic growth and minimises the negative impact on the environment and, significant and lasting degradation of ecosystems, fragmentation of habitats or loss of biodiversity, promoting environmentally friendly modes of transport and leading to the reduction of transport emissions.

If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries are expected to describe how the use of Copernicus and/or Galileo/EGNOS are incorporated in the proposed solutions.

Proposals should also consider results from previous calls on infrastructure resilience[330] construction and sustainable construction and should uptake relevant EU guidance on development and management of European transport infrastructures.

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329 https://digital-strategy.ec.europa.eu/en/activities/work-programmes-digital, main work programme, section 5.1.1

330 FORESEE: https://trimis.ec.europa.eu/project/future-proofing-strategies-resilient-transport-networks-against-extreme-events
SAFEWAY: https://trimis.ec.europa.eu/project/gis-based-infrastructure-management-system-optimized-response-extreme-events-terrestrial

Safety and resilience

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D6-01-10: Better infrastructure safety on urban and secondary rural roads throughout a combination of adaptable monitoring and maintenance solutions

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 5.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 10.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5-6 by the end of the project – see General Annex B.

Expected Outcome: Research is expected to contribute to all the following outcomes:

- Enhanced criteria catalogue for road safety assessment for urban and secondary roads with particular applicability for non-trunk roads and the safety impact on all – including new – types of users. Criteria can be mapped on to established safety-related Key Performance Indicators (KPIs) e.g. reduction of collisions, homogeneous driving speed, reduction of maintenance costs, etc. to provide measurable societal benefits.

- Technology for the real-time generation and communication of infrastructure Key Performance Indicators (KPIs) related to safety, including those created/derived from vehicle sensor data

PANOPTIS: https://trimis.ec.europa.eu/project/development-decision-support-system-increasing-resilience-transportation-infrastructure
RESIST: https://trimis.ec.europa.eu/project/resilient-transport-infrastructure-extreme-events
CLARITY: https://cordis.europa.eu/project/id/730355

- Concepts for interaction of infrastructure elements in a digitalised ecosystem for road safety resulting in measurable benefits (reduced number of collisions, reduced maintenance costs, reduced time spent in congestions, monetary economic benefits, etc.).

Scope: Road infrastructure can be improved to decrease the risk of crashes and other incidents as well as crash severity. The benefits of this will be amplified in a connected transport system where automated or partially automated vehicles are supported by infrastructure features to perform as expected. In addition, road infrastructure can provide clear guidance towards desirable road user behaviour, which may lead to more predictable behaviour, and consequently to less crashes.

It is essential to understand how to upgrade the infrastructure network to make it compatible with all road users (e.g. powered two-wheelers are not considered as users for which urban infrastructures are usually designed) and in particular with automated vehicles at different levels of automation. The research should focus on urban and secondary rural networks as most of the resources for upgrading the road network is often devoted to primary networks (with specific attention to the Trans-European Road Network). For urban and secondary roads, resources are generally limited, and potential negative impact of roadworks on the surrounding territory is extremely relevant. Low-cost interventions with low negative impact need to be studied for these roads.

Advanced monitoring, warning and maintenance techniques need to be developed to guarantee a timely assessment of the operating conditions of road structures and furniture. Recent events have highlighted the importance of roadside safety devices monitoring, but also proper signs and marking, pavement and overall road structures (bridges, tunnels etc.).

The results of the research will enhance the safety level of the infrastructure by enabling a prompt reaction to potentially unsafe conditions and will enable to identify the infrastructures where connected, automated vehicles can travel under safe conditions.

Aspects to be addressed are expected to include:

- Connection of infrastructure elements to the digitalised ecosystem, including but not limited to research on digital twins.
- Identification of criteria to perform safety assessments of urban and secondary rural roads accounting also for new users (including but not limited to powered two-wheelers, e-bikes etc.) and to identify cost effective upgrade solutions.
- Further development of infrastructure measures to elicit desired road user behaviour.
- Pilot testing of selected interventions in at least three sites.

In addition, actions should address at least three out of the following aspects:

- Integration of safety and V2I issues in asset management to ensure that the infrastructure is always capable to provide the minimum required level of performance to provide safe travel conditions for automated vehicles (ISAD concept).

- Development of new technology for monitoring and communicating in real time infrastructure distress conditions and deterioration. This should include malfunctioning and post impact warning for road equipment and Infrastructure.

- Development of onsite data storage and communication systems (e.g. RFID) capable to provide in real time details on the properties of the road equipment relevant to road safety.

- Use of data from connected probe vehicles to detect safety relevant conditions and collect maintenance indicators.

- Development of new maintenance techniques for road equipment with low negative impact on the surroundings (including but not limited to roadside safety features, signs and marking, lighting).

Actions should be based on the results of previous EU projects.

HORIZON-CL5-2023-D6-01-11: Aviation safety - Uncertainty quantification for safety and risk management

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 3-5 by the end of the project – see General Annex B.

Expected Outcome: Project results should focus to the quantification of uncertainty (UQ) in all aspects of the design, manufacturing and operations for achieving high level of safety and

a better management of risks. Project results are expected to contribute to at least three (or more) of the following expected outcomes:

- UQ for modelling/simulation of design, manufacturing and integration processes.
- UQ for operational aspects.
- UQ for virtual certification.
- Big data processing and data science for safety intelligence and risk management, including both structured and unstructured (text-based) data.
- Development of UQ (as open as possible) mathematical libraries and management Tools (e.g. tolerancing, kriging, higher order reliability methods).
- Validation campaigns in challenging test cases.

Scope: Uncertainties are always present due to limited manufacturing precision and variable operating conditions and life cycle events. Integrating these uncertainties into the design process of aircraft, aircraft engines and systems is a key element to reduce program risk and to ensure safe and economic operation.

Uncertainty is an upper bound between the estimate of aircraft characteristics and performance at a certain stage of its development and characteristics of the aircraft once in service. As such, the full lifecycle of aviation systems should be taken into account, including uncertainties occurring during manufacturing operations. This uncertainty can be the consequence of the quality of the means used during the development phase to estimate these characteristics and an inaccurate knowledge of the actual status of the aircraft, and appropriate tolerancing in the design phase. The planning and design of the current and future aviation system requires an advanced model of the interactive aviation operational system, not just of pilot or aircraft-centric operations.

Evaluation of uncertainties associated to each measurement should be the result of a detailed and justified methodology, fully taking account of the role of human factors or human agents within the aviation socio-technical system. Treatment of uncertainties enables a rigorous management of performance engagements and associated risks assessment. Traditional safety margin approaches will be replaced by engineering procedures based on sound data analysis using both mathematical modelling and knowledge engineering appropriate to both structured and unstructured (text-based) data.

As appropriate, safety risk assessment should be addressed in cooperation with EASA, notably with regard to big data processing on safety intelligence.

HORIZON-CL5-2023-D6-01-12: New ways of reducing serious injuries and the long-term consequences of road crashes

Specific conditions

Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5-6 by the end of the project – see General Annex B.

Expected Outcome: Research results are expected to contribute to all the following outcomes:

- Validated mechanisms of personal injuries leading to significant long-term consequences, for all road users (pedestrians, bicyclists, motorcycle riders, car and bus drivers and occupants, etc.).
- Established system for classification of long-term injuries, including methods for follow-up of personal injuries for the required time after a crash.
- Validated tools and methods for the assessment of injuries leading to long-term consequences, such as upgraded virtual human body models.
- Preconditions to develop policy, regulatory, and standard requirements for the purpose of reducing serious injuries, in particular those with long-term consequences.
- A general upgrade in protection for all road users through safe and robust countermeasures and solutions.

Scope: In addition to fatal and near-fatal injuries, personal injuries with long-term consequences continue to pose a threat to personal mobility. Particularly pedestrians, bicyclists, and motorcycle riders, as well as users of new mobility devices, have a high risk to sustain personal injuries with long-term outcomes, such as brain and neck injuries. In cars, despite new collision mitigation systems, low and medium severity collisions may still cause similar permanent neurological disorders to occupants. Long-term injuries to both the upper and lower extremities are further examples, occurring among all road user types. As of today, neither any standardized nor any accepted method exists for the evaluation of solutions to reduce long-term outcomes. In addition, there is a need to include more aspects of human variability like age, sex, weight, and stature, with particular focus on long-term disability.

Several research areas, also social sciences, are required for the sake of understanding and reducing the long-term consequences fully. Cognitive capabilities could for example be impaired by physical head trauma, and there is at the same time a need for more knowledge of psychiatric impairment related to posttraumatic stress or reduced quality of life. In other words, cognitive issues and depression have to be fully recognized as potential long-term consequences of road crashes.

More research is needed to establish a relevant system for classification of long-term or permanent disability that can be used for the development and design of future protective solutions as well as policies and requirements. There is a strong need for refined knowledge of the relations between initial injury and long-term consequences of personal injury, which will demand new in-depth crash data for the reconstruction of collisions combined with long-term injury follow-up. New models for measuring long-term consequences will need a lot of real-world data to become validated. In-depth analysis of data from hospitalized patients will in this perspective also continue to be needed as well as efficient means to follow up on psychiatric impairment measurable. Hence, new efforts in accident research are required, as well as the most related social sciences (economics and psychology), further to research in biomechanics, vehicle crashworthiness, and other aspects of crash dynamics. New technologies open possibilities for gathering new types of data with higher levels of detail.

