

Destination – 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.

The transport sector is responsible for 23% of CO₂ emissions and remains dependent on oil for 92% of its energy demand. While there has been significant technological progress over past decades, projected GHG emissions are not in line with the objectives of the Paris Agreement due to the expected increase in transport demand. 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.

The areas of rail and air traffic management will be addressed through dedicated Institutional European Partnerships and are therefore not included in this document.

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 autonomy²³⁵ 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 “*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 (more detailed information below).
- Accelerating the reduction of all **aviation** impacts and emissions (CO₂ and non-CO₂, including manufacturing and end-of-life, noise), developing aircraft technologies for

²³⁵ ‘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.

deep reduction of greenhouse gas emissions, and maintaining European aero-industry's global leadership position (more detailed information below).

- Accelerate the development and prepare the deployment of climate neutral and clean solutions in the inland and marine shipping sector, reduce its environmental impact (on biodiversity, noise, pollution and waste management), improve its system efficiency, leverage digital and EU satellite-navigation solutions and contribute to the competitiveness of the European **waterborne sector** (more detailed information below).
- Devising more effective ways for **reducing emissions and their impacts** through improved scientific knowledge (more detailed information below).

Several levels of interactions are foreseen with other European initiatives, in particular with the Industrial Battery Value Chain (BATT4EU) partnership, the Cooperative Connected and Automated Mobility (CCAM) partnership and the Mission on Climate Neutral and Smart Cities, in particular:

- Joint topic “2ZERO – BATT4EU” *D5-1-4 B - Innovative battery management systems for next generation vehicles (2ZERO & Batteries Partnership) (2023)*
- Joint topic “CCAM – 2ZERO – Mission on Climate Neutral and Smart Cities” *D5-1-5 Co-designed smart systems and services for user-centred shared zero-emission mobility of people and goods in urban areas (2ZERO, CCAM and Cities’ Mission) (2023)*

Zero-emission road transport

Main expected impacts:

- Affordable, user-friendly charging infrastructure concepts and technologies that are easy to deploy with a wide coverage of urban spaces and of the road network and include vehicle-grid-interactions, ready for mass electrification of passenger and freight road transport.
- Accelerated uptake of affordable, user-centric solutions for optimised energy efficiency and energy flexibility (vehicles and services).
- Effective design, assessment and deployment of innovative zero-emission solutions for the clean road transport challenge.
- Innovative demonstrations use cases for the integration of zero tailpipe emission vehicles, and infrastructure concepts for the road mobility of people and goods.
- Increased user acceptability of zero tailpipe emission vehicles, improved air quality, a more circular economy and reduction of environmental and health²³⁶ impacts.

²³⁶ These aspects are also dealt with in the specific “Impact of transport on environment and human health” section

- Support EU leadership in world transport markets at component, vehicle and transport system level, including related services.

Aviation

Main expected impacts:

- Disruptive low TRL technologies that have potential to lead to 30% reduction in fuel burn and CO₂, by 2035, between the existing aircraft in service and the next generation, compared to 12-15% in previous replacement cycles (when not explicitly defined, baselines refer to the best available aircraft of the same category with entry into service prior to year 2020).
- Disruptive low TRL technologies that have potential to enter into service between 2035 and 2050, based on new energy carriers, hybrid-electric architectures, next generation of ultra-high efficient engines and systems, advanced aerostructures that will enable new/optimised aircraft configurations and their cost-competitive industrialisation.
- New technologies for significantly lower local air-pollution and noise.
- Increased understanding and analysis of mitigation options of aviation's non-CO₂ climate impacts.
- Accelerated uptake of sustainable aviation fuels in aviation, including the coordination with EU Member States/Associated countries and private initiatives.
- Maintain global competitiveness and leadership of the European aeronautics ecosystem. Focus on selected breakthrough manufacturing and repair technologies that have high potential to lower the overall operating cost.
- Further develop the EU policy-driven planning and assessment framework/toolbox towards a coherent R&I prioritisation and timely development of technologies in all three pillars of Horizon Europe. Contribute to the mid-term Horizon Europe impact assessment of aviation research and innovation.

Waterborne transport

Main expected impacts:

- Increased and early deployment of climate neutral fuels, and significant electrification of shipping, in particular intra-European transport connections.
- Increased overall energy efficiency and use of renewable energies such as wind to drastically lower fuel consumption of vessels. This is increasingly important considering the likelihood of more expensive alternative fuels, where in some cases the waterborne sector will have to compete with other transport modes.

- Enable the innovative port infrastructure (bunkering of alternative fuels and provision of electrical power) needed to achieve zero-emission waterborne transport (inland and maritime).
- Enable clean, climate-neutral, and climate-resilient inland waterway vessels before 2030 helping a significant market take-up and a comprehensive green fleet renewal which will also help modal shift.
- Strong technological and operational momentum towards achieving climate neutrality and the elimination of all harmful pollution to air and water.
- Achieve the smart, efficient, secure and safe integration of maritime and inland shipping into logistic chains, facilitated by full digitisation, automation, resilient and efficient connectivity.
- Enable safe and efficient fully automated and connected shipping (maritime and inland).
- Competitive European waterborne industries, supporting employment and reinforcing the position of the European maritime technology sector within global markets. Providing the advanced green and digital technologies which will support European jobs and growth.

Impact of transport on environment and human health

Main expected impacts:

- The reduction of road vehicle polluting emissions (looking at both regulated, unregulated and emerging ones) from both existing and future automotive fleets in urban and peri-urban areas.
- The better monitoring of the environmental performance and enforcement of regulation (detection of defeat devices, tampered anti-pollution systems, etc.) of fleets of transport vehicles, be it on road, airports and ports.
- Substantially understand and provide solutions to reduce the overall environmental impact of transport (e.g.: as regards biodiversity, noise, pollution and waste) on human health and ecosystems.

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

Call	Budgets (EUR million)		Deadline(s)
	2023	2024	
HORIZON-CL5-2023-D5-01	217.00		20 Apr 2023
HORIZON-CL5-2024-D5-01		202.05	18 Apr 2024

*Horizon Europe - Work Programme 2023-2024
Climate, Energy and Mobility*

Overall indicative budget	217.00	202.05	
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Call - Clean and competitive solutions for all transport modes

HORIZON-CL5-2023-D5-01

Conditions for the Call

Indicative budget(s)²³⁷

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR million) ²³⁸	Indicative number of projects expected to be funded
		2023		
Opening: 13 Dec 2022 Deadline(s): 20 Apr 2023				
HORIZON-CL5-2023-D5-01-01	IA	15.00 ²³⁹	4.00 to 5.00	3
HORIZON-CL5-2023-D5-01-02	IA	10.00 ²⁴⁰	Around 5.00	2
HORIZON-CL5-2023-D5-01-03	IA	20.00 ²⁴¹	7.00 to 12.00	2
HORIZON-CL5-2023-D5-01-04	RIA	12.00 ²⁴²	Around 12.00	1
HORIZON-CL5-2023-D5-01-05	CSA	1.00 ²⁴³	Around 1.00	1
HORIZON-CL5-2023-D5-01-06	CSA	1.50 ²⁴⁴	Around 1.50	1
HORIZON-CL5-2023-D5-01-07	IA	20.00 ²⁴⁵	8.00 to 10.00	2
HORIZON-CL5-2023-D5-01-08	RIA	17.00 ²⁴⁶	3.00 to 4.00	4

²³⁷ 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.

²³⁸ Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.

²³⁹ Of which EUR 8.40 million from the 'NGEU' Fund Source.

²⁴⁰ Of which EUR 5.60 million from the 'NGEU' Fund Source.

²⁴¹ Of which EUR 11.20 million from the 'NGEU' Fund Source.

²⁴² Of which EUR 6.70 million from the 'NGEU' Fund Source.

²⁴³ Of which EUR 0.50 million from the 'NGEU' Fund Source.

²⁴⁴ Of which EUR 0.84 million from the 'NGEU' Fund Source.

²⁴⁵ Of which EUR 11.20 million from the 'NGEU' Fund Source.

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HORIZON-CL5-2023-D5-01-09	RIA	15.00 ²⁴⁷	3.00 to 5.00	4
HORIZON-CL5-2023-D5-01-10	CSA	2.00 ²⁴⁸	Around 2.00	1
HORIZON-CL5-2023-D5-01-11	RIA	16.00 ²⁴⁹	Around 8.00	2
HORIZON-CL5-2023-D5-01-12	IA	34.00 ²⁵⁰	8.00 to 13.00	3
HORIZON-CL5-2023-D5-01-13	IA	15.00 ²⁵¹	Around 7.50	2
HORIZON-CL5-2023-D5-01-14	IA	8.50 ²⁵²	Around 8.50	1
HORIZON-CL5-2023-D5-01-15	IA	9.00 ²⁵³	Around 4.50	2
HORIZON-CL5-2023-D5-01-16	RIA	9.00 ²⁵⁴	Around 4.50	2
HORIZON-CL5-2023-D5-01-17	CSA	1.50 ²⁵⁵	Around 1.50	1
HORIZON-CL5-2023-D5-01-18	IA	10.00 ²⁵⁶	Around 5.00	2
HORIZON-CL5-2023-D5-01-19	CSA	0.50	Around 0.50	1
Overall indicative budget		217.00		

General conditions relating to this call	
<i>Admissibility conditions</i>	The conditions are described in General Annex A.
<i>Eligibility conditions</i>	The conditions are described in General Annex B.
<i>Financial and operational capacity and exclusion</i>	The criteria are described in General Annex C.
<i>Award criteria</i>	The criteria are described in General Annex D.
<i>Documents</i>	The documents are described in General Annex E.

²⁴⁶ Of which EUR 9.50 million from the 'NGEU' Fund Source.
²⁴⁷ Of which EUR 8.40 million from the 'NGEU' Fund Source.
²⁴⁸ Of which EUR 1.12 million from the 'NGEU' Fund Source.
²⁴⁹ Of which EUR 9.50 million from the 'NGEU' Fund Source.
²⁵⁰ Of which EUR 19.00 million from the 'NGEU' Fund Source.
²⁵¹ Of which EUR 8.40 million from the 'NGEU' Fund Source.
²⁵² Of which EUR 4.80 million from the 'NGEU' Fund Source.
²⁵³ Of which EUR 5.00 million from the 'NGEU' Fund Source.
²⁵⁴ Of which EUR 5.00 million from the 'NGEU' Fund Source.
²⁵⁵ Of which EUR 0.75 million from the 'NGEU' Fund Source.
²⁵⁶ Of which EUR 5.60 million from the 'NGEU' Fund Source.

<i>Procedure</i>	The procedure is described in General Annex F.
<i>Legal and financial set-up of the Grant Agreements</i>	The rules are described in General Annex G.

Zero-emission road transport

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D5-01-01: User-centric design and operation of EV for optimized energy efficiency (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve at least TRL 6 by the end of the project – see General Annex B.
<i>Legal and financial set-up of the Grant Agreements</i>	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: In the coming years, user-centric design, predictive control and artificial intelligence will offer significant opportunities to improve both the design and the operation of electric vehicles (EV) to make them more affordable, efficient and offer an even more attractive driving experience. This includes particularly the potential for improved thermal energy management, ranging from the HVAC system and components to powertrain and

vehicle interior thermal design. Project results are expected to contribute to all the following outcomes:

- Accelerated uptake of affordable and more energy efficient electric vehicles (EVs) through the development of innovative and holistic user-centric solutions, optimized system concepts and components sizing.
- Increase comfort and safety (e.g. de-misting) functions' effectiveness and leading to a real world range increase of 20% (compared to the chosen State of the Art donor vehicle or demonstrator) at external temperature of 0 degrees Celsius
- Component sizing and performance matched to vehicle reliability and performance requirements to reduce costs by at least 5% at vehicle level.
- Reduced development time at vehicle systems and components by 30% through the use of Artificial Intelligence (AI) for advanced design support and control algorithms in EV holistic thermal management and powertrain systems.

Scope: This topic's scope relates to both the operational perspective (especially intended vehicle usage, as well as user behaviour, preferences, route planning, infrastructure, weather conditions, etc.) and the technological perspective, addressing new concepts and components, their efficiency, as well as new approaches based on artificial intelligence (AI) employed in design, development and controls, and the potential of cloud-based solutions.

Proposals should involve all relevant stakeholders and are expected to address all of the following aspects:

- Development of optimised heating/cooling and demisting concepts and components capable of greatly reducing energy consumption to perform these functions, particularly when coupled with smart controls.
- Development of methods to automatically pre-condition vehicles prior to trips and enabling self-adjusting control strategies during operation. This includes vehicle systems, powertrain electric and thermal management based on AI supported learning/analysis of EV user driving patterns, travel route conditions and weather conditions to maximise the range benefit.
- Data driven decision making enabling optimal interior design fulfilling perceived driver needs, as well as, e.g., AI supported adjustment of operation and controls of the system including of powertrain and auxiliary, components and their thermal state as well as cabin comfort to avoid peak loads and ensure minimum energy consumption.
- Identify the optimal system layout and possible interactions through multiple scalable digital twins (thermal modelling of vehicle, powertrain, components and the driver).
- New modular interoperable systems to enable the use of real-life data from vehicle fleet operation to automatically (pre-)adjust control parameters and minimize engineering

effort in calibration stage as well as to maintain optimal performance over vehicle life-time, e.g., to enable continuous learning of the applied AI and adaptability to work on-board in “real-time” control systems, while considering the access needs of third parties for services such as repair and maintenance. Protection of users’ data must be guaranteed.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-02: Innovative battery management systems for next generation vehicles (2ZERO & Batt4EU Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 10.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 6 by the end of the project – see General Annex B.
<i>Legal and financial set-up of the Grant Agreements</i>	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:

- A simplified, efficient and connected battery management system (BMS) including a reduction of parts and cost (optionally by using cloud-based battery status calculation with adequate consideration of security aspects provided a low overall climate impact), including data necessary for second life and Vehicle-to-everything (V2X) applications.

- Improved and optimized monitoring and predictive diagnostics for a more accurate reliable and efficient battery management maintenance (data-driven diagnostics, over-the-cloud software updates and firmware replacements, self-testing and on-board diagnostics) that are accessible to other third parties in non-discriminatory terms, for instance for maintenance or reuse.
- Development of relevant interfaces to allow access to the BMS and its database by vehicle charging infrastructure and related mobility services providers with the consent and input of EV driver preferences through an appropriate user interface, for instance for battery and cabin pre-conditioning, minimum final state of charge selection etc.
- Generally improved exploitation of battery performance (such as faster charging and enhanced regenerative braking control for higher energy recovery), and increased battery pack volumetric density (by 10% or more due only to BMS contribution compared to 2022 State of the Art), safety and prolongation of battery life-time (by at least 30%) by considering algorithms for cell level state of health, cell aging prediction and battery state estimation, including also the integration of smart sensor systems – with validation under real driving conditions (demonstrating up to 15 years lifetime in the future).
- Improved control of battery operating conditions and determination of key state estimators (SoX = e.g. State of Health, State of Power, State of Safety, State of Charge) to increase accuracy and to improve the early warning capability for performance, reliability, safety, and lifetime issues on all battery system levels.
- New simulation tools and test methods for faster development, validation and integration of the battery pack, considering assembly design (reducing cabling for the external voltage detection communication function) and realizing a reduction of testing time by 30% (collection of battery characteristics for SoX algorithm optimisation using less calibration).
- Enhanced communication between battery and vehicle control unit for a more efficient battery operation by synchronizing the electronic control units (ECUs) of the BMS and the EV.

Scope: Advances in the design, functioning and data accessibility of an efficient battery management system (BMS) are of high significance when it comes to the integration of batteries in electric vehicles (passenger cars and commercial vehicles) and the general improvement of battery performance.

Proposals are expected to address all the following aspects:

- Predictive SoX diagnostics (based on sensing at cell level) to accurately predict the end-of-life, as well as high connectivity and data storage to optimize the life and general use of the EV.

- Advanced use of physics-based, data-driven or hybrid models in general, considering for example Artificial Intelligence (AI) with machine learning algorithms, model training and self-adaptive functions.
- Secure, real-time and databased battery management to reduce margins in a controlled manner and to ensure optimized, safe utilisation during all modes of operation and accurate classification for a second life.
- A link between the BMS and the ECU of the vehicle to exchange data about weather, temperature, speed, topographies, etc. and detailed information on battery operation, thereby achieving the best possible battery monitoring, diagnostics and lifetime, while optimizing driving range.

Proposal should leverage and not duplicate activities underway under Important Project of Common European Interest (IPCEI) and Batteries partnership ²⁵⁷, and link with projects funded under topics:

- HORIZON-CL5-2022-D2-01-05: Next generation technologies for High-performance and safe-by-design battery systems for transport and mobile applications (Batteries Partnership);
- HORIZON-CL5-2022-D2-01-09: Physics and data-based battery management for optimised battery utilisation (Batteries Partnership).

Where appropriate, links will need to be ensured with projects funded under topic HORIZON-CL5-2024-D5-01-03: Advanced battery system integration for next generation vehicles.

Projects should take into account the access to battery information as defined in the proposal for the Renewable Energy Directive COM(2021)557 of 14 July 2021.

This topic implements the co-programmed European Partnerships on ‘Towards zero emission road transport’ (2ZERO) and Batteries (Batt4EU). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) and Batteries (Batt4EU) in support of the monitoring of their KPIs.

HORIZON-CL5-2023-D5-01-03: Frugal zero-emission vehicles concepts for the urban passenger challenge (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 7.00 and 12.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.

²⁵⁷ <https://bepassociation.eu/synergies-and-collaborations/ipceis/>; <https://bepassociation.eu/>

<i>Indicative budget</i>	The total indicative budget for the topic is EUR 20.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 7-8 by the end of the project – see General Annex B.

Expected Outcome: Projects are expected to deliver solutions tailorable for specific usage models and particular market factors in order to contribute to all of the following outcomes:

- Accelerated global uptake of affordable, user and mission centric solutions tailorable for specific usage models e.g. occasionally transporting additional passengers (and particular market factors both in advanced and emerging markets).
- Effective design, assessment, and deployment of innovative low-cost but upgradable Electric Vehicles solutions (powered two-wheelers, light cars or minibuses) for the clean urban transport challenge.
- Higher sustainability and minimized cost by leveraging economies of scale but still offering flexible variations through modularity.
- Ensured ease of use in targeted urban and sub-urban areas that accounts for traffic and parking conditions as well as for battery charging/swapping points availability.
- Lower energy consumption by means of vehicle tailored to the urban environment conditions and constraints (e.g. lighter mass, suitable range and dynamic performances, higher utilisation of local resources, including reuse of components and systems, and eco-sustainable materials²⁵⁸).

Scope: Urban spaces will be changing in the future. There will be a massive shift from the parking-lot culture in the city to recovery of living spaces as well as increasing intelligence in the urban spaces. Both will have a strong impact on individual means of mobility. New vehicle concepts that harmonize with these new developments, but also achieve widespread user-acceptability, will be needed. Platform concepts with sufficient variability will be able to meet the needs of both advanced and emerging countries.

²⁵⁸ The future Commission initiative for 'Safe and Sustainable by Design' will set a framework for assessing safety and sustainability of chemicals and materials and should be considered as a baseline for proposals.

