Climate, Energy and Mobility

Anastasios (Tasos) Karakostas

Rsearcher, Computer Scientist, Ph. D.

Call - Clean and competitive solutions for all transport modes

HORIZON-CL5-2022-D5-01

Call - Clean and competitive solutions for all transport modes

- This Destination addresses activities that improve the **climate** and **environmental footprint**, as well as competitiveness, of different transport modes.
- Intensified research and innovation activities are therefore needed, across all transport modes and in line with societal needs and preferences, in order for the **EU to reach its policy goals** towards a net-zero greenhouse gas emissions by 2050 and to reduce significantly air pollutants.
- *Making Europe the first digitally enabled circular, climate-neutral and sustainable economy through the transformation of its mobility, energy, construction and production systems;*
- *Promoting an open strategic autonomy 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.

Call - Clean and competitive solutions for all transport modes

- The **expected impact**, in line with the Strategic Plan, is to contribute *“Towards climate- neutral and environmental friendly mobility through clean solutions across all transport modes while increasing global competitiveness of the EU transport sector*", notably through:

    - Transforming **road transport to zero-emission mobility** through a world-class European research and innovation and industrial system, ensuring that Europe remains world leader in innovation, production and services in relation to road transport

    - Accelerating the reduction of all **aviation** impacts and emissions (CO_2 and non-CO_2, including manufacturing and end-of-life, noise)

Call - Clean and competitive solutions for all transport modes

- Accelerate the development and prepare the deployment of climate neutral and clean solutions in the shipping sector, reduce its environmental impact
- Devising more effective ways for **reducing emissions and their impacts** through improved scientific knowledge

Zero-emission road transport

- The main impacts to be generated by topics targeting zero emission road transport under this Destination are:
  - Accelerated uptake of zero tailpipe emission, affordable, user-centric solutions (technologies and services) for road-based mobility all across Europe.
  - Increased user acceptance, improved air quality, a more circular economy and reduction of environmental impacts.
  - Affordable, user-friendly charging infrastructure concepts and technologies that include vehicle-grid-interactions.

Call - Clean and competitive solutions for all transport modes

- The environmental impact, although in absolute terms small, it is projected to increase towards 2050 to a level that is not compatible with the Paris Agreement, if action is not taken now.
- Disruptive technologies entering into service by 2035 as well as 2050, based on new energy carriers, hybrid-electric architectures, next generation of ultra-high efficient engines and new aircraft configurations.

- Enabling climate neutral, clean, smart, and competitive waterborne transport
- The European Green Deal refers to the need to achieve clean, climate neutral shipping and waterborne operations and to the importance of research and innovation in this respect.
- Waterborne transport, in particular where large sea-going vessels are used, remains an important emitter of GHG and the sector needs to step up its efforts on a significant scale and through a wide range of measures.

Call - Clean and competitive solutions for all transport modes

- ***Impact of transport on environment and human health***
- Transport emissions are one of the main contributors to air quality problems, particularly in urban areas. At the same time, noise also negatively affects health.
- The main impacts to be generated by topics targeting transport-related health and environmental issues under this Destination are:
  - The reduction of road vehicle polluting emissions
  - The better monitoring of the environmental performance
  - The reduction of noise emitted by L category road vehicles.

Call - Clean and competitive solutions for all transport modes - HORIZON-CL5-2022-D5-01

Indicative budget(s)[214]

Topics	Type of Action	Budgets (EUR million) 2022	Expected EU contribution per project (EUR million)[215]	Number of projects expected to be funded
Opening: 02 Dec 2021 Deadline(s): 26 Apr 2022				
HORIZON-CL5-2022-D5-01-01	IA	16.00 [216]	Around 8.00	2
HORIZON-CL5-2022-D5-01-02	RIA	15.00	Around 5.00	3
HORIZON-CL5-2022-D5-01-03	RIA	18.00	Around 9.00	2
HORIZON-CL5-2022-D5-01-04	IA	25.00 [217]	Around 5.00	5
HORIZON-CL5-2022-D5-01-05	RIA	15.00	Around 15.00	1
HORIZON-CL5-2022-D5-01-06	IA	7.00 [218]	Around 7.00	1
HORIZON-CL5-2022-D5-01-07	RIA	7.00	2.50 to 3.00	3
HORIZON-CL5-2022-D5-01-08	IA	58.00 [219]	15.00 to 20.00	3
HORIZON-CL5-2022-D5-01-09	RIA	20.00	3.00 to 6.00	4
HORIZON-CL5-2022-D5-01-10	IA	25.00 [220]	20.00 to 25.00	1
HORIZON-CL5-2022-D5-01-11	CSA	2.00	Around 2.00	1
HORIZON-CL5-2022-D5-01-12	RIA	20.00	2.00 to 5.00	5
HORIZON-CL5-2022-D5-01-13	RIA	20.00	2.00 to 5.00	5
HORIZON-CL5-2022-D5-01-14	RIA	5.00	0.50 to 2.50	3
Overall indicative budget		253.00		

HORIZON-CL5-2022-D5-01-01

- Exploiting electrical energy storage systems and better optimising large battery electric power within fully battery electric and hybrid ships (ZEWT Partnership)
- 8m (16m total)
- IA
- TRL 7
- 70 pages
- ZEWT Partnership - ZERO EMISSION WATERBORNE TRANSPORT - The Partnership will ***provide and demonstrate zero-emission solutions for all main ship types and services before 2030, which will enable zero-emission waterborne transport before 2050.***

HORIZON-CL5-2022-D5-01-01 – outcome

- Contributions to two full scale vessel demonstrators, hybrid and fully electric, by 2027 covering a sailing distance of at least 300 nm in the case of a fully electric vessel. (*100 NM (115 miles*)
- Development and validation of electrical architectures for large battery systems on- board.
- Proof of the safe integration of battery systems into the ship's electrical grid for a relevant number of ship types (e.g. IWT, short sea vessels, cruise ships, ferries) and operational scenarios.
- Verification of the architecture and the power management system for two cases: hybrid and fully electric.
- Documentation of skills requirements for the crew.
- In the short term, facilitate full battery electric transit for reduced noise and zero emissions on shorter routes (up to 100 nm) and during approach and harbour stay.

HORIZON-CL5-2022-D5-01-01 – scope

- Electrification and electrical energy storage is one of the major drivers for climate neutrality in the waterborne sector.
- Large battery based electrical energy storage systems offer the highest energy conversion efficiencies. Within fully electric ships, notably ferries, batteries are the most energy efficient method to achieve climate neutrality.
- The latest industrial outcomes in large marine batteries are already addressing safe, long-life and cost-effective solutions.
- On the other hand, at ship level, the development of systems which ensure the full integration of batteries in the ship's highly complex electrical network is crucial to ensure the optimal use of the electrical energy stored, alone or in combination with other zero-emission ship power sources like, for instance, fuel cells.

HORIZON-CL5-2022-D5-01-01 – scope

- Projects will develop solutions for the on-board integration (including the optimisation of the electrical distribution grid) and control of batteries which will maximise the operational flexibility of different ships under electric-driven zero-emission operations, focussing on an optimal operation and the longest lifetime and lowest weight of the electrical systems and its key components.
- While ensuring the ship's energy balance and efficiency, solutions need to address one of these two cases:
  - The hybrid arrangement for zero local pollution (long and complete discharge cycles), or
  - The full electric arrangement, plug-in charging (charging strategy and battery size adapted to route).
- Strategies for safe energy management systems with sufficient safety margins need to be addressed.
- Projects will also investigate (e.g. through performance modelling) different optimisation strategies for the large capacity batteries on board and will need to prove the applicability to several ship types and operational profiles.
- It will need to establish connections with the project(s) awarded under the Horizon 2020 call LC-BAT-11-2020 which is focused on the development of cost-efficient batteries, including the certification methodology.
- Consideration should be given to technology transfer from potentially related sectors, such as the energy management from solar panel systems.
- Long term skills' development needs and strategies with the aim to provide operational transferability of the developed solutions are integral to the topic and should also be investigated.

