Destination - Clean environment and zero pollution

Anthropogenic pollution undermines the integrity of Earth's ecosystems and severely affects natural resources essential for human life. Keeping our planet clean and our ecosystems healthy will not only help addressing the climate crisis but also help regenerate biodiversity, ensure the sustainability of primary production activities and safeguard the well-being of humankind. In line with the objectives of the European Green Deal and related initiatives targeting environmental challenges, particularly the EU zero pollution action plan, the 2030 climate target plan, and other relevant EU legislation, this destination seeks to halt and prevent pollution by focusing on:

- removing pollution from fresh and marine waters, soils, air, including from nitrogen and phosphorus emissions;
- substituting harmful chemicals;
- improving the environmental sustainability and circularity of bio-based systems;
- reducing environmental impacts of and pollution in food systems.

Synergies with other clusters (notably 1 for health issues and 5 for air pollution from urban sources), relevant destinations, missions (particularly 'A Soil Deal for Europe' and 'Restore our Ocean and Waters by 2030') and partnerships will be exploited.

Topics under the heading ***Halting pollution of air, soil and water*** aim to identify and demonstrate approaches to combat diffuse emissions of pollutants from land and other sources. In this context, keeping nitrogen (N) and phosphorus (P) cycles in balance is a major challenge. N and P flows from anthropogenic sources, mostly from excessive or inefficient input of fertilisers (manure, sewage sludge, etc.) in agriculture and from waste water treatments, currently exceed planetary boundaries. Their leaching and run-off negatively affect soil biodiversity, pH, organic matter concentration and carbon sequestration capacity, and cause the eutrophication of water bodies while ammonia and nitrous oxide emissions affect air quality and climate. As all environmental compartments are concerned, a systemic approach is needed to limit N/P emissions from different sources, and to bring N/P flows back within safe ecological boundaries, e.g. by improving the way fertilising products in agriculture are managed while taking into account regional conditions. Actions will include showcasing best practices to recover nutrients from secondary raw materials in order to produce alternative fertilisers and demonstrating pathways for regions to keep their N/P flows within ecological boundaries.

Topics under ***Protecting drinking water and managing urban water pollution*** seek to develop and demonstrate a comprehensive framework bringing together new innovative solutions and approaches to ensure drinking water is of a good quality, address urban water pollution and harmonise different policies and management approaches. Actions should explore solutions to increase the resilience of urban waste water systems, reducing the carbon

footprint and emissions, improve resource efficiency and energy recovery, and limit risks from contaminants of emerging concern. An integrated strategy to harmonise and update monitoring with prioritisation for comprehensive control of urban water cycles should be developed by harnessing the potential of digital solutions.

Topics under ***Addressing pollution in seas and ocean*** strive to fill knowledge gaps about risks and impacts of pollution from contaminants of emerging concern in the marine environment (in particular pharmaceuticals and endocrine disruptors) including in the context of the changing marine environment due to changes in the climate system. They will further develop and test solutions for the integrated assessment and monitoring of the circulation and impacts of contaminants of emerging concern in the marine environment, in order to help implement EU policies and legislation, e.g. the Water Framework Directive and Marine Strategy Framework Directive. Actions should also explore the role of pollution in intensifying impacts related to climate change, including in the Arctic, resulting in solutions and strategies to help ecosystems and human communities adapt as regards the changes in the Arctic.

Topics under ***Increasing the environmental sustainability and circularity of bio-based processes and products*** look at developing bio-based solutions for environmental monitoring and remediation as well as the concept of integrating sustainability and circularity into bio-based systems. This concept also includes bio-based chemicals, additives and materials solutions contributing to carbon removal objectives, the chemicals strategy for sustainability (CSS strategy) and the development of safe- and -sustainable-by-design materials and products.

Furthermore, topics under the heading ***Reducing the environmental impact and pollution of food systems*** focus on increasing our knowledge of the soil, water and air pollution stemming from different food production and supply practices and providing opportunities to reduce environmental and climate impacts of food systems. This also includes preventing and reducing plastic pollution stemming from plastic food packaging.

Expected impact

Proposals for topics under this destination should set out a credible pathway that helps to halt and eliminate pollution to guarantee clean and healthy soils, air, fresh and marine water for all and ensure that natural resources are used and managed in a sustainable and circular manner. To reach this objective, it will be vital to advance the knowledge of pollution sources and pathways to enable preventive measures to be rolled out, improve sustainability and circularity, apply planetary boundaries in practice and introduce effective remediation methods. To this end, the following is required:

- move towards achieving clean, unpolluted surface water and groundwater bodies in the EU and Associated Countries by increasing understanding of diffuse and point sources of **water pollution in a global and climate change context**, enabling novel solutions to avoid degradation and restore water bodies, aquatic ecosystems and soil functionality, and further improve the quality and management of water for safe human and ecological

use, while strengthening the EU's and Associated Countries' positions and roles in the global water scene;

- balance **N/P flows within safe ecological boundaries** at regional and local level, helping restore ecosystems;
- move towards achieving **clean, unpolluted oceans and seas**, including in the Arctic, by means of successful scientific, technological, behavioural, socio-economic, governance and green-blue transitions;
- **strengthen circular bio-based systems** to operate within planetary boundaries, replacing fossil-based systems and their carbon footprint, mitigating climate change, and restoring biodiversity and protecting air, water and soil quality along the supply chain of biological feedstocks and industrial value chains within the EU and Associated Countries and across borders;
- **substitute harmful chemicals** for safer and more sustainable alternatives, notably by boosting innovative biotechnology and other sustainable technologies to create zero-pollution bio-based solutions;
- **reduce the environmental impact of food systems**, e.g. by increasing knowledge of the environmental and climate impacts stemming from the food systems and reducing pollution from plastic food packaging.

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

Call	Budgets (EUR million)		Deadline(s)
	2023	2024	
HORIZON-CL6-2023-ZEROPOLLUTION-01	64.50		28 Mar 2023
HORIZON-CL6-2023-ZEROPOLLUTION-02	15.00		28 Mar 2023 (First Stage) 26 Sep 2023 (Second Stage)
HORIZON-CL6-2024-ZEROPOLLUTION-01		38.00	22 Feb 2024
HORIZON-CL6-2024-ZEROPOLLUTION-02		23.00	21 Feb 2024 (First Stage) 17 Sep 2024 (Second Stage)
Overall indicative budget	79.50	61.00	

Call - Clean environment and zero pollution

HORIZON-CL6-2023-ZEROPOLLUTION-01

Conditions for the Call

Indicative budget(s)[305]

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR million)[306]	Indicative number of projects expected to be funded
		2023		
Opening: 22 Dec 2022 Deadline(s): 28 Mar 2023				
HORIZON-CL6-2023-ZEROPOLLUTION-01-1	RIA	6.00	Around 6.00	1
HORIZON-CL6-2023-ZEROPOLLUTION-01-2	RIA	12.50	Around 6.25	2
HORIZON-CL6-2023-ZEROPOLLUTION-01-3	RIA	12.00	Around 6.00	2
HORIZON-CL6-2023-ZEROPOLLUTION-01-4	RIA	8.00	Around 4.00	2
HORIZON-CL6-2023-ZEROPOLLUTION-01-5	IA	10.00	Around 5.00	2
HORIZON-CL6-2023-ZEROPOLLUTION-01-6	RIA	8.00	Around 4.00	2
HORIZON-CL6-2023-ZEROPOLLUTION-01-7	RIA	8.00	Around 4.00	2

305 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.

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

Overall indicative budget		64.50		

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

Halting pollution of air, soil and water

Proposals are invited against the following topic(s):

HORIZON-CL6-2023-ZEROPOLLUTION-01-1: Knowledge and innovative solutions in agriculture for water availability and quality

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

	Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).
Technology Readiness Level	Activities are expected to achieve TRL 3-5 by the end of the project – see General Annex B.

Expected Outcome: In line with the European Green Deal's farm to fork strategy and the zero pollution ambition, the Water Framework Directive, and the data provided by the European Environmental Agency (EEA), successful proposals will contribute to enhancing sustainable water management, based on increased resilience of agriculture to drought and floods, while maintaining the good functioning of the water ecosystem to ensure good status of water bodies.

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

- The quality and safety of irrigation water, as well as the prevention of contamination of natural habitats, including minimizing groundwater pollution and securing groundwater resources, and minimizing eutrophication of surface waters, are ensured.
- Enhanced understanding of current water, fertilizer and pesticide requirements in the agricultural sector for different systems and regions, in order to prevent surface water and groundwater contamination with pesticides, nutrients from fertilizers and other contaminants.
- Protection of surface water and groundwater quality against harmful impacts of climate change.
- Advanced understanding and prediction of the impacts to water availability and quality of climate change affecting agricultural water consumption patterns, to protect surface water and groundwater quality against harmful impacts of climate change.
- Solutions, pathways and strategies for risk assessment, mitigation and adaptation to agricultural (irrigation) practices in the event of extreme weather pressures (flooding, drought), which consider technical (such as land features/soil types) and socio-economic parameters.

Scope: Water availability (including permitting, measuring volumes and pricing) and quality is one of the most pressing issues, affecting human health, limiting food production, limiting ecological services, and hindering economic growth.

Extreme climatic events (notably droughts) are leading to increased water stress, affecting the water needs for agriculture and other uses. At the same time, water availability is itself impacted by climate change and this resource is becoming scarce in many places in the EU. The repartition of water to the users is becoming challenging. Agriculture is currently

accounting to around one fourth of the total water extraction in the EU,[307] which is leading to tensions and in some cases to conflicts, in particular where illegal abstraction takes place. It is therefore crucial to prepare agriculture to adapt to a new context where water in agriculture is more sustainably and efficiently used, without compromising the water availability for other users or undermining the good status of waterbodies.

Proposals should address the following:

- Produce tools and techniques to support farmers, special planners, policy makers and water managers with scientific and practical knowledge, including advice on appropriated price incentives and water management assistance, optimising agricultural water use, not only water for irrigation but also water used by local people and in other economic sectors, for the benefit of a healthy environment.

- Develop or improve with new scientific knowledge and practice the methodology for monitoring and prediction of water quality and quantity requirements for agricultural use, based on information provided by Earth Observation systems and in situ measurements, using digital technologies such as smart (bio)sensors[308] and artificial intelligence (AI), as well as DNA-based indicators, that integrate monitoring and modelling tools to support decisions in relation to water management.