New designs, shapes, architectures, and functionalities capable of delivering mass-market capable frugal versions for emerging markets and versions in the EU, associated countries and advanced markets with a single, generic platform, including swappable and interoperable battery systems (for L-category) should be covered. Proposals should address battery electric vehicles that are specifically better suited for operation (in appropriate versions) in future urban spaces both in emerging as well as established markets.

Proposals are expected to address all the following aspects:

- Systematic and thorough analysis of user centric needs, due to future evolution of urban areas representative for both emerging and established market use cases and of the required infrastructure development (e.g. charging infrastructure and related information and communication technologies).
- Development and demonstration of at least two variations of the modular and scalable vehicle (i.e. basic low-cost version and higher value version based on the same adaptable platform with high-production volume potential; optionally and additionally, proposals can foresee an extension to goods transport). For L-category vehicles this should include the option of swappable and interoperable standard battery systems (across world regions, for larger economies of scale) which can optionally be used for light vehicles or minibuses, for instance for range extension or emergency use.
- Validation with real electric vehicle(s) and related battery solutions testing, demonstrating the developed functions, in particular the capabilities of the proposed architecture in terms of payload, charging requirements, vehicle efficiency to optimise range and battery sizing, also to match local needs.
- Confirmation of user acceptability by showcasing the solutions in both emerging markets and established markets according to the purpose of the particular version.
- Assess the potential impact in terms of emissions reduction considering the potential scale-up opportunities of the addressed use cases, prioritizing higher impact use cases.
- Taking into consideration future development pathways for urban public, semi-public, private charging infrastructure adapted for such future urban vehicle concepts, in particular in the developing countries where such infrastructure is currently non-existent.
- Projects should deliver digital twin models of the demonstrator vehicles, so that the impact of the innovations towards the overall objectives of the 2ZERO partnership might be determined. Data that are produced as output from a ‘digital twin’ will be enacted in line with FAIR principles for data²⁵⁹, and deposition in relevant repositories should be encouraged.

International cooperation with emerging economies e.g. from Asia and Africa is encouraged.

²⁵⁹ Final Report and Action Plan from the European Commission Expert Group on FAIR Data, “TURNING FAIR INTO REALITY” - https://ec.europa.eu/info/sites/info/files/turning_fair_into_reality_0.pdf

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-04: Circular economy approaches for zero emission vehicles (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 12.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 12.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve at least TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Implementing a consistent circularity along the electric vehicle (EV) value chain and life cycle (in particular for mass produced Light Duty vehicles but with potential learning for other types of applications) will be a significant factor to reach the goals defined in the European Green Deal.

Project results are expected to contribute to all the following outcomes:

- Increasing the degree of circularity of EVs, thus reducing their environmental footprint over the full life cycle. Specific circular design approaches are needed in particular for some light-weighting materials (recycling of fibre reinforced materials and advanced steel, aluminium and magnesium alloys), reuse and recycling technologies for new types of components (traction motors, electronic components, wire bundles, etc.) and improved post shredder technologies supporting higher recovery of critical raw materials.
- Increasing the awareness and acceptability of circular economy and Life Cycle Assessment (LCA) based design of innovative zero-emission solutions for the clean road transport challenge.

- Contributing to a harmonised way of measuring the circularity of the economy in the automotive industry.
- Demonstrating the potential of these actions by delivering a circular car prototype (test bench ready) aiming at 0% virgin material use by mass for all vehicle components except cells, e-machines and electronics.
- Accelerating the transformation of Europe towards being the first digitally enabled, circular, climate-neutral and sustainable economy.
- Improving markets for secondary raw materials and facilitate higher uses of recycled content of plastics, glass and possibly REEs in the automotive supply chain.
- Contributing to Europe's world leadership in automotive innovation, production and services through increasing skills with circular economy techniques and accelerating the uptake of innovative circular economy-based solutions for EV, reducing the dependency on critical raw materials via the consistent recovery and use of secondary materials.

Scope: The objective will be to demonstrate the feasibility of circular economy (CE) and net-zero approaches for the EV value chain over its full lifetime (cradle to cradle). The proposed activities should focus on vehicle production (design, manufacturing and assembly), maintenance, repair and End-of-Life (EoL). Additionally, LCA-based vehicle concepts, their related resource and energy efficient manufacturing and CE consistent EoL strategies should be shown.

Proposals are expected to address all the following EV-related research activities:

- Developing an appropriate set of technologies, from production (design, manufacturing and assembly) until End-of-Life and demonstrating their feasibility on vehicle level over the full life cycle by means of prototypical manufactured components ready for test benches verifications. This includes a re-design of components for circularity.
- Assessing the potential for high value and/or energy or rare material content components to be refurbished and reused in new vehicles or as spares.
- Enhancing digital tools enabling a higher degree of circularity along the automotive value chain, e. g. supporting circular design and development, manufacturing or to track materials, their use and the EoL.
- The impact of maintenance and repair technologies and operational strategies will be developed or adapted to ensure a higher degree of circularity compared to existing practices in the passenger car industry.

- Deriving a concept for measuring and assessing the circularity of EV solutions as well as for ensuring a sufficient exchange of information along the automotive supply chain applying FAIR principles²⁶⁰.
- Concepts for training and increasing the required skills in the automotive industry regarding CE.
- A digital twin of the demonstrator should be used to assess various scenarios, including the exclusive use of recycled or bio-based materials and for the assessment of KPIs.

The research activities are expected to apply the findings of vehicle level LCA methodology developed by the CSA funded under HORIZON-CL5-2021-D5-01-04 as far as they are available. International cooperation addressing requirements of and the impact on global supply chains is encouraged.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-05: Measuring road transport results towards 2ZERO KPIs (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 1.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 1.00 million.
<i>Type of Action</i>	Coordination and Support Actions
<i>Eligibility conditions</i>	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).
<i>Legal and financial set-up of the Grant</i>	The rules are described in General Annex G. The following exceptions apply:

²⁶⁰ Final Report and Action Plan from the European Commission Expert Group on FAIR Data, “TURNING FAIR INTO REALITY” - https://ec.europa.eu/info/sites/info/files/turning_fair_into_reality_0.pdf

<i>Agreements</i>	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). ²⁶¹ .
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Expected Outcome: In its Strategic Research and Innovation Agenda (SRIA²⁶²), the 2ZERO partnership identified a large number of Key Performance Indicators (KPIs) related to its general, specific and operational objectives – that are not directly under the control of the 2ZERO partnership. In order to analyse the effectiveness and impact of the research and innovation actions in this relevant area, project results are expected to contribute to all the following outcomes:

- Account for the contribution of the 2ZERO partnership and the results of its projects, towards its main goals (as measured against the whole set of the identified KPIs).
- Support the identification and quantification of all interactions, impacts and effectiveness of the partnership within the road transport challenge, mainly as a result of the information gleaned from the 2ZERO partnership project results.
- Provide additional recommendations for further development and analysis of means of measurement and evaluation of the partnership within the road transport challenge.

Scope: In order to properly monitor the contribution of the different funded projects to the achievements of the 2ZERO partnership objectives, a common framework for monitoring and assessment of the results needs to be agreed, ultimately allowing their comparison and a proper evaluation of their cumulative benefits at an EU level. Moreover, general objectives, such as a carbon-neutral road transport system by 2050, air quality, technology leadership, economic growth, European competitiveness, and circular economy aspects should be also addressed. In order to do so, proposals are expected to address all of the following aspects:

- Assess and measure results related to the specific partnership KPIs, how they are predicted to vary (as a consequence of the project outcomes) in the 2025 to 2035 period.
- Exploit the capabilities and techniques generated through the development and delivery of digital twin representations and of the results of the 2ZERO funded projects.
- Address at least the means of measuring all relevant parameters related to the 2ZERO KPIs: more generically, climate, air quality and circular economy aspects could also be quantitatively projected.

²⁶¹ This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

²⁶² <https://www.2ZEROemission.eu/wp-content/uploads/2021/12/2021-2ZERO-SRIA-FINAL-1.pdf>

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 selected project will cooperate with the 2ZERO partnership that shall on its side provide access to all needed data and element in order to perform the foreseen activities.

The project should take account Open Science, its practices and learning, and the project’s results will be enacted in line with FAIR principles for data²⁶³.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-06: EU Member States/Associated countries research policy cooperation network to accelerate zero-emission road mobility (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 1.50 million.
<i>Type of Action</i>	Coordination and Support Actions
<i>Eligibility conditions</i>	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).
<i>Legal and financial set-up of the Grant Agreements</i>	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

²⁶³ Final Report and Action Plan from the European Commission Expert Group on FAIR Data, “TURNING FAIR INTO REALITY” - https://ec.europa.eu/info/sites/info/files/turning_fair_into_reality_0.pdf

	Research and Training Programme of the European Atomic Energy Community (2021-2025). ²⁶⁴ .
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Expected Outcome: European Commission and EU Member States/Associated countries are reinforcing and developing their research & innovation policy to accelerate zero-emission road mobility development. A framework for cooperation will enhance the efforts to achieve this pan-European challenge by joining forces, sharing knowledge, bundling financial resources and coordinating activities, creating complementarities, coherence and building synergies across the EU (e.g. 2ZERO partnership) and EU Member States/Associated countries' R&I funding programmes, national plans, efforts, approaches and in collaboration with the Associated Countries.

Project results are expected to contribute to all the following outcomes:

- Stronger harmonised national policy plans, efforts, approaches with a focus on R&I funding programmes of the different EU Member States/Associated countries, accelerating zero-emission road mobility.
- Maximally deployed and effectively utilised synergy effects, pooled resources and aligned R&I funding programmes to support the EU 2030 and 2050 CO₂ emission goals for the road mobility sector in an affordable and effective way.
- Exchange of knowledge and experiences and mutual coordination at multiple levels (EU/ national / regional / cities and stakeholders, funding organisations, OEMs, fleets, users, etc.), implementation activities, regulations, incentives and demonstrations and the sharing of data, information and best practices.
- Provide companies, regions, cities and the research community with a holistic overview of policy plans and R&I funding programmes across EU (and Associated Countries) to maximise synergy effects and the efficient utilisation of resources, such as from recovery packages and cohesion funds.
- Allow a clear overview of the national projects and better take into account their results in the development of their research and deployment actions.
- In order to facilitate the above-mentioned coordination of efforts at national and EU level and the sharing of best practices and results, data on national projects (to a level at least equivalent to those present in the CORDIS database) should be made available by MS and AC. The consortium will endeavour to promote and harmonise the registration of data on national projects of participating countries, to make data more accessible internationally and to facilitate their exchange and comparison. This will be supporting

²⁶⁴ This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

the integration of data on national projects into existing databases, such as TRIMIS and CORDIS.

- Long lasting, strong coordination and cooperation between the European Commission, MS and AC and the Stakeholders involved in the 2ZERO Partnership, facilitated by the States Representatives Group (SRG).

Scope: Although there is a relatively large degree of similarity in the targets and approaches of the EU Member States and Associate Countries to address the climate change targets, still considerable differences in the paths can be observed: more coordination and collaboration is urgently needed to promote zero emission road mobility, building on the policy cooperation network of the EU Member States/Associated countries built-up in ERA-NET Transport, Electromobility+ and ERA-NET Co-fund Electric Mobility Europe (EMEurope) with over two decades of experience.

Proposals are expected to address all of the following aspects

- Address zero-emission road mobility for people and goods programmes supporting all phases of the innovation: technology development, demonstration, deployment and implementation will be considered.
- Develop a long-lasting network (beyond the project duration) of public and private stakeholders connecting EU Member States/Associated countries and European initiatives, under the umbrella of the 2ZERO partnership States Representative Group (also building on existing links with the supporting European technology platforms ALICE, ETIP-SNET, EPoSS, ERTRAC and Batteries Europe) to share knowledge, coordinate activities and bundling financial resources to achieve synchronicity, synergies and complementarity in the R&I-related plans, efforts, approaches, incentives and funding programmes to effectively support the EU and national objectives for 2030 and 2050.
- More concretely contribute to:
 - Support EU Member States/Associated countries in implementing and accelerating priority actions identified in the 2ZERO Strategic Research and Innovation Agenda (SRIA) in coordination with the 2ZERO States Representatives Group.
 - Collect and share, up-to-date and targeted information on European and national R&I funding programmes, demonstration projects and testing activities, test sites, living labs with their features and capabilities, standards, testing and assessment methodologies as well as programmes in the field of zero emission mobility in Europe and beyond.
- Exchange knowledge and experiences on zero emission road transport programmes in Europe, building on and connecting existing database platforms, such as TRIMIS, 2ZERO events and conferences, including the H2020RTR series, Member State's and stakeholder's information sharing portals.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

Aviation

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D5-01-07: Hydrogen-powered aviation

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 8.00 and 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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 20.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve at least TRL 6 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:

- Innovative ground-based refuelling and supply systems for liquid hydrogen at air transport ground infrastructures, with the potential to be up-scaled at system level by 2027.
- Transformative aircraft-based hydrogen refuelling technologies, with emphasis on safety, standardisation and scalability to various types of aircraft concepts (including Vertical Take Off and Landing aircraft (VTOL) and Unmanned Air Vehicles (UAV)).
- Hydrogen-powered aircraft ground movements, demonstrated and scalable across airports of different sizes, locations and capacities in Europe.

- Comprehensive and validated liquid hydrogen demand and supply-matching models at air transport ground infrastructures in Europe and globally, towards a potential entry into service of hydrogen aircraft by 2035.
- New standards and certification procedures for the roll-out of the new technologies and solutions at large scale, in EU Member States/Associated countries and on the TEN-T network.

Scope: Hydrogen-powered commercial aviation is today on a promising path towards climate neutrality by 2050, with European industry setting 2035 as an expected date of entry into service of the first hydrogen-powered commercial aircraft. While the Horizon Europe Clean Hydrogen partnership focuses on the production side (e.g. developing new fuel cells and hydrogen storage technologies), the Clean Aviation partnership addresses the integration and demonstration of disruptive technologies, including ones on hydrogen-powered aviation and subsequent aircraft architectures. However, there is currently a clear research and innovation gap for the phase in-between. Most notably, this gap relates to the demonstration of hydrogen refuelling and supply from air transport ground infrastructures to the aircraft, with follow-on demonstrations of ground-based aircraft movements (e.g. taxiing). In particular, hydrogen refuelling entails significant operational issues, safety risks and other barriers (e.g. scalability) at both air transport ground infrastructure and aircraft levels. This has the potential to create a bottleneck for Europe to proceed on the path to climate neutrality, lower emissions and reducing Europe's dependency on oil and fossil fuels, which are clear objectives of the Versailles Declaration²⁶⁵ and REPowerEU²⁶⁶. At the same time, demonstration pilots of hydrogen-powered aircraft ground movements need to start urgently, in order to be able to achieve full operations of hydrogen-powered airplanes in the EU by 2035.

In this context, building on good practices, studies and research projects (e.g. Horizon 2020 green airport projects, Horizon 2020 ENABLE-H2), as well as other policy initiatives (e.g. Fit for 55 and ReFuelEU Aviation), actions should address all of the following aspects:

- Assessing and validating potential liquid hydrogen demand models at air transport ground infrastructures in Europe and globally, considering also multimodality issues at airports arising from the use of hydrogen in road and rail transport. The techno-economic assessment should also consider the energy supply side and be aligned with the targets, investments and regulatory aspects addressed by REPowerEU, ReFuelEU Aviation, the Alternative Fuels Infrastructure Regulation and the Trans-European Networks for Transport and Energy (TEN-T and TEN-E).
- Testing and demonstrating innovative and safe ground-based refuelling, storage and supply systems for liquid hydrogen at air transport ground infrastructures, going beyond the state-of-the-art and in view of future standardisation, with focus on airports and vertiports serving national, intra-European and/or regional routes. Consideration should

²⁶⁵ <https://www.consilium.europa.eu/en/press/press-releases/2022/03/11/the-versailles-declaration-10-11-03-2022/>

²⁶⁶ https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511

also be made to the hydrogen production (including on-site), supply, materials performance, storage and refuelling systems, with the concurrent use other liquid fuels (e.g. kerosene and sustainable aviation fuels) and electricity at air transport ground infrastructures, in order to enable zero-emission airport operations along the entire value chain, from multimodal road/rail connections, to ground handling and aircraft ground movements.

- Developing and demonstrating new aircraft-based hydrogen refuelling technologies, with emphasis on operational feasibility, safety, interoperability, standardisation, scalability and cost optimisation, to showcase a clear technical and business case. The technologies should be compatible with various propulsion technologies and aircraft concepts (e.g. different types of commercial aircraft and architectures, including VTOL and UAV, as also addressed in the Horizon Europe Clean Aviation partnership).
- Performing small-scale demonstration pilots of zero-emission hydrogen-powered aircraft ground movements, in one or two airports (e.g. taxi-in / taxi-out), in view of deploying the new technologies and solutions to various aircraft types and airports across Europe.
- Initiating and developing new standards and certification procedures, for the new technologies and systems to be scalable and serve different types of aircraft and air transport ground infrastructures of various sizes, locations and capacities for both passenger and freight transport.

The EU's Hydrogen Strategy prioritises renewable hydrogen (low-carbon hydrogen being considered a transitional technology) and should be taken into account to develop the proposals, considering, inter alia, how the hydrogen will be produced and supplied.

The topic aims to exploit synergies with the Horizon Europe Clean Aviation and Clean Hydrogen partnerships, for the roll-out of transformative aircraft liquid hydrogen propulsion technologies, with an eye towards future large-scale demonstrations and real-life airborne plane trials during the later phase of the Clean Aviation partnership. The retained proposals, should, during the implementation phase, regularly exchange information with the Technical Committee and the Governing Board of the Clean Aviation and Clean Hydrogen partnerships respectively (in-line with articles 65 and 80 of the COM(2021) 87).

For standardisation activities and in view of future certification of airports and vertiports and aircraft, including VTOL and UAV, the participation of EASA is deemed necessary to address airport and aircraft certification issues. The involvement of airports, vertiports and aircraft manufacturers in the project activities is required. Since regional and short haul aviation is likely the first segment to start the transition to hydrogen-based fuel technology, the involvement of regional and insular airports in the project will be an asset.

In line with the Union's strategy for international cooperation in research and innovation, the participation of airports and regulatory bodies outside of the European Union is encouraged.

Projects should collaborate with the Clean Hydrogen Joint Undertaking on aspects that require integration of hydrogen and are expected to contribute and participate to the activities of the TRUST database and the hydrogen observatory.

HORIZON-CL5-2023-D5-01-08: Accelerating climate-neutral hydrogen-powered/electrified aviation

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 17.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 2-3 by the end of the project – see General Annex B.

Expected Outcome: Project results should focus on transformative technologies that address existing technology gaps for an aircraft hydrogen and electrified powertrain of a megawatt class. Project results are expected to contribute to one of the following expected outcomes:

- Deliver transformative aircraft energy storage, conversion and distribution technologies for hydrogen and electrified propulsion that exceed the state-of-the-art.
- Deliver novel heat dissipation, thermal management and recuperation technologies for megawatt class, that exceed the state-of-the-art.
- Deliver advanced simulation tools, validation methodologies and control approaches for an aircraft hydrogen and electrified powertrain of megawatt class.