HORIZON-CL5-2022-D5-01-02

- Innovative energy storage systems on-board vessels (ZEWT Partnership)
- 5m (15m)
- RIA
- TRL 5

HORIZON-CL5-2022-D5-01-02 – Outcome

- Contributions to at least two full scale on-board demonstrators for two different electrical energy storage solutions by 2027.
- Improve efficiency and make waterborne transport climate neutral through the exploitation of new innovative electrical storage systems.
- In the medium term, upscaling of proven solutions for a broad range of ship types (e.g. IWT, ferries, short sea shipping) and operational scenarios, as an alternative to batteries.
- Ensuring European leadership for energy storage solutions based on different technologies that will be fit-for-purpose for diverse waterborne applications.

- *Achieve a comprehensive understanding of potential innovative energy storage systems other than batteries and their applicability to waterborne transport.
- *Solutions to improve energy efficiency and make waterborne transport climate neutral founded upon innovative energy storage.
- *Comprehensive assessment of the technical feasibility and adequacy of innovative energy storage for a range of waterborne operations including efficiency, safety, cost competitiveness compared to batteries, skills requirements, and regulatory aspects.

HORIZON-CL5-2022-D5-01-02 – scope

- Projects will focus on low TRL solutions for waterborne transport, preliminary integration, safety studies and the potential combination with other disruptive technologies such as super conductors and the wider use of DC grids.
- It will address the integration on-board of innovative energy storage systems (excluding storage of fuels and conventional batteries), including control systems and optimised operational deployment, and the connection to the on-board electrical grid.
- Projects will address the cost competitiveness of the innovative solutions when compared with batteries, specify the applicability in specific waterborne segments (in particular in IWT where electrification may be pioneered through a dedicated project), determine risk levels, identify safety measures and propose possible regulatory aspects. The pertinent skills development will be outlined.
- Activities will address innovative energy storage for waterborne applications, it will not address the internal design of the energy storage technology itself. For example, the design of super capacitors would be excluded.

HORIZON-CL5-2022-D5-01-03

- Exploiting renewable energy for shipping, in particular focusing on the potential of wind energy (ZEWT Partnership)
- 9m (18m)
- RIA
- TRL 5

HORIZON-CL5-2022-D5-01-03 – outcome

- Renewable energy assistance is commercially viable and deployed at scale in commercial shipping and maritime operations, significantly contributing to making waterborne transport climate neutral.
- In the medium term, enabling the wide adoption of automated wind technologies for long distance maritime transport.

- *Through full scale demonstration prove the viability at large scale of power generation and propulsion assistance systems on-board harvesting renewable energies such as wind and solar.
- *System designs (including modular/drop-in) to reduce the costs of and increase confidence in refitting of the most appropriate existing vessels addressing several types of ships and different forms of renewable energy.
- *System designs including power management architectures and energy efficiency solutions (including wind-assisted and wind-based propulsion) for purpose built new ships including designs that are “wind-ready”. Demonstration of efficiency gains of at least 15% for power generation or at least 25% for propulsion purposes.
- *Provision of a summary and an analysis of pertinent regulatory issues and how to address them.
- *Documentation of skills requirements and incentives for the crew, for different types of ships and renewables adopted.

HORIZON-CL5-2022-D5-01-03 – scope

- Projects are expected to address both retrofitting existing ships and new purpose built designs, taking into account regulatory issues and making use of the existing guidelines by classification societies on wind-assisted shipping.
- Large scale testing and preferably demonstration is expected. Attention should be given to the conditions under which renewable power sources on-board compete with specific fuel solutions in terms of life cycle and opportunity costs, proven sustainability and reliable sourcing, and operational risks in order to make the most convincing business case.
- In addition to wind, other renewables such as solar electric systems should be considered for different ship types, to the extent they can significantly contribute to the ship's overall power systems.

HORIZON-CL5-2022-D5-01-04

- Transformation of the existing fleet towards greener operations through retrofitting (ZEWT Partnership)
- 5m (25m total)
- IA
- TRL 7-8
- 70 pages

HORIZON-CL5-2022-D5-01-04 – outcome

- Accelerated achievement of climate neutrality of waterborne transport through retrofit modifications to the existing fleet.
- Ensuring cost effective solutions for retrofitting existing ships, thus supporting ship owners in the process of making the European fleet more environmentally friendly.
- Business models, industry standards, regulatory approvals, best practice guidance, and easy-to-customise strategies for retrofitting removing the commercial risk of deployment.
- Increased competitiveness of European shipyards, repair yards, and European marine equipment providers within the domain of green shipping technology.

- *Demonstrated retrofitting solutions for sea-going and inland navigation vessels in operation.
- *Retrofit solutions to reduce GHG emissions that are developed and ready to deploy. The target is to achieve a GHG emissions reduction of at least 35% compared to the original design.
- *Retrofit solutions involving climate neutral fuels making vessels GHG emission free. These solutions are expected to have a significant R&I content going beyond a simple exchange of fuels through minor technical adaptations.
- *Establishment of an up-to-date catalogue of suitable solutions for a wide variety of ship types and operation scenarios.

HORIZON-CL5-2022-D5-01-04 – scope

- For inland navigation and/or maritime shipping projects are expected to address one or more of the following:
  - Retrofit solutions to significantly reduce air or water pollution without increasing fuel consumption and hence GHG emissions, for example main engine abatement systems or engine and propulsion system modifications.
  - Retrofit solutions which significant reduce GHG emissions through partial or full electrification, clearly progressing beyond the state of the art. Indicative examples are battery ICE hybridisation for the main propulsion system and auxiliary power, electric network reconfiguration, electrical power management.
  - Retrofit innovative hydrodynamic improvements (hull, hull management, appendages) to significantly improve energy efficiency and reduce GHG emissions by reducing fuel consumption.
- Projects will focus on the design for technically and economically efficient retrofitting of the ship along these main lines. Cost efficiency of the proposed solutions will come from standardised and modular solutions applicable to different ships or by significantly reducing operational costs over the expected remaining life time of the asset.
- This may require new business models and implementation strategies based on a catalogue of solutions including smart maintenance. Attention will be paid to solutions which are not causing secondary emissions to air or water and which will not significantly increase fuel consumption.

HORIZON-CL5-2022-D5-01-05

- Seamless safe logistics through an autonomous waterborne freight feeder loop service
- 15m (15m total)
- PIA
- TRL 5

HORIZON-CL5-2022-D5-01-05 – outcome

- Enable seamless safe logistics through an autonomous (or highly automated) waterborne freight feeder loop service for inland waterway and/or maritime transport applications.
- Provide increased legal and regulatory certainty concerning autonomous waterborne services within national maritime and/or inland waters, e.g. concerning COLREGs, national and inter-governmental legislation etc. Expansion to the international dimension where feasible.
- Improved European competitive advantage within global markets with respected to connected and autonomous shipping as well as broadening expertise across several member states and associated countries.
- Exploitation of EU satellite navigation and other space based services.
- Better understanding of the societal issues and consequences of automated shipping services, in particular regarding skills challenges.
- *Preferably demonstrate the solution at full scale with all technology building blocks in a real world scenario. If full scale demonstration is unfeasible, solutions and key technology building blocks may be validated by means of testing within relevant environments, noting the lower project budget foreseen in this case.

HORIZON-CL5-2022-D5-01-05 – scope

- Develop business cases which demonstrate the viability of the proposed solutions and their impact on logistic chains.
- Address requirements for telemetry, its architecture, infrastructure monitoring and security needed for controlling the system's water-side and shore-side assets.
- Address the necessary safety, regulatory and legal rules (including liability, COLREGs etc.) needed to deploy such services.
- Whilst ensuring European added value, and visibility of the European activities, engage with wider activities addressing automated shipping, including internationally within IMO, as well as supporting EU policy making in the domain of autonomous and connected shipping.
- Address reliability, liability and the consequences of system failure or breakdown. Special attention needs to be given to cyber security and resilience against malicious acts in all aspects.
- Address the socio-economic implications of such automated feeder services, including employment, training and skills requirements as well as the social acceptance of such vessels. The latter may have higher pertinence where vessel operations are taking place in proximity to population areas.
- Broaden European autonomous waterborne transport expertise amongst EU Member States and associated countries.