Virtual testing tools are crucial for new more efficient evaluation methods, and accordingly further development of human body models (HBM) is particularly important. The effectiveness of new systems should for instance be assessed in a wide range of crash load cases, which the current test dummies cannot support, and another possibility with the use of virtual HBM will be to evaluate integrated and adaptive safety at a significantly higher level of detail. The potential of HBM to be usable for the evaluation of long-term injuries in product development is strong and will be supported by further multidisciplinary research. Research is also needed to assess any limitations in this respect and, if applicable, examine how best to complement HBM with Anthropomorphic Test Devices and physical tools.

Virtual methods with HBM should not only be developed further for passenger car safety, but for the purpose of assessing personal protection equipment, forgiving road infrastructure (including road surfaces), and the protection of motorcycle, moped and bicycle riders, as well as pedestrians and users of new micro-mobility devices against long-term injuries. Virtual HBM need to reflect human variability, and there is a particular need to focus attention on children in all different road user roles, e.g. preteens in passenger vehicles who normally are not seated in child seats, yet often too small to be fully protected by current vehicle integrated safety systems.

New and upgraded vehicle interiors (including non-conventional seating and new interior features) of highly automated passenger cars, shuttle buses (including minibuses), and other driverless passenger vehicles, will play an important role in the efforts to raise the road safety level further regarding passenger vehicles. Persons who are standing, for instance passengers in public transport, should also be included. Market drivers (e.g. increased automation,

comfort, and infotainment) will be reinforced with safety-intended development strategies when supported by relevant research and policies regarding long-term consequences.

Research within this field is expected to recommend upgrades to concerned policies, regulatory requirements, and standards. For this reason, international cooperation is recommended.

Findings, knowledge, and experience are encouraged to be shared with other fields, such as certain sport, recreation, and work activities, as well as with other transport modes, which may have similar issues regarding personal injuries with long-term consequences as road traffic, although a different incidence.

Actions should take into account the results of previous EU research projects in that domain (e.g. Seniors, VIRTUAL, SafetyCube).

Integration of relevant expertise from social sciences and humanities (SSH) and international cooperation with partners from the US and/or Australia is encouraged.

Cross-cutting actions

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D6-01-13: Support for dissemination events in the field of Transport Research

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 1.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 1.50 million.
Type of Action	Coordination and Support Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions

	under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025). [331].

Expected Outcome: Project's results are expected to contribute to all of the following expected outcomes:

- Higher visibility, political and strategic relevance of the transport sector and of the EU policy in the field;
- Enhanced dissemination, communication and valorisation of transport R&I objectives, perspectives, strategies and results;
- More effective links and exchanges between research and innovation stakeholders and policy makers, to support the development and deployment of innovative solutions in Europe;
- Increased attractiveness of transport related studies and reinforce the pursuit of excellence in European transport research and innovation, by giving recognition and visibility to the best achievements.

Scope: Actions should address the activities of both Part A and Part B:

Part A: The action will prepare and provide support to the Transport Research Arena conference (TRA) to be organised in 2026 gathering transport stakeholders for discussing political, industrial and research issues on a European and global level.

Proposals are expected to demonstrate the financial and organisational support of the national authorities' and a preliminary economic plan covering the additional funding needs. In order to ensure high political and strategic relevance, preference will be given to proposals involving Member States holding the Presidency of the European Union in year 2025, 2026 or 2027.

In line with previous TRA biannual conferences, the event should address the technological and industrial developments of the transport sector (road, rail, waterborne, aviation sectors and cross-modal aspects) providing a high level, future oriented perspective coming from politics, the industry and the research community, in response to Europe's social needs and expectations.

In collaboration with the relevant actors, such as the European Commission services, the different European Technology Platforms (ERTRAC for road, ERRAC for rail, WATERBORNE TP for waterborne, ALICE for logistics and ACARE for aeronautics and

[331] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

ECTP for construction), the Conference of European Directors of Roads (CEDR), the European Transport Research Alliance (ETRA), relevant transport-related European partnerships, such as 2ZERO, CCAM, EU-Rail, ZEWT and Clean Aviation and the previous TRA conference organisers in order to maintain continuity, the action will define the overall planning of the conference, structure the technical and political sessions of the event, contribute to select the appropriate location for the venue and offer operational IT tools for the registration of participants, the handling of speakers' contributions, contribute to the organisation of logistics, etc. Support to the organisation of demonstration activities should also be foreseen.

Specific attention should be put on a broad and balanced participation i.e. students, young researchers, women, a large number of countries' representatives, etc.

Part B: The proposal is expected to also organise two competitions for transport research and innovation awards covering all transport modes and cross-cutting issues (technological, socio-economic and behavioural aspects) in line with the EU policy objectives for climate-neutral and environmentally friendly mobility:

- A competition for students and young researchers with the goal of stimulating the interest among young researchers/students in the field of transport;
- A competition for senior researchers in the field of innovative transport concepts based on results from EU-funded projects only.

The organisation of these awards should ensure high-quality competition and very good media coverage before, during and after the TRA conference, in line with previous editions (TRA Visions). The competition is expected to give particular attention to gender issues.

Call - Safe, Resilient Transport and Smart Mobility services for passengers and goods

HORIZON-CL5-2024-D6-01

Conditions for the Call

Indicative budget(s)[332]

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR	Indicative number of

[332] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
The Director-General responsible may delay the deadline(s) by up to two months.
All deadlines are at 17.00.00 Brussels local time.
The budget amounts are subject to the availability of the appropriations provided for in the general budget of the Union for years 2023 and 2024.

		2024	million)[333]	projects expected to be funded
Opening: 07 May 2024 Deadline(s): 05 Sep 2024				
HORIZON-CL5-2024-D6-01-01	RIA	12.00	Around 6.00	2
HORIZON-CL5-2024-D6-01-02	RIA	14.00	Around 14.00	1
HORIZON-CL5-2024-D6-01-03	IA	12.00	Around 6.00	2
HORIZON-CL5-2024-D6-01-04	RIA	10.00	Around 5.00	2
HORIZON-CL5-2024-D6-01-05	CSA	4.00	Around 4.00	1
HORIZON-CL5-2024-D6-01-06	RIA	10.00	4.00 to 5.00	2
HORIZON-CL5-2024-D6-01-07	IA	20.00	Around 10.00	2
HORIZON-CL5-2024-D6-01-08	IA	15.00	Around 5.00	3
HORIZON-CL5-2024-D6-01-09	RIA	3.00	Around 3.00	1
HORIZON-CL5-2024-D6-01-10	RIA	8.50	Around 4.00	2
HORIZON-CL5-2024-D6-01-11	RIA	7.00	3.00 to 3.50	2
HORIZON-CL5-2024-D6-01-12	RIA	7.00	Around 3.50	2
Overall indicative budget		122.50		

General conditions relating to this call	
Admissibility conditions	The conditions are described in General Annex A.
Eligibility conditions	The conditions are described in General Annex B.
Financial and operational capacity and exclusion	The criteria are described in General Annex C.
Award criteria	The criteria are described in General Annex D.

[333] Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.

Documents	The documents are described in General Annex E.
Procedure	The procedure is described in General Annex F.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G.

Connected, Cooperative and Automated Mobility (CCAM)

Proposals are invited against the following topic(s):

HORIZON-CL5-2024-D6-01-01: Centralised, reliable, cyber-secure & upgradable in-vehicle electronic control architectures for CCAM connected to the cloud-edge continuum (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 6.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 12.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Project results are expected to contribute to all of the following outcomes:

- New, centralised, reliable, cyber-secure and upgradable in-vehicle electronic control architectures for CCAM based on the application of co-designed hardware, software and big or smart data flows in combination with over-the-air updates.

- Widespread deployment of level 4 automation in road vehicles by expanding the Operational Design Domains (ODDs) of the control system towards higher complexity (city traffic, adverse weather conditions etc.) or greater scale.

- Safe operation of Connected and Automated Driving (CAD) functions e.g. regarding Vulnerable Road Users (VRUs) and ODD transitions through system agility, experience-based decision making and access to cloud intelligence.

- Paradigm shift from human-based and component-supported vehicle control to a more integrated, resource efficient and reliable system for the control of CCAM systems.

- Strengthened cooperation of European OEMs and suppliers to co-design a standard cyber secure electronic architecture layout with harmonised interfaces.

Scope: Since current on-board electronic systems are assembled from various controllers in a piecemeal fashion, they are not suitable for the complex, combined performance requirements of advanced levels of CCAM applications in terms of bandwidths, latency, flexibility, fail safety and cyber security. Therefore, a complete redesign of the in-vehicle control architecture is needed, combining innovations at hardware, software and data levels in the vehicle and in connection with distributed intelligence in the edge-cloud continuity. It should build on a centralised e.g. zonal or domain-based layout using distributed high-performance computing for connecting sensing and actuation systems with software updates over the air, big data flows and AI at the edge, resulting in a novel and upgradable electronic in-vehicle control scheme for safe and efficient automated driving functions and tele-operations.