Scope: The proposal is expected to develop further transformative technologies, at low TRL, that have potential to be reviewed and considered for further development and demonstration beyond 2027, towards contributing to aviation climate neutrality by 2050. Electrified aircraft propulsion is the use of electric motors to drive a subset or all of its propulsors. Hydrogen and electrified aircraft propulsion explicitly expands the scope to include hydrogen combustion propulsion.

Hydrogen as energy carrier and batteries as energy storage have the potential to eliminate aviation CO₂ emissions as well as reduce non-CO₂ ones. Key enabling technologies for aircraft thermal and power management have been identified as showstoppers for their integration.

The topic is open also to fundamental hydrogen research - relevant to aviation – which can be combined to any of the three expected outcomes, such as:

- better understanding of advanced materials’ compatibility and capability in aircraft hydrogen and electrified powertrain applications including effect of water vapour from hydrogen burning;
- computational materials science and innovative characterisation techniques across different length scales.

Beyond the development of transformative systems, the topic may consider the development of innovative control approaches as well as simulation tools and validation methodologies for hydrogen and electrified powertrain of a megawatt class. The development of dedicated test benches (at a TRL range within the scope of this call) should exploit synergies with the CA (cf. note).

The topic aims to exploit synergies with the Clean Aviation partnership, towards developing transformative aircraft hydrogen and electrified powertrain technologies, with an eye towards their review, selection and further development during the second phase of CA. The retained proposals, should, during the implementation phase, regularly exchange information with the Technical Committee and the Governing Board of the Clean Aviation and Clean Hydrogen partnerships respectively (in-line with articles 65 and 80 of the COM(2021) 87).

The topic is not open to hydrogen and electrified architectures, their integration and new aircraft configurations, as those are dealt exclusively in the Clean Aviation partnership (except aircraft types/missions not covered by the CA partnership). Activities should exploit synergies with the Clean Aviation (CA) partnership, with an eye towards their review, selection and further development during the second phase of CA.

To topic addresses primarily to RTOs/Academia/SMEs with guidance and support from aircraft high-tier suppliers and integrators.

Projects should collaborate with the Clean Hydrogen Joint Undertaking on aspects that require integration of hydrogen and are expected to contribute and participate to the activities of the TRUST database and the hydrogen observatory.

HORIZON-CL5-2023-D5-01-09: Competitiveness and digital transformation in aviation – advancing further capabilities, digital approach to design

Specific conditions	
<i>Expected EU</i>	The Commission estimates that an EU contribution of between EUR 3.00

<i>contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 2-4 by the end of the project – see General Annex B.

Expected Outcome: Project results should focus on innovative hybrid numerical/experimental procedures, tools and methodologies that will advance further the industrial aircraft design capabilities. Project results are expected to contribute to at least one of the following expected outcomes:

- Multi-disciplinary and multi-fidelity design and optimisation integrated tools for industrial environment.
- New advancements in aerodynamics and aeroacoustics (with emphasis on interference), including data-driven (Artificial Intelligence – Machine Learning, Hybrid modelling) high-performance computing and advanced validation-verification procedures.
- Advance further design for manufacturing optimisations, including additive manufacturing, circularity and sustainability aspects.
- Methodologies for simulation, testing and further certification of urban air-mobility safety critical applications, considering for example, virtual or extended reality technologies.

Scope: The proposal is expected to develop further advanced computational/experimental procedures/methodologies and industrial aircraft design capabilities that have potential to contribute to the digital transformation of the European aircraft supply chain.

Aircraft development requires testing for airframe, dynamic systems, materials performance, new manufacturing techniques, propulsion, cabin and system and their sub-components in order to ensure their performance but also the highest level of safety. As a result, the proposal is also expected to develop methodologies and approaches dedicated to the use of combined experimental testing with numerical simulation in order to enhance the testing results and their integration - and therefore accelerate the development cycle.

Regarding the expected outcome on urban air-mobility safety critical and hazardous missions, the scope is expanded to mission specific testing of the whole aerial vehicle after system integration.

The proposal should seek to exploit synergies with Clean Aviation (and big demonstrations in the second phase of the partnership) such as ground vibration testing, flutter mitigation, design of Ultra performant aircraft, advanced dynamic systems, hydrogen systems testing, thermal management, flight testing and long-term hydrogen exposed materials behaviour testing. The retained proposals, should, during the implementation phase, regularly exchange information with the Technical Committee of the Clean Aviation partnership (in-line with article 65 of the COM(2021) 87).

All developed hybrid numerical/experimental procedures and methodologies should be benchmarked (e.g. drag prediction, solver convergence, grid optimisation) for challenging industrial cases. Proposals that include virtual certification are encouraged to invite the participation of EASA.

To topic addresses primarily to RTOs/Academia/SMEs with guidance and support from aircraft high-tier suppliers and integrators.

HORIZON-CL5-2023-D5-01-10: Aviation research synergies between Horizon Europe, AZEA and National programs

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 2.00 million.
<i>Type of Action</i>	Coordination and Support Actions
<i>Eligibility conditions</i>	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).
<i>Legal and financial set-up of the Grant Agreements</i>	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). ²⁶⁷ .
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Expected Outcome: Project results are expected to contribute to the following expected outcomes:

- Coordinate and support synergies between European, National and Regional R&I aviation programmes.
- Contribute to the preparation of the European Aerodays 2024-2025.
- Support the Alliance on Zero Emission Aviation (AZEА).

Scope: The overall scope of this coordination and support action is to provide support and advice to the European Commission on anticipated and small ad-hoc actions within 2023-2025 period.

The action should contribute to the coordination and support of synergies between European, National and Regional R&I aviation programmes, including joint calls or other co-funding mechanisms aligning EU, National and Regional activities in specific fields. The action is also expected to assist the European Research Area (ERA) in accelerating the update and sharing of aviation technology infrastructures. Close collaboration with ACARE is expected.

The action should contribute to the organisation and preparation of the European Aerodays 2024-2025 as well as other ad-hoc communication activities.

Finally, the action should contribute to the communication of the impact of EU aviation research and relevant policies (Fit for 55, Industrial Strategy, Alliances, Space Policy) and provide support the Alliance on Zero Emission Aviation (AZEА) work with ad-hoc mapping and analysis, including identification of potential technology gaps and lack of related R&I and standardisation efforts.

Waterborne transport

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D5-01-11: Developing the next generation of power conversion technologies for sustainable alternative carbon neutral fuels in waterborne applications (ZEWT Partnership)

Specific conditions

²⁶⁷ This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 8.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 16.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

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

- Establish the basis for the on-board deployment of power conversion technologies for sustainable alternative climate neutral fuels by 2030;
- Validate the technical feasibility of the use of innovative power conversion technologies for sustainable alternative carbon neutral fuels in waterborne transport;
- Prove the scalability to power outputs significantly above 3 MW with acceptable power density and high efficiency; Validate achievement of the additional KPIs of; minimum 5 kW/m³ power density (refers to power density of the energy converter, i.e. excluding storage of fuel or liquid electrolytes); minimum 45 % total system energy efficiency including all required ancillaries with zero carbon or climate neutral operation weighted over the MARPOL Annex VI E2 or E3 cycle;
- Support regulatory development within both EU and IMO frameworks;
- Prove the safety of the proposed solutions through verifiable KPIs for the use of the fuel and power conversion system concerned;
- Validate resilience of the power system to possible fuel impurities and variability of the power required by the ship;
- Developed a realistic pathway to the wider use of power conversion system technologies in waterborne transport (e.g. Long Distance, Inland, Cruise, Ferries, Short Sea and Offshore);

- Risk assessed the power conversion system with respect to lifetime, maintenance scheme and life cycle cost as well as a life cycle GHG emissions;
- Where relevant, be coherent with the activities of the Batteries co-programmed partnership and the Clean Hydrogen Joint Undertaking.

Scope: Sustainable climate neutral fuels with emissions considered on a full well to wake life cycle basis are expected to be essential to decarbonise deep sea, large scale and energy intensive shipping, with their associated high-power demands. A range of candidate fuels are advocated, including for example liquid and gaseous advanced biofuels and liquids, advanced synthetic renewable energy carriers, green hydrogen, green ammonia and green methanol. Whilst power conversion technologies for these fuels, include novel internal combustion engines and fuel cells are being addressed by ongoing R&I, whilst power outputs are slowly increasing, in most cases, they remain well below that needed for a primary power source which is usable for commercial shipping and systems remain very sensitive to fuel impurities, whereas high purity fuel cannot always be assured for waterborne transport. Large uncertainties with respect to the operational and capital costs are also a barrier for innovative technologies being taken up in the market.

To be widely deployed, new power conversion technologies are expected to be technically and economically viable for integration on board ships. They have to be capable of delivering:

- High powers for prolonged periods,
- A power density which would be acceptable for integration within ship structures,
- High efficiency, without increasing air pollutants.

Progress beyond the state of the art is required. To facilitate scalability, the developed power conversion technology should be robust to the typical fuel qualities expected within a waterborne transport environment as well as potential contaminations introduced when blending different fuels, while maintaining endurance and reliable power output with reduced air pollution. Power conversion technologies have to be also robust under variable power demand, experienced in typical seaways and ship manoeuvres.

The topic is open to all potentially sustainable climate neutral fuels and all energy conversion technologies, including but not limited to Internal Combustion Engines, Turbines and fuel cells.

Projects are expected to advance beyond the state of the art addressing all the following aspects,

- Develop and validate, in a laboratory or relevant environment, power conversion technologies for sustainable alternative climate neutral fuels. Scope should include ship configuration, performance simulation and scenario comparisons to enable the use of one or more fuels onboard the ships;

- Validate in a relevant environment resilience to fuel impurities accepted by the power system and to cope with the variable power demand;
- Potential fuel blends and combinations should be considered as solutions to reach required power conversion performance, taking into account; any increase in total energy (or even decrease) output compared to current fuels, lowest possible levels of noise and air pollutant emissions (SO_x, NO_x, CO, PM, ammonia slip, nitrous oxides), and the lowest possible well-to-wake GHG emissions.
- In addition, safety KPIs for the use of the fuel concerned, in particular when using green ammonia and methanol, should be developed and verified.
- The projects should undertake a risk and predictive assessment of lifetime of the power conversion and fuel system, the life-cycle cost throughout vessel life, maintenance scheme, as well as the life-cycle cost and GHG emissions on a well-to-wake assessment basis.
- Develop a realistic pathway to the wider use of power conversion system technologies in waterborne transport

Where relevant, plan for synergies with the activities of the Batteries co-programmed partnership and the Clean Hydrogen Joint Undertaking.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-12: Demonstrations to accelerate the switch to safe use of new sustainable climate neutral fuels in waterborne transport (ZEWT Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 8.00 and 13.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 34.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 7-8 by the end of the project – see General Annex B.

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

- Full scale on board operational demonstration of a sustainable climate-neutral fuel system, including fuel distribution, bunkering, fuels storage, power conversion and possible residue handling, in a realistic on-board operational environment;
- Verifiable KPIs to prove the effectiveness, viability, and impact of the demonstrated solutions;
- KPIs to be demonstrated include: ship power optimisation; bunkering specificity (equipment, safety, operations, flowrate); energy consumption efficiency in waterborne transport; reduction of the global emission of GHGs; life-cycle GHG emissions on a well-to-wake assessment basis and reduction of the air pollution emissions (notably SO_x, NO_x, CO, PM, black carbon) in a range of operating scenarios.
- Accelerated transition to climate-neutral or zero-emission maritime and inland ship operations, by facilitating the wider adoption of sustainable climate neutral fuels at a larger scale and for vessels requiring prolonged autonomy. Particularly focusing on fuels where significant on-board challenges remain, with consideration of the specific supply chain requirements to satisfy the needs of maritime transport and inland navigation, in particular shipping activities with frequent cargo handling operations.
- Demonstrated possibilities from smart digitalisation, to facilitate the on-board use of sustainable climate neutral waterborne fuels.
- Demonstrate achievement of the 2040 targets specified within the European Commission proposal for a Fuel EU Maritime regulation reference COM/2021/562.

Scope: Whilst smaller scale demonstration of vessels running on potentially sustainable climate neutral fuels have been ongoing in the waterborne transport sector²⁶⁸, large-scale demonstrations, particularly with more challenging fuels such as hydrogen and ammonia for which end-to-end transnational operations, safety, environmental effects, risks and their mitigation are still lacking. The assessment of the results from such large-scale demonstrators are necessary to trigger the wider adoption of sustainable climate neutral fuels within the waterborne transport sector.

Adoption of sustainable climate neutral fuels within waterborne transport assets will in turn be possible only if the outstanding challenges of the daily operations are solved, for example

²⁶⁸ Waterborne transport concerns both maritime shipping and inland waterway transport, explanation of the segments is included in the Strategic Research and Innovation Agenda of the ZEWT co-programmed partnership.

bunkering, storage, handling and on-board operations have to be proven safe. Sustainable climate neutral fuels include potential new safety issues, such as toxicity, different flashpoints or fire hazards which are expected to be addressed.

Operational performance and efficiency of the overall system in full operations have to be demonstrated, especially with respect to air pollution (NO_x, SO_x, PM, methane or ammonia slip, black carbon etc.) and well to wake GHG emissions. The systems, processes and components needed to handle and use sustainable climate neutral fuels will also be demonstrated. Continuous emission and performance monitoring systems and their integration are an additional challenge that should be taken into consideration, including monitoring of emission profiles and identifying operating patterns that require optimisation as well as the identification and management of potential trade-offs.

Smart digitalisation also provides new opportunities to facilitate the efficient, clean and safe use of climate neutral sustainable fuels, for example by enabling advanced engine emission management.

Activities will also underpin the pre-normative R&I required to facilitate the routine deployment of Sustainable Alternative Fuels (SAFs).

Demonstration within operational conditions is targeted. The challenge is to increase confidence in, and acceptability of, the viability of sustainable climate neutral fuels where full operational demonstration has yet to be achieved, including for example green hydrogen, green ammonia, green methanol sustainable liquid and gaseous advanced biofuels and other advanced intermediate bioenergy and synthetic renewable energy carriers, together with their associated power systems.

Projects are expected to address **all** of the following aspects **either** for a) inland waterway transport or b) maritime transport applications:

- Develop, validate and demonstrate a sustainable climate-neutral fuels system on board, in full transnational operations including fuel distribution, bunkering, fuel storage, power conversion and possible residue handling. A minimal power of 1MW (for either full or partial vessel power), addressing significant challenges and going beyond state-of-the-art as well as demonstrating achievement of FuelEU Maritime 2040 targets is required. Demonstrating higher powers which will be applicable to a wider range of applications is encouraged. Due to the scale of resources required, for option a) inland waterway transport- demonstration is expected to be undertaken on more than one vessel type, for option b) maritime transport- it is optional to demonstrate more than one vessel. Use of replacement renewable low carbon fuels in otherwise conventional oil/gas-based energy conversion technology should not be considered.
- Demonstrate applicability of sustainable climate neutral fuels in particular considering stricter environmental expectations and regulations, such as those applicable to passenger ships, inland waterway transport and other environmentally sensitive regions.

- Provide validated risk and safety assessments, mitigation measures and demonstration supporting the development of safety provisions in regulation proposals both in EU and potentially at IMO, ISO and inland waterway regulatory frameworks and taking into account operational conditions such as cargo handling activities.
- Demonstrate the capacity of innovative smart digitalisation to facilitate the safe, clean and efficient on-board use of sustainable climate neutral fuels.
- Plan for the exploitation and dissemination of results for proposals submitted under this topic should include a strong business case and sound exploitation strategy, as outlined in the introduction to this Destination. The exploitation plans should include preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan) indicating the possible funding sources to be potentially used (such as the Innovation Fund).
- Proposals should plan and propose relevant synergies with relevant Horizon Europe activities such as the Clean Oceans Mission, the Batteries co-programmed partnership and the Clean Hydrogen Joint Undertaking results and activities arising from projects under topics HORIZON-CL5-2021-D5-01-07 or HORIZON-CL5-2021-D5-01-14.

Projects are expected to address either a) inland waterway transport or b) maritime transport applications.

To ensure coverage of both areas, the most highly ranked projects scoring above the minimum threshold will be selected in each area. Subsequent projects will be ranked and selected based upon their scoring. Proposals are expected to clearly indicate if area a) inland waterway transport **or** area b) maritime transport is the focus of the application.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-13: Integrated real-time digital solutions to optimise navigation and port calls to reduce emissions from shipping (ZEWT Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 7.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.
<i>Type of Action</i>	Innovation Actions

<i>Eligibility conditions</i>	<p>The conditions are described in General Annex B. The following exceptions apply:</p> <p>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).</p>
<i>Technology Readiness Level</i>	<p>Activities are expected to achieve TRL 6-8 by the end of the project – see General Annex B.</p>
<i>Legal and financial set-up of the Grant Agreements</i>	<p>The rules are described in General Annex G. The following exceptions apply:</p> <p>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.</p>

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

- Progressing beyond the state of the art, full-scale demonstration of an interoperable port call and voyage optimisation tool on existing routes and services involving at least three ports and two shipping companies and relevant stakeholders in port call operations.
- Improved operational efficiency of vessels when arriving to/departing from ports, towards elimination of waiting times during navigation and at the port. Develop and demonstrate in realistic environment, KPIS's to quantify these gains.
- Increased navigational safety through improved sea traffic management from onshore which has been assessed with respect to the status quo considering also situational awareness during port entrance, manoeuvring, berthing, departure and potentially related skills issues.
- Optimised fuel efficiency and reduced vessel emissions through voyage, waiting at anchorage and port arrival optimisation to facilitate more efficient sailing speeds. Reductions in fuel consumption of 10 to 20% with corresponding reductions in greenhouse gas emission should be demonstrated, compared to business as usual during navigation and at port and port-to-port approach.
- Enable shipping companies to quantify their fuel savings and the GHG emissions avoided as a result of the optimisation system and the real-time information shared with ports during vessel voyage.
- Development of port call optimisation standards considering the on-going standardisation initiatives by IMO/ISO groups to facilitate a secure and resilient operational, real-time digital data sharing and decision support system for port and

voyage optimisation; and develop operational roadmap(s) for standard technical committees.

- Assessment and quantification of the benefits of port and navigation optimisation for different types of maritime traffic, e.g. tramp and regular services for bulk, container, passenger, cruise ships, Ro-Pax, Ro-Ro, etc.
- Adaption to the existing and/or development of business models to prove the commercial viability of voyage and port call optimisation to facilitate take up and its wider application.

Scope: Shipping is frequently subject to prolonged waiting periods offshore before birthing and offloading cargo. Vessels waiting at anchorage pending the availability of port capacity reduce operational efficiency as well as increasing emissions, either whilst waiting or due to faster sailing speeds to arrive at port in case of birth availability. To avoid these situations, port call optimisation systems have been developed and are now being piloted. However, these have been generally limited to specific services. More widely applicable navigation and port call optimisation tools which can address the entire voyage, promote the most efficient sailing speeds to reduce emissions and ensure direct berthing without delay could substantially improve operational efficiency and reduce emissions.

