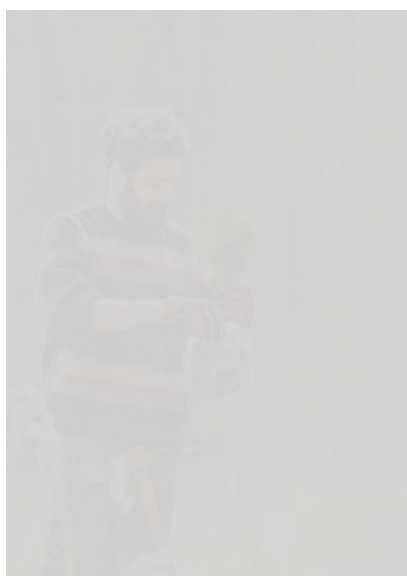


FTP CALL TOPICS MANUAL HORIZON EUROPE 2021-2022

The complete manual for the Call topics relevant for
the wood working sector



v2.0 – 21/06/2021

Forest-based Sector
Technology Platform



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Introduction

Horizon Europe is the EU's key funding programme for research and innovation for 2021-2027. After more than three years of negotiations, it has finally been approved by the European Parliament on the 27th April 2021. The approved budget amount is € 95,5 billion in current prices.

Horizon Europe is structured into three main Pillars. Pillar I focus on the funding of excellent science through the European Research Council and young researchers through the Marie Skłodowska-Curie grants programme. It also funds European research infrastructures.

Pillar II addresses global challenges and increasing the competitiveness of the European industry. Pillar II is divided into 6 thematic sub-budgets that are called Clusters. The third Pillar focus on innovation and acts mainly through the European Innovation Council and the European Institute of Technology.

For the stakeholders of the European Technology Platform for the forest-based sector (FTP), the most relevant funding opportunities are found under Pillar II Clusters 4, 5 and 6.

Cluster 4 is called 'Digital, Industry and Space', Cluster 5 is called 'Climate, Energy and Mobility', and Cluster 6 has the rather long title 'Food, Bioeconomy, Natural Resources, Agriculture and Environment'. Each Cluster has a sub-budget, called Work Programme, that identifies Call Topics for a period of two or three years. **Call Topic Manual covers the relevant Call Topics of the 2021-2022 Work Programmes for Clusters 4, 5 and 6.**

The Horizon Europe budget is distributed by competitive Calls for Proposals. This means that applicants have to submit proposals that will be evaluated and scored by external experts and only the best scoring proposals will be funded under each Call for Proposals.

The proposals, if they are funded, are annexed as part of the contract between the applicants and the European Commission. A proposal could be compared to a business plan of a start-up company. If the proposals are funded or not will depend on how they are ranked in the evaluation by independent experts. The scoring is based on three main criteria; **Excellence** (is the idea sound, is the proposal actually covering the scope of the Call, etc), **Impact** (how will the outcomes of the project contribute to the objectives of the Call and relevant EU objectives), and **Quality and efficiency of the implementation** (is the project well planned in terms of budget, are all the reports and deliverables relevant and well described, Are the project milestones relevant and are there contingency plans prepared if the project run into problems). Although all three criteria are scored equally, the Impact criteria is usually considered the most important of the three.

This FTP Manual showcases a list of the most relevant Call topics for the forest-based sector. Each Call contains topics and each topic describes the specific challenge to be addressed, the scope of the activities to be carried out, and the expected impacts to be achieved by the projects proposed. The relevant topics selected and compiled in this manual are arranged with the link to the corresponding Research and Innovation Areas [of FTP's Strategic Research and Innovation Agenda for 2030 \(SIRA 2030\)](#).

Proposals can be submitted electronically through the European Commission's [Funding and Tenders Portal](#). The complete list and description of Calls and further guidance to submit a proposal are also published on the Portal.

Preparing a proposal takes time and effort. By this version of the FTP Call Topics Manual, we wish to give our stakeholders the advantage of an early start.

The three Work Programme documents we have analysed for this document, together constitute close to 2000 pages text and several hundreds of Call Topics. We have identified approximately 150 of those Call Topics as relevant for stakeholders in the forest-based sector.

Information on the Call Topics in this Manual will also be available on the FTP Database.

Horizon Europe (2021-2027) with its dedicated budget of around €95 billion is the biggest EU Research and Innovation programme ever.

Budget for 2021–2022: Call topics relevant for the woodworking sector

	Number of Calls	Funding (million EUR)
Cluster 4 – Digital, Industry and Space	27 (8 indirect)	484,8
Destination 1 - Climate neutral, circular and digitised production	7 (1 indirect)	145,5
Destination 2 - Increased autonomy in key strategic value chains for resilient industry	12 (3 indirect)	236
Destination 4 - Digital and emerging technologies for competitiveness and fit for the Green Deal	4 (1 indirect)	79,5
Destination 6 - A human-centred and ethical development of digital and industrial technologies	3 (3 indirect)	14,5
EUSPA	1	9,3
Cluster 5 – Climate, Energy and Mobility	11	156
Destination 4 - Efficient, sustainable and inclusive energy use	11	156
Cluster 6 – Food, Bioeconomy, Natural Resources, Agriculture and Environment	16 (1 indirect)	129
Destination 1 - Biodiversity and ecosystem services	5	42
Destination 3 - Circular economy and bioeconomy sectors	6 (1 indirect)	60
Destination 4 - Clean environment and zero pollution	3	19
Destination 7 - Innovative governance, environmental observations and digital solutions in support of the Green Deal	2	8
MISSIONS	4 (2 indirect)	34
Mission: Adaptation to climate change	1 (1 indirect)	5
Mission: Climate neutral and smart cities	2 (1 indirect)	4
Destination: Deployment of NEB lighthouse demonstrators in the context of missions	1	25
Total all Calls	58 Calls (11 indirect)	803,8 mln EUR
Total (High, Medium, Low)	47 Calls	704,8 mln EUR

How to read this manual: The Call Topic Headers

For each Call Topic, we provide in the header key information such as the Call publication date, application deadline(s), Call budget, recommended EU funding per project, starting TRL and ending TRL (TRL=Technology Readiness Levels).

Further on, to assist the reader to find their way to the Call Topics of highest relevance to them, we have introduced a few concepts in the header of each Call Topic: FTP Subsector, Relevance, Keywords, FTP Comment and FTP SIRA 2030.

FTP Subsector: F&F, WW, P&P + Biodiversity, Bioenergy, Policy

This manual makes a very broad classification of the forest-based sector into three subsectors: forests and forestry, pulp & paper industries, and woodworking industries.

In many cases, the scope of the Call Topic is relevant to actors in more than one subsector and if the scope covers, chain-of custody, life-cycle analysis, circular economy etc, we have included the whole value-chain, i.e., all three subsectors in this identification.

Forests and Forestry (abbreviated F&F): Sustainable forest management, forest-related sciences, remote sensing technologies, plant breeding and much more.

WoodWorking Industries (abbreviated WW) includes sawmilling, building with wood, wood manufacturing, boards, panel industry, carpentry, wood composite products like CLT, construction, reuse and recycling and much more.

Pulp & Paper Industries (abbreviated P&P): packaging, paper, biocomposites, biochemicals, hygiene and healthcare products, nanocellulose, foams, gels, recycling and reuse and much more.

Besides these three subsectors, we sometime use Biodiversity, Bioenergy and Policy to emphasise the scope of the Call Topic.

Relevance: High, Medium, Low, Indirect

High relevance is used when the Call Topic is specifically targeting an area of the forest-based sector, or when it is targeting a broader context but addresses a challenge of very high relevance to the sector.

Medium relevance is used when the Call Topic is relevant but the scope is encompassing for instance agriculture AND forestry, or process industries in general.

Low relevance is used when the topic is either covering a very narrow, special niche of the forest-based sector (e.g. New biocompatible healthcare products), or when the scope is

broadly relevant to a much larger group of actors (e.g. a topic on transport and logistics solutions).

Indirect relevance is used when the actors in the forest-based sector should keep an eye of future outcomes, but the Call Topic is unlikely to be addressed by FTP stakeholders. For instance, projects related to standardisation of earth observation data from satellites or studies of climate change effects on biodiversity. Those indirect topics can be found in Annex 1.

Keywords are selected from the Call Topic description.

FTP Comment: In some cases, we have made some own reflections and recommendations on the call topics that we have collected.

FTP SIRA 2030: Here we identify which of the ten Vision Targets and the related Challenges that are described in the FTP Strategic Research and Innovation Agenda 2030 that could be considered addressed by the call topic.

10 Vision Targets and Challenges of SIRA 2030:

1	Sustainable forest management, biodiversity and resilience to climate change
1.A	Capitalizing on the interdependencies between forest management and functional diversity
1.B	Strengthening forest ecosystem resilience and fostering Climate Smart Forestry
1.C	Enhancing the vital role of forests in regional and continental water supply
1.D	Mitigating wildfire risks in forested landscapes
1.E	Improving the partnership with citizens
2	Increased, sustainable wood production and mobilization
2.A	Improving seeds, seedlings and plants to increase productivity and resilience
2.B	Using digital revolution for precision forestry
2.C	Empowering small-scale forest owners
2.D	Harnessing novel technologies and automation in forest operations
2.E	Analysing and foresighting markets and material flows of forest-based products
3	More added value from non-wood ecosystem services
3.A	Improving business opportunities for non-wood forest products
3.B	Enhancing value creation with other ecosystem services
3.C	Providing forest-based benefits for urban and peri-urban societies
3.D	Identifying the benefits of forest expansion as a consequence of land-use change
3.E	Innovation in forest governance to promote forest-based benefits for society
4	Towards a zero-waste, circular society
4.A	Optimizing material recovery through efficient collection, sorting and separation
4.B	Adapting reuse and recycling technologies to complex products
4.C	Defining methods for cost assessment and optimization of recycling
4.D	Boosting the circularity of forest fibres and wood products
5	Efficient use of natural resources
5.A	Reducing energy consumption in biorefineries, including pulp and paper mills

- 5.B Optimizing the use of raw materials by exact control of natural variations
- 5.C Improving raw material efficiency and production value in wood-based manufacturing
- 5.D Improving water balance and process water treatment
- 6 Diversification of production technologies and logistics
- 6.A Developing industrial symbiosis
- 6.B Creating new biorefinery concepts for the circular and biobased economy
- 6.C Adopting additive manufacturing technologies and new production methods
- 6.D Extracting and producing natural compounds with high added value
- 6.E Improving traceability and chain-of-custody throughout the value chain
- 6.F Integrating autonomous and/or electrified harvesting and transportation systems
- 7 Purposeful, safe jobs and links between rural and urban regions
- 7.A Growing the forest-based sector through creative jobs
- 7.B Creating job opportunities along the value chain through proactive management of small forest ownerships
- 7.C Developing new marketplaces and jobs in response to changing consumer trends
- 7.D Adapting job offers in an era of Artificial Intelligence (AI)
- 7.E Improving operator safety and ergonomics
- 8 Renewable building materials for healthier living
- 8.A Developing new building systems, including modular and pre-fabricated systems
- 8.B Improving wood-based products, including engineered wood and composites
- 8.C Harmonization and standardization research and more intelligent, digital design tools
- 8.D Exploring the experience of living with wood and its health benefits
- 9 New fibre-based products and 80 per cent lower CO2 emissions
- 9.A Providing sustainable, fibre-based, high-value consumer products
- 9.B Developing more sustainable and competitive processes for paper-making and other biobased products
- 9.C Developing building blocks for biobased materials and chemicals in the circular society
- 9.D Adding value through digitalization and functionalization
- 10 Renewable energy for society
- 10.A Developing new, efficient production systems for advanced, clean biofuels and chemicals
- 10.B Enhancing the valorization of forest residues
- 10.C Establishing integrated and holistic energy systems (including energy storage and managing demand fluctuations)
- 10.D Supporting fact-based decision-making on bioenergy-related issues

DISCLAIMER: Please be aware that only the officially published Work Programme (WP) text, budget and deadlines should be taken as a reference for any proposal preparation. All applicants should consult the Funding and Tenders Portal to find the latest version.

Pillar II : Global challenges and European industrial competitiveness Pillar

Cluster 4: Digital, Industry and Space¹

Destination 1: Climate neutral, circular and digitised production

This destination will directly support the following Key Strategic Orientations, as outlined in the Strategic Plan:

- KSO C, **‘Making Europe the first digitally led circular, climate-neutral and sustainable economy** through the transformation of its mobility, energy, construction and production systems.’
- KSO A, **‘Promoting an open strategic autonomy by leading the development of key digital, enabling and emerging technologies, sectors and value chains** to accelerate and steer the digital and green transitions through human-centred technologies and innovations.’
- KSO D, **‘Creating a more resilient, inclusive and democratic European society,** prepared and responsive to threats and disasters, addressing inequalities and providing high-quality health care, and empowering all citizens to act in the green and digital transitions.’

Proposals for topics under this Destination should set out a credible pathway to the following expected impact of Cluster 4:

- **Global leadership in clean and climate-neutral industrial value chains, circular economy and climate-neutral digital systems and infrastructures (networks, data centres),** through innovative production and manufacturing processes and their digitisation, new business models, sustainable-by-design advanced materials and technologies enabling the switch to decarbonisation in all major emitting industrial sectors, including green digital technologies.

Accelerating the twin green and digital transitions will be key to building a lasting and prosperous growth, in line with the EU’s new growth strategy, the European Green Deal. Europe’s ability to lead the twin transitions will require new technologies, with investment and innovation to match. Research and innovation will be fundamental to create the new

¹ [Work Programme published by the European Commission on 15 June 2021](#)

products, services and business models needed to sustain or enable EU industrial leadership and competitiveness, and to create new markets for climate neutral and circular products. The shift towards a sustainable and inclusive economic model will be further enabled by the broader diffusion and uptake of digital and clean technologies across key sectors.

As Europe transitions towards climate neutrality, some sectors will have to make bigger and more transformative changes than others, due to their centrality in a variety of value chains and their large potential contribution to emissions reductions. Activities under this Destination focus on the twin green and digital transition providing a green productivity premium to discrete manufacturing, construction and energy-intensive industries, including process industries. This will make an essential and significant contribution to achieving climate neutrality in the European Union by 2050, and to the achievement of a circular economy. It will also enhance the Union's open strategic autonomy with regard to the underlying technologies. To achieve these goals, the activities in this Destination are complementary to those in Destination 2, which will enhance open strategic autonomy in key strategic value chains for a resilient industry.

The gross added value of the European manufacturing sector is EUR 2,076 billion (2019). The sector employs more than 30 million people in the Union and represents 22% of the world's manufacturing output. The Union's trade surplus in manufactured goods is EUR 421 billion (2019). Similarly, the construction ecosystem (driven mainly by SMEs) offers 22 million jobs and contributes 10.5% of EU-27 global value added². However, the manufacturing and construction sectors must significantly reduce their pollution and waste, and increase their recycling. Moreover, the potential of digital technologies is underused in manufacturing industry, e.g. 12% of EU enterprises use big data technologies and only 1 out of 5 SMEs is highly digitised, and in construction, which remains one of the least digitised sectors with a notable underinvestment in R&D.³ A key issue for the manufacturing sector is that its complex supply and value chains are heavily affected by the current pandemic crisis, and the sector needs to further develop resilience against financial and technical disruptions.

In addition, the Union's process industries are important to its economy, its resilience and its environmental credentials. Process industries are responsible for a turnover of > 2 trillion, 8.5 million direct jobs and 20 million indirect jobs. They represent 0.5 million enterprises and 5 % of the EU27 GDP. The process industry however faces two key challenges: a strong global competition, and an environmental challenge. In particular, energy-intensive industries are resource intensive, using extensive amounts of raw materials (often imported and fossil based). In their operations, they generate large amounts of waste, 20% of global greenhouse gases (GHG) but also pollutants. The industries need to transform itself to decrease GHG and pollutant emissions, its resource utilisation and its overall environmental impact. It will have

to achieve climate neutrality, near zero waste, zero pollution and zero landfill by 2050 at the latest. By 2030, decisive steps need to be taken given the long investment cycles these industries are facing. As the process industry is transforming primary raw materials into materials ready for use by the manufacturing industry, it will play a key role in the pathways toward circularity of materials by transforming industrial and end-of-life waste into secondary raw materials leading to the same quality output in the newly produced materials.

In the first Work Programme, outcomes of R&I investments in the long-term will focus on the following impacts:

- Accelerate the twin green and digital transition of the manufacturing and construction sectors;
- Create a new green, flexible and digital way to build and produce goods. This will lead to sustainable, flexible, responsive and resilient factories and value chains, enabled by digitisation, AI, data sharing, advanced robotics and modularity. At the same time it will help reduce CO₂ emissions and waste in these sectors, and enhance the durability, reparability and re-cycling of products/components. It will also ensure better and more efficient use of construction-generated data to sustain competitiveness and greening of the sector;
- Make the jobs of the humans working in the manufacturing and construction sectors more attractive and safer, and point the way to opportunities for upskilling;
- Set out a credible pathway to contributing to climate neutral, circular and digitalised energy intensive industries;
- Increase productivity, innovation capacity, resilience, sustainability and global competitiveness of European energy intensive industries. This includes as many as possible new large hubs for circularity by 2025 (TRL 7 or above); developing sustainable ways for circular utilisation of waste streams and CO₂/CO streams; and electrifying industry to enable and foster a switch to a renewable energy system;
- Contribute to a substantial reduction of waste and CO₂ emissions, turning them into alternative feedstocks to replace fossil-based raw materials and decrease reliance on imports.

In order to achieve the expected outcomes, for particular topics international cooperation is clearly not mandatory but advised with some regions or countries to get internationally connected and add additional specific expertise and value to the activities.

In line with the European Green Deal objectives, research and innovation activities should comply with the ‘do no significant harm’ principle⁴. Compliance needs to be assessed both for activities carried out during the course of the project as well as the expected life cycle impact of the innovation at a commercialisation stage (where relevant). The robustness of the compliance must be customised to the envisaged TRL of the project. In this regard, the potential harm of Innovation Actions contributing to the European Green Deal will be monitored throughout the project duration.

To achieve wider effects activities beyond R&I investments will be needed. Three co-programmed partnerships will enhance dissemination, community building and foster spillover effects: Made in Europe for the manufacturing sectors, Clean Steel and Processes4Planet for the energy intensive industries. This destination has strong links to other clusters in Pillar II, notably Cluster 5 for the activities related to the integration of renewables and thermal energy management in industry, and with the European Innovation Council and Pillar III of Horizon Europe given the strong role of SMEs in the development of the innovations planned. Synergies will be sought to access blended funding and finance from other EU programmes; testing and deployment activities under the Digital Europe Programme (DEP); links to the EIT (Manufacturing and Digital KICs); and links to the thematic smart specialisation platform on industrial modernisation.

Much of the research and innovation supported under this Destination may serve as a cradle for the New European Bauhaus: this is about designing sustainable ways of living, situated at the crossroads between art, culture, social inclusion, science and technology. This includes R&I on manufacturing, construction, advanced materials and the circular economy approaches.

Business cases and exploitation strategies for industrialisation: This section applies only to those topics in this Destination, for which proposals should demonstrate the expected impact by including a *business case and exploitation strategy for industrialisation*.

The *business case* should demonstrate the expected impact of the proposal in terms of enhanced market opportunities for the participants and enhanced manufacturing capacities in the EU, in the short to medium term. It should describe the targeted market(s); estimated market size in the EU and globally; user and customer needs; and demonstrate that the solutions will match the market and user needs in a cost-effective manner; and describe the expected market position and competitive advantage.

The *exploitation strategy* should identify obstacles, requirements and necessary actions involved in reaching higher TRLs, for example: matching value chains, enhancing product robustness; securing industrial integrators; and user acceptance.

For TRLs 7-8, a credible strategy to achieve future full-scale manufacturing in the EU is expected, indicating the commitments of the industrial partners after the end of the project.

Activities beyond R&I investments will be needed to realise the expected impacts: these include the further development of skills and competencies (also via the European Institute of Innovation and Technology, in particular EIT Manufacturing); and the use of financial products under the InvestEU Fund for further commercialisation of R&I outcomes.

Where relevant, in the context of skills, it is recommended to develop training material to endow workers with the right skillset in order to support the uptake and deployment of new innovative products, services, and processes developed in the different projects. This material should be tested and be scalable, and can potentially be up-scaled through the European Social Fund Plus (ESF+). This will help the European labour force to close the skill gaps in the relevant sectors and occupational groups and improve employment and social levels across the EU and associated countries.

The topics serving these objectives are structured as follows:

- Green, flexible and advanced manufacturing
- Advanced digital technologies for manufacturing
- A new way to build, accelerating disruptive change in construction
- Hubs for circularity, a stepping stone towards climate neutrality and circularity in industry
- Enabling circularity of resources in the process industries, including waste, water and CO₂/CO
- Integration of Renewables and Electrification in process industry

Call – Twin green and digitised transition 2021

Green, flexible and advanced manufacturing

Topic ID and title	HORIZON-CL4-2021-TWIN-TRANSITION-01-05: Manufacturing technologies for bio-based materials (Made in Europe Partnership) (RIA)				
Budget	EUR 20 million	Opening date	22 June 2021	Deadline 1	23 September 2021
Budget per project	EUR 4 to 6 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	Value chain, recycling, bioplastics, biopolymers, fibre-based materials, cellulose-based components, product lifecycle, construction, packaging, textiles				
FTP comments					
FTP SIRA 2030 Challenges addressed	8A,B - 9 - 6	FTP relevance		Medium	
		Starting TRL		4	
		End TRL		6	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Demonstrate relevant scale production of innovative bio-based products to substitute traditional materials with high environmental footprint;
- Develop products with similar or better mechanical, physical and chemical properties, while having a substantially lower environmental footprint and being sustainable, non-toxic and recyclable when compared to non-bio-based materials
- Demonstrate disruptive innovation of bio-based materials production in at least three different manufacturing value chains;
- Develop sustainable business models for materials sourcing and recycling.

Scope:

The 2020 Circular Economy Action Plan aims at making sustainable products the norm in the EU. Twenty-first century manufacturing requires new materials and new techniques to produce them. Rapid progress in manufacturing technologies using new and alternative materials, such as biomaterials, is one of the drivers of this trend. This new frontier of science is a multidisciplinary research field combining engineering, physics, chemistry, biology, material science, which allow the production of bio-based products. Particularly interesting with respect to the green transition of the economy are sustainable products made from

bio-based materials that are easy to reuse and recycle. Also, these materials would reduce the environmental footprint of waste streams. However, the use of reusable and recyclable products based on bio-based materials should increase substantially in order to build a truly sustainable manufacturing industry.

These technologies provide a valid alternative to conventional materials with a substantially lower environmental impact with a range of applications for example in construction, food, medical, packaging and textile industries.

Research activities should address the following areas:

- Optimisation and improvement of smart manufacturing processes, e.g. additive manufacturing, injection moulding, extrusion etc., to unlock the full potential of bio-based materials, such as carbon-positive bioplastics, biopolymers and other fibre-based materials (e.g. cellulose-based components and marine-based components);
- Use of carbon positive bio-based materials, such as composite, rubber, plastics, in different products to achieve high technical properties while lowering the environmental footprint;
- Combine the use of different bio-based materials to facilitate refurbishing and re-manufacturing of products to achieve circularity by design
- Adapt existing or new characterisation methods and quality controls for the bio-based materials in different formats and for new and regenerated products;
- Support the creation of a skilled workforce, through training/qualification of personnel, capable of using and implementing biomaterial-based manufacturing activities
- Demonstrations and use cases for transitions towards green manufacturing technologies incorporating bio-based materials with a significant reduction in the environmental footprint across the entire manufacturing and/or product lifecycle.
- Address standardization activities of bio-based materials and adapted characterisation methods and quality controls for bio-based materials in their different formats and applications.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

Research must build on existing standards or contribute to standardisation. Interoperability for data sharing should be addressed. Additionally, a strategy for skills development should be presented, associating social partners when relevant.

All projects should build on or seek collaboration with existing projects and develop synergies with other relevant European, national or regional initiatives, funding programmes and platforms.

This topic implements the co-programmed European Partnership Made in Europe.

Advanced digital technologies for manufacturing

Topic ID and title	HORIZON-CL4-2021-TWIN-TRANSITION-01-08: Data-driven Distributed Industrial Environments (Made in Europe Partnership) (IA)				
Budget	EUR 24 million	Opening date	22 June 2021	Deadline 1	23 September 2021
Budget per project	EUR 4 to 8 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	WW, P&P				
Keywords	Efficient data processing, private 5G networks (5G NPN), cybersecurity, deep industrial data				
FTP comments					
FTP SIRA 2030 Challenges addressed	6A,E,F	FTP relevance		Low	
		Starting TRL		4	
		End TRL		7	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Establishing European industry as leader in sustainable data-driven manufacturing and process industries through efficient data processing and notably at the edge of the network, improving the environmental, economic and social sustainability of industrial production, and reinforcing European leadership in the deployment and operations of industrial network;
- Improving the agility of European manufacturing industry and increase its resiliency to external shocks, including with agile, secure and easy-to-implement non-public 5G systems, leading to more resilient production processes;
- Demonstrate the use of open systems and qualified open source software tools for data monitoring & collection as well as data analytics;
- Foster industrial data and distributed computing standardisation;
- Facilitate the development of technologies requiring only minimal training of the industrial workforce.

Scope:

Fully reaching the opportunities of sharing and exploiting industrial data, including deep industrial data¹⁵, requires to strike the right balance between storing and handling data centrally in the cloud or locally at the edge of industrial network. Such a balance has to take into account not only efficiency but also the real-time requirements and cybersecurity aspects as well as the ability to systemically integrate and upgrade operational technology

to the innovative developments in (self-) configuration, therefore building a flexible industrial Internet for distributed control and modular manufacturing while keeping the high-level of reliability and safety required by the manufacturing sector.

Computing, storage and networking technologies will have to show also flexibility along the industrial value chains and promote the introduction of new business models, based on the availability of deep industrial data from different data sources and ontologies, within an agreed data governance, with mutual trust and adequate distribution of the value created by sharing data.

Proposals are expected to address one of the following technology areas for data-driven industrial environments:

- Development of technologies and definition of specifications and standards for data, products, and/or business processes, that can be agreed and commonly used by many industrial actors, and that have the potential for the emergence of future digital value chains, identify promising industrial areas and organisational models that facilitate cooperation and collaborative product and service design among industry players facilitating industry agreements.
- Quick uptake of advanced 5G technologies by European manufacturing sector to support the convergence towards greater exploitation of industrial data and increase resilience and cybersecurity by design. Private 5G networks (5G NPN) are exclusive mobile networks that manufacturers can use for a defined local production site; they can be tailored to the individual needs of the manufacturer and meet future requirements in the area of Industry 4.0. Innovative approaches to simplify the deployment and operation of such private 5G networks throughout their life cycle are needed. Implementers in industrial environments need to take a holistic view, including both the connectivity infrastructure (with 5G as a central component) and the actual production system. An important element for rapid deployment is also the development and evaluation of new business models for private 5G networks. In particular, projects should offer opportunities for new players that have their main focus on non-public (campus) networks (NGN) for connected industries and in particular automation applications. Projects will aim at "Zero-Touch Management", using network automation, AI / ML, Self-organizing Networks (SON), etc. and taking into account the specifics of industrial environments.

Projects are encouraged to develop toolkits of open hardware, software and toolware, and qualify the use of these to provide opportunities to SMEs to further automate and digitalise their manufacturing, through, for example, OPC-UA and Administrative Shell (AAS) as well as

further development on top of these Industrial Internet standards and there inherent cyber security demands for Operational Technology environment.

The distributed industrial computing environments will be demonstrated effectively in a minimum of two specific manufacturing applications. The topic will integrate new or existing technologies to make them practically and economically viable in the industrial world, and will encompass modern manufacturing technologies such as digital twins.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

Research must build on existing standards or contribute to standardisation. Interoperability for data sharing should be addressed. Additionally, a strategy for skills development should be presented, associating social partners when relevant.

All projects should build on or seek collaboration with existing projects and develop synergies with other relevant European, national or regional initiatives, funding programmes and platforms.

This topic implements the co-programmed European Partnership Made in Europe.

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

A new way to build, accelerating disruptive change in construction

Topic ID and title	HORIZON-CL4-2021-TWIN-TRANSITION-01-11: Automated tools for the valorisation of construction waste (RIA)				
Budget	EUR 21 million	Opening date	22 June 2021	Deadline 1	23 September 2021
Budget per project	EUR 6 to 10 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW				
Keywords	Construction and demolition waste (CDW), reusability, Building Information Modelling (BIM), cross-sectorial actors				
FTP comments					
FTP SIRA 2030 Challenges addressed	4	FTP relevance	Low		
		Starting TRL	4		
		End TRL	6		

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Increase significantly the construction and demolition waste (CDW) utilisation (at least 80% weight in line with the current waste Directive 2008/98/EC19 as amended by Directive 2018/85120) by cascade approach including re-use, recycle and transformation of waste into secondary products in full cooperation between construction and waste management companies
- Provide new value chain and sustainable business models for construction waste reduction mobilising cross sectorial actors;
- Implement appropriate tracing of material and /or component along the new value chain.
- Increase by 50% the reusability of construction products post demolition and reduce the down cycling of construction waste by facilitating modular dismantling of complex construction products;
- Plan a list of actions for overcoming relevant barriers (e.g. end of waste criteria, lack of trust in secondary products, awareness of circular potential);
- Develop holistic and replicable solutions for more circular and climate neutral construction materials and activities involving upstream and down-stream actors.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Scope:

Based on volume, construction and demolition waste (CDW) is the largest waste stream in the EU. Considering that most of the waste share is glass, concrete, steel and aluminium (or other metals), the embodied energy and embodied eq. CO₂ emission in the CDW is significant (8.5 MT eq. CO₂ for construction in Sweden in 2015). By reusing and recycling CDW in new constructions, the sector would come closer to the targets of becoming fully circular and climate neutral. Precise quantitative and qualitative waste estimation is crucial for waste management. This could be achieved by utilising digital technologies for instance Building Information Modelling (BIM), material and component tracing, dedicated apps for construction/de-construction and optimize site management. Such tools could provide data about material type and composition (e.g. whether there are hazardous materials that require special care) and quantities, and thus an estimation of the logistics needs, cost, etc. and make waste separation easier and faster, e.g. by combining with automated equipment and robots.

Proposals should:

- Develop, test and promote the necessary digital tools for material and/or component tracing and CDW management in different types of construction or demolition sites. The proposed tools should use as far as possible existing databases for waste management;
- Develop automated solutions for de-construction and waste separation process;
- Implement cross-sectorial holistic solutions involving glass, concrete, steel, ceramics, non-ferrous, etc. from the construction product and material side but also waste management, transportation and construction equipment and machinery side;
- Produce all required training material for the proper use of the developed technologies The content should be sufficiently inclusive and encompass the diversity of different users;
- Demonstrate all developed solutions (reutilisation, recycling, transformation, etc.) in at least four implementation sites across different European countries, considering the material recovery, transformation and utilisation;
- Assess the value of the solutions in terms of the additional monetary value/reduction of eq. CO₂ emissions produced;
- Besides the new solutions benefits, safety should be considered (on construction issues, hazardous materials, etc.)

- Proposals should consider the development of learning resources for the current and future generations of employees, with the possibility to integrate them in existing curricula and modules for undergraduate level and lifelong learning programmes. The projects should provide contributions to relevant standards or best practices.
- The projects should provide contributions to relevant standards or best practices.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

In order to achieve the expected outcomes, international cooperation is encouraged, in particular with Asian countries.

Call – Climate Neutral, circular and digitised production 2022

Green, flexible and advanced manufacturing

Topic ID and title	HORIZON-CL4-2022-TWIN-TRANSITION-01-02: Products with complex functional surfaces (Made in Europe Partnership) (RIA)				
Budget	EUR 21,5 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 4 to 6 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	Surface treatments, thermo-chemical processes, thermal treatments, additive manufacturing, biochemical treatments				
FTP comments					
FTP SIRA 2030 Challenges addressed	6C – 9C – 10A	FTP relevance		Low	
		Starting TRL		4	
		End TRL		6	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Develop more efficient manufacturing processes to increase market share increase for products with functional surfaces that contribute to competitiveness and a transition to green and sustainable production flows;
- Significant reduction of the environmental footprint for surface treatments;
- Uptake of treatment technologies in applications for a sustainable society, targeting reductions in energy use and environmental footprint.

Scope:

Surface treatments are an integral part of any manufacturing process. Surface treatments include many disciplines, such as painting/coating/printing (spray, powder, dip coating, inkjet etc.), plating/implantation (electroplating, vacuum plating/coating, etc.), thermal treatments (annealing, thermo-chemical processes, etc.), laser-based treatments (annealing, texturing, etc.), additive manufacturing, micro manufacturing (micro electrical discharge machining, micro milling, etc.) chemical and electrochemical treatments (anodizing, electropolishing, chemical deposition, etc.), biochemical treatments, etching (wet etching, plasma/dry etching, also for texturing).

While the integration of these treatment technologies into a manufacturing line has been well reported, the technologies as such need to be adapted for each particular profile. In addition, with progressively more complex and customised requirements on shape, material

and functionality, the demands on efficient and flexible surface treatments are increasing. In a transition towards a sustainable production, with a substantially lower environmental footprint, the demands are even higher.