Important building blocks for the in-vehicle control architecture include sensors and sensor data fusion for environment perception with AI “at the edge”, using on-board high-performance computers and generic hard- and software including cyber secure components.

At the same time, the new control architecture and its context aware building blocks are expected to enable the following:

- reliable, low-latency and high-bandwidth data communication for automated driving systems control to safeguard against cyber-attacks, malfunctions and malicious interactions.

- systemic functionality gains in upgradability, efficiency, modularity, compatibility, scalability, fail-operation, reliability and redundancy.

- definition of safety and security targets, open-source standard layouts and harmonised validation methods.

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D6-01-02: Scenario-based safety assurance of CCAM and related HMI in a dynamically evolving transport system (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 14.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 14.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Project results are expected to contribute to all of the following expected outcomes:

1. Safe scaling up of the deployment of CCAM systems for all levels of automation, including systems that for part of the driving phases rely on human-machine interaction.
2. Assurance of vehicle safety despite system changes, e.g., due to software updates and data exchanges between vehicles and the infrastructure.
3. Facilitating the introduction of fast developing technological innovations in the CCAM system's functionality, such as AI.

Scope: To ensure the safety of CCAM, it is essential that vehicles are not only safe during the (first) type approval, but also during their complete lifetime in a fast-changing road transport system. Changes can result from the evolution of the CCAM system itself, for example, as a result of increasing connectivity using V2X communication, the use of AI-based systems, and OTA (over-the-air) software updates. The traffic system, in which CCAM systems are being deployed, is changing at a rapid pace as well, with an increased market share of vehicles with

higher levels of automation, new (personal) mobility devices and autonomous mobility robots (e.g., for package delivery).

At the same time, the way CCAM systems interact with humans in traffic is changing. Until full automation in transport is reached, the human driver will keep on playing an essential role. Also, the interaction with other road users will change, supported by technologies that allow a CCAM system to communicate its intentions to other road users.

As a consequence of these innovations and developments, the safe deployment of CCAM systems needs an extension of the safety validation procedures and certification schemes, taking advanced human-machine interaction and a continuous in-service monitoring approach into account. Due to the many different scenarios and variations that can occur realistically and that consequently need to be tested, it should be possible that a large part of the assessment is performed in a virtual simulation environment.

The proposed actions are expected to address all of the following aspects:

1. Developing a validation methodology for scenario-based safety assurance of AI-based CCAM functions. Trustworthiness of the AI-algorithms depends on how well the system responds to scenarios in its Operational Design Domain (ODD) – specificity and how it responds in case it ends-up outside its ODD – robustness. Consequently, methods need to be developed on the use of scenarios to describe the ODD of AI-based systems.

2. Connectivity. Developing validation procedures for CCAM systems that rely on V2X for safety-critical functions i.e., the inclusion of the connectivity context. Ensuring aspects of reliability, trustworthiness and cyber-security with respect to V2X is essential. The approach to V2X connectivity is technology neutral.

3. Continuous Safety Assurance approach. Developing an approach for a continuous safety validation methodology, to monitor the safety state of deployed CCAM systems in operation (real traffic) during its service life, following type approval. Performance metrics for the reliability of the monitored data, including cyber-security aspects, and indicators for the safety state should be proposed. Also needed is the development of requirements for the monitoring system for use in future standardisation, regarding the exchange of data and safety performance indicators with service organisations and authorities.

4. Validating the virtual approach. Developing tools that ensure the relevant degree of detail and the appropriate representation of other road users' behaviour (incl. Vulnerable Road Users such as pedestrians and/or bicyclists) in virtual scenario-based testing. This includes methods to deal with perception, localisation, and world modelling errors in the validation procedures.

5. Human Machine Interaction. Developing a safety assurance methodology that incorporates the assessment of Human Machine Interaction (both driver-vehicle and vehicle-road user) concepts for higher levels of automation (conformity checks as well as test set-ups with suitable metrics) ensuring safe communication between driver and

vehicle and between vehicle and other road users, making Human Machine Interaction inclusive (i.e. in terms of age, mental and physical ability, cultural aspects, etc.).

Proposed actions are expected to develop recommendations for harmonisation and standardisation and to feed into on-going discussions regarding EU type vehicle approval rules as well as in the framework of the UNECE.

Actions should be based on the outcomes of previous methodologies developed in HEADSTART[334], as well as research funded under HORIZON-CL5-2021-D6-01-02[335].

Upcoming CCAM projects, in particular in the area of large-scale demonstrations, validation, digital infrastructure and key enabling technologies should be taken into account to ensure compatibility.

Links should be established with the Mobility Data Space initiatives from Digital Europe, federated data infrastructure projects (Gaia-X, International Data Spaces, Big Data Value - BDV).

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D6-01-03: Orchestration of heterogeneous actors in mixed traffic within the CCAM ecosystem (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 6.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 12.00 million.
Type of Action	Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of

334 https://www.headstart-project.eu/
335 "Common approaches for the safety validation of CCAM systems"

	Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 6-7 by the end of the project – see General Annex B.

Expected Outcome: Project results are expected to contribute to all of the following outcomes:

1. System approach towards traffic management that integrates the operations and needs of a wide range of road network users (vehicle drivers, passengers and different kinds of VRUs) traffic management centres and public authorities as well as service providers, (public transport/commercial/logistics fleet managers, infrastructure industry) within the mobility ecosystem.

2. Safer, more efficient and sustainable traffic management through the orchestration of heterogeneous actors in mixed traffic[336] within the CCAM ecosystem.

3. Proven orchestration schemes in traffic management for operations of all types of vehicles and the different CCAM systems in real-time CCAM traffic conditions in urban and/or motorway environments.

4. Governance and operational models that allow for better cooperation and collaboration of all relevant actors in the orchestration of traffic management through new mobility management for all modes and road types.

5. Mobility management tools to seamlessly integrate CCAM systems and services including fleets of vehicles, public transport, logistics operations, demand management needs as well as governance and business models into the transport system.

6. Strategic transport planning methods for all modes in the CCAM ecosystem including individual as well as public transport.

Scope: The aim is to advance on the orchestration of heterogeneous actors in mixed traffic by building on, linking and integrating the following streams of research results and innovation challenges[337]:

336 The term 'heterogeneous actors' comprises the heterogeneity of Road actors such as fleet managers, service providers, traffic managers, individual vehicles, Public Transport operators and users, Road operators and contractors and VRUs. Their actions differ due to their position in the ecosystem, their objectives and behaviour, which have an impact on traffic flow and other actors in the road network). The term 'mixed traffic' refers to different levels of vehicle automation (including human driven vehicles) present in the road network. Orchestration of heterogeneous actors in mixed traffic takes place when the managing authorities take the needs and plans of all relevant actors into account when planning and directing traffic flows in the system also balancing the priorities set by the public.

337 CCAM Partnership, Strategic Research and Innovation Agenda 2021-2027, December 2021, Lessons Learned from completed projects, Horizon Europe Work Programme 2021-2022, Climate, Energy and Mobility, *European Commission Decision C(2021)4200 of 15 June 2021*, SOCRATES 2.0: Connecting Europe Facility (CEF) 2016-EU-TM-0148-S 2017, TM 2.0 Innovation Platform on interactive traffic management.

1. Smart routing and interactive traffic management using connectivity and C-ITS for the orchestration of heterogeneous actors in mixed traffic within the CCAM ecosystem[338].

2. Solutions for ensuring the safety and efficiency of early CCAM deployment in the interaction of drivers, riders, passengers, traffic participants and automated systems performing driving tasks in mixed traffic[339].

3. Coherent approach towards managing fleets from an overall system perspective in real-life urban demonstrations of CCAM via testing and demonstrations in large sets of traffic environments with an emphasis on different fleets, i.e. groups of vehicles (including e.g. public transport/commercial/logistics fleets, fleets operated by public or private transport operators) that are typically controlled/supervised/managed by heterogeneous actors[340].

4. New governance and operational models facilitating the orchestration schemes of traffic management that are inclusive towards all heterogeneous actors in traffic management[341].

Proposed actions will develop and demonstrate an orchestration scheme for traffic management energy according to priorities set by traffic authorities (including targets) that will facilitate the coexistence of heterogeneous actors or fleets on the road network (individual vehicles, public transport, Vulnerable Road Users) as well as, at different levels of vehicle automation (including human driven vehicles) in mixed traffic. Actions should contribute to the transformation of traffic management from managing traffic volumes to the management of vehicles (or even travellers) taking benefit from the advantages of fleet management (groups of vehicles that share the same attributes). Vehicles should be considered in their different sizes and usages, as well as by the mobility service they provide (private, public, shared, pooled etc.). Proposed actions should address both the transport of people and goods within automated fleets (commercial/logistics fleets, fleets operated by public or private transport operators) and individual vehicles (CCAM- or conventional vehicles, including micro-mobility) that are well integrated in the entire traffic management system.