- Assess and propose relevant adaptation of water infrastructures for irrigation, agricultural practices and land use. Consider nature-based solutions and latest technologies to address emerging needs and challenges like floods, droughts and/or salinization. Proposed measures should increase the resilience of agriculture by lowering the need for irrigation, reducing at the same time the environmental impact associated with irrigation in agriculture (e.g. salinisation and concentration of nutrients and pollutants) and therefore enhancing ecosystem protection and biodiversity preservation.

- Develop scientific and practice advice to reduce water losses in agricultural activities while considering farmer's water security and quality challenges.

- Technologies to support a significant reduction of the presence of pesticide residues and nutrients in water bodies to levels that are no longer harmful.

Proposals should earmark the necessary resources for cooperation and networking activities. Activities should build upon and link with the work done under relevant Horizon 2020 and Horizon Europe projects including as part of the Horizon 2020 art. 185 PRIMA partnership. Collaboration with the European partnership Water4all – Water security for the Planet should be explored, as needed.

---

307 European Environment Agency, "Water and agriculture: towards sustainable solutions", EEA Report No 17/2020.

308 See for example the parallel topic HORIZON-CL6-2023-ZEROPOLLUTION-01-6: Biosensors and user-friendly diagnostic tools for environmental services.

Addressing pollution in seas and ocean

Proposals are invited against the following topic(s):

HORIZON-CL6-2023-ZEROPOLLUTION-01-2: Integrated assessment and monitoring of emerging pollutants in the marine environment

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 6.25 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 12.50 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, beneficiaries must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used). The Joint Research Centre (JRC) may participate as member of the consortium selected for funding.
Technology Readiness Level	Activities are expected to achieve TRL 3-5 by the end of the project – see General Annex B.

Expected Outcome: In line with the European Green Deal's zero pollution ambition, successful proposals will contribute to the protection of marine ecosystems and marine biodiversity from impacts of pollution, in particular from contaminants of emerging concern. They should analyse the impacts and risks of the contaminants of emerging concern on marine ecosystems and marine biodiversity and provide basis for an integrated assessment and monitoring of the pathways of these contaminants in the marine environment. This will contribute in particular to the implementation of EU zero pollution action plan for air, water and soil and of the EU biodiversity strategy for 2030.

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

- Filled gaps in knowledge about the impacts and risks of contaminants of emerging concern (e.g. pharmaceuticals, endocrine disruptors, biocides, micro and nano plastics) on marine ecosystems, including in marine sediments and on deep-sea ecosystems and on marine biota and on marine biodiversity, and including in relation to climate change mitigation and adaptation;

- Provided advanced understanding of possible interactions between the changing marine environment (e.g. increased temperatures, changes in salinity and pH, etc.) due to changes in the climate system and contaminants of emerging concern in the marine environment, including marine sediments and impacts on marine ecosystems and marine biota and biodiversity;

- Designed and tested solutions for integrated assessment, monitoring, modelling and forecasting of the circulation and impacts of contaminants of emerging concern in marine environment (including marine sediments and taking into account the climate change dimension –both mitigation and adaptation-), ecosystems and on marine biota, including establishing testing methods, effect-based monitoring protocols and ensuring sustained collection and sharing of data under FAIR principles;

- Build on, and widen, the data availability in European Research Infrastructures federated under the European Open Science Cloud[309];

Developed tools and guidance to support the implementation of relevant EU policies (e.g., Water Framework Directive, EU Marine Strategy Framework Directive, and EU zero pollution action plan for air, water and soil, the EU biodiversity strategy for 2030).

Scope: Contaminants of emerging concern including pharmaceutical products, endocrine disruptors and contaminants found in personal care products, including micro plastics and nano plastics, are increasingly detected in surface and marine waters, as well as in marine sediments. There are concerns about the impact of these contaminants on the marine environment, ecosystems and biodiversity as some of these substances exhibit impacts on aquatic organisms at very low concentrations, in particular on their reproduction and development. There are also concerns about the accumulation of these contaminants in different parts of the marine environment, including sediments and deep sea marine ecosystems and biota.

Also, changes in the marine environment driven by the changing climate system (such as increases in water temperature, changes in salinity and in pH levels, increase in invasive species, etc.) may further influence the possible impacts of the contaminants of emerging concerns on the marine environment, ecosystems and biota.

The projects are expected to develop and test integrated assessment and effect-based monitoring of impacts of contaminants of emerging concern on marine environment, ecosystems and biodiversity, including testing methods that are aligned with the relevant OECD guidance[310], and where relevant develop new contaminant thresholds. The projects are expected to adopt an integrated and systemic approach to the assessment of impacts, including not only impacts on marine biota but also the circulation, accumulation, magnification, persistence and degradation of the contaminants of emerging concern in marine environment

309 https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/european-open-science-cloud-eosc_en.

310 For instance as regards endocrine disruptors, see Revised Guidance Document 150 on Standardised Test Guidelines for Evaluating Chemicals for Endocrine Disruption | en | OECD.

and ecosystems (including marine sediments and deep-sea ecosystems) and their interaction with the changing marine environment. Projects should contribute to the improvement of understanding of the spatial and temporal distribution patterns of contaminants of emerging concern in marine environment and should close knowledge gaps as regards the characteristics, occurrence and impacts of those contaminants on marine environment and marine biodiversity. The projects should furthermore contribute to the understanding of impacts of contaminants of emerging concern on marine biota and on marine biodiversity and provide basis for the design of effective future measures for the protection of marine biodiversity from the impacts of such contaminants.

The projects should recommend best practices in monitoring of the circulation of these contaminants in the marine environment and for the measurement of their impacts and risks, for their possible future integration into EU pollution monitoring and assessment systems, in particular under the Water Framework Directive, the Marine Strategy Framework Directive, the EU zero pollution action plan and for the implementation of the EU biodiversity strategy for 2030.

The projects funded under this topic will:

- build links with the European Mission 'Restore our ocean and waters by 2030', in particular: HORIZON-MISS-OCEAN-2021-03-01: Mediterranean sea basin lighthouse: actions to prevent, minimise and remediate litter and plastic pollution, HORIZON-MISS-OCEAN-2021-03-02: Mediterranean sea basin lighthouse: coordination activities and HORIZON-MISS-OCEAN-2022-01-03: Mediterranean sea basin lighthouse: actions to prevent, minimise and remediate chemical pollution;
- build links Mission implementation monitoring system that will be part of the Mission Implementation Support Platform for reporting, monitoring and coordination of all relevant implementation activities;
- build links and support the Mission ocean and water knowledge and information system (Digital Twin Ocean), in particular by contributing to pollution monitoring, forecasting, modelling and knowledge creation and data and sharing;
- Collaboration of the projects with research infrastructures (ERICs) such as ARGO and EMSO and with accredited laboratories is encouraged.

HORIZON-CL6-2023-ZEROPOLLUTION-01-3: Tackling human and climate change induced pollution in the Arctic - building resilient socio-ecological systems

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 6.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.

Indicative budget	The total indicative budget for the topic is EUR 12.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: The Joint Research Centre (JRC) may participate as member of the consortium selected for funding.
Technology Readiness Level	Activities are expected to achieve TRL 3-5 by the end of the project – see General Annex B.
Procedure	The procedure is described in General Annex F. The following exceptions apply: To ensure a balanced portfolio, grants will be awarded to applications not only in order of ranking but at least also to one project within the area A that is the highest ranked, and one project highest ranked within the area B, provided that the applications attain all thresholds. Proposals shall clearly indicate the area they are applying to.

Expected Outcome: In line with the European Green Deal's zero pollution ambition, successful proposals should contribute to protecting Arctic ecosystems. They should analyse main pollution sources in a climate change context, and examine ways to prevent or eliminate pollutants, consequently protecting environmental and human health and the quality of aquatic ecosystems. This will contribute to the implementation of the new EU policy for a peaceful, sustainable and prosperous Arctic, to the follow-up of the 3rd Arctic Science ministerial meeting and to the work of the Arctic Council.

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

- Advanced scientific understanding of the impacts of pollution in the Arctic, including marine litter, emerging pollutants and plastic pollution, as well as diverse chemical discharges, and its interactions with the changing climate and thawing permafrost;
- Advanced understanding of the main ecological, socio-economic and health associated risks and challenges, following a One Health approach[311];
- Resilience and adaptation strategies identified for both ecosystems and human communities, in relation to the changes in Arctic. Design solutions and pathways for ecological and societal mitigation and adaptation;
- Contribute to making the case for the designation and, if applicable, contribute to the establishment management plans of MPAs in international Arctic waters.

311 The term "One Health" describes a multidisciplinary approach to health risks in humans, animals, plants, and the environment.

- Assessment and monitoring tools developed for pollution impacts, using participatory approaches, citizen science and involving local and indigenous communities;

- Contribute to the implementation of the EU policy for the Arctic and the follow-up of the 3rd Arctic Science Ministerial meeting.

Scope: Main environmental concerns in the Arctic stem from the loss of pristine environment and unique ecosystems. On one hand, ice melting allows for more people and economic activities to enter the area, and on the other hand, transboundary pollution brings into the Arctic contaminants whose sources are thousands of kilometres away.

Arctic economic development is associated with a high risk of air and marine pollution, particularly from oil spills, local mining, Persistent Organic Pollutants (POP), heavy metals, radioactive substances, marine litter and plastics. Pollution from Arctic shipping and tourism relying on heavy diesel fuels induce greater ice melting pack and have negative effects on marine life. Pollutants from local and distant sources are taken up by organisms and incorporated into polar food webs, jeopardizing human and environmental health.

Another threat to the Arctic environment is the growing prevalence of marine litter, and specifically plastic pollution. High concentrations of microplastic particles have been detected in Arctic ice, with a good deal of it suspected to have originated outside of the region.

Moreover, the share of MPA coverage in Arctic water (see for example the OSPAR Convention area) is particularly low.

Thawing permafrost brings in additional risks for pollution, from releasing pathogens to infrastructure degradation and failure. Combined, these drivers create a mosaic of multiple and mutually reinforcing anthropogenic stressors acting on the unique and highly vulnerable Arctic ecosystem.