The projects under this topic should address the following:

- Develop new surface treatments specifically targeting and enabling end-products with the purpose of reducing the end-products' energy usage and/or environmental footprint. This may include co-design of product geometry and surface properties;
- Use of innovative production technologies for further functional integration and miniaturisation in order to reduce environmental footprints and resource use of products;
- Integrate the new surface treatments in a manufacturing line for profiles with complex shape or multimaterial content, with clear metrics on its efficiency during operation;
- Develop new business models and strategies for the uptake of these new technologies and with clear objectives on how to expand the uptake to other sectors and other applications.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

Research must build on existing standards or contribute to standardisation. Interoperability for data sharing should be addressed. Additionally, a strategy for skills development should be presented, associating social partners when relevant.

All projects should build on or seek collaboration with existing projects and develop synergies with other relevant European, national or regional initiatives, funding programmes and platforms.

This topic implements the co-programmed European Partnership Made in Europe.

Advanced digital technologies for manufacturing

Topic ID and title	HORIZON-CL4-2022-TWIN-TRANSITION-01-07: Digital tools to support the engineering of a Circular Economy (Made in Europe Partnership) (RIA)				
Budget	EUR 22 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 3 to 6 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	innovative digital tools, engineers, technicians, operators, recycling, reuse, material consumption reduction, secondary raw materials, data exchange, transparency and traceability increasing, circular economy				
FTP comments					
FTP SIRA 2030 Challenges addressed	4 – 5C – 6E – 8C			FTP relevance	Low
				Starting TRL	3-4
				End TRL	6

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Provide a range of support solutions and innovative digital tools for engineers, technicians and operators on the factory floor, in order to build agile, sustainable and responsive production environment and supply chains, with specific focus on areas such as material saving, repair, refurbishing, re-manufacturing, recycling, and reuse of products and components;
- Reduction of the dependency from imported raw materials or harmful materials for the European manufacturing sector (e.g. by material consumption reduction, material substitution and use of secondary raw materials);
- Define specifications and standards for data, products, and/or business processes, that can be agreed and commonly used by many industrial actors and across different industry sectors; and facilitate industry agreements on circularity and sustainability through increased data exchange among value chain actors and enable the development of new types of businesses;
- Reduce the skills and knowledge gap for the actors involved.

Scope:

The focus is on developing new concepts, methods, and digital tools to support further engineering of the industrial processes for recycling, re-manufacturing, refurbishing, and reuse of manufactured products and components. New solutions will enable remanufacturing and high-quality recycling by digitalisation of product and component

information throughout the whole product lifecycle, in line with the 2020 Circular Economy Action Plan.

Another challenge that falls within this scope is the human dimension. The support tools need to work with the user, and training, knowledge transfer, cognitive interfaces, as well as acceptance and uptake will be vital in the solutions proposed.

Proposals should cover all of the following aspects:

- Development of innovative concepts, methods, and tools that track and trace the status of relevant manufactured products and components, such as electronic systems and components as well as machine tools, and increase transparency and accountability for these along their lifecycle. Where appropriate, proposals need to be able to link up with manufacturing industrial data spaces platforms, so that circular economy data can be shared with a larger set of organisations;
- Inclusion and handling of real-time production data in analysis software and tools, notably for decision making and control, as well as knowledge management;
- Demonstration of the support tools in at least two different realistic production environments with a clear target of improving quality and sustainability with significant economic value. If applicable, legal obstacles to implementation of the proposed solutions should be identified.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

Research must build on existing standards or contribute to standardisation. Interoperability for data sharing should be addressed. Additionally, a strategy for skills development should be presented, associating social partners when relevant.

All projects should build on or seek collaboration with existing projects and develop synergies with other relevant European, national or regional initiatives, funding programmes and platforms.

This topic implements the co-programmed European Partnership Made in Europe.

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

A new way to build, accelerating disruptive change in construction

Topic ID and title	HORIZON-CL4-2022-TWIN-TRANSITION-01-09: Demonstrate the use of Digital Logbook for buildings (IA)				
Budget	EUR 9 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 4,5 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	WW				
Keywords	digital building logbooks (DBL), resource efficiency, decarbonisation of buildings, collection and update data tools, climate resilience, User eXperience (UX)				
FTP comments					
FTP SIRA 2030 Challenges addressed	8C	FTP relevance		Low	
		Starting TRL		5	
		End TRL		7	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Measurable improvements in resource efficiency and decarbonisation of buildings and their construction/renovation, as a result of using digital building logbooks;
- Improved linkages of existing databases, tools and sources for digital building logbooks;
- Improved usability of digital building logbooks through user eXperience, taking into account issues of accessibility as well as inclusivity;
- New or improved tools for collection and update of relevant data;
- Demonstrate other benefits of using digital building logbooks e.g. safety and health in buildings and construction for instance by structural health monitoring; cost effectiveness, efficiency gains in terms of time; enhanced climate resilience.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Scope:

There is a need to demonstrate and realise the potential benefits of using digital depositories of information that accompany buildings throughout their lifecycle. These digital building logbooks (DBL) can potentially result in greater efficiency, circularity and transparency in the building stock. DBLs should also improve decision making for all actors along the lifecycle of

the building, thereby facilitating better design choices and greater sustainability, contributing in this way to the New European Bauhaus initiative.

Proposals should:

- Research and propose innovative approaches that utilise DBL features and functionalities, User eXperience, interoperability, data governance and the connection with other initiatives;
- Demonstrate the benefits of DBL in terms of e.g. productivity, collaboration across the construction ecosystem, resource efficiency, decarbonisation, safety and health, climate resilience;
- Consider both current and future opportunities to collect data from new technologies (e.g. sensors, real-time energy use, drones, 3D scanning) or existing and upcoming platforms (e.g. Sustainable product passports for construction materials) enabling additional data platforms. The DBL could link as well to those new data platforms, which will come with new possibilities and responsibilities in terms of data privacy and security;
- Research and develop common ‘languages’ – interfaces and protocols – to enable interoperability, data consistency (as for example through common European data spaces for the manufacturing sector to ensure enhanced access to privately held data, via industrial data platforms) and information exchange; introduce a Common Information Model for next generation DBL capitalizing on existing standards and proposing extensions for missing features;
- Address the problem of “data matching” and data verification. There is also a high potential for advanced technologies, such as blockchain, to support the alleviation of these issues and the application of such technologies should be explored;
- Consider developing or making use of data quality marking schemes.

The DBL “features” (e.g. digital interface, data syncing, etc.) and “functionalities” (services built around the DBL) should prioritise user-friendliness and a smart interface for end-users. Proposals are expected to demonstrate a “modular and layered” structure for the DBL, developing additional functionalities as extensions to the national schemes, ensuring that it is flexible enough to make the right information available to the right actor at the right time.

Proposals should take into account User eXperience (UX) principles in order to stimulate the update of the building logbook and its use by construction professionals and building owners.

Proposals should ensure that the functionalities offered by DBL and the corresponding benefits are easily understood by construction and building professionals as well as building owners. Proposals should take into account issues of accessibility and inclusivity, such as age, gender, disability, and socio-economic background.

Proposals may address the DBL to any or all types of buildings and infrastructures as appropriate.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

Finally, proposals should provide contributions to relevant standards and seek to ensure synergies with the Horizon Europe 'Built4People' co-programmed Partnership.

Destination 2: Increased autonomy in key strategic value chains for resilient industry

This destination will directly support the following Key Strategic Orientations, as outlined in the Strategic Plan:

- KSO C, '**Making Europe the first digitally-enabled circular, climate-neutral and sustainable economy** through the transformation of its mobility, energy, construction and production systems'
- KSO A, '**Promoting an open strategic autonomy by leading the development of key digital, enabling and emerging technologies, sectors and value chains** to accelerate and steer the digital and green transitions through human-centred technologies and innovations'
- KSO D, '**Creating a more resilient, inclusive and democratic European society**, prepared and responsive to threats and disasters, addressing inequalities and providing high-quality health care, and empowering all citizens to act in the green and digital transitions.

Proposals for topics under this Destination should set out a credible pathway to contributing to the following expected impact of Cluster 4:

- **Industrial leadership and increased autonomy in key strategic value chains with security of supply in raw materials**, achieved through breakthrough technologies in areas of industrial alliances, dynamic industrial innovation ecosystems and advanced solutions for substitution, resource and energy efficiency, effective reuse and recycling and clean primary production of raw materials, including critical raw materials, and leadership in the circular economy.

The COVID-19 crisis has shown that global competitiveness and resilience are two sides of the same coin⁴². Resilience is about more than the ability to withstand and cope with shocks; it is an opportunity to undergo transitions in a sustainable and fair way. As the EU gears up to becoming a climate-neutral, circular and competitive economy by 2050, resilience will require paying attention to new vulnerabilities as entire sectors undergo deep transformations while creating opportunities for Europe's industry to develop its own markets, products and services which boost competitiveness.

Research and innovation will be fundamental to spur industrial leadership and enhanced resilience. It will support the modernisation of traditional industrial models while developing novel technologies, business models and processes. This can enhance the flexibility of the

EU's industrial base, and increase its resilience by reducing EU dependencies on third countries for critical raw materials and technologies.

In the first Work Programme, topics under Destination 2 '**Increased autonomy in key strategic value chains for resilient industry**' will tackle missing segments in strategic areas and value chains, to strengthen the EU's industrial base and boost its competitiveness and open strategic autonomy. In addition, it will explore how increased circularity has the potential to increase the open strategic autonomy of EU industry through the more efficient use of resources and secondary raw materials.

This will be achieved through R&I activities focusing on four areas key for the resilience of EU industry:

- *Raw materials*: The EU is highly dependent on a few third countries for the (critical) raw materials it needs for strategic value chains (including e-mobility, batteries, renewable energies, pharmaceuticals, aerospace, dual-use and digital applications). In a context where demand is set to increase⁴³, these will remain, more than ever, a vital prerequisite for both Europe's open strategic autonomy and a successful transition to a climate-neutral and circular economy. Responding to the Critical Raw Materials action plan R&I activities will tackle the vulnerabilities in the entire EU raw materials value chain, from sustainable and responsible exploration, extraction, processing, recycling, contributing to building the EU knowledge base of primary and secondary raw materials and ensuring secure, sustainable and responsible access to (critical) raw materials.
- *Advanced materials* that are sustainable by design are needed to meet the challenges of climate neutrality, transition to a circular economy and a zero-pollution Europe, as well as broader benefits in many different applications. While chemical and related materials production is expected to double globally by 2030, this will largely take place outside Europe⁴⁴. To overcome its reliance on imports of basic chemicals and related materials, Europe needs to strengthen its capacity to produce and use chemicals in a sustainable and competitive way. In addition, it is necessary to continue work on an ecosystem, based on open innovation test beds (OITBs), which enables the rapid development, uptake and commercialisation of advanced materials. All actions should be guided by sustainable-by-design principles, i.e. environmental and health safety, circularity and functionality.
- *Circular value chains*: to complement the circular technologies in Destination 1, further technological and non-technological elements (such as business models and the

traceability of products) are necessary in the transition to novel low-emission and circular industrial value chains.

- *Preparedness of businesses/smes/startups*: European companies, and in particular SMEs, have shown a chronic lagging behind the US and China in the uptake of new, and especially digital, technologies.⁴⁵

To achieve these wider effects, unprecedented investments in re- and upskilling are central to supporting the green and digital transitions, enhancing innovation and growth potential, fostering economic and social resilience and ensuring quality employment and social inclusion. This is why activities planned under Destination 6 “A human-centred and ethical development of digital and industrial technologies” will also contribute to the objectives of a more resilient industrial base. Further, as industrial leadership and resilience are two sides of the same coin, activities targeting industrial leadership are a key factor in the EU’s long-term industrial resilience. This is why activities supported under Destination 1 ‘Climate neutral, circular and digitised production’ and Destination 3 ‘World leading data and computing technologies’ that further ensure Europe’s productivity growth and competitiveness are also key to safeguarding its open strategic autonomy and resilience.

In addition, activities beyond R&I investments will be needed, in particular in terms of synergies with the European Innovation Council and Pillar III of Horizon Europe given the strong role of SMEs in the development of the innovations planned. Synergies will also be sought to access blended funding and finance from other EU programmes notably under InvestEU; testing and deployment activities under the Digital Europe Programme (DEP); links to the EIT (Raw Materials and Digital KICs); links with the Single Market programme to promote entrepreneurship and the creation and growth of companies and links to the thematic smart specialisation platform on industrial modernisation.

In line with the European Green Deal objectives, research and innovation activities should comply with the ‘do no significant harm’ principle⁴⁶. Compliance needs to be assessed both for activities carried out during the course of the project as well as the expected life cycle impact of the innovation at a commercialisation stage (where relevant). The robustness of the compliance must be customised to the envisaged TRL of the project. In this regard, the potential harm of Innovation Actions contributing to the European Green Deal will be monitored throughout the project duration.

Proposals for topics under this Destination should set out a credible pathway to contributing to **increased autonomy in key strategic value chains for resilience industry**, and more specifically to one or several of the following impacts:

- Resilient, sustainable and secure (critical) raw materials value chains for EU industrial ecosystems, in support of the twin green and digital transformations.
- New sustainable-by-design materials with enhanced functionalities and applications in a wide range of industrial processes and consumer products.
- Leadership in producing materials that provide solutions for clean, toxic/pollutant free environment, decarbonising industry, and safeguarding civil infrastructures.
- Leadership in circular economy that strengthens cross-sectorial cooperation along the value chain and enable SMEs to transform their activities and business models.
- Increased adoption of key digital and enabling technologies in industrial value chains and strategic sectors, paying particular attention to SMEs and start-ups.

Much of the research and innovation supported under this Destination may serve as a cradle for the New European Bauhaus: this is about designing sustainable ways of living, situated at the crossroads between art, culture, social inclusion, science and technology. This includes R&I on manufacturing, construction, advanced materials and the circular economy approaches.

Business cases and exploitation strategies for industrialisation: This section applies only to those topics in this Destination, for which proposals should demonstrate the expected impact by including a *business case* and *exploitation strategy for industrialisation*.

The *business case* should demonstrate the expected impact of the proposal in terms of enhanced market opportunities for the participants and enhanced manufacturing capacities in the EU, in the short to medium term. It should describe the targeted market(s); estimated market size in the EU and globally; user and customer needs; and demonstrate that the solutions will match the market and user needs in a cost-effective manner; and describe the expected market position and competitive advantage.

The *exploitation strategy* should identify obstacles, requirements and necessary actions involved in reaching higher TRLs, for example: matching value chains, enhancing product robustness; securing industrial integrators; and user acceptance.

For TRLs 7-8, a credible strategy to achieve future full-scale manufacturing in the EU is expected, indicating the commitments of the industrial partners after the end of the project.

Activities beyond R&I investments will be needed to realise the expected impacts: these include the further development of skills and competencies (also via the European Institute

of Innovation and Technology, in particular EIT Manufacturing); and the use of financial products under the InvestEU Fund for further commercialisation of R&I outcomes.

Where relevant, in the context of skills, it is recommended to develop training material to endow workers with the right skillset in order to support the uptake and deployment of new innovative products, services, and processes developed in the different projects. This material should be tested and be scalable, and can potentially be up-scaled through the European Social Fund Plus (ESF+). This will help the European labour force to close the skill gaps in the relevant sectors and occupational groups and improve employment and social levels across the EU and associated countries.

Call – A digitised, resource-efficient and resilient industry 2021

Novel paradigms to establish resilient and circular value chains

Topic ID and title	HORIZON-CL4-2021-RESILIENCE-01-01: Ensuring circularity of composite materials (Processes4Planet Partnership) (RIA)				
Budget	EUR 24,7 million	Opening date	22 June 2021	Deadline 1	23 September 2021
Budget per project	EUR 8 to 9 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	Secondary raw materials, new value streams, dismantling, sorting, reuse, recycle				
FTP comments					
FTP SIRA 2030 Challenges addressed	4	FTP relevance		Medium	
		Starting TRL		3	
		End TRL		6	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Reuse of composite material and recovery of secondary raw materials with higher value than currently available;
- Reduction of waste sent to landfill and positive environmental impact;
- Creation of new value streams through new technologies with potential for commercial exploitation; new business opportunities and revenue flows for recycling companies, benefiting particularly SMEs which dominate this sector of the market;
- Increased uptake of novel composites materials in industrial applications e.g. enhanced lightweight designs for transport, currently limited due to costs and adherence by industry to environmental legislation and the end of life directive.

Scope:

The European composites market size was worth €16 billion in 2018 and is estimated to register an annual growth rate of 7.5% from 2020 to 2025 owing to increasing demand for lightweight materials in various energy intensive value chains such as wind energy or transport. However, composites are difficult to reuse or recycle as available technologies such as high-temperature pyrolysis, and grinding (to be used as filler material) are either not environment friendly or economically unattractive. In addition, the environmental legislation on recycling of end-of-life components and structures will mean that from 2025, for example, 80,000 tons of fibre reinforced polymer composites will have to be recycled every year in Europe. In this context it is imperative that technologies are found to reuse and recycle these

materials in a useful and sustainable manner. Furthermore, new solutions should also be envisaged to allow their recycling with very few or no need to separate them without a compromise to downcycling.

Proposals should:

- propose innovative dismantling and sorting systems enabling reuse and functional recycling of complex composite materials;
- develop and integrate novel solutions for a higher reuse of whole products and components (i.e. products' reusability, upgradability, etc);
- develop novel, safe, environment friendly and commercially attractive methods of recycling a wide range of composite materials and reuse of secondary raw materials;
- demonstrate at pilot level the feasibility of reuse and/or recycle approaches of composites and its secondary raw materials, for specific applications;
- develop tools that will enable to demonstrate the circularity and the environmental benefits of the solutions tested;
- consider the co-design of learning resources together with local and regional educational organisations for current and future generations of employees, with the possibility of integrating them in existing curricula and modules for undergraduate level and lifelong learning programmes; learning resources should integrate the identification of new skills and should propose innovative learning-teaching methods that meet regional social needs and have a high potential for replication.

Where relevant, any solution proposed for the reduction of the content of toxic elements or compounds in the resulting materials should also include the appropriate management of the hazardous substances removed.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

This topic implements the co-programmed European partnership Processes4Planet.

Raw materials for EU open strategic autonomy and successful transition to a climate-neutral and circular economy

Topic ID and title	HORIZON-CL4-2021-RESILIENCE-01-04: Developing climate-neutral and circular raw materials (IA)				
Budget	EUR 36 million	Opening date	22 June 2021	Deadline 1	23 September 2021
Budget per project	EUR 12 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	WW, P&P				
Keywords	Sorting technologies, recycling, wood-based materials, construction, forest-based raw materials, wood-based panels, multi-material paper packaging				
FTP comments					
FTP SIRA 2030 Challenges addressed	4			FTP relevance	Medium
				Starting TRL	/
				End TRL	6-7

Expected Outcome:

Projects outcomes will enable achieving the expected impacts of the destination by providing advanced solutions for resource efficiency, effective reuse and recycling of secondary raw materials, for EU industrial value chains and strategic sectors.

Projects are expected to contribute to the following outcomes:

- Scale up promising raw materials recycling from end-of-life products technologies and urban mines, including efficient sorting technologies for separation and recycling.
- Develop demonstration pilot showing that raw materials can be produced in an innovative and sustainable way in order to make sure that research and innovation end up on the market,
- Strengthen the competitiveness of the EU raw materials industries, contribute to ambitious energy and climate targets for 2030, minimise environmental impacts and risks, maximise circularity or resources and gain the trust of EU citizens in the raw materials sector.

Scope:

Securing the sustainable access to raw materials, including metals, industrial minerals, wood- and rubber-based, construction and forest-based raw materials, and particularly Critical Raw Materials (CRM), is of high importance for the EU economy. Complex primary and secondary resources contain many different raw materials. Their processing, reuse,

recycling and recovery schemes are complex and imply different steps, ranging from collection, logistics, sorting and separation to cleaning, refining and purification of materials.

Actions should develop and demonstrate innovative pilots for the clean and sustainable production of non-energy, non-agricultural raw materials in the EU from end-of-life products, targeting at least one of the following: waste electrical and electronic equipment (WEEE), batteries, wood-based panels, multi-material paper packaging, end-of-life tyres finishing at Technology Readiness Levels (TRL) 6-7.

Actions should facilitate the market uptake of solutions developed through industrially- and user-driven multidisciplinary consortia covering the relevant value chain and should consider standardisation aspects when relevant. The action should also include the analysis of financial opportunities ensuring the market exploitation and replication of the circular business model behind the developed solutions as new processes, products and/or services.

Actions should justify importance of targeted raw materials and the relevance of selected pilot demonstrations in different locations within the EU (and also outside if there is a clear added value for the EU economy, industry and society).

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination. For TRLs 6-7, a credible strategy to achieve future full-scale manufacturing in the EU is expected, indicating the commitments of the industrial partners after the end of the project.

Actions should also contribute to improving the awareness of relevant external stakeholders and the general public across the EU about the importance of raw materials for society, the challenges related to their supply within the EU and about proposed solutions which could help to improve society's acceptance of and trust in sustainable raw materials production in the EU.

Actions should also cover social, economic and environmental impacts of recovering value from secondary raw materials in comparison to primary raw materials, making focus on the entire process chain.

Actions should envisage clustering activities with other relevant selected projects for cross-projects co-operation, consultations and joint activities on cross-cutting issues and share of results as well as participating in joint meetings and communication events. To this end proposals should foresee a dedicated work package and/or task, and earmark the appropriate resources accordingly.

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

Call – A digitised, resource-efficient and resilient industry 2021

Improving the resilience and preparedness of EU businesses, especially SMEs and Startups

Topic ID and title	HORIZON-CL4-2021-RESILIENCE-02-32: Social and affordable housing district demonstrator (IA)				
Budget	EUR 10 million	Opening date	16 September 2021	Deadline 1	25 January 2022
Budget per project	EUR 2,5 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW				
Keywords	Renovation Wave, cross-sectoral industrial, multi-actor approach, Public Private Partnerships (PPP's), energy efficiency, modular building, smart living, digital technologies				
FTP comments					
FTP SIRA 2030 Challenges addressed	8	FTP relevance		Medium	
		Starting TRL		/	
		End TRL		/	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Demonstrate renovation pilots in the sense of “*lighthouse districts*” as announced by the *Affordable Housing Initiative in the Renovation Wave communication*⁴⁶ following a smart neighbourhood approach and providing blueprints for replication, setting liveability and latest technological and social innovations at the forefront;
- Mobilise cross-sectoral industrial⁴⁷ and Public Private Partnerships (PPP's) at local level to develop, adapt, design new processes, methods and technologies (e.g. energy efficiency, circular, modular building, smart living, eco-design,...). Special attention should be paid to the needs of residents in social using, through social innovation and using a human centred approach;
- Following a multi-actor approach, as defined in WP/ Annex X, engaging both, different sectors and fields of operation related to construction such as renewable energy, water treatment, and electronics as well as residents, social and public housing associations and civil society actors will be key to boost tailor-made and fit for purpose innovation;
- Demonstrate through such partnerships *lighthouse districts* that allow integrated renovation approaches. Besides technological innovation, specific focus on social innovation is crucial as it can provide social engagement models to empower and

engage residents, foster the co-design, co-development and co-implementation, offer spatial organisation allowing socio-economic activities and services, improve the wellbeing of citizens, and promote intergenerational and mixed forms of housing and accessible architecture open for cultural and creative innovation. Social innovation may also form a key aspect in developing business models for these types of lighthouse districts;

- Develop new bottom-up human-centred business models in housing area that facilitate engagement of residents in renovation – for example by co-investing, setting up energy communities, housing cooperatives and resident owned social services and (creative, green, ...) commons;
- Identify "ready to go projects" for the *lighthouse districts* as well as "low hanging"⁴⁸ fruit in terms of social housing renovation and worst performing buildings to test new methods, practices and technologies. The selected districts/ use cases, the diverse climatic and biogeographic conditions and settlement types in urban, sub-urban and rural areas across the EU are to be well reflected;
- Support businesses and the private sector in developing demonstration projects that go the extra mile (environmental - social – cultural ambition) and allow innovations and new technologies putting inclusion and social progress at the forefront;
- Pilot circular construction methods taking into account the different industrial perspectives and value chains relevant for the renovation of the districts;
- Apply and pilot innovative smart housing applications (at individual dwelling level) and general smart grid or district-level energy, waste, water, storage and other systems using newest technology at scale as well as technology that improves the social housing service provision itself;
- Plan actions for overcoming relevant barriers for renovation at district level with a majority of social housing dwellings (e.g. regulatory limits, lack of trust amongst different stakeholders, lack of private investors and awareness of the integrated approach potential);
- Effectively disseminate major innovation outcomes established in districts to support the implementation of industrial-urban symbiosis, connection to the European Community of Practice (ECoP) and development of flexible learning resources;
- Act as a catalyst for relevant EU projects and policies and channel this intelligence towards local projects and stakeholders, e.g. active aging, smart communities, including smart cities and smart villages, energy communities, skills, etc.;

- The final objective is to obtain a set of lighthouse districts that each have followed a different approach, focussing on different innovative solutions addressing the local reality and needs and to have demonstrated replication potential towards other districts by providing blueprints for replication and adaptation and by setting up a network amongst social housing providers.

Relevant indicators and metrics, with baseline values, should be stated clearly in the proposal.

Scope:

To support a wide implementation of these district renovations, industrial urban symbiosis needs to be fostered amongst most relevant partners engaged in construction and renovation of social housing facilities. The local and regional dimension is important since local energy and utility networks, adjacent industrial infrastructures and available by-products and services in such districts would have to be considered in a holistic and integrated approach. In the same way, logistics should be optimised wherever possible and should be an advantage from the sustainable and competitiveness perspective.

Technology based innovations should prove the potential for novel symbiotic renovation projects acting as demonstrators involving multiple industrial sectors (combining non-exhaustively energy, construction, renewables, circular, electronics and creative industries, social housing associations and public authorities) in pilot multi-stakeholder partnerships focussing on a district approach and social needs related to social housing. Projects are expected to address:

- The development of a broader integrated methodology towards renovation of social housing districts starting from a cross-sectoral approach (e.g. INNOSUP) and engagement models of residents to develop the application of technologies that make social housing more energy efficient, accessible and liveable;
- Research how technologies for housing and renovation can be adapted in a way that serves the needs of residents in social housing at affordable cost as well as how development at scale (e.g. district level of multi-apartment building) might bring cost optimisation and improve the affordability;
- The adaptation of technology in way it addresses the basic and essential needs of residents rather than to showcase the most advanced application from a technical perspective (human centred, fit for purpose and tailor made);

- Research on how renovation of social housing districts can deliver a more balanced population in terms of income, age and socio-economic profile as well as to avoid formation of ghetto's on the one hand and gentrification on the other hand;
- Aspects of environmental friendly traffic and internet connectivity to facilitate inclusion are to be considered;
- Energy poverty issues that must be avoided as a result of the renovation. Social innovation and financial planning must ensure that the cost of living will not increase significantly for tenants and residents;
- Integration of ICT and digital tools, including smart grids, smart living applications, advanced modelling for eco-design and modular construction, to design and establish novel symbiotic interactions, data sharing and preservation of data confidentiality, as a non-exhaustive list;
- Assessment methodologies and KPIs to measure the performance of symbiosis, including environmental, economic and social impacts. Life cycle assessment and life cycle cost analysis should take into account existing sustainability standards (e.g. ISO 14000) and existing best practices;
- New skills acquisition in construction sector by piloting new technologies and processes in the renovation at district level focussing on needs in social housing;
- Development of common reporting methodologies for the assessment of industrial symbiosis activities and exchanges;
- Tools to support companies in redefining their products process and systems from the point of view of design, production, logistic and business models;
- Research on how realised lighthouse models can be duplicated and adapted to other social housing contexts, for example, where no strong social housing sectors are present or where participation models are less developed, such as energy communities and cooperatives;
- This topic supports the Bauhaus Initiative as lighthouse districts could display the application of the New European Bauhaus practices focussing on the aesthetic and co-creative aspects of renovation and building of social housing districts.

Clustering and cooperation with other selected projects under this cross-cutting call and other relevant projects as well as building on existing projects is essential, as many existing

EU projects can contribute to very specific applications or process in such a district renovation.

Call – A digitised, resource-efficient and resilient industry 2022

Novel paradigms to establish resilient and circular value chains

Topic ID and title	HORIZON-CL4-2022-RESILIENCE-01-01: Circular and low emission value chains through digitalisation (Processes4Planet Partnership) (RIA)				
Budget	EUR 25,3 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 6 to 8 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	Waste reduction, digital technologies, secondary raw materials, certification				
FTP comments					
FTP SIRA 2030 Challenges addressed	4B – 8C	FTP relevance		Low	
		Starting TRL		/	
		End TRL		/	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Demonstrate an increase in the waste reduction by application of digital technologies
- Demonstrate optimisation of use of secondary raw materials in the value chains.

Scope:

Circularity is an essential part of a wider transformation of industry towards climate neutrality and long-term competitiveness. It can deliver substantial material savings throughout value chains and production processes, generate extra value and unlock economic opportunities. While circularity is in simple terms addressed by waste from one process becoming secondary materials for others, an efficient use in the value chain in order to close the loop or reuse in other industries, can be ensured only through a transparent information system. There is thus a need for designing and piloting an information system for raw materials and components in products throughout the whole value chain of process industries.

Proposals should:

- Propose new solutions for improved use of secondary raw materials along the value chain of the own industry or in other industries;

- Propose methodologies for digital tracing and certification of secondary raw materials. This should include real-time access to information on material compositions and material quality along the whole value chain;
- Propose digital tools for integration of product passport and/or certification schemes;
- Propose open source software, open hardware design, and easy access to data, in order to facilitate access to information for the own and for other industries;
- Develop means and tools to indicate the composition and origin of recycled materials (bar code could be an option) indicating the composition and origin.
- Consider the co-design of learning resources together with local and regional educational organisations for current and future generations of employees, with the possibility of integrating them in existing curricula and modules for undergraduate level and lifelong learning programmes. Learning resources should integrate the identification of new skills and should propose innovative learning-teaching methods that meet regional social needs and have a high potential for replication.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination. Proposals should contribute to standardisation,. Wherever possible.

This topic implements the co-programmed European partnership Processes4Planet.

Green and Sustainable Materials

Topic ID and title	HORIZON-CL4-2022-RESILIENCE-01-11: Advanced lightweight materials for energy efficient structures (RIA)				
Budget	EUR 20 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 3 to 5 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	Reduction of production cost, bio-based materials, bioresins, recycled fibres, bio-fibres,				
FTP comments					
FTP SIRA 2030 Challenges addressed	8A,B – 9A,C	FTP relevance		Medium	
		Starting TRL		3	
		End TRL		5	

Expected Outcome:

The positive environmental impact of lightweight composite materials most often occur due to benefits during the use-phase. The overall life-cycle benefits are often reduced as a consequence of negative environmental impacts associated with the manufacturing (energy consumption) and inherent challenges to regain the high-value components (fibre and matrix) at industrial scale. Development of new chemistries for fast curing resins, new bio-based composites (including fibres and core materials), joining technologies between composites and other materials and associated novel production techniques are expected to result in

- Reduced cost for production of renewable lightweight materials, 25 % lower cost than currently used materials;
- Light-weight products containing >50% sustainable, bio-based materials;
- Up to 30% lightweight potential through tailored functionality for a range of extreme environment (energy, infrastructures, aeronautics, space) applications and in surface transport;
- Reduction in CO2 emissions (LCA) of at least 20 %;
- Business models and circular value chains for lightweight bio based components;
- Improved time-to-market for European providers of lightweight solutions.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Scope:

A step change is needed to develop new sustainable and high performance lightweight materials and associated novel manufacturing techniques which comply with industrial demands for quality and reliability. Research areas to be addressed include:

- Development of new chemistries for fast curing resins (including bioresins) and associated novel production techniques (e.g. out-of-autoclave processes to reduce energy consumption);
- Utilisation of existing or development of cost competitive renewable resins and/or core materials in combination with new fibres to make all renewable lightweight composites and structures;
- Technologies and material design paradigms that enable hybrid composites based on a variety of constituents e.g. combinations of virgin and recycled fibres, bio-fibres including appropriate fibre coatings, etc. towards maximum cost and environmental benefits with a life-cycle perspective;
- High performance high temperature polymer composites with potential to extended use at temperatures above 300C. Besides general material and manufacturing, the long-term durability of materials in service is a potential area of research and development;
- New multifunctional composites where the materials and structures, besides traditional structural capacity, also is optimized towards one or several other functions such as thermal management (heating/cooling), energy harvesting and storage, morphing, self-monitoring, etc.;
- New recycling technologies for polymer composites structures and, in particular, composite constituents. The high value constituents e.g. carbon fibres or matrix are not easily separated and technologies to recycle both in the same process should be addressed.

Improving advanced lightweight materials will have a positive environmental impact, which is in direct relation to the well-being of citizens.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

This topic is open for international cooperation where the EU has reciprocal benefit, while excluding industrial competitors from countries where the safeguarding of IPRs cannot be guaranteed.

Topic ID and title	HORIZON-CL4-2022-RESILIENCE-01-12: Functional multi-material components and structures (RIA)				
Budget	EUR 20 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 4 to 6 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	Additive manufacturing, biomaterials, energy efficiency, nanotechnology, recycling				
FTP comments					
FTP SIRA 2030 Challenges addressed	8A,B – 9A,C,D	FTP relevance		Low	
		Starting TRL		3	
		End TRL		6	

Expected Outcome:

Optimised lightweight designs often require the use of multi-materials, often with different physical properties, such as polymers composites and metals. The manufacturing of multimaterial structures is thus a challenging task and many industries are today addressing specific critical challenges that come with mixing of materials. It is of great importance that multimaterial design is analysed from a holistic and multidisciplinary perspective where all aspects from design to manufacturing, use and recycling are included in the process. This will help industry make the change from traditional design based on one material to multi-material design of lightweight structures.