Proposed actions are expected to develop and demonstrate orchestration schemes for operations in mixed traffic by addressing all of the following aspects:

338 Building on the results of SOCRATES 2.0 pilots reflecting the TM 2.0 concept on smart routing and interactive traffic management.

339 Expanding on the results of Horizon 2020 projects (such as CoExist, TransAID, INFRAMIX, MAVEN). While the solutions above should be embedded in a technology-neutral approach, actions should ensure that future technological options such as photonics applications (Photonics Partnership "Green and efficient lighting for future mobility") are also addressed, if possible.

340 Expanding on the results of the projects of SHOW and HiDrive.

341 Building on the work and results of SOCRATES 2.0 and TM 2.0 as well as expanding on the results of the projects being funded under HORIZON-CL5-2022-D6-01-04: Integrate CCAM services in fleet and traffic management systems (CCAM Partnership).

1. Defining the comprehensive requirements (including data exchange) for the orchestration schemes with regards to the heterogeneous actors in mixed traffic (automated and non-automated traffic, people and goods and different modes).

2. Developing traffic management tools that are essential for the coordination of mixed automated and non-automated mobility. These management tools should be robust and able to address uncertainty due to uncertain technological developments, performances, services and business cases that go beyond what is available through current research results. Tools should support orchestration by, among others, integration of ad-hoc and manoeuvre coordination (SAE cooperation classes[342]), efficient route guidance and capacity aware demand management.

3. Defining and demonstrating business and governance models (including for public actors) for the orchestration of traffic management in real-time CCAM traffic conditions in urban and motorway environment, allowing actors to address their needs on a win-win basis.

4. Developing measures and KPIs to demonstrate the benefits and added value of orchestration for traffic management actions (in terms of traffic efficiency, energy efficiency, safety etc.).

5. Demonstrating a process that ensures trust in the traffic orchestration scheme proposed as well as sufficient accessibility to quality data for all traffic actors involved and readiness for large-scale demonstration actions.

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs[343].

HORIZON-CL5-2024-D6-01-04: AI for advanced and collective perception and decision making for CCAM applications (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 5.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a

342 SAE J 3216, Taxonomy and Definitions for Terms Related to Cooperative Driving Automation for On-Road Motor Vehicles.

343 'Sustainable Urban Mobility Indicators", as well as other published impact evaluation methodologies such as the EU-CEM, should be used to evaluate the impact of the solutions as appropriate.

	proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 10.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Project results are expected to contribute to all of the following expected outcomes:

- Approaches for resilient collective awareness, which can eventually be used in e.g. complex models of collective behaviour.
- Advanced collective awareness, decision making and triggering of actions for CCAM applications, enabled by new concepts and tools built on advancements in Artificial Intelligence (AI), including Hybrid Intelligence (HI).
- CCAM solutions evolving from reactive into predictive system state awareness (including driver state and road user diversity), decision making and actuation, enhancing road safety.
- Understanding of AI-related ethical issues and user needs, together with capabilities, limitations and potential conflicts of AI based systems for CCAM, including a definition and a measure of human-like control.
- Increased user acceptability and societal benefit of CCAM solutions, based on explainable, trustworthy and human-centric AI. Interactions with AI-based vehicles are understandable, human-like and reflect human psychological capabilities.

Scope: Today's mobility landscape is rapidly changing, as is seen in the recent boom in the detection of advanced and/or complex urban scenarios that add new challenges to the development of CCAM technologies. These novel scenarios are especially emerging with the establishment of new urban traffic regimes and cultures, such as restricted zones, shared zones, and cycle-streets, which need to be taken into account when designing and developing CCAM solutions.

To integrate and tackle complex traffic scenarios, CCAM technologies will require highly advanced decision-making based on enhanced collective awareness – the stage beyond on-

board perception, advancing on e.g. results from projects under CL5-2022-D6-01-05[344] – incorporating information from multiple sources and including interpretation for the aggregation of this information. Developing collective awareness should take into account the state of the vehicle, the driver and the road user environment. It can also involve the tracking of other road users' behaviour and generating predictions on a short horizon, which can be based on the input from advanced behavioural models, e.g. those developed within CL5-2022-D6-01-03[345] projects. The integration of these findings will lead to collective awareness for CCAM.

The use of multiple sources (sensors and sensor fused information, maps, infrastructure, other road users, and localisation systems) and the sharing of the overall situational information and related intentions of the vehicle and that of its direct environment will be an important building block towards collective awareness. Eventually, in future work this can be incorporated in complex, self-organised bottom-up models of collective behaviour based on the change/modelling of individual interactions. Collective awareness should create a larger time window in safety critical situations and generate benefits for the overarching mobility system, which include efficient traffic management and improved traffic flow as it incorporates situation prediction capabilities and environmental benefits (which can eventually include e.g. smart charging strategies).

AI is a key enabler to bring these increasing amounts of information together, with decision-making enabled both at vehicle level (including safety critical decisions) and at a mobility system level. In order to continue to define the role and limits of AI and of emerging new developments within AI, this topic recommends exploring Hybrid Intelligence (HI) as such a new subset of AI. Hybrid Intelligence is the process of developing and mobilising Artificial Intelligence (AI) to expand on human intelligence and expertise, thereby ensuring human-like control of CCAM operations. Applying an HI approach will allow CCAM technologies to integrate human expertise and intentionality into its decision-making in order to generate meaningful and appropriate actions that are aligned with ethical, legal and societal values. This will be essential to foster user acceptability, trust and adoption, especially when appropriate SSH expertise is included.

Proposed R&I actions are expected to address all of the following aspects:

1. Methods to establish collective awareness of CCAM applications that are resilient to faulty sources, thereby ensuring safe operations. Guidance for failsafe designs should be developed.

2. Methods to embed an HI approach in the entire action chain towards collective awareness (from basic perception to driving functions) to allow for seamless operation and real-time decision-making while enabling human-like control of CCAM applications by combining system and domain knowledge (of the vehicle and its technologies on one hand and of the transport environment including all the human interactions on the other,

344 "Artificial Intelligence (AI): Explainable and trustworthy concepts, techniques and models for CCAM"

345 "Human behavioural model to assess the performance of CCAM solutions compared to human driven vehicles"

thereby understanding of potential risks and capabilities and needs of other road users). Tooling will be required to deliver situational awareness information in a structured way, based on multiple sources and in real-time. In addition, the development and integration of ethical goal functions to support collective awareness should be included. Work is expected to be based on:

- At least perception systems, sensor fusion, high-level world models/maps, vehicle positioning information. Guidance on common reference systems for positioning and time for synchronisation should be included in order to secure robustness and traceability.

- Relationships between the vehicle and forecasted intentions of other road users (e.g. a pedestrian crossing the street at a zebra crossing), as such including spatial temporal relation of elements in the driving-situation.

This topic requires the effective contribution of SSH disciplines including ethics and the involvement of SSH experts, institutions as well as the inclusion of relevant SSH expertise, in order to produce meaningful and significant effects enhancing the societal impact of the related research activities.

Proposals should monitor and align relevant developments under this topic with on-going discussions regarding EU type vehicle approval rules as well as in the framework of the UNECE.

In order to achieve the expected outcomes, international cooperation is encouraged in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D6-01-05: Robust Knowledge and Know-How transfer for Key-Deployment Pathways and implementation of the EU-CEM (CCAM Partnership)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 4.00 million.
Type of Action	Coordination and Support Actions

Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025). [346].

Expected Outcome: Project results are expected to contribute to all of the following outcomes:

- Extended and up to date CCAM Knowledge Base [347], including CCAM projects, demonstration and deployment initiatives, standards, facilitating the exchange of best practices and the deployment of CCAM services.
- Well established network of experts and forum for stakeholders in the different thematic R&I fields of CCAM.
- Strong collaboration and cooperation between all CCAM stakeholders through effective collaboration mechanisms fostering exchanges of practices, experiences, tools and methodologies supporting the transition to large-scale deployment.
- Increased and high-quality exchanges and cooperation between the EU Member States/Associated countries,
- EU CCAM common evaluation methodology (EU-CEM) widely used in Europe.
- Good level of understanding and awareness of CCAM among citizens, decision and policy makers in Europe.

Scope: A common basis for CCAM Knowledge in Europe is available today with the online CCAM Knowledge Base which constitutes a one stop shop for all relevant R&I initiatives, tools, methodologies, regulations and standards in the field. Targeted content will be available

346 This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

347 https://www.connectedautomateddriving.eu

for some stakeholder categories[348]. The Knowledge Base should be expanded and further adapted to the needs of all relevant stakeholders. Results and lessons learned from the EU, national and international projects should be made available and accessible to targeted user groups. Proposed actions should in particular provide support for stakeholders to move into operations by identifying key building blocks and standards for deploying pilot services and enable capacity building for key actors of different use cases /applications domains as well as for citizens and non-experts on how to use CCAM systems and services and to become aware of new developments and related risks.