Proposals should aim at developing innovative approaches to address only one of the following options:

- Area A: Local and transboundary Pollutants in the Arctic – risks and challenges in a One Health approach

Actions are expected to identify, assess, and analyse major impacts and risks of remote and local sources of pollution on the health, well-being and food security of Arctic societies and ecosystems and beyond, and propose adaptation and resilience strategies.

Actions should improve the understanding of the interactions between the changing climate system, changes in biological diversity and pollutant levels, including climate-driven ecosystem changes that are affecting natural emissions, such as wetlands (CH4), wildfires (CO2, black carbon), pollutant deposition or transfer and bioaccumulation in marine systems. They should analyse the cultural, socio-economic and health impacts on residents of the Arctic, their livelihood and food security, as well as adverse effects on the marine and terrestrial biodiversity of the region. They are expected to contribute to a better understanding

of long-distance transport of marine plastic litter in the Arctic and air transport of micro plastics, as well to the dynamics between melting ice and increasing discharges of, for example, mercury in the marine ecosystem, and their impact on ecosystems and food safety.

- Area B: Pollution and health risks linked to permafrost thaw

Rising temperatures induce thawing of permafrost, bringing an extra layer of complexity for assessing pollution and health risks in the Arctic environments. Greenhouse gases released from thawing permafrost threaten to cause irreversible changes in the Arctic and other regions. Thawing permafrost causes change in mechanical properties of soils, which in turn deteriorates stability and service-life of built infrastructure and increases coastal erosion.

Actions should address and analyse the adverse effects and pollution risks linked to permafrost thaw, infrastructure degradation and failure, and other associated risks for the environment and human health and well-being. Actions will focus on an improved quantification of these effects, as well as emerging contaminants and re-emission of legacy contaminants due to melting cryosphere or thawing permafrost.

Actions are expected to improve the understanding of the impacts of permafrost thaw on the health of humans, plants, animals, and wider environment, in a One Health approach, including critical infrastructure, water and food security aspects, and wider socio-economic, demographic and cultural impact.

Proposals should assess the impact, trends and new scenarios on ecosystem services, including exploring ecosystems management techniques with special attention to community or nature-based solutions. Potential measures should focus on developing community-oriented decision support systems, and co-design mitigation and adaptation measures.

For both options, proposals should focus on an improved quantification of these effects and explore pathways to minimise risks and should be linked with state-of-the-art climate change predictions coupled with socio-economic models; assess the ecosystems' responses to risk factors and how these responses are affecting the well-being of indigenous populations and local communities but also health of the environment, in a One Health approach; identify adaptation and mitigation strategies, aiming at building resilient Arctic socio-ecological systems.

Proposals are expected to adopt a system thinking or transdisciplinary approach, with simultaneous analysis of environmental, societal, climatic and biodiversity impacts, their relationships and interlinkages, and positive and negative feedbacks. The participation of technical sciences, social sciences and humanities disciplines is important for addressing the complex challenges of this topic, as well as engaging local communities in the research process, as appropriate.

International cooperation is encouraged, with a strong linkage with the ongoing activities under the All-Atlantic Ocean Research and Innovation Alliance and encouraging participation from countries that take part in the Arctic Science Ministerial meetings.

Actions under this topic should plan on a close collaboration among each other and with the EU Polar Cluster. Actions should build upon and link with past Horizon 2020 projects (e.g., Nunataryuk and Arctic PASSION), EU Polarnet 2, Copernicus, Sustaining Arctic Observing Networks (SAON).

Synergies and complementarities with HORIZON-CL5-2024-D1-01-02: Inland ice, including snow cover, glaciers, ice sheets and permafrost, and their interaction with climate change; HORIZON-CL6-2023-COMMUNITIES-11: Participation and empowerment of Arctic coastal, local, and indigenous communities in environmental decision-making; HORIZON-CL6-2023-ZEROPOLLUTION-01-2: Integrated assessment and monitoring of emerging pollutants, and activities under the Arctic-Atlantic Lighthouse of the EU Mission Restore our ocean and waters.

Increasing environmental performances and sustainability of bio-based processes and products

Proposals are invited against the following topic(s):

HORIZON-CL6-2023-ZEROPOLLUTION-01-4: Environmental sustainability and circularity criteria for industrial bio-based systems

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

Expected Outcome: Successful proposals will support bio-based industries, traders and researchers and innovators, to assess and trace the environmental impacts and circularity of industrial bio-based systems in order to enable responsible production and to steer innovation in the industrial bio-based systems in the EU. Project outcomes will contribute to enhancing circular bio-based systems to operate according to planetary boundaries, replacing fossil-based systems and their carbon footprint, mitigating climate change, restoring biodiversity and protecting air, water and soil quality along supply chain of biological feedstock and industrial value chains, in line with the 2030 climate target plan, the EU zero pollution action plan and the communication on sustainable carbon cycles.

Projects results are expected to contribute to the following expected outcome:

- Standardisation of methods assessing the environmental impacts on soil, water and air quality, biodiversity and climate, and the circularity along the value chains of bio-based products for international trade at EU and global scale.

- Methods to assess the environmental sustainability and the circularity of low TRL bio-based technologies.

- Orientations for research and innovation programmes in the bio-based sectors.

Scope: The environmental sustainability and circularity assessment of industrial bio-based systems is instrumental to guarantee and monitor that they are developed in a way they can contribute to the just green transition of the EU economy away from a linear fossil-based system. On one hand, the method for such assessment, applied to high TRL bio-based solutions, would represent an instrument for policy makers and for investors, to support the deployment of and to leverage investments in the best performing bio-based sectors. On the other hand, the assessment of the environmental sustainability and circularity of low TRL, cutting-edge bio-based technologies is important to understand the potential of emerging technologies to contribute to the just green transition, also compared to the more mature technologies. Such knowledge would have an impact on the programming of R&I support initiatives, to save resources and move faster towards the scaling-up of the most promising bio-based technologies, including focussing on the potential environmental hotspots of the emerging technologies.

The assessment of the environmental sustainability and circularity should benefit to the greatest extent possible from existing methodologies and indicators, which can be adapted if needed. Methods and indicators should use the available environmental observations efficiently.

To deliver on the expected outcome, proposals should:

- Identify the range of high TRL industrial bio-based systems in the Union to be analysed in the project. Industrial bio-based systems within the scope of this topic do not include food, feed, biofuels, bioenergy and cultural and recreation sectors;

- Improve existing and/or develop new methods to assess environmental impacts of the selected industrial bio-based systems on climate, biodiversity, land use and water resources as priorities, but also on soil, water and air quality. Assessments should consider the life cycle perspective. The impact on climate should include the both the greenhouse gas emissions and the carbon removal potential of bio-based systems. The analysis should include trade-offs, for example between direct and indirect land use and land use change impacts and the carbon storage and substitution effect of bio-based products and provide an overall assessment of the environmental sustainability of the systems within the scope;

- Improve existing and/or develop new metrics of circularity of industrial bio-based systems based on the application of the cascading approach of biomass use, the resources

efficiency, and effectiveness on a life-cycle perspective (i.e. durability, reuse, repair, remanufacturing and recycling patterns of bio-based products), other circular aspects;

- Analyse trade-offs and synergies with economic and social objectives (including geographical distribution aspects, urbanization pressures, etc.) and with competing and adjacent economy sectors in the bioeconomy (e.g. food and feed, biofuels and bioenergy) as well as with the fossil-based industrial systems;

- Collect and analyse the (range of) best available industrial bio-based systems within the Union in terms of environmental and circular performances, to build a set of benchmarks or references with best performances for similar industrial systems;

- Include the environmental sustainability and circularity of bio-based products, as assessed through the methods developed under the project, in existing certification scheme at EU and global scale, to enable international trade of certified sustainable bio-based products;

- Consult stakeholders on the applicability of proposed certification schemes, also to improve the societal readiness adaptation in terms of acceptability and uptake of innovations by society;

- Develop and disseminate guidelines for targeted stakeholders on the assessment methods and the enhanced certification schemes developed in the project;

- Perform a preliminary analysis and improvement of the methods for the assessment of environmental sustainability and circularity performances of bio-based supply and value chains adapted to very low TRL bio-based technologies through: i) a review of the "prospective" LCA approaches and applications to bio-based and fossil-based technologies, with a focus on the environmental sustainability and circularity assessment approaches and tools. This task would lead to improve understanding and classifying the main challenges of prospective LCAs, e.g., comparability of results, input data availability, uncertainties/robustness, etc.; ii) the adaptation of the "prospective" LCA approaches to very low TRL bio-based technologies, including via modelling approach; iii) modelling the tests to validate the developed methods on a range of low TRL technologies and processes, including in relevant environments for future R&I projects; iv) including the analysis of potential synergies and trade-offs with economic and social objectives;

- Develop and disseminate guidelines to targeted stakeholders on the assessment of environmental sustainability and circularity performances of bio-based supply and value chains adapted to very low TRL bio-based technologies.

Consortia of applicants should involve LCA experts and researchers in the bio-based technologies, bio-based industries, trade bodies, consumers' organisations and any relevant stakeholder along the value chain of industrial bio-based systems.

Where relevant, proposals should seek links with and capitalise on the results of past[312] and ongoing EU funded projects, including under the Circular Bio-based Europe JU[313] and other partnerships of Horizon Europe.

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

HORIZON-CL6-2023-ZEROPOLLUTION-01-5: Industrial biotechnology approaches for improved sustainability and output of industrial bio-based processes

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 5.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 10.00 million.
Type of Action	Innovation Actions
Technology Readiness Level	Activities are expected to achieve TRL 6-8 by the end of the project – see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: 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). [314].

Expected Outcome: A successful proposal will contribute to all Destination ‘’Zero pollution’ and in particular impacts related to enhancing circular bio-based systems to operate according to planetary boundaries, replacing fossil-based systems and their carbon footprint, mitigating climate change, restoring biodiversity and protecting air, water and soil quality along supply

312 See for example HORIZON-CL6-2021-ZEROPOLLUTION-01-07: International and EU sustainability certification schemes for bio-based systems.

313 See for example CBE JU2022.S1. Developing and validating monitoring systems of environmental sustainability and circularity: collection of best practices and benchmarks

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

chain of biological feedstock and industrial value chains within the EU and Associated Countries and across borders. Furthermore, it will contribute by substituting harmful chemicals by safer, less toxic and generally more sustainable alternatives notably by boosting innovative biotechnology and other related technologies to create zero-pollution bio-based solutions.