Activities should take a holistic approach to the development and scale up of an integrated port scheduling and voyage optimisation tool to address real multi vessel traffic scenarios, focussing on vessel routing and voyage optimisation, minimising emissions and the eventual port call process, going beyond existing systems and combining the perspectives of both shipping and port operators.

Proposals are expected to address all of the following aspects:

- Develop collaborative harmonized collaborative standards and communication amongst relevant stakeholders to enable an interoperable optimisation system to be deployed across the operations of the stakeholders concerned. Thereby facilitate the real time sharing of operational digital data, supporting enhanced situational awareness and decision support to reduce emissions through lower total voyage fuel consumption. For example, the following functions may be included; cargo handling, port services, clearance, commercial services such as bunkering, onshore power connection, berth availability, terminal capacity, weather, sailing speed, voyage data etc. Standards should address security, resilience as well as potential integration within existing port infrastructures and their monitoring systems.
- Develop methodologies and tools to enable information sharing and optimisation of routes and time of arrival in real time, including decision algorithms that use methods such as AI, Edge Analytics, heuristics, and business analytics.
- Using existing routes and services, progressing beyond the state of the art, demonstrate the operation at full-scale of an interoperable port call and voyage optimisation tool

towards at least three ports and two shipping companies in addition other stakeholders linked to port call operation.

- Consider system security as well as resilience and mitigation actions in case of failure.
- Carry out risk assessment for the developed solutions, using existing models (such as FSA, HAZOP, etc.) to support safety and business continuity in case of failure as well as regulatory development at IMO and EU level.
- Address the full voyage, including vessel positions far from port, to maximise emission reduction and operational efficiency benefits. Data sources should include among others weather, consumption, emission, traffic and port planning.
- Build upon existing systems, technologies and regulations (for instance, European Maritime Single Window and other national undertakings) to ensure direct applicability with existing requirements. Other innovative and new technologies can also be deployed.
- Develop and measure KPIs for efficiency from real cases, including calculation of the gains from the application of the solutions developed within the project. Measure the resulting reduction in emissions achieved as a result of the voyage and port scheduling optimisation system compared to a typical similar non-optimized service.
- Plans for the exploitation and dissemination should include a strong business case and sound exploitation strategy, as outlined in the introduction to this destination. The exploitation plans should include preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan) indicating the possible funding sources to be potentially used

Participation of end users in proposals is necessary. Commitment from end users towards the deployment of solutions developed in the project will be considered positively. All proposals will need to demonstrate a clear and credible pipeline from development to the operational deployment of the solution following the projects end.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-14: Developing a flexible offshore supply of zero emission auxiliary power for ships moored or anchored at sea deployable before 2030 (ZEWT Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 8.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a

	proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 8.50 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 6-8 by the end of the project – see General Annex B.

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

- In close cooperation with ship owners, operators and ports, demonstration and testing of an innovative solution to provide auxiliary power and possibly battery charging for ships moored and anchored at sea which will cut pollution and GHG's and which can be deployable before 2030;
- Developing guidelines on technical, operational and safety aspects for the provision of offshore power supply services;
- Assessing the GHG and polluting emission savings from ships moored or at anchor through verifiable KPIs;
- Assessment of the CAPEX and OPEX of the developed solution and optimisation of the concept to increase the financial viability of the developed solution.

Scope: The provision of electric energy to vessels at port is a mature technology which provides important benefits in terms of reducing the emissions from the waterborne transport sector, not only for CO₂ but also for other pollutants. Within Europe this is particularly important as many ports are either an integral part of densely populated cities or very close to them. The provision of onshore power supply (OPS) to vessels in European ports forms an integral part of the “Fit for 55” initiative. Due to direct electrification being more efficient, OPS is an important long-term solution applying to vessels with other clean technology solutions which will become more widely available. So far, the provision of OPS has been designed and applied for vessels securely berthed at terminals. This is an important step, which needs to be encouraged. However, in many cases, vessels need to spend important time at port anchorage, before a berth at a terminal is available. Some vessels such as cruise ship may also disembark their passengers to tenders offshore. During this period, vessels are using their main or auxiliary engines, thus creating emissions which impact port cities and coastal areas as well. A solution needs to be developed which can provide OPS to these vessels whilst

not at berth. Current consideration of such applications has been mainly limited to barge mounted solutions and concept development of offshore cabled power buoys (e.g. floating power plants, LNG HIVE2, OPS barges and offshore charging buoys). Generally, solutions are not yet mature and, in several cases, use fossil fuels. Consequently, a range of other possibilities may remain. The solutions to be developed and demonstrated by the projects are expected to address all the following aspects:

- The project should develop and test potential solutions for the provision of electric power to maritime vessels (primarily container ships and passenger vessels, including cruise ships) of at least 5000 GT.
- Be adaptable, so that as required, power can be provided to different locations within the port anchorage.
- Develop and demonstrate a solution which is flexible in terms of area of application i.e., that can be deployed in other areas within a port or possibly be moved to other ports, including if relevant, both inland and seaports.
- Be based on direct electrification from shore grid connections or offshore renewable power or the use of sustainable alternative fuels including for example liquid and gaseous advanced biofuels, synthetic renewable energy carriers or energies.
- Aim to minimize air pollution, including when solutions are founded upon biofuels.
- If applicable, assess the possible use of circular energy sources such as those from industrial processes taking place within the port perimeter (chemical processing, scrap processing, melting etc.).
- Aim for operational deployment by 2030. Minimize costs taking into account Capex and Opex with consideration of the energy conversion efficiency, the cost and availability of the supplied sustainable alternative fuels and/or energies.
- Pay particular attention to all safety aspects relating to the provision of clean energy, while a vessel is at anchorage.
- Evaluate the range of applicable regulatory instruments by reaching out to relevant Authorities.
- For example, the proposed solution maybe founded upon one of the following concepts, although other concepts may also be proposed:
 - Barge mounted generators, using sustainable low GHG fuels.
 - Floating energy storage units, using batteries together with inverters and a capability to provide the typical total energy need of a ship at a port anchorage.
 - Barge mounted fuel cells using green hydrogen fuel or other climate neutral sustainable alternate fuel.

- o Cabled offshore power supply connections towards buoys or other supply interface.
- Plan for the exploitation and dissemination of results should include a strong business case and sound exploitation strategy, as outlined in the introduction to this Destination. The exploitation plans should include preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan) indicating the possible funding sources to be potentially used.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2023-D5-01-15: Reducing the environmental impact from shipyards and developing a whole life strategy to measure and minimise the non-operational environmental impacts from shipping

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 4.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 9.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 7-8 by the end of the project – see General Annex B.

Expected Outcome: Project outputs and results are expected to contribute concretely to the following expected outcomes whilst supporting the overall medium- and long-term impacts marked “*”:

1. *Reduce the non-operational environmental impacts from shipping including construction and end of life strategies.
2. *Understand the most significant environmental factors in shipbuilding and throughout a ships circular life cycle including ship repair and the associated costs.

3. * Enhanced environmental and personnel awareness. Development of skills for greening of shipyards to improve the environmental performance and productivity in shipbuilding and ship repair processes.
4. * Enhanced circularity of waterborne transport assets through recycling and re-use of materials, parts and components.
5. * In the long term, contribute to the objective of a ship environmental performance indicator of the non-operational environmental impacts from the ship which takes construction, embedded materials, capacity for repair, end of life strategies into account.
6. Development of a shipyard environmental performance index (SEPI), relevant KPI's and benchmarks for shipyards through an inquiry into current shipyard processes and utilities (i.e. energy use and emissions to air, water and earth);
7. Demonstration of advanced production processes which reduce the environmental impact of shipyards and assessment of the shipyards' environmental performance (SEPI) which would achieve an improvement in environmental performance utilising current benchmarks, of at least 20%.
8. Development of a generic digital shipyard model encompassing shipyard processes with the associated energy use and emissions, enabling to assess and benchmark the environmental performance and cost-efficiency of shipyards and their contribution to the environmental impact assessment within the ships' Life Cycle (LC).
9. Development of guidelines on technical, organisational and personnel training solutions for reducing energy use and emissions to air, water and soil and improving the environmental performance of shipyards.
10. Development of a blueprint for an EU-material passport for waterborne transport assets classifying the ship circularity readiness level (CRL). In addition, a guideline for the passport maintenance throughout the ship life cycle backed by a business model for circularity and an appropriate regulatory regime in line with Regulation (EU) No. 1257/2013 on Ship Recycling (EU SRR) and coordinated with other ongoing Horizon 2020 / Horizon Europe projects.

Scope: The environmental impact of ships throughout their operational life is governed by the IMO Energy Efficiency Design Index (EEDI, mandatory for new ships), the Ship Energy Efficiency Management Plan (SEEMP, all ships), as well as by IMO and EU GHG-targets for 2030 and 2050 respectively. In addition, the IMO Carbon Intensity Indicator (CII) for all cargo, RoPax and cruise vessels above 5,000 GT and trading internationally will come into effect in 2023. To ensure that ships at the end of their operational lives can be recycled and do not pose any unnecessary risks to human health, safety and harm to the environment, the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships was introduced in 2009. Furthermore the 2013 EU ship recycling regulation sets higher standards and requires that from 2019 ships have to be recycled within an approved facility.

Furthermore, Green Passport and Green Passport EU may be assigned to ships by class societies which include an Inventory of on-board Hazardous Materials (IHM).

Assessment of a ships full environmental value chain misses in particular:

- Sufficient data or industry standards to describe the characteristics of a ships non-hazardous materials which may contribute additional value from recovery, recycling and re-use. For example, in line with "circular economy" principals, a cradle-to-cradle material passport which is analogous to that applied within the building industry is missing.
- Key performance indicators (KPI's) addressing the environmental impact shipyard pollution to air, water and earth caused by shipbuilding, ship maintenance, repair, retrofit and dismantling. High performance and clean production processes.
- The contribution from the shipyards towards ship design and the application of non-hazardous recyclable materials beyond the current IHM-passport.
- Guidance concerning best practices to minimise the non-operational environmental impacts from shipping considering construction, materials, capacity to repair, design and capacity for recycling. For example, including difficult materials such as plastic composites.

Activities will address the greening of shipyards, facilitating clean, efficient, low-energy processes which minimise pollution to air, water and earth and contribute to increasing ship circularity.

Proposals should address all of the following points:

- Develop and validate an environmental performance index with corresponding KPI's and determine a benchmark for shipyards through an investigation of shipyard floor processes, logistics and utilities i.e., energy use and emissions to air, water and earth, taking into account current environmental regulations, including those applicable to other land-based industries which may apply to shipyards.
- Identify the contribution of shipyards and ship design to the circular life cycle of ships in terms of reuse of components and materials within the context of shipyard processes, the shipbuilding value chain, capacity for repair and refit, end of life circularity and disposal value/cost. Considering also difficult materials such as reinforced plastics.
- Develop and validate a digital shipyard model encompassing shipyard floor technologies and logistic processes with the associated energy use and emissions, links to safety (e.g., ventilation to reduce indoor VOC's increasing energy consumption), enabling the assessment and benchmarking of the environmental performance of shipyards and the impact of "clean floor" technologies on shipyards.

- Develop and validate in line with the “Green Passport” a material circularity passport for maritime assets and identify the role of the manufacturing and design value chain stakeholders to apply best practices to increase circularity, reduce life cycle impacts and optimise end of life value. Foresee the compilation and maintenance of the passport over the ship lifecycle.
- Plan for the exploitation and dissemination of results should include a strong business case and sound exploitation strategy. The exploitation plans should include preliminary plans for scaling up application, wider commercialisation, and deployment (feasibility study, business plan), if necessary indicating the possible funding sources to be potentially used.

HORIZON-CL5-2023-D5-01-16: Developing small, flexible, zero-emission and automated vessels to support shifting cargo from road to sustainable Waterborne Transport

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 4.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 9.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 5-6 by the end of the project – see General Annex B.

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

- Development and validation of a small zero-emission automated vessel concept which can support shifting cargo from road to water. The concept will take into account cargo types and navigation conditions (e.g. small waterways, bridges, locks and shallow coastal waters and estuaries).
- Quantification and assessment of the reduced costs and emissions and stronger intra- and intermodal competitiveness of waterborne transport through integration of zero emission

propulsion of automated vessels and transshipment into automated transport chains, internet of things and possibly urban logistics.

- Development of business models that benefit from a high degree of automation digitalisation, considering technical, safety, security and organisational aspects and when relevant smart on demand services.

Scope: Waterborne transport can transfer large freight volumes from road and as a result reduce emissions and decongest road infrastructure. There are large opportunities to increase waterborne freight, especially in coastal and inland or congested urban regions. This potential is particularly underdeveloped within smaller waterways, lakes, estuaries and intra urban regions and with the use of less developed ports which are not accessible for larger vessels.

Whilst projects addressing coastal transport and metropolitan inland waterway transport, including new autonomous waterborne feeder loop logistic services are underway, these remain at an early stage or are tailored to specific use cases which cannot be widely deployed.

Emerging energy efficient, zero-emission and automation technology can help fully exploit the potential of small-sized waterborne transport but are expected to be adopted to the needs of such vessels and the related additional transshipment.

Lower costs are needed for small waterborne transport to become more competitive with road transport.

Flexible, fully automated transport chain is expected to facilitate waterborne services to new and previously poorly accessible regions.

Shallow water depths of smaller waterways with confined conditions require a broad variety of intelligent vessel solutions, which are tailored to the regional requirements, the specifics of individual cargo types and load units, e.g., ISO containers, swap-bodies, unitized and palletized goods for urban transport etc.

Decarbonisation of propulsion systems is needed to address the challenges of climate change. Automated solutions need to also take into account unexpected recreational users of the waterways.

Research should develop versatile zero emission solutions for small, shallow water capable automated vessels that are also usable on different classes of waterway and/or coastal waters.

Developments should advance beyond the state of the art taking into account current and emerging developments concerning low-water designs, modular vessels, automation, digital communication and security battery electrification, charging, and propulsion systems.

Proposals are expected to address all of the following aspects:

- Development, testing and demonstration of the automated flexible vessel concepts with emission-free propulsion systems in a relevant environment. In addition, the optimisation of the logistics chain will be assessed through logistics modelling.

- Innovative automation approaches for substantial cost savings.
- Tailored propulsion arrangements for small, flexible and versatile vessels which are compatible with shallow water.
- Automated operations in multimodal logistics should be envisaged through further development and integration of single automated functions into fully autonomous systems such as; navigation and vessel command, machinery surveillance, maintenance, berthing, cargo handling, transshipment etc.
- Self-organised or remotely controlled fleet-wide coordination of operations, along with an integration of the vessels into land-based digital logistics processes.
- The development of new business models including a high degree of digitalisation and smart on-demand services. Consideration of key stakeholder behaviours, including retailers' and customers.
- Ensuring safety, cyber security and resilience of automations systems.
- Early communication and discussion with relevant regulatory and standardisation bodies.

HORIZON-CL5-2023-D5-01-17: Towards the implementation of the inland navigation action programme with a focus on Green and Connected Inland Waterway Transport

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 1.50 million.
<i>Type of Action</i>	Coordination and Support Actions
<i>Eligibility conditions</i>	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).
<i>Legal and financial set-up of the Grant Agreements</i>	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). ²⁶⁹ .
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Expected Outcome: Project outputs and results are expected to contribute to the following expected outcomes:

- Development of inland waterway transport policies to ensure the implementation of green and digital, water protection and environmentally sound solutions.
- Identification of best practices and increase their take up and faster modernisation of the inland fleet.
- Building of a viable financial engineering instruments to support investments in zero emission, digitalised and connected vessels.
- Proposal of a European labelling system for EU waterways.
- Estimation of the potential modal shift to inland waterways transport with Impact of each Naiades III actions on modal shift.
- Provision of a knowledge exchange, discussion and promotion platform for implementing Naiades III innovative actions
- Working together with the Waterborne Technology Platform and the inland waterway transport sector; strengthen the coordination between national, EU and industrial research across the waterborne transport sector, the wider logistics chain in cooperation with relevant international organisations so as to increase the deployment of the solutions developed and provide input towards EU R&I and deployment programmes.
- With the direct involvement of end users' improvement of the environmental performance of inland waterways and contribute to future-proof; workforce, infrastructure, digital and automation developments which are compatible with a changing climate.

Scope: The European Green Deal and NAIADES III challenges require a breakthrough Action Plan for the innovative system change from a holistic perspective to achieve drastic emission reduction and modal shift targets. These elements lead to:

- a change in the ownership structure and business models (e.g. energy as a service, leasing),

²⁶⁹ This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

- intensive horizontal and vertical collaboration, vessels using (near) zero-emission technologies and energy carriers (e.g. batteries, fuel cell, synthetic fuels and clean combustion),
- standardised and modular hardware and ship design as well as advanced IT solutions for connected inland waterways transport,
- synchro-modal planning,
- safe and autonomous navigation and smart shipping.

Also, the required infrastructure, regulations, incentives need to be addressed. Finally, end user buy-in and commitment will be key to facilitate these changes.

Targeted follow up coordination and support activities are needed in the Inland Waterways sector, and in particular to support implementation of NAIADES III. These actions will address greening, and digitalisation and the leverage of the outcomes from related projects. In addition, actions should support a bridge between research, innovation and the buy in and deployment within inland waterways sector in coordination with the wider waterborne and logistics sectors.

A dedicated Coordination and Support Action will act as European platform and catalyst by bringing together the required expertise, disciplines and stakeholders. Synergies and collaboration with other sectors and transport modes will be crucial elements.

Proposals are expected to address all of the following aspects:

- Identification and analysis of barriers and opportunities for the development, implementation and take up of low and zero-emission innovations as well as digital solutions for the inland waterway transport sector in close cooperation with relevant projects and initiatives, including those targeting the broader waterborne transport sector. In this respect, a particular focus will be to decarbonise and improve the environmental performance of inland waterway transport, particularly within urban and protected areas as well as future-proofing infrastructure and ensuring compatibility with digital and automation developments within a changing climate.
- Development of an implementation plan, in close cooperation with the industry, which includes an assessment of the Total Cost of Ownership. Lessons learnt from frontrunners will be included in the assessment. In addition, the industrial commitment in terms of investments will need to be leveraged with additional resources, which might be available in the next Multiannual Financial Framework, aiming for a dedicated financial instrument for co-financing the deployment of zero-emission, automated vessels with innovative public-private collaboration models for deployment²⁷⁰.

²⁷⁰ Communication de la Commission: Future-proofing European inland waterway transport - NAIADES III action plan: NAIADES III Annex I action 33 "Facilitate the efforts of stakeholders and Member States to create a fund complementing EU and national financial instruments",

- The development and validation of a Digital Twin to support conclusions and recommendations on policy measures and regulations. The Digital Twin enables quantitatively simulating different scenarios and options to assess the contributions on modal share by the NAIADES III measures and emission reductions and the impacts for the various stakeholders involved.
- The consolidation of the Inland Waterways Transport (IWT) knowledge network, which was previously established with the support of H2020 and will end in 2023. The coordination and support action will build on the results of previous work and will reflect the multi-disciplinary requirements and complexity of the subject, coordinating with the wider waterborne, land transport and logistics communities. It will identify the appropriate measures and define the necessary means and tools.
- Develop further a RD&I roadmap and implementation plan, in coordination with the Waterborne technology platform, by integrating all stakeholders.
- Monitor the inland waterway transport RD&I project from relevant European programmes and their impacts, in coordination with the Waterborne Technology Platform.