The EU Common Evaluation Methodology (EU-CEM) developed in project "FAME" funded under CL5-2021-D6-01-06[349] aims at becoming the basic methodology for all CCAM related evaluations to support collaboration, exchange and harmonisation. The methodology will need to be implemented for existing and innovative use cases by CCAM projects and aligned with national mobility strategies and approaches. Training programmes for CCAM projects will be necessary to integrate the methodology and to collect feedback on lessons learned during its implementation.

A States Representatives Group (SRG)[350] has been created within the CCAM Partnership to ensure a continuous dialogue at European and national level for the sharing of information on CCAM R&I to increase coordination between European and national R&I funding schemes, and among national programmes. To carry out its mission efficiently, the SRG will need support to collect and analyse information on national R&I initiatives and to implement cooperation activities.

To successfully contribute to the expected outcomes, proposed actions are expected to address all of the following aspects:

1. Ensure the maintenance and expansion of the Knowledge Base to support the CCAM stakeholder community and CCAM Partnership for the identification of future needs for R&I, testing and demonstration initiatives and for moving into operations (minimum block requirements, standards and common definitions to run pilot services across Europe). The content of the Knowledge Base should support the monitoring of the progress made on the targets and impacts set by the CCAM Partnership[351].

2. Identify further needs for targeted content for specific stakeholder categories and in particular, develop content that is accessible to non-experts, thereby supporting capacity building of the general public. The proposed action should define the above-mentioned stakeholder categories, and develop a subsequent communication strategy (content, material, media, etc.) using realistic and accessible terms to address different target groups (including non-experts).

348 Outcomes of the project resulting from the call CL5-2021-D6-01-06: Framework for better coordination of large-scale demonstration pilots in Europe and EU-wide knowledge base.
349 Ibid
350 https://www.ccam.eu/what-is-ccam/governance/ccam-states-representatives-group/
351 See KPI included in the SRIA

3. Provide effective dissemination and concertation mechanisms and means for the stakeholder community (e.g. conferences, workshops, international cooperation, capacity building content for non-experts) to enable the exchange of experiences and practices, stimulate collaboration and cooperation between all CCAM stakeholders and reach consensus on challenges and future R&I needs within the thematic clusters of the European Partnership.

4. Facilitate the work of the CCAM SRG and stimulate the cooperation between EU Member States/Associated Countries for improved coordination of activities in the areas identified as priorities by the SRG. Provide an analysis of initiatives in EU Member States/Associated countries and support the SRG in identifying areas for R&I cooperation.

5. Ensure representation of European stakeholders in international cooperation, information exchange and harmonisation initiatives on CCAM. Provide a global output on CCAM activities to support the development of European agendas by exploring potential opportunities and R&I domains for international cooperation.

6. Continue to evaluate and update the EU-CEM through targeted discussions with EU Member States/Associated countries in order to align the CEM with national mobility strategies and regulations, also looking at both national and regional transport and mobility data to ensure compatibility.

7. Support the practical implementation of the EU-CEM (for existing and innovative use-cases) and provide training programmes for CCAM projects to integrate the methodology.

8. Assess the level of awareness and attitudes of European citizens, decision- and policy makers about CCAM as well as their intention to use through regular surveys and workshops. Results should be published in the Knowledge Base and mechanisms should be provided to integrate findings into the EU-CEM. A link should be established with existing survey initiatives in place at EU and Member States'/Associated countries' levels. This action should be grounded in a co-creative process.

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Japan and the United States but also with other relevant strategic partners in third countries.

This topic implements the co-programmed European Partnership on 'Connected, Cooperative and Automated Mobility' (CCAM). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Connected, Cooperative and Automated Mobility' (CCAM) in support of the monitoring of its KPIs.

Multimodal transport, infrastructure and logistics

Proposals are invited against the following topic(s):

HORIZON-CL5-2024-D6-01-06: Optimising multimodal network and traffic management, harnessing data from infrastructures, mobility of passengers and freight transport

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of between EUR 4.00 and 5.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 10.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Project results are expected to contribute to at least 4 of the following expected outcomes:

- Optimised multimodal transport network and traffic management, for efficient door-to-door mobility of passengers and freight (from producers to last mile deliveries).
- Validated solutions for effective and secure data exchange across all modes of transport, for dynamic and responsive multimodal network and traffic management.
- Validated systems for accurate detection and resolution of network bottlenecks, improving safety, security, resilience and overall performance of the transport network, enabling pro-active mobility management.
- New tools and services for optimising mobility of passengers and freight, in cities and other areas, cutting traffic jams and improving multimodal traffic flows. The proposed solutions should demonstrate (e.g. through simulations, pilots) the potential to reduce by at least 30% the average travel delay, as well as the overall transport energy consumption and emissions of greenhouse gases and other pollutants in the network.
- Workable governance arrangements for multimodal transport network and traffic management, in view of further supporting regulatory and policy actions.

Scope: Optimised multimodal network and traffic management is essential for an efficient transport network and seamless door-to-door mobility of passengers and freight. Such advanced capabilities need to be supported by harnessing data from physical and digital infrastructures, as well as from the mobility of passengers and freight, involving different types of vehicles, rolling stock, aircraft and vessels (including zero-emission, connected and automated), technologies and the use of innovative services. At the same time, novel forms of mobility (e.g. shared, micro-mobility or even hyperloop) and new services (e.g. Mobility as a Service) present new challenges, but also great opportunities for enhanced management and optimisation of the transport network. This includes advances to fully utilise dynamic and interoperable data exchange from multiple actors and transport modes, for well-tested and validated systems and operations, with appropriate governance arrangements in place.

In this context, building on best practices (technological, non-technological and socio-economic), ongoing projects on multimodal network and traffic management, as well as other initiatives (e.g. the Digital Transport and Logistics Forum and the common European mobility data space), actions should address at least 6 of the following aspects:

- Developing and testing new generation multimodal, flexible, agile and adaptable, secure and resilient transport network and traffic management systems, leveraging state of the art technologies (e.g. artificial intelligence, big data, edge computing, internet of things, blockchain).

- Assessing and simulating the effects on multimodal network and traffic management of new forms of mobility (e.g. zero-emission, connected and automated vehicles and vessels, car sharing/pooling, active-/micro-mobility, sustainable land/air transport modes and drones), as well as of innovative services (e.g. Mobility/Logistics as a Service), in different urban and rural environments, considering the socio-economic acceptability and different user needs (including vulnerable and gender groups).

- Performing simulations for network-wide optimisation of traffic models, aiming towards a “social optimum” and an evaluation of mobility options for multimodal mobility and freight flows (including last-mile), enabling a modal shift to more sustainable modes (leveraging public transport), while addressing planned and unplanned events of mobility and freight systems under disruption.

- Demonstrating the collection, aggregation, analysis and use of network-wide data from infrastructures, vehicles/vessels and users (using ICT and EU satellite-based systems), from across transport modes (modal and intermodal data), stakeholders and national borders, while preserving data privacy, security and confidentiality to data providers, thereby enabling effective and intelligent multimodal network and traffic management, and even further data exchanges with other sectors (e.g. energy and telecoms).

- Performing early pilot activities on multimodal network and traffic management of limited scale in mobility hubs (e.g. rail nodes, maritime or inland ports), where cross-modal or hinterland inter-connections are present for passenger and freight traffic flows.

- Designing and testing innovative multimodal network and traffic management services, offered by public and/or private stakeholders, which can be operated at network centres (e.g. at cities or hubs) and/or at decentralised level (e.g. by users or vehicles/vessels themselves).

- Developing and showcasing workable governance and dynamic incentive models, for the effective engagement of public and private stakeholders in interoperable data exchange, in the optimisation of transport network and traffic management and in promoting a better use of (public) transport systems.

- Evaluating the qualitative and quantitative impact of the proposed measures and project results, including on reducing travel delay, transport emissions and energy consumption, with a clear baseline for each use case.

If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries are expected to describe if and how the use of Copernicus and/or Galileo/EGNOS are incorporated in the proposed solutions. In addition, proposals should describe the technological and societal readiness of the systems and/or techniques proposed for development and use, particularly in the case of systems based on Artificial Intelligence.

The multimodal aspects listed above are complementary and in synergy with actions foreseen in other parts of the Work Programme, such as in the areas of C-ITS (as part of Connected, Cooperative and Automated Mobility), rail traffic management (as part of EU-Rail Joint Undertaking), air traffic management (as part of SESAR 3 Joint Undertaking) and vessel traffic management (as part of Zero-Emission Waterborne Transport).

In line with the Union's strategy for international cooperation in research and innovation, international cooperation is encouraged.

HORIZON-CL5-2024-D6-01-07: Scaling up logistics innovations supporting freight transport decarbonisation in an affordable way

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 10.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 20.00 million.
Type of Action	Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation

	and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 7 by the end of the project – see General Annex B.

Expected Outcome: Projects are expected to contribute to all of the following outcomes:

- Reduced greenhouse gas emissions by 55%[352] by 2030 in the project networks, without reducing the overall performance of the logistics supply chain and taking account of all costs and externalities.
- Gains in terms of operational efficiency and environmental impact from the implementation of the Physical Internet[353] are clearly identified, demonstrated and measured.
- Logistics concepts speeding up freight decarbonisation and adoption of zero emissions vehicles/vessels and multimodality are developed.