Projects are expected to contribute to the following outcomes:

- Contribute to energy efficiency, increase competitiveness of new multi-materials items and multi-functional materials and products for a wide range of applications in the additive manufacturing industries and in specific industrial sectors e.g. transport including aeronautic, and maritime, consumer customised goods, communications, biomaterials, health and energy;
- Develop optimised structures in terms of operational performance and weight with a goal of reducing weight by 50% compared to traditional designs;
- Reduced lead-time of multimaterial products of 20% compared to today's design of multimaterial products that creates an increased competitiveness for the EU's industry;
- Strengthening of the EU's manufacturing industry through the intensive implementation of innovative and unconventional technologies along the EU's manufacturing value chain;

- Combine materials with high uniformity and with high mobility in industrial quantities with high reproducible quality;
- Increase of the product performance by at least 30% whilst retaining the product price;
- Dissemination of the challenges and benefits of functional multi-material components and structures in the relevant industrial sectors.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Scope:

By combining several materials, proposals should advance the state of the art through the development of ready assembled multifunctional devices. The role of new development in additive manufacturing processes with dissimilar materials will be of importance. Proposals should address and demonstrate several of the below simultaneous activities:

- Quantification of improved functionalities, properties, quality and lifespan of fabricated pieces;
- Evaluation of matching materials properties to the production process to enable the joining of dissimilar materials for AM tools;
- Combination of precision engineering design with additive manufacturing methods to provide tailor-made joining solutions for dissimilar materials, with the ability to be reused/dismantled;
- Demonstration of a better understanding of the nanotechnology integrated materials properties and manufactures;
- Integration and validation at early stage of the qualification and certification considerations of the materials, including innovative non-destructive inspection techniques;
- Recycling aspects of multimaterial components and structures should also addressed in detail.
- Joint development with material suppliers and end-users is required for a rapid uptake by industry;
- Modelling, simulation, standardisation and regulatory aspects (especially safety and nano-safety) and the process and materials qualification.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

This topic is open for international cooperation where the EU has reciprocal benefit, while excluding industrial competitors from countries where the safeguarding of IPRs cannot be guaranteed.

Materials for the benefit of society and the environment and materials for climate-neutral industry

Topic ID and title	HORIZON-CL4-2022-RESILIENCE-01-16: Building and renovating by exploiting advanced materials for energy and resources efficient management (IA)				
Budget	EUR 21 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 5 to 7 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	WW				
Keywords	insulation materials, environmental footprint, circular design, air quality, fire resistant, Life Cycle Assessment (LCA), Build4People				
FTP comments					
FTP SIRA 2030 Challenges addressed	8 – 9C - 10B	FTP relevance		Medium	
		Starting TRL		5	
		End TRL		7	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Buildings are responsible for approximately 40% of energy consumption and 36% of CO2 emissions in the EU. Renovation of existing old buildings has the potential to lead to significant energy savings – potentially reducing the EU's total energy consumption by 5-6% and lowering CO2 emissions by about 5%;
- Compared to state of the art materials and components, the newly developed materials should deliver:
 - Reduction by at least 30% of the embodied energy and CO2 at component level;
 - Improvement by at least 20% of insulation properties;
 - Reduction by at least 15% of the total costs compared to existing solutions;
 - Demonstration of at least a 5% reduction of the energy spent during the whole life cycle of a building.
 - Increased durability and lifetime, lower maintenance costs and environmental footprint.
- Demonstrate innovative retrofitting solutions using the building insulation materials as real cases approaching net zero energy standards and their replicability potential;

- Improvement of the quality of information from product manufacturers to facilitate better decision making;
- Strengthening of the competitiveness of the European construction sector in the field of “green” construction technologies;
- Sustainable building materials will be supporting the circular design. Self-sustaining buildings in respect to energy usage;
- New insulation materials should be cost effective, environmentally safe, fire resistant and can be easily applied on existing surfaces (e.g. spray coating);
- Return on investment should be below 7 years for deep retrofitting of buildings;
- Advent of a new generation of skilled workers and SME contractors in the construction sector aware of the need of a systemic approach towards energy efficiency should be promoted through the proposed activities.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

Scope:

Building envelopes and renovation materials that boost energy savings, save resources and decrease carbon emissions, both during construction and operation of the buildings. In view of the climate targets, Europe's building infrastructure needs a deep rehabilitation of residential buildings (including buildings of historic value) while lowering the costs of refurbishment. Building materials with adequate insulation properties are directly related to the Green Deal and the well-being of our citizens.

Proposals should address and demonstrate several of the below activities:

- Demonstrating that new insulation materials (not external cladding) will have reduced embodied energy, lower CO₂ emissions and improved insulation properties during operation, and are cost effective, environmentally safe, fire resistant and can be easily applied on existing surfaces (e.g. spray coating);
- New components should also contribute to improve indoor air quality, by limiting VOCs emissions and/or by advanced properties aiming to absorb and biodegrade indoor contaminants;
- Enhanced durability for increased use duration, reduced maintenance and consequently reduced costs, respect of sustainability principles (the sustainability of

each developed solution should be evaluated via life cycle assessment studies carried out according to the International Reference Life Cycle Data System - ILCD Handbook);

- New components should have to be lightweight construction with an ease of installation and provide for increased comfort and noise reduction, and find application to both new build and renovation and deliver realistic solutions at a reasonable price;
- Energy efficiency should be addressed by system integration and installation, exploiting synergies between technologies, which proved valid at a small scale and need a larger scale demonstration;
- Synergy with existing relevant Open Innovation Test Beds is encouraged;
- Clustering and cooperation with other relevant projects is strongly encouraged; in particular, liaison and synergies with the Horizon Europe Partnership on 'People-centric sustainable built environment' and Build4People.

Building materials with adequate insulation properties are directly related to the Green Deal and the well-being of our citizens.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

The topic is open for international cooperation, while excluding industrial competitors from countries where the safeguarding of IPRs cannot be guaranteed¹⁰³

Materials and data cross-cutting actions

Topic ID and title	HORIZON-CL4-2022-RESILIENCE-01-19: Advanced materials modelling and characterisation (RIA)				
Budget	EUR 18 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 4 to 6 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	Open repository, material properties, CHADA, MODA, EMMO, model-based innovation processes, product development, material development, Artificial Intelligence (AI), Machine Learning				
FTP comments					
FTP SIRA 2030 Challenges addressed	9C,D - 10A,B			FTP relevance	High
				Starting TRL	3
				End TRL	5

Expected Outcome:

The future of European industrial manufacturing requires further advances in characterisation methods and computational modelling, in order to lead the way to the reliable design of new and sustainable materials and processes, rapid upscaling, and effective quality control. These advances can only be achieved through the development of innovative techniques and a new generation of instrumentation, responding to industrial needs.

Projects are expected to contribute to the following outcomes:

- Develop an open repository for knowledge transfer, data sharing for integration between advanced materials characterisation (material properties/functionalities) and modelling (data and physics based, engineering modelling), allowing full interoperability between data and workflows (CHADA, MODA and EMMO), with direct connection to manufacturing process;
- Develop characterisation techniques supporting key European technology area strongholds. The developed characterisation methods should be complemented with and validated by modelling tools;
- Enable a model-based innovation processes covering all stages from materials design (including several scales, e.g. from molecular to macroscale) to product development, including validation, characterisation and life cycle assessment, with the aim, in particular, of translating industry needs into innovation challenges and provide solutions;

- Increase the efficiency and effectiveness of materials and product development by reducing costs and time for product design, time-to-market and regulatory compliance, which will enable the transition to a decarbonised economy;
- Improve handling of missing data by means of artificial intelligence/machine learning methods and/or simulation;
- Proposals should include a business case and exploitation strategy after the end of the action.

Scope:

Proposals should:

- Develop a relevant range of characterisation methods, models and simulation tools to enhance the design – with clear demonstration of modelling and characterisation integration – and development stages of advanced materials and products, focusing on user cases related to low carbon and clean industry applications;
- Coordinate efforts towards data documentation, exchange procedures and ontologies that can aid the traceability, integrity and interoperability of data in line with Industry Commons and FAIR data principles;
- Seek the involvement of standardisation bodies for the development of standards, test guidance or guidance documents;
- Focus on the combination of theory with large-scale computational screening (e.g. Artificial Intelligence or Machine Learning);
- Facilitate the re-use of existing research results on modelling and characterisation, as well as the uptake of new project results;
- Projects should contribute to the objectives of the European Materials Characterisation Council (EMCC) and European Materials Modelling Council (EMMC) and foresee the necessary resources to this effect.

Topic ID and title	HORIZON-CL4-2022-RESILIENCE-01-20: Climate Neutral and Circular Innovative Materials Technologies Open Innovation Test Beds (IA)				
Budget	EUR 34 million	Opening date	12 October 2021	Deadline 1	30 March 2022
Budget per project	EUR 10 to 12 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	WW, P&P				
Keywords	Innovative value chains, technological risk reduction, Open Innovation Test Beds (OITB), cost reduction				
FTP comments					
FTP SIRA 2030 Challenges addressed	3C,E - 4D - 6 - 8A,B - 9A - 10A			FTP relevance	Low
				Starting TRL	5
				End TRL	7

Expected Outcome:

Climate Neutral and Circular Innovative Materials Technologies are essential in enabling the transition towards a European decarbonised economy. They can contribute to a stronger circular economy, a cleaner Industry, a more sustainable growth and reduction of greenhouse gas emissions, which is fully in line with the Green Deal Strategy. To maintain its competitive advantage in clean Materials technologies the EU needs to increase significantly the large-scale deployment and demonstration of new technologies across sectors and across the single market, building new innovative value chains. Climate Neutral and Circular Innovative Materials Technologies Open Innovation Test Beds (OITBs) will support companies, especially SMEs, to become world leaders in clean products and technologies.

Projects are expected to contribute to the following outcomes:

- Increase significantly the large-scale deployment and demonstration of Climate Neutral and Circular Innovative Materials Technologies across sectors and the single market, as well as to build and maintain new innovative value chains;
- Reduce the technological risk of innovative materials and products, thus attracting more investors, and cut the time to market;
- Support companies, especially SMEs, to become world leaders in clean products and technologies by setting up a new generation of Open Innovation test Beds focused on the creation of Business Opportunities and Sustainability. Enhancing ownership and engagement of the society through active collaboration and empowering people and communities as actors of the climate neutral and circular transition ;

- Translation of industrial needs into scientific problems and concrete solutions, increased awareness and uptake by industry, and effective access of relevant stakeholders to know-how and advanced tools/infrastructure.

Scope:

The following specific activities should be considered:

- Establish Open Innovation Test Beds (OITB) by upgrading existing or developing new materials facilities and pilot lines, and made available services for the design, development, testing, regulatory and environmental assessment and upscaling to industry and interested parties, specially SMEs;
- Specific focus will be given to the sustainability of the ecosystem by designing new funding instruments that would complement the already existing ones and provide further support for industrial uptake of climate neutral and circular innovative materials technologies in key strategic value chains;
- Proposals should include actions designed to facilitate cooperation with other projects, to enhance user involvement and to reuse other projects results;
- Open access at fair conditions and cost as well as outreach and dissemination across Europe, based on a distinct methodology;
- Demonstrate measurable reduction of costs for product design, time-to-market and regulatory compliance by means of faster and cheaper evaluation of production process deviations. Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal.

In order to avoid duplication, the work will be aligned with the third pillar on Open Innovation that will essentially focus on scaling up breakthrough and market-creating innovation by establishing a European Innovation Council, support the enhancement of European ecosystems of innovation and continued support to the European Institute of Innovation and Technology (EIT) OITB for: Clean hydrogen Technologies; Fuel cells and other alternative fuels; Carbon capture, storage and utilisation.

Proposals submitted under this topic should include a business case and exploitation strategy, as outlined in the introduction to this Destination.

Destination 4: Digital and emerging technologies for competitiveness and fit for the Green Deal

This destination will directly support the following Key Strategic Orientations, as outlined in the Strategic Plan:

- KSO A, '**Promoting an open strategic autonomy by leading the development of key digital, enabling and emerging technologies, sectors and value chains** to accelerate and steer the digital and green transitions through human-centred technologies and innovations.'
- KSO C, '**Making Europe the first digitally led circular, climate-neutral and sustainable economy** through the transformation of its mobility, energy, construction and production systems

Proposals for topics under this Destination should set out a credible pathway to contributing to the following expected impact:

- **Open strategic autonomy in digital technologies and in future emerging enabling technologies**, by strengthening European capacities in key parts of digital and future supply chains, allowing agile responses to urgent needs, and by investing in early discovery and industrial uptake of new technologies.

Electronic and photonic components, and the software that defines how they work, are the key digital technologies that underpin all digital systems. As the digitalisation of all sectors accelerates, most industries depend on early access to digital components. Dependence on these technologies represents a clear threat to Europe's autonomy, particularly in periods of geopolitical instability, exposing Europe to risks of vulnerability. Actions under this Destination will build on EU strengths in low-power consumption and ultra-secure components, Europe needs to develop the essential electronic and photonic components for a wide range of applications such as healthcare equipment, electric and autonomous vehicles, manufacturing and production plants and equipment, telecom networks, aerospace vehicles, consumer products

R&I initiatives on 6G technologies are now starting in leading regions world-wide, with the first products and infrastructures expected for the end of this decade. 6G systems are expected to offer a new step change in performance from Gigabit towards Terabit capacities and sub-millisecond response times, to enable new critical applications such as real-time automation or eXtended Reality ("Internet of Senses"). Europe must engage now to be among the top influencers of - and competitors in - these technologies and ensure that emerging network technology standards are defined following European values and energy-efficiency

requirements. Main actions on 6G technologies will be undertaken in the Smart Networks and Services Joint Undertaking.

Despite a strong European scientific community's on AI and robotics, Europe lags behind in AI diffusion. Actions under this Destination will develop world-class technologies serving the needs of all types of European industries (e.g. manufacturing, healthcare, transport, agriculture, energy, construction), providing top-performing solutions that businesses will trust and adopt to maintain their competitiveness and maximise their contribution to environmental sustainability.

While Europe is strong in many sectors, it must take ownership of its unavoidable future transformations for competitiveness, prosperity and sustainability, by early leadership in new and emerging enabling technologies, e.g. alternative computing models such as bio- and neuro-morphic approaches, use of biological elements as part of technology, and sustainable smart materials. In particular, the far-reaching impact of quantum and graphene technologies on our economy and society cannot be fully estimated yet, but they will be disruptive for many fields. Actions in this Destination will ensure that Europe stays ahead in this global race and is in a position to achieve game-changing breakthroughs.

In line with the vision set out in the Digital Decade Communication (COM(2021)118), in particular its 'secure and performant sustainable digital infrastructures' pillar, actions under this Destination will support Europe's open strategic autonomy, and reinforce and regain European industry's leaderships across the digital supply chain. It will direct investments to activities that will ensure a robust European industrial and technology presence in all key parts of a greener digital supply chain, from low-power components to advanced systems, future networks, new data technologies and platforms. Autonomy will require sustaining first-mover advantage in strategic areas like quantum computing and graphene, and investing early in emerging enabling technologies.

Investments in this Destination contribute substantially to climate change objectives. Energy efficiency is a key design principle in actions, which will lead to new technologies and solutions that are cornerstones for a sustainable economy and society. These solutions range from ultra-low-power processors to AI, Data and Robotics solutions for resource optimisation and reduction of energy consumption and CO₂ emissions; from highly efficient optical networking technologies and ultra-low-energy 6G communication networks to robotics that overcome the limitation of energy autonomy. Furthermore, promising emerging avenues are addressed via ultra-low power operations enabled by spintronics and 2D materials-based devices and systems for energy storage and harvesting.

Actions should devote particular attention to openness of the solutions and results, and transparency of the research and innovation process. To ensure trustworthiness and wide adoption by user communities for the benefit of society, actions should promote high standards of transparency and openness. Actions should ensure that the processes and outcomes of research and innovation align with the needs, values and expectations of society, in line with Responsible Research and Innovation.

As a result, this Destination is structured into the following headings, which group topics together with similar outcomes to address a common challenge:

- Ultra-low power processors

Today Europe is not highly present in the microprocessor market. The objective of this heading is to ensure EU open strategic autonomy through the development of low-power, low environmental impact, secure and trusted components and software for strategic value-chains.

Proposals are invited under the topics of this heading in this work programme and under the topics of the 'Key Digital Technologies' Joint Undertaking addressing the electronics value chain (including software technologies).

- European Innovation Leadership in Electronics

Europe currently has a leading position in key digital technologies for the strategic sectors of automotive, industrial manufacturing, aerospace, defence and security and healthcare. In the emerging area of post-Moore components, there is a number of promising technological approaches with no established players or dominant regions.

The objective of this heading is to secure access in Europe to cutting-edge digital technologies, to strengthen current leadership in strategic value-chains, and to seize emerging opportunities addressing existing technological gaps.

Proposals are invited under the topics of this heading in this work programme and under the topics of the 'Key Digital Technologies' Joint Undertaking addressing the electronics value chain (including software technologies).

- European Innovation Leadership in Photonics

The European photonics industry has an excellent position in core segments, far above the average EU market share. The objective of the topics grouped in this heading is to strengthen current leadership in photonic technologies and applications, and to secure access in Europe to cutting-edge photonic technologies.

The topics of this heading are under the co-programmed Partnership ‘Photonics’.

- 6G and foundational connectivity technologies

Today European suppliers of connectivity systems are well placed with around 40% of global 5G market share, but with high competitive pressure from Asian and US players. In terms of technology, first 5G standards are available since end of 2017 enabling Gigabit/s speeds and ~millisecond latencies. Trusted industrial services based on 5G technology are at very early stage.

The objective of this heading is to develop a strong supply chain for connectivity, increase European competitiveness and autonomy in Internet infrastructures, and to contribute to a reduction of the growing global energy consumption of the Internet and of the industry vertical users of the Internet, and to other key SDG’s such as affordability and accessibility to infrastructures. The topics under this work programme address in particular the need to develop micro electronic components and systems supporting future disaggregated Radio Access Networks and components enabling the advent of all optical networks for ultra low consumption and ultra high security networks.

Proposals are invited under the topics of this heading in this work programme and under the topics of the ‘Smart Networks and Services’ Joint Undertaking addressing the future connectivity platforms including edge cloud and IoT technologies.

- Innovation in AI, Data and Robotics

Europe has an outstanding track record in key areas of AI research, Europe’s scientific community is leading in AI and robotics, but substantial efforts are needed to transform this into (disruptive) European AI technology products that can withstand international competitors. Europe also lags behind in technology diffusion, less than half of European firms have adopted AI technology, with a majority of those still in the pilot stage. 70% of these adopter companies, only capture 10% of full potential use, and only 2% percent of European firms in healthcare are using those technologies at 80% of potential¹²⁴. Moreover, as demonstrated during the COVID-19 crisis, many AI, Data and Robotics solutions exist today but only a limited number of them reaches the level of maturity and adoption necessary to solve the problems at hand. Therefore, there is room for improved adoption by industry, which requires a drastic increase of industry-driven R&I, from basic research to large-scale piloting. In general, industry acknowledges the potential of AI technologies, but often lacks demonstrable benefits for their particular use cases.

The objective of this heading is to ensure autonomy for Europe in AI, data and robotics in developing world-class technologies serving the needs of all types of European industries,

from manufacturing to healthcare, public sector, utilities, retail, finance, insurance, transport, agriculture, energy, telecommunications, environmental monitoring, construction, media, creative and cultural industries, fashion, tourism, etc. providing top-performing solutions that industries will trust and adopt to maintain their competitiveness and maximise their contribution to environmental and resources sustainability.

Several topics of this heading are under the co-programmed Partnership 'AI, Data and Robotics'.

- Tomorrow's deployable Robots: efficient, robust, safe, adaptive and trusted

Europe is leading in robotics industry, with a high intensity of use of robots. Europe is also scientifically leading in robotics' cognition, safety, manipulation, soft robotics, underwater and aerial robotics, with demonstrated impacts in many use-cases in key industrial sectors (e.g.: healthcare, agri-food¹²⁵, forestry, inspection and maintenance, logistics, construction, manufacturing, etc.) and across multiple modalities (aerial, marine, ground, in-vivo and space).

The objective of this heading is to ensure autonomy for Europe in robotics, leading the way in research, development and deployment of world-class technologies.

Several topics of this heading are under the co-programmed Partnership 'AI, Data and Robotics'.

- European leadership in Emerging Enabling Technologies

Europe's leading industry sectors have a solid track-record in constant improvement, but less so for embracing transformative ideas. The pathway from research to industry uptake is often long and staged, with no intertwining of research and industry agendas. In the age of deep-tech, though, this intertwining is essential.

The objective of this heading is to identify early technologies that have the potential to become Europe's future leading technologies in all areas of this cluster and to establish industry leadership in these technologies from the outset. This heading has a unique focus on off-roadmap transformations with a longer time-horizon but profound potential impact.

- Flagship on Quantum Technologies: a Paradigm Shift

Since 2018, the Quantum Technologies Flagship has been consolidating and expanding Europe's scientific leadership and excellence in quantum, in order to foster the development of a competitive quantum industrial and research ecosystem in Europe. The EU's aims for quantum R&I in the next decade are set out in detail in the Quantum Flagship's Strategic

Research Agenda (SRA126) and its associated main Key Performance Indicators,¹²⁷ which drafted and published in 2020 on quantum computing, quantum simulation, quantum communication, and quantum sensing and metrology. Projects in each of these areas are currently supported by the Flagship, by other EU research initiatives and by national programmes.

The objective of this heading is to further develop quantum technologies and their applications in the areas of quantum computing, simulation, sensing and communication, in order to strengthen European technological sovereignty in this strategic field and achieve first-mover industry leadership, capitalising on Europe's established excellence in quantum science and technology maintaining and developing quantum competences and skills available in the EU and raising the capabilities of all Member States in this field.

The aim of the Commission's Digital Decade strategy is for the EU to become digitally sovereign in an interconnected world, and in the coming years quantum technologies will be a key element of this digital sovereignty, as they are of global strategic importance. Quantum technologies will be also used, among others, for sensitive applications in the area of security, and in dual-use applications. Other world regions are already investing heavily in all areas of quantum technologies research. In this context, the EU must take action to build on its strengths, and to carefully assess and address any strategic weaknesses, vulnerabilities and high-risk dependencies which put at risk the attainment of its ambitions. This will enable it to safeguard its strategic assets, interests, autonomy and security, while advancing towards its goal of open strategic autonomy.

The Quantum Technologies Flagship conducts research and development activities in the key domains of quantum computing and simulation, quantum communication, and quantum sensing. The Flagship will contribute to world-leading quantum computers and simulators, that will be acquired by the European High Performance Computing Joint Undertaking, and will be crucial to achieving its Digital Decade goal of having its first computer with quantum acceleration by 2025, with a view to being at the cutting edge of quantum capabilities by 2030. These machines will have a profound impact, with applications in medicine, manufacturing, or new material and new drugs design but also in cryptography, finance and many other sensitive domains.

Moreover, the Flagship's research into quantum communication will support the development of a European quantum communication infrastructure (EuroQCI). This key component of the EU Cybersecurity Strategy will provide an extremely secure form of encryption to shield the EU's government data and critical infrastructures against cyber-attacks. Ensuring that the latest quantum communication technologies remain accessible in the EU is crucial to maintaining European security in the face of future threats.

Research in quantum sensing technologies is also vital to the EU's interests, as it will develop European expertise in quantum clocks for navigation (including for embarkation on Galileo satellites) and precise timing applications, sensors for autonomous vehicles, and the next generation of medical sensors.

It is therefore clearly in the EU's interests to protect European research in these domains, the intellectual property that it generates, and the strategic assets that will be developed as a result, while taking steps to avoid situations of technological dependency on non-EU sources (in line with the call of the October 2020 European Council to reduce Europe's strategic dependencies). With this in mind, the Commission has decided that, in the research areas covered by 12 actions in this work programme in quantum computing and simulation, communication, and sensing, only Associated Countries that meet certain conditions will be eligible to participate in these actions.

As agreements with candidate Associated Countries are not yet in force, the eligibility to participate in such actions is limited for the moment to legal entities established in the EU, Norway and Iceland. However, in view of ensuring maximum excellence of R&I for the EU and to maintain EU's spirit of global openness, before opening these actions for applications, the eligibility to participate in these 12 actions will be extended to include legal entities established in (candidate) Associated Countries which provide assurances concerning the protection of EU's strategic assets, interests, autonomy or security. On the basis of the outcome of the discussions in the relevant configurations of the Horizon Europe Programme Committee, the Commission will reflect the changes in the work programme in full consistency with the decision establishing the Horizon Europe specific programme, especially through comitology procedures as foreseen in articles 13 and 14(4) of it.

- Graphene: Europe in the lead

The starting point is the Graphene Flagship, launched in 2013, which already reached European leadership in graphene and related 2D materials. The work is now coming to a critical point where first simple products are being launched. R&I activities would now need to be pursued and accelerated in order to translate achieved technology advances that are at TRL 3-5 into concrete innovation opportunities and into production capabilities in many industrial sectors (e.g. aviation, automotive, electronics, batteries, healthcare).

The objective of this heading is to strengthen and accelerate the technology developments that support a strong European supply and value chain in graphene and related materials and provide first-mover market advantages of scale.

Activities beyond R&I investments will be needed to realise the expected impacts: testing, experimentation, demonstration, and support for take-up using the capacities,

infrastructures, and European Digital Innovation Hubs made available under the Digital Europe Programme; large-scale roll-out of innovative new technologies and solutions (e.g. new energy-efficient connectivity technologies) via the Connecting Europe Facility; further development of skills and competencies via the European Institute of Innovation and Technology, in particular EIT Digital; upscaling of trainings via the European Social Fund +; and use of financial instruments under the InvestEU Fund for further commercialisation of R&I outcomes.

Expected impact

Proposals for topics under this Destination should set out a credible pathway to contributing to **digital and emerging technologies for competitiveness and fit for the Green Deal**, and more specifically to one or several of the following impacts:

- Europe's open strategic autonomy by sustaining first-mover advantages in strategic areas including AI, data, robotics, quantum computing, and graphene, and by investing early in emerging enabling technologies.
- Reinforced European industry leadership across the digital supply chain.
- Robust European industrial and technology presence in all key parts of a greener digital supply chain, from low-power components to advanced systems, future networks, new data technologies and platforms.

Call – Digital and emerging technologies for competitiveness and fit for the Green Deal 2021

Innovation in AI, Data and Robotics

Topic ID and title	HORIZON-CL4-2021-DIGITAL-EMERGING-01-10: AI, Data and Robotics at work (AI, Data and Robotics Partnership) (IA)				
Budget	EUR 22 million	Opening date	22 June 2021	Deadline 1	21 October 2021
Budget per project	EUR 3 to 5 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	F&F, WW, P&P				
Keywords	Human-centric AI				
FTP comments					
FTP SIRA 2030 Challenges addressed	2B,D - 7	FTP relevance		Low	
		Starting TRL		3-5	
		End TRL		6-7	

Expected Outcome:

Project results are expected to contribute to at least one of the following expected outcomes:

- A new human-centred paradigm to keep people away from unsafe and unhealthy jobs via collaborative embodied (physical) AI, engaging and empowering end-users and workers, regardless of their gender, age or background.
- Human-centric AI supporting professionals in trustworthy hybrid decision-making, and optimising their tasks

Scope:

Proposals are expected to demonstrate how AI, data, robotics and automation solutions can support workers in their daily tasks, improving working conditions (both physical and social) and work performance/efficiency, while considering safety, security and resilience, as appropriate. The added value to the application field should be demonstrated by qualitative and quantitative industry/production or service relevant KPIs, demonstrators at TRL6-7, benchmarking and progress monitoring processes.

The involvement of the application sector stakeholders, including social partners, workers, managers and decision makers must be a key driver in the proposals, not only to identify the needs and the application scenarios, but to be involved in the co-creation and testing and uptake of the solutions and providing feedback to adapt the solutions to optimise the impact on working conditions and performances.

The selection of the application sector should prioritise sectors and use-cases where the technology can demonstrate maximum impact and added value.

While the focus is on technology, a human-centred approach will be key, with involvement of the workers, professionals, (front-line operators and managers) and other relevant experts, such as experts in human-centred design. They will closely collaborate with the technology providers and integrators. Engagement with SSH140 expertise is also needed to improve interaction design and to provide expertise on trustworthiness and acceptability by workers, as well as ethical perspective of human-machine collaboration. Gender and intersectionality dimension¹⁴¹ analysis should be a part of the proposals, where relevant.

Each proposal will focus on one of the two following use-cases:

1. Collaborative embodied AI (robotics system), empowering end-users and workers keeping them away from unsafe and unhealthy jobs: the focus will be on demonstrating improved working conditions (health/safety/level of stress, etc.), and worker trust and acceptance. The assistance should also take into account other factors less related with physical assistance like stress level. Meaningful human oversight of autonomy should be addressed.
2. AI and data supporting professionals in trustworthy hybrid decision-making and supporting workers to optimise and facilitate their tasks; the focus will be on demonstrating how AI and data can improve the effectiveness and efficiency as well as management of trade-offs within the decision-making, building on the human and machine complementarities, exploiting the best capability of both for a better outcome. Meaningful human oversight of decision outcomes and explainability should be addressed. Specific effort should be made to develop re-usable decision-support systems or modules.

All proposals should exploit the latest results in AI, data and robotics, as well as multimodal interaction technologies, User interface experience, for natural and seamless interaction between the human and the technology/sources of information, including Augmented/Virtual Reality when appropriate.

Proposals should incorporate skills developments activities or/and connect with existing skills activities in that domain, as appropriate.

Proposals should clearly identify which of the two use-cases listed above they will focus on.

Two types of proposals are expected:

1. Focused projects (EU contribution around EUR 3.00 million), involving the user industry and technology provider(s),
2. Larger projects (EU contribution around EUR 5.00), where a number of companies in a given application sector will identify in the proposal common challenges and use-cases, and organise competitive calls for AI, data and robotics solution providers to address such challenges. Competitive calls will be open to all types of companies, but only SMEs and Start-ups¹⁴² will receive financial support to third parties, with a maximum of EUR 200 000 per third party¹⁴³ and 70% funding (100% for start-ups). At least 40% of the requested amount should be dedicated to financial support to third parties. The consortium will provide technical support with expertise in engineering integration, testing and validation to support the selected SMEs and start-ups acting as technology providers to demonstrate the added value of their solutions to address the challenges of the use-cases. Maximum one type of third party project will be funded per use-case.

In all proposals, user industries are expected to play a major role in the requirement and validation phases.

Besides financial support, these SMEs and start-ups successfully demonstrating the potential of their solutions, must receive support from business experts, provided by the action, to further develop their business and develop their market reach, and maximise their business opportunities.

When possible, proposals should build on and reuse public results from relevant previous funded actions. Proposals should make use of connections to the Digital Innovation Hub networks, particularly those in Robotics, Data and AI. Full use should be made of the common resources available in the AI-on-Demand platform¹⁴⁴, Digital Industrial Platform for Robotics¹⁴⁵, data platforms¹⁴⁶ and, if necessary other relevant digital resource platforms. Communicable results from projects should be delivered to the most relevant of these platforms in order to enhance the European AI, Data and Robotics ecosystem through the sharing of results and best practice.

All proposals are expected to allocate tasks to cohesion activities with the PPP on AI, Data and Robotics and funded actions related to this partnership, including the CSA HORIZON-CL4-2021-HUMAN-01-02. Where relevant, synergies with other PPPs are encouraged.

This topic implements the co-programmed European Partnership on Artificial Intelligence, Data and Robotics.

Call – Digital and emerging technologies for competitiveness and fit for the Green Deal 2022

Innovation in AI, Data and Robotics

Topic ID and title	HORIZON-CL4-2022-DIGITAL-EMERGING-01-05: AI, Data and Robotics for Industry optimisation (including production and services) (AI, Data and Robotics Partnership)(IA)				
Budget	EUR 19 million	Opening date	23 November 2021	Deadline 1	5 April 2022
Budget per project	EUR 3 to 5 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	F&F, WW, P&P				
Keywords	Artificial Intelligence (AI), production optimisation, competitiveness, environment sustainability, human-robot collaboration				
FTP comments					
FTP SIRA 2030 Challenges addressed	2B,D – cross-sectional	FTP relevance		Low	
		Starting TRL		3-5	
		End TRL		6-7	

Expected Outcome:

Proposal results are expected to contribute to at least one of the following expected outcomes:

- Advancing AI, data and robotics, and automation for the optimisation of production and services value-chains, optimisation of products, services, processes, to increase competitiveness, improve working conditions, and environmental sustainability, and supporting the European Economy using AI, data and robotics technologies.
- AI or learning systems (including, but not limited to self-learning, continuous and transfer learning, self-configuring systems) adapting production or services workflows to changing environments, dynamic and unpredictable resource constraints and to the capabilities and restrictions of humans and transferring results from one domain to another.

Scope:

Proposals are expected to integrate and optimise AI, data and robotics solutions in order to demonstrate, by addressing use-cases scenarios in actual or highly realistic operating environments, how they optimise production and service use cases.