This coordination and support action will ensure an active participation of key industrial stakeholders, the Waterborne Technology Platform, EU Member States/Associated countries' administrations, industry associations and river commissions.

Transport-related health and environment

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D5-01-18: Advanced transport emissions monitoring networks

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 10.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation

<https://ec.europa.eu/transport/sites/default/files/com20210324-naiades.pdf> and EP report P9_TA(2021)0367 “Towards future-proof inland waterway transport in Europe - European Parliament resolution of 14 September 2021 towards future-proof inland waterway transport.

	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 7-8 by the end of the project – see General Annex B.

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

Supporting the Zero Pollution Action Plan and its monitoring strategy by:

- Monitoring pollutant (including both exhaust and non-exhaust traffic related particles²⁷¹) and noise emissions of road vehicles on specific sites in urban areas with high density traffic in order to feed multiple real time systems and databases for air quality and environmental noise monitoring, anti-tampering enforcement, market surveillance and policy support at local, national and EU level.
- Monitoring pollutant (including both exhaust and non-exhaust traffic related particles) and noise emissions around ports, rail stations or junctions, dry ports, and airports, allowing for instance to monitor and enforce the respect of fuel use mandates in specific protection areas, correct noise abatement procedures, aircraft type limitations, etc.
- Establishing real time maps and networks in at least eight cities with at least three traffic air quality and noise stations on each city (a minimum of 5 stations in ports and 5 stations in airports is required) capable of measuring noise and solid particle number (PN down to 10nm according to WHO recommendations) and other emerging pollutants and GHGs in addition to the currently regulated ones and the impact of nature-based solutions (such as line trees along the streets, green facades in buildings, urban parks etc.) for mitigating them.
- Supporting local, regional and national emissions and noise reduction plans (including dynamic ones based on smart traffic management systems, capable of influencing the behaviour of drivers and automated vehicles) by providing supporting real time data and integrating the impact of road, rail, port and airport traffic into the management strategy.
- Supporting health studies about the impact of ultrafine particles according to recent WHO guidance
- Stimulate citizen awareness and engagement in the Zero Pollution strategy (also through citizen science approach)

²⁷¹ Like the brake and tyre wear emissions which are generated from non-exhaust traffic related sources such as brake, tyre, clutch and road surface wear.

- Providing recommendations concerning the use of nature-based solutions for mitigating urban air and noise pollution and contribute to the standardisation effort of sensing/monitoring technologies.

Scope: Transport emissions are a known cause of air and noise pollution in Europe, and therefore negative health impacts, particularly in urban environments. Road emissions play a significant part, but there can be important contributions by other transport sources if airports, ports, or rail stations with significant traffic from diesel locomotives are within or close to the city boundaries. Moreover, construction machinery can largely contribute to both emissions and noise where large building sites are present.

Long-term exposure to air pollutants from road traffic, railways and aircrafts can lead to serious health effects, such as sleep disturbance, cardiovascular diseases, metabolic disorders, annoyance, cognitive impairment and mental health problems. Noise pollution has its share of causing those health impacts and is an equally important environmental concern, likewise emitted by means of transport (road, rail, air traffic) and from sites of industrial activity. Besides the combustion engine, it can also be caused by aerodynamics or tyre-road or wheel-rail interactions. It adversely affects quality of life and well-being, prompting the need for seeking solutions to tackle these two forms of environmental pollution in order to reduce their harmful effects on human health and on the natural environment.

While some of these emissions are regulated, it has become apparent that the performance of propulsion and after treatment systems can change depending on use conditions or over time due to different causes (poor or even fraudulent design, tampering by the user, poor maintenance, catalyst degradation ...). Therefore, there is more and more interest to monitor these pollutant and noise emissions to the level of the individual vehicle and their cumulative effect at the city scale in order to provide a sound basis to understand the causes and to tackle, if needed, higher-than-expected emissions by enforcement or regulatory means.

Traffic-related particles can be distinguished into exhaust traffic related particles, which are emitted as a result of incomplete fuel combustion and lubricant volatilisation during the combustion procedure, and non-exhaust traffic related particles, which are either generated from non-exhaust traffic related sources such as brake, tyre, clutch and road surface wear or already exist in the environment as deposited material and become re-suspended due to traffic induced turbulence. It is estimated that exhaust and non-exhaust sources contribute significantly to total traffic related PM10 emissions, thus it is important to monitor both these categories of pollutant emissions, while differentiating their contribution to PN.

The Flagship on the contribution of transport to pollution in the 2019 call has included several topics addressing the development of technologies to monitor some of these emissions, and it is now important to transfer these technologies to the field and to integrate them in networks capable of 24/7 unassisted operation and data management and reporting for enforcement and fleet monitoring by cities and national bodies, and where appropriate shared with EU level bodies.

The design, testing and demonstration of these applications will be developed in cooperation with the involved cities, citizen associations, and authorities, to achieve the best use of monitoring data. Citizen science approach could be appropriate for these activities.

Projects are expected to install monitoring stations around at least 5 ports and 5 airports, allowing for instance to monitor and enforce the respect of fuel use mandates, correct noise abatement procedures, aircraft type limitations, etc. Projects should achieve synergies between the monitored cities, ports and airports.

At the same time, recent WHO guidance²⁷² recognised the specific risks posed by nanoparticles and provided for the first time a quantification of what can be considered a low and a high concentration of particles in terms of numbers instead of mass. Guidance was also provided to widen the collection of data to ultrafine particles down to at least 10nm, in order to allow the performance of epidemiological studies and, in the longer term, the establishment of new limit values.

Moreover, emerging pollutants and greenhouse gases are increasing due to the deployment of new technologies. Nitrous oxide, for instance, is both a very potent GHG and a neurotoxic with negative effects also on liver and kidneys and is a by-product of several catalysts. Ammonia is also posing similar by-product issues, in particular for methane and SCR-equipped vehicles, by leading to high secondary particulate levels. Therefore, monitoring these and other chemicals and their synergistic effects is becoming more and more important to inform policy decisions and provide data for modelling and emissions inventories.

A specific topic in the 2020 Green Deal call²⁷³ foresaw the developments of measurement instruments and methodologies for ambient ultrafine particles and atmospheric particulate matter, their sizes, constituents, source contributions and gaseous precursors. The wider deployment of the results on a cross-European base, encompassing as many as possible different locations in terms of urban morphology and meteorological and pollution conditions is paramount for the validation of the system and for the establishment of an EU-wide network.

Establishing, or contributing to, national level databases of traffic related emissions could support population-based health studies about the impact of these emissions to human health. These databases could, for example, contain detailed information on traffic density, modal split, current composition of the respective road traffic fleet, especially in urban areas, and all health relevant pollutants, such as particles (PM10, PM2.5, PN), NO_x, benzene and UFP/EC/BC.

In consideration of the above, proposals should address all the aforementioned aspects and issues in order to achieve the expected outcomes.

²⁷² <https://apps.who.int/iris/handle/10665/345329>

²⁷³ https://cordis.europa.eu/programme/id/H2020_LC-GD-9-1-2020 and <https://cordis.europa.eu/project/id/101037319> and <https://cordis.europa.eu/project/id/101036245> projects

Cross-cutting actions

Proposals are invited against the following topic(s):

HORIZON-CL5-2023-D5-01-19: Support for the organisation of EU-US symposia in the field of Transport Research

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 0.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 0.50 million.
<i>Type of Action</i>	Coordination and Support Actions
<i>Eligibility conditions</i>	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).
<i>Legal and financial set-up of the Grant Agreements</i>	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). ²⁷⁴ .

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

- Reinforced cooperation between the European Union (EU) and the United States of America (US) in the field of transport research and innovation.
- EU-US Transport Research Symposia organisation with high visibility, political and strategic relevance of the transport sector and of the EU policy in the field.

²⁷⁴ This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

- More effective links and exchanges between research and innovation stakeholders and policy makers from the EU and the US.

Scope: The EU and the US are both world leaders in transport research. On both sides, there is an increasing willingness to enhance and extend EU-US cooperation in the area of transport research.

An Implementing Arrangement between the European Commission and the US DoT was signed in 2013 for cooperative activities in the field of research, development, technology and innovation applied to all modes of transport. The purpose of this arrangement is to advance the EU and US cooperation and collaboration in R&I for all the four modes of transport, including multi-modal activities. To implement that arrangement, a Steering Group has been established, composed of DG MOVE and RTD officials for the EU side, to identify, elaborate and coordinate collaborative activities.

Within this context, EU-US Transport Research Symposia are to be co-organised on one side by the European Commission and on the US side, by the US DoT and the Transportation Research Board (TRB) on a yearly basis. Hosting of the Symposia's organisation is done on alternate years by the EC and the US.

The symposia promote common understanding, sharing of experience and best practices, efficiencies, and transatlantic cooperation within the international transportation research community, while accelerating transport-sector innovations in EU Member States/Associated countries and the United States.

Six symposia already took place in the last years addressing themes such as: 'Urban City Logistics' (Washington, 2013), 'Transport Research Implementation' (Paris, 2014), 'Automated Road Vehicles' (Washington, 2015), 'Infrastructure Resilience' (Brussels 2016), 'Decarbonizing transport for a sustainable future: mitigating climate change' (Washington, 2017), ' Socio-economic Impacts of Automated and Connected Vehicles' (Brussels, June 2018).

The aim of this action is to support the European Commission in organising the future annual symposia in 2024 (Washington), in 2025 (Brussels), in 2026 (Washington) and in 2027 (Brussels). Symposia are closed events with 50 experts -25 from the US and 25 from the EU- selected by US DoT and the European Commission respectively. Throughout the 3-day event, these experts are brought together to identify, discuss and elaborate strategic R&I recommendations related to the jointly chosen theme of each symposium by the US DoT and the European Commission.

The action will have to foresee the involvement of and collaboration with all the relevant European actors – researchers, industry, users, innovation leaders, etc. - representing the transport sector, in collaboration with the European Commission services in the relevant Directorate Generals. Consultation of key transport players in Europe including the different European Technology Platforms in transport and relevant Horizon Europe partnerships is foreseen, depending on the theme selected for the future symposia.

The action will have to work together with the two EC services to define the overall planning of each symposium, to support the drafting of a White Paper and conference proceedings reports, to design the structure the sessions of the event, to manage the expert’s contributions (25 EU experts, 3 of them being part of a planning committee with their US counterparts) and cover the travel and subsistence of the EU experts, communication material, etc. For those years when the Symposia is held in Brussels, to also manage the overall organisation of the symposia including selecting the appropriate location for the venue, covering the costs for the venue, the logistics, the travels and subsistence for the EU experts, communication material etc.

The list of the European experts that will be invited to the symposia will be proposed by the project after consultation with the stakeholders and will be finalised by the Commission.

The outcome of these symposia will help define a common vision for future transportation, lay the foundation for activities of mutual interest and benefit in all modes of transport, including enhancing EU international cooperation activities within the TRB International Committee (ICC).

Call - Clean and competitive solutions for all transport modes

HORIZON-CL5-2024-D5-01

Conditions for the Call

Indicative budget(s)²⁷⁵

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR million) ²⁷⁶	Indicative number of projects expected to be funded
		2024		
Opening: 07 Dec 2023 Deadline(s): 18 Apr 2024				
HORIZON-CL5-2024-D5-01-01	IA	15.00	7.00 to 8.00	2
HORIZON-CL5-2024-D5-01-02	RIA	15.00	4.00 to 6.00	3

²⁷⁵ 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.

²⁷⁶ Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.

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Climate, Energy and Mobility

HORIZON-CL5-2024-D5-01-03	RIA	10.00	Around 5.00	2
HORIZON-CL5-2024-D5-01-04	IA	17.00	7.00 to 8.50	2
HORIZON-CL5-2024-D5-01-05	RIA	10.00	4.00 to 5.00	2
HORIZON-CL5-2024-D5-01-06	IA	10.00	Around 10.00	1
HORIZON-CL5-2024-D5-01-07	RIA	17.00	4.00 to 5.00	4
HORIZON-CL5-2024-D5-01-08	RIA	16.00	3.00 to 5.00	4
HORIZON-CL5-2024-D5-01-09	RIA	8.00	Around 8.00	1
HORIZON-CL5-2024-D5-01-10	RIA	16.00	Around 16.00	1
HORIZON-CL5-2024-D5-01-11	RIA	15.00	Around 7.50	2
HORIZON-CL5-2024-D5-01-12	IA	15.00	Around 7.50	2
HORIZON-CL5-2024-D5-01-13	IA	6.00	Around 6.00	1
HORIZON-CL5-2024-D5-01-14	IA	15.00	Around 7.50	2
HORIZON-CL5-2024-D5-01-15	IA	7.70	Around 7.70	1
HORIZON-CL5-2024-D5-01-16	CSA	0.85	Around 0.85	1
HORIZON-CL5-2024-D5-01-17	CSA	1.50	Around 1.50	1
HORIZON-CL5-2024-D5-01-18	RIA	7.00	Around 3.50	2
Overall indicative budget		202.05		

General conditions relating to this call	
<i>Admissibility conditions</i>	The conditions are described in General Annex A.
<i>Eligibility conditions</i>	The conditions are described in General Annex B.
<i>Financial and operational capacity and exclusion</i>	The criteria are described in General Annex C.
<i>Award criteria</i>	The criteria are described in General Annex D.
<i>Documents</i>	The documents are described in General Annex E.

<i>Procedure</i>	The procedure is described in General Annex F.
<i>Legal and financial set-up of the Grant Agreements</i>	The rules are described in General Annex G.

Zero-emission road transport

Proposals are invited against the following topic(s):

HORIZON-CL5-2024-D5-01-01: Smart, low-cost pervasive stationary slow charging and bi-directional solutions synergic with the grid for EV mass deployment (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 7.00 and 8.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL7-8 by the end of the project – see General Annex B.
<i>Legal and financial set-up of the Grant Agreements</i>	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 the following outcomes:

- Development and demonstration of innovative, interoperable, efficient, low-power smart and bi-directional on-street charging, removing barriers to EV user acceptability in

densely populated areas. User acceptability should be quantifiably improved from technological, investment costs and costs of charging point of view.

- The proposed innovative solutions should be conducive to optimise efficiency and reduce costs, but ideally should not be visually and physically intrusive, or these aspects should be kept to a minimum level, given the high level of expected deployment that would create problems for pedestrians and other road users.
- Development of an analytical methodology including representative models (replicable at an EU-wide scale) to ensure an efficient planning for the mass deployment and integration of public (and where applicable private) EV charging infrastructure²⁷⁷, satisfying concrete user needs (in particular for night charging of L, M1 and N1 vehicles and their opportunistic day charging) and making it compatible as much as possible with existing low voltage grid and power system capabilities.
- Quantifiable improvement of related business models and gaps for users compared to current State of the Art, additionally also including considerations for less densely populated areas.
- Development of socio-cultural databases at city, regional and national level comprising daily charging habits, practices, and ideas of different community clusters (including individuals with special needs) and their integration into charging and planning tools, to support the determination of the most efficient and most accepted charging solutions. These developments should interact with the work of Sustainable Transport Forum²⁷⁸.
- The identification and analysis of potential regulatory aspects and barriers for relevant standardisation activities via common, interoperable and open standards, protocols and digital services.
- Deployment of multilevel systemic architecture and solutions for smart and bi-directional charging power management that will increase RES penetration as well as enhance the grid capacities and power system resilience by alleviating grid congestions and levelling off the load curve.

Scope: Future charging infrastructure deployment should be ubiquitous, and should parallel, with a certain level of anticipation the growth of EV sales. Associated charging solutions should enable seamless processes that are easy, fully interoperable across European country borders and available at any time. The aim of this topic is to enable and improve massive smart on-street low-cost charging of EVs as well as improving the overall efficiency of power supply to the grid, including a space-and-time-oriented prediction and control of the global charging power demand, also enabling and improving smart home and office charging that could be explored by proposals to complement the on-street charging solutions.

²⁷⁷ Considering, where appropriate, deployment targets under the Alternative Fuels Infrastructure Regulation (AFIR) and Energy Performance of Buildings Directive (EPBD) proposals

²⁷⁸ https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sustainable-transport-forum-stf_en

Proposals are expected to address all the following aspects:

- Guarantee an exhaustive coverage of high-efficiency, low-power, low-cost on-street smart charging points considering grid infrastructure and capacity, optimisation of civil works and grid requirements for services and charging needs, including the parking patterns (charging on long- and short-term parking spaces) to reduce the need for additional buffers to stabilise the grid.
- Address users' needs and requirements in socio-cultural contexts of different communities to incorporate daily habits, practices and ideas into the design and development of people-friendly infrastructure with emphasis on public charging (also considering smart use, while connected, of energy consuming convenience functions like cabin and battery pre-heating and cooling).
- Use statistical models of parking, traffic and grid configuration and energy flows to predict and support power supply planning on a larger scale (e.g. at least regional), along with methodologies and demonstrations to derive or calibrate such models on the basis of real traffic and behavioural data.
- People centric applications equipped with the analytical capability and Human Machine Interfaces (HMI) for friendly access and use, that support the interactions related to the ratio between location, power (and its guaranteed minimum) and price for prompt decision making or pre-allocation of charging stations in line with users' charging preferences and vehicle state of charge, also allowing charging point operators to predict power demand.
- Support and demonstration of smart and bi-directional operation in overnight publicly accessible environments to accommodate demand for long-term charging, and meeting some of the requirements of opportunistic charging types, motivating the people to optimally charge (maximising the use of renewable power) and promoting the development and use of interfaces with customized vehicle charging technology which can be preconditioned and set-up by the driver, including the pre-allocation of charging points.
- Development of innovative optimisation functions exploiting real-time access to battery information such as state of health, state of charge, capacity and power set point, which should be provided respecting any GDPR and data disclosure terms to the owners, users or other stakeholders in the value chain, such as building energy system managers, mobility and logistics service providers and electricity stakeholders.
- The developed solutions are expected to be provided on non-discriminatory terms between users and classes of users and allow the choice of the e-mobility service providers, so as to avoid consumers lock-in with a single e-mobility service provider, affiliated to specific vehicle manufacturers.

- Optimise the use of energy resources and infrastructures to cater not just for private mobility usage but also integrating opportunity use of the same infrastructure by other light duty captive fleets if their needs are compatible with the low power level.

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. Furthermore, in order to achieve the expected outcomes, social innovation should be considered.