HORIZON-CL5-2022-D5-01-06

- Computational tools for shipbuilding
- 7m (7m total)
- IA
- TRL 7-8
- 70 pages

HORIZON-CL5-2022-D5-01-06 – outcome

- Achieve a competitive advantage for European shipbuilders within global markets, particularly for complex high added value vessels.
- Rapid early ship design (including an AI-based analysis of technical and legal requirements derived from historic data or from a structured feedback loop between builder and operator), underpinning the functional design concept and production cost estimations.
- Virtual prototyping to increase the reliability of early stage capital cost estimations, particularly taking into account the full range of greening options and innovative (and potentially difficult to cost) technologies such as green power systems (batteries, fuels etc.), the impacts on weight and revenue generating spaces as well as benefits towards operational cost.
- The platform is expected to be based on Industry 4.0 digital technologies and is expected to be fully tested through a dedicated design case as a demonstrator. This should include all relevant design disciplines and focus specifically on the full range of technologies supporting the reduction of emissions, with linkage to highly automated and robotised processes in parts manufacturing, assembly and outfitting with full supply chain integration.
- Integration of the ship design stages (conceptual, functional, production), considering also supply chain management issues. Demonstration of a future proof ship design concept based on modular architectures that allow for (cost) efficient retrofitting during the ship’s life cycle.
- Computational shipbuilding tools and data management systems which are resilient to cyber threats.

HORIZON-CL5-2022-D5-01-06 – scope

- Proposals should develop advanced innovative computational tools for shipbuilding that increase the European sectors competitiveness by addressing all of the following points:
- Facilitate rapid early stage design to support lower risk bid development particularly when integrating innovative new technologies.
- Provide better capital cost estimations and performance predictions, particularly showing the improvements expected from the inclusion of new technologies.
- Tools to be integrated with ship construction and production, as well as considering supply chain management and future maintenance and repair of vessels.
- Address and quantify the competitiveness gains provided by the tool(s) in the context of the wider European shipbuilding sector.
- Ensure that the tool is robust and resilient against cyber threats.
- Identify and address the necessary skills development needed to achieve the maximum benefit from innovative advanced computational shipbuilding tools.
- Develop a business case to quantify the added value from the developed tool to the shipbuilder concerned and within the context of the wider European shipbuilding sector.

HORIZON-CL5-2022-D5-01-07

- Prevent smog episodes in Europe: Air quality impact of engine-emitted volatile, semi volatile and secondary particles
- 2.5-3m (7m total)
- RIA
- TRL 5

HORIZON-CL5-2022-D5-01-07 – outcome

- Achieve better understanding of (semi)volatiles particles and secondary aerosol formation as well as their effects on health, air quality (in particular during winter season) and climate.
- Assess the contribution to PM2.5 of precursors present in exhaust from transport through the formation of secondary aerosol (organic –SOA- and inorganic).
- Find ways in which scientific evidences of the role of emissions in atmospheric processes could be an input to develop policies and mitigate SOA formation in urban areas of EU.
- Improved quantification of transport externalities.
- Support of future emissions legislation and of “polluter pays” legislation

HORIZON-CL5-2022-D5-01-07 – scope

- Proposals should assess in detail engines emissions in Real Driving Emissions (RDE)- compliant testing conditions (based on currently used fuels) leading to volatile and semi- volatile and secondary particulate, taking into account the wide available literature and results from projects issuing from topics LC-MG-1-1-2018 and GV-02-2016, prioritise them according to available information and assess their health impact with relevant modelling and in vitro and in vivo testing.
- After assessing the risks associated to each emission, proposals should define a robust and transparent measurement and modelling system in order to determine an equivalent total particles emissions index for each engine encompassing all these emissions, to complement the direct solid particles emissions count currently in use to better quantify the total externalities of combustion engines in all transport fields and related fuels.
- In line with the Union's strategy for international cooperation in research and innovation, international cooperation is encouraged.

HORIZON-CL5-2022-D5-01-08

- Modular multi-powertrain zero-emission systems for HDV (BEV and FCEV) for efficient and economic operation (2ZERO)
- 15-20m (58m total)
- IA
- TRL 7-8
- 70 pages

HORIZON-CL5-2022-D5-01-08 – outcome

- Demonstration of high efficiency long haul Heavy Duty Vehicle (HDV) powertrain for truck-trailer combinations, Vehicle Group 4, 5, 9, 10, 11 or 12 of VECTO capable of 750 km unrefuelled/unrecharged range whilst operating at maximum gross vehicle weight (GVW) of minimum 40 tons under operational conditions comparable to the VECTO long haul mission profile.
- Demonstration of the developed concepts over a period of at least 6 months in real world conditions involving manufacturer(s), energy provider(s), electric and hydrogen infrastructure and end users (e.g. carriers, logistics service providers and cargo owners) from across Europe, covering at least 500 km (for long haul) average daily operation in real conditions – in line with drive and resting time regulation.
- Provide fleet managers with ZEV-specific, flexible, managerial tools (e.g. adapted to the characteristics of vehicles and infrastructure) supporting the seamless integration of zero tailpipe emissions vehicles into fleets and facilitating the assignment of tasks and routes (infrastructure, range, charging time, payload etc.).
- Contribute to significant price reduction steps by targeting and showing a pathway towards total cost of operation equality with 2020 engine-based solutions assuming a production volume of >= 10.000 pieces/year, and net TCO reductions beyond that.

HORIZON-CL5-2022-D5-01-08 – scope

- The call is asking for a modular and flexible powertrain approach for large heavy-duty trucks which can serve varying mission demands (range, power and re-charging/-fuelling requirements) by varying battery/tank sizes to serve different missions and driving profiles within one vehicle platform.
- Flexible vehicle platforms can allow the installation of modular powertrain solutions including either pure BEV/FCEV versions or hydrogen FC range extended battery vehicles, exploiting the scalability and modularity of the installed power units to allow cost efficient solutions for dedicated missions.
- At least two different prototypes need to be demonstrated covering two different missions under operational conditions: one of which is mandatorily for long haul freight transport, as defined in expected outcomes, while the additional prototype(s) is/are open to Vehicle Group 4, 5, 9, 10, 11 or 12 of VECTO capable of operating at maximum gross vehicle weight (GVW) of minimum 40 tons under operational conditions comparable to the VECTO regional mission profile, and/or long distance coach(es).

HORIZON-CL5-2022-D5-01-08 – scope

- Applicants should go beyond activities carried out by actions funded under topic HORIZON- CL5-2021-DEST5-CCT-01-01, avoiding duplication of activities already performed under this topic, as well as of activities developed by ongoing Fuel Cell and Hydrogen Joint Undertaking projects221.
- Proposals are expected to address the following:
  - Efficient energy/thermal management including the HVAC system and during ultra-fast charging both while driving and during breaks (including auxiliaries like overnight hotel and, optionally, refrigeration loads) achieving a minimum 44% energy efficiency in FC “charge sustaining mode” or 82% for BEV configurations (both at “tank-to-wheel” on the VECTO Regional Distribution and Long Haul cycles as appropriate).
  - For FC applications, the scalable power level of a hydrogen-based power unit for full power operation or range extension to vary power and range demands of different mission profiles is expected to demonstrate at least 90% availability and 30.000 hr FC operational life for safe and efficient operations, including scale-up options; (FC and tank development are excluded from this topic; suitable engagement with FCH projects needs to be foreseen).
  - For BEV long haul applications, demonstration of fast charging concepts, capable of fitting established regulations and business practices, with a range recovery of at least 400 km in 45 min, with an overall charge efficiency of at least 80%. The proposed solutions are expected to not reduce transport productivity (i.e. km per day, including driver resting time) and should be deployable at load/unload points and staging areas, while ensuring grid compatibility.