Industrial biotechnology has a high potential to contribute to increased sustainability and in particular 'zero pollution' ambition of the European Green Deal, in respect to the (circular) industrial bio-based processes.

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

- Improved environmental sustainability, especially in terms of reduced toxicity, and overall safety to live organisms and ecosystems, of industrial bio-based processes, and of chemical and materials outputs, aligned with the EU climate-goals and zero-pollution ambition of the European Green Deal, in particular by lowering the input requirements in terms of e.g., land use, (virgin) feedstocks, water and energy, and by general advancement of non-toxic / zero-pollution production processes with positive impacts on water, air and soil quality.

- Improved industrial competitiveness by developing scalable, flexible and robust multi-product manufacturing, responding to current trends in the industrial biotechnology (e.g., on-demand production, small-volume outputs, lower capital expenditure, digital / artificial intelligence (AI) solutions, lower/minimal dependence on scarce natural resources, especially in terms of biological feedstocks), ensuring links to EU / Associated Countries industrial ecosystems (SMEs, EU Partnerships such as Circular Bio-based Europe JU).

- Enhanced social engagement and understanding of advanced bio-based innovation and in particular biotechnology among broad sectors of society, with active social innovation supported via dialogue with e.g., NGOs, end-user and consumer groups, schools or science centres etc.

Enhanced market up-take linked to improved governance [315] enabled by dialogue with regulatory actors and supporting networks, and by improved public awareness.

Scope:

- The scope covers a wide array of biotechnology techniques, including targeted and specific approaches for DNA modification, including synthetic engineering at gene or genome level, in line with the binding regulatory requirements, including related necessary technical aspects in other fields, such as synthetic biology, cell sorting, automation, robotics, IT data/digital/AI innovations, or the 'biofoundry' concept[316, 317].

315 See parallel topic HORIZON-CL6-2023-GOVERNANCE-01-6: Co-creation and trust-building measures for biotechnology and bio-based innovation systems.

316 http://www.weforum.org/agenda/2019/10/biofoundries-the-new-factories-for-genetic-products/.

317 http://www.oecd-ilibrary.org/sites/bd16d851-en/index.html?itemId=/content/component/bd16d851-en

Approaches based on improved enzymatic solutions should carefully consider a parallel topic[318], to avoid overlaps, and create synergies.

- Environmental improvements, especially reduced pollution/toxicity and lowered impacts should be verified and demonstrated by established methodology of life cycle assessment, and the monitoring approaches throughout the project need to be clearly established.
- Production of biofuels and bioenergy is excluded from scope, to avoid overlaps with Horizon Europe Cluster 5. Health applications need to be carefully considered to avoid possible overlaps with activities supported under Horizon Europe Cluster 1.
- Clear communication and dissemination activities are an essential element, including awareness raising, engagement of societal actors (NGOs, consumer organisations, professional organisations). Proposals should include a dedicated task, appropriate resources and a plan on how they will collaborate with other projects funded under this topic and other relevant topics.
- International cooperation options may be considered, for win-win cooperation, and pursued if contributing to the European industrial competitiveness.
- In this topic the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.

HORIZON-CL6-2023-ZEROPOLLUTION-01-6: Biosensors and user-friendly diagnostic tools for environmental services

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Technology Readiness Level	Activities are expected to achieve TRL 3-5 by the end of the project – see General Annex B.

Expected Outcome: A successful proposal will contribute to all Destination 'Zero pollution' and in particular impacts related to enhancing circular bio-based systems to operate according to planetary boundaries, replacing fossil-based systems and their carbon footprint, mitigating

[318] HORIZON-CL6-2023-CIRCBIO-01-5: Broadening the spectrum of robust enzymes and microbial hosts in industrial biotechnology.

climate change, restoring biodiversity and protecting air, water and soil quality along supply chain of biological feedstock and industrial value chains within the EU and Associated Countries and across borders. Furthermore, it will contribute to substitute harmful chemicals by safer and more sustainable alternatives notably by boosting innovative biotechnology and other sustainable technologies to create zero-pollution bio-based solutions.

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

- Improving the quality of environment (water, soil and air) by stepping up the reliable monitoring and detection, of any biotic or abiotic pollutants, by developing practical, specific, adaptable and economic tools, based on bio-based principles, for the use of consumers, inspection services and industry operators alike. This can cover the use at industrial locations, but also at ecological disaster- or accidents' sites, or at home applications;

- Contributing to the zero-pollution objective of the European Green Deal and to the European Missions such as one on 'Restoring our ocean and waters by 2030' or 'A Soil Deal for Europe' by up-scaling the application of modern biosensors underpinned by the biotechnology, across a variety of ecosystems, including marine and freshwater or soil ecosystems and real-life conditions impacted by the pollution issues;

- Increasing engagement and competitiveness of the European environmental services sector, such as the SMEs and industry operators, including the digital sector actors, supporting the convergence between bio-based and digital sectors (including the role of artificial intelligence (AI) solutions). Increasing the awareness and understanding of the underpinning technologies by the civil society, including NGOs and consumer organisations, as well as participatory approaches such as citizen engagement, including citizen science, in environmental observation and monitoring.

Scope: The scope covers the development of high-resolution biosensors for environmental monitoring and detection. The focus is on:

- (1) large scale synthesis of biosensor variants, across kingdoms (from bacteria/archaea to plants);

- (2) improved biosensor/genetic circuit designs for a multitude of sensor inputs, integrating modified microorganism (elements) with transduction/detection systems enabling to relay the information to the user, while guaranteeing environmental safety, especially related to any risk of potential release of such microorganisms into open environment, if relevant;

- (3) develop protein-based (RNA) biosensors to detect and measure metabolites and organisms of interest;

- (4) create organisms that can act as multiplexing sensors capable of canalizing multiple environmental cues and providing measurable responses or combination of responses that may be deconvoluted to determine stimuli, while guaranteeing environmental safety,

especially related to any risk of potential release of such organisms into open environment;

- (5) build more extensive and fully-sequenced metagenomics databases/libraries to enable searches for diverse functionalities across multiple gene clusters; and
- (6) better enable real-time data feeds.

The end-users targeted include consumers but also inspection services and the industry operators, as well as environmental emergency responders. Communication and inclusive participation form an essential part of the proposals. All environmental conditions and ecosystems (water, soil, air etc), may be covered.

Concrete efforts shall be made to ensure that the data produced in the context of this project is FAIR (Findable, Accessible, Interoperable and Re-usable), particularly in the context of real-time data feeds, exploring workflows that can provide "FAIR-by-design" data, i.e., data that is FAIR from its generation. Projects shall further build on, and widen, the data availability in European Research Infrastructures federated under the European Open Science Cloud.

To respect the 'Do-No-Significant-Harm' (DNSH) principle, proposals using any alive organisms need to properly assess and exclude any potential risk of their release to open environment.

The projects funded under this topic may:

- build links with the European Mission 'Restore our ocean and waters by 2030' or Soil Mission, in particular as regards stepping up the monitoring of ecosystems and their biodiversity;
- build links with Missions implementation monitoring system;
- build links and support the Missions knowledge and information system, in particular by contributing to pollution monitoring, modelling and knowledge creation and data.

In this topic the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.

Proposals should include a dedicated task, appropriate resources and a plan on how they will collaborate with other projects funded under this topic and other relevant topics.

Reducing the environmental impact and pollution in food systems

Proposals are invited against the following topic(s):

HORIZON-CL6-2023-ZEROPOLLUTION-01-7: Strategies to prevent and reduce plastic packaging pollution from the food system

Specific conditions

Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: The following additional eligibility criteria apply: the proposals must apply the multi-actor approach. See definition of the multi-actor approach in the introduction to this work programme part.

Expected Outcome: To support the implementation of the European Green Deal, the new circular economy action plan, the EU 2030 climate target plan, the farm to fork strategy, the food 2030 initiative and the Mission 'Restore our ocean and waters by 2030', successful proposals are expected to contribute to all of the following expected outcomes:

- Increased knowledge on the impacts of littered plastic food packaging on the terrestrial, freshwater and marine environments and ecosystems, including the climate change mitigation and adaptation dimensions;
- Uptake of innovative business strategies, design and production models to prevent and reduce the use of plastic food packaging;
- Adoption of increasingly sustainable, effective and efficient fit-for-purpose packaging solutions by food operators, and reduction of the dependency on fossil-based materials, thus contributing to EU climate action;
- Increased reuse and recycling of sustainable packaging;
- Increased consumer acceptance of sustainable, efficient and fit-for-purpose food packaging solutions including where appropriate the non-use of any type of packaging;
- Support to the implementation of the relevant targets as outlined in the revised packaging and packaging waste directive and the directive on single-use plastics and support to operators, especially SMEs, in meeting the requirements of the relevant EU legislation.

Scope: The use of single-use plastics in food packaging has grown significantly in the last decades, leading to increased pollution in the environment and greenhouse gas emissions. While plastic packaging is an enabler for the safety and shelf life of food products, contributing to the reduction of food waste, there is a need for improved solutions that promote the prevention and reduction of excessive packaging in the food industry. Often, the excessive food packaging results in its inappropriate disposal or littering by consumers. This

can be reduced through the application of circular models for design and production and the proper disposal and recycling of packaging waste.

Proposals are expected to:

- Provide a comprehensive and evidenced based analysis of the negative impacts and externalities of littered plastic food packaging in the different terrestrial, freshwater and marine environments and ecosystems across Europe. This analysis should provide reliable quantitative new data and fill in existing data gaps on these negative impacts and externalities through multiple sources, including citizen science tools.

- Provide an analysis of the main challenges and existing good practices of prevention and reduction of single use plastics, aiming at shifting the current packaging design and production practices. This analysis should address the availability of sustainable and innovative alternatives as well as the readiness of food packaging producers and food business operators to adopt such solutions.

- Develop innovative business strategies, design and production models that improve the prevention, reduction and reuse of plastic food packaging, whilst ensuring that they can be easily implemented in European countries. These business strategies and models should involve all relevant actors, including food SMEs and, when appropriate, policy makers. They should consider health and environmental impacts [319] of packaging, guaranteeing they do not cause any contamination of food and the environment by hazardous chemicals. Moreover, they should maintain the microbiological and chemical safety and quality of food, taking into account relevant parameters such as their contact with aqueous and fatty foods, aging, and effect on shelf life.