Industry-empowering AI, data and robotics: enable and boost wide spread deployment of European technologies, in demonstrating clear benefits in particular applications coming

from major industrial sectors, in improving processes, products or services, contributing to their competitiveness, quality of services, and strategy for environmental sustainability. Providing industry with more autonomous and more intuitive and easier to operate technologies they can trust and that are tailored for their needs, with the adapted and guaranteed levels of performance, reliability, safety, dependability, security and transparency. Providing trustworthy AI solutions combining various sources of data, sensors, interaction and information to address industrial challenges; combining the power of latest progress in AI, FAIR¹⁸³ data, autonomous or interactive robotics, smart devices and next generation networks and computing to increase automation and optimise processes, resources, and services, and addressing new technological challenges removing barriers for industrial deployment, and improving trust through more transparent and explainable AI. Where relevant latest development from low power consuming sensors, actuators and mechanisms, as well as new energy sources and batteries will be exploited to ensure energy autonomy for robotics. Promoting versatile, flexible, scalable, resilient physical and digital architecture that facilitate the future AI, data and robotics based services adoption.

Proposals should demonstrate how major European industries (covering all the sectors, from production¹⁸⁴ to services) can substantially benefit from optimising AI, data and/or robotics to maximise such benefits. Proposals are expecting to focus on specific use-cases to demonstrate such benefits, cross-sector use-cases are encouraged. Added value to the selected use-cases should be demonstrated by qualitative and quantitative industry and service relevant KPIs, demonstrators, benchmarking and progress monitoring.

While the proposals should be application driven, involving problem owners to define needs and validate the proposed solution, the focus is on optimising the enabling of AI, data and robotics technologies to maximise the benefit they bring.

Proposals should focus on demonstrating the added value of AI and/or Data and/or Robotics technologies to optimise value-chains, products, services or associated processes, including knowledge automation (including capturing and elicitation), to increase competitiveness, environmental sustainability, and where relevant, working conditions, for example, through added flexibility, configurability, adaptability, etc.

Digital twin approaches could be considered, where necessary and of added value.

Proposals should also address non-technical issues hampering the adoption of AI, data and robotics in the selected application domain, e.g. ethical aspects for the possible replacement of human operators, trust, human-robots collaboration and cooperation, security and safety.

Proposals will address the production or service sector, where substantial added value of AI, data and/or robotics can be demonstrated. This should be demonstrated with actual or highly realistic operating demonstrators at TRL6-7.

Proposals should clearly identify the sector it will focus on (either production or services).

Two types of proposals are expected:

1. Focused projects (EU contribution around EUR 3.00 million), involving the user industry and technology provider(s),
2. Larger projects (EU contribution around EUR 5.00 million), where a number of companies in a given application sector will identify in the proposal common challenges and use-cases, and organise competitive calls for AI, data and robotics solution providers to address such challenges. Competitive calls will be open to all types of companies, but only SMEs and Start-ups¹⁸⁵ will receive financial support to third parties, with a maximum of EUR 200 000 per third party¹⁸⁶ and 70% funding (100% for start-ups). At least 40% of the requested amount should be dedicated to financial support to third parties. The consortium will provide technical support with expertise in engineering integration, testing and validation to support the selected SMEs and start-ups acting as technology providers to demonstrate the added value of their solutions to address the challenges of the use-cases. Maximum one type of third party project will be funded per focused area (either production or services).

In all proposals user industries are expected to play a major role in the requirement and validation phases.

Besides financial support, these SMEs and start-ups successfully demonstrating the potential of their solutions, must receive support from business experts, provided by the action, to further develop their business and develop their market reach, and maximise their business opportunities.

When possible, proposals should build on and reuse public results from relevant previous funded actions, including public results developed in Member States and Associated Countries. Proposals should make use of connections to the Digital Innovation Hub networks, particularly those in Robotics, Data and AI. Full use should be made of the common resources available in the AI-on-Demand platform¹⁸⁷, Digital Industrial Platform for Robotics¹⁸⁸, data platforms¹⁸⁹ and, if necessary other relevant digital resource platforms. Communicable results from projects should be delivered to the most relevant of these platforms so as to enhance the European AI, Data and Robotics ecosystem through the sharing of results and best practice.

Where appropriate, issues such as data access, data sovereignty and data protection should be addressed along the whole value chains, respecting all stakeholder interests, particularly SMEs.

The re-use and sharing of data collected and processed for AI and Data innovation should be encouraged to contribute to UN SDGs and the Green Deal (e.g.: sharing private data for the public good, B2G in addition to B2B; G2B data sharing may be identified, in view of helping businesses to increase sustainability and competitiveness).

Proposals should include dissemination activities to increase awareness about the potential value for society and people as well as the business of AI, data and robotics driven innovation.

This topic implements the co-programmed European Partnership on AI, Data and Robotics.

All proposals are expected to allocate tasks to cohesion activities with the co-programmed partnership on AI, Data and Robotics and funded actions related to this partnership, including the CSA HORIZON-CL4-2021-HUMAN-01-02. Where relevant, synergies with other European partnerships are encouraged.

Tomorrow's deployable Robots: efficient, robust, safe, adaptative and trusted

Topic ID and title	HORIZON-CL4-2022-DIGITAL-EMERGING-01-07: Increased robotics capabilities demonstrated in key sectors (AI, Data and Robotics Partnership) (IA)				
Budget	EUR 36 million	Opening date	23 November 2021	Deadline 1	5 April 2022
Budget per project	EUR 6 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	F&F, WW, P&P				
Keywords	adaptation and flexibility, human-robot interaction, robot-robot interactions, dull, dirty or strenuous tasks				
FTP comments					
FTP SIRA 2030 Challenges addressed	4A - 5 - 6B,C,F - 10A	FTP relevance		Low	
		Starting TRL		3-5	
		End TRL		6-7	

Expected Outcome:

Proposals results are expected to contribute to at least one of the following expected outcome:

- Demonstrators able to show the added value of robotics and their performances in addressing challenges in major application sectors, or in dangerous, dull, dirty tasks or those strenuous for humans or in extreme environments.
- Systems able to demonstrate beyond human performance in complex tasks, with high impact in key sectors, that show extended levels of adaptation and flexibility.
- Systems able to show high levels of reactivity and responsiveness and intelligibility when performing human-robot and robot-robot interactions in major application sectors.

Scope:

Proposals are expected to focus on application oriented use cases that enhance specific sectors in achieving significant improvements functional and economic performance.

Proposals will integrate novel robotics technologies into solutions that are capable of autonomously taking over dangerous, dull and dirty jobs, or that are capable of achieving tasks beyond human capabilities, in a range of innovative applications in key sectors or that are capable of reaching the level of reactivity, flexibility and adaptivity and natural intelligibility required for smooth and beneficial human-robot, as well as robot-robot collaboration and interaction. Engagement with SSH193 expertise is needed to improve

human robot interaction design, behavioural intelligibility of robot interaction and action, especially in novel service applications, and to provide expertise on trustworthiness and acceptability by humans that impact at the design stage.

This topic will support innovation proposals, expected to exploit the latest robotics advances and demonstrate at TRL6-7 use-case scenarios considering end-user needs and expectations, in highly realistic operating environments, how they can directly contribute to the chosen application, supported by quantitative and qualitative industry or service related KPIs. Proposals need to make the case for the added value of such technologies, and demonstrating scalability, and short-term deployment potential. Progress should be demonstrated by appropriate KPIs, demonstrators, benchmarking and progress monitoring.

The proposals should be primarily application driven, with a concrete problem-solving approach, exploiting the most suitable robotics technologies at hand. The focus should be on real-world scenarios which can benefit in short term from the technology and demonstrate substantial impact on the chosen application, also taking into account the maturity of the technologies which can solve the problems at hand.

In case of shared workspaces, safe, dependable efficient and intuitive interaction will be key.

Considering that human factors and socio-economic aspects can limit or lessen efficient use of robots, human-centred and socio-economic approaches in combination with multi-stakeholder co-design activities can contribute to sustainable development of new enabling technologies. Putting people at the forefront will ensure novel transformation pathways, which help utilise existing technology in novel ways, and propose feedback loop systems that engage human users in developing new sociotechnical learning situations and tools. Further, agile sociotechnical learning designs, can remedy e.g., less efficient technologies, by emphasizing human aspects of technologies in any application sector, from service to production, to domestic use. For this, an interdisciplinary approach involving both technical and SSH194, in particular ethics, researchers is needed to improve interaction design and to provide expertise on trustworthiness and acceptability by workers, and address gender equality and intersectionality¹⁹⁵ where relevant.

The involvement of the user industry and the workers, possibly also the social partners, would be key to drive the proposals, not only to identify the needs and the application scenarios, but to be involved in the testing of the solutions and providing feedback to adapt the solutions to optimise the working conditions and performances. This is also essential for the acceptance of the technology. A human-centred approach will be key in all proposals, with deep involvement of the workers, professionals and other relevant stakeholders including experts in human-centred design, work safety, ergonomics, social partners or work

organisation as appropriate. They will closely collaborate with the technology providers and integrators. The proposals should also take into consideration trustworthy AI principles including respect of human dignity and agency. Special attention will be given to including users of diverse age, gender and background.

Proposals are requested to dedicate at least 20% of their requested amount for FSTP to support SMEs or Start-ups in the development or enhancement of demonstrators, with a maximum of EUR 200 000 per third party¹⁹⁶, and 70% of the costs (100% for start-ups). The consortium will provide technical support with expertise in engineering integration, testing and validation to support the selected SMEs and start-ups acting as technology providers to demonstrate the added value of their solutions to address the challenges of the use-cases.

The selection of the application sectors should prioritise high impact sectors and use-cases where the technology can demonstrate maximum added value.

Each proposal will focus on one of the following use-cases:

- Demonstrating substantial added value of robotics in major application sectors with high socio-economic and/or environmental potential impact, improving the effectiveness and efficiency of processes or services.
- Demonstrating how robotics can improve human working conditions and satisfaction in taking over dangerous, dull, dirty or strenuous tasks, keeping workers away from unsafe and unhealthy jobs.

Proposals are encouraged, where appropriate, to develop configuration and deployment tools as well as tools for rapid configuration and re-configuration of robotics to improve deployability, reduce time to deployment, increase user driven (re)configuration, including through model-based approaches.

When possible, proposals should build on and reuse public results from relevant previous funded actions. Proposals should make use of connections to the Digital Innovation Hub networks, particularly those in Robotics, Data and AI. Full use should be made of the common resources available in the AI-on-Demand platform¹⁹⁷, Digital Industrial Platform for Robotics¹⁹⁸, data platforms¹⁹⁹ and, if necessary other relevant digital resource platforms. Communicable results from projects should be delivered to the most relevant of these platforms so as to enhance the European AI, Data and Robotics ecosystem through the sharing of results and best practice.

Proposals are expected to develop synergies with relevant activities in AI, Data and Robotics, primarily in destinations 1, 3, 4 and 6, but also in other destinations and clusters, and share or exploit results with relevant funded actions where appropriate.

This topic implements the co-programmed European Partnership on AI, Data and Robotics.

All proposals are expected to allocate tasks to cohesion activities with the PPP on AI, Data and Robotics and funded actions related to this partnership, including the CSA HORIZON-CL4-2021-HUMAN-01-02. Where relevant, synergies with other PPPs are encouraged.

Indirectly managed actions delegated to EUSPA

Development of applications for Galileo, EGNOS and Copernicus

Actions under this area will address downstream R&D activities in the form of calls to proposals to be launched by the European Union Space Programme Agency (EUSPA) in accordance with the specification included in Appendix below.

We need to make the best use of EGNSS and Copernicus capacities for EU citizens, companies and society. Research and innovation should therefore foster the development of EGNSS downstream applications and promote their adoption in the EU and worldwide, in particular in markets with a long lead-time (e.g. maritime, rail, aviation), and in areas where Galileo offers unique differentiators (high accuracy, authentication, Search and Rescue, PRS).

Copernicus based applications and services can serve, for example, polar research, monitoring of the environment, maritime and coastal monitoring, natural disasters, civil security, migration and agriculture. They and can bring, with EGNSS, a key contribution to the European Green Deal and to the sustainable management of natural resources. The public sector should be supported as customer of space based technologies via innovation procurement. Synergies between Galileo/EGNOS and Copernicus, as well as synergies with non-space programmes, leveraging the combination of space data with non-space data, will open new avenues for the creation of a wealth of new and innovative applications and services. The use of Copernicus and Galileo/EGNOS for the EOSC and DestinE initiatives should equally be taken into account and promoted.

Indicative budget for this action: EUR 32.60 million from the 2021 budget and EUR 48.10 million from the 2022 budget

Topic ID and title	HORIZON-EUSPA-2021-SPACE-02-53: EGNSS applications for the Digital Age				
Budget	EUR 9,3 million	Opening date	2021 (indicative)	Deadline 1	2021-2022 (indicative)
Budget per project	EUR 2 to 3 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	F&F, WW, P&P				
Keywords	Internet of Things (IoT), Artificial Intelligence (AI), Big Data, geo-tagging, mobile solutions, multiple sensors, cybersecurity, quantum, drones, 5G, Copernicus, augmented reality				
FTP comments					
FTP SIRA 2030 Challenges addressed	1A,B - 2B - 4 - 6F - 9D	FTP relevance		Low	
		Starting TRL		/	
		End TRL		7-9	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Foster the adoption of EGNSS in mass markets and professional markets.
- Create applications that will make the best use of EGNSS innovative features such as better multipath resistance, authentication etc.
- Contribute to the competitiveness of the European GNSS industry in the area of mobile applications, with special focus on the innovative role of SMEs and midcaps, and non-space countries.
- maximise public benefits by supporting the development of EGNSS applications that will address major societal challenges in focus areas such as health, citizen safety and security, mobility and the sharing economy.

Scope:

Proposals may be submitted in any of the following areas:

- **Internet of Things:** Within Internet of Things solutions, there is a clear trade-off in terms of accuracy and battery life that prevents users to rely on GNSS in any situation. EGNSS solutions should demonstrate how power reduction techniques can effectively deliver GNSS-level accuracy in IoT devices and develop IoT solutions able to demonstrate the EGNSS compositeness in the IoT domain, to be used in application fields such as food geo traceability, blockchain and Artificial Intelligence
- **Mobile solutions.** Development of new EGNSS enabled solutions which exploit the EGNSS differentiators such as High Accuracy Service and authentication features or which leverage the availability of GNSS raw measurements in smartphones.

- **mHealth-solutions for ‘silver economy’, robotics.** With the ageing population growing fast in the EU, governments will be increasingly challenged to meet the needs of older people in a cost-effective manner. EGNSS can support the ‘silver economy’ by satisfying the specific needs of elderly and disabled persons. The innovations brought by EGNSS, together with technologies such as robotics or enhanced home automation – should be exploited to develop innovative solutions.
- **Artificial intelligence- Big Data, geo-tagging, optimisation for multiple sensors.** Advances in AI will improve the capabilities of applications and services, providing improved experiences to all users. AI-enabled machine learning can be used to improve the GNSS data processing to provide greater performance thanks to the optimization of multiple sensors. Proposals shall explore synergies between EGNSS and Artificial Intelligence, in the frame of applications relaying on big data and geo-tagging techniques. Synergies with earth observation data can be also exploited.
- **Cybersecurity- solutions that are stimulating privacy, security of location data, exploiting synergies with quantum.** In a digitalised world, privacy and cybersecurity are of utmost importance for individuals who are increasingly relying on digital applications to perform day-to-day task and activities. EGNSS solutions shall enhance the security of location-based applications. Additionally, synergies with quantum can be leveraged as well.
- **Sharing economy- solutions for logistics, mobility services, goods and food. The** sharing economy covers many different sectors. It is rapidly emerging across Europe. Within this trend, GNSS is a key technology for all services requiring geographic information. Newly developed EGNSS solutions in the field of logistics, mobility services, and food industry should capitalise on the enhanced accuracy and the innovative features provided by EGNSS.
- **Sports and fitness - smart wearables.** Wearables represent the beginning of the separation between smartphones and end users, as an increasing number of smartphone services and apps are now accessible via new interfaces (smartwatches, fitness trackers, smart glasses, clothing, etc.). Currently, wearables are mostly used for fitness, health and entertainment. Proposals should ensure the use of EGNSS innovative features and differentiators in the smart wearables domain, integrating also other non-space technologies.

Synergies with other space components and other non-space technologies are applicable to this topic.

The developed applications should have a clearly defined commercial potential and should respond to user needs. Standardisation of new technologies is also in the scope of the topic and might be considered by the applicant. The solution developed is expected to achieve TRL7-9 by the end of the project.

Proposals should deliver new innovative applications, with commercial and social benefits, impact and a clear market uptake. The standardisation of new technologies is also in the scope of the topic and might be considered by the applicant. The use of other space components such as Copernicus is highly encouraged. The developed solutions may integrate other non-space technologies like IoT, big data, artificial intelligence, drones, 5G, augmented/mixed reality etc.

For proposals under this topic:

- Participation of industry, in particular SMEs and midcaps, is encouraged;
- Participation of, or outreach to, entities based in countries without a space tradition is encouraged;
- Involvement of post-graduate researchers (engineers, scientists, and others) is also encouraged, for example through professional work experience or through fellowships/scholarships when applicable;
- A Business Plan and evidence of user engagement is compulsory and must be provided as part of the proposal, to demonstrate the user need and sustainability of the project.
- Proposals addressing PRS (Public Regulated Service) related applications are not in the scope of this action.

Applicants are advised to exploit all possible synergies with other security specific actions funded under the work programme of Cluster 1 “Health”, other parts of Cluster 4 “Digital, Industry and Space”, and Cluster 5 “Climate, Energy and Mobility” (e.g. destinations 5 and 6).

Proposals under this topic should exploit synergies and be complementary to national activities and activities funded by ESA.

Applicants are welcome to use the European space data infrastructures, e.g. Galileo Service Centre, EGNOS Data Access Service (EDAS) and the EGNOS user support facilities (ASQF).

Cluster 5: Climate, Energy and Mobility²

Destination 4: Efficient, sustainable and inclusive energy use

This Destination addresses activities targeting the energy demand side, notably a more efficient use of energy as regards buildings and industry.

Demand side solutions and improved energy efficiency are among the most cost effective ways to support the transition to climate neutrality, reduce pollution and raw materials use, to create inclusive growth and employment in Europe, to bring down costs for consumers, to reduce our import dependency and redirect investments towards smart and sustainable infrastructure. The transition to a decentralised and climate neutral energy system will greatly benefit from the use of digital technologies which will enable buildings and industrial facilities to become inter-active elements in the energy system by optimising energy consumption, distributed generation and storage and vis-à-vis the energy system. They will also trigger new business opportunities and revenue streams for up-graded, innovative energy services which valorise energy savings and flexible consumption.

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

- *C: Making Europe the first digitally enabled circular, climate-neutral and sustainable economy through the transformation of its mobility, energy, construction and production systems;*
- *A: Promoting an open strategic autonomy¹⁶¹ by leading the development of key digital, enabling and emerging technologies, sectors and value chains to accelerate and steer the digital and green transitions through human-centred technologies and innovations.*

It covers the following **impact areas**:

- Industrial leadership in key and emerging technologies that work for people;
- Affordable and clean energy;
- Circular and clean economy.

The **expected impact**, in line with the Strategic Plan, is to contribute to the “*Efficient and sustainable use of energy, accessible for all is ensured through a clean energy system and a just transition*”, notably through

² [Work Programme published by the European Commission on 15 June 2021](#)

- a. Technological and socio-economic breakthroughs for achieving climate neutrality and the transition to zero pollution of the **building stock** by 2050, based on inclusive and people-centric R&I (more detailed information below).
- b. b. Increased energy efficiency in **industry** and reducing industry's Greenhouse Gas (GHG) and air pollutant emissions through recovery, upgrade and/or conversion of industrial excess (waste) heat and through electrification of heat generation (more information below).

Other Horizon Europe Clusters include topics and activities that can be relevant to this Destination, e.g. in order to seek synergies. These include (but are not limited to) the following:

Cluster 2:

- Destination 2 – Innovative Research on the European Cultural Heritage and the Cultural and Creative Industries. That Destination is most relevant for the topics which scope addresses heritage buildings.
- Destination 3 - Innovative Research on Social and Economic Transformations. That Destination is most relevant for the social innovation items included in some of the topics.

Cluster 3:

- Destination 4 – Increased Cybersecurity. This potential link is most relevant for the topics that address smart buildings and digitalisation of buildings.
- Destination 5 – A Disaster-Resilient Society for Europe. This potential link can be relevant for the topics that address the resilience of the building stock.

Cluster 4: the whole cluster is relevant, in particular Destination 1 – Climate Neutral, circular and digitised production, which is highly relevant for all topics on buildings (e.g. for the digitalisation of construction / renovation workflows).

Cluster 6:

- Destination 3 – Circular economy and bioeconomy sectors and Destination 4 – Clean environment and zero pollution. This potential link is relevant for all topics, in particular those that address sustainable renovation of buildings.

Beyond Horizon Europe, other programmes include some components with which synergies and complementarities can be found. For instance, the Clean Energy Transition and Circular

Economy sub-programmes under LIFE can contribute to the market uptake of the innovation delivered under this Destination. The Digital Europe programme includes actions that can be relevant to consider in relation to the topics that entail the development or use of (big) data approaches.

Highly energy-efficient and climate neutral European building stock

Topics under this Destination targeting highly energy-efficient and climate-neutral European building stock focus on both, the energy challenge in buildings and, more broadly, the transformation of the built environment towards more sustainable living.

In line with the new European Bauhaus aiming to “bring the European Green Deal to life in an attractive, and innovative and human-centred way”, the sustainable built environment should go beyond merely improving the energy and resource efficiency of buildings and also include a qualitative, aesthetic and human dimension. At the intersection of science, technology and the arts, new creative design and architectural solutions should be developed to ensure the sustainable renovation of the existing European building stock for the well-being of its users. In particular the renovation or adaptive reuse of historical and heritage buildings and sites needs to embrace quality principles to safeguard the cultural values of Europe’s historical environment and local architectural identity.

Topics targeting energy efficiency in buildings under this Destination seek to achieve the following impacts:

- More energy efficient building stocks supported by an accurate understanding of buildings performance in Europe and of related evolutions.
- Building stocks that effectively combine energy efficiency, renewable energy sources and digital and smart technologies to support the transformation of the energy system towards climate neutrality.

Addressing the broader transformation of the built environment, though, requires a larger involvement of all players across the built environment value chain and throughout building life cycle. To this end, a co-programmed European Partnership on a people-centric, sustainable built environment has been set up (Built4People) to develop holistic R&I for an effective transition to sustainability. All Horizon Europe R&I actions addressing the challenges related to the buildings and construction sector will contribute to achieving the Built4People Partnership goals and will benefit from the coordinated approach within the community of its partners and stakeholders. Topics contributing to the implementation of the Built4People European Partnership seek to achieve the following impacts:

- Higher buildings' performance with lower environmental impacts through increased rates of holistic renovations.
- Higher quality, more affordable built environment preserving climate and environment, and safeguarding cultural heritage and ensuring better living conditions.

Industrial facilities in the energy transition

Topics on industrial facilities in the energy transition supported under this Destination focus on thermal energy management in industry. The bulk of R&I activities related to industry is however supported under Cluster 4 "Digital, Industry and Space".

Call – Efficient, sustainable and inclusive energy use 2021

Highly energy-efficient and climate neutral EU building stock

Topic ID and title	HORIZON-CL5-2021-D4-01-01: Advanced energy performance assessment and certification				
Budget	EUR 10 million	Opening date	24 June 2021	Deadline 1	19 October 2021
Budget per project	EUR 3 to 5 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	energy performance calculation methods, well-being, indoor air quality and comfort, acoustics, whole life carbon, Building Information Modelling (BIM), smart sensors, digital innovations, Energy Performance Certificates (EPCs)				
FTP comments	relevant life-cycle performance aspects (e.g. well-being, indoor air quality and comfort, acoustics, water consumption, resilience, or whole life carbon)				
FTP SIRA 2030 Challenges addressed	8C,D	FTP relevance		Medium	
		Starting TRL		/	
		End TRL		6-7	

Expected Outcome:

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

- Improved construction quality and service life compliance.
- Improved accuracy of energy performance assessment and any other assessment conducted in parallel, reduced gap between assessment and actual performance.
- Improved and automated monitoring of energy performance of buildings, and other relevant life-cycle performance aspects with a direct link to the energy efficiency performance.
- Improved user-friendliness of Energy Performance Certificates and post-occupancy performance data, in terms of clarity, accuracy, trade-offs and usability of the information provided.
- Increased uptake of design standards and practices based on actual performance.
- More reliable understanding of energy and environmental performance in the early stage of the building life cycle, and over service life, based on robust and consistent assessment practices across the buildings sector and across Member States and Associated Countries.

Scope:

The next generation of energy performance assessment and certification schemes needs to support the transition towards a climate neutral building stock over the full life cycle, relying on technological innovations to improve speed and quality of as-built performance assessment and service life compliance checks, also linking to other instruments such as building logbooks, building renovation roadmaps, Level(s) and other datasets. Energy performance assessment and certification schemes should seek to work coherently, where relevant, with other performance data generated over the building's life cycle. This can include well-being, indoor air quality, noise and acoustic quality, daylight levels, pollutants and health related data, as well as data pertaining to other issues such as accessibility of buildings, and consumption of non-energy resources such as water.

The proposal should:

- Develop more reliable, cost-effective and highly replicable energy performance calculation methods also addressing, in parallel, relevant life-cycle performance aspects (e.g. well-being, indoor air quality and comfort, acoustics, water consumption, resilience, or whole life carbon) with a direct link to the energy efficiency performance.
- Address the definition and demonstration of advanced and innovative approaches for building energy performance and certification, and how these can interact with other relevant life cycle performance data and certification, focusing on a credible assessment of building intrinsic performance but also increasingly working towards output-based assessments using available building data; Investigate how such approaches can rely on automatic and semi-automatic assessment based on building digital models (e.g. BIM).
- Seek to incorporate in those approaches social and economic indicators.
- Develop dynamic energy and other relevant life-cycle performance assessment and certification databases as a unique source of information on individual buildings over their lifetime for home owners, investors, real estate agents and public authorities.
- Demonstrate how data from smart sensors can be included in assessments in a dynamic way, also exploring, where relevant, how to combine building asset rating with building operational rating, and how to use digital innovations for the assessment of energy and other relevant life-cycle performance.
- Ensure the proposed solutions build on the results of previous projects dealing with building performance including Energy Performance Certificates (EPCs), also

considering where relevant integrating building renovation passports or roadmaps in EPCs.

- Ensure the proposed solutions allow for synergies with other relevant instruments (e.g. the smart readiness indicator under Directive 2010/31/EU, building renovation passports and relevant parts of Level(s)).
- Seek to ensure from the design phase that the project is developed with a view to integrate its results/deliverables under a digital building logbook.
- Ensure that the proposed solutions comply with, and support a broad adoption of, relevant EU standards (e.g. Energy Performance of Buildings standards developed by CEN, CENELEC and ETSI under Mandate M/480) and codes in order to allow for an EU-wide deployment.
- Ensure the involvement of relevant stakeholders (including European, national and regional certification bodies and consumer organisations).

Clustering and cooperation with other relevant projects is strongly encouraged; in particular, liaison and synergies with the Horizon Europe Partnership on 'People-centric sustainable built environment'.

Proposals submitted under this topic should include a clear business case and exploitation strategy, as well as demonstration activities (at least three demonstration use cases) of an adequate scale.

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.

Topic ID and title	HORIZON-CL5-2021-D4-01-02: Industrialisation of deep renovation workflows for energy-efficient buildings				
Budget	EUR 16 million	Opening date	24 June 2021	Deadline 1	19 October 2021
Budget per project	EUR 5 to 8 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	construction productivity, renovation processes, waste reduction, work time reduction, costs reduction, automated and robotised construction/renovation, workforce safety, robotic support, renewable energy source integration, circularity, prefabrication, Building Information Modelling (BIM), digital twins, drones				
FTP comments	30 % waste reduction; improved quality of renovation; at least 30% and towards 50% reduction of on-site construction / renovation work time and 25% costs reduction.				
FTP SIRA 2030 Challenges addressed	7E - 8C - 10C			FTP relevance	Medium
				Starting TRL	/
				End TRL	8

Expected Outcome:

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

- Significant improvement in productivity of construction and renovation processes for energy-efficient buildings, supporting an increase in scale in the renovation process and streamlining resource efficient nearly zero-energy performance renovation: 30 % waste reduction; improved quality of renovation; at least 30% and towards 50% reduction of on-site construction / renovation work time and 25% costs reduction.
- More affordable renovation projects for owners, for all building types but with a specific focus on residential buildings.
- Enhanced quality of construction, backed up by post-occupancy evaluations, also supporting a better integration of design and construction activities, streamlining commissioning of buildings, in particular in relation to energy management but also taking into account cross-cutting issues such as accessibility of buildings.
- Reduced performance gap between as-built and as-designed (difference between theoretical and measured performance), allowing tracking performance across the life cycle.
- Increased trust towards construction and renovation processes, by allowing tracking energy performance across the life-cycle.

- Upskilled workforce for industrialised renovation workflows, including automated and robotised construction / renovation, relying on interoperable digital modelling data.
- Enhanced safety of the construction workforce and increased acceptance of robotic support for deep renovation.
- Innovative, tailored business models for deep renovation allowing increased scale of renovation, generating economies of scale and increasing the potential for attractive and affordable packages for end users including financing.
- Tailored access to building information across the life cycle for relevant stakeholders (owners, facility managers, contractors, public authorities).
- Integration with distributed renewable energy sources in neighbourhoods and districts, favouring the emergence of related initiatives (e.g. renewable energy communities).
- Enhanced synergies of renovation with local resources, e.g. district heating & cooling networks.

Scope:

Several recent projects & calls have focused on prefabrication for deep renovation, but more work is needed to innovate seamless workflows from design through to offsite manufacture, installation, and compliance checking on site, also ensuring due consideration of life cycle performance. There is also a need for more demonstrations across the EU.

Proposals should:

- Investigate innovative approaches for industrialised deep renovation, covering the whole workflow from design through to offsite manufacture, installation, compliance checking on site and end strategies for maintenance, operation and end of life.
- Make use of innovative processes and technologies, including those delivered by previous research such as design based on circularity principles, prefabricated components and digital tools, that allow to optimise workflows (cost, time, quality, resource use).
- Develop significantly improved integrated digital twin solutions that can support all stakeholders involved in the different phases of the construction or renovation processes, i.e. from concept to end-of-use, including design, construction,

commissioning, operation (management and maintenance) and, where relevant, change of use.

- Demonstrate a seamless integration of the proposed approaches with state-of-the-art digital technologies for construction and renovation (Building Information Modelling, digital twins, etc.).
- Investigate the use of robotic systems and automation such as additive manufacturing, on-site automated and robotic systems (e.g. robots for building component assembly), drones and autonomous vehicles (e.g. for surveying, inspection and monitoring), and other types of automated support to augment workers' capability and safety (e.g. lift robots, exoskeletons) for deep renovation.
- Investigate the application of the proposed approaches at neighbourhood- and district-level, with the aim to maximise synergies in renovation work and processes, decrease costs, and to optimise the use of energy-related shared district resources (e.g. heating and cooling networks, renewable energy sources, energy storage facilities, etc.).
- Select processes and technologies that have a maximum potential for rapid and broad deployment at European level, with due consideration of the sector's practices.
- Ensure effective involvement of the buildings supply chain, in particular SMEs, as well as of building owners/tenants and other relevant stakeholders.
- Where relevant, investigate whether and how the proposed approaches could apply to cultural heritage buildings.
- Ensure the proposed approaches allow to reach the highest level of energy performance, also considering other relevant aspects (e.g. life cycle, accessibility), while keeping costs in an attractive range for owners.
- Seek to ensure from the design phase that the project is developed with a view to integrate its results/deliverables under a digital building logbook.
- Demonstrate, based on well-defined metrics and key performance indicators, that the innovative approaches proposed lead to fewer mistakes, less waste, higher resource efficiency, higher quality in particular with regard to energy performance (reduced performance gap), increased replicability across sites, and other relevant life cycle aspects, enhanced safety of workers and their ability to work alongside robots, and faster construction.

- Investigate business models in view of mass deployment and EU-wide impact, seeking to address split of incentives between the owner and tenant of a building as a barrier to investments.
- Lead at least 3 large-scale demonstration to assess the proposed approaches for a variety of buildings typologies representative of the European building stock, ensuring the most adequate coverage of climatic conditions.

Clustering and cooperation with other relevant projects is strongly encouraged; in particular, liaison and synergies with the Horizon Europe Partnerships on 'People-centric sustainable built environment' and 'Driving Urban Transitions'.

Call – Efficient, sustainable and inclusive energy use 2021

Highly energy-efficient and climate neutral EU building stock

Topic ID and title	HORIZON-CL5-2021-D4-02-01: Demonstrating integrated technology solutions for buildings with performance guarantees (Built4People)				
Budget	EUR 15 million	Opening date	2 September 2021	Deadline 1	25 January 2022
Budget per project	EUR 5 to 7,5 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	resource efficiency, whole life carbon, consumer trust, envelope, heating, renewable energy, energy suppliers, product manufacturer, environmental performance, resource efficiency, energy flexibility, block chain, digital logbooks				
FTP comments	Design and demonstrate innovative integrated technology solutions based on state-of-the-art components (envelope, heating, ventilation and air-conditioning, cooling, automation and control, renewable energy, etc.)				
FTP SIRA 2030 Challenges addressed	8C - 10C	FTP relevance		Low/Medium	
		Starting TRL		/	
		End TRL		6-7	

Expected Outcome:

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

- Demonstrated viability of, and proven integrated technology solutions for, performance guarantees and performance-based contracts to increase buildings energy performance but including aspects going beyond energy towards a broader range of climate- and environment- relevant matters (e.g. resource efficiency, whole life carbon, etc.).
- Enhanced consumer trust in guarantees of performance and related contracts.
- Increased number of market actors, especially SMEs, offering performance-based business models.
- Enhanced awareness of end users and capacity building of businesses on performance-based contracts.