Scope: Building on previously funded projects and ongoing activities (e.g. Connecting Europe Facility, Horizon 2020 and Horizon Europe projects), ensuring compliance with the data sharing framework pursued by the Digital Transport and Logistics Forum (DTLF), and taking into account the development of the common European mobility data space, proposals will pilot, demonstrate and scale up systemic collaborative solutions regarding logistics nodes, multimodal logistics networks connectivity, business and governance models. The focus will be on both digital and physical interoperability as well as on the adoption of zero-emission vehicles/vessels.

Proposals will have to research and demonstrate in a structured and systemic way all of the following points:

- Demonstrate at least 10 working open standard processes, procedures and services across several logistics nodes providing seamless access to users. Processes, procedures, and services are expected to have an open access definition and scalability aspects need to be addressed.
- Develop and demonstrate further compatibility and interoperability of the full range of standardised multimodal transport units (from containers to boxes), also across transport modes.

352 In line with the 2030 Climate Target Plan the baseline for the greenhouse gas emissions reduction is at least 55% below 1990 levels.

353 "The Roadmap to the Physical Internet" was developed in the frame of the EU-funded project SENSE, ref. http://www.etp-logistics.eu/wp-content/uploads/2020/11/Roadmap-to-Physical-Intenet-Executive-Version_Final.pdf

- To achieve scalable multimodal logistics networks connectivity, demonstrate models and processes, supported by Artificial Intelligence, Internet of Things, etc., which can increase utilisation of assets and resources in actual logistics service providers' networks dynamically. These models should also consider how to increase the adoption of automated and zero-emission vehicles/vessels and the use of rail and inland waterways through multimodal solutions.

- Demonstrate tools, technologies and processes to achieve different types of flows compatibility (e.g. through shared standard boxes) and synchro-modal solutions over the logistics service providers' networks, involving shippers and retailers to that purpose.

- Demonstrate the benefit (e.g. GHG reductions vs increased operational costs) of decentralised inventory positions in the pooled logistics network allowing low speed multimodal transport for (re-)positioning stock levels and answering short term lead times with closer to consumer inventory positions (e.g. full visibility of inventory positions in retail networks extended to suppliers and logistics service providers).

- Test and demonstrate sound business and governance models and rules (including organisational change requirements) for resource-sharing across logistics networks, to ensure operational efficiency of freight movements irrespective of mode, nodal operations and freight characteristics.

- Test and demonstrate the functionalities and relevance of the data sharing framework, serving for optimisation of the logistic system, including through the establishment of an appropriate semantic model and its components, such as for instance Digital Twins with specific algorithms allowing for predictive planning of logistic related events. Synergies for rail will need to be sought with the EU-Rail Programme projects implementing the Transversal Topic on Digital enablers and Flagship Area 5[354].

- Develop and demonstrate scalability of the proposed solutions providing open access mechanisms and low thresholds to the system of logistics networks. Consider realising visualisation and simulation models and tools to show the practical use of collaborative models for the various types of stakeholders and the potential benefits based on actual cases. Develop specific actions to encourage, facilitate and ensure the access of SMEs and smaller players.

- Measure and demonstrate the benefits in terms of use of resources, affordability of proposed solutions, throughput capacity and environmental impact of the scaled up horizontal collaboration among logistics networks (system of logistics networks).

If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries have to describe if and how the use of Copernicus and/or Galileo/EGNOS are incorporated in the proposed solutions. In addition, if the activities

[354] See EU-Rail Multi Annual Work programme at https://shift2rail.org/wp-content/uploads/2022/03/EURAIL_MAWP_final.pdf

proposed involve the use and/or development of AI-based systems and/or techniques, the technical and social robustness of the proposed systems is to be described in the proposal.

HORIZON-CL5-2024-D6-01-08: Improved transport infrastructure performance – Innovative digital tools and solutions to monitor and improve the management and operation of transport infrastructure

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 5.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 15.00 million.
Type of Action	Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 7 by the end of the project – see General Annex B.

Expected Outcome: Projects are expected to contribute to ALL of the following outcomes (with a clear baseline for each use case):

- Better interconnection of transport infrastructure and transport means resulting in optimised door-to-door mobility for passengers and goods by assuring at least 30% reduction of average delay (time lost per vehicle per km).
- Reduction of transport operation costs by 20% for transport operators along with 20% reduction of fossil fuels consumption in transport.
- Assessment and redesign of existing infrastructure (e.g. cycling lanes, walking paths, charging points, parking spaces etc.) in order to ensure its effective and safe use by different transport modes. Different infrastructure types should be assessed in each of the pilot demonstrations and safe coexistence of various forms of mobility enhanced (e.g. soft, active, shared mobility).
- Increase in the robustness of transport infrastructure by reducing the infrastructure failure probability by 30%.

- Reduce the transport emissions of greenhouse gases and other pollutants by 30% by 2030 in the pilot demonstrations.

- Reduce the number of accidents involving infrastructure users and infrastructure workers by 50% in the pilot demonstrations.

Scope: Innovative digital tools and solutions will allow to upgrade transport infrastructure ensuring an improved performance and safety, together with a reduction of emissions and better inclusiveness. Increasing the performance of multi-modal transport infrastructure can be achieved through improving the efficiency of the assets and by the cross-modal data management. Digital solutions are key to reduce drastically disruptions in traffic flows, increase transport efficiency and lower its dependency on fossil fuels.

Transport infrastructure needs to be capable of harvesting the benefits from digitalisation at management and operations levels, as well as in relation with the user. Digitalisation can support the achievement of sustainability targets and provide a better service to infrastructure end users, including enhanced public transport services. Digital technologies, such as big data, the Internet of Things, Digital Twins, together with Artificial Intelligence and Machine Learning techniques provide a great potential for developing mobility solutions.

The integration between transport infrastructure and digital technologies will help achieve personalised seamless passenger and freight journeys transport across different transport modes. This integration will consider safety and security starting from the design phase, while simultaneously automating and accelerating the decision process at every level from maintenance to traffic management.

Special attention should be given to the accessibility of new digital tools from persons with disabilities and older persons, in order to ensure that this segment of the population is also able to participate fully and benefit from digital progress. As set by the Green Deal, priorities should be given for projects allowing modal shift from road to more sustainable mode such rail and inland waterways.

Proposals will have to address all of the following points:

- Improve performance of transport infrastructure and increase multimodality with the use of, for example: IoT, edge computing and decentralised artificial intelligence, or other digital tools in view of its potential to facilitate real-time decision-making, improve safety and to save bandwidth and energy. Develop solutions for self-monitoring, self-reporting, non-intrusive/non-destructive inspection and testing methods, including advanced predictive modelling and structural safety assessment.

- Demonstrate ability to process internal and external raw data, such as sensor data, into smart data and related cloud architecture that can be deployed to optimize infrastructure management processes

- Building on the common European mobility data space and the Digital Transport and Logistics Forum (DTLF), facilitate the seamless use and provision of data and

information to the end user across the transport infrastructure network and logistic chain, with a view to progress advancing towards smart mobility concepts for passengers and freight.

- Enhance prediction of demand from individual behaviours, enabling appropriate modal capacity and demand management.
- Propose digital solutions contributing to a more inclusive, comfortable, accessible and flexible infrastructures and multi-modal services.
- Include at least three pilot demonstrations of the proposed solutions in operational environment (minimum at TRL7) on land and inland waterways transport infrastructure.
- Evaluate the qualitative and quantitative impact of the proposed measures with a clear baseline for each pilot demonstration.

For rail infrastructure the solutions will need to be harmonised with the EU-RailRAIL Programme projects implementing the Flagship Area 1, 3 and 5[355]. Proposals should consider results from previous calls on infrastructure maintenance, digitalisation, and on edge-IoT, and focus on validation of innovative solutions (i.e. robotics, IoT, edge computing and AI).

If the activities proposed involve the use and/or development of AI-based systems and/or techniques, the technical and social robustness of the proposed systems is to be described in the proposal.

HORIZON-CL5-2024-D6-01-09: Policies and governance shaping the future transport and mobility systems

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 3.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may

[355] See EU-Rail Multi Annual Work programme at https://shift2rail.org/wp-content/uploads/2022/03/EURAIL_MAWP_final.pdf

	additionally be used).
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025). [356].

Expected Outcome: Projects are expected to contribute to all of the following outcomes:

- A better understanding of the effects of governance[357], policies[358], and incentives, but also land use and spatial planning, on the choice of individuals, families, or social groups of different kinds to use a specific transport and/or mobility mode.
- Reinforced public engagement in shaping co-created transport and mobility policies.
- Effective policy interventions, co-created with target constituencies and building on high-quality policy; strengthening of research-policy cooperation models to reinforce impact and trust in science.
- More effective and sustainable national, regional and transnational transport and mobility policies toward accepted approaches, based on a system-thinking perspective.
- Better harnessing the potential of digitised mobility data while protecting citizen's privacy.
- Providing concepts and policy recommendations sustainably integrating passenger and freight transportation in order to create a future proof holistic mobility system.