- Develop innovative strategies, design and production models to facilitate packaging recycling, linking developers of sustainable packaging with converters and recyclers, taking into account the recycling capacity technologies and the relevant technical specifications of the use of recycled content. These strategies should namely target collection systems, the use of mono-materials, the reduction of labelling materials and the promotion of easy to sort and clean materials.

- Develop strategies aimed at improving consumer acceptance of sustainable, efficient and fit-for-purpose packaging solutions, facilitating the use of reusable and recyclable packaging for consumers, easing the sorting and appropriate disposal of packaging, and helping them to correctly interpret labelling of packaging. These strategies should be designed based on a joint effort of developers of sustainable packaging and consumers and should aim at avoiding confusion, minimising misuse, increasing user convenience and encouraging a greater uptake of such packaging solutions.

---

319 Examples of these impacts include endocrine disrupters or perfluoroalkyl substances in coatings, lack of inertness or organoleptic risks from uncoated paper, and characterising risks such as from epoxy silanes in adhesives, and from mineral oil hydrocarbons and printing ink residues in paper, aging effects of reusable materials, and the suitability for recycling (mono-material, labelling, minimum recycled content).

- Implement multi-actor approach by involving a wide range of food packaging actors and consumers and conducting inter-disciplinary research.
- Support social innovation for inclusive and long-term solutions aiming at the reduction of plastic food packaging.

The proposals may:

- build links with the European Mission 'Restore our ocean and waters by 2030', in particular with the Mission activities under objective 2 – prevent and eliminate pollution in our ocean, seas and water, and with the Mission lighthouse activities in the Mediterranean Sea basin focusing on preventing, minimising, remediating and monitoring pollution;
- build links with the Mission implementation monitoring system;
- build links and support the Mission's knowledge and information system (Digital Twin Ocean), in particular by contributing to pollution monitoring, modelling, and knowledge creation and data.

Proposals must implement the 'multi-actor approach' and ensure adequate involvement of researchers, food business operators, food packaging producers, developers of sustainable packaging, packaging converters and recyclers, consumers, local and regional authorities and other relevant actors.

This topic should involve the effective contribution of social sciences and humanities (SSH) disciplines. In order to achieve the expected outcomes, international cooperation is encouraged.

Call - Clean environment and zero pollution

HORIZON-CL6-2023-ZEROPOLLUTION-02

Conditions for the Call

Indicative budget(s)[320]

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project	Indicative number of projects
		2023		

[320] 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.

			(EUR million)[321]	expected to be funded
Opening: 22 Dec 2022 Deadline(s): 28 Mar 2023 (First Stage), 26 Sep 2023 (Second Stage)				
HORIZON-CL6-2023-ZEROPOLLUTION-02-1-two-stage	RIA	7.00	Around 7.00	1
HORIZON-CL6-2023-ZEROPOLLUTION-02-2-two-stage	RIA	8.00	Around 4.00	2
Overall indicative budget		15.00		

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

Halting pollution of air, soil and water

Proposals are invited against the following topic(s):

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

HORIZON-CL6-2023-ZEROPOLLUTION-02-1-two-stage: Optimisation of manure use along the management chain to mitigate GHG emissions and minimize nutrients/contaminants dispersion in the environment

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 7.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 7.00 million.
Type of Action	Research and Innovation Actions
Admissibility conditions	The conditions are described in General Annex A. The following exceptions apply: Applicants submitting a proposal under the blind evaluation pilot (see General Annex F) must not disclose their organisation names, acronyms, logos, nor names of personnel in Part B of their first stage application (see General Annex E).
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: The following additional eligibility criteria apply: the proposals must apply the multi-actor approach. See definition of the multi-actor approach in the introduction to this work programme part.
Procedure	The procedure is described in General Annex F. The following exceptions apply: This topic is part of the blind evaluation pilot under which first stage proposals will be evaluated blindly.

Expected Outcome: In line with the farm to fork strategy, the methane strategy, the EU zero pollution action plan and the UN Sustainable Development Goals, the successful proposal will support research and innovation (R&I) to help farm business reduce local and global GHG and ammonia emissions from livestock farming systems. It will contribute to support policy makers with enhanced knowledge to limit emissions and investigate further measures, inter alia under the common agricultural policy, to achieve reduction targets of 2030 and beyond.

The proposed project is expected to contribute to the reduction of the environmental and climate footprint of the livestock farming systems, through a better understanding of i) the potential of scaling up efficient and innovative manure management practices and technologies, and ii) the impact of emission abatement and contaminant reduction measures on health and environment (air, water and soil) safety.

Activities under this topic will contribute to all of the following outcomes:

- Improved cost-effective solutions to reduce greenhouse gas (GHG) emissions and atmospheric, air, water and environment pollutants produced by the livestock manure management chain, both in conventional and organic livestock farming
- Boosted uptake of improved and innovative practices and technologies to optimise manure management (while considering potential trade-offs)
- Improved capacity to better manage manure nutrients, minimizing their losses, increasing circularity and matching demand and supply
- Policy recommendation on improving manure management to mitigate GHG and ammonia emissions and minimize dispersion of undesirable manure components such as biological and chemical contaminants in the environment.

Scope: Agriculture is a sector that significantly contributes to GHG emissions in EU and to air pollution, mainly through ammonia emissions. Reducing the environmental and climate footprint of the livestock farming system is therefore of paramount importance. Several practices and technical measures to limit emissions from manure management are already available. Some other techniques are still considered experimental. Despite major advancements, there is still no widespread application of these practices and further research is needed to assess their socio-economic and environmental impacts. Furthermore, there is the need to do a comprehensive analysis of the effectiveness of mitigation strategies along the entire manure management chain and to take into account different GHGs and the pollution swapping effect, i.e. decreasing the emission of one GHG that can cause the increase of another one or the increase of the emission of the same GHG at one of the other stages of manure management.

Another important aspect of manure management is to reduce environmental pollution caused among others by ammonia emissions, excess of nitrogen and phosphorus, by nitrate leakages, and by different components of manure, including potential contaminants, on air and water quality, on soil health, on animal health, welfare and productivity and on human health.

Therefore, there is the need to develop further strategies and technologies for livestock farming systems to reduce GHG, ammonia and nitrate emissions from manure through an integrated approach for the management of manure, taking into account all steps: feeding, housing, handling, collection, treatment, storage and application. The following elements should be incorporated:

- Identify and establish inventory of up-to-date manure management practices, technologies and data originating from R&I activities (from feeding to low-emission manure storage and processing, composting, exchange of manure/slurries between livestock and crop farms, manure additives to reduce emissions, etc.) in conventional/intensive, semi-intensive, household and organic livestock farming systems;

- Improve or develop lifecycle assessment methods, models and equipment for the measurement and monitoring of GHG (CH4, N2O), atmospheric and air pollutants (NH3, NOx) at each stage of manure management practices, from feeding to field application;

- Improve knowledge on the fate and persistence in the environment (e.g., water, soil, air) of manure chemicals and biological contaminants, including pathogens antibiotic resistance genes, heavy metals and associated health/environmental risks;

- Demonstrate and test the most efficient strategies and technologies to mitigate GHG emissions and air pollutants from manure at regional/local scale. Activities should take into account relevant practices, strategies and data on GHG, atmospheric and air pollutants mitigation from several livestock farming systems, covering conventional/intensive, semi-intensive, grazing/low input or organic, in different climate/biogeographical regions;

- Cost-benefit assessment of practices/technologies used to mitigate GHG emissions, air pollutants and nitrate emissions from manure, including assessment of pollution swapping effects, trade-offs and co-benefits on animal (e.g., health and welfare, production efficiencies) and environment (e.g., ammonia emissions, nitrate leakage, nitrogen balance and P losses to water);

- Formulate technical guidelines and policy recommendation to enhance the implementation and uptake of methods, technologies or practices to limit emissions and contaminants from manure management.

The proposal should take into account other EU-funded projects, including those funded under the ERA-NETs SusAn[322] and ERA-GAS[323]. Proposals should be based on a gap analysis taking into account the existing legislation[324] and related knowledge.

Proposals must implement the 'multi-actor approach' and ensure adequate involvement of the farming sector, agricultural advisory services, manufacturers, ecology and nature conservation experts, and other relevant actors.

In this topic, the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.

Due to the scope of this topic, international cooperation is strongly encouraged, in particular with China. This topic is within the scope of the Administrative Arrangement between the European Commission and the Ministry of Science and Technology of the People's Republic of China on a Co-funding Mechanism for the period 2021-2024 to support collaborative

322 https://era-susan.eu/.

323 https://eragas.eu/en/eragas.htm.

324 Such as Directive 2000/60/EC on the water framework directive; Directive 91/676/EEC on protection of waters against pollution caused by nitrates from agricultural sources; Directive 2010/75 on Industrial Emissions; Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants.

research projects under the Food, Agriculture and Biotechnologies (FAB) and the Climate Change and Biodiversity (CCB) flagship initiatives.

Actions will contribute to implementing the EU-China Food, Agriculture and Biotechnology (FAB) flagship initiative, which aims to ensure sustainability of agri-food systems, catering for the needs of a growing population, the reduction of food and agricultural losses and waste, and the provision of safe and healthy foodstuffs. Interaction with other actions developed under the EU-China Climate Change and Biodiversity (CCB) Research Flagship and the Flagship on Food, Agriculture and Biotechnologies (FAB) is encouraged if relevant.

Increasing environmental performance and sustainability of processes and products

Proposals are invited against the following topic(s):

HORIZON-CL6-2023-ZEROPOLLUTION-02-2-two-stage: Safe-and-sustainable-by-design bio-based platform chemicals, additives, materials or products as alternatives

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Admissibility conditions	The conditions are described in General Annex A. The following exceptions apply: Applicants submitting a proposal under the blind evaluation pilot (see General Annex F) must not disclose their organisation names, acronyms, logos, nor names of personnel in Part B of their first stage application (see General Annex E).
Technology Readiness Level	Activities are expected to achieve TRL 4-5 by the end of the project – see General Annex B.
Procedure	The procedure is described in General Annex F. The following exceptions apply: This topic is part of the blind evaluation pilot under which first stage proposals will be evaluated blindly.