HORIZON-CL5-2022-D5-01-08 – scope

- Demonstration of a delivery load capacity not less than 90% of a current such vehicle.
- Improvement of inverter and DC/DC technologies integration in regard to optimized and novel cooling concepts and cost reduction, considering where appropriate synergies with HORIZON-CL5-2021-DEST5-CCT-01-02.
- Improvement of specific central, high power electric motors or modular in-wheel motor concepts, considering where appropriate synergies with HORIZON-CL5-2022-DEST5- CCT-01-02.
- Achievement of cost benefits by optimization of the control architecture.
- Predictive maintenance strategies considering AI technologies, including deployment of prognostic and diagnostic techniques and control units in order to improve the lifetime of the fuel cells systems.
- Show the minimum achievable impact on environment (GHG, polluting emissions, biodiversity, resources etc.) using a comparative life-cycle assessment.

HORIZON-CL5-2022-D5-01-08 – scope

- Price reduction resulting from economies of scale due to modularity and standardization of components in other truck, bus/coach (and where possible railway) applications (also creating links with on-going projects in the FCH partnership) with a clear roadmap for how to increase production numbers after the end of the project and for developing the necessary value chains.
- System level cost-effectiveness of solutions (including needed infrastructure) need to be analysed.
- Develop and validate tools for zero tailpipe emission vehicles integration in fleets (and mixed fleets) for efficient assignment of tasks (routes, charging strategies, assignments etc.).
- Identify European cross-border corridors with lower barriers or higher benefits to start market operations, along with possible future initiatives within the Connecting Europe Facility context.
- This topic implements the co-programmed European Partnerships on ‘Towards zero emission road transport’ (2ZERO).

HORIZON-CL5-2022-D5-01-09

- Nextgen EV components: High efficiency and low cost electric motors for circularity and low use of rare resources (2ZERO)
- 3-6m(20m total)
- RIA
- TRL5-7

HORIZON-CL5-2022-D5-01-09 – outcome

- Lower cost, higher efficiency and power density electric motors for mass produced cars and vans, with a design-to-X approach enabling easy dismantling and recyclability and a reduced use of (rare) resources through the development or application of alternative materials or advanced configurations.
- Lower electric vehicles (EV) cost and improved range and, therefore, a wider market penetration.
- Improved motor design and development processes, considering a full product life-cycle assessment in a circular economy environment, for lower total energy and resources consumption.
- European job creation/retention by developing a world-leading design and production base, including supplying SMEs.

HORIZON-CL5-2022-D5-01-09 – scope

- Electrical machines are a fundamental part of zero emission powertrains for all classes of road vehicles, but the target of this topic is the core market (with powertrains of 50-120kW continuous power).
- Proposals are expected to address all the following:
  - Increasing primary efficiency, in particular by widening the high efficiency area and compactness, for example through topology or operational improvements, inclusion of increased features in integrated solutions, analysis of performance aspects over the machine-in-system life-cycle.
  - Demonstrate the following specific targets (percentages with respect to automotive state of the art in 2020):
    - Continuous power densities >23kW/litre and >7 kW/kg or continuous torque densities > 50Nm/litre and >20Nm/kg, for the complete motor including its cooling, allowing global performance optimisation specific for the category and type of vehicle;
    - A 20% reduction in losses during typical vehicle operation;
    - A reduction in the use of rare resources by 60%;
    - Unit cost for the complete motor at mass production levels (100.000 units/year) < 6€/kW;
    - A recyclability rate >60%, or demonstrating the possibility of “functional” recycling of critical raw materials by repurposing magnets without extracting the single rare elements, thus keeping a higher share of the value.

HORIZON-CL5-2022-D5-01-09 – scope

- Increase high system voltages offering new opportunities for readdressing the current versus voltage trade-offs, throughout the vehicle systems and in aspects of the recharging infrastructure, duly considering potential impacts.
- Guarantee the heat rejection of high energy density motors through multiphysics models in order an optimal design (use of rare resources, reduction in losses, high efficiency).
- Novel manufacturing process supporting increased integration, enabling, amongst other things, improved thermal control.
- The use of alternative architectures and materials to the currently used rare earths-based magnets and configurations. Recyclability plus life-cycle environmental impact aspects need to be considered, aiming at the best compromise with other performance parameters to reach the stated outcomes.
- If composite reinforced materials (CRM) are included in the design, the development of processes for the economic recycling of at least 60% of any rare materials needs to be included: only this additional work will justify the use of up to EUR 2 million of the expected EU contribution.
- The proposed motor concepts are expected to comply with automotive standards, given the normal dynamic and duty-cycle requirements, reliability, EMC etc.
- The proposed concepts should consider the motor (integration of electronics, excluding their development at component level), and integration of any related transmission. The concept has to be validated through representative duty-cycle evaluation, as a minimum on the test bed or, optionally with minimum-change integration, on an existing vehicle.
- The provision of a digital-twin of the concept, in-line with current best practice modelling and simulation standards, is required.

HORIZON-CL5-2022-D5-01-10

- New generation of full electric urban and peri-urban Bus Rapid Transit systems to strengthen climate-friendly mass transport (2ZERO)
- 20-25m (25m total)
- IA
- TRL 7-8
- 70 pages

HORIZON-CL5-2022-D5-01-10 – outcome

- Development of next generation innovative effective public transport systems concepts using full electric buses (M3223) through e-BRT.
- Present efficient, economically viable and flexible, integrated solutions of e-BRT within existing mass transport networks (all modes) and with personal mobility solutions (walk, bike, powered two-wheelers, cars etc.).
- Develop innovative, integrated, infrastructure solutions combining charging, bus-stops and dedicated bus lines, for both urban and peri-urban road networks.
- Development of flexible bus transport, end-user solutions, for both urban use in dense city centres and for less populated peri-urban environments, meeting future user demands of convenience, efficiency, safety and security.
- Development of an international market for European e-BRT systems, in particular, in countries with low offer of public transport with challenging conditions (climate, environment, poverty, etc.).
- Reduction of greenhouse gas and pollutant emissions as well as traffic congestion, by demonstrating the developed technologies and advanced electrified Bus Rapid Transit (e-BRT) concepts in European and in developing countries' partner countries cities.

HORIZON-CL5-2022-D5-01-10 – scope

- Demonstration and testing in real operation are expected to be developed in four or five different European cities and at least one city in a partner country in a developing context either in Africa or in the region of Latin American and Caribbean countries.
- The demonstration activities should include mega-cities, larger/smaller cities and the link to peri-urban, inter-urban and sub-urban dwellings in order to afford complementary solutions in test and demonstrations.
- Zero tailpipe emission buses and their related infrastructure are expected to be applied in BRT lines, in different city contexts, together with the needed integration of e-BRT with other mass-public transport systems, and with personal mobility solutions.
- Solutions include both the physical vehicles, recharging infrastructure and the overall services offering.

HORIZON-CL5-2022-D5-01-10 – scope

- Proposals are expected to address all the following:
- Operational concepts: increasing the capacity use rate; the average commercial speed; punctuality / regularity.
- Synchronization with other city transport; service quality whilst reducing CO2 emissions, and cost per km/passenger.
- Replicability: use of the e-BRT technology under environmental, infrastructure and social conditions different from the European ones.
- The focus of projects is expected to be on mass transport, full electric Bus Rapid Transit (e- BRT) systems using full size buses (M3).
- Proposals are expected to take into consideration the transport operators' and transport authorities' needs for financial viability, effectiveness, flexibility, environment conformance, safety and security.
- This topic requires the effective contribution of Social Sciences and Humanities (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 activities.

HORIZON-CL5-2022-D5-01-11

- Stimulating Road Transport research and innovation dissemination and implementation in Europe and around the World
- 2m (2m total)
- CSA

HORIZON-CL5-2022-D5-01-11 – outcome

- Strengthen and widely promote research and innovation activities, including among the public/civil society, via road transport dedicated even
- Identify, highlight and disseminate the contribution from road transport, in particular from projects focused on zero tailpipe emission solutions, to the realization of the European Green Deal and the Paris Agreement;
- Provide a comprehensive overview of international developments in the field of road transport research to keep Europe competitive and successful;
- Increase of cooperation with road transport related national and international organizations and support of international EU activities in line with the UN Sustainable Development Goals;
- Contribute to identifying and analyse research and innovation areas for the future of road transport in the EU.