Scope: Governance, policies and incentives play an important role in shaping transport and mobility systems and influence the development and implementation of different technologies and modes of transport (e.g. walking, cycling, public transport and rail). It is therefore important to study how policies and regulations could be best used to govern transport and mobility systems in desired directions, so that they become more sustainable and just, for instance with regard to gender, place, or low-income households, as well as their fiscal impacts.

356 This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

357 Governance is all the processes of interactions be they through laws, norms, power or language of an organized society over a social system, done by the government of a state.

358 Policies are deliberate systems of guidelines to guide decisions and achieve rational outcomes. Policies are generally adopted by a governance body within a national or local authority.

In addition, the COVID-19 crisis has significantly altered commuting habits; remote and telework have become widespread together with other flexible work arrangements. The true impact of these changes on gas emissions and on the well-being of people as well as on the real-estate market (offices) are not known. This is now an opportunity to leverage on an ongoing change in habits that could result in significant GHG reduction.

Proposals should address all of the following aspects:

- Analyse the influence of politicians on the making of sustainable and non-sustainable transport policies, as well as the impact of their design on accessibility in peripheral areas, identifying synergies with the reform of governance instruments of the European Union (e.g. Trans-European Transport Network, Urban Mobility Framework) to enhance the gradual phase-out policy effect for private car ownership.

- Propose approaches that better integrate mobility policies with policies from other sectors (e.g. energy efficiency, renewables, gender mainstreaming, healthcare, retail and poverty and low income population reduction).

- Consider the benefits of public/private partnerships towards future transport and mobility system, as to secure local adjustment and solutions that are effective and economic for private stakeholders, with a long-term sustainable horizon for the society.

- Identify and assess the potential of (shared) mobility hubs at neighbourhood-level and define the role of organisational innovations in supporting them.

- Explore how small, medium cities and metropolitan areas manage the emergence of micro-mobility and how driverless vehicles are likely to affect urban areas and land use (e.g. mixed use of urban space, dynamic parking).

- Identify the major flaws on national transport and mobility regulations in EU countries and provide recommendations on how to better harmonize them trans-nationally (e.g. incentives for putting bicycles on trains etc.).

- Identify regulations and accountability measures to ensure that mobility data are best utilised for the common good, for example, harnessing the potential of data to stimulate innovation for more sustainable mobility behaviour patterns and guide urban planning, while also protecting citizen privacy.

- Analyse the drivers for public acceptability of stringent and mandatory transport policies (e.g. carbon taxes, urban traffic bans).

- Examine the most effective strategies in promoting the transition to more sustainable freight transport in Europe following the recent and ongoing changes in consumer culture, such as the increase in e-commerce and online.

A ’social optimum’ balance should be included to developing research knowledge within new governance models from several perspectives (e.g. socio-economic, environmental, health,

accessibility, gender and inclusion, safety and security aspects). This concept complements the work launched within the Cities Mission regarding MaaR (Mobility as a Right). Synergies with the projects GECKO[359], ACCTING[360] and SHARED GREEN DEAL[361] should be explored, given that mobility behaviours and the role of cities as agent of change will influence policy makers in enabling adaptive and anticipatory regulatory schemes and governance with novel policies contributing to sustainable mobility goals.

In addition to the research activities, actions are expected to involve citizens from different backgrounds and origins in the policy analysis to gather and study their understanding, perceptions, opinions and positions, thus contributing to co-designing and co-assessing the most appropriate policies' recommendations. The collection of children's views can also be included in the study. Citizen platforms if existing, can be used for this purpose.

This topic requires the effective contribution of SSH disciplines and the involvement of SSH experts, institutions as well as the inclusion of relevant SSH expertise, in order to produce meaningful and significant effects enhancing the societal impact of the related research.

Safety and resilience

Proposals are invited against the following topic(s):

HORIZON-CL5-2024-D6-01-10: Ensuring the safety, resilience and security of waterborne digital systems

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.50 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology	Activities are expected to achieve TRL 5-6 by the end of the project –

359 https://h2020-gecko.eu/
360 https://www.esf.org/eu-projects/accting/
361 https://mailchi.mp/06ac151106cf/shared-green-deal

Readiness Level	see General Annex B.

Expected Outcome: Project outputs and results are expected to contribute to the following expected outcomes:

- Increased safety and resilience of waterborne digital systems, including system of systems and their functions and considering both malicious intervention and system failure with particular regard to the application of artificial intelligence methodologies, networks of sensors and the onshore on-board communications.
- Improved system design addressing human factors issues in the changing levels of human/automated system interactions
- Assurance of the resilience, safety and security of waterborne digital and connected systems is undertaken on the basis of robust methodologies to a similar standard to that applied within other sectors which apply safety critical digital technology and their application in safety critical conditions including the safety of navigation and its systems.
- Robust by design waterborne digital and connected systems for safety and resilience (incl. reliability regimes such as fail safe, fail secure, fail to operation etc., HAZOP, system of systems, security, hardware and equipment data, etc.)
- Methodologies to enable effective HAZOP analysis and validation of waterborne digital systems are developed and disseminated, increasing the use of common approaches, also when using artificial intelligence applications.
- Increased software safety (incl. functional analysis and reliability assessment).
- Increased cyber security for operation and maintenance (incl. software maintenance).

Scope: Increasingly, modern waterborne transport relies upon smart digital and connected systems to ensure safe and efficient operation. Within large complex vessels, system of systems approaches are used together with Internet of Things and Artificial Intelligence approaches to integrate diverse systems ranging from sensors, business and cargo management systems, power and engine management, electronic navigation and situational awareness. System integration of systems with proprietary digital control systems has become more and more critical in terms of ensuring safety and efficiency. The complexity and foundation upon software, makes assurance of the resilience of such systems challenging and requires a different to that applied to hardware- based systems. Waterborne digital system can be vulnerable to both malicious intervention and the consequences of system failure. Examples have included the spoofing of navigational GPS signals, ransom wear attacks on integrated container management systems, complete power shutdown and the helicopter evacuation of a large passenger ship when engine protection systems identified a common fault across all engine waterborne systems. The challenge to assure the safety and resilience of digital systems is particularly important within large complex vessels where the level of

integration and connectivity is high and where the consequences of failure can be particularly severe.

In the domain of power generation and management the vastness of new technological solutions, often driven by environmental regulations, poses new challenges in ships' design and management, where the need for integration of diverse energy converters (ICEs, batteries, fuel cells, wind, capacitors, etc.) confront designers and operators with systems based on profoundly different operating principles coming together with different requirements and control and digital systems. Integration for harnessing the full potential in a safe and secure frame is key to their implementation.

Furthermore, the capability of integrating different systems (and their dynamics) involve an always increased number of sensors, whose data, fused, should become available for optimisation and increased awareness during normal and safe critical operations.

Comprehensive HAZOP (Hazard Operability) studies are essential for such vessels, yet the methodologies are poorly established within the waterborne sector whilst other sectors operating safety critical digital systems (aerospace, nuclear, medical automotive etc.) have well established practices. Furthermore, applying "hardware in the loop" to simulation and validation of digital systems in dependent on the quality of the digital simulation model. This can be difficult for waterborne transport due to the variability of ship designs, complexity and lack of relevant data concerning the integrated components. Pre-delivery testing and sea trials could include fault simulation and digital testing founded upon the identification of critical digital systems identified by the HAZOP, yet such trials focus on hard-ware or subsystems such as rudder control rather than addressing the entire integration. For safety critical systems, reliability regimes need to be established to identify the safe default state in case of system failure or the identification of malicious intervention. In this respect the best system state could be: "fail operational", "fail soft", "fail safe", "fail secure", "fail passive", "be fault tolerant".

Activities will address the development of a HAZOP methodology for whole system assessment of highly digitised, connected complex vessels. The methodology should include system, system of systems designed for specific function or sets of functions and/or a methodology for the entire vessel, including when application of artificial intelligence algorithms is foreseen. The methodology will be developed with relevant stakeholders including shipbuilders, system designers and equipment providers, IT professionals, operators, class societies, regulators. The acceptability of the methodology to all stakeholders will be assessed and an implementation roadmap will be developed to account for any identified barriers. Work will draw upon the expertise of other sectors with more developed procedures for the assessment and assurance of digital safety.

On-board systems and functions integration by design, for safe and secure operation should be used to test and demonstrate the safety and security of the applications.

The developed methodology will be applied to a representative complex highly digitised vessel, safety critical systems and functions will be identified, and appropriate reliability

regimes and mitigation measures will be established with consideration of both malicious intervention and system failure.

Cost effective methodologies for validating the safety, resilience and correct functioning of digital and connected safety critical ship systems, including system of systems, will be developed and demonstrated.

- In case of validation on the basis of a theoretical digital models and/or digital twinning (e.g. hardware in the loop) then the validity of the model should be proven as well as its flexibility to be applied towards a range of vessel designs.
- In case of validation on the basis of physical testing of the responses of the final system to a range of fault conditions and malicious interventions during the final trials, there should be assurance that test conditions are representative of the identified risks.