Scope:

The proposal should:

- Design and demonstrate innovative integrated technology solutions based on state-of-the-art components (envelope, heating, ventilation and air-conditioning, cooling,

automation and control, renewable energy, etc.) solutions for cost-effective buildings' overall performance enhancement with performance guarantees.

- Investigate the viability of performance-based business models combining those technology solutions with attractive and innovative contractual frameworks for performance guarantees and testing them with the relevant market players (e.g. energy suppliers, product manufacturer, technology/service providers).
- Develop business models that suit new industrialised design and production methods, and include enhanced energy and resource (based on suitable Level(s) indicators) performance guarantees with longer commissioning and condition-based maintenance to replace maintenance contracts.
- Develop performance contracts that work with industrialised solutions for the renovations in the residential sector, valorising energy and environmental performance, resource and energy efficiency, energy flexibility (through demand response) and comfort (Comfort Performance Contracts) for all building elements (e.g. building envelope, equipment & systems, energy storage).
- Build, where possible, on existing business approaches that have shown effectiveness for renovation (e.g. one-stop-shops, ESCOs).
- Ensure that those business models make use of digital tools (e.g. energy management systems, block chain, digital logbooks) to increase data availability for measurement and verification and therefore increase the traceability of performance (e.g. energy savings, energy generation, GHG emissions, location of components and substances in the buildings) and to ease the implementation of performance-based contracts.

This topic implements the co-programmed European Partnership on 'People-centric, Sustainable Built Environment' (Built4People).

Topic ID and title	HORIZON-CL5-2021-D4-02-02: Cost-effective, sustainable multi-functional and/or prefabricated holistic renovation packages, integrating RES and including re-used and recycled materials (Built4People)				
Budget	EUR 22 million	Opening date	2 September 2021	Deadline 1	25 January 2022
Budget per project	EUR 9 to 11 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	renovation, work time, insulation improvement, air-tightness improvement, use comfort, embodied energy and CO2 reduction, air pollutants, built-in renewable energy generation solutions, reused/recycled/biosourced construction materials, circular economy				
FTP comments					
FTP SIRA 2030 Challenges addressed	8	FTP relevance		Medium/High	
		Starting TRL		/	
		End TRL		7	

Expected Outcome:

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

- Increased scale and productivity in the renovation process: demonstrated and quantified decrease of on-site construction / renovation work time (at least 30% and towards 50%).
- Benchmarked and quantified improvement of insulation and air-tightness compared to standard renovation solutions.
- Demonstrated improvement of indoor environment and user comfort and satisfaction, as well as accessibility, increasing attractiveness of renovation for buildings owners and users.
- Improved affordability of sustainable renovation and RES systems in buildings, in particular for households experiencing energy poverty issues.
- Demonstrated reduction of embodied energy and CO2 of renovation, and emission of air pollutants over the life cycle.
- Increased deployment of built-in renewable energy generation solutions for on-site multi-purpose (heating, cooling, electricity) renewable energy generation.
- Increased share of reused and /or recycled and/or biosourced construction materials / products used in building renovation to contribute to circular economy.
- Faster uptake of EU-wide standards or certification of reused and / or recycled construction materials / products.

Scope:

Proposals are expected to deliver large-scale, real life demonstration of promising technology innovations already demonstrated at lab level. Proposals should cover all of the following:

- Develop renovation solutions for a range of needs (from renovations limited in scope to deep renovations) applying predominantly re-used and / or recycled and/or biosourced construction materials / products in a cradle-to-cradle approach, allowing for installation without significantly modifying the structure of the building (or without overloading existing structures) and demonstrating a high replication and industrial potential.
- Develop multi-functional (passive & active) and scalable renovation solutions to improve energy performance of buildings, applicable to different building types based on prefabricated components and integrated RES systems.
- Develop building envelope solutions with integral means for combined active/passive management of energy transfer, i.e., integrating RES for active heat and sound insulation and direct on-site renewable electricity generation.
- Seek to support the integration of local sources of reused components and secondary raw materials in the renovation packages relying, where relevant, on urban mining.
- Develop novel testing methodologies oriented towards assessing the long-term performance of the elements. This should include the estimation of durability and service life.
- Model and test in actual scale the materials and components selected.
- Benchmark energy and environmental performance (applying the appropriate Level(s) indicators), monitoring (at least one year) at real scale of the new solutions, also demonstrating compliance with project and regulatory requirements, and demonstrating cost-effectiveness of the renovation solutions over the lifetime.
- Assess the risks related to major disruptive events (such as flooding, heat waves, and/or other climate-driven events and/or earthquakes) that apply to the geographical zones targeted and, where relevant, include an analysis of resilience of the renovated building / infrastructure against those major disruptive events.
- Demonstrate, based on clear and thorough documentation of relevant activities, that the proposed solutions lead to reduced maintenance costs, lead to an improvement

of indoor environment and user comfort and satisfaction, as well as accessibility, can be used in a wide range of environmental conditions, favour sustainable use of resources, respect sustainability life cycle principles, including end-of-life analysis involving the reuse of new and replaced elements at the end of service life.

- Consider renovation packages also integrating renewable energy sources for buildings with respect of the aesthetic, the historical value and/or the local architectural identity.
- Lead at least 3 large-scale demonstration of the solutions in diverse geographical areas, with various local environmental, social, and economic conditions, addressing both residential and non-residential buildings.
- Where relevant, contribute to standardisation (e.g. recycled concrete CEN standard) and certification activities (e.g. guides for non-standard hybrid component assessment).

This topic implements the co-programmed European Partnership on 'People-centric, Sustainable Built Environment' (Built4People).

Topic ID and title	HORIZON-CL5-2021-D4-02-03: Strengthening European coordination and exchange for innovation uptake towards sustainability, quality, circularity and social inclusion in the built environment as a contribution to the new European Bauhaus (Built4People)				
Budget	EUR 1 million	Opening date	2 September 2021	Deadline 1	25 January 2022
Budget per project	EUR 1 million			Deadline 2	/
Type of action	Coordination and Support Actions (CSA)				
FTP subsector	WW				
Keywords	cross-sectorial, interdisciplinary, circular economy, co-financing, whole value chains Innovation Clusters, Research and Innovation support, dissemination actions				
FTP comments					
FTP SIRA 2030 Challenges addressed	4 - 8	FTP relevance		Medium/High	
		Starting TRL		/	
		End TRL		/	

Expected Outcome:

Projects are expected to contribute to the following outcomes:

- Increased uptake of innovative solutions for a sustainable, digitalised, human-centric and inclusive, quality built environment, following circularity principles across the value chain;
- Intensified, cross-sectorial and interdisciplinary peer-learning from front runners;
- Increased awareness on benefits from technological and non-technological (social, cultural) innovation and the synergetic cross-border cooperation in the built environment sector, with due consideration of all relevant aspects such as sustainability, energy and resource efficiency, life-cycle perspective, digitalisation, inclusion and accessibility;
- (In line with the New European Bauhaus) better acknowledgement and integration of quality architecture and design principles, blending design and sustainability in innovative solutions to improve sustainability of the built environment, including, if appropriate, cultural heritage, also ensuring compliance with the principles of circular economy, with due consideration of relevant aspects such as style, human-centric inclusivity and accessibility for persons with disabilities;
- Improved visibility, more systematic adoption (including by users of the built environment) and uptake of innovative results, including from EU funded projects, in the field of sustainable built environment;

- Strengthened, long-lasting and multi-disciplinary networking in the field of innovative sustainable built environment;
- Scaled-up co-financing of innovation in the field of innovative sustainable built environment.

Scope:

The proposal should:

- Develop business models to ensure co-financing options to foster innovation for sustainability, style, accessibility and quality of the built environment;
- Support the creation and operation of whole value chain Innovation Clusters linked to the 'Built4People' (B4P) partnership (People-centric sustainable built environment¹⁷⁴).
- Link up the concept of whole value chain Innovation Clusters with regional/national innovation hubs and clusters, and, to relevant pilot projects of the New European Bauhaus, seeking to improve collaboration between those;
- Combine specialisation and advanced expertise with multi-disciplinary knowledge for cross-border value chains and offer the best possible R&I support to all actors of the European built environment ecosystem in particular for SMEs and mid-caps, as well as their stakeholders and clients;
- Put in place a long-term and multi-disciplinary network structure for those Innovation Clusters, along with an appropriate governance, to focus and nurture public investments that would serve several regions of Europe;
- Organise supporting dissemination actions, including workshops, conferences, peer-learning activities involving final end-users and relevant experts (e.g. accessibility), industrial fora, dissemination material, etc. and develop an organisation and business model for an effective collaboration among these Innovation Clusters, including after the end of the grant;
- Seek to cooperate with other coordination actions designed to support the New European Bauhaus, for instance in relation to education and dissemination, in the scope of Horizon Europe¹⁷⁵ and beyond;
- Cooperate closely with the leading partners of the B4P partnership.

This topic implements the co-programmed European Partnership on 'People-centric, Sustainable Built Environment' (Built4People).

Call – Efficient, sustainable and inclusive energy use 2022

Highly energy-efficient and climate neutral EU building stock

Topic ID and title	HORIZON-CL5-2022-D4-01-02: Renewable-intensive, energy positive homes				
Budget	EUR 12 million	Opening date	28 April 2022	Deadline 1	6 September 2022
Budget per project	EUR 4 to 6 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	cost-effective energy positive residential buildings, smart technologies, renewable energy, storage solutions, air quality, human health, well-being, multi-storey buildings, Building Management Systems (BMS), Building Automation Systems (BAS)				
FTP comments					
FTP SIRA 2030 Challenges addressed	8A,D	FTP relevance		Medium	
		Starting TRL		/	
		End TRL		6-7	

Expected Outcome:

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

- Faster transition to the next generation of new constructions and renovation of cost-effective energy positive, climate neutral residential buildings.
- Streamlined integration of advanced smart technologies, renewable energy and storage solutions in residential construction and renovation projects.
- Faster transition to buildings and technical elements that are capable to adapt to different user profiles and lifestyles, improving air quality, human health and well-being parameters.
- Improved skills and competences among the workforce to support a rapid uptake of energy positive buildings in the residential sector.

Scope:

The aim is to move beyond NZEB (nearly zero-energy buildings) for new constructions and to the extent possible, for renovations, and to streamline energy positive buildings, ensuring buildings can marry high energy performance with maximum flexibility and adaptability to a changing society in a cost-effective manner. This is a key challenge for the residential sector in the transformation to a highly energy-efficient and climate neutral EU building stock, where energy positive homes should become the norm.

Proposals should:

- Investigate and demonstrate approaches for the construction of new energy positive residential buildings (and /or the renovation of existing residential buildings), with a focus on multi-family, multi-storey buildings, encompassing all relevant areas:
 - Design phase (aesthetic and technical solutions and their potential, passive and active strategies, sustainable design);
 - Integrated design and construction concepts;
 - Reconfigurable designs and technical elements capable of adapting to different user profiles and lifestyles;
 - Selection and installation of affordable and high performance construction products and materials, building on previous projects;
 - Innovative processes from manufacturing to construction site;
 - Integration of renewable energy production for heating and cooling, electricity production (e.g. BIPV and BAPV), and where relevant, thermal and electrical storage, including shared at neighbourhood and district levels; for existing buildings, cost-effective, innovative solutions that allow to (at least) fully cover the energy consumption of the building (electricity, heat and cooling) with renewable energy;
 - Advanced use of smart management technologies (for control and operational issues, Building Management Systems (BMS) or Building Automation Systems (BAS)) to improve air quality, human health and well-being parameters, to facilitate engagement and inclusiveness of occupants and support measurement of (as-built) building performance;
 - Reuse and recycling of elements, components and materials, in particular in relation to buildings end of life, also minimizing embodied carbon emissions over the whole life cycle, in particular for smart technologies;
 - Where applicable, the use of grey- and black-waters.
- Ensure that the cost of such buildings/apartments does not increase substantially compared to current local / regional practises.

Clustering and cooperation with other relevant projects is strongly encouraged; in particular, liaison and synergies with the Horizon Europe Partnership on 'People-centric sustainable built environment'.

Each project is expected to include at least three demonstration sites located in different climatic regions.

The demonstrations are expected to span a continuous interval of at least twelve months and to ensure measurement of (as-built) building performances. The relevant building professionals (e.g. architects, installers, workers, craftsmen, building managers) should be involved.

Projects are expected to assess the sustainability of the proposed solutions in environmental, social and economic terms, considering among others the embodied carbon emissions from materials. The reuse and recycling of elements, components and materials of the proposed solutions at the end of life should be ensured.

Topic ID and title	HORIZON-CL5-2022-D4-01-03: Smarter buildings for better energy performance				
Budget	EUR 12 million	Opening date	28 April 2022	Deadline 1	6 September 2022
Budget per project	EUR 4 to 6 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	renewable energy, replicability, smart building devices, interoperability of systems, IoT, indoor environment quality, digital building logbook				
FTP comments					
FTP SIRA 2030 Challenges addressed	8A,C,D	FTP relevance		Medium/Low	
		Starting TRL		/	
		End TRL		8	

Expected Outcome:

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

- More innovative, affordable, user-friendly and accessible products and systems to continuously monitor and improve the energy performance of buildings.
- Increased building energy performance through the optimisation and integration of different technologies, including renewable energy and storage, and services.
- Easier and more systematic use smart products and services to achieve savings where energy renovation is not an option.
- Higher replicability to increase number of buildings with smart building devices and digital infrastructure resulting in a higher smart readiness rating.

Scope:

Improvement and cost-reduction of technologies to predict, assess, monitor and control in real time the energy performance of buildings, including energy efficiency, renewables, storage and their optimisation.

The proposal should:

- Develop new or enhance existing solutions for interoperability of systems, including between building automation and control systems (BACS) and other technical building systems and devices (including IoT ones), as well as between buildings and the grid.
- Investigate innovative approaches to ensure high level of security and privacy by design in buildings.

- Investigate approaches to reduce costs of systems allowing the integration of energy efficiency, renewables, storage and their optimisation.
- On the basis of the above, demonstrate the potential for energy savings from energy management solutions based on smart technical building systems (predictive controllers, smart thermostats, active sensors, smart lighting, etc.).
- Assess the contribution of proposed solutions to the enhancement of smart readiness of buildings as rated by the smart readiness indicator under Directive 2010/31/EU.
- Demonstrate that the developed solutions are user-friendly and ensure the desired indoor environment quality and user satisfaction.
- Where possible, demonstrate that such solutions can build flexibly on services/products not originally intended for energy management (e.g. a smart home system).
- Seek to ensure from the design phase that the project is developed with a view to integrate its results/deliverables under a digital building logbook.

Each project is expected to include at least three demonstration sites located in different climatic regions.

Clustering and cooperation with other relevant projects is strongly encouraged; in particular, liaison and synergies with the European Partnership on 'People-centric sustainable built environment'.

Call – Efficient, sustainable and inclusive energy use 2022

Highly energy-efficient and climate neutral EU building stock

Topic ID and title	HORIZON-CL5-2022-D4-02-01: Designs, materials and solutions to improve resilience, preparedness & responsiveness of the built environment for climate adaptation (Built4People)				
Budget	EUR 15 million	Opening date	6 September 2022	Deadline 1	24 January 2023
Budget per project	EUR 5 to 7,5 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	improve resilience, improve climate proofing, cost-effective, natural risks and disasters, digital tools, comfort, well-being, energy performance				
FTP comments					
FTP SIRA 2030 Challenges addressed	8	FTP relevance		Low	
		Starting TRL		/	
		End TRL		6-7	

Expected Outcome:

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

- Increased awareness of the built environment's protective role for people and climate adaptation in case of disruptive events.
- Mainstreamed resilience as a key feature of the built environment across its life cycle.
- Improved ability of the built environment to support the preparedness and responsiveness to disruptive events at larger scales.
- Improved ability of the built environment to contribute to the overall quality of living and working.
- Strengthened supply chains for materials and solutions for a resilient and climate proof built environment, adapted to local risks.

Scope:

The proposal should:

- Deliver innovative designs, materials and solutions to improve resilience and climate proofing of the built environment (in particular new and existing buildings) in a cost-effective and reliable manner.

- Ensure the proposed solutions cover a broad spectrum of natural risks and disasters, for instance natural disruptive events such as earthquakes, floods, heat waves, with a particular focus on extreme climatic events.
- Ensure the proposed solutions make use of natural, easy to manage, as well as advanced, evolutive materials and technologies that help combat the effects of global warming (increased cooling demand, heat island effects, etc.) and result in increased durability, resilience and adaptability of buildings and infrastructures, including their foundations.
- Consider social innovation where relevant, notably as new tools, ideas and methods leading to active citizen engagement and resilience, and as drivers of social change, social ownership, and new social practices.
- Develop and deploy digital and interoperable tools for monitoring, detection of, and response to critical situations (e.g. evacuation of people and first responders).
- Rely, where relevant, on self-sensing and adaptable materials, and materials with embedded sensors and actuators.
- Include, as part of the proposed solutions, built environment concepts that are self-sustained for a certain period of time – including off-grid electricity supply, green infrastructure and water purification and / or rain water provision in buildings.
- Where relevant, investigate whether and how the proposed approaches could apply to cultural heritage buildings across different typologies and geographic conditions, also including innovations in business models and ensuring holistic integration of disciplines across the value chain.
- Validate the proposed solutions for a set of locations that is coherent with the risks and disasters considered in the proposal, ensuring a high degree of awareness and involvement of supply chains.
- Demonstrate that the proposed solutions improve the protection of people when experiencing disruptive events and contribute to enhance resilience and climate proofing at a larger scale (e.g. district, city, energy system).
- Demonstrate that the proposed solutions contribute to improving the overall quality of living and working in the buildings (e.g. in terms of accessibility, comfort and well-being).

- Demonstrate cost-effective improvement of the energy performance, reducing the cost of the interventions compared to traditional methods, as well as the energy related operational costs after the renovation.
- Demonstrate that the proposed solutions improve the use of relevant data such as weather forecasts or catastrophe warnings by monitoring and management systems in the built environment (e.g. to launch automatic emergency protocols to warn and protect buildings users).
- Lead at least 3 large-scale demonstration of the solutions in diverse geographical areas, with various local environmental, social, and economic conditions.

Clustering and cooperation with other relevant projects is strongly encouraged; e.g. with the Horizon Europe Partnership on 'Driving urban transitions'.

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.

For this topic, projects are encouraged to define and implement ambitious international outreach and cooperation strategies.

This topic implements the co-programmed European Partnership on 'People-centric, Sustainable Built Environment' (Built4People).

Topic ID and title	HORIZON-CL5-2022-D4-02-02: Solutions for the sustainable, resilient, inclusive and accessible regeneration of neighbourhoods enabling low carbon footprint lifestyles and businesses (Built4People)				
Budget	EUR 15 million	Opening date	6 September 2022	Deadline 1	24 January 2023
Budget per project	EUR 5 to 7,5 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	behavioural change, low emissions, sustainable built environment, digital tools, well-being, deep renovation, circular economy, efficient use of resources, durability, reuse, recyclability, energy circularity				
FTP comments					
FTP SIRA 2030 Challenges addressed	1E - 8D	FTP relevance		Low	
		Starting TRL		/	
		End TRL		6-7	

Expected Outcome:

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

- Lasting behavioural change of people and economic actors towards lower carbon footprint lifestyles and businesses.
- Mainstreamed participatory planning processes and interaction with all relevant stakeholder groups in city planning.
- More sustainable, low emission, inclusive and affordable neighbourhoods and built environment.
- Improved accessibility of neighbourhoods through building-integrated, sustainable mobility solutions.
- Extended application of digital applications and tools to ease decision-making processes in complex stakeholder structures.
- Raised awareness and increased capacity of citizens on participatory processes for enhanced sustainability and environmental performance.
- Increased well-being and economic prosperity of citizens in a low carbon, sustainable built environment by ensuring high indoor and outdoor quality, and affordability of renovation solutions.
- Increased attractiveness of deep renovation through new regeneration and smart growth models for sustainable living.

Scope:

The proposal should:

- Deliver innovative methods and solutions for the regeneration of neighbourhoods, with due consideration of, inter alia, energy efficiency, sustainability, resilience, health, inclusiveness and accessibility, based on participatory planning processes and innovative decision-making procedures and digital applications.
- Ensure the proposed solutions allow to identify and integrate local sources of raw materials for building renovation in built environment planning scenarios.
- Ensure the proposed solutions include new evidence-based approaches (e.g. strategies and digital tools) to help quantify the benefits of integrated built environment transformation aimed at climate neutrality.
- Ensure the proposed solutions allow for involving all stakeholder groups, including inter alia elderly people, those with reduced mobility and persons with disabilities, and households affected by energy poverty, also seeking to address gentrification issues in neighbourhoods affected by energy poverty.
- Ensure the proposed solutions include concepts for local renewable energy generation and consumption integrated at building and district level in combination with multi-modal mobility concepts targeted to both urban and rural neighbourhoods.
- Ensure the proposed solutions contribute to optimising energy balancing at local level (e.g. thanks to energy sharing platforms and services connected to local micro-grids and / or virtual energy markets, including demand response and decision-support systems and block chain applications).
- Ensure the proposed solutions comply with the principles of circular economy, favouring urban mining, efficient use of resources, durability, reuse and recyclability.
- Ensure the proposed solutions are developed taking into account local environmental, social, and economic conditions and are relevant for the different geographical locations targeted.
- Where relevant, include concepts for energy circularity such as waste heat recovery from local industries (or other sources) and use in nearby buildings or in low-temperature district networks and, valorisation of by-products and residues (e.g. from local agro-food industry) for energy or other uses.

- Where relevant, investigate whether and how the proposed approaches could apply to cultural heritage buildings.
- Lead at least 3 large-scale demonstrations of the solutions in diverse geographical areas, with various local environmental, social, and economic conditions.
- Consider social innovation where relevant and in the case where the proposed solutions are at the socio-technical interface and require social change, new social practices, social ownership or market uptake.
- Facilitate awareness raising and capacity building of citizens and relevant stakeholders (e.g. citizen associations, local authorities, businesses from the relevant sectors) on the principles and multi-benefits of sustainable, inclusive and accessible built environment.

Clustering and cooperation with other relevant projects is strongly encouraged; e.g. with the European Partnership on 'Driving urban transitions'.

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.

This topic implements the co-programmed European Partnership on 'People-centric, Sustainable Built Environment' (Built4People).

Topic ID and title	HORIZON-CL5-2022-D4-02-03: Sustainable and resource-efficient solutions for an open, accessible, inclusive, resilient and low-emission cultural heritage: prevention, monitoring, management, maintenance, and renovation (Built4People)				
Budget	EUR 20 million	Opening date	6 September 2022	Deadline 1	24 January 2023
Budget per project	EUR 4 to 5 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW				
Keywords	historical renovation, heritage buildings, sustainable, resource-efficient				
FTP comments					
FTP SIRA 2030 Challenges addressed	8A	FTP relevance		Low	
		Starting TRL		/	
		End TRL		5	

Expected Outcome:

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

- Increased availability and enhanced overall performance, including with regard to cost-effectiveness, of solutions applicable to the reliable and respectful historical renovation of heritage buildings, preserving their architectural and cultural identity.
- Demonstrated potential of sustainable, energy and resource-efficient historical renovation of heritage buildings.
- Better protection of the value and long-term inclusiveness, accessibility and usability of cultural heritage sites.
- More cost-effective and less disruptive modernisation and preservation of the heritage built environment.
- Enhanced prevention and monitoring of the heritage built environment.
- More important role of the cultural heritage in deployment, showcasing and replication of solutions for a sustainable built environment.

Scope:

The proposal should:

- Deliver technically and socially innovative, sustainable, energy and resource-efficient solutions for the cost-effective improvement and preservation of cultural heritage built environment along all relevant aspects: inclusiveness, accessibility, resilience, environmental and energy performance.

- Ensure the proposed solutions cover all relevant aspects of the heritage built environment's life cycle: design, renovation works, operation, monitoring and management, and maintenance.
- Ensure the proposed solutions allow to maintain the heritage value (e.g. artistic, historic, archaeological, social and scientific) of targeted sites, while improving access and comfort of users and visitors, and reducing maintenance and operational costs
- Ensure, where relevant, that the proposed solutions rely on (adapted) historical or traditional construction techniques and materials for sustainable restoration.
- Ensure the proposed solutions include natural low maintenance as well as advanced renovation techniques for high quality design and construction, including new digital technologies, while preserving the cultural value of the targeted sites.
- Ensure the proposed solutions contribute to facilitate the integration renewable energy sources while respecting the aesthetic and cultural identity of the targeted buildings.
- Ensure the proposed solutions contribute to the cost-effective improvement of the energy performance, also reducing the cost of the interventions compared to traditional methods.
- Ensure the involvement of relevant stakeholder groups (e.g. civil society organisations, associations, cultural heritage stakeholders such as cultural heritage protection bodies) and citizens' acceptance thanks to co-creation processes and socially innovative ideas.
- Deliver and demonstrate decision-support tools for low-disruptive, optimal renovation of heritage built environment to enhance sustainability.
- Clustering and cooperation with other relevant projects is strongly encouraged; e.g. with the Horizon Europe Partnership on 'Driving urban transitions'.
- 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.
- This topic should consider social innovation as driver of social change, new social practices, social ownership and/or market uptake.

This topic implements the co-programmed European Partnership on 'People-centric, Sustainable Built Environment' (Built4People).

Topic ID and title	HORIZON-CL5-2022-D4-02-05: More sustainable buildings with reduced embodied energy / carbon, high life-cycle performance and reduced life-cycle costs (Built4People)				
Budget	EUR 18 million	Opening date	6 September 2022	Deadline 1	24 January 2023
Budget per project	EUR 6 to 9,5 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	GHG emissions reduction, circularity improvement, environmental impact, energy consumption reduction, carbon footprint, bio-based materials, reused, recycled, upcycled, digital tools, digital building logbook, digital twin				
FTP comments					
FTP SIRA 2030 Challenges addressed	8A,B,D	FTP relevance		High	
		Starting TRL		/	
		End TRL		6-7	

Expected Outcome:

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

- Increased and more traceable reduction of the GHG emissions of buildings in design, construction, renovation, operation and end of life.
- Faster market uptake of design solutions, materials, products, techniques and business models that are demonstrated to reduce significantly building related life-cycle costs and impacts, including whole life emissions, compared to current building completions.
- Mainstreamed affordable high life-cycle performance, and improved circularity of buildings in construction and renovation.

Scope:

The proposal should:

- Demonstrate innovative design, construction and renovation methods, design and technology solutions that minimise the overall life-cycle environmental impact, reducing energy consumption and carbon footprint of the built environment across the life cycle, from construction to end of life thanks to, inter alia, applying circularity principles throughout the design and construction process, flexible use and lifecycle extension by design, design for deconstruction, disassembly and reassembly, integration of waste, reused, recycled, upcycled and bio-based materials and components, optimisation of design, construction and operation by means of digital tools.

- Deliver scalable full building demonstrations (both new and renovation) with validated performance measurements based on appropriate Level(s) indicators, demonstrating that the proposed methods and technology solutions optimise the use of energy and resources, and minimise the emissions of CO₂ and other air pollutants across all phases of the life cycle, including construction and renovation works, and operation.
- Integrate the use of low embodied carbon products and solutions, including those that are locally sourced and bio-based with low carbon impact and capturing / storing CO₂, selected based on modelling of their performance in terms of (inter alia) insulating, cooling, acoustic and hygrometric performance, ageing patterns, potential for deconstruction and/or reuse at end of life, and potential for automated / mechanised deployment.
- Identify and integrate local sources of reused or recycled construction products and secondary raw materials for building renovation in urban and rural planning scenarios.
- Where relevant, investigate whether and how the proposed approaches could apply to cultural heritage buildings.
- Seek to ensure from the design phase that the project is developed with a view to integrate its results/deliverables under a digital building logbook.
- Deploy advanced, market-ready prefabs and multifunctional materials and components with optimal recycling and re-using potential (e.g. through new designs enabling the re-use) and optimal performance across relevant areas (energy, durability, safety and protection against fire).
- Demonstrate innovative solutions for optimal design, construction, operation and maintenance of sustainable buildings, including efficient technical building systems, automation and control, digital building logbooks, digital twins and other tools.
- Demonstrate the solutions in diverse geographical areas, with various local environmental, social, and economic conditions.
- Clustering and cooperation with other relevant projects is strongly encouraged; e.g. with the Horizon Europe Partnership on 'Driving urban transitions'.

This topic implements the co-programmed European Partnership on 'People-centric, Sustainable Built Environment' (Built4People).

Cluster 6 : Food, Bioeconomy, Natural Resources, Agriculture and Environment³

Destination 1: Biodiversity and ecosystem services

The EU biodiversity strategy for 2030 is a cornerstone of the European Green Deal that will put Europe's biodiversity on the path to recovery by 2030, for the benefit of people, the climate and the planet. It will also prepare the EU to take a leading role in the upcoming international negotiations on a new global framework to halt biodiversity loss. With the Green Deal's 'do no significant harm' vision, all EU policies will become more biodiversity-friendly, focusing more on the sustainable use of ecosystems, supporting the recovery in a post-pandemic world⁶. This policy vision is fully supported in the strategic plan of Horizon Europe for 2021-2024 in its first key strategic orientation 'Protecting and restoring ecosystems and biodiversity and managing sustainably natural resources on land and at sea, and achieving climate neutrality and adaptation'. Consequently, Destination 'Biodiversity and ecosystem services' intends to achieve the following expected impact from Cluster 6 **'Biodiversity is back on a path to recovery, and ecosystems and their services are preserved and sustainably restored on land, inland water and at sea through improved knowledge and innovation'**. All actions funded under this destination must therefore help to deliver this main impact.

Research and innovation is key to delivering results that will have an important impact on biodiversity, food, health, water and climate, which are all interconnected, and to achieving the goal of healthy and resilient ecosystems by 2030. It will also enable transformational change engaging European society and economy and their global impacts, making decisions more biodiversity-friendly. R&I will support policy targets, develop nature-based solutions⁷ and holistic approaches to address the main causes of biodiversity loss, particularly in connection to production systems, bringing all sectors together to be integrated in ecosystem-based management. Investments in R&I will help to protect and restore the integrity of terrestrial, aquatic and marine ecosystems, currently under multiple pressures, and protect and restore their capacity to deliver a wide range of essential services. Under Horizon Europe, a **long-term strategic research agenda for biodiversity** will also be developed.

The sixth mass extinction is taking place: one million species are at risk of extinction, and the degradation of ecosystems severely affects the fabric of life that enables the survival of humankind⁸. None of the globally agreed targets of the 2011-2020 strategic plan for

³ [Work Programme published by the European Commission on 15 June 2021](#)

biodiversity has been fully achieved⁹, with the biodiversity crisis even deepening. Our knowledge on biodiversity status, pressures, impacts and responses needs to be improved, requiring even basic taxonomic work in certain ecosystems. **Understanding biodiversity decline** and addressing its main drivers through data-driven science, integrated multidisciplinary knowledge, new tools, models and scenarios, will support Europe's policy needs and boost global biodiversity science. Solutions for preventing and addressing the individual and cumulative effect of direct drivers of biodiversity loss (land use change, overexploitation, climate change, invasive species, pollution) need to be further developed and made available to policy makers and practitioners, such as through the new EC Knowledge Centre for Biodiversity¹⁰. For more impact on society and economic sectors, citizen science and crowdsourcing also require big data analysis, artificial intelligence, social sciences, communications and policy tools.

Valuing and restoring biodiversity and ecosystem services is necessary to develop tools to guide decisions, inform and implement policies on the environment, water, health, climate, disaster risk reduction, agriculture, forests and other land use types, protected areas management, the sustainable bioeconomy, the blue economy, maritime and cross-sectoral spatial planning, and responsible business practices. The continued degradation of the ecosystems and their services affects biodiversity and climate change¹¹, and increases the risk of severe ecological disasters and pandemics. The European Green Deal and its biodiversity strategy call for urgent action to restore damaged aquatic and terrestrial ecosystems in order to increase biodiversity and deliver a wide range of ecosystem services.

The contribution of ecosystems to human wellbeing and the economy is not properly accounted for in market transactions, or in planning and investment decisions: the social and economic co-benefits of healthy ecosystems are often disregarded. Natural capital accounts need to be developed and mainstreamed. Investments in R&I will also lay the ground for scaling up and speeding up the implementation of technological, societal and nature-based solutions (NBS). NBS support vital ecosystem services, biodiversity and biomass provision, as well as access to drinking water, clean soil, improved livelihoods, healthy diets and food safety and security from sustainable food systems. NBS deployment will also create green jobs and build resilience to climate change and natural disasters. Citizens, authorities, businesses, social partners and the research community must be engaged at local, regional, national and European levels.