HORIZON-CL5-2022-D5-01-11 – scope

- The objective of this topic is to promote sustainable road transport in Europe and at international level.
- Organisation of events, conferences, workshops and dissemination activities to present and discuss future technology and trends, results, exchange experience and foster innovation aspects of road transport research and innovation;
- Identification of actions to support road transport area, in particular in the fields of education, training and skills at European level and standardisation and business models – mainly at EU level;
- Fostering of the links between European, national and (where feasible) regional programmes for road transport research, supporting coordination of activities with Member States;
- In the field of international cooperation, facilitating exchange between Europe and emerging economies in particular within Africa, Asia and Latin America;
- Identification of barriers for the deployment of research results and improvement of framework conditions at European and international level, including development of pre- feasibility studies at least in the specific areas of “Urban zero-emission mobility”, “Air quality and climate change” and “Road safety”;
- Updating and coordinating research agendas and roadmaps in the field of road transport, in particular for urban mobility, road infrastructure, considering also road safety and logistics, taking into account relevant Horizon Europe partnerships and international activities in the field.

HORIZON-CL5-2022-D5-01-12

- Towards a silent and ultra-low local air pollution aircraft
- 2-5m (20m total)
- RIA
- TRL 2-4

HORIZON-CL5-2022-D5-01-12 – outcome

- Deliver transformative technologies that will allow a step change in the reduction of local air quality
- Deliver transformative technologies towards a silent aircraft operations around airports, including a study on airport noise map towards assessing the airports that would most benefit from noise reduction policies.
- Advance further integrated and reference European models and methods for estimating aircraft emissions (LAQ and noise) inventories for operations in the airport vicinity, highly accurate estimations on the number of people affected.
- The models, methods and advancements in measurement technologies should advance further, contribute to and collaborate with existing ICAO CAEP and EUROCONTROL initiatives. They should also be aligned with H2020-ARTEM outcomes towards meeting the ACARE Flighpath2050 goals.

HORIZON-CL5-2022-D5-01-12 – scope

- Regarding the reduction of local air quality (LAQ) from NOx and particulate matter (PM), the selected technologies may consider sustainable drop-in and non-drop-in fuel options, aligned with EU industrial roadmaps and R&I activities in topic HORIZON-CL5-2021-D5-01-05.
- Regarding the reductions of aviation noise around airports, the selected technologies should consider propulsion and aircraft-propulsion integration interdependencies as well as operational air-traffic management procedures.
- This topic aims to support the EU and ICAO LAQ and noise policies. This topic aims for new aircraft and engine technologies that satisfy the design and operational interdependencies between CO2, non-CO2 and noise emissions, are compatible with approved operational procedures and are aligned with the European industrial roadmaps for further development, validation and integration beyond 2030.

HORIZON-CL5-2022-D5-01-13

- Digital aviation technologies for new aviation business models, services, emerging global threats and industrial competitiveness
- 2-5m (20m total)
- RIA
- TRL2-4

HORIZON-CL5-2022-D5-01-13 – outcome

- Transformative digital aviation technologies that will enable new European business models and products (e.g. Urban Air-Mobility (UAM), seaplanes) with minimal environmental impact and opportunities for European competitiveness.
- Transformative digital aviation and space technologies as well as Unmanned Aircraft Systems (UAS), that will enable new services with pronounced societal impact for intermodal and multimodal transport, search and rescue operations, fast response to natural disasters, freight, firefighting, high altitude earth data-services, agriculture and forestry.
- New aviation products and services that exploit Artificial Intelligence and have pronounced impact to productivity, efficiency, automation and cost reduction.
- Breakthrough technologies that will minimise the risks from emerging global threats (cybersecurity, COVID-19) as well as increase the resilience of aircraft systems from increasing frequency of extreme weather conditions (e.g. temperature change, wind patterns).
- Transformative and breakthrough technologies that exploit synergies with aviation, space and defence. The development of materials and components for high-power density electrical architectures at high altitude environment (e.g. cabling, insulation, power electronics) are within the scope of this topic.

HORIZON-CL5-2022-D5-01-13 – scope

- On 10 March 2020 the Commission presented a new Strategy to help Europe's industry lead the twin transitions towards climate neutrality and digital leadership. Europe needs industry to become greener, more circular and more digital while remaining competitive on the global stage.
- The topic aims to enable new digital aviation technologies for new aircraft business models and services, (e.g. EGNSS-based search and rescue, urban air-mobility, firefighting, AI-based technologies, digital data platforms) as well as minimise the risk from emerging threats (extreme weather phenomena, cybersecurity, COVID-19 communicable diseases) to aviation.
- Synergies with other EU initiatives should be exploited towards European digital platforms that deliver insights and analytics for citizens, businesses and decision makers.
- Third-country participation should guarantee and respect European IPR, interests and values.

HORIZON-CL5-2022-D5-01-14

- European Aviation Research Policy in support to EU policies and initiatives
- 0.5-2.5m (5m total)
- RIA
- TRL2-4

HORIZON-CL5-2022-D5-01-14 – outcome

- Deliver at mid-term of Horizon Europe an update of European aviation R&I roadmap, while ensuring the alignment with the EU regulatory framework.
- Deliver a coherent framework and toolbox for technology and policy assessment of the impact of European aviation research – with emphasis to GHG emissions, local air- quality and noise.
- Support EU Member States/Associated Countries towards a coherent update of ICAO standards that will prevent backsliding.
- Connect better European aviation R&I with education and skills and communicate the European aviation R&I to citizens and stakeholders.
- Strengthen ERA in Aviation R&I, assess the R&I needs of European SMEs and promote aeronautics/aerospace spin-offs in all aspects of life.
- Strengthen the synergies between all aviation-relevant R&I activities in Horizon Europe.

HORIZON-CL5-2022-D5-01-14 – scope

- The European aviation research policy aims to contribute with science-based informed decisions that will bridge the gap between R&I, regulatory framework and economic investments (with emphasis on climate neutrality by 2050 and European competitiveness).
- The European aviation research policy also aims to connect better European aviation R&I with education and skills as well as communicate the European aviation R&I to citizens and stakeholders.

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

HORIZON-CL5-2022-D6-01

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.

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

- 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*227 *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.

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

- 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:
- 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).

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

- ***Connected, Cooperative and Automated Mobility (CCAM)***
- The aim of relevant topics under this Destination is to accelerate the implementation of innovative connected, cooperative and automated mobility (CCAM) technologies and systems. Actions will help to develop new mobility concepts for passengers and goods – enabled by CCAM - leading to healthier, safer, more accessible, sustainable, cost-effective and demand-responsive transport everywhere.
- CCAM solutions will shift design and development from a driver-centred to mobility-user oriented approach, providing viable alternatives for private vehicle ownership while increasing inclusiveness of mobility. CCAM must be integrated in the whole transport system to fully exploit the potential benefits of CCAM and minimise potential adverse effects, such as increasingly congested traffic or new risks in mixed traffic environments.
- The focus is on road transport, but relevant interfaces with other modes (for instance transfers and integration with public transport or rail freight transport) will be considered.
- All technologies, solutions, testing and demonstration activities resulting from these actions should be documented fully and transparently, to ensure replicability, increase adoption, up- scaling, assist future planning decisions and EU and national policy-making and increase citizen buy-in.

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

- ***Multimodal and sustainable transport systems for passengers and goods***
- Multimodal and sustainable transport systems are the backbone for efficient mobility of passengers and freight. In particular, the areas of infrastructure, logistics and network/traffic management play a major role in making mobility and transport climate neutral, also through the digitalisation of the sectors.
- At the same time, being vulnerable to climate change and other disruptions, resilience in these three areas need to be increased. New and advanced infrastructures across all transport modes are required to enable the introduction of new vehicles, operations and mobility services.
- Furthermore, efficient and smart multimodal logistics are key for seamless and sustainable long-haul, regional and urban freight transport movements. Finally, dynamic multimodal network and traffic management systems are the “glue” of the entire transport network, for optimised door-to-door mobility of both passengers and freight.