Expected Outcome: Successful proposals will address expected impacts under the Destination 'Clean environment and zero pollution' and in line with: the European Green Deal's zero pollution ambition, the bioeconomy strategy, the chemicals strategy for sustainability, and the chemicals transition pathways, via R&I in bio-based safe-and-sustainable-by-design (SSbD)

solutions for a variety of applications. Bio-based solutions' design and assessment is expected to also go beyond compound/material-level considerations, with an additional reflection on end-use and final application(s).

Projects are expected to contribute to:

- Enable circularity(-by-design) of final products, predominantly in applications where recyclability is currently hindered or very challenging, especially due safety implications;
- In addition to fossil-feedstock substitution, reduce the dependency on or replace harmful substances, in particular in materials and formulations, leading eventually to safe(r) (low human and eco-toxicity) final bio-based products, while meeting overall environmental sustainability requirements;
- Build on a portfolio of promising bio-based solutions showing potential for scaled up production and future market uptake of alternative, safe, circular and sustainable bio-based products.

Scope: To deliver on the expected outcome, proposals should:

- Perform a wider scoping exercise, including opportunities and challenges, to propose priority areas [325] and which (optimised or novel) bio-based solutions (chemicals, materials) show 'solid' potential as safer and sustainable alternatives/substitutes. This 'exercise'/analysis should especially cover, but not only, areas where substances of very high concern (SVHC), substances of concern, persistent organic pollutants or legacy additives are currently in (end) use (e.g. textiles, plastics value chains);
- Select chemicals/group of chemicals/(advanced)materials/products and justify. Proceed then with design, (process) development and testing (to targeted TRL) of the chosen bio-based alternatives;
- Embed and assess functionality and value chain considerations for any novel solutions designed and developed, providing equivalent or improved functional performance versus existing and specified benchmarks. Functional performance should be assessed together with showcasing benefits on safety and environmental performance.
- Integrate the safe-and-sustainable-by-design (SSbD) framework, developed by the Commission, for assessing the safety and sustainability of chemicals and materials.[326]

[325] Thematic priority areas can span across one or more of the following critical areas: i) materials functionality (e.g., repelling water, grease and dirt, fire safety, plasticizing) to ii) formulation applications (e.g., preservation, solvents, and surfactants and where relevant also to iii) process applications (e.g., solvents, process regulation agents and surface protection). This list is not exhaustive.

[326] See documents defining the SSbD framework and criteria on: https://ec.europa.eu/info/research-and-innovation/research-area/industrial-research-and-innovation/key-enabling-technologies/advanced-materials-and-chemicals_en.

- Contribute with and develop recommendations that can advance further the application of the SSbD framework.[327] More specifically, provide thresholds that can support the criteria definition and improvements for the assessment SSbD methodologies, including any specificities related with bio-based chemicals and materials. Recommendations should also include identification of data gaps, especially safety, environmental, but also socio-economic factors, as well as priorities for data collection.

- Contribute with relevant data generated, along targeted value chain(s) (e.g. with regards to the bio-based substance/group of chemical substances or material). Projects have to make data, results and methodologies FAIR. They are also encouraged to link with trusted repositories for data, results and methodologies.

Where relevant, proposals should seek links and synergies and capitalise on the results of past and ongoing EU research projects (including the Bio-based Industries Joint Undertaking (BBI JU) /Circular Bio-based Europe Joint Undertaking (CBE JU)). This topic has important synergies and complementarities with Horizon Europe Cluster 4 calls (including its PPPs) as well as ongoing projects that should be taken into account.[328,329],[330].

Proposals should also include a dedicated task, appropriate resources and a plan on how they will collaborate with other projects funded under this topic and other relevant topics.

Call - Clean environment and zero pollution

HORIZON-CL6-2024-ZEROPOLLUTION-01

Conditions for the Call

Indicative budget(s)[331]

---

327 Idem.

328 SSbD topics in Cluster 4 WP 23-24, broader than bio-based chemicals and materials: HORIZON-CL4-2023-RESILIENCE-01-21: Innovative methods for safety and sustainability assessments of chemicals and materials (RIA), HORIZON-CL4-2023-RESILIENCE-01-22: Integrated approach for impact assessment of safe and sustainable chemicals and materials (RIA), HORIZON-CL4-2023-RESILIENCE-01-23: Computational models for the development of safe and sustainable by design chemicals and materials (RIA), HORIZON-CL4-2024-RESILIENCE-01-24: Development of safe and sustainable by design alternatives (IA) as well as European Partnership on Assessment of Risks from Chemicals (PARC).

329 Cluster 4, WP 21-22: HORIZON-CL4-2021-RESILIENCE-01-08: Establishing EU-led international community on safe-and-sustainable-by-design materials to support embedding sustainability criteria over the lifecycle of products and processes, HORIZON-CL4-2021-RESILIENCE-01-11; Safe- and sustainable-by-design polymeric materials, HORIZON-CL4-2021-RESILIENCE-2021-01-12; Safe- and sustainable-by-design metallic coatings and engineered surfaces and HORIZON-CL4-2022-RESILIENCE-01-23; Safe- and sustainable-by-design organic and hybrid coatings.

330 As appropriate, also consult the future 'EU Strategic Research and Innovation Plan for chemicals and materials'.

331 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.

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR million)[332]	Indicative number of projects expected to be funded
		2024		
Opening: 17 Oct 2023 Deadline(s): 22 Feb 2024				
HORIZON-CL6-2024-ZEROPOLLUTION-01-1	IA	27.00	Around 9.00	3
HORIZON-CL6-2024-ZEROPOLLUTION-01-2	CSA	4.00	Around 2.00	2
HORIZON-CL6-2024-ZEROPOLLUTION-01-3	RIA	7.00	Around 7.00	1
Overall indicative budget		38.00		

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

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

Halting pollution of air, soil and water

Proposals are invited against the following topic(s):

HORIZON-CL6-2024-ZEROPOLLUTION-01-1: Demonstrating how regions can operate within safe ecological and regional nitrogen and phosphorus boundaries

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 9.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 27.00 million.
Type of Action	Innovation Actions
Technology Readiness Level	Activities are expected to achieve TRL 8 by the end of the project – see General Annex B.

Expected Outcome: Successful proposals will deliver, to all actors involved in nitrogen (N) and phosphorus (P) emitting activities in a given region, a demonstrated set of measures to limit N/P emissions and re-balance N/P flows within safe ecological boundaries at regional and local scale, thereby contributing to restoring ecosystems in line with the European Green Deal and the EU zero pollution action plan.

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

- Best practice, including technical and governance solutions, to reduce N/P emissions into water, air and soil from all emitting sectors, in line with relevant EU limit values;
- Demonstrated environmental, economic and behavioural effects of aforementioned N/P limiting solutions while promoting local and regional sustainability and circular economy schemes;
- Comprehensive guidance on sustainable and circular practices to control regional N/P flows at regional level in the EU, and recommendations to relevant actors (policymakers, local administrations, practitioners, industries etc.).

Scope: Building on recent innovations in regional N/P budgeting and quantification methodologies to ensure good status for air, water and soil ecosystems, this Innovation Action should demonstrate how to apply optimised N/P budgets, based on maximum allowable inputs of N/P at a regional/river basin scale, and create the necessary systemic and multi-actor transition pathways to ensure a sustainable integrated N/P management in the future. The aim is to show how N/P-relevant sectors (e.g., agriculture, aquaculture, forestry, industrial sectors, food/drink sector, water supply, water/waste management, bioenergy, fossil-based energy production, mining activities, transport, unintentional losses through leaching and run-off of

agricultural nutrients etc.) in a given region can limit N/P emissions to air, water and soil from their activities by respecting pre-established regional N/P budgets and applying N/P balancing practices. N/P-balancing practices comprise activities that enhance the sustainability and circularity of N/P relevant resources and services between urban/industrial and rural/coastal environments and apply respective governance measures. Finally, it will be essential to develop comprehensive guidelines to disseminate best practices and techniques to all involved actors.

Proposals should:

- Implement a reliable N/P budgeting methodology to identify the maximum allowable input of N/P at regional/river basin scale and ensure good status for air, water and soil ecosystems. N/P budgets should stay within safe ecological and regional boundaries, i.e. by respecting limit values of N/P in air, water and soil, as specified in existing EU legislation [333] or based on recent scientific evidence [334] and complying with the precautionary principle.

- Demonstrate single or integrated region-specific practices in all relevant N/P sectors that help balance emissions from N and P-based fertilisers in agriculture, enhance soil health, reduce eutrophication and water pollution and limit harmful emissions to air.

- Showcase how innovative governance models can contribute to fostering ecologically responsible and sustainable use, recovery and exchange of N/P relevant resources, services and infrastructures between urban/industrial and rural/coastal environments while meeting overarching EU objectives (farm to fork and biodiversity strategies).

- Test innovative practices and technologies to make use of secondary raw materials and produce N and P-based fertilisers recovered from organic waste, wastewater, biological residues or by-products and promote local and regional value chains.

- Apply novel governance approaches and other incentives supporting practices to limit N/P emissions and develop respective guidelines and recommendations for all concerned stakeholders (local and regional authorities, municipalities, environmental organisations, farmers and other practitioners industry, civil society etc.), to encourage behavioural change and public acceptance of recovered products as well as more effective problem-solving mechanisms while envisaging regional twinning and mentoring schemes.

- Disseminate results and best practice to all stakeholders involved across the EU and Associated Countries, and provide recommendations on the design of harmonised, coherent and efficient regional policies and regulatory instruments that facilitate eliminating and preventing N/P pollution.

---

333 EU Water Framework Directive, Nitrates Directive.

334 EEA 2020, Is Europe living within the limits of our planet? An assessment of Europe's environmental footprints in relation to planetary boundaries' https://www.eea.europa.eu/publications/is-europe-living-within-the-planets-limits.

Applicants are encouraged to join different regional clusters per project and to diversify their proposed consortia by involving a wide range of relevant stakeholders, such as primary producers and practitioners, local and regional administrations, municipalities, related industries, environment organisations, academia, civil society, citizens, etc.

The projects funded under this topic are expected to build close links and exchange knowledge and information with the Horizon Europe Mission "Restore our Ocean and Waters by 2030". In particular, they should link to the Mission activities under Objective 2 – "Prevent, minimise and eliminate pollution in marine and freshwater environment", and to the Mission lighthouse activities in the Mediterranean sea basin focusing on the prevention, reduction and elimination of all kinds of pollution in marine and freshwater ecosystems, including pollution from excess nutrients (phosphorus and nitrogen).