Managing biodiversity in primary production: Biodiversity is the basis for sustainable and resilient agriculture, fisheries, aquaculture and forestry, as also recognised in the farm to fork and biodiversity strategies under the Green Deal. With diverse genetic resources, it is possible to use in primary production plants and animals that are adapted to different

environments, ecosystems and meet diverse needs. Furthermore, the interplay between species below and above ground delivers important ecosystem services, such as pollination, soil fertility, pest and risk control. Despite these recognised benefits, current production systems tend to be specialised and rely on a limited number of crops, breeds and forest tree species whose genetic basis is narrow. Reversing this trend and increasing their resilience is critical and of global concern in particular in the current context of accelerated climate change and a growing population whose production and consumption footprint is increasing.

Enabling transformative change¹² in biodiversity: Science (IPBES and IPCC) and Policy (the global post-2020 biodiversity framework and the EU biodiversity strategy) clearly underline that biodiversity loss can only be successfully addressed if transformative changes are initiated, accelerated, and up-scaled. There is however hardly any knowledge on potentials and challenges arising from transitions focused on biodiversity. System-level change of this kind starts with social innovation in the form of, for example, regulations, incentives, local and participatory processes, and through the introduction of new technologies, new production processes, or new consumer products, which change how socio-technical and socio-ecological systems operate and impact their environment. Such transformative change must decrease the impacts of indirect drivers of biodiversity loss, which are in turn, underpinned by societal values and behaviours. Indirect drivers of biodiversity loss are understood to mean here: production and consumption patterns, human population dynamics and trends (including their footprints), trade, technological innovations, and local to global governance (including financing). Research and innovation can enable these transformative changes to happen and initiate processes, behaviour changes and actions which are transforming the way we impact biodiversity. Socio-economic and multidisciplinary research, including on the role of education, will develop knowledge and tools to understand the role of transformative change for biodiversity policy making, address the indirect drivers for biodiversity loss, and accelerate transformative changes in our society that are relevant to biodiversity.

Interconnecting biodiversity research and supporting policies refers to the establishment of the European Partnership ‘Rescuing biodiversity to safeguard life on Earth’ and to the support to other science-policy interfaces. The European partnership on biodiversity¹³ will connect national, local and European research, innovation and environmental programmes, combining resources in support of one goal, i.e. that by 2030 biodiversity in Europe is back on the path to recovery. It will co-develop multidisciplinary research and innovation programmes with stakeholders, set up a European network of coordinated observatories for biodiversity monitoring, and implement a broad range of

activities to increase the relevance, impact and visibility of EU research and innovation in tackling the biodiversity crisis in line with the EU biodiversity strategy for 2030.

Science-policy interfaces on biodiversity and nature-based solutions have made good progress in recent years¹⁴, and must be stepped up to achieve targeted impacts on biodiversity-relevant policies, that can in turn be used as structured policy input into the research cycle. These interfaces are also key to guiding biodiversity governance, and to implement the EU Green Deal and international conventions¹⁵. In line with the Commission priority 'A stronger Europe in the world', the EU must take and demonstrate leadership in this field, notably by increasing its support to IPBES¹⁶ -to bring it up to the same level as the IPCC-, and to the Convention on Biological Diversity. Besides economic support, this also includes efforts to create synergies and cooperation between IPBES, regional Multilateral Environmental Agreements and other relevant research communities to ensure a full coverage of all relevant aspects of biodiversity and ecosystem services in order to underpin the full scope of the post 2020 global biodiversity framework.

All topics will directly contribute to the EU biodiversity strategy for 2030 and to the Sustainable Development Goals (SDGs) 13, 14, 15, 17.

Several missions will also help to achieve biodiversity-related impacts, notably in the areas of 'Adaptation to climate change including societal transformation', 'Climate-neutral and smart cities', 'Ocean, seas and waters' and 'Soil health and food'.

Expected impact

Proposals for topics under this destination should set out a credible pathway contributing to Biodiversity and Ecosystem Services, and more specifically to one or more of the following impacts:

- **Biodiversity decline, its main direct drivers and their interrelations are better understood and addressed** through the production, integration and use of open data, knowledge, education and training, innovative technologies, solutions and control measures, in collaboration with European and international initiatives.
- **Biodiversity and natural capital are integrated into public and business decision-making at all levels for the protection and restoration of ecosystems and their services**; science base is provided for planning and expanding protected areas, and sustainably managing ecosystems.
- **Europe builds competitive sustainability and tackles climate change and natural disasters through the deployment of nature-based solutions**, including

ecosystem-based disaster risk-reduction approaches fully reaping their economic, social and environmental benefits for a green recovery across all European regions.

- **The interrelations between biodiversity, health, food, soil, water, air and climate are better known** and communicated to citizens and policy-makers; in particular, risks associated with microbiomes and biodiversity-friendly prevention/mitigation measures, and opportunities for biodiversity recovery are identified.
- **Practices in agriculture and forestry support biodiversity and the provision of other ecosystems services** based on a) a better understanding of functional biodiversity (above and below ground), b) effective knowledge and innovation systems and c) ready-to use solutions for land managers, adapted to specific conditions.
- **Access to a wider range of crops and breeds with a broadened genetic base is improved in line with global biodiversity commitments** by gaining greater insight into the characteristics of genetic resources and by enhancing capacities for their preservation and use in breeding and in primary production (farming, forestry, fisheries, aquaculture). More (bio)diverse, resilient production systems will have positive knock-on effects on value chains, consumption, healthy diets and the wider, non-managed biodiversity.
- **Approaches for enabling transformative changes in society** for biodiversity and ecosystems recovery are identified, tested and implemented in policy, governance, law business and society; all indirect drivers of biodiversity loss are addressed and 'do not harm' biodiversity policies become a mainstream part of all sectors.
- **Biodiversity research is interconnected** across Europe, supporting and enhancing the ambition of national, EU and international environmental policies and conventions.

When considering the impact of the proposals, their compliance with the 'do no significant harm' principle¹⁷ has to be assessed. Also it has to be ensured that the research and innovation activities do not cause a significant harm to any of the six environmental objectives of the EU Taxonomy Regulation.

The portfolio of actions under this destination will have impacts in the following areas: "Enhancing ecosystems and biodiversity on land and in waters"; "Climate change mitigation and adaptation"; "Clean and healthy air, water and soil"; "Sustainable food systems from farm to fork on land and sea"; and "A resilient EU prepared for emerging threats".

Call – Biodiversity and Ecosystem Services 2021

Enabling transformative change on biodiversity

Topic ID and title	HORIZON-CL6-2021-BIODIV-01-15: Quantify impacts of the trade in raw and processed biomass on ecosystems, for offering new leverage points for biodiversity conservation, along supply chains, to reduce leakage effects				
Budget	EUR 10 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 2 to 3 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW				
Keywords	Raw and processed biomass, trade, import, export, biodiversity				
FTP comments					
FTP SIRA 2030 Challenges addressed	1A	FTP relevance	Medium		
		Starting TRL	/		
		End TRL	/		

Expected Outcome

In line with the EU biodiversity strategy, a successful proposal will develop knowledge and tools to understand the role of transformative change for biodiversity policy making, address the indirect drivers of biodiversity loss, and initiate, accelerate and upscale biodiversity-relevant transformative changes in our society.

Projects should address all following outcomes:

- understanding and quantifying the impacts of the trade in raw and processed non-food biomass⁶⁴ from land and sea on biodiversity and on the wide range of services that ecosystems can provide, including in relation to climate change mitigation and adaptation.
- identifying new leverage points for biodiversity conservation⁶⁵, for example along supply chains, within and beyond the retailing sector, reducing leakage effects (including carbon leakage), and providing recommendations on how to address these leverage points at corporate and institutional level.
- making available and using (local) solutions for retailers and their leverage effects on (global aspects of) patterns of biomass production and consumption, rebuilding our economy in a biodiversity-friendly way within planetary boundaries, including through sustainable corporate governance.
- specifying the meaning of transformational change in practice, based on case studies.

- improving the understanding of the biodiversity inter-dependencies of the SDGs; strengthening IPBES and IPCC by the contribution of European research and innovation.
- providing approaches, tools and knowledge influence policies at the right level on transformative change for biodiversity – the key elements of this change by the portfolio of cooperating projects (of which these projects are part).

With the focus on quantifying impacts of trade of raw and processed biomass on ecosystems, projects are encouraged to engage in international cooperation (in particular with African countries, Brazil, Latin American and Caribbean countries or the Mediterranean region) to find new leverage points for biodiversity conservation along supply chains and to reduce leakage effects for the EU and associated countries⁶⁶.

Scope

In addition to focusing on limiting the impacts from biomass production and consumption on biodiversity, proposals should look at the whole trade-related value chain, at the scale needed to have a greater effect on protecting and restoring biodiversity. Proposals should analyse how the biomass sector could increase its positive impact on biodiversity. They should support biodiversity to deliver a wide range of ecosystem services, including on mitigating and adapting to climate change.

Proposals should increase the volume of evidence available by taking systematic approaches that take account of links between activities and leakage effects at different stages in the value chain or link production and consumption explicitly, including with institutions, businesses, retailers and investors, civil society, and should cover more than one product at a time.

The knowledge gained should help establish an ‘ecological footprint’ of biomass and the manufactured goods based on biomass, within planetary boundaries as stipulated in the EU bioeconomy strategy⁶⁷. The knowledge should be usable for science-industry cooperation on the bioeconomy⁶⁸, and should follow the pollution and climate neutrality targets and commitments, due diligence and human rights requirements, and the policy on just transition, for the service industry and the financial sector.

Proposals should take into account the role of governments as major consumers of goods and services (and the leverage in procurement processes), and of manufacturers and retailers as consumers of primary resources.

The outcomes of these projects should help integrate biodiversity values into the circular economy, for example by cutting waste from the biomass chain, reducing leakage effects,

tele-coupling, using carbon and nitrogen footprints in production processes and minimising the use of plastic in the economy. The projects should give explicit values and accounting of these benefits for biodiversity.

Proposals should look at how to further mainstream biodiversity into socio-economic and environmental agendas, from the transformative aspect of minimising the impacts of trade in raw and processed biomass for protecting, sustainably managing and restoring biodiversity and the wide range of ecosystem services it can deliver, in order to nudge pathways towards fair and equitable development and just transitions (1) across the EU Member States and associated countries, and (2) globally.

Proposals should build their analysis on the synergies between multiple Sustainable Development Goals, to deliver directly and indirectly biodiversity benefits. They should highlight the role of biodiversity in attaining the set of Sustainable Development Goals relating to the trade in raw and processed biomass.

Proposals should provide case studies and collect good and failed examples that can serve as useful inputs to these transformations. They should inform and inspire transformative change through learning, co-creation and dialogue.

Proposals should include specific tasks and allocate sufficient resources for coordination measures, to develop joint deliverables (e.g. activities, workshops, joint communication and outreach measures) with all projects on transformative change related to biodiversity funded under this destination. This applies to projects funded under this destination that aim to deliver multiple co-benefits, including on the reduction of biodiversity loss⁶⁹. Proposals should use existing platforms and information sharing mechanisms relevant to promoting transformational change and sharing biodiversity knowledge⁷⁰. Furthermore, projects are expected to cooperate with the European partnership on biodiversity⁷¹ (HORIZON-CL6-2021-BIODIV-02-01) and the Science Service (HORIZON-CL6-2021-BIODIV-01-19).

Proposals should show how their results can provide timely information for relevant IPBES and IPCC functions. They are expected to cooperate with the CBD, and with projects 'HORIZON-CL6-2021-BIODIV-01-20: Support to processes triggered by IPBES and IPCC', 'HORIZON-CL6-2022-BIODIV-01-10: Cooperation with the Convention on Biological Diversity' and 'HORIZON-CL6-2021-BIODIV-01-21: Impact and dependence of business on biodiversity'.

Topic ID and title	HORIZON-CL6-2021-BIODIV-01-18: Understanding the impacts of and the opportunities offered by digital transformation, new emerging technologies and social innovation with respect to biodiversity				
Budget	EUR 5 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 2 to 3 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	F&F, WW, P&P				
Keywords	Digital technologies, Artificial Intelligence (AI), biodiversity loss, ecosystem services, policy making, governance, Copernicus, GEO, GEOSS				
FTP comments					
FTP SIRA 2030 Challenges addressed	1A	FTP relevance		Low	
		Starting TRL		/	
		End TRL		/	

Expected Outcome

In line with the EU biodiversity strategy, successful proposals will develop knowledge and tools to understand the role of transformative change for biodiversity, tackle indirect drivers of biodiversity loss, and initiate, accelerate and upscale biodiversity-relevant transformative change in our society.

Digital technologies are transforming all sectors of society, from food production to mobility, energy, climate mitigation and adaptation measures, construction, infrastructure, technology use, human behaviour and societal organisation, with different impacts on and perceptions of biodiversity, due to the speed, scale and level of connectivity of these transformations. Projects should help identify a safe operating space, in which digitalisation and new emerging technologies generate no unsustainable rebound effects, but instead can be a vehicle for accelerating and amplifying the transition to a safe and just world for humankind whilst protecting, restoring and sustainably using biodiversity and ecosystem services.

Project should address all following outcomes:

- A better understanding, today and for the future, of the impacts on, risks and opportunities for biodiversity of digital transformation (for example smart technologies, artificial intelligence, automation, miniaturised sensors, citizen science applications, crowdsourcing), new materials (e.g. for biomimicry), and new and emerging technologies.
- Identification and an assessment of how system-level change affecting biodiversity through social innovation happens. This should cover bringing in new technologies, new production processes, consumer products, regulations, incentives, or

participatory processes, and changes how socio-technical and socio-ecological systems operate.

- Making proposals for safeguards to build public understanding of the range of diverse values held by members of the public (i.e. indigenous communities, youth, women, vulnerable groups in society, socially or economically marginalised groups), to promote democracy and a socially just transition taking action on biodiversity. Proposals should promote incorporating these safeguards in transformative processes linked to the digital sector and technology, which can have positive or negative impacts on biodiversity and on the wide range of services ecosystems can provide.
- Demonstrating the potential of social innovation to tackle biodiversity loss, as well as using biodiversity and the ecosystem services it provides, with nature-based solutions as case studies. Demonstrating how nature-based solutions, enabled by social innovation, tackle poverty, low resilience and social inequality to achieve a just transition.
- Testing active intervention by R&I policy and sector policies (niche creation, reformulation of governance, 'exnovation'), also by empowering and endowing communities.
- Approaches, tools and knowledge influence policies provided at the right level on transformative change for biodiversity. The key elements for this change are to be delivered by the portfolio of cooperating projects (of which these projects form part).

Outcomes should be formulated in such a way that enables their potential users (policy makers, institutions, businesses, engineers, civil society) to understand and concretely apply them, including for monitoring, accounting and reporting purposes. The outcomes should be translated into options to ratchet up the targets and enabling mechanisms of the EU biodiversity strategy for 2030, the global post-2020 biodiversity framework, and to feed input into the processes on the Paris Agreement, the Sustainable Development Goals and IPBES. With the focus on the impacts and opportunities of digital transformation, new emerging technologies and social innovation on biodiversity for the EU and associated countries, projects are strongly encouraged to engage in international cooperation, in particular with African countries, Brazil, Latin American and Caribbean countries or the Mediterranean region, in order to understand differences between the EU/AC and other world regions.

Scope

- Proposals should generate, collect and distribute knowledge on how to tackle the indirect drivers of biodiversity loss linked to technological and social innovation, which includes digitalisation. They should also assess the impacts on biodiversity of the digital divide between urban, peri-urban and rural areas. Proposals should explain how changes in our societies are fostered by technological and social innovation impacting biodiversity – for example by bringing in new and emerging technologies, new production processes, consumer products, regulations, incentives, or participatory processes, which change how socio-technical and socio-ecological systems operate.
- Proposals are expected to contribute to informing stakeholders and users on the social and technological impacts of new and emerging technologies that are not covered by existing procedures for biodiversity-related risk assessments⁷⁹. This includes the wider positive and negative impacts on societal values, behaviour, institutional, financial and business frameworks, which in turn are having an impact on biodiversity and the capacity of ecosystems to provide a wide range of services.
- Proposals should assess which tools further mainstream biodiversity into policy making, and governance (including financing, the promotion of innovation, and bringing in new and emerging technologies) to achieve transformative action that benefits biodiversity, to avoid, mitigate or manage conflicts linked to these transformational changes⁸⁰. In doing this, proposals should engage with civil society, policy makers, finance and business leaders, to create a toolbox for transformative change via action on biodiversity.
- Proposals should build their analysis on the synergies between multiple Sustainable Development Goals to deliver both direct and indirect biodiversity benefits, staying within planetary boundaries, and on the role of biodiversity in reaching the set of Sustainable Development Goals. Proposals should factor in impacts and opportunities of digital transformation, new emerging technologies and social innovation on biodiversity. This explicitly includes the interdependence of biodiversity loss and climate change, and the impacts on biodiversity of digital, technological or social approaches on action to mitigate and adapt to climate change – and vice versa.
- Proposals should develop pathways for digital developments to achieve a successful twin digital and biodiversity transition. They should develop methodologies to assess their impacts (including the impacts from energy/electricity infrastructure, or on democracy and on trust in science) on environmental, social and economic systems. Such assessments should focus on the direct and indirect effects of digital developments on biodiversity, intertwined with climate change and health.

- Proposals should provide case studies and a collection of good and failed examples, including current relevant business models, the role of citizen science, and scenarios that could provide useful impact to these transformations and inform and inspire transformative change through learning, co-creation and dialogue.
- Proposals should include specific tasks and allocate sufficient resources to develop joint deliverables (e.g. activities, workshops, and joint communication and dissemination) with all projects on transformative change related to biodiversity funded under this destination. They should use existing platforms and information sharing mechanisms relevant to transformational change and to biodiversity knowledge⁸¹. Furthermore, projects are expected to cooperate with the Biodiversity Partnership and the Science Service. Proposals should show how their results and outcomes can provide timely information to major science-policy bodies such as the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC), and to the Convention on Biological Diversity. They are expected to cooperate with projects 'HORIZON-CL6-2021-BIODIV-01-20: Support to processes triggered by IPBES and IPCC' and 'HORIZON-CL6-2021-BIODIV-2022-01-10: Cooperation with the Convention on Biological Diversity'.
- Where relevant, projects are expected to create links to and use information, data and impact-related knowledge from the European Earth observation programme Copernicus, the Group on Earth Observations (GEO) and the Global Earth Observation System of Systems (GEOSS).

Interconnecting biodiversity and supporting policies

Topic ID and title	HORIZON-CL6-2021-BIODIV-01-21: Impact and dependence of business on biodiversity				
Budget	EUR 5 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 2 to 3 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	F&F, WW, P&P				
Keywords	Ecosystem services, corporate decision making, business resilience, investment risks, interdisciplinary				
FTP comments					
FTP SIRA 2030 Challenges addressed	1A - 2E	FTP relevance		Low/Medium	
		Starting TRL		/	
		End TRL		/	

Expected Outcome

In line with the EU biodiversity strategy for 2030⁹⁵, the topic aims to support the development of policies, business decisions and knowledge generation, to tackle the indirect drivers of biodiversity loss, and accelerate biodiversity-relevant transformative changes in businesses and our society.

Successful proposals will help integrate biodiversity into business decisions to improve:

- public health and well-being and to tackle inequalities, create new jobs and sustainable growth in rural, post-industrial and coastal areas; strengthen resilience against environmental and climate stressors; minimise the risks of future diseases linked to business activities, with disastrous health, economic and social impacts, and
- corporate decision making and business resilience and to minimise investment risk and thereby play a key role in the sustainable transition of the economy.

Projects should produce all following outcomes:

- A better understanding and awareness of how businesses depend, and impact upon, biodiversity and ecosystem services, based on past and ongoing knowledge, also from practical business experience (by private companies), to feed into business decision making.
- Making available knowledge (e.g. meta-studies, publications) for the production of the IPBES methodological assessment on business and biodiversity, which is planned to be adopted in 2024-25, following a fast-track approach. Putting in place capacity building, policy support, and science brokerage of the projects, including after the

release dates of the IPBES assessment, through effective and impactful dissemination.

Making accessible scientific evidence that is directly relevant to multiple Sustainable Development Goals, in particular closely related to Goals 9 (build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation), 12 (ensure sustainable consumption and production patterns, i.e., issues of production and efficient use of natural resources), 13 (climate change), 14 (life below water) and 15 (life on land).

Scope

Key economic sectors depend on and have a direct and indirect, positive or negative impact on biodiversity. Biodiversity is directly at the centre of many economic activities, and a healthy biodiverse planet is a precondition for humankind to exist – and thus for businesses to grow and for the economy to recover following a crisis such as the COVID-19 pandemic.

Keeping nature healthy is critical for the economy, both directly and indirectly. The World Economic Forum ranks biodiversity loss and ecosystem collapse as one of the top five threats humankind will face in the next ten years. Businesses rely on biodiversity as inputs into their production processes, with over half of global GDP – some €40 trillion – dependent on nature and the services it provides.

Conversely, if we continue doing business as usual, and contribute to destroying ecosystems, the continued degradation of our natural capital will considerably limit business opportunities and socio-economic development potential. Internalising biodiversity into business decisions can enhance the health and well-being of all people and tackle inequalities, create new jobs and sustainable growth in rural, post-industrial and coastal areas; strengthen resilience against environmental and climate stressors; and minimise the risks of future outbreaks of infectious diseases with disastrous health, economic and social impacts. From the perspective of the private sector companies, integrating natural capital and biodiversity impacts and dependencies will enhance corporate decision making and business resilience as well as minimise investment risks. It will better inform, transform and improve their companies' sustainable decision-making processes, including by removing key blind spots in company risk assessments.

This means putting together a highly interdisciplinary team of experts, including biodiversity and corporate practitioners. It needs to cover biophysical and socio-economic aspects related to multiple sectors that have different impacts and ways of managing and accounting. Key expertise is needed in accounting, ecology, business management and organisation, social, political and environmental economics. This topic does not cover developing natural capital accounts or measuring biodiversity footprints.

The proposals should cover all of the following points:

- identifying criteria and indicators for measuring dependence, impact and contribution to the recovery of biodiversity and ecosystem services;
- developing methods to reduce adverse impacts and related material and reputational risks, and to develop the business case for long-term sustainability, for business sectors in addition to forestry, agriculture and fisheries, tourism, energy and mining, infrastructure and manufacturing and processing, that are directly dependent upon ecosystem services;
- developing a tool box to measure, assess and monitor the dependence and impact of the business sector on biodiversity, improved risk management linked to biodiversity, and the contribution of business to biodiversity recovery⁹⁶;
- assessing the broader impact of businesses on biodiversity, the cumulative impact and the indirect impact from supply chains, trade or substitution effects (such as tele-coupling);
- collating targets and regulations (at any level within the EU and in associated countries) that stimulate innovation generating a positive impact on biodiversity and on the decoupling of environmental pressures from increased output;
- promoting (1) business cases that contribute to the conservation, restoration and sustainable use of biodiversity and the wide range of ecosystem services and (2) public accountability, informing regulatory agencies and guiding financial investments and influencing producer, retailer and consumer behaviour. Analysing the added value of creating a Horizon Europe prize⁹⁷ for innovative businesses that improve biodiversity and its wide range of ecosystem services, focused on nature-based solutions⁹⁸. Delivering timely input to IPBES assessment on business, and the processes on IPBES objectives for building capacity, strengthening the knowledge basis, supporting policy, and communicating and engaging, on impact and dependence of business on biodiversity, and the relevant IPBES task forces.

Proposals should also show how their results could provide timely information on project outcomes to the Intergovernmental Panel on Climate Change (IPCC), and to the Convention on Biological Diversity. Projects are expected to cooperate with projects HORIZON-CL6-2021-BIODIV-01-20: Support to processes triggered by IPBES and IPCC, HORIZON-CL6-2022-BIODIV-01-10: Cooperation with the Convention on Biological Diversity and HORIZON-CL6-2022-BIODIV-01-04: Natural capital accounting: Measuring the biodiversity footprint of products and organizations.

Proposals should make available the relevant evidence, data and information via the Oppla portal, and prepare to feed in the uptake of its results according to an agreed format to the EC Knowledge Centre for Biodiversity. Collaboration with the Knowledge Centre should also include its stakeholders forum.

The project should set out a clear plan on how it will collaborate with other projects selected under this and any other relevant topics, such as HORIZON-CL6-2021-BIODIV-01-16: Biodiversity, water, food, energy, transport, climate and health nexus in the context of transformative change, and with the European partnership on biodiversity HORIZON-CL6-2021-BIODIV-02-0199, by participating in joint activities such as workshops or communication and dissemination activities. The project should also set out a clear plan on how it will collaborate with key business-related networks that promote the integration of biodiversity into corporate decision making. Proposals should include specific tasks and allocate sufficient resources for these coordination measures.

This topic should involve the contributions from the social science and humanities disciplines.

Call – Biodiversity and Ecosystem Services 2022

Valuing and restoring biodiversity and ecosystem services

Topic ID and title	HORIZON-CL6-2022-BIODIV-01-04: Natural capital accounting: Measuring the biodiversity footprint of products and organizations				
Budget	EUR 10 million	Opening date	28 October 2021	Deadline 1	15 February 2022
Budget per project	EUR 10 million			Deadline 2	/
Type of action	Innovation Actions (IA)				
FTP subsector	F&F, WW, P&P				
Keywords	Biodiversity, corporate natural capital accounting, Product Environmental Footprint (PEF)				
FTP comments					
FTP SIRA 2030 Challenges addressed	1E - 3	FTP relevance		Medium	
		Starting TRL		/	
		End TRL		/	

Expected Outcome

In keeping with the EU biodiversity strategy for 2030 the successful proposal is expected to contribute to measuring and integrating the value of nature into public and business decision making at all levels for the protection and restoration of ecosystems and their services.

Successful proposals will contribute to all the following expected outcomes:

- Change the way in which EU and associated countries organizations and companies allocate capital or influence their activities to promote a sustainable management by mainstreaming the use of corporate natural capital accounting.
- Integrate biodiversity and ecosystem considerations into business decision-making at different levels by measuring the biodiversity footprint of products and organisations through improving, developing and implementing standardised methods, criteria and standards that focus on essential features of biodiversity, ecosystems services, values, and sustainable use.
- Improve corporate biodiversity disclosure through innovative approaches to foster principles of biodiversity data transparency to accurately report on biodiversity, ecosystems and services.
- Demonstrate innovative solutions for valuing business impacts and dependencies in biodiversity and ecosystem and how this ends up in risks and opportunities for businesses private decision-making.

- Explore solutions to decrease the biodiversity footprint of retailers in global value chains.

Scope

The EU biodiversity strategy for 2030 recognises that biodiversity considerations need to be better integrated into public and business decision-making at all levels. This should include measuring the environmental footprint of products and organisations on the environment, through life-cycle approaches complemented and eventually integrated by natural capital accounting. In this context, the Commission will support the establishment of an international natural capital accounting initiative.

Natural capital accounting has potential in providing a meaningful basis for business performance reporting by explicitly mapping out impacts and/or dependencies on natural resources and placing a monetary value on them. Specific examples include business accounting and reporting and the disclosure of non-financial reporting and accounting directives.

The successful proposal should develop, take up or demonstrate in real settings standardised natural capital accounting practices to support companies to measure, value and synthesise biodiversity and ecosystem risks assessment, notably in a way that is suitable for routine consideration in business and economy decision-making (including at executive level). It should also mainstream environmental footprints methods for instance through quantifying the environmental impacts of products, or supply and value chains, business models or organisations based the Commission Organisation Environmental Footprint (OEF) and the Product Environmental Footprint (PEF).

The successful proposal should contribute to the alignment of natural capital accounting between the public and private sectors and to explore how the links to link the collection and use of statistics and data for natural capital accounting. It should also address the obstacles businesses are facing, in particular on data collection and improving the access and utility of European environmental data sets at different levels (i.e.: national statistical offices, environmental agencies, corporate reports) allowing better corporate and national data integration for economic and financial decision making.

The successful proposal should work on methodologies for companies to set science-based biodiversity targets. It should also address the specific decision-making needs of corporates and financial service provider to allow a specific and meaningful linkage with the macro-economic perspective and the ecological concept of planetary boundaries at the scale of decision to be taken at corporate level enabling to assess and understand to corporate safe operating space.

The successful proposal should develop and test concrete natural capital accounting and reporting frameworks for business performance with respect to biodiversity and ecosystem services reporting. This should include explicit mapping of the impacts and/or dependencies on natural resources and placing a monetary value on them. Specific examples should include business accounting, reporting, and the disclosure of non-financial reporting.

The successful proposal should explore to which extent the System of Environmental-Economic Accounting / Experimental Ecosystem Accounting (SEEA EEA) framework in its current form is useful for natural capital assessment and natural capital accounting by businesses. This should be done both in terms of methodological approach and data collection o the opportunities for adapting the SEEA EEA framework to make it more tailored to the business needs or the extent to which national statistical offices can benefit from data collection by businesses.

The successful proposal should develop and test concrete natural capital accounting basis for business performance on biodiversity and ecosystem services reporting by explicitly mapping out impacts and/or dependencies on natural resources and placing a monetary value on them. Specific examples should include business accounting, reporting, and the disclosure of non-financial reporting.

The successful proposal should support the European contribution to a globally consistent approach to account for ecosystems and their value. The proposal should ensure that the EU continues to play a lead role in international environmental affairs through its support for effective measures, international standards and accounting relating to natural capital.

The successful proposal should improve the access and utility of European environmental data sets at different levels (i.e: national statistical offices, environmental agencies, corporate reports) allowing better corporate and national data integration for economic and financial decision making.

The successful proposal should support developing and testing natural capital and biodiversity based business models. These are expected to invest in nature for the benefit of biodiversity, ecosystems functioning and ecosystem services and address the challenge to turn the value of ecosystem into a revenue stream. The successful proposal should help making natural capital and biodiversity based business models bankable, thereby enabling private investments in nature conservation. In other words, 'how to facilitate making money with nature by enhancing ecosystem conditions but not by exploiting it to the detriment of nature'.

The successful proposal should therefore take stock and establish links with the work undertaken by ongoing initiatives, European and national platforms on business and

biodiversity, the Natural Capital Protocol, Value balancing alliance, the Knowledge Innovation Project KIP INCA and other Horizon 2020 related projects¹¹⁷.

The successful proposal should support the practical implementation of corporate reporting obligations such as under the EU Non-Financial Reporting Directive (2014/95/EU)¹¹⁸ or of the EU Taxonomy on Sustainable Finance.

Applicants should create synergies with relevant projects under this call ('HORIZON-CL6-2021-BIODIV-01-07: Ecosystems and their services for an evidence-based policy and decision-making'; 'HORIZON-CL6-2021-BIODIV-01-17: Policy mixes, governance (including financing) and decision-making tools for transformative action for biodiversity' the EU Biodiversity Partnership and the Science Service. To this end, proposals should include specific tasks and appropriate resources for coordination measures, and, where possible, envisage joint activities and joint deliverables.

The proposal should set practical policy recommendations for the EU biodiversity strategy for 2030 targets and commitments. Proposals should contribute to strategic dialogue with the EC Knowledge Centre for Biodiversity forum and ensure that all evidence, results, data and information will be accessible and interoperable with the KCBD¹¹⁹.

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

This topic should include the effective contribution of social sciences and humanities disciplines.

Enabling transformative change on biodiversity

Topic ID and title	HORIZON-CL6-2022-BIODIV-01-08: Assessing the nexus of extraction, production, consumption, trade and behaviour patterns and of climate change action on biodiversity in the context of transformative change				
Budget	EUR 12 million	Opening date	28 October 2021	Deadline 1	15 February 2022
Budget per project	EUR 3 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	F&F, WW, P&P				
Keywords	Biodiversity loss, human impacts, primary production, ecosystem services, bioeconomy, multi-actor approach, nature-based solutions (NBS), environmental footprint, GIS-mapping, Bid data, Copernicus, GEO, GEOSS				
FTP comments					
FTP SIRA 2030 Challenges addressed	1A			FTP relevance	Medium
				Starting TRL	/
				End TRL	/

Expected Outcome

In line with the EU biodiversity strategy, a successful proposal must develop knowledge and tools to understand the role of transformative change for biodiversity policy making, address the indirect drivers of biodiversity loss, and initiate, accelerate and upscale biodiversity-relevant transformative changes in our society.

Projects must address all of the following outcomes:

- Economically, socially, ethically and institutionally viable and sustainable pathways are designed to minimise biodiversity loss or to enhance biodiversity. These pathways should consider mutually influencing extraction, production, consumption, trade patterns in the medium- and long-term (beyond 2030).
- Improve understanding of the human dimensions impacting biodiversity i.e. ethics, social context, institutions, organisation, behaviour will provide policy makers, industrial stakeholders and civil society the tools needed to reframe their actions, by highlighting the synergies of mainstreaming biodiversity with climate transitions, including on how to avoid or minimise trade-offs.
- Better understand social norms and behaviours, linked to socio-economic values (e.g. ethics, social context of individuals, consumers, institutions, organisations, industry) affecting biodiversity.
- Inform and motivate transformational change through learning, co-creation and dialogue based on case studies. The understanding of the biodiversity inter-

dependencies of the SDGs has improved; IPBES and IPCC are strengthened through European research and innovation. Provide a set of approaches, tools and knowledge influence policies at the appropriate level on transformative change for biodiversity – the key elements for this change are delivered by the portfolio of cooperating projects (of which these projects form part).

With focus on assessing the nexus of extraction, production (including processing), consumption, trade and behaviour patterns, including transformative changes for climate change on biodiversity for the EU and Associated Countries, international cooperation in particular with African countries, Brazil, Latin American and Caribbean countries or the Mediterranean region is strongly encouraged.