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

- ***Safety and resilience - per mode and across all transport modes***
- Safety and resilience are of primary concern for any transport system. The EU set ambitious targets in its 2011 Transport White Paper, the third Mobility Package and, more recently, the Sustainable and Smart Mobility Strategy229. COVID-19 has been a stark reminder of the importance of resilience to external disruptions, particularly for transport. Research and innovation will underpin the three pillars affecting safety and resilience: technologies; regulations (alongside acceptable level of risks); and human factors (individual and organisational aspects, including interaction with automation). The approach is risk-based and systemic, including transport means/vehicles, infrastructure, the physical environment (e.g. weather) and the various actors (e.g. manufacturers, regulators, operators, users) as well as all their interfaces, including certification and standardisation bodies.
- Synergies should be exploited across research at national, EU and international level together with national authorities, EU agencies and international organisations to improve rulemaking, safety promotion and oversight.
- The main impacts to be generated by topics targeting transport safety and resilience under this Destination are:
- *Safety in Urban Areas/ Road Transport Safety*
- 50% reduction in serious injuries and fatalities in road crashes by 2030.

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

Indicative budget(s)[261]

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR million)[262]	Number of projects expected to be funded
		2022		
Opening: 14 Oct 2021 Deadline(s): 12 Jan 2022				
HORIZON-CL5-2022-D6-01-01	IA	50.00 [263]	20.00 to 25.00	2
HORIZON-CL5-2022-D6-01-02	RIA	8.00	6.00 to 8.00	1
HORIZON-CL5-2022-D6-01-03	RIA	8.00	7.00 to 8.00	1
HORIZON-CL5-2022-D6-01-04	IA	10.00 [264]	4.00 to 5.00	2
HORIZON-CL5-2022-D6-01-05	RIA	12.00	5.00 to 6.00	2
HORIZON-CL5-2022-D6-01-06	RIA	13.00	4.00 to 4.33	3
HORIZON-CL5-2022-D6-01-07	IA	9.00 [265]	4.00 to 8.00	1
HORIZON-CL5-2022-D6-01-08	IA	12.00 [266]	3.50 to 6.00	2
Overall indicative budget		122.00		

HORIZON-CL5-2022-D6-01-01

- European demonstrators for integrated shared automated mobility solutions for people and goods (CCAM Partnership)
- 20-25m(50m total)
- IA
- TRL 7
- 70 pages

HORIZON-CL5-2022-D6-01-01 – outcome

- Demonstration of inclusive, user-oriented and well-integrated shared CCAM systems and services for people and goods in real traffic conditions, which contribute to
  - reduced carbon footprint and harmful emissions;
  - reduced congestion, more reliable, predictive travel times and more efficient
  - transport operations;
  - Increased safety and security;
  - End-users' adoption for specific use cases of innovative shared mobility solutions.
- Demonstration of innovative cross-sector business models and partnerships for CCAM.
- Assessment of all impacts of shared CCAM solutions in real world conditions, specifically on sustainability, inclusiveness and safety based on viable economic use cases for passengers and goods.

HORIZON-CL5-2022-D5-06-01 – scope

- Implement a set of European demonstrators of smart, shared mobility and/or logistics use cases in real traffic conditions with ambitious and realistic operational domains (balancing environmental complexity, risk, speed, economic viability, etc.) enabled by CCAM solutions (SAE Level 4) with market potential (i.e. with scalable business and operating models).
- Test robustness, reliability and safety of highly automated CCAM systems and services, while focussing on user interaction and interaction with other road users (specifically vulnerable road users such as pedestrians and cyclists). This includes testing of key enabling technologies (e.g. sensors, connectivity, cybersecurity, AI, big data, space- based services), physical/digital infrastructure support and optimised traffic and fleet management.
- Address user and customer needs for mobility and logistics, paying special attention to differences in mobility patterns by gender, age, disability and other social groups267. Further, deploy high quality services that are well integrated with other modes and existing mobility services.

HORIZON-CL5-2022-D5-06-01 – scope

- Proposed actions are expected to focus on demonstrators for integrated shared automated mobility solutions for people, for goods or for both, and should address resulting synergies and complementarities in the CCAM ecosystem when possible. All vehicles used for testing the innovative CCAM concepts should use zero emission technologies.
- In order to achieve the expected outcomes, international cooperation is advised, in particular with projects or partners from the US, Japan, Canada, South Korea, Singapore, Australia.
- This topic implements the co-programmed European Partnership on ‘Connected, Cooperative and Automated Mobility’ (CCAM).

HORIZON-CL5-2022-D6-01-02

- Reliable occupant protection technologies and HMI solutions to ensure the safety of highly automated vehicles (CCAM Partnership)
- 6-8m(8m total)
- RIA
- TRL 5

HORIZON-CL5-2022-D6-01-02 – outcome

- Protection systems in Connected and Automated Vehicles (CAVs) designed for a greater variation of unconventional seating positions and body postures, including sex, age and ability differences, to be sufficiently inclusive to encompass the diversity of the occupant population, considering all situations and conditions for the application of such systems and taking into account different accident configurations with a higher market penetration of CAVs.
- New, advanced Human-Machine-Interface (HMI) solutions as enablers for the safe and efficient co-existence and interaction of CAVs with other road users (including Vulnerable Road Users and non-automated vehicles). Interfaces should be reliable and seamless, based on comprehensive knowledge and models of individual human behaviour and capabilities.
- Advanced driver/passenger condition monitoring and improved HMI functionalities to prepare the driver to take control as may be necessary when the vehicle reaches the limits of its Operational Design Domains (ODD).
- Consistent design methodologies and tools for performance assessment of the new protection systems.
- Delivering evidence-based support to the regulatory bodies for the potential adaptation of traffic rules.

HORIZON-CL5-2022-D6-01-02 – scope

- Development of vehicle crashworthiness and advanced safety solutions in order to protect passengers and mitigate injury risk in unavoidable collisions also with new, unconventional seating positions and body postures, considering new protection principles and taking into account all situations and conditions for the application of such systems (for example in shared automated road vehicles).
- Development of empathic HMI solutions, which includes a framework for modelling human emotions, in order to enable natural and intuitive interaction of CAVs with the driver, passengers and with other road users (including unprotected ones) also in mixed traffic situations.
- Monitoring approaches and simulation models to detect and assess occupant status (including health) and level and point of attention of the driver, enabling appropriate HMI, linked also to the new intelligent protection systems in order to fully leverage their potential in terms of adapting to different seating positions, body postures, occupant sizes etc., including gender, age, and ability differences.
- Improved solutions to address situations in which human drivers are expected to seamlessly resume control, for example when the limit of the ODD is approaching.
- Recommendations for user-centric HMI design guidelines and for an extension of the European Statement of Principles for human-machine interaction (ESoP)[268] towards automated vehicles should be derived, taking into account also the interaction with unprotected road users and other non-automated, non-connected vehicles.
- Development of assessment tools for the developed protection technologies and advanced safety solutions in order to support the definition of safety requirements, standards (e.g. UNECE) and the analysis of potential needs for the adaptation of traffic rules.

HORIZON-CL5-2022-D5-06-02 – scope

- 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 activities.
- In order to achieve the expected outcomes, international cooperation is advised, in particular with projects or partners from the US, Japan, Canada, South Korea, Singapore, Australia.
- This topic implements the co-programmed European Partnership on ‘Connected, Cooperative and Automated Mobility’ (CCAM).

HORIZON-CL5-2022-D6-01-03

- Human behavioural model to assess the performance of CCAM solutions compared to human driven vehicles (CCAM Partnership)
- 7-8m(8m total)
- RIA
- TRL4

HORIZON-CL5-2022-D6-01-03 – outcome

- A robust and scalable reference model of human driving behaviour:
- Replicating the full performance spectrum of human drivers, which allows comparing the performance of an automated driving system in a specific situation to the human driver population.
- This serves as a basis to define the required safety level of CCAM systems and to take decisions on validation requirements in type approval schemes. The model will also help to define fair assessment criteria in consumer testing campaigns relative to human-driven vehicles and for the safety verification of CCAM systems in industrial development processes.
- Serving as a reference for the automotive industry and its R&I partners to design human- like and therefore easily predictable and acceptable behaviour of automated driving functions in mixed traffic.
- Helping the automotive industry, its R&I partners, certification bodies and consumer testing organisations to realistically represent the behaviour of other human-driven
- vehicles in the (virtual) simulation of mixed traffic. Virtual testing shortens development cycles and accelerates the implementation of CCAM technologies.