This topic will be part of the demonstration projects for the implementation of the European Commission's Circular Cities and Regions Initiative (CCRI) and must be carried out in close cooperation with it.

SSH aspects should be included.

HORIZON-CL6-2024-ZEROPOLLUTION-01-2: Best available techniques to recover or recycle fertilising products from secondary raw materials

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 2.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 4.00 million.
Type of Action	Coordination and Support Actions
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025). [335].

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

Expected Outcome: Successful proposals will deliver recommendation to policy makers and stakeholders on the alternative fertilising products able to balance nitrogen (N) and phosphorus (P) flows within safe ecological boundaries at regional and local scale, thereby contributing to restoring ecosystems. Projects will contribute to deliver alternative fertilising products with reduced environmental impacts on soil, water, and air quality, biodiversity and climate, in line with the European Green Deal and the EU zero pollution action plan.

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

- Lower environmental impacts on soil, water, and air quality, biodiversity and climate from alternative fertilising products recovered from secondary raw materials;
- Circular use of alternative fertilising products recovered from secondary raw materials;
- Best available techniques for recovering/recycling fertilising products from secondary raw materials, in terms of technical feasibility, environmental performance and socio-economic aspects: collection and sharing among European and international stakeholder.

Scope: The scope of this CSA is the analysis of best available technologies for recovering/recycling fertilising products from secondary raw materials in Europe while limiting nitrogen and phosphorus pollution in soil, water and air and any other form of pollution from the use of such fertilising products and from the replacement of nitrogen- and phosphorus-based fertilisers produced from conventional processes (including mining and fossil-based processes). Examples of fertilising products within the scope are: recycled nutrients from urban and industrial waste water and sewage sludge, organic fertilising products from bio-waste, digestate and treated manure as well as other fertilising products from biological resources.

To deliver on the expected outcomes, proposals should:

- Collect data on case studies of existing installations converting secondary raw materials into fertilising products in Europe and outside. Secondary raw materials should include: urban and industrial waste water and sewage sludge, bio-waste, digestate, treated manure, others. Case studies of existing installations should range in volume and type of secondary materials treated, as well as in technologies employed in the installations;
- Analyse the technical aspects of the available technologies, such as on the characterisation of secondary raw materials, the recovery/recycling processes and their environmental impacts on soil, water and air quality, biodiversity and climate, their resources efficiency (including energy), as well as the pollution prevention operations. The analysis should also include the assessment of the costs for installation, maintenance and upgrade of both recovery/recycling and pollution prevention operations;
- Compare the environmental impacts and the resources efficiency (including energy) of the available technologies in the scope with the impacts of the conventional processes producing nitrogen- and phosphorus-based fertilisers. The comparison should be performed based on appropriate selection of the functional unit;

- Analyse the fertilising products from each case study selected at the first step: e.g., their composition (in a range of values of main components, following the current content of labelling provisions of EU fertilising products), with special focus on any potential polluting substance, including microplastics and persistent substances and their impacts on soil, water, air quality, biodiversity and climate, their suggested use and management, especially preventing the emissions of nitrogen and phosphorus to the environment but also any other pollutants, their compliance with certifications and labels, etc.;

- Analyse the market and the regulatory framework of the identified practices (according to the EU legislation, certification and standardization schemes) and their potential to enable or prevent the wider uptake of these technologies;

- Analyse the technical availability of feedstock supply and potential to upscale the identified practices and the production of fertilising products from secondary raw materials;

- Select the best available technologies based on: the analysis carried out on the whole database of case studies, the market and the regulatory framework and the availability of feedstock supply. The best techniques should meet the best performances, especially in terms of lower impacts on soil, water, and air quality, biodiversity and climate;

- Deliver specific datasheets of relevant techniques with their technical and environmental performances, as well as with economic and social analysis;

- Build links with the European Mission 'Restore our ocean and waters by 2030', in particular with the Mission activities under objective 2 – *prevent, minimise and eliminate pollution in marine and freshwater environment, and with the Mission lighthouse activities in the Mediterranean sea basin focusing on prevention, reduction and elimination of all kinds of pollution in marine and freshwater ecosystems, including pollution from excess nutrients (phosphorus and nitrogen)*;

- Build links with the European Mission 'A Soil Deal for Europe', especially with the activities under objective -*reduce soil pollution and enhance restoration*.

- Provide recommendations to policy makers and practitioners to ensure the deployment of the best available technologies preventing the emissions of nitrogen and phosphorus to soil, water and air;

- Establish a forum of stakeholders from the whole supply and value chain, in order to feed the projects with advice and discussion and share best practices eventually. The forum will be open to stakeholders from Europe and outside.

Applicants from different groups of stakeholders will cover all the technical, environmental, economic and social aspects of supply chains of secondary raw materials, installations and processes converting those materials into fertilising products and end users.

In order to achieve the expected outcomes, and in line with the EU strategy for international cooperation in research and innovation, international cooperation is encouraged.

Where relevant, proposals should seek links with and capitalise on the results of past[336] and ongoing EU funded projects[337].

The projects funded under this topic should develop their tasks in synergy, in order to select the best available technologies on the broader base of case studies, possibly covering all different conditions in Europe (i.e., different secondary raw materials available, different techniques, regulatory and market frameworks, etc.). The projects should also establish common formats of the specific datasheets of relevant techniques and of the recommendations to policy makers and practitioners, both described in the scope. Moreover, they should establish together the forum of stakeholder, which will be unique for all projects.

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

In this topic the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.

Reducing the environmental impact and pollution in food systems

Proposals are invited against the following topic(s):

HORIZON-CL6-2024-ZEROPOLLUTION-01-3: Environmental impacts of food systems

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 7.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 7.00 million.
Type of Action	Research and Innovation Actions
Eligibility conditions	The conditions are described in General Annex B. The following exceptions apply: The following additional eligibility criteria apply: the proposals must use

336 See for example https://sea2landproject.eu/ and projects under BBI JU https://www.bbi.europa.eu/projects/b-ferst, https://www.bbi.europa.eu/projects/newfert.

337 See for example HORIZON-CL6-2021-ZEROPOLLUTION-01-09: Environmental impacts and trade-offs of alternative fertilising products at global/local scale.

	the multi-actor approach. See definition of the multi-actor approach in the introduction to this work programme part.

Expected Outcome: The food sector contributes to food security but is also responsible for air, water and soil pollution. It can contribute to biodiversity loss, soil erosion and climate change, and it consumes excessive amounts of natural resources, including water and energy, while a significant amount of food is wasted. In supporting the implementation of the European Green Deal, the EU zero pollution action plan, the farm to fork strategy, the European climate pact, the common agricultural policy and the common fisheries policy and the Food 2030 initiative, the successful proposal should address all of the following outcomes:

- Increased overall knowledge of the environmental and climate impacts stemming from the food systems, including potential trade-offs/synergies with other sustainability aspects (environmental, social, economic).
- Robust evidence-based understanding of the impacts of food systems related to direct and indirect soil, water and air pollution that drive biodiversity losses, soil erosion, climate change and can negatively affect human health.
- Improved capacity to reduce the environmental and climate impacts of food systems, particularly in relation to pollution.
- Support to actors across the food systems through new available knowledge, shared existing data on environmental and climate impacts of food systems and identification of innovative solutions.

Scope: There is an increasing understanding of the impacts related to the green-house gas (GHG) emissions stemming from food systems. Around one third of human-caused GHG emissions worldwide originate from food systems.[338] A similar share of emissions is also recorded in Europe. Although the largest share of the GHG emissions and other relevant environmental impacts can be attributed to the primary food production (or harvesting in the case of fisheries), a significant amount of food-related environmental impacts is also generated in post-production and post-harvest processes along food supply chains. However, when considering wider environmental and climate impacts of food systems, more information is needed to understand these impacts, particularly when it comes to pollution stemming from food processing, manufacturing, packaging, distribution, trade, consumption (including emerging food consumption trends, such as products of alternative diets), food waste and end of life practices.

The relevant data covering these latter industries or practices are often less available and/ or accessible compared to the agricultural data, for example through the CAP indicators. At the same time, knowledge gaps also exist when it comes to environmental impacts of primary food production and harvesting. Therefore, the successful proposal should fill the relevant

338 Crippa, M., Solazzo, E., Guizzardi, D. et al. Food systems are responsible for a third of global anthropogenic GHG emissions. Nat Food 2, 198–209 (2021).

knowledge and data gaps. It should explain how it will deliver co-benefits to some of the Food 2030 priorities: climate, biodiversity and environment, circularity and resource efficiency, innovation and empowering communities. The data should be aligned with, and support the relevant objectives of the upcoming Sustainable food system framework initiative.[339]

Proposals are expected to:

- Collect relevant qualitative and quantitative data on environmental and climate impacts related to water, air and soil pollution stemming from the food systems, biodiversity losses, climate change and negative impacts on human health, as well as data on freshwater consumption, soil erosion, resource and energy efficiency of food production and supply practices.

- Increase the accessibility of relevant high quality life cycle inventory data according to FAIR principles and the EU's open science policy by setting up actions to develop, review and make available existing databases.

- Provide new data based on requirements for Environmental Footprint compliant datasets[340] and in line with the 2021 Recommendation on the use of the Environmental Footprint methods[341].

- Assess the environmental impacts of food systems from a life-cycle perspective, using the Environmental Footprint methods.

- Identify and map opportunities and innovative solutions, including existing good practices that address the identified impacts and promote the uptake of sustainable food production (including harvesting) and/ or food supply practices, including consumption practices, with minimum impact.

- Identify and map opportunities and innovative solutions, including existing good practices, that maximise synergies among the three dimensions of sustainability (i.e. environmental – including climate and biodiversity, economic, social - including health), different sectors, as well as actors across the food systems (from production/ harvesting to consumption), minimising trade-offs and reducing pollution as well as other environmental and climate impacts in food systems as a whole.

- Implement the multi-actor approach by involving a wide range of food system actors and conducting inter-disciplinary research.

- In order to achieve the expected outcomes, international cooperation is encouraged.

339 See f2f_legis_iia_fsfs_5902055.pdf (europa.eu)

340 See JRC Publications Repository - Guide for EF compliant data sets (europa.eu).

341 Commission Recommendation (EU) 2021/2279 of 15 December 2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations C/2021/9332, OJ L 471, 30.12.2021, p. 1–396 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021H2279.