Guidance should be produced and disseminated concerning the recommended methodology for assuring the safety and resilience of complex digitalised and connected shipping.

The safety assessment should be developed by using methodologies suitable for being assessed in international fora such as the International Maritime Organisation.

HORIZON-CL5-2024-D6-01-11: Effects of disruptive changes in transport: towards resilient, safe and energy efficient mobility

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of between EUR 3.00 and 3.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 7.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for

	Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025). [362].

Expected Outcome: Research is expected to contribute to all the following outcomes:

- Transport systems that are resilient, i.e. prepared for disruptive changes of different kinds, and thereby supporting continuously improved traffic safety.
- Resilience to unexpected events (pandemics, natural disasters, political decisions, conflicts, energy and fuel disruptions, raw materials and component supply vulnerabilities etc.) as an integrated principle in the design and development of future transport systems.
- Increased understanding how sudden changes in the availability of transport means e.g. through dramatic weather events or emission induced ban of certain vehicles in a city, affect the safety of transport system users, and the underlying psychological effects for users' reactions.

Scope: The importance of a robust transport systems becomes highly evident in times of rapid, changes that are neither planned, scheduled nor predicted. The COVID-19 pandemic has pointed at several issues (e.g. delivery of essential goods, ensuring uninterrupted and safe public transport operations for essential workers etc.) that need to be addressed to secure future resilience of the transport system and to ensure that the level of transport safety is not only maintained, but also meeting more demanding targets. For instance, the decreased use of public transport during the pandemic has to some extent led to increases in both biking and walking, but also an increased use of cars in some parts of the world. At the same time, decreased traveling has meant fewer vehicles on the roads in certain areas, whereas others have seen an increase of delivery vehicles, as home deliveries have surged. Likewise, the current energy market realities have made even more pressing the need of an energy efficient mobility system that could absorb disruptions in the fuel supply chain.

Digital tools/services and new transport means (e.g. urban air mobility and micro mobility), new ways how to use the infrastructure (e.g. even more shared spaces with different types of vehicles, both highly automated and manually controlled) in a more energy efficient manner and new behaviour should be included in the research.

In order to provide safe and resilient transport for all, many aspects are expected to be considered in a clearly multidisciplinary approach. Proposed actions are expected to address at least three out of the following aspects:

[362] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

- Scenarios of disruptive changes that can make a transport system unstable should be identified, the consequences on transport safety be analysed, and solutions to tackle them developed. This includes safety implications of rapid changes / new incentives (sometimes contradictory to previous ones, e.g. regarding the use of public transport in a pandemic situation).

- Analysis of how socio-economic differences may affect the safety of individuals in case of disruptive changes (e.g. individual mobility options are determined by the socio-economic status).

- Study of how the concept of resilience at the system level can be applied and used for the improvement of transport safety.

- Evaluation of the potential and development of recommendations on how to improve transport safety and resilience through suburban planning and future housing developments with their effects on the demand for transport and through the design of transport infrastructure networks.

A definition of resilience in the context of transport systems should be provided, and factors of transport safety and energy efficiency that are essential to take into account should be determined. Moreover, scenarios for disruptive changes should be identified that can make a transport system instable, the consequences on transport safety be analysed, and solutions to tackle them be developed. Hence, a structured method to secure safety as an integrated part in resilient transport systems should be provided.

A solid foundation for this research is the Safe System Approach. It requires the inclusion of relevant expertise in social sciences and humanities (SSH) and will benefit from international cooperation.

HORIZON-CL5-2024-D6-01-12: A new framework to improve traffic safety culture in the EU

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 3.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 7.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of

	Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025). [363].

Expected Outcome: Research results are expected to contribute to all the following outcomes:

- Growing a positive traffic safety culture across the EU that supports the Vision Zero goal and the Safe System Approach, and which is in line with the UN Sustainable Development Goals and the 2020 Stockholm Declaration, UN General Assembly Resolution and Global Plan of Action for the second decade on road safety
- Remedial action against detrimental, non-temporary impacts of the COVID-19 pandemic on certain road safety risk factors such as a shift from collective to individual means of transport. Facilitation of a shift to increase efficiency in road safety related public spending across Europe together with a shift towards more energy efficient mobility choices.
- Development and evaluation of strategies to transform the traffic safety culture of road users and stakeholders based on a valid model that identifies the key components defining traffic safety culture, including, for example, social norms, attitudes, perceived control, values, and system assumptions (including its energy efficiency and consumption)
- Concepts and guidelines to make the concept of traffic safety culture an integral part of road safety work of actors across the socio-economic systems of European societies
- Better understanding of the link between road safety outcomes and safety culture; pilot implementation of road safety education at secondary school level and also for decision makers and practitioners in EU Member States/Associated countries.

Scope: A Safe System entails the understanding and managing of all elements of the transport system, including the behaviour and interplay of its actors. Comparative analysis shows persistent differences in road safety performances between EU Member States/Associated countries. These differences may be attributable to differences in culture, which are hard to

[363] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

explain with classical risk models. Efforts should therefore be made to complement road safety initiatives by a *safety culture* perspective, i.e., the values, beliefs, priorities and viewpoints shared among groups of road users and stakeholders that influence their decisions to behave or act in ways that affect safety, while also considering energy consumption. This concept is already well established in organisational research.

Assessing road safety cultures in different national, regional or local systems, groups and organisations is believed to help understanding and explaining different patterns of risk perception and risk taking across communities and countries – and can likewise inform tailored interventions for these (sub-)cultures, which all come with their specific norms, values, beliefs and behaviours (including gender-related behavioural patterns). These interventions should address all relevant actors in the system for road transport of people and goods, and consider future developments, such as potential impacts by increasing automation levels or by the introduction of new means of road transport such as e-scooters and hoverboards.

Within this context, actions should contribute to establishing a framework for cultural transformation in road safety across the EU and thereby address all the following aspects:

- Better understanding of the link between road safety outcomes and safety culture, i.e. of sociocultural factors like values, beliefs, attitudes, and norms and their effects on actual behaviour of road users (including subjective perception of safety as well as implications of value of time and institutionalised travel costs) – and the ways how these factors can be sustainably transformed.

- Consideration in particular - but not exclusively - of traffic behaviour with high safety impacts, such as inadequate speed choice, distraction by communication or control devices, driving or riding under the influence of alcohol or drugs, non-use of protective devices, and risks triggered by professional drivers' requirements to multitask and report while driving.

- Assessment of safety cultures and respective activities from other transport modes such as aviation and rail and their potential for road safety.

- Assessment of the interplay between shifting to more energy efficient mobility solutions and traffic safety.

- Consideration of safety impacts of new technologies (including better understanding and use of Advanced Driver Assistance Systems (ADAS)) and emerging transport means and services.

- Consideration of the safety impact of the increasing penetration of urban micro-mobility systems in mixed traffic scenarios and evaluation of potential safety improvements for the protection of micro-mobility users.

- Stocktaking of good practices from countries and companies worldwide already successfully applying cultural approaches to (road) safety work, including countries outside of the EU such as the US and Australia.

- Targeting all levels of the socio-economic systems of societies in the EU, i.e. from European to national, regional and local communities, including entities such as schools and workplaces. Also, NGOs, victims' organisations etc. can play an important role in that regard.

- Clear guidance & hands-on advice on the design and evaluation of interventions to define, measure, transform and institutionalise traffic safety culture across all areas affecting road safety – for decision-makers and practitioners, with a good geographic coverage across EU institutions, EU Member States/Associated countries. At the level of individual road users, including VRUs, such interventions may entail targeted educational and communication efforts to challenge wrong beliefs or to clarify misperceived social norms, and the use of incentives and nudging to encourage compliant behaviour. At the level of enterprises and authorities, initiatives may include the take-up of safety culture principles in sustainability reporting and encompass various activities from staff training and supervision to procurement and operations – at best permeating work culture and norms of an organisation. Advice at the level of EU Member States/Associated countries and the EU is sought on how to support such transformation such as with legislation, enforcement, and data.

- At least three different pilot tests of selected interventions at various levels in different EU Member States/Associated countries.

Actions should be based on the results of previous research projects in this domain, such as the TraSaCu project, and make advances by completing and updating their theoretical foundations, teaming up with EU stakeholders and bringing their findings to life by establishing a framework for true cultural transformation in road safety both among stakeholders and road users. Making use of data that is already being collected in EU Member States/Associated countries about traffic safety culture such as the ESRA initiative (which already involves 60 countries, including over 20 European ones) and Baseline[364] project is strongly encouraged.

Special attention should be given to EU countries with lower safety performance [365]. Integration of relevant expertise from social sciences and humanities (SSH) and international cooperation with partners from the US and/or Australia is encouraged.

[364] https://www.baseline.vias.be/en/

[365] According to the data provided by the European Road Safety Observatory (https://ec.europa.eu/transport/road_safety/statistics-and-analysis/data-and-analysis/facts-and-figures_en)