Scope

Proposals should address all the following points:

- Assess how extraction, production, processing, consumption, trade, behaviour patterns, especially linked to primary production (e.g. livestock with/or energy crops, etc. including through tele-coupling from consumption and all along supply chains), integrated food systems, and transformative changes towards climate neutrality, affect biodiversity and ecosystem services.
- Develop pathways together with key industries and key stakeholders to minimise loss of, and enhance biodiversity, whilst increasing the delivery of a wide range of ecosystem services. These industries cover food, feed, fibre, energy production and the wider food chain (related to bio-economy, renewable energies, infrastructure, technologies)¹²², and the deployment of climate mitigation and adaptation measures potentially harmful for biodiversity (e.g. concrete walls in coastal areas, replacement of biodiversity rich ecosystems for energy crops, etc.).
- Identify and address leverage points for transformational change in trade, triggering changes in established and new production and consumption patterns for new business models.
- Highlight the potential of (1) public procurement for delivering biodiversity benefits and (2) nature-based solutions for enabling and accelerating the relevant aspects of transformative change.
- Quantify investments into infrastructure and labour that could be shifted from impacting biodiversity negatively towards benefits for biodiversity, including the anticipation, mitigation and management of social, institutional and economic conflicts this may trigger (or decrease), to achieve a just transition process.

- Understand and engage communities and other social actors, including through citizens science, and initiate behavioural changes leading to production and consumption patterns preventing further biodiversity loss.
- Cooperate with ongoing activities to include biodiversity into integrated assessment models¹²³ and analyse the usability of existing and emerging concepts such as 'Planetary Boundaries', 'Doughnut Economy', 'Environmental Footprints'.
- Explain the relevance of transition pathways for biodiversity for competitive sustainability, towards a just transition in the full range of SDGs and climate neutrality.

Unsustainable production and consumption, including the role of trade for linking both, are pushing many of the direct drivers of biodiversity loss: land use change, overexploitation, climate change and pollution. Proposals should, based on a clear understanding of these relationships¹²⁴ address how leverage points and levers can be identified and used for generating benefits for biodiversity, e.g. through revision of regulation, standards, funding practices or governance processes.

They should highlight how the primary production sectors (in particular in agriculture, forestry, fisheries, raw material extraction, and also the construction sector) and the related infrastructure and energy provision and use impacts biodiversity directly. They should show effects on the direction of economic development, which leads to lock-in effects, inequalities, lack of capacities of institutions at every level to shift towards sustainable use, the protection and restoration of biodiversity and ecosystem services. On patterns of consumption, proposals should show how their impacts such as uneven use and exploitation of resources, generation of waste and pollution, value setting, power setting in societies, institutions and financial streams could be addressed in business, institutional and consumer agendas to achieve positive outcomes for biodiversity.

Proposals should assess the cultural diversity that influences these compromises and people's engagement, and lead the way to further mainstream biodiversity in socio-economic and environmental agendas, from the transformative aspect of changing extraction, production and processing, consumption, trade and behaviour patterns, including on actions for addressing climate change on biodiversity. They should also analyse and test the use of nature-based solutions as tool in this regard. Optimal and cost-effective use of behavioural games, networks of sensors, GIS-mapping, big data and observational programmes such as the European Earth observation programme Copernicus, through the Group on Earth Observations (GEO) and the Global Earth Observation System of Systems

(GEOSS) as well as citizens' observatories, should be used as appropriate to enable the integration and visualisation of data.

Social innovation is recommended when the solution is at the socio-technical interface and requires social change, new social practices, social ownership or market uptake.

Proposals should build their analysis upon the links between multiple Sustainable Development Goals, to deliver direct and indirect biodiversity benefits, and of the role of biodiversity in reaching the set of Sustainable Development Goals, when related to extraction, production, consumption, trade and behaviour patterns.

Proposals should produce case studies and collect good and bad examples that could inform these transformations and inform and inspire transformative change through learning, co-creation and dialogue.

Proposals should include specific tasks and ensure sufficient resources to develop joint deliverables (e.g. activities, workshops, as well as joint communication and dissemination) with all projects on transformative change related to biodiversity. This concerns projects funded under this destination, or under calls included in Destination 'Fair, healthy and environmentally-friendly food systems from primary production to consumption' related to transformational change (Fair, healthy and environmentally-friendly food systems from primary production to consumption) that aim to deliver various co-benefits, including on the reduction of biodiversity loss. Projects should use existing platforms and information sharing mechanisms relevant for transformational change and on biodiversity knowledge¹²⁵. Cooperation and possibly synergies with relevant topics in Cluster 5 should be explored and established as relevant. Furthermore, cooperation is expected with the European partnership on biodiversity and with the Science Service.

Proposals should show how their results might provide timely information for major science-policy bodies such as the Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC), as well as the Convention on Biological Diversity on project outcomes. Cooperation is requested with projects under 'HORIZON-CL6-2021-BIODIV-01-20: Support to processes triggered by IPBES and IPCC' and 'HORIZON-CL6-2022-BIODIV-01-10: Cooperation with the Convention on Biological Diversity'.

This topic should involve the effective contribution of social science and humanities disciplines.

Destination 3: Circular economy and bioeconomy sectors

This destination and its topics target climate-neutral **circular and bioeconomy transitions**, covering safe **integrated circular solutions at territorial and sectoral levels**, for important material flows and product value chains, such as the textile, electronics, plastics and construction sectors, as well as **key bioeconomy sectors** such as **sustainable bio-based systems, sustainable forestry, small-scale rural bio-based solutions**, and **aquatic value chains**. With this approach, the destination supports the European Green Deal, and other European initiatives such as the Industrial Strategy, SME Strategy, Circular Economy Action Plan, Bioeconomy Strategy, Biodiversity Strategy, Farm to Fork Strategy, Textile Strategy, Plastics Strategy, the Action Plan on Critical Raw Materials, and the Forest Strategy.

More specifically, the focus on **circularity**¹⁹⁷ aims at less waste and more value by extending the lifetime and retaining the value of products and materials. It supports a sharing, reusing, and material-efficient economy, in a safe way, and minimises the non-sustainable use of natural resources. The cascading use of materials and innovative upcycling of waste to new applications is encouraged. The safe and sustainable use of biomass and waste¹⁹⁸ for the production of materials and products, including nutrients, can reduce Europe's dependence on non-renewable resources, cut GHG emissions, offer long-term circular carbon sinks and substitutes to fossil-based and carbon-intensive products, and reduce pressures on biodiversity and its wide range of ecosystem services. The potential of biological resources goes beyond biomass processing into renewable products. It includes the use of organisms and their parts in "green" (i.e. more environmentally friendly) bio-based industrial processes. Marine and land-based biotechnology can provide new sustainable and safe food and feed production methods, greener industrial products and processes, new health-related products, and can help characterise, monitor and sustain the health of marine and terrestrial ecosystems. The potential of marine resources and biotechnology will contribute to the coming "blue economy", accelerating the transition towards a circular and climate-neutral economy that is sustainable and inclusive. The concepts of the circular economy, bioeconomy and blue economy converge and altogether provide an opportunity to balance environmental, social and economic goals, with their sustainability ensured by the life cycle assessment approaches.

Acknowledging the multiple benefits of circularized material/substance and energy flows, such circularity however has to be achieved in a safe, non-hazardous way without (re-)connecting epidemiological pathways or introducing pathogen/toxin enrichment cycles when involving biogenic materials. Established circularized material/substance flows have to be complemented with accompanying research in their safety and non-hazardous to health, society, economy and nature. In addition, a **local and regional focus**¹⁹⁹ is crucial for a

circular economy and bioeconomy that is sustainable, regenerative, inclusive and just. Innovative urban and regional solutions and value chains can create more and better quality jobs and help our economies rebound from the COVID-19 crisis.

A systemic and science-based circular transition with the help of research, innovation and investments will address all issues from material selection and product design via resource efficiency along the value chain to an optimised after-use system, incorporating reuse, repair and upgrade, refurbishment, remanufacturing, collection, sorting and new forms of recycling and upcycling also to improve the waste cycle management. It will tackle all barriers and mobilise all key stakeholders. The development of definitions, taxonomies, indicators and targets will inform and support policy and decision making. The use of advanced life cycle methods such as the European Commission Product Environmental Footprint (PEF), data and information will enable economic actors, including consumers, to make sustainable choices. The development and deployment of specific technological and non-technological circular solutions, including new business models, will cover intra- and inter-value chain collaboration between economic actors. The development of a working after-use system for plastic-based products, incorporating reuse, collection, sorting, and recycling technologies will provide insights into the transition towards a circular economy for key material flows including plastics. The Circular Cities and Regions Initiative (CCRI)²⁰⁰ under the European Circular Economy Action Plan will expand the circular economy concept beyond traditional resource recovery in waste and water sectors and support the implementation, demonstration and replication of systemic circular solutions for the transition towards a sustainable, regenerative, inclusive and just circular economy at local and regional scale. Water use will be tackled from a circularity perspective, aiming at pollution prevention, resource efficiency and business opportunities.

Bio-based innovation lays the foundations for the transition away from a fossil-based carbon-intensive economy by encompassing the sustainable sourcing, industrial²⁰¹²⁰² and small scale processing and conversion of biomass from land and sea into circular bio-based materials and products with reduced carbon and environmental footprint including lower impacts on biodiversity and long-term circular carbon sinks in sustainable products substituting carbon-intensive ones, with improved end-of-life including biodegradability in specific natural as well as controlled environments. It also capitalises on the potential of living resources, life sciences and industrial biotechnology for new discoveries, products, services and processes, both terrestrial and marine. Bio-based innovation can bring new and competitive economic activities and employment to regions and cities in the recovery from the COVID-19 crisis, revitalising urban, rural and coastal economies and strengthening the long-term circularity of the bioeconomy, including through small non-food bio-based

solutions. Furthermore, targeted and well-tailored investments can increase and diversify the income of primary producers and other rural actors (e.g. SMEs).

To enable the bio-based innovation, environmental objectives and climate neutrality will build on a robust understanding of environmental impacts and trade-offs of bio-based systems at the European and regional scale, including the comparisons to similar aspects on the fossil and carbon-intensive counterparts. Systemic impacts of bio-based systems on biodiversity and its wide range of ecosystem services as well as how we restore and use them, need to be assessed, and negative impacts avoided in line with the “do no harm” principle of the European Green Deal. Implementing sustainable and just bio-based value chain requires symbiosis across primary production and industrial ecosystems in regions, Member States and Associated Countries and improved environmental performance of products, processes, materials and services along value chains and life cycles.

The **multifunctional and sustainable management of European forests** as well as the environmentally sustainable use of wood and woody biomass as a raw material have a crucial role to play in the achievement of the EU’s climate and energy policies, the transition to a circular and sustainable bioeconomy as well as the preservation of biodiversity and the provision of ecosystem services such as climate regulation, recreation, clean air, water resources and erosion control among many others. Furthermore, forestry and the forest-based sector offer important opportunities for wealth and job creation in rural, peripheral and urban areas. The condition of European forests is increasingly threatened by a growing number of social, economic and environmental and climatic pressures. The European Green Deal and the EU Biodiversity Strategy for 2030 recognise that the EU’s forested area needs to improve, both in quality and quantity, for the EU to reach climate neutrality and a healthy environment. The multifunctionality and the sustainable forest management under rapid climate change will be enabled through a variety of approaches, including the use of intelligent digital solutions, enhanced cooperation in forestry and the forest-based sector as well as the establishment of an open-innovation ecosystem with relevant stakeholders.

Aquatic biological resources and blue biotechnology are crucial to delivering on the Green Deal’s ambition of a ‘blue economy’, which alleviates the multiple demands on the EU’s and the Associated Countries’ land resources and tackles climate change.

The immense marine and freshwater biodiversity both faces and offers solutions to multiple challenges such as climate, biodiversity loss, pollution, food security, green products, and health but remains largely unexplored. Unprecedented advances in the biotechnology toolbox (e.g. -omics, bioinformatics, synthetic biology) have triggered an increased interest in the potential of aquatic bioresources. Further research and innovation will be key to unlocking the value of the marine and freshwater biological resources available in Europe,

including its outermost regions by learning from the functioning and processes of aquatic living organisms to provide a sustainable products and services to the society, whilst avoiding systemic impacts on biodiversity. Algae biomass is becoming increasingly important not only as food but also as a sustainable source of blue bioeconomy products such as pharmaceuticals, cosmetics, and speciality chemicals. Although only a small fraction of marine microbial diversity has been characterised to date, advances in genetic and sequencing technologies are opening new avenues for the understanding and harnessing marine microbiomes such as for the biodiscovery of new products and services for the environment and society.

Expected impacts

Proposals for topics under this destination should set out a credible pathway to developing circular economy and bioeconomy sectors, achieving sustainable and circular management and use of natural resources, as well as prevention and removal of pollution, unlocking the full potential and benefits of the circular economy and the bioeconomy, ensuring competitiveness and guaranteeing healthy soil, air, fresh and marine water for all, through better understanding of planetary boundaries and wide deployment and market uptake of innovative technologies and other solutions, notably in primary production (forestry) and bio-based systems.

Specifically, the topics will target one or several of the following impacts, for circular economy, bio-based sectors, forestry and aquatic value chains:

- **Regional, rural, local/urban and consumer-based transitions** towards a sustainable, regenerative, inclusive and just circular economy and bioeconomy across all regions of Europe based on **enhanced knowledge and understanding of science**, in particular regarding biotechnology-based value chains, for all actors, including policy makers, to design, implement and monitor policies and instruments for a circular and bio-based transitions.
- **European industrial sustainability, competitiveness and resource independence** by lowering the use of primary non-renewable raw materials and reducing greenhouse gas emissions and other negative environmental footprint (including on biodiversity), enabling climate-neutrality and higher resource efficiency (e.g. by circular design, improved waste management, cascading use of biomass) along and across value chains, developing innovative and sustainable value-chains in the bio-based sectors, substituting fossil-based ones, increasing circular practices in textiles, plastics, electronics and construction, developing recycling technologies and industrial symbiosis, increasing circular bio-based systems from sustainably sourced

biological resources replacing carbon-intensive and fossil-based systems, with inclusive engagement of all stakeholders;

- **Improved consumer and citizen benefits**, including in the rural settings by establishing circular and bio-based systems based on sustainability, inclusiveness, health and safety; reaching a significantly higher level of involvement of all actors (manufacturers, retailers, consumers, public administration, primary biomass producers etc.);
- **Multi-functionality and management of forests** in Europe based on the three pillars of sustainability (economic, environmental and social);
- **Enlarged potential of marine and freshwater biological resources and blue biotechnology** to deliver greener (climate-neutral circular) industrial products and processes, and to help characterise, monitor and sustain the health of aquatic ecosystems for a healthy planet and people.

When considering their impact, proposals also need to assess their compliance with the “Do No Significant Harm” principle²⁰³ according to which the research and innovation activities of the project should not be supporting or carrying out activities that make a significant harm to any of the six environmental objectives of the EU Taxonomy Regulation.

In addition to the impacts listed above, topics under this destination will address the following impact areas of the Horizon Europe Strategic Plan for 2021-2024: “Climate change mitigation and adaptation”, “Enhancing ecosystems and biodiversity on land and in waters”, “A resilient EU prepared for emerging threats”; “Inclusive growth and new job opportunities”; “Industrial leadership in key and emerging technologies that work for people”.

Call – Circular economy and bioeconomy sectors 2021

Innovative sustainable bio-based systems and the bioeconomy

Topic ID and title	HORIZON-CL6-2021-CircBio-01-08: Mainstreaming inclusive small-scale bio-based solutions in European rural areas				
Budget	EUR 9 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 3 million			Deadline 2	/
Type of action	Coordination and Support Action (CSA)				
FTP subsector	WW, P&P				
Keywords	Bio-based innovations, rural areas, innovation support services, circular bioeconomy				
FTP comments					
FTP SIRA 2030 Challenges addressed	7C	FTP relevance		Low	
		Starting TRL		/	
		End TRL		/	

Expected Outcome

In line with the European Green Deal objectives and the EU bioeconomy strategy, successful proposals will support innovators to scale-up inclusive and small-scale biobased solutions in rural areas contributing to regional, urban and consumer-based transitions towards a sustainable, regenerative, inclusive and just circular economy and bioeconomy across all regions of Europe at local and regional scale.

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

- Enhanced cooperation between the key players and knowledge holders resulting in sustainable business model pathways for bio-based innovations in rural areas;
- Provision of tailored and independent support to innovators in order to accelerate the development of marketable products and services and to improve the market penetration of bio-based solutions in Europe;
- Successful deployment of existing scientific and practical knowledge and more bio-based solutions introduced in rural areas in line with relevant policy initiatives (e.g. bioeconomy strategy, European Green Deal, common agricultural policy (CAP), long-term vision for rural areas, etc.).

Scope

Europe's future economic growth and job creations will increasingly stem from innovation in products, services and business models. This is why there is currently considerable investment in research and innovation. However, there are barriers to the adoption and

implementation of research results and cooperation between research, advisory services, farmers, foresters and other actors in the supply chain is not adequately supported. Regional platforms for innovation support services are needed to help European regions develop their bio-based economies and to increase awareness and knowledge about emerging opportunities as well as the environmental and socio-economic impacts relating to the valorisation of locally or regionally available biomass.

Proposals will:

- Establish regional platforms that provide innovation support services to multi-actor partnerships (e.g. farmers, foresters, clusters, business support organisations, social partners, civil society organisations including non-governmental organisations, etc.) and increase regional stakeholders' awareness and understanding of the bioeconomy, its potential and impacts, and help them build the capacity to identify innovative bio-based business models.
- Based on previous research results (e.g. BE-RURAL226, Power4Bio227, BioeastUp228, etc.), activities should help match information on regionally available biomass, waste and residue streams with market information and technologies to enable full utilisation and sustainable production of bio-based products.
- Help transfer training and knowledge on better nutrient recycling in the circular bioeconomy, by identifying links between different agricultural/forestry and industrial value chains, raising awareness and sharing best practice on the use of residues as soil improvers and fertiliser in the bio-based economy.
- Consider contributing data and results to the European Commission's Knowledge Centre for Bioeconomy hosted by the JRC.

Clustering and cooperation with other selected projects under this topic and other relevant topics (e.g. HORIZON-CL6-2021-COMMUNITIES-01-02: Expertise and training centre on rural innovation) is strongly encouraged.

Social innovation²²⁹ is recommended when the solution is at the socio-technical interface and requires social change, new social practices, social ownership or market uptake.

Call – Circular economy and bioeconomy sectors 2022

Innovating sustainable bio-based systems and the bioeconomy

Topic ID and title	HORIZON-CL6-2022-CircBio-01-03: Benefits of the transition towards sustainable circular bio-based systems from linear fossil-based				
Budget	EUR 4 million	Opening date	28 October 2021	Deadline 1	15 February 2022
Budget per project	EUR 2 million			Deadline 2	/
Type of action	Coordination and Support Action (CSA)				
FTP subsector	F&F, WW, P&P				
Keywords	Environmental impact, social impact, economic impact, waste production, non-renewable resources, biodiversity loss, land use, ecosystem services, scenarios comparison, nature-based solutions (NBS), bio-based solutions				
FTP comments					
FTP SIRA 2030 Challenges addressed	4			FTP relevance	Low
				Starting TRL	/
				End TRL	/

Expected Outcome

Successful proposals will support policy makers in their efforts to develop sustainable pathways to replace fossil and carbon-intensive systems with circular bio-based systems at the EU and regional scale, in line with the 2030 climate targets and European Green Deal objectives. Project outcomes will contribute to foster European industrial sustainability, competitiveness and resource independence.

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

- Policies are designed to enable the transition from linear fossil-based systems to circular bio-based systems, setting priorities.

Scope

Abandoning the current linear fossil-based economy is a prerequisite for European Green Deal objectives and, in general, for preserving life on our planet. Biogenic resources are key means of mitigating climate change as they can strengthen natural and anthropogenic carbon sinks. Circular bio-based systems are part of the solution to achieving climate neutrality, where they replace carbon-intensive and fossil-based systems and are based on sustainably sourced biological resources. Policies must ensure that this transition from linear fossil-based to circular bio-based systems is sustainable and aims at i) climate change mitigation and adaptation; ii) increasing resource efficiency and circularity; iii) preserving and restoring natural resources, their ecosystem services and biodiversity; and i) ensuring a just transition for everyone. Policies and priorities should be comprehensive and underpinned

by a critical assessment of the environmental/social/economic impacts of the current linear fossil-based economy. That assessment should help individuating policy priorities, as well.

To support designing policies to transition away from linear fossil-based systems towards sustainable circular bio-based ones, proposals should:

a. Consolidate knowledge on current trends in terms of the environmental, economic and social limits of a linear carbon-intensive and fossil-based economy. By limits, we mean technical and structural barriers and/or inability to reach local and global Sustainable Development Goals (e.g. SDGs, climate change mitigation targets, European Green Deal objectives). Cultural and social limits should also be considered, including barriers related to gender and age.

b. Develop new/improve existing methodologies to assess environmental/social/economic impacts of linearity vs circularity in the economy, including on waste production and disposal, non-renewable resources exploitation and loss, geographically (and socially) unbalanced distribution of resources and growth, biodiversity loss at global and local scale. The methodologies should consider circular economy indicators, methods and concepts developed or under development in existing initiatives, including Commission's ongoing work on the circular economy monitoring framework and R&I activities.

c. Assess the environmental/social/economic impacts of the EU's current linear fossil-based economy. This should include aspects related to the geographical distribution of oil origins and global trade, direct and indirect environmental impacts of fossil-based value chains on a life cycle base, including on, but not limited to, climate change, resource use including land, water and marine space, air/water/soil quality, ecosystems services and biodiversity. Costs arising from environmental and social impacts should be internalised in the economic impacts assessment.

d. Develop and compare multiple scenarios of transitioning from fossil-based to circular bio-based systems, modelling the replacement of the fossil-based activities, with a focus on the most carbon-intensive ones, with bio-based systems, including innovative solutions, at EU and global scale. Environmental/social/economic impacts of bio-based systems should be assessed with validated methodology, considering also the benefits of applying a circular approach to the bio-based systems. Biogenic carbon capture utilization (BCCU) solutions for bio-based systems via nature-based solutions (e.g. in soils or long-term circular bio-based materials) should be part of the assessment. Scenarios should compare the impacts of fossil-based and bio-based solutions, and include social aspects and social innovation, especially at the socio-technical interfaces of innovative solutions.

e. Identify knowledge gaps in the assessment of the sustainability of the transition from fossil-based to circular bio-based systems and in the comparison between alternative scenarios as described under point d).

f. Identify priorities in the transition from fossil-based to circular bio-based systems, according to scenarios analysed in the project and develop guidelines and policy recommendations.

Proposals should include a task dedicated to sharing methodologies and findings with projects funded within this topic.

This topic should involve the effective contribution of social sciences and humanities (SSH) disciplines.

Safeguarding the multiple functions of EU forests

Topic ID and title	HORIZON-CL6-2022-CircBio-01-06: Strengthening the European forest-based research and innovation ecosystem				
Budget	EUR 4 million	Opening date	28 October 2021	Deadline 1	15 February 2022
Budget per project	EUR 4 million			Deadline 2	/
Type of action	Research and Innovations Actions (RIA)				
FTP subsector	F&F, WW, P&P				
Keywords	EU Forest Strategy, open-innovation ecosystem, funding possibilities, trans-national R&I cooperation, R&I roadmap, multifunctionality of forest, forest management, multi-actor approach				
FTP comments					
FTP SIRA 2030 Challenges addressed				FTP relevance	High
				Starting TRL	/
				End TRL	/

Expected Outcome

To support the new EU forest strategy, successful proposals will assess research needs and funding possibilities for forestry and the forest-based sector, notably for the multifunctionality and management of forests in Europe based on the three pillars of sustainability (economic, environmental and social). Project results are expected to contribute to all of the following expected outcomes:

- Better insights into existing funding sources (including Horizon Europe, rural and regional development funds) and streamlining of research and innovation (R&I) actions in Europe.
- Establishment of a co-creative environment allowing stakeholders to identify jointly existing research gaps and future priorities to coordinate research efforts at regional, national and European level.
- Intensified trans-national R&I cooperation in forestry and the forest-based sector on research priorities, critical and key technologies.
- Creation of an open-innovation ecosystem with relevant stakeholders in the EU and associated countries to support the evolution of the forest-based sector.

Scope

A key R&I challenge for the coming years is to address the complexity of the forest-based sector in environmental terms (long life cycle, ecosystem functioning and diversity, spatial variability, interface between the soil and the atmosphere, in the middle between cultivated and natural assets), economic terms (multiple forest owners and SMEs, competitiveness on

global markets) and policy terms (many forest-related policies including biological diversity, climate and energy, bioeconomy, rural development, trade, agriculture, etc.).

A successful transition of the forest-based sector towards greater sustainability needs to be underpinned by a comprehensive scientific assessment. Better coordination of research activities is also required to overcome fragmentation of public research efforts, to strengthen the link between forest managers, industries and society and to streamline the activities of European, national and regional stakeholders.

Proposals will:

- Analyse the forest-based sector in an integrated way, considering different biodiversity and bioeconomy issues, societal expectations and climate change risks that call for an intensified European and international collaboration.
- Design a suitable method for conducting foresight analysis on issues that are likely to have an impact on forests in European regions and globally.
- Consider the future availability of and demands for different forest resources, and assess their sustainability within the changing global economic, social and environmental conditions.
- Provide evidence and knowledge on how existing funding sources at EU (including Horizon Europe, rural and regional development funds), Member State, associated countries' and regional levels are mobilised to support research and innovation initiatives in the forest-based sector.
- Address the necessity for new knowledge to support major transitions and innovations in forestry and the forest-based sector in view of the new EU forest strategy and other major policy initiatives.
- Develop a structured framework for a European network of research funding and research policy organisations across the different parts of the forest-based and related sectors to increase cross-fertilisation between different areas of knowledge generation and innovation activities.
- Develop an R&I roadmap at EU-level and prepare for a possible European partnership or other appropriate comprehensive actions under Horizon Europe.
- Provide scenarios and information on how to maximise synergies and minimise trade-offs between the different funding instruments and research needs (environmental, economic and social dimensions)

- Assess the potential of flagship projects in selected key strategic areas in the forest-based sector (e.g. integrated forest research across several dimensions of sustainable forest management; landscape-level integration of forest research at the interface with other sectors (agriculture, cities, water); increased, sustainable wood production and mobilisation; renewable building materials for healthier living; role of new wood-based products to reach climate neutrality by substitution effects; contributions of the forest-based sector in the green recovery).

Proposals must implement the ‘multi-actor approach’ and ensure a value chain approach, with adequate involvement of the forestry and forest-based sector.

Social innovation is recommended when the solution is at the socio-technical interface and requires social change, new social practices, social ownership or market uptake.

Call – Circular economy and bioeconomy sectors 2022 two-stage

Enabling a circular economy transition

Topic ID and title	HORIZON-CL6-2022-CircBio-02-01-two-stage: Integrated solutions for circularity in buildings and the construction sector				
Budget	EUR 21 million	Opening date	28 October 2021	Deadline 1	15 February 2022
Budget per project	EUR 6 to 8 million			Deadline 2	01 September 2022
Type of action	Innovations Actions (IA)				
FTP subsector	WW				
Keywords	circular solutions, waste management, reuse, recycling, digital solutions, life cycle, construction and demolition waste (CDW), Building Information Modelling (BIM), Digital Twin, GHG emissions				
FTP comments					
FTP SIRA 2030 Challenges addressed	4			FTP relevance	Medium
				Starting TRL	/
				End TRL	6-8

Expected Outcome

A successful proposal will contribute to all Destination ‘Circular economy and bioeconomy sectors’ impacts related to consumers and industry, in particular to European industrial sustainability, competitiveness and resource independence by lowering the environmental footprint, enabling climate-neutrality and higher resource efficiency, through increased circularity and a resulting reduction in GHG emissions.

Project results are expected to contribute to at least four of the following outcomes:

- Increased deployment and market uptake of innovative climate-neutral circular solutions for construction, waste prevention, lifetime extension and significant improvement of lifecycle performance of buildings and their components, including GHG emissions
- Increased deployment and market uptake of innovative solutions to design and manufacture for disassembly, waste prevention and management, reuse and recycling in the construction sector, including production and assembling
- Enhanced diffusion and demonstrated benefits of advanced digital solutions, ensuring coherence with other initiatives such as digital logbooks for logistics of construction materials and the energy-efficient operation of buildings
- Increased recovery and recycling rates of construction and demolition waste

- Improved elimination of hazardous substances from secondary materials
- Increased upcycling of reused and recycled material in construction materials, products and buildings
- Increased knowledge about the overall environmental footprint of buildings and construction materials, including the integrated assessment of material and energy efficiency with regard to possible trade-offs and synergies, and increased practical application of the Commission's Product Environmental Footprint method.

Scope

The 2020 circular economy action plan (CEAP) states that “the built environment has a significant impact on many sectors of the economy, on local jobs and quality of life. It requires vast amounts of resources and accounts for about 50% of all extracted material. The construction sector is responsible for over 35% of the EU's total waste generation. Greenhouse gas (GHG) emissions from material extraction, manufacturing of construction products, construction and renovation of buildings are estimated at 5-12% of total national GHG emissions. Greater material efficiency could save 80% of those emissions.” Measures should strive for the use of more climate-neutral circular materials with low environmental footprint and tackle material recovery, upcycling, recycled content in products, durability and adaptability of buildings, and they should have a strong life cycle and digitalisation focus. They should also focus on circular design that facilitates reuse and recycling beforehand.

This activity should demonstrate at large scale and deploy innovative climate-neutral circular solutions that prevent waste, expand the lifetime and improve the life cycle performance of buildings and their components, but also improve the quality of and the confidence in reused and recycled material. This targets materials, products, equipment and systems, their sourcing, design, upgradability, durability, material efficiency, dismantling, recyclability, etc. Dismantling and deconstruction should be embedded already in the design phase, with the adoption of circular economy principles, and thus reduce construction and demolition waste (CDW). As part of an overall digitalisation of the construction ecosystem, projects should use digital tools such as Building Information Modelling (BIM) or Digital Twin, which are key to traceability and circularity, and can be further used during deconstruction. Appropriate material recycling within construction operations, waste material identification, sorting and decontamination solutions should be considered to improve material logistics, processing and upgrading. Projects should aim to support the strengthening of preferably local or regional secondary material markets. All solutions should be based on life-cycle approaches and proposals should integrate life cycle assessment using the European Commission's Product Environmental Footprint (PEF) method and relevant costing methods. The projects

should also propose, test and demonstrate new business models. Projects should also develop training material to endow workers in this occupational group with the right skillset in order to deploy the new technologies developed. All achieved outcomes should be demonstrated using quantitative indicators and targets wherever possible.

With regard to the territorial aspects of all proposed solutions, proposals seek to contribute to the goals and cooperate with the services of the European Commission's Circular Cities and Regions Initiative (CCRI). Joint activities with CCRI projects are encouraged.

Proposals should seek to build synergies with projects funded under Cluster 4 Destination 'Climate neutral, circular and digitised production', section "A new way to build, accelerating disruptive change in construction". Projects are therefore strongly encouraged to organise joint activities, ensure synergies and undertake clustering activities with projects under Cluster 4.

Projects should seek to contribute to the New European Bauhaus initiative by supporting the green and digital transitions in communities' living environments through merging sustainability, inclusiveness and quality of experience.

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

Safeguarding the multiple functions of EU forests

Topic ID and title	HORIZON-CL6-2022-CircBio-02-06-two-stage: Harnessing the digital revolution in the forest-based sector				
Budget	EUR 15 million	Opening date	28 October 2021	Deadline 1	15 February 2022
Budget per project	EUR 6 to 8 million			Deadline 2	1 September 2022
Type of action	Innovations Actions (IA)				
FTP subsector	F&F, WW, P&P				
Keywords	EU Forest Strategy, digital solutions, ICT innovations, ecosystem services, forest resources, wood value chain, precision forestry, harvesting systems, nurseries, harvest planning, operations management, timber transport, Copernicus, Galileo/EGNOS pests, forest fires, multi-actor approach				
FTP comments					
FTP SIRA 2030 Challenges addressed	2B,D - 8C - 9D - 10C,D	FTP relevance		High	
		Starting TRL		/	
		End TRL		6-7	

Expected Outcome

line with the EU forest strategy and the European digital strategy, successful proposals will demonstrate the potential of digital solutions in forestry and forest-based value chains contributing to the multifunctionality and management of forests in Europe based on the three pillars of sustainability (economic, environmental and social). Project results are expected to contribute to all of the following expected outcomes:

- Deployment of information and communication technology (ICT) innovations in forestry to optimise productivity as well as the delivery of ecosystem services.
- Application of innovative approaches along the forest-based value chain by more accurate tracing methodologies of forest resources.
- A greater competitive advantage for European industries that utilise forest resources more efficiently.

Scope

The improved use of information flows and intelligent digital solutions that are increasingly available in forest monitoring, management and forestry operations, could help to significantly improve and unlock the efficiency of wood supply chain activities. Modern digital applications also provide promising possibilities to improve forest managers' decision making in a precious and complex forest environment and to improve ecosystem monitoring.

This topic addresses innovations in information systems for forest managers, forest-based industries and policy makers as well as advances in precision forestry, harvesting systems and forest nursery operation, optimised harvest planning, operations management, timber transport and logistics, as well as safety, ergonomics and smart assistance for human workers. The synergetic use of geo-spatial, statistical, and modelling technologies together with information and communication technologies such as aerial and satellite retrievals, (in particular from the Copernicus programme) and the 'web of things' combined with big-data analytics is highly encouraged.