- Where relevant, build on and expand the results of past and ongoing research projects and collaborate with relevant initiatives.

This topic has strong links with destinations "biodiversity and ecosystem services", "fair, healthy and environment-friendly food systems from primary production to consumption" and "circular economy and bioeconomy sectors".

Call - Clean environment and zero pollution

HORIZON-CL6-2024-ZEROPOLLUTION-02

Conditions for the Call

Indicative budget(s)[342]

Topics	Type of Action	Budgets (EUR million)	Expected EU contribution per project (EUR million)[343]	Indicative number of projects expected to be funded
		2024		
Opening: 17 Oct 2023 Deadline(s): 21 Feb 2024 (First Stage), 17 Sep 2024 (Second Stage)				
HORIZON-CL6-2024-ZEROPOLLUTION-02-1-two-stage	IA	15.00	Around 5.00	3
HORIZON-CL6-2024-ZEROPOLLUTION-02-2-two-stage	RIA	8.00	Around 4.00	2
Overall indicative budget		23.00		

General conditions relating to this call	
Admissibility conditions	The conditions are described in General Annex A.
Eligibility conditions	The conditions are described in General

342 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.

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

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

Protecting drinking water and managing urban water pollution

Proposals are invited against the following topic(s):

HORIZON-CL6-2024-ZEROPOLLUTION-02-1-two-stage: Holistic approaches for effective monitoring of water quality in urban areas

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 5.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 15.00 million.
Type of Action	Innovation Actions
Admissibility conditions	The conditions are described in General Annex A. The following exceptions apply: Applicants submitting a proposal under the blind evaluation pilot (see General Annex F) must not disclose their organisation names, acronyms, logos, nor names of personnel in Part B of their first stage application (see General Annex E).
Procedure	The procedure is described in General Annex F. The following exceptions apply: This topic is part of the blind evaluation pilot under which first stage proposals will be evaluated blindly.

Expected Outcome: In line with the European Green Deal's zero pollution ambition, successful proposals will contribute to protecting water quality by managing urban water pollution, and consequently also protecting biodiversity and the quality of aquatic ecosystems, as addressed by several impacts under the Destination 'Clean environment and zero pollution', in particular "Move towards achieving clean, unpolluted surface water and groundwater bodies in the EU by advancing the understanding of diffuse and point sources of water pollution in a global and climate change context, enabling novel solutions to avoid degradation and restore water bodies, aquatic ecosystems and soil functionality, and further enhancing water quality and its management for safe human and ecological use, while fostering the EU's and Associated Countries' position and role in the global water scene."

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

- Enhance urban water quality with a view of providing better guidance for policy making and prioritisation by developing integrated urban water quality monitoring management plans;
- Sound, safer and risk-based urban water quality management plans supported by enhanced holistic monitoring, advanced novel methods and digital solutions, modelling and evidence-based scenarios;
- Increase uptake of digital tools in the water sector to support water management decisions for all stakeholders.

Scope: Water management in urban areas is confronted with a wide range of water quality issues. Urban runoff, is an increasingly important source of pollution. This is going to be aggravated by an increasing frequency of extreme events, such as floods and droughts, due to the impacts of climate change, as well as the increasing sealing of surfaces and rapid growth of urban areas. Moreover, water leakages from ageing water-service infrastructure and combined sewer or storm water overflows, leads to additional pollution releases into the environment. Water quality deterioration due to trace organic pollutants such as pharmaceuticals and industrial chemicals, microbial contaminants, such as pathogens or antimicrobial resistance genes, micro-plastic, nanomaterial, and diffuse pollution from urban areas (roads, urban runoff) and from upstream agricultural areas or industries and many other pollutants often released unintentionally to the environment and finally leading to several forms of pollution of urban water sources. These issues are also exacerbated by the complex interactions between pollutions sources and pathways at the urban/catchment level interface.

In line with the ambition of the EU zero pollution action plan there is a need to develop an integrated and harmonised approach to monitor all sources of surface and groundwater pollution and their impact, including micro-pollutants, micro-plastics, pharmaceuticals and other contaminant of emerging concerns, as well as mixtures of pollutants.

This objective of this action is to develop and demonstrate a European wide 'whole system monitoring approach' to address emerging water pollution and water quality assurance in urban areas in various urban areas covering a wide number of water pollution challenges, ,

taking into consideration the interactions of pollution sources and pathways between urban areas and the surrounding river and where appropriate drainage basin, and improve the resilience of urban water systems towards pandemics and global and climate change challenges. New systemic concepts and holistic strategies to enhance urban water quality should be integrated and demonstrated in an operational environment, including decentralised systems, hybrid green-grey infrastructures or cascading use of water.

An advanced monitoring and control system, going beyond the conventional pollutants, linking drinking and wastewater urban cycles, integrating risk management approaches and exploiting upgraded digital solutions to support urban water quality management, should be developed and tested, combined with appropriate modelling tools and scenarios to assess and forecast the long-term impacts of future changing socio-economic and climatic conditions on water quality. This monitoring system should consider the overall monitoring and outlook requirements of the EU zero pollution action plan, the monitoring requirements of existing EU water policy legislation (e.g., Water Framework Directive, Drinking Water Directive , Urban Waste Water Treatment Directive, Bathing Water Directive, etc.) and relevant national and/or European water quality monitoring tools, and develop recommendations and guidance to strengthen the implementation of the EU and/or national legislation. It should allow to identify cause-effect relationships and big data management to address quality pressures For this purpose there is a need to develop better methods to access chemical data to be able to track the use or the flows of chemicals in urban areas (e.g., to support case studies using mass balance approach to clarify hotspots of pollution sources). New and refined analytical tools and monitoring methods (e.g. effect-based monitoring, biological monitoring) to analyse broad spectrum of contaminants of emerging concerns should be also developed. Recommendations for the standardisation of monitoring and identification of contaminants (including detection limit) should be also provided.

To enhance the capabilities of real-time monitoring of water quality, the potential of earth observations technologies and the use of digital technologies, such as online sensors, artificial intelligence, digital twins, digital data spaces, etc. should be further explored and consolidated.

In general, the participation of academia, research organisations, utilities, industry and regulators is strongly advised, as well as civil society engagement whenever necessary, also aiming to broaden the dissemination and exploitation routes and to better assess the innovation potential of developed solutions and strategies. The direct participation of urban and catchment/river basin managing water authorities and utilities is essential.

Where relevant, activities should create synergies with the projects funded under the protecting drinking water and managing urban water pollution topics in the work programme from WP2021-2022, namely HORIZON-CL6-2021-ZEROPOLLUTION-01-03 and HORIZON-CL6-2022- ZEROPOLLUTION-01-04.

Increasing environmental performances and sustainability of bio-based processes and products

Proposals are invited against the following topic(s):

HORIZON-CL6-2024-ZEROPOLLUTION-02-2-two-stage: Innovative technologies for zero pollution, zero-waste biorefineries

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of around EUR 4.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Actions
Admissibility conditions	The conditions are described in General Annex A. The following exceptions apply: Applicants submitting a proposal under the blind evaluation pilot (see General Annex F) must not disclose their organisation names, acronyms, logos, nor names of personnel in Part B of their first stage application (see General Annex E).
Technology Readiness Level	Activities are expected to achieve TRL 4-5 by the end of the project – see General Annex B.
Procedure	The procedure is described in General Annex F. The following exceptions apply: This topic is part of the blind evaluation pilot under which first stage proposals will be evaluated blindly.

Expected Outcome: Successful proposals will support researchers and innovators to improve the environmental performances and circularity of bio-based systems in industrial sectors. Project outcomes will contribute to enhance circular bio-based systems operating according to planetary boundaries, replacing fossil-based systems and their carbon footprint, mitigating climate change and protecting air, water and soil quality along industrial value chains, in line with the European Green Deal and the EU zero pollution action plan.

Projects results are expected to contribute to the following expected outcomes:

- Enhanced environmental performances of bio-based processes approaching the zero-waste, zero-pollution ambition.

- Integrated pollution prevention and control in bio-based systems targeting soil, water and air quality as well as noise levels.

Scope: Pollution from anthropogenic activities undermines the integrity of Earth ecosystems and severely affects the natural resources essential for human life. The EU bioeconomy strategy 2030 sets environmental protection at the basis of the modernisation of bio-based industries in the Union, to ensure a trustful green transition of EU economy away from a linear fossil-based system.

To develop solutions for preventing and controlling pollution from bio-based industries, proposals should:

- Design integrated technical solutions reducing exhaust flows from bio-based processes through innovative technologies of extraction, recirculation, fractionation and conversion of such flows, to reach the zero-pollution ambition starting from the emissions to soil, water and air. The exhaust flows considered should include the ones that are usually not considered in the common pollution prevention and control operations, such as hot water, vapours, odours etc. The reduction of impacts on climate change, based on the reduction of greenhouse gas emissions and accessorily via increase of carbon removals, and on biodiversity should be considered as well;

- Individuate replacement of hazardous substances used in the processes with safe bio-based ones;

- Design the biorefinery operations to re-circulate any process flows such as process air and water and to increase energy efficiency including heat recovery;

- Design the biorefinery operations in order to reduce noise emissions;

- Design circularity of any processes, including through symbiosis between industrial installations to share and exploit materials and carrier streams, and looking on the best practices already available or under development, including in other EU R&I programmes to reach the zero-waste ambition;

- Develop a case-study of integrated zero-pollution technical solutions in a selected biorefinery and design the adaptation of the case-study to be operational at all scales, from the large/medium to the small scale (the latter shows potentially high specific environmental impacts);

- Pilot and validate digital innovation for bio-based processes enabling the zero-pollution and zero-waste biorefinery ambition. Digital tools may include data sharing platforms for the management of supply and value chains, as well as industrial symbiosis operations between biorefineries, industrial hubs, etc.;

- Develop and validate integrated monitoring systems, operated by the industry at the level of the biorefinery, of the effective reduction of pollutant emissions, affecting soil, water and air quality, noise levels and waste production from biorefineries.

Where relevant, proposals should seek links with and capitalise on the results of past and ongoing EU funded projects, including under the Circular Bio-based Europe JU and other partnerships of Horizon Europe.

In this topic the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.