The selected projects are invited to participate to BRIDGE²⁷⁹ activities when considered relevant.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-02: Integration and testing of next generation post-800V electric powertrains (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 4.00 and 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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Next generation powertrain architectures using voltages 1200 V and above might contribute to the achievement of safer, higher-performing and more sustainable end products to serve high volume markets. A holistic approach to the whole powertrain

²⁷⁹ <https://www.h2020-bridge.eu/>

should contribute to determining the optimal next generation voltage level. Project results are expected to contribute to all the following outcomes:

- Very fast charging, ultra-efficient electric vehicles (EVs) for broad mass markets, taking into account volume effects and cost optimized architectures for future markets.
- A cost reduction of a minimum of 20% of power electronic modules and inverters for a given power, as well as for the whole powertrain, should be demonstrated (in comparison to the cost of the best current-generation or close to market components and architectures at proposal submission time).
- Fast charging of a mass market C segment vehicle demonstrator from 20 to 80 percent in 10 minutes with currently available 350kW chargers.
- Practical range increases over travel time (~20 percent increase with the same battery weight) with overall higher efficiency and easier thermal management of the whole powertrain allowing reasonably sized, lower cost and environmentally friendly batteries to perform long trips conveniently.
- Significant advancements in efficiency (reduction of losses by 25%) versus the state of the art of the targeted application with a special attention to partial load condition in EVs and charging stations alike.
- Backwards compatibility and reliability aspects.
- Improved application safety and robustness that contribute to a better user buy-in.
- Improved resource efficiency with better lifecycle impact and recycling capability → contributing to a circular economy approach.

Scope: In the last decade, the more and more demanding power and application requirements led to an increase of board net HV voltage from an initial 400V level to 800V in the latest electric vehicles, already trickling down to lower categories. Significantly higher voltages (indicatively, in the 1200V region) may be the next logical step and become standard in the next decade, providing benefits in terms of efficiency, copper use and weight. If not properly managed, they could have a constraining impact on the overall architecture especially in terms of DC charging and efficiency for low power use. Thus, new challenges for the powertrain arise in the areas of the motor, battery, cabling, couplers etc. as well as in electromagnetic compatibility and the development and integration of new power semiconductors.

To successfully address the expected outcomes in the constant drive to improve efficiency and performance while increasing affordability, proposals are expected to address several of the following aspects capable of demonstrating the achievement of the intended objectives at system level:

- Assess in a holistic way the positive and negative impacts of higher voltage levels at vehicle and powertrain level, defining the best option for the post-800V EV generation.

- Development and integration of power-electronic components with new concepts for component miniaturisation and modularity. Also, solutions that can transition rapidly from modular to integrated systems need to be identified, depending on demand and eco-balance.
- Topologies adapted to advanced wide-bandgap semiconductors and new materials, leading to higher power density.
- Modular powertrain platforms, with the aim of coming closer to a full mechanical, electrical or thermal integration of the three main systems (electric motor, power electronics systems and battery pack) benefitting from the smaller sizes and cooling demands due to higher voltage.
- Defining suitable testing and validation procedures on component, powertrain or vehicle level and demonstrating them on a suitable use case. Furthermore, the projects should identify and analyse potential regulatory aspects and barriers to contribute to a definition of common EU standards for system validations.
- Small-sized, ‘ready for integration’ power modules at the best system fitting position (e.g. e-motor or battery) for greater design flexibility while optimizing costs.
- Packaging and coupler solutions e.g., substrates, moulding epoxy, electrical interconnections, adapted for higher voltages, increased isolation demands, high-frequency switching, frequent thermal cycling, elevated temperatures etc.
- Heat spreading technologies for short power pulses/ heat dissipation approaches for long duration pulses, long acceleration phases.

Exploitation of outcomes, and knowledge from ECSEL/KDT partnership²⁸⁰ projects should be foreseen where applicable, as well as feedback in terms of future needs to achieve the project outcomes should problems be encountered. The development of the needed semiconductors, however, is not part of this topic's funding, and the proposal is expected to specify the components that the involved semiconductor suppliers guarantee to provide for the research activities.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-03: Advanced battery system integration for next generation vehicles (2ZERO Partnership)

Specific conditions

²⁸⁰ <https://www.kdt-ju.europa.eu/>

<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 10.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve at least TRL 5 by the end of the project – see General Annex B.

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

- Novel and innovative approaches to battery integration into vehicle structure focusing on solid state generation-4 cells, including modular systems capable of temporary expansion for long trips in small and medium sized cars without a permanently installed large battery.
- Improvement of the fast-charging capabilities up to at least 3C, and aiming for higher capabilities for high energy cells, independent of battery topology in the vehicle.
- Increase gravimetric energy density of the integrated pack (excluding contributions by cell chemistry) by at least 25%, and volumetric energy density by 70% from 2023 State of the Art).
- Reduced battery system cost considering the functionalities of the vehicle structure (excluding contributions by cell chemistry, below EUR 100/kWh for systems used in light duty Electric Vehicles (EVs) by 2030). Safety aspects of the prototype cells need to be considered.

Scope: In order to reduce the overall cost of electric vehicles modularity, scalability and the development of strategies for their implementation will become increasingly important in the future. With the expected introduction of new cell technologies, specific choices for connections, cooling system concepts and materials for housing will play a crucial role in the battery performance improvements and the battery integration in the vehicle structure. The development and integration of structural, thermal and mechanical aspects (at different levels of modularity or integration) will need to be improved, while exploiting the intrinsic advantages of innovative type of cells.

Proposals are expected to address all the following aspects:

- Structural battery pack design and integration in the vehicle considering trade-offs in all important areas such as energy density, thermal management, maintainability and reparability, crash safety, energy density, production cost, second life, dismantling and recycling processes.
- Smart thermal management systems for both heating and cooling, with smart interfaces to the vehicle systems (including energy-efficient preconditioning, using internal or external energy sources whilst charging), contributing to further improvements in the overall battery system efficiency and optimizing the overall battery system, also in consideration of passenger comfort.
- Novel cooling system concepts exploiting the reduced thermal constraints of generation-4 cells ensuring minimal impact on system mass and costs, especially taking into account the thermal and electrical interfaces of different possible cell geometries (e.g. pouch, prismatic or cylindrical).
- Take into account the development of the technical communication channel for the access and exchange of relevant data types from the battery management system (BMS), such as state of charge (SoC), state of health (SoH), temperature (T) or voltage (V) that are essential to ensure efficient and secure recharging processes.
- Digital twin of thermal behaviour of EV and battery for optimal chemistry / energy management and safety assessment of batteries.
- Enhanced communication between battery and vehicle control units for a more efficient battery operation by synchronizing ECUs of the BMS and the EV (links are expected to be established with projects funded under topic HORIZON-CL5-2023-D5-01-02: Innovative battery management systems for next generation vehicles).

Projects should take into account the access to battery information as defined in the proposal for the Renewable Energy Directive COM(2021)557 of 14 July 2021.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-04: Integrated flexible multipoint megawatt charging systems for electric truck mass deployment (2ZERO Partnership) (2024)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 7.00 and 8.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and

	selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 17.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 8 by the end of the project – see General Annex B.

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

- Improved designs, architectures and models of interoperable multipoint megawatt charging systems for future mass deployment of Heavy-Duty trucks and concepts for managing their grid impact.
- Tools to identify the energy needs and the charging profiles of the electric vehicles that are expected to charge on megawatt charging systems.
- Integrated and flexible interaction control and energy management based on interoperable and open protocols between on-board and off-board charging-related components and the local grid demand flexibility providers, renewable electricity generation and energy storage systems,
- Improved modelling of the optimal geographical locations for large-scale megawatt charging hubs for Heavy and Medium Duty Vehicles and multiplexed Light Duty passenger/commercial vehicles usage at traffic peak times while also considering the relevant challenges to the grids and their mitigation with smart charging concepts, in consideration of locally available energy grids capacities and local energy storage.
- Tools and services for planning, operation, availability and reliability of the overall megawatt charging multipoint hubs from users' perspectives (vehicle driver, fleet manager) and grid operators and energy providers.
- Highly energy efficient megawatt-charging hubs, also with optimal utilisation of multi-point megawatt charging stations for HDV-users but also considering other types of vehicles.
- The proposed concept for a charging stations with at least four flexible megawatt charging points of 1MW or more will be demonstrated at the end of the project, each of these points being in turn also capable of recharging at least four lighter vehicles.

Scope: Next generation battery electric vehicles need to be more energy efficient and affordable, which means to keep battery size to the practical minimum. Megawatt charging is then required to meet the demand for long operational range with even shorter charging times. Ultra-high-power charging on-board and off-board sub-systems design is, as a first step, covered in topic HORIZON-CL5-2022-D5-01-08. The present topic covers their evolution towards multi-charger hubs that cater for a widespread deployment of these vehicles on the 2030 horizon. Limited on-board systems optimisation may be included if properly justified. At the same time each charger in these charging hubs will be usable for multiple lighter vehicles with lower power (150-350 kW) during peak times such as weekend or holiday periods, when demand from heavy duty vehicles may be lower. This will also require concepts for topologies capable for accommodating one heavy vehicle or 4-6 light vehicles in each charging spot.

Proposals are expected to address all the following aspects:

- Consider typical demands along significant TEN-T corridors, including under severe weather and peak conditions, as well as opportunities for sharing and balancing power supply within studied areas, locations of logistics terminals and truck stops with nearby depots for overnight charging of trucks, buses, and construction machines, car-parking etc.
- Input from EU Member States/Associated countries' maps with aggregated charging demands and expected high power charging station localisations as well as input from grid operators on power system local and regional conditions is also expected. Such terminals/ hubs for charging should offer charging on non-discriminatory basis.
- Particular attention should be paid to the real needs of end users, including optimised infrastructure locations, its reverse impact on the traffic flow, ease of use and interoperable protocols that do not hinder universal use across different countries; the identification and analysis of potential regulatory aspects and barriers for relevant standardisation activities is encouraged.
- The developed tools should have the capability to map the optimal locations for a fast and high-power charging infrastructure (already built-up logistics hubs, truck service centres, truck and bus depots, and for new ones also considering the permitting process), offering planning information including to the developers of the targeted infrastructure. For optimisation of the overall system use, services and tools should be developed keeping into account on-board EV system characteristics.

Topic is open to international collaboration, in particular regarding interface specifications (e.g. with the USA).

This topic implements the co-programmed European Partnership on 'Towards zero emission road transport' (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership 'Towards zero emission road transport' (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-05: Advanced digital development tools to accelerate the development of software defined vehicles that enable zero-emission mobility (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 10.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 4-5 by the end of the project – see General Annex B.

Expected Outcome: Advanced digital tools can enable the mobility industry to efficiently develop and operate software-defined electric vehicles that are key for achieving sustainable mobility solutions. Core functions of the electric powertrain or vehicle dynamics are primarily enabled and controlled via software. Function updates are at the fingertip of the end-users to offer maximum customer benefits and satisfaction. Such next generation modelling and simulation tools & methods empowering e.g., software-driven development, automated engineering as well as credible simulation pave the way to make mobility safer, more sustainable and more comfortable in a new way.

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

- Design and validate digital tools for the automotive industry for enabling best possible combination of digital development and digital operation for innovative zero-emission solutions enabling up to 20% energy consumption reduction by e.g. deploying always latest software-driven energy saving functions becoming available during vehicles entire lifetime and to ensure performance, security, safety and reliability by design.
- Increase speed of innovation by optimising the utilisation of data (engineering, operational, infrastructure data etc.) in an effective and efficient way (synthesis and utilisation of data).

- Contribute to the development of solutions for reliable ‘virtual’ decision-making based on digital twins and for enhancement of the credibility of simulations based on process and artefact quality measures, as well as KPI-driven quality assurance and traceability.
- Method and tools for reliable modelling and simulation of total vehicle systems including its environment.
- Significantly enhance the capabilities in design, development and application of “software-defined” EV and thus strengthening the competitiveness of the European automotive industry.
- Improve product quality, improve decision making efficiency, quality, and exploiting operation data and thus contributing to the reduction of the overall development time.

Scope: The data driven development of software-defined functions and systems of EVs (e.g. in context of battery and e-motor control, predictive eco-driving functions or control of vehicle dynamics, as well as comfort) requires the use of improved tools across domains (e.g. mechanical, dynamic, electrical, and acoustical) and scales (from component to vehicle in a mobility scenario) as well as a deep understanding of the vehicle operation in real life.

However, the current development and design framework does not allow such complex software-defined functions and systems to be addressed in an integrated manner, resulting often in solutions optimised for a specific operating point that is only partially representative of real use conditions and lacking the resource-efficient reuse of these solutions across multiple vehicle platforms. Moreover, the development of vehicles that are constantly capable to adapt during lifetime (e.g. by remote programming capabilities) is also not sufficiently enabled. As such the scope of this call topic is expected to go far beyond today’s product development as addressed in previous Horizon 2020 topics (e.g. H2020-GV-2018 “Virtual product development and production of all types of electrified vehicles and components”).

In order to fully exploit the potential of software-defined EV functions and vehicles, an advanced dedicated digital development framework is needed. Proposals under this topic are expected to address all of the following aspects:

- Design and validation of robust digital tools to efficiently and effectively develop complex EVs that are increasingly software-defined.
- Advanced methods for development of trustworthy (24/7 available, secure, safe) software-defined EV solutions.
- Promoting the use and adaption of conceptual tools and demonstrate integration into development frameworks for virtual approval (early demonstrators) that are applicable to all EV types considered in 2ZERO (from L-category to Heavy Duty vehicles).
- Concepts enabling the feedback to and use of all types of data (e.g. engineering data, real-life operational data of EVs) in the product development of software-defined vehicle functions including automated update of the applied digital tools and models.

Close collaboration is expected between selected projects under this topic and modalities need to be outlined in the proposal.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-06: New designs, shapes, functionalities of Light Commercial Vehicles (2ZERO Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 10.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL7-8 by the end of the project – see General Annex B.

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

- Develop and demonstrate new and innovative mission focused and efficient Light Commercial Vehicles (LCV) battery electric concepts to address new requirements (e.g. growing of e-commerce overall and in segments such as groceries or cold chain products, urban logistics consolidation schemes) from zero emission logistics processes in cities increasing the affordability and scalability of the proposed solutions.
- Demonstrate scalable zero emission real life operations in the city environment including charging and building synergies between the new LCVs and zero emission Heavy Duty Vehicles operations to address user needs in a sustainable and safe manner.
- User and mission-centric definition of requirements on vehicles, infrastructure and system from mobility operators and logistics companies considering new and innovative solutions.

Scope: The main objective of this call is to deliver new urban optimized light commercial zero-emission vehicles with a focus on goods transport, that are affordable, safe, sustainable and reliable and with a strong engagement from freight services users and fleet owners in the definition of requirements and testing. The focus will be to identify and overcome the main barriers for the development of new LCV concepts for urban and sub-urban logistics and freight mobility. Proposals are expected to address all of the following aspects:

- Engage with users of the vehicles, define requirements, expectations and potential developments that may influence future demand for these vehicles as well as considering the integration of vehicles in existing and future charging infrastructures.
- Develop and demonstrate new designs, shapes and functionalities of Light Commercial Vehicles to meet current and future needs for commercial delivery of goods, including safety aspects.
- Demonstrate the developed vehicles and operational concepts considering current and future demands for these vehicles in a growing e-commerce market for deliveries and returns of parcels, groceries and refrigerated goods and addressing the challenges holistically (i.e. by demonstrating the concepts in actual current or new logistics operations including charging and addressing requirements in cities with extended zero emission zones).
- Establish synergies and links with new logistics concepts developed in R&I projects focused on logistics operations and innovative concepts (such as the Physical Internet).
- Demonstrated vehicles and operational concepts are expected to target important markets with the potential for the largest environmental impact.
- Optionally and additionally, concepts for demonstration of the combined usage of people and freight vehicle operation, fleet utilisation optimisation in dense-urban areas might be included.
- Development of appropriate operational and control strategies during acceleration and braking to reduce secondary brake and tyre particle emissions, optimise energy recuperation and further reduce environmental impact in urban environments.

This topic implements the co-programmed European Partnership on ‘Towards zero emission road transport’ (2ZERO). As such, projects resulting from this topic will be expected to report on the results to the European Partnership ‘Towards zero emission road transport’ (2ZERO) in support of the monitoring of its KPIs.

Aviation

Proposals are invited against the following topic(s):

HORIZON-CL5-2024-D5-01-07: Accelerating climate neutral aviation, minimising non-CO2 emissions

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 17.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 2-4 by the end of the project – see General Annex B.

Expected Outcome: Project results should focus to the minimisation of aviation non-CO2 emissions. Project results are expected to contribute to at least three of the following expected outcomes:

- Primarily, further increase the scientific understanding related to the impact of aerosols on clouds as well as the contribution of aviation NOx emissions to climate change.
- Investigate further on how to support potential policy measures identified in the EASA study²⁸¹, including whether they are proportionate, feasible and reduce the overall climate impact (CO2 and non-CO2 emissions).
- Perform detailed analysis of optimal relation between costs and climate.
- Perform engine gas and particle emissions characterisation, when data is incomplete or unavailable.
- Perform flight tests and demonstrate the benefits and fuel burn trade-offs of avoiding climate sensitive regions.
- Perform hydrogen and aviation drop-in fuel research with an eye towards reducing further non-CO2 emissions.

²⁸¹ COM(2020) 747 final - Updated analysis of the non-CO2 climate impacts of aviation and potential policy measures pursuant to EU Emissions Trading System Directive Article 30(4).

- Develop further real-time decision-support software for airlines and ATM, to predict the location and global warming impact of contrail and contrail cirrus formation.

Scope: EU-studies show that approximately 50-75% of aviation's climate impact is caused by non-CO2 emissions. It is because of their local geographical character, their dependency on atmospheric phenomena, the incomplete understanding and uncertainty as well as operational trade-offs that non-CO2 emissions have been less-targeted so far from international and European regulatory measures. Recent studies show that cost-effective mitigation measures are possible, provided that focused R&I actions together with flight tests resolve the final uncertainties. However, today any avoidance that increases CO2 emissions, even at a net reduction of overall climate warming impact, introduces a complex policy issue of mitigating short-term versus long term climate effects.

Recent EU and National-funded research activities (i.e. FP7-REACT4C, SESAR-FLyATM4E, ALARM, SINOPTICA, DLR-WeCARE, H2020-ACACIA, HE-BECOM) characterized better the contrail formation and provided more insight in the aviation NOx emissions and ozone formation. The studies also showed that if aircraft operations are only optimized for fuel use, they may have an increased climate impact, since non-CO2 effects may compensate the reduced warming from CO2 savings.

Avoiding climate sensitive regions has a large potential in reducing climate impact at relatively low costs without causing significantly more CO2 emissions that outweigh the overall climate effect. The integration of data analytics and weather forecasting into advanced decision-support software tools that are able to predict real-time the contrail formation as well as propose alternative paths, are well in-line with the scope of this topic. This topic aims to integrate and provide clear operational guidelines supported by validated flight tests. Engine gas and particle emissions characterisation, when data is incomplete or unavailable, is in-line with the scope of this topic.

As a follow-up of EASA study, on non-CO2 climate impacts, and for the standardisation in view of safety considerations and future certification, the involvement of EASA is necessary (e.g. as part of the steering group), as well as the coordination with ICAO relevant groups (CAEP).

Synergies with SESAR3 should also be exploited – in view of the relevant topics in the SESAR3 JU bi-annual work programme 2022-2023. Furthermore, international collaboration for research and Air-Traffic Management should be sought (e.g. SESAR/NextGen).

Synergies may also be considered with the Digital Sky Demonstrators, including in particular flights for demonstrating green trajectories or equipped with sensors to collect data for the assessment of the non-CO2 impact on aviation. Finally, synergies with Destination Earth should also be sought.