The aim is to harness the potential of ICT and new technologies to improve the sustainability of forest management and logging operations with a view to sharing data throughout the wood value chain, thereby driving greater sustainability, to offer new business models along the value chain and to improve the traceability of forest resources for optimised and transparent supply chains. The integration in the new technologies of climate change impacts on these wood chains should be an essential component. Activities may also include robust and transparent methods and tools for high resolution forest and ecosystems services assessments, natural disturbance risk monitoring and analysis (including pests and forest fires) and disaster response systems.

Besides activities such as prototyping, testing, demonstrating and piloting in a near to operational environment, proposals may include limited research activities. Assessing and deepening the understanding of economic, social and environmental impacts through an enhanced application of digital technologies for foresters, small and medium-sized enterprises (SMEs) and industries, as well as end-consumers will be of special interest, including the assessment of risks and opportunities for jobs in forestry, the wider forest-based sector and rural communities.

Proposals must implement the 'multi-actor approach' and ensure adequate involvement of the primary sector and the wider forest-based value chain. Cooperation with other selected projects under this topic and other relevant projects is strongly encouraged.

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

Destination 4: Clean environment and zero pollution

Anthropogenic pollution undermines the integrity of Earth ecosystems and severely affects natural resources essential for human life. Keeping our planet clean and our ecosystems healthy will not only contribute to 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, particularly its zero pollution ambition, and the 2030 Climate Target Plan, and other relevant EU legislation²⁶⁰, this destination seeks to halt and prevent pollution by focussing the work programme 2021-2022 on fresh and marine waters, soils, air, including from nitrogen and phosphorus emissions, as well as on the environmental performance and sustainability of processes in the bio-based systems. Synergies with other clusters (notably 1 and 5), relevant destinations as well as missions and partnerships will be exploited.

Halting emissions of pollutants to soils and waters is of fundamental significance for the planet. Diffuse emissions of pollutants from land and urban sources, including atmospheric depositions, are a major stress factor for terrestrial and aquatic ecosystems, threatening the quality of surface waters and aquifers, and affecting soil quality and all water-dependent sectors that require a holistic understanding of the pollution sources, key vectors and pathways. Projected impacts of climate change will alter, and notably reduce, the hydrological flows in many parts of Europe, while eutrophication could be exacerbated by increasing temperatures. Climate change and increasing water demand will exert significant pressures on surface and groundwater quality²⁶¹, notably where the combined effect of water table depletion and sea level rise will endanger the integrity of coastal aquifers and groundwater quality. This is due to saline water intrusion or extreme events (e.g. higher tides, storm surges or inland flooding events), which will put coastal wetlands and reservoirs, estuaries and ecosystems at risk. While recognising its essential role in aquatic ecosystems functioning and services, the sediments originating mostly from run-off and erosion are likely the major source of physical pollution of water bodies (excessive turbidity, impacts of deposition, accumulation of litter and debris) and contribute to a large extent to chemical and biological pollution of receiving waters. Beside land use practises, the increasing intensity and variability of precipitation will exacerbate erosion risks, affect the deposition and transport of sediments and could lead to a remobilisation of legacy contaminants and further deteriorate the quality of soils, sediments and water bodies, including aquifers, estuaries and coastal areas, and of their ecosystem function and services.

Keeping nitrogen (N) and phosphorus (P) cycles in balance is another crucial challenge. N and P flows from anthropogenic sources, mostly from excessive or inefficient input of fertilisers (including manure, sewage sludge, etc.) in agriculture, 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 media are concerned, a systemic approach is necessary to limit N/P emissions from different sources, for example through the deployment of alternative fertilising products, and considering regional conditions (geography, climate zones, economy activities, soil properties, eco-system condition, agricultural practices, governance structures etc.), and to bring N/P flows back within safe ecological boundaries

Protecting drinking water and managing water pollution in rural settlements, and in increasingly dense urban areas requires innovative and holistic approaches at city/catchment level to ensure water quality, resilient to the impacts of climate and global change, by considering different spatial and temporal scales and contexts, aging water infrastructures, as well as pollution derived from point and non-point sources, and natural/human-made disasters. Protective measures should consider current and future land use, environmental needs and socioeconomic interests as essential elements for improving water quality and its management and governance. Re-emerging pollutants, such as polychlorinated biphenyls (PCB) or mercury, and contaminants of emerging concern (CECs) in water bodies may have impacts on ecological and human health, and some are not well regulated under existing environmental legislation. Sources of these pollutants include e.g. industry, agriculture, urban runoff, household products, coatings, paints and pharmaceuticals that are normally disposed of to sewage treatment plants and subsequently discharged into water bodies. Micro-pollutants, plastics, pathogens and CECs, individually or combined, represent a concern for a safe and good quality drinking water supply. Increasing water temperatures, notably due to climate change could deteriorate the quality of aquatic ecosystems and drinking water sources by favouring the conditions for enhanced eutrophication as well as pathogen development or the spread of invasive species. Emerging concerns are also growing at the level of drinking water treatment and distribution, notably in relation with disinfection operations and possible harmful effects of by-products and metabolites.

Addressing pollution on seas and ocean is a prerequisite for a healthy planet. The ocean is being polluted and destroyed due to the release of substances or energy in marine waters which initiate a range of subsequent effects. According to a new European Environment Agency report, all four regional seas in Europe have a large-scale contamination problem, ranging from 96% of the assessed area in the Baltic Sea and 91% in the Black Sea, to 87% in the Mediterranean and 75% in the North-East Atlantic Ocean. The main sources of pollution include industrial, agricultural and municipal waste runoff, other human activities (e.g. transport), underwater noise, light, atmospheric deposition, etc. into marine waters.

Increasing the environmental performance and sustainability of processes and products plays a significant role in keeping our planet clean. Environmental pollution resulting from human activity is detrimental to ecosystems at different functional levels, representing, also, an important economic burden for society. Circular bio-based systems, including biotechnology, have the potential to substantially contribute to the European Green Deal objectives, provided that they are developed sustainably and systemically aiming at mitigating the climate change and its impacts, increasing resource efficiency and circularity, preserving and restoring ecosystems services, natural resources, air/water/soil quality and biodiversity. Indicators of such sustainability are needed, building on dynamic perspectives at scales ranging, in space, from planetary to local ecosystems and, in time, from next decade to the end of century and beyond. Environmental impacts should be traced along value chains and trades to enable responsible production and consumption.

Expected impacts

Pollution must be halted and eliminated to guarantee clean and healthy soils, air, fresh and marine water for all. To reach this objective, it will be paramount to advance the knowledge of pollution sources and pathways to enable preventive measures, improve monitoring and control, apply planetary boundaries in practice and introduce effective remediation methods.

Proposals for topics under this destination should set out a credible pathway to contribute to the aforementioned goal to achieve a clean environment and zero pollution, and more specifically to one or several of the following impacts:

- Advanced understanding of diffuse and point sources of water pollution in a global and climate change context, enabling novel solutions to protect 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.
- Balanced N/P flows well within safe ecological boundaries at EU and Associated Countries, regional and local scale, contribute to restoring ecosystems.
- Clean, unpolluted seas in the EU and Associated Countries as a result of successful behavioural, social-economic, demographic, governance and green-blue transitions.
- Circular bio-based systems reversing 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.
- Innovative biotechnology creating zero-pollution bio-based solutions.

When considering their impact, proposals also need to assess their compliance with the “Do No Significant Harm” principle²⁶² according to which the research and innovation activities of the project should not be supporting or carrying out activities that make a significant harm to any of the six environmental objectives of the EU Taxonomy Regulation.

Actions should develop scientifically robust and transparent approaches and methodologies, building on achievements from previous research activities, where possible and appropriate. To ensure deployment, trustworthiness, swift and wide adoption by user communities, and to support EU and national policy-makers, they should adopt high standards of transparency and openness, going beyond ex-post documentation of results and extending to aspects such as assumptions, models and data quality during the life of projects.

Topics under this destination will address the following impact areas of the Horizon Europe strategic plan for 2021-2024: “Climate change mitigation and adaptation”; “Enhancing ecosystems and biodiversity on land and in waters”; “Good health and high-quality accessible healthcare”; “Clean and healthy air, water and soil”; “A resilient EU prepared for emerging threats”; and “Inclusive growth and new job opportunities”.

Call – Clean environment and zero pollution 2021

Increasing environmental performances and sustainability of processes and products

Topic ID and title	HORIZON-CL6-2021-ZEROPOLLUTION-01-05: Environmental sustainability criteria for biological resources production and trade in bio-based systems: impacts and trade-offs				
Budget	EUR 6 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 6 million			Deadline 2	/
Type of action	Innovations Actions (IA)				
FTP subsector	F&F, WW, P&P				
Keywords	Certification, international trade, bio-based systems, primary biomass resources production, biological feedstock, secondary raw materials, environmental impacts, land use, GHG emissions, ecosystem services, biodiversity, energy consumption, life cycle, traceability				
FTP comments					
FTP SIRA 2030 Challenges addressed	1 - 2E	FTP relevance		Medium	
		Starting TRL		/	
		End TRL		7-8	

Expected Outcome

The successful proposal will support tracing environmental impacts of biological resources production and trade by primary producers, traders and certification companies to enable responsible production in the industrial bio-based systems, in line with the 2030 Climate Target Plan and the zero pollution ambition. Project outcomes will contribute to establish circular bio-based systems reversing climate change, restoring biodiversity and protecting air, soil and water quality along supply chain of biological resources and industrial value chains, within the EU and across borders. Project results are expected to contribute to the following expected outcome:

- Certification schemes for international trade at EU and global scale of biological resources for bio-based systems include the environmental impacts and trade-offs along the bio-based supply chains.

Scope

Assessment of environmental sustainability of biological resources production and trades in the bio-based systems is still a challenge. Indicators of such sustainability should build on dynamic perspectives at scales ranging, in space, from planetary to local ecosystems and, in time, from next decade to the end of century and beyond.

Proposals should:

- a. Identify the range of biological resources intended for industrial bio-based systems at EU and local (regional/rural/urban/coastal) scale, including primary biomass resources production and biological secondary raw materials from rural/urban/industrial activities. Industrial bio-based systems do not include food/feed, biofuels, bioenergy and cultural/recreation sectors. However, relevant initiatives in the field of assessment and certification of environmental sustainability of biological resources arising from EU policies in the bioeconomy sectors should be taken into account. Aspects of trade of biological resources within the EU and at global level should be part of the analysis.
- b. Collect data and figures on volumes of biological resources identified under a) in global trade flows and imports into the EU and their geographic distribution. The data collection should be based on existing and consolidated statistics and market databases.
- c. Improve existing and/or develop new methodology for the assessment of the environmental impacts and trade-offs of biological resources in the scope addressing, but not limiting to, the following environmental categories: i) GHG emissions/savings and carbon footprint; ii) emissions from nitrogen and phosphorous based fertilisers; iii) land use and land use change and its related impact on land carbon sink capacity; iv) marine space use and marine space use change; v) water use; vi) biodiversity and ecosystem services; vii) energy consumption, viii) any other aspects of air/water/soil environmental quality. Assessments should consider the life cycle perspective and relevant regulatory requirements in terms of trade (across and within the EU), to the extent possible. Trade-offs and synergies with food production, nature-based solution to protect biodiversity or other resources use and ecosystem services (e.g. recreation, urban creep) should be included in the assessment;
- d. Align methodology in c) with indicators (e.g. environmental, demographic, geophysics indicators) provided by consolidated and available database, including networks of environmental observations, efficiently.
- e. Adapt methodology in c) to be suitable to definition/identification of environmental sustainability criteria compliant with the format of certification schemes in terms of either adopting existing certification schemes or developing of ad hoc ones. Criteria should be aligned with the Commission's Taxonomy Regulation²⁷¹. Traceability of biological resources at European and global scale should be essential part of certification.
- f. Demonstrate the developed methodologies for the assessment of environmental impacts and trade-offs, sustainability criteria and certification schemes to a range of biological resources intended for industrial bio-based systems in an operational environment and deliver guidelines.

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

Proposals' consortia should involve primary producers of biological resources, trade bodies, bio-based industries, agencies/companies developing certification, consumers' organisations and any stakeholder along the supply chain of biological resources for bio-based industries.

Topic ID and title	HORIZON-CL6-2021-ZEROPOLLUTION-01-06: Increasing the environmental performance of industrial processes in bio-based sectors: construction, woodworking, textiles, pulp and paper and bio-chemicals				
Budget	EUR 7 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 3,5 million			Deadline 2	/
Type of action	Research and Innovation Actions (RIA)				
FTP subsector	WW, P&P				
Keywords	GHG emissions, carbon footprint, emissions to air/water/soil, water use, biodiversity, ecosystem services, bio-based processes, energy efficiency, resource efficiency, materials circularity, non-toxic substances, Life Cycle Assessment (LCA)				
FTP comments					
FTP SIRA 2030 Challenges addressed	5 - 8	FTP relevance		High	
		Starting TRL		/	
		End TRL		5	

Expected Outcome

The successful proposal will support circular bio-based systems in industrial sectors in line with the European Green Deal and its zero pollution ambition and 2030 Climate Target Plan by increasing the environmental performance and sustainability of processes, and their ability to reverse climate change, restore biodiversity and protect air, water and soil quality along industrial value chains, within EU and across borders.

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

- Improvement of the environmental performance of industrial processes in the following bio-based sectors: construction, woodworking, textiles, pulp and paper, and bio-chemicals.

Scope

Proposals under this topic should focus on all of the following industrial bio-based sectors: construction, woodworking, textiles, pulp and paper, and bio-chemicals.

Proposals should:

- Identify and analyse case studies for each aforementioned industrial bio-based sector at the local (regional, rural, urban or coastal) or international scale within the EU and Associated Countries, and collect data and figures on the environmental performance of industrial processes in these sectors.
- Improve existing and/or develop new methodologies to assess the environmental impacts of these processes. The assessment should use, when possible, the Life Cycle Assessment methodology (in line with the existing international standards, the European Commission's

Product Environmental Footprint method²⁷² and other relevant sources of information), and include, but not limited to, the following environmental impacts: GHG emissions and carbon footprint, emissions to air/water/soil, water and primary energy use, biodiversity and ecosystem services. The assessment methodology should also look at social and economic aspects. Relevant data may feed into the European Platform on Life Cycle Assessment²⁷³.

c. Assess and analyse the environmental impacts and trade-offs of bio-based processes identified in a) based on the methodology developed in b).

d. Identify and evaluate possible solutions to improve the environmental performance of bio-based processes based on c). The aspects to be evaluated include, but are not limited to the following: GHG emissions reduction, resource and energy efficiency, shift to renewable energy sources, enhanced circularity of materials (including upcycling and cascading use of biomass), non-toxic substances used in the processes, replacement of toxic substances with non-toxic ones, minimisation of residual waste at all phases of the processes, efficient recovery of any waste and residual flows.

e. Demonstrate, where possible, the best solutions identified under point d) in order to evaluate their effectiveness and assess monitoring procedures.

f. Develop recommendations and guidelines to improve the environmental performance of processes in each of the aforementioned industrial bio-based sector. These should include a prioritisation of solutions and recommendations for modifications in specific processes and preliminary indications for monitoring procedures.

Proposals should include a task dedicated to sharing methodologies and findings with projects funded within this topic. Moreover, they should build synergies with research and innovation projects funded under Horizon Europe notably under “HORIZON-CL6-2021-ZERO POLLUTION-01-05: Environmental sustainability criteria for biological resources production and trade in bio-based systems: impacts and trade-offs”, and where relevant, seek complementarities and capitalise on the results of other past and ongoing research projects (especially under the Bio-based Industries Joint Undertaking).

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

Topic ID and title	HORIZON-CL6-2021-ZEROPOLLUTION-01-07: International and EU sustainability certification schemes for bio-based systems				
Budget	EUR 6 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 2 million			Deadline 2	/
Type of action	Coordination and Support Action (CSA)				
FTP subsector	F&F, WW, P&P				
Keywords	Business-to-business (B2B), certification schemes, LCA, Labels for biobased materials, bio-based value chain transparency, circular bio-based systems, biodiversity restoration, bio-waste, secondary raw materials				
FTP comments					
FTP SIRA 2030 Challenges addressed				FTP relevance	Medium
				Starting TRL	/
				End TRL	/

Expected Outcome:

The successful proposals will support tracing environmental impacts along value chains and trades in the bio-based systems for business-to-business communication to enable responsible production and consumption, in line with the 2030 Climate Target Plan and the zero pollution ambition. Project outcomes will contribute to establish circular bio-based systems reversing climate change, restoring biodiversity and protecting air, soil and water quality along supply chain of biological resources and industrial value chains, within the EU and across borders.

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

- Bio-based value chains transparency in international and EU trade is enhanced through business-to-business labels of biological resources and bio-based materials and products.
- Harmonization of existing international and EU certification scheme and the monitoring system and indicators of their effectiveness and robustness.

Scope:

Climate neutral circular bio-based systems have the potential to establish a zero-pollution economy provided that they are developed sustainably. Environmental, social and economic impacts and trade-offs should be traced along value chains and trades to enable responsible production and consumption. Activities under this topic should assess scope, potential and requirements of international and EU sustainability certification schemes and business-to-business labels applicable to biological resources including primary biomass resources and bio-waste and residues intended for bio-based industrial value-chains and to bio-based materials and products, also in complementarity with actions on bio-based innovation and

market measures. Industrial bio-based systems do not include food/feed, biofuels, bioenergy and cultural/recreation sectors. However, relevant initiatives in the field of assessment and certification of environmental sustainability arising from EU policies in the bioeconomy sectors should be taken into account. Traceability of biological resources and bio-based materials and products on a business-to-business level, at the EU and the global scale, should be part of certification, including aspects on primary and secondary biomass and bio-based intermediates in global trade flows and imports into the EU.

Proposals should:

- a. Review and analyse existing international and EU sustainability certification schemes and business-to-business labels for biological resources. The analysis should encompass schemes applied/applicable to biological resources intended for industrial bio-based value chains. Certified environmental, social and economic impacts and trade-offs should be analysed. Bio-waste and any biological secondary raw materials from rural/urban/industrial activities are included in the definition of biological resources.
- b. Collect data and figures on volumes of biological resources and bio-based materials and products in global trade flows and imports into (exports from) the EU and their geographic distribution, distinguishing between certified and uncertified resources and materials/products. The data collection should be based on existing and consolidated market databases.
- c. Review and analyse existing international and EU sustainability certification schemes and business-to-business labels for bio-based materials and products with the same level of detail apply to the analysis of resources (point a).
- d. Assess existing/develop new monitoring system and indicators of effectiveness and robustness of existing certification schemes and labels reviewed in point a) and c). The task should consider the life cycle analysis perspective and identify minimum requirements of a certification scheme to ensure its completeness covering environmental, social and economic aspects.
- e. Demonstrate/test effectiveness of existing (voluntary) certification schemes and labels and monitor their robustness; this action includes testing the monitoring system and indicators assessed/developed within the project, point d, on the reviewed schemes, point a) and c). The results should consolidate the optimal monitoring system and indicators and provide a preliminary selection of (parts of) the certification schemes covering the minimum requirements identified in point d). The same for labels.

f. Assess costs from the adoption of certification schemes and labels in selected industrial bio-based value-chains. The assessment includes selecting a range of value-chains in the EU and Associated Countries and the corresponding biological resources and flows of materials and products among those certified and reviewed in point a and c and collecting data and figures on the known costs: actual economic and internalised environmental and social ones. The evaluation of the externalised environmental and social costs should be part of the overall assessment, based either on primary data or/and on models taken from peer-reviewed literature in the related fields of economy, social and environmental sciences.

g. Evaluate the feasibility of business-to-business labels that award best performances either of resources or material or products from either environmental or social aspects. The feasibility should include modelled economic costs and benefits.

h. Analyse and develop recommendations on how to promote the best practices in the adoption of effective and robust certification schemes and business-to-business labels. Promoting actions may include deployment and take-up by industrial sectors of certification schemes, building trust between business stakeholders, deploying corporate responsibility, engagement with and awareness of bio-based sectors.

i. Engage in cooperation with international partners and organisations, to increase impact and outreach, while ensuring sufficient focus on the EU's situation.

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 task dedicated to sharing methodologies and findings with projects funded within this topic. Proposals' consortia may include, but not be limited to, experts in certification schemes and stakeholders of the international and EU trade of biomass resources and bio-based materials and products.

This topic should involve the effective contribution of SSH disciplines.

Destination 7: Innovative governance, environmental observations and digital solutions in support of the Green Deal

Transformative changes such as the ones required within the Green Deal are dynamic processes that require appropriate governance. At the same time, to ensure coordination and for collaborative decision-making, governance requires multiple channels and networks that provide readily available data and information coming from different sources.

R&I activities under this destination aim at both: experimenting with new ways to govern the transition process and modernising the governance, in particular by making information and knowledge available and accessible. R&I for governance to support the Green Deal shall provide insights into institutional barriers such as lock-ins, path dependency, political and cultural inertia power imbalances and regulatory inconsistencies or weaknesses.

Innovative governance supporting the Green Deal objectives needs to recognise, cope with and promote resilience in the face of on-going shocks and disruptions both globally and across Europe, whether these be climatic, ecological, economic, social, geo-political or related to health. Critical risk assessment and reduction strategies need to be incorporated, including the diversification of infrastructures, resources and knowledge through more self-sufficiency and autonomy.

Taking advantage of the use, uptake, deployment and exploitation of environmental observations³⁸² as well as digital solutions, assessed through the “do not harm” principle of the Green Deal, is key for innovative governance models and a more science-based policy design, implementation and monitoring. To maximise impacts of R&I on the ground and spark behavioural and socio-economic change, the knowledge and innovation produced throughout the whole cluster should be widely disseminated to key stakeholders of the relevant sectors of the cluster. In particular, the Agricultural Knowledge and Innovation Systems (AKIS) needs to be reinforced to accelerate the required transformative changes.

Data and information obtained through Environmental Observation is of great value when assessing the state of the planet and is delivering crucial information to support the Green Deal and the climate and ecological transition. Integration of this information from different sources (space-based, airborne including drones, in-situ and citizens observations) with other relevant data and knowledge while ensuring (better) accessible, interoperable or deployable information, delivers information necessary for shaping the direction of the development of policies in the broad context of Cluster 6 of Horizon Europe. A strong link to the European Earth observations programme Copernicus (in Cluster 4) and the European Space Agency’s (ESA) Earth observation programme, as well as support to the Group on Earth Observations (GEO), its European regional initiative (EuroGEO) and the Global Earth

Observation System of Systems (GEOSS) is foreseen for topics on environmental observations under this destination. R&I activities relevant to ocean, seas and coastal waters will complement and support the UN Decade of Ocean Science for Sustainable Development and UN Decade on Restoration, the G7 Future of the Seas and Oceans Initiative, the pan-Commission Destination Earth initiative, the European Global Ocean Observing System (EOOS) and the GOOS 2030 strategy.

Digital innovation, in complementarity with Cluster 4 and Digital Europe Programmes activities, should bring benefits for citizens, businesses, researchers, the environment, society at large and policy-makers. The potential of the ongoing digital transformation, and its wider impacts, positive and negative, need to be better understood and monitored in view of future policy design and implementation, governance, and solution development

This destination will develop innovative digital and data based solutions to support communities and society at large, and economic sectors relevant for this cluster to achieve sustainability objectives. R&I activities will add value to the knowledge and cost-effectiveness of innovative technologies in and across primary production sectors, food systems, bioeconomy, ocean and biodiversity.

Knowledge and advice to all actors relevant to this cluster are key to improve sustainability. For instance, primary producers have a particular need for impartial and tailored advice on sustainable management choices. Knowledge and Innovation Systems are key drivers to enhance co-creation and thus speed up innovation and the take-up of results needed to achieve the Green Deal objectives and targets. This will include promoting interactive innovation and co-ownership of results by users, as well as strengthening synergies with other EU Funds in particular the CAP, reinforcing the multi-actor approach and setting up structural networking within national/regional/local AKISs. AKIS goes beyond agriculture, farming and rural activities and covers environment, climate, biodiversity, landscape, bio-based economy, consumers and citizens, i.e., all food and bio-based systems including transformation and distribution chains up until the consumer.

Expected impact

Proposals for topics under this destination should set out a credible pathway to contributing to innovative governance and sound decision making in policy for the green transition, and more specifically to one or several of the following impacts:

- Innovative governance models enabling sustainability and resilience notably to achieve better informed decision-making processes, societal engagement and innovation;

- Green Deal related domains benefit from further deployment and exploitation of Environmental Observation data and products ;
- A strengthened Global Earth Observation System of Systems (GEOSS)³⁸³;
- Sustainability performance and competitiveness in the domains covered by Cluster 6 are enhanced through further deployment of digital and data technologies as key enablers;
- More informed and engaged stakeholders and end users including primary producers and consumers thanks to effective platforms such as Agriculture Knowledge and Innovation Systems (AKIS)
- Strengthened EU and international science-policy interfaces to achieve the Sustainable Development Goals

When considering their impact, proposals also need to assess their compliance with the “Do No Significant Harm” principle³⁸⁴ according to which the research and innovation activities of the project should not be supporting or carrying out activities that make a significant harm to any of the six environmental objectives of the EU Taxonomy Regulation.

Topics under this destination will have impacts in the following areas: “Climate change mitigation and adaptation”; “Clean and healthy air, water and soil”; “Enhancing ecosystems and biodiversity on land and in water”; “Sustainable food systems from farm to fork on land and sea”; “High quality digital services for all”; and “A Competitive and secure data-economy”.

Social innovation is recommended when the solution is at the socio-technical interface and requires social change, new social practices, social ownership or market uptake.

Call – Innovative governance, environmental observations and digital solutions in support of the Green Deal 2021

Innovating with governance models and supporting policies

Topic ID and title	HORIZON-CL6-2021-GOVERNANCE-01-09: Revitalisation of European local communities with innovative bio-based business models and social innovation				
Budget	EUR 5 million	Opening date	22 June 2021	Deadline 1	06 October 2021
Budget per project	EUR 2,5 million			Deadline 2	/
Type of action	Coordination and Support Actions (CSA)				
FTP subsector	F&F, WW, P&P				
Keywords	local communities revitalisation, local bio-based economy, ecosystem services, recreation, sustainable biomass production				
FTP comments					
FTP SIRA 2030 Challenges addressed	3	FTP relevance		Low	
		Starting TRL		/	
		End TRL		/	

Expected Outcome:

Successful proposal(s) will contribute to the expected impacts of Destination ‘Innovative governance, environmental observations and digital solutions in support of the Green Deal’, and the European policies it supports, in particular the European Green Deal, and EU bioeconomy strategy, by supporting the establishment of the innovative governance models notably to achieve better-informed decision-making processes, social engagement and innovation. In addition, the topic supports the strengthened EU and international science-policy interfaces to achieve the Sustainable Development Goals.

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

- Higher awareness of stakeholders (e.g. by development of a programme that focuses on helping local stakeholders, including primary biomass producers, civil society organisations including NGOs and SMEs to be integrated in and benefit from bio-based value chains) – identifying local actors and improve communication between them, showing opportunities for collaboration along the bio-based value chain.
- Increased opportunities to develop skilled jobs and small-scale establishments in the bioeconomy, thus helping to revitalise local communities (by supporting the local and regional rural development, economic and implementing authorities, to raise awareness of bio-based options)

- Advancement of the role of 'social enterprise' model for local communities, including the low-income populations, benefiting from creativity linked to bio-based solutions and promoting inclusiveness and cooperation at all levels.
- Increased opportunities created by the local bio-based economy within broader bioeconomy transition, e.g. by linking valorisation of ecosystem/nature services' (e.g. recreation) with sustainable biomass production, processing, product design and manufacture, circular use and upcycling to new applications.
- Supporting the development of for small businesses and for business-to-consumers communication of innovation, climate-neutrality and low environmental footprint/benefits/trade-offs and performances of bio-based products and services (e.g. by development of best practice guidelines);
- Supporting novel business models and related social measures to enable consumers, industry and public bodies to switch to socially and environmentally responsible behaviour within their choices (e.g. guidelines on regulatory measures, corporate responsibility initiatives, education); ensuring synergies, transparency and inclusiveness of all actors)

Scope:

The action advances the role and impact of bio-based innovation to accelerate the transition from a linear fossil-based economy, which leads to overuse and depletion of natural resources, into a resource-efficient and circular bio-based systems operating safely within planetary boundaries. Improved and informed governance and especially social innovation contributes to reducing resource consumption and results in an increased innovation capacity of all actors, while reducing the risk of leaving anyone behind, particularly in the areas and communities in need of revitalisation. This also helps to advance innovation at local scale and engage all actors (especially the 'social enterprise' model relevant for vulnerable populations).

Proposals should benefit from social creativity and opportunities at regional scale unleashed for bio-based systems, ensuring their low environmental footprint, in terms of feedstock, resources, processes, materials and products. Impacts and trade-offs, such as the carbon footprint and environmental footprint of the whole value chains should be part of the assessment of the bio-based systems. The proposals should seek complementarities with related actions³⁹², under rural development programs on the governance of bio-based innovation and ensure inclusiveness and engagement of all actors.

Social innovation is recommended when the solution is at the socio-technical interface and requires social change, new social practices, social ownership or market uptake. Proposal could explore intersectionality approaches and consider aspects like gender, ethnicity, migrant or refugee status, social class, sexual orientation and disability to ensure inclusion of marginalised groups in citizen engagement and the development of tools and guidelines.

Proposals should:

- a. select a range of bio-based systems where value chains can be tailored to specific needs in respect to the revitalisation of local communities (understood both in territorial and social sense), to their environmental and social impacts (benefits and trade-offs) from trade in the primary materials to the final products;
- b. focus on relevant new or updated business models and local capacities (feedstocks, infrastructure, human skills, etc), and innovation actors (including community knowledge and marginalised groups), to enable sufficient impacts/benefits/positive trade-offs and performances of the specific value chains;
- c. assess existing/develop new monitoring system and indicators of the effectiveness and robustness of existing governance schemes, to allow replication across Europe (e.g. income generation for all stakeholders, labour conditions, environmental indicators, social engagement, innovation parameters etc);
- d. ensure efficient engagement of all actors (public authorities, SMEs, NGOs, knowledge providers) via robust and transparent communication and awareness-rising campaigns;
- e. analyse social and economic barriers and potentialities to enable the transition towards socially and environmentally responsible behaviour within all ranges (e.g. regulatory measures, corporate responsibility initiatives, education), ensuring inclusiveness of all actors (NGOs, civil society etc).

Deploying and adding value to Environmental Observations

Digital and data technologies as key enablers

Call – Innovative governance, environmental observations and digital solutions in support of the Green Deal 2022

Innovating with governance models and supporting policies

Topic ID and title	HORIZON-CL6-2022-GOVERNANCE-01-04: Consumer-focused labelling options for bio-based products				
Budget	EUR 3 million	Opening date	28 October 2021	Deadline 1	15 February 2022
Budget per project	EUR 3 million			Deadline 2	/
Type of action	Coordination and Support Actions (CSA)				
FTP subsector	WW, P&P				
Keywords	traceability, carbon footprint, transparency, business-to-consumers labels, bio-based systems, climate-neutrality, feedstock, bio-waste, certification, digital solutions				
FTP comments					
FTP SIRA 2030 Challenges addressed	1E			FTP relevance	Low
				Starting TRL	/
				End TRL	/

Expected Outcome

The successful proposal will support the deployment of business-to-consumers communication by producers and traders of bio-based products to enable responsible production and consumption in line with the objectives of the European Green Deal, the EU bioeconomy strategy and the European Climate Pact. Project outcomes will contribute to improve the sustainability performance and competitiveness in the bio-based systems and to the establishment of the innovative governance models notably to achieve better-informed decision-making processes, social engagement and innovation. Project results are expected to contribute to all of the following expected outcomes:

- Transparency of bio-based products and information to consumers and public authorities are provided through effective and robust business-to-consumers labelling on product traceability, quality, carbon footprint, biodiversity impacts and other environmental footprints.
- Consumers, industry and public bodies are enabled to switch towards socially and environmentally responsible behaviour within their choices in a transparent and inclusive way.

- Improved understanding of metrics on value generated per unit of biological resources.

Scope

The project is expected to advance the role and impact of bio-based innovation to accelerate the transition from a linear fossil-based economy, which leads to overuse and depletion of natural resources, into resource-efficient and circular bio-based systems operating within safe planetary boundaries. Improved and informed governance and social innovation contribute to reducing resource consumption and result in an increased innovation capacity of all actors. Informed consumers may pursue the objectives of circular economy, asking for efficiency and inclusiveness of services provided through less resources and goods, changing consumption patterns (e.g. reducing meat consumption), preventing food waste and separating bio-waste from other waste streams so that it can be (partly) converted to bio-based materials.

Proposals will focus on consumer-oriented labelling options for industrial bio-based products with low environmental footprint, in terms of resources, processes and materials used. Industrial bio-based products do not include food/feed, biofuels, bioenergy and cultural/recreation sectors. However, relevant initiatives in the field of consumer-focussed labelling of sustainability of bio-based products, arising from EU policies in the bioeconomy sectors, should be taken into account.

Proposals should:

- a. Select a range of bio-based systems where value chains can be monitored in their environmental and social impacts (benefits and trade-offs) from the primary materials trade to the final products.
- b. Develop pre- and co-normative research to design or update standards and labels for business-to-consumers communication