HORIZON-CL5-2022-D5-06-03 – scope

- Proposed actions have to develop a probabilistic human behavioural model with the potential to cover all relevant aspects of human driving performance as well as the broad spectrum of drivers and influencing factors.
- A methodology will be needed to extract consistent data on human driving performance from different data sources (e.g. real traffic, simulator tests) and collect such data with the long-term objective of fully depicting the large variance of human driving behaviour in different situations, while respecting gender, age and other factors like disabilities and diversity criteria.
- Proposals should calibrate the parameters of the model with the help of this data and develop a corresponding validation concept based on real-world experiments. Potential ethical issues will have to be considered, as tests with humans need to be carried out and their personal data will have to be captured.
- In order to achieve the expected outcomes, international cooperation is advised, in particular with projects or partners from the US, Japan, Canada, South Korea, Singapore, Australia.
- This topic implements the co-programmed European Partnership on ‘Connected, Cooperative and Automated Mobility’ (CCAM).

HORIZON-CL5-2022-D6-01-04

- Integrate CCAM services in fleet and traffic management systems (CCAM Partnership)
- 4-5m (10m total)
- IA
- TRL 6-7
- 70 pages

HORIZON-CL5-2022-D6-01-04 – outcome

- Concepts of fleet and traffic management in the CCAM eco-system enabling optimised systems for the mobility of people and goods that take into account the balance between societal and individual user needs.
- Intermodal interfaces and interoperability between traffic management systems (of different geographical locations and/or of CCAM vehicles and other modes of transport) considering integration beyond road transport in the overall multimodal transport system providing seamless mobility services.
- Advanced simulation models and tools that enable and help assessing new traffic management strategies (including dedicated lanes, priorities at intersections etc.) for CCAM.
- Optimised mobility network load balancing approaches through advanced traffic management guidance and information loops that can reach individual users as well as operational traffic management actors.
- Effective cooperation and governance models for operating CCAM services as part of real-life fleet and traffic management systems developed and tested.

HORIZON-CL5-2022-D6-01-04 – scope

- Proposed actions should develop and demonstrate concepts of traffic and fleet management to achieve a desirable integration of CCAM vehicles in the entire mobility system. CCAM vehicles should be considered in their different sizes and usages as well as their mobility service provision (private, public, shared, pooled etc.). Proposed actions should address both the transport of people and goods with automated fleets (commercial/logistics fleets, fleets operated by public or private transport operators) and individual vehicles (CCAM- or conventional vehicles) well integrated in the entire traffic management system.
- This involves planning, forecasting and managing fleet and individual vehicles' movements according to their specific needs. Proposed actions should demonstrate traffic efficiency improvements by mobility network load balancing of routes, optimizing reliability of arrival times of goods delivery or shared mobility services, organize measures in case of events, or bilateral communication and acknowledgement of traffic management guidance if advised from an appropriate control centre.
- Proposed R&I actions are expected to address intermodal interfaces and interoperability between traffic management systems from one geographical location to another and from one user group to another to attain seamless mobility for all.

HORIZON-CL5-2022-D5-06-04 – scope

- Proposed R&I actions are expected to address intermodal interfaces and interoperability between traffic management systems from one geographical location to another and from one user group to another to attain seamless mobility for all.
- Proposed actions should develop and demonstrate mixed traffic orchestration concepts, enabling or involving new mobility business cases for fleet operation (logistics, public or private transport operator, etc.).
- Advanced simulation models and tools should be able to test and demonstrate in real life traffic their ability to support the optimisation and balancing of the mobility network load. Testing and demos in real life traffic conditions should be undertaken through engagement with stakeholders from the industry, public authorities, public and private operators, service providers, the research sector and road and vehicle users and by satisfactorily addressing the priorities of all (win-win-win).

HORIZON-CL5-2022-D5-06-04 – scope

- Governance of the traffic management system has to take into account the different needs and requirements of the users, depending on their gender, socio-economic background, age, ethnicity or ability, and the availability of services enabled by CCAM and the accordingly relevant supporting infrastructure.
- Both citizen-led needs and CCAM developments will guide the governance of traffic management systems which will eventually see the CCAM fleets of private and public transport (including on demand PT) integrated fully into the transport network. It is recommended to develop solutions that are grounded in social innovation.
- 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 activities.
- In order to achieve the expected outcomes, international cooperation is advised, in particular with projects or partners from the US, Japan, Canada, South Korea, Singapore, Australia.

HORIZON-CL5-2022-D6-01-05

- Artificial Intelligence (AI): Explainable and trustworthy concepts, techniques and models for CCAM (CCAM Partnership)
- 5-6m (12m total)
- RIA
- TRL 5

HORIZON-CL5-2022-D6-01-05 – outcome

- Concepts, techniques and models based on Artificial Intelligence (AI) used for situational awareness, prediction, decision making and triggering of actions for time critical and safety relevant CCAM applications as well as for cyber threat detection and mitigation.
- A clear understanding of the capabilities, limitations and potential conflicts of AI based systems for CCAM.
- Increased user acceptance from an early stage, based on explainable, trustworthy and human-centric AI. Interactions with vehicles using AI should be understandable, human- like and reflect human psychological capabilities, and free of gender, ethnic or other biases.
- Accelerated AI development and training for CCAM enabled by a relevant set of real and synthetic traffic events and scenarios.
- AI based CCAM solutions will evolve from reactive and/or adaptive system support into predictive system state awareness (including driver state and user diversity), decision- making and actuation, enhancing road safety especially in near-critical situations.

HORIZON-CL5-2022-D5-06-05 – scope

- Support the development and integration of AI in CCAM with explainable, trustworthy and human-centric and unbiased concepts, techniques and models; this can be on vehicle level and on transport system level, where tactical and strategic links to traffic management and traffic conditions need to be established.
- Address the knowledge gap on AI training and validation approaches as well as efficient and ethical approaches for data handling of increasing amounts of data.
- Build upon existing and generated data for training and verification of AI supporting situational awareness in CCAM in more complex traffic scenarios (e.g. digital twins).
- Specific automotive requirements on functional safety and security need to be considered in the development process of an automotive-grade AI ensuring consistency with existing validation procedures.
- 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 activities.
- In order to achieve the expected outcomes, international cooperation is advised, in particular with projects or partners from the US, Japan, Canada, South Korea, Singapore, Australia.

HORIZON-CL5-2022-D6-01-06

- Predictive safety assessment framework and safer urban environment for vulnerable road users
- 4-4.33m (13m total)
- RIA
- TRL5-6
- A) Predictive safety assessment framework and another one for area
  B) Safer urban environment for vulnerable road users, provided that the applications attain all thresholds

HORIZON-CL5-2022-D6-01-06 – outcome

- For Area A:
- Harmonised, prospective assessment framework for road safety, both active and passive, solutions (for policy, regulatory and consumer assessment).
- Comprehensive virtual representation of challenging scenarios in future road traffic.
- Well-founded prognoses on the effects of new solutions on road safety and protection of
- vulnerable road users and vehicle occupants.

- For Area B:
- 50% reduction in serious injuries and fatalities in road crashes by 2030, with a focus on measures addressing unprotected vulnerable road users
- Better prediction of all road users behaviour and the use of new transport modes
- Concepts and guidelines for safe inclusion of new types of vulnerable road users, e.g. those using new means of transport into the traffic system
- Development of solutions that facilitate inclusion of all vulnerable users in the transport system, including people with disabilities, the elderly, and children by providing a safe environment for walking and cycling.
- Facilitation of modal shift to active and clean modes of transport, improving the health of road users and the quality of urban environments.

HORIZON-CL5-2022-D6-01-06 – scope

- **Area A – Predictive safety assessment framework**
- Develop new methods to efficiently predict the effects of the implementation of a new technology, new means of transport and regulatory or behavioural changes on road safety up to the level of socio-economic benefits.
- Further develop virtual models of the relevant elements of the transport system for which such further development is most urgently needed, and validate them through testing activities and corresponding correlation.
- Analyse, based on selected examples, how the application of new technology and/or the introduction of new regulation will affect the remaining road safety burden, and how traffic and crash scenarios will change with their market penetration and/or enforcement respectively.

HORIZON-CL5-2022-D5-06-06 – scope

- **Area B – Safer urban environment for vulnerable road users**
- Protection principles and solutions to provide a safe environment for vulnerable road users through infrastructure measures and lifelong learning initiatives for vulnerable road users as well as for vehicle occupants (behavioural change, training courses, road safety education from an early age)
- Identify specific mobility needs and public space design needs to promote a safe journey for the vulnerable road users, and enhance their perception of safety
- Protective equipment (helmets, clothes, reflectors) that is innovative, effective, user friendly and likely to lead to higher usage rates. Possibilities of active equipment able to detect oncoming collisions and warn the VRU in order to prevent crashes should be explored and demonstrated
- Improved detection mechanisms of vulnerable road users by other users and accurate prediction of their behaviour including at road intersections.
- Analysis of the most common causes of accidents concerning vulnerable road users and demonstration of applied solutions.
- Provide clear guidance to cities and Member States/Associated Countries on how to incorporate the vulnerable road users dimension into infrastructure planning and sustainable urban mobility plans especially for the aspects of safety, security and accessibility.
- Typically, projects should have a duration of 36 to 48 months. Nonetheless, this does not preclude submission and selection of proposals requesting other durations.
- Social innovation is recommended when the solution is at the socio-technical interface and requires social change, new social practices, social ownership or market uptake.

HORIZON-CL5-2022-D6-01-07

- More resilient aircraft and increased survivability
- 4-8m(9m total)
- IA
- TRL 6
- 70 pages

HORIZON-CL5-2022-D6-01-07 – outcome

- Near real-time proactive prediction, detection, communication and avoidance/mitigation of anomalies and hazards at the airport (e.g. on the runway, at ground-handling, etc.), in the atmosphere (e.g. extreme weather phenomena) and on-board (e.g. fire, electromagnetic interference, structural issues, etc.), including self-protection.
- Improved safety modelling and design of aircraft and airports to increase survivability e.g. in case of fire, crash, ditching, including impact of new fuels or energy systems.
- Improved means and methods for reliable tracking of aircraft and timely evacuation, search and rescue of passengers and crew.

HORIZON-CL5-2022-D6-01-07 – scope

- Activities should contribute to maintain a high-level of safety in aviation by encompassing the evolution of external hazards with the evolution of aviation systems. Aircraft should be more resilient to external hazards and internal failures in all phases - from ground-handling, runway operations, up to flight and emergency operations.
- Should such rare events occur, the aircraft should be able to fly safely back to an airport, or, in the worst case, ensure the survivability of passengers and crew and their safe evacuation and rescue.
- Increase the ability to predict and avoid or mitigate weather hazards, which remain one of the major challenges on the ground and in flight, such as thunderstorms, lightning strikes, turbulence and wind shear to icing, snow and fog, as well as emerging events such as drones incursion, and major events such as volcanic ash clouds that can affect large swathes of airspace.
- Prevent and handle electromagnetic interferences (including cosmic radiation) and fire events, triggered by internal failures or external hazards. Improve modelling and protections systems accordingly together with tools to assist the design and the certification process, considering also climate risks.
- Advance systems and methods for reliable aircraft tracking and for safe evacuation, search and rescue of passengers and crew, including with new aerial means as drones.

HORIZON-CL5-2022-D5-06-07 – scope

- Features of Galileo Search & Rescue operating service should be fully explored and exploited, if applicable.
- Activities should go beyond the state of the art and previous R&I activities, at least at EU level. The proposals may include the explicit commitment from the European Aviation Safety Agency (EASA) to assist or to participate in the actions.
- In order to achieve the expected outcomes with increased resources and impact, international cooperation can be foreseen with third countries with relevant capacities in this domain, while ensuring that the respect of European IPR, interests and values is strictly guaranteed.
- Synergies with other transport modes and safety/security critical sectors is welcomed, in particular on risk assessment and pre-normative research to ensure fit-for-purpose rulemaking and management systems.
- Synergies with the relevant topics in Horizon Europe Cluster 4 can be exploited e.g. HORIZON-CL4-2021-SPACE-02-52 (EGNSS applications for Safety and Crisis management), HORIZON-CL4-2022-SPACE-02-51(EGNSS applications for Smart mobility) as well as with other EU programmes such as Connecting Europe Facility (CEF), NextGenerationEU and Digital Europe.

HORIZON-CL5-2022-D6-01-08

- Safer navigation and tackling containership fires
- 3.5-6m(m total)
- IA
- TRL 7
- 70 pages

HORIZON-CL5-2022-D6-01-08 – outcome

- Navigational accidents including vessel collisions and groundings, damage to vessels and boats from debris (in particular lost containers), and harm to marine mammals are significantly reduced.
- There is systematic understanding of the causes of navigational accidents and high standards are established for their prevention.
- Automated systems reducing the human factor as a cause of navigational accidents are introduced on a relevant scale and deployed in particular on vessels operating in sensitive areas where navigational accidents and incidents would have a particular negative impact (coastal zones, marine protected areas).
- Digital solutions (“smart ships”) that help in the prevention of accidents are developed and integrated in the overall vessel architecture and in traffic control systems. A link to automated and autonomous shipping solutions under development is established.
- Containership fires can be systematically prevented, and when occurring they will be detected swiftly and tackled safely without recourse to external intervention.
- The serious risk to crews, coastal and port communities from the toxic combustion products of containership fires is mitigated.
- The frequency of containership fires is reduced in a statistically proven way.

HORIZON-CL5-2022-D6-01-08 – scope

- Navigational accidents
- Systematically assess the causes, consequences and probability of navigational accidents, including collisions involving vessels and offshore structures, groundings, container losses, as well as collisions with marine mammals and floating objects.
- Develop solutions and standards to address the most important causal factors, including the removal/reduction of human factors through smart sensors and automatic prevention and evasion measures.
- To reduce and potentially eliminate the human factor develop and test innovative solutions beyond the state of the art to locate and stay clear of objects in order to avoid navigational accidents including collisions with marine mammals, floating debris and small surface vessels, in particular recreational crafts and fishing boats. Based on open source principles and common data protocols (e.g. AIS) the developed systems should also support digital networking to alert other waterborne traffic in real time of the location of hazards as well as supporting a European navigational hazards data base. The exploitation of Galileo GNSS services and eventually other space based services is to be foreseen.
- Propose solutions to the tracking and recovery of lost containers in cases where those containers pose a risk to navigation and the marine environment.

HORIZON-CL5-2022-D5-06-08 – scope

- Containership fires
- Undertake a systematic analysis of containership fires' causal factors (including malicious and erroneous cargo declarations), the currently established responses based on on-board means, and the consequences, including the potential consequence of a fire in coastal regions with an onshore wind.
- Research should address the range of risks, ship and cargo system design issues, fire detection and firefighting methods, accident management methodologies, and pertinent regulatory issues in order to greatly reduce the risk of fires at sea.
- Special attention should be given to fires within cargo areas (in holds and on deck) for which relevant risk control options should be presented, analysed and the effects of their application validated though computer simulation and model tests, including those for specific firefighting equipment.
- In cooperation with relevant authorities (EMSA, European flag states, coast guards, rescue services) accident management strategies and plans to minimise the consequences from containership fires in European coastal and port areas should be developed. This should include an analysis of and proposition for stand-by equipment and assets.
- Outcomes and strategies should be widely communicated to facilitate best practice and develop specific training plans, including practical exercises on a realistic scale, for crews in cooperation with operators and seafarer organisations.

- Thank you

- Anastasios (Tasos) Karakostas
- akarakos@gmail.com