**HORIZON-CL5-2024-D5-01-08: Competitiveness and digital transformation in aviation
– advancing further composite aerostructures**

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of between EUR 3.00 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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 16.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 2-4 by the end of the project – see General Annex B.
<i>Legal and financial set-up of the Grant Agreements</i>	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). ²⁸² .

Expected Outcome: Project results should focus on advancements in composite aerostructures and deliver new tools and processes in support of the European aviation supply ecosystem. Project results are expected to contribute to at least two of the following expected outcomes:

- Advanced composite technologies, with emphasis on new designs, high-volume sustainable manufacturing with integrated inspection, sustainable and free of toxic substances, recycling and circularity, structures safety requirements (EMC/lighting protection, ice formation, fire, fatigue, crashworthiness and ditching) and additive manufacturing of the new generation of composites - for aerostructures and propulsion.

²⁸² This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

- Breakthrough technologies in coupled aerostructures-systems-propulsion integration.
- Cost-competitive maintenance and repair of composite aerostructures, including Structural Health Monitoring (SHM).
- Advancements in physical and digital research infrastructures, with emphasis on aerostructures for all aircraft configurations with emphasis on synergies with the three Clean Aviation (CA) Strategic Research and Innovation Agenda (SRIA) thrusts, with an eye towards virtual certification.

Scope: The proposal is expected to develop further advanced composite design and manufacturing technologies that have potential to contribute to the digital transformation of the European aircraft supply chain.

The proposal is expected to give emphasis to cost-competitive and sustainable manufacturing, characterisation, maintenance and end-of-life solutions of composite aerostructures. Composite multifunctional and multi-material innovations that result from closer aerostructures-systems-propulsion integration are expected to be addressed.

All developed advanced composite technologies should be scale-demonstrated in relevant challenging industrial cases.

The proposal should seek to exploit synergies with Clean Aviation (and big demonstrations in the second phase of the partnership). The retained proposals, should, during the implementation phase, regularly exchange information with the Technical Committee of the Clean Aviation partnership.

HORIZON-CL5-2024-D5-01-09: Impact monitoring of EU Aviation R&I

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 8.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 8.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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 should deliver an impact monitoring toolbox, including impact assessments, of the European aviation research and innovation - integrating the impact of all Horizon Europe relevant aviation R&I actions along its three pillars and including actions beyond technologies and optimised operations (i.e. use of sustainable aviation fuels and market-based measures). Project results are expected to contribute to the following expected outcome:

- Deliver a toolbox, including impact assessments, that will be the reference choice for the definition and assessment of environmental, climate and competitiveness policy options of future European aviation R&I and regulatory measures (e.g. be used as the reference software to support future European Commission Impact Assessments) and assist EU Member States/Associated Countries, the European Commission and EASA in ICAO Working Groups and other International regulatory agencies. The toolbox, including impact assessments, should also be able to perform trade-off studies, include all aircraft types, address the most cost-effective policy options as a function of time (towards up to 2070) and allow policy makers, industry and scientists to take informed decisions.

Scope: The proposal is expected to build on and improve an already established reference European toolbox (e.g. developed in retained proposal(s) from HORIZON-CL5-2022-D5-01-14) able to assess the impact of European aviation R&I, which is deployed to perform impact assessments of European relevant aviation R&I actions in Horizon Europe. The European Aviation R&I policy, and aviation policy at large, need a European capability (as open-source as possible) to assess what has been achieved and provide forecast analysis of the expected outcome of technological, operational, fuel and policy options such as market-based-measures (MBM) choices. The toolbox, through its impact assessments, should provide insight that will be used in the communication of the impact and achievements of European, National and private aviation R&I investments. Impact assessments performed in Horizon partnerships and missions are a subset of this toolbox.

The toolbox should:

- incorporate methodological, science-based and validated models that can be traced;
- pay particular attention – beyond CO₂ emissions - to non-CO₂ emissions and climate-sensitive regions as well as address interdependencies (e.g. noise in the airport vicinity);
- address and improve (as a result of new technologies, aircraft configurations and missions) climate-assessment methods and optimised trajectories towards identifying promising mitigation options;
- integrate and make use of existing toolboxes developed in previous EU R&I Framework Programmes (e.g. TEAM_PLAY, CS2-TE);
- be able to set the level of fidelity for aircraft technologies and air transport system, based on available data;

- have an interactive user interface and incorporate modern open-source visualisation tools;
- be aligned with the European Commission open-source strategy 2020-2023 and be made available for non-profit use for governmental/EU studies from EU Member States/Associated Countries, European Commission, EASA and EEA;
- be aligned with the methodology, assumptions, criteria, and required data for seamless data exchange with the Clean Aviation and SESAR 3 partnerships. The Commission will further take into consideration other Horizon Europe impact assessments and coordinate it with the Clean Aviation Technical Committee and SESAR 3 Scientific Committee.
- include impact assessments of European relevant aviation R&I actions in Horizon Europe.

The participants should work closely together with the relevant European Commission Services, the European Union Aviation Safety Agency, the Clean Aviation and SERAR3 European Partnerships as well as the European Environment Agency.

HORIZON-CL5-2024-D5-01-10: Towards a flying testbed for European leadership in aviation

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 16.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 16.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 4-5 by the end of the project – see General Annex B.

Expected Outcome: Projects should contribute to Europe's industry lead the twin transitions towards climate neutrality and digital leadership. The project is expected to deliver on all of the following expected outcomes:

- Design of concepts and validation of an experimental aircraft that will test, validate and accelerate radical new technologies and aircraft configurations that go well beyond the state-of-the-art;
- Deliver feasibility studies of the targeted aircraft concept, towards a preliminary design review, making use of sound/proven advanced simulation and modelling techniques;
- Deliver detailed technical roadmaps that demonstrate the path towards a flying test bed. Such roadmaps should include a needs and gaps analysis in terms of Technology Infrastructures with respect to radical aircraft configurations and related technology validation and certification;
- Provide a preliminary implementation and execution plan for the targeted aircraft concept, including a business and operating model.

Proposals may also address any of the following expected outcome(s):

- Address the impact on the air transport system of the targeted aircraft concept. Depending on the chosen concept, this may include Air Traffic Management, Safety and Security (including Cyber), New business models, Unmanned Aerial Systems, societal acceptability and impact, noise and quality of life, aircraft end-of-life aspects;
- Address sustainable and agile design, digital manufacturing methodologies and technologies, as well as the promotion of systemic circularity throughout the value chain;
- Provide a preliminary labour market analysis, including skills and education needs, needed for the development and full-scale commercial production of the concepts;
- Address the critical dependencies of aviation on imported fossil fuels and critical materials, contributing to a significant reduction of overall Europe's dependencies²⁸³ and promotion of European resilience and competitiveness;
- Propose new approaches to shorten the time to market, such as through digitalisation of key processes, virtual certification techniques, open innovation, etc.

Scope: Faced with the urgent imperative to decarbonise aviation, the industry is expected to be prepared to change from the current traditional aircraft designs evolved over decades and move to new sustainable disruptive solutions across its complete portfolio of aircraft for the long-term.

A fundamental steppingstone to achieve the long-term goal of developing more sustainable disruptive solutions are experimental aircraft which have shown over the decades to have a lasting influence on the industry's long-term design choices and competitiveness. Experimental aircraft have been essential to de-risk and understand the possibilities of new solutions before irreversible decisions need to be made.

²⁸³ <https://ec.europa.eu/social/main.jsp?catId=1223&langId=en>

In addition, experimental aircraft programmes have an agglomeration effect on key skills and facilities throughout the research and development value chain, as well as providing a notable source of inspiration to multiple generations of future aspiring aerospace professionals and society in general.

Therefore, this type of endeavour is an ideal opportunity for a pan-European approach to lead the way and build upon the findings from the H2020-RINGO²⁸⁴ project where a strong need was found for sub-scale to full-scale flying demonstrators for validation and demonstration of new configurations and concepts. These flying test beds should focus on innovations that go well beyond anything currently addressed in Clean Aviation and should focus on generating impact in 2050 and beyond.

This topic aims at significantly reinforcing the EUs leading position in Aerospace innovation through radical, experimental innovation needed for zero-emission aircraft of the future. By creating a flying, experimental test bed the twin transition of Europe towards a climate neutral and digital society will be accelerated and EU global industrial leadership will be strengthened. The European flying testbed, the E-Plane will enable disruptive ideas to be tested and will shape the sustainable, zero-emission air transport of tomorrow.

The concept aircrafts are also expected to address long-range (>4000km) missions, where new radical configurations are still needed to be explored to fill gaps for implementation in time to help ensure global aviation carbon neutrality by 2050. To allow for new, disruptive business models, no passenger range or payload is prescribed. However, future competitiveness of the concept should be addressed.

This topic should contribute to the European Skills Agenda The topic addresses primarily to RTOs/Academia/SMEs, with guidance from suppliers and aircraft integrators. One retained project for this topic will allow meaningful validation and feasibility studies and common platform.

Waterborne transport

Proposals are invited against the following topic(s):

HORIZON-CL5-2024-D5-01-11: Achieving high voltage, low weight, efficient electric powertrains for sustainable waterborne transport (ZEWTP Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 7.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.

²⁸⁴ <https://cordis.europa.eu/project/id/724102>

<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

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

- Demonstrate increased performance, efficiency, feasibility and reliability of battery installations in high voltage on board distribution systems and thereby facilitate the greater deployment of battery electric shipping.
- Development and validation of battery real-time condition monitoring systems with predictive analytics integrated algorithms.
- Demonstration of high-capacity energy storage systems above 1 MWh directly interfaced to medium voltage AC (3.3 kV or above) or DC (above 1 kV) power systems, by modular approaches.
- Demonstrate the feasibility of an innovative low weight, high-energy density battery concept in demonstrators, considering maritime and inland waterway transport applications, including demonstration of on-board battery safety.
- Efficient modular redundant conversion systems with low voltage battery modules at floating potential and insulation for cost effective integrated battery modules and conversion systems are designed.
- Evaluation of sustainable life cycle management of electrical energy storage systems.

Scope: The voltage level of battery installations on-board vessels is typically limited and within the regulations for low voltage installations. By increasing the voltage level of the on-board distribution system, the energy conversion can achieve higher efficiencies and be more compact, due to the smaller cross-sectional area of conductors and lower losses. However, for waterborne transport (waterborne transport refers to both maritime and inland waterway transport) applications, challenges remain related to the design of conversion systems and insulation methods for integrating low voltage battery systems in high voltage AC or DC distribution systems. The necessary regulatory aspects also need to be defined to facilitate market take up for waterborne transport. Although e.g. high-voltage Li-Ion battery packs may be presently applied, the current state-of-the-art still offers solutions that are too heavy to

enable electrification of a wider range of larger waterborne transport assets. However new developments show potential for a reduction of battery pack weight. Further study of the adaptation and the on-board integration solutions available for recently developed technologies, such as Li-Ion NMC, LTO, LFP is needed.

Building on the current state of the art solutions should contribute towards the battery electrification of a wider range of vessel types, for both maritime and inland waterway transport which are characterized by the need for larger battery systems and longer autonomy.

Projects are expected to address all of the following aspects:

- Design of battery management systems of high voltage battery installations for AC and DC distribution systems in waterborne transport.
- Design and control of conversion systems, insulation design and insulation coordination.
- Adoption of low weight electrical energy storage designed to be integrated on board (e.g. not an on deck ISO container).
- Sustainability and circularity criteria to be preferably adapted for whole life of on-board battery pack solutions (i.e. second-life applications).
- Identification and characterisation of the specific requirements needed for inland waterway and maritime transport.
- Development of battery safety concept that is in principle suitable for class approval, especially for large battery spaces on-board, considering detection, ventilation and fire suppression technology.
- Identify and, if necessary, support the development of any new standards and certification procedures which will be required to facilitate deployment of the developed new technologies and solutions.

The new solutions should also contribute significantly to the overall safety for on-board battery applications (i.e. for toxic emissions, fire propagation, etc.). The form factor, the battery management system and the interface with the shore side electric grid should also be considered.

The projects are expected to ensure synergies with the Horizon Europe Batteries Partnership and are encouraged to envisage clustering activities with the project funded from the topics HORIZON-CL5-2021-D2-01-02 and HORIZON-CL5-2021-D2-01-03.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-12: Combining state-of-the-art emission reduction and efficiency improvement technologies in ship design and retrofitting for contributing to the "Fit for 55" package objective by 2030 (ZEWT Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 7.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 7 by the end of the project – see General Annex B.
<i>Legal and financial set-up of the Grant Agreements</i>	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 outputs and results are expected to contribute to the following expected outcomes:

- Development of at least three market ready vessel design solutions to address short sea shipping, inland waterway transport and high seas shipping making innovative use of combinations of close to market (TRL 7 or higher) emission reduction and efficiency improvement technologies to reduce emissions from shipping in line with the expectations within the EUs “Fit for 55” legislative package.
- Quantitative assessment of the designs towards achieving significant emissions reductions consistent with the EU’s ‘Fit for 55’ package objectives and the IMO’s Carbon Intensity Indicator through verifiable KPI’s.
- Facilitation of the continuous improvement and upgrading of existing vessels to increase efficiency and reduce emissions through the measurement and bench marking of operational profiles.

- Quantification of the contribution towards cutting emissions from a range of emission reduction technologies on a life cycle basis. Including the separate and joint consideration of design and operations within relevant environments. Enable assessment of the retrofit and refurbishment options of applied emission reduction technologies.
- Support accelerated conversion of inland and maritime vessels towards better energy efficiency and reduced emissions.
- Development of robust business models for the design concepts, to ensure a high probability of commercial European deployment and the expectation of becoming operational by 2030.

Scope: Legislative proposals within the EU's "Fit for 55" package targeting the reduction of waterborne transport emissions will assess emissions reductions based on operational data collected within the framework of the EU's MRV regulation. Internationally, for global maritime shipping, the forthcoming IMO Carbon Intensity Indicator and Data Collections System (DCS) will be used. Vessels visiting EU ports will need to provide data to ensure compliance with both MRV (EU) and DCS (IMO) data requirements. This change from assessing emission reductions based on design to the direct measurement and verification of actual operational emissions requires a new approach to design. Consequently, the vessel design process will need to employ modelling and simulation techniques which take into account the vessel's expected operational profile and life cycle so as to ensure that the delivered vessel or modification will deliver the expected emission reductions in the "real world"

For new builds, present improvements in ship energy efficiency have reduced consumption by 15-30% compared to equivalent reference ships in 2008. Contributing to fit for 55 objectives, the challenge is to develop at least three concept vessels which will further improve energy efficiency by at least 20%, compared to a 2022 reference performance for equivalent ships.

This "design for operation" approach will integrate and combine both operational energy savings and emission reduction technologies. Several technologies and solutions to be combined and integrated should be chosen so as to provide the largest impact and these are expected to already be individually demonstrated or developed to TRL 7. This could for example concern various combinations of; power conversion/electrification /energy devices, sustainable climate neutral low emission fuels, HVAC, energy storage, operations, smart energy monitoring, renewables including wind assistance, hydrodynamics, cold ironing, slow steaming, just in time scheduling, propeller designs etc.

In order to address the above-mentioned challenge, proposals are expected to address all the following aspects:

- Energy system modelling and fast simulation assessment to demonstrate the expected energy efficiency gains and life-cycle emission reductions achieved by the resulting designs within their operating reference cases. A holistic/systemic approach should be

applied to the design, which is to be based upon total vessel energy needs for use within reference operating profiles and business cases.

- A minimum of three vessel concept designs and use cases are expected to be developed including the following vessel types: short-sea, inland waterway and high-seas. For each vessel type, retrofit solutions for the baseline design (from 2008) should be proposed, as well as a completely new design.
- Development of an open-source design assessment tool which can be used to assess the operational Carbon Intensity of vessel designs.
- Development of decision-support or automation systems to facilitate the most effective implementation of operational energy efficiency improvements.
- Plans for exploitation and dissemination of results should include a strong business case and sound exploitation strategy. Development of business models to facilitate the deployment of the resulting vessel design concepts, in particular addressing financing, market needs and possibilities to support first of a kind deployment. Considering the potential of opportunities within EU support schemes such as the Connecting Europe Facility, Climate Change Innovation Fund and regional funds. Proposals are expected to demonstrate a clear and credible pipeline from the development to the operational deployment of the developed designs by 2030. This should include preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan) indicating the possible funding sources to be potentially used.

When appropriate, activities may also address the definition of a secure knowledge sharing platform to enable the necessary data-transfer to obtain detailed operational performance information.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-13: Demonstration of Technologies to minimise underwater noise generated by waterborne transport (ZEWT Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 6.00 million.
<i>Type of Action</i>	Innovation Actions

<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 6-8 by the end of the project – see General Annex B.

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

- Demonstration of underwater radiated noise (URN) reduction through large scale demonstrators or retrofitted ships employing URN reduction modifications and assessment through verifiable KPIs.
- Demonstration of the effectiveness, safety and cost-effectiveness of noise mitigation devices, mitigation measures and management options and assessment through verifiable KPIs.
- Development of standards for the specification of source noise levels by equipment suppliers and shipyards, which build upon the current state-of-the art.
- Has increased the awareness of European ship owners of the environmental impact from underwater noise and the possibilities to reduce noise and its harm to the marine environment.
- Provide evidence to regulators concerning waterborne transport underwater noise to better take into account operational conditions and environmental impact within any forthcoming regulation.

Scope: Whilst on-going research seeks to characterize the underwater radiated noise (URN) which poses the greatest threat to aquatic species and the marine environment as well as characterizing potentially promising solutions to reduce the impacts of URN, the demonstration of technologies to minimize the harmful impacts from waterborne transport URN remains less developed. Current on-site URN measurement campaigns do not address all potential waterborne transport related noise sources and selecting suitable mitigation measures remains a challenging task as there are many options for URN reduction. Consequently, assessments need to be made on a case-by-case basis considering environmental, operational and economic factors and when relevant taking into account previous work such as the European Marine Board position paper on underwater noise. An important challenge is to predict URN at the design stage to be able to implement less noisy environmentally friendly solutions from an early stage. This challenge is faced both at equipment design level and at the ship integration stage. Consequences of the noise reduction solutions for GHG emissions should be considered.

Current approaches to the regulation of URN focus on controlled criteria (fixed speed, no waves etc.), whilst ships operate at various speeds, loads and sea states which further complicate the challenge of designing a quiet ship suitable for a wide range of conditions. A further challenge is to be able to operate a noise measurement system on-board which can provide instantaneous information to the crew on the ship's operational radiated noise. Noting that an informed balance may also need to be taken between GHG emissions and URN.

In order to address the above-mentioned challenge, proposals are expected to address all the following aspects:

- Development of methods and models to predict under water radiated noise levels in the design phase.
- Conduct modelling and field studies to improve the effectiveness, safety and cost-effectiveness of noise mitigation devices, mitigation measures and management options in different sea states and in different ship loads. The identified solutions should be tested and demonstrated through large scale demonstrators that may, when appropriate, and feasible, also include the monitoring of the response of key susceptible species.
- Projects should develop systems for on-board measurement of noise, and decision support systems to reduce radiated noise whilst maintaining energy efficiency in normal operation.
- The project should build upon the current state of play, for example taking into account the H2020 project SATURN and the LIFE+ project PIAQUO to support the development of standards for the specification of source noise levels by equipment suppliers and shipyards. The projects are expected to propose synergies and clustering with related projects and activities addressing underwater noise, including from non-transport sources.
- In addition, the project should address communication towards the European ship owners and operators to raise awareness, inform about the environmental impact and on the technical possibilities to reduce their noise and its impact on the underwater environment.
- Engage with regulators to raise awareness on noise from waterborne transport depending on operational status, weather conditions, loading conditions, water conditions (depth, type of bottom, temperature salinity etc.) the frequency and type of noise and its impact on the environment for the purpose of considering them in future potential regulations.

This topic implements the co-programmed European Partnership on 'Zero Emission Waterborne Transport' (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Zero Emission Waterborne Transport' (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-14: Demonstrating efficient fully DC electric grids within waterborne transport for large ship applications (ZEWTP Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 7.50 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 15.00 million.
<i>Type of Action</i>	Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 6-8 by the end of the project – see General Annex B.
<i>Legal and financial set-up of the Grant Agreements</i>	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 outputs and results are expected to contribute to the following expected outcomes:

- Enabling reduced emissions from waterborne transport through increased electrification including hybrid power systems.
- Demonstration of the feasibility of a secondary smart DC grid (engineering framework, distribution/protection devices).
- Demonstration of smart management and control of hybrid electric plants, combining different energy sources, including sustainable climate neutral fuels so as to minimize total lifecycle net GHG emissions
- Development of a new configuration for the entire power generation architecture for large scale waterborne transport ready to be deployed.

- Development of new power electronic systems for AC/DC converters and DC circuit breakers within the electrical network with higher efficiency.
- Assessment of the waterborne transport emission reduction from increased electrification including hybrid power systems. Benchmarking and quantification of achieved GHG emission reduction through relevant quantifiable KPIs.
- Assessment through verifiable KPIs of the operating costs reductions and the reduction in emissions by cutting energy consumption and extending service intervals of the generator sets.
- Assessment through verifiable KPIs of the efficiency and power density improvements to reduce the overall volume and weight.

Scope: Primary DC systems are now applied on multiple types of ships, employing battery energy storage. The application of DC grids on-board has already started and will grow significantly because of its promising aspects such as reduction of complexity, increased modularity and improved integration. However, further progress is required to unlock the full potential of an on-board DC grid for large ship applications (over 5000 GT) addressing the entire network for both primary and secondary (auxiliary) distribution system, taking into account the various on-board applications of ship's electrification systems (e.g. high-power fuel cells, batteries, etc.) The challenge is to focus not only on secondary distribution, but also on the integration/interconnection of new sustainable primary power systems within a DC grid network serving the entire ship

In order to address the above-mentioned challenge, proposals are expected to address all the following aspects:

- Develop high TRL innovative power electronic systems (e.g. converters, circuit breakers with logic selectivity) adapted and certified for waterborne transport applications.
- Develop a new concept of smart, flexible, plug-and-play DC power grid which leverages the capability of new power electronic systems and allows for different DC power generation systems based on sustainable alternative energy sources.
- Research the impact of design choices, safety measures and integration on the ship. This will require the development and on-board integration of high-power equipment and systems to complement the electrical grid (e.g. solid-state protection, solid-state transformers, Silicon-Carbide Power Devices,
- Develop a prototype system at small scale (min. 100kW) within a real waterborne transport environment. Demonstrate the functionality and the integration of its components, prove the possibilities for further upscaling. Prove the feasibility and benefits of distributing main power based on DC instead of AC.
- Validate the system with classification societies ensuring the highest standards for safety and reliability.

- Develop standards for on-board DC microgrids and communication protocols which are particularly valuable for large ships where there is differentiation between the electrical supplies towards different zones (e.g. zones with ICE and zones with RES systems).
- Integrate new power electronic systems within the ship’s network with advanced control systems to cope with variable loads and high levels of DC currents to interrupt.
- The emissions, efficiency and operational savings are expected to be demonstrated on a relevant ship type to validate the research results. The transferability of the applications to be applied has to be proven towards a range of vessel types, including those which have larger battery systems and longer autonomy. The demonstration is expected to serve as a reference for a wide spectrum of ship's types using electrical propulsion and auxiliary power.
- Where relevant, synergies and collaboration should be planned with the related activities and projects arising from linked Horizon Europe initiatives, in particular the Batteries and Clean Hydrogen JU partnerships.
- Plan for the exploitation and dissemination of results should include a strong business case and sound exploitation strategy, as outlined in the introduction to this Destination. The exploitation plans should include preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan) indicating the possible funding sources to be potentially used.

All relevant stakeholders (electrical distribution and protection manufacturers, engineering companies, manufacturers of electrical equipment, users, shipyards, etc.) should participate in proposals in view of the systems development.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-15: Advanced digitalisation and modelling utilizing operational and other data to support zero emission waterborne transport (ZEWT Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 7.70 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 7.70 million.
<i>Type of Action</i>	Innovation Actions

<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 6-7 by the end of the project – see General Annex B.

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

- Development and demonstration of a platform for Integrated Green Vessel Digital Twins that will provide a basis to continuously improve the environmental performance of vessels over their entire life cycle.
- Improved environmental performance through verifiable KPIs.
- Proven applicability of the platform to a wide variety of vessel operations throughout the vessels’ lifetime, by using model-based systems engineering, simulation and hardware in the loop approaches.

Scope: State-of-the-art of Digital Twins (DT) applied to waterborne transport are typically characterised by a focus on specific limited aspects of the design or operation of a vessel based on numerical simulations. Integrated Green Vessel DTs, which take an integrated approach to combine design and operation to improve efficiency and reduce emissions are not well addressed. Furthermore, aspects of open (software) architecture, data standards, security guarantees and data sovereignty of data owners are also not comprehensively addressed. Whilst some advances in data integration for different applications have been made, a comprehensive global integration of data remains missing.

These higher levels of integration between different functions of an Integrated Green Vessel DT (e.g. during design and operation of waterborne transport assets) require both complex multi-physics simulations and advanced levels of data organisation. This leads to the need for higher computational efficiency to meet future requirements in terms of accuracy, and the integration of the digital representation of suitable technologies for the transformation of vessels into “Green Vessels” within an Integrated Green DT that will aim to improve the vessels environmental performance.

Integrated Green Vessel DTs need to be applicable throughout the life cycle of the vessel, from initial design, to detailed design, engineering and production, operation, retrofitting, and circular end of life. To make best use of an Integrated Green Vessel DT, it should allow addressing optimisation for enhanced energy efficiency and reduced environmental footprint in a consistent way throughout the lifecycle of the vessel. This will require a thorough consideration of potential operational conditions as well as possible future regulatory changes.

The Green Vessel DT will play a key role in design and operation of future zero or low emission vessels as well as their through-life sustainability upgrades. Mapping all relevant data influencing operational environmental performance, it will be the basis for decision support for operational (AI-based) optimisation, for considering the use of for example propulsion changes, retrofits, alternative fuel options, use of renewable energies solutions) and predictive maintenance.

Proposals are expected to address all of the following aspects:

- Development of an Integrated Green Digital Twin.
- Make best use of available (simulation) concepts and consider all relevant life-cycle aspects, including end of life disposal.
- Incorporate all relevant aspects of physics simulation, design and operational planning and optimisation as well as data organisation and storage, integrating also real data obtained from monitoring and measurements.
- Ensure the system will be adaptable to consider all potentially relevant retrofits needed to meet future regulations and changes in operational profile both during initial design and throughout the vessels lifecycle.
- Assessment of the environmental performance through verifiable KPIs.
- Optimisation of the vessel's equipment in operational conditions in order to provide the best environmental and economic solution for a given waterborne transport operation.
- Use open standards, libraries and tools to create generic and reusable solutions applicable to a wide range of waterborne assets.
- Ensure the interoperability of data models, address data ownership and integrity of data sets as well as ensuring security against cyber and physical threats.
- For case studies on at least 2 different ship types, test and demonstrate the developed digital twin model to quantify the improved environmental performance and efficiency achieved as a result.

Plan for the exploitation and dissemination of results should include a strong business case and sound exploitation strategy, as outlined in the introduction to this Destination. The exploitation plans should include preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan) indicating the possible funding sources to be potentially used.

This topic implements the co-programmed European Partnership on 'Zero Emission Waterborne Transport' (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership 'Zero Emission Waterborne Transport' (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-16: Structuring the Waterborne transport sector, including through changed business and industrial models in order to achieve commercial zero-emission waterborne transport (ZEWTP Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 0.85 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 0.85 million.
<i>Type of Action</i>	Coordination and Support Actions
<i>Eligibility conditions</i>	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).
<i>Legal and financial set-up of the Grant Agreements</i>	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). ²⁸⁵ .

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

- A full understanding of the business model, labour, financial and commercial barriers to the take up of innovative low and/or zero emission solutions for waterborne transport, including consideration of ship financing and investment structures, charter and other contracts.
- Identification of potential solutions to overcome business model and commercial barriers to the take up of innovative low and zero emission solutions in waterborne transport.

²⁸⁵ This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

- Understanding of the industrial capacity and how it would be scheduled to retrofit and/or replace the current European fleet to meet 2030 and 2050 emission reduction and pollution targets. Considering all vessels operating within the European region, including inland waterway transport vessels, short sea shipping services (including ferries and cargo vessels), cruise and offshore vessels;
- Increase commitment from the wider waterborne sector, including finance, contracting insurance, charterers, operators, owners, public stake holders, technology providers as well as civil society towards recognizing the importance of European waterborne transport, its environmental objectives and the consequential economic impacts.

Scope: The European Green Deal sets ambitious objectives to transform Europe into the first climate neutral continent by 2050. This presents a valuable opportunity for the European industry, and in particular for the waterborne transport sector, where Europe leads in high technology and green energy efficient shipping development. Also digitalisation has an impact on reducing emissions and increasing efficiency, while increasing safety, security, and reliability of the waterborne transport, and therefore is already impacting the business models and dynamics of the sector.

Whilst Europe is still a worldwide leader in advanced, digital and green shipping, there is a lack of take up of new technologies within the wider waterborne transport market. In part, this is a reflection of the sectors' conservatism and reluctance to change unless driven by regulation. It is also hindered by the complex commercial structures and finance models which can distance the interests of ship owners who commission new builds, financiers who commoditise vessel value by type, operators who can benefit from lower fuel consumption as well as cargo owners who may benefit from 'environmentally friendly image' and final points of sale where the use of low emission shipping can be a potential commercial advantage. Whilst new business models and labelling schemes to better incentivize green shipping have been developed, they are yet to be widely established and are largely unknown. There is a need to objectively analyse the segments of the waterborne transport sector, and within each segment characterize the business models, identify the barriers to the take up innovative low and zero-emission waterborne transport solutions and in cooperation with the stakeholders to propose commercial models which can provide a better incentive for increasing the investment in low or zero-emission solutions in the European waterborne transport sector.

Furthermore, it is important to increase awareness of the public and the broader non research waterborne sector about the economic and environmental importance of the European waterborne transport sector, highlighting its commitment, ability and opportunities to develop and implement competitive solutions which will meet the ambitious objectives reflected in the European Green Deal.

To ensure a coordinated approach to develop zero-emission, digital, automated and competitive European waterborne transport the participation of all types of both private and public stakeholders, including financiers, charterers and others within the commercial side of the waterborne business community should be envisaged. Cooperation with relevant existing

initiatives, like the European Sustainable Shipping Forum, CESNI, the Waterborne Technology Platform and others, will be key. In addition, it should be ensured that proposals take into account the results of relevant R&I projects (including Horizon 2020 and Horizon Europe) and relevant studies. Proposals should address all of the following:

- Identify business models and the financial and commercial barriers to the take up of innovative low and/or zero emission solutions for waterborne transport. The financial investment, labelling and contract structures as well as the new possibilities enabled by digitalisation should be considered. An analysis of the different responsibilities and business motivations between charterer, cargo owner, ship owner, point of sale etc. should also be taken into account.
- Analyse the needs and timing to retrofit and replace the current European fleet (including inland waterway transport vessels, ferries, short sea shipping, cruise ships and offshore vessels). The analysis should be combined with an overview of the European capacity (with respect to technology and skilled workforce) available to retrofit these vessels and identify any capacity gaps for the timely implementation of the European Green Deal emission targets;
- Provide an analysis of where disincentives exist to the increased deployment of innovative low and/or zero emission and smart shipping, within different market segments/ The analysis should consider for example the investment decision cycle: finance models, bunkering and fuel supply infrastructure, availability, longevity and costs of technologies, possibilities to retrofit/build a vessel timely, properly skilled workforce, etc. and propose incentives and improvements to the business models such as new contract models and financing structures.;
- Organise specific communication and exploitation activities towards relevant stakeholders outside the participants of the project to ensure that all stakeholders from EU Member States/Associated countries are informed about the solutions developed;
- To assure a beneficial societal impact from the activities, relevant social science and humanities expertise are expected to be taken into account, including the active contribution from SSH experts and/or institutions.

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

HORIZON-CL5-2024-D5-01-17: Coordinating and supporting the combined activities of member and associated states towards the objectives of the Zero Emission Waterborne Transport partnership so as to increase synergies and impact (ZEWT Partnership)

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 1.50 million.
<i>Type of Action</i>	Coordination and Support Actions
<i>Eligibility conditions</i>	<p>The conditions are described in General Annex B. The following exceptions apply:</p> <p>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).</p> <p>In order to ensure appropriate impact, proposals must include National Authorities or national R&I funding bodies from at least 5 EU Member States or Associated Countries.</p>
<i>Legal and financial set-up of the Grant Agreements</i>	<p>The rules are described in General Annex G. The following exceptions apply:</p> <p>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).²⁸⁶.</p>

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

- Increase the impacts arising from the Zero Emission Waterborne Transport (ZEWT) European partnership towards the achievement of zero emission waterborne transport in Europe.

²⁸⁶ This [decision](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf) 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

- Leverage the efficiency of national and EU R&I investment to accelerate the development and deployment of zero emission waterborne transport for both European and national benefit.
- Further align national programs with the activities and outcomes of the ZEWT co-programmed European Partnership;
- Establish a cooperation mechanism between EU Member States and Associated countries to jointly fund research related to the objectives of the ZEWT co-programmed European Partnership;
- Creating a critical mass and excellence in precompetitive breakthroughs related to the objectives of the ZEWT co-programmed European Partnership.
- Reinforced synergies between ZEWT actions within Horizon Europe and those of EU Member States and Associated countries within other EU programs such as the Blue Economy Partnership, European Regional Development Fund, Connecting Europe Facility, Innovation Fund and other national programmes.

Scope: EU Member States and Associated Countries have previously cooperated in the framework of the Horizon 2020 ERA-NET Co-fund MarTERA (“Maritime and Marine Technologies for a New ERA”) which engaged 16 countries which together launched joint calls that supported nearly 50 joint projects with €56M of funding. This has established valuable coordination between national and European research, including with the waterborne transport sector. The benefits from synergies towards the achievement of common goals which align with the objectives of the ZEWT partnership. This requires better coordination and harmonisation of individual national funding programmes as well as consideration and alignment with the ZEWT partnership and its related calls and projects. Furthermore, national administrations are best placed to facilitate this alignment and the increased participation of SMEs within European projects which are aligned with the objectives of ZEWT. Amongst a critical mass comprising national authorities and R&I funding bodies from multiple EU Member States/Associated countries will contribute to increasing the impact from the activities of the partnership and its related calls and projects as well as accelerating implementation of the partnerships SRIA and enhancing the efficiency, synergies and impacts of national activities which are aligned with ZEWT objectives, also engaging with relevant networks of Horizon Europe National Contact Points.

With respect to actions which are aligned with the objectives of the ZEWT partnership, activities should include all of the aspects below:

- Facilitating collaboration between member and associated states in a variety of configurations including possibly joint calls to increase synergies, impact and efficiency of national activities as well as accelerating progress towards achieving the objectives of the ZEWT partnership. However, activities will not include support to the projects themselves and their management.

- Reinforcing the complementarity of national schemes towards the take up and deployment of European R&I results which are aligned with the objectives of ZEWT and thereby increasing impact and value from European and national investments.
- Reinforcing synergies between ZEWT related actions addressed within Horizon Europe and those of EU Member States and Associated States within other EU programs such as the Blue Economy Partnership, European Regional Development Fund, Connecting Europe Facility, Innovation Fund and other national programs

This topic implements the co-programmed European Partnership on ‘Zero Emission Waterborne Transport’ (ZEWT). As such, projects resulting from this topic will be expected to report on results to the European Partnership ‘Zero Emission Waterborne Transport’ (ZEWT) in support of the monitoring of its KPIs.

Transport-related health and environment

Proposals are invited against the following topic(s):

HORIZON-CL5-2024-D5-01-18: Assessment of air pollutant emissions from low-carbon fuels in the heavy-duty, aviation, and maritime sectors

Specific conditions	
<i>Expected EU contribution per project</i>	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.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 7.00 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Eligibility conditions</i>	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).
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 5-6 by the end of the project – see General Annex B.

Expected Outcome: To support the [Zero Pollution Action Plan](#)²⁸⁷, project results are expected to contribute to all of the following expected outcomes:

²⁸⁷ https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_

- The air pollutant emissions from combustion-based heavy-duty vehicles (including Non-Road Mobile Machinery like excavators, bulldozers, harvesters etc.), aircraft and ships using alternative fuels, with a broad coverage of existing (at least in advanced prototype form) powertrains and exhaust after treatment technologies, are measured and characterised according to real-life scenarios of use.
- Emerging pollutants resulting from the use of novel low-carbon fuels are identified and quantified.
- In light of recent WHO guidelines, concentrations of ultrafine particle emissions down to at least 10nm are also measured and chemical compounds present on those particles are characterised (in particular carcinogenic compounds like aldehydes, PAHs and NPAHs).
- Air pollution exposure projections based on plausible technological trajectories are produced, up to the year 2050.
- Technology packages to mitigate the emerging forms of pollution are proposed and projections updated accordingly.
- Reliable scientific data to guide future policy and technology choices following the “do no significant harm” principle is provided.
- Guiding principles for optimized Design, Operation and Maintenance, to minimize emissions, for designers and operators.

Scope: Low- or zero-carbon fuels proposed for use in the next decade can be covered, however the priority is on fuels that have already been demonstrated in real world applications or are foreseen to gain market share according to the projections made in the context of the ‘Fit for 55’ package.

A complete polluting emissions speciation should be performed in different working conditions encountered in real use. Therefore, the pollutants expected to be quantified should go beyond the list of the currently regulated ones.

Since accessing ships and aircrafts for testing is not straightforward, and no fuel or engine development work should be funded in the proposals, cooperation with existing projects where such fuels are tested is expected.

A study of possible mitigation actions should focus on any new pollutants that have a high toxicity, a high global warming potential, or both.

The potential from upstream emissions and of secondary pollutants formation in the atmosphere deriving from the new emissions should also be considered and quantified. Any trade-offs between GHG effects over the next 20-year period, health and other environmental impacts should be identified and assessed.

The projects should assess impacts on human health, in particular those of any emerging pollutants.

In consideration of the above, proposals should address all the aforementioned aspects and issues in order to achieve the expected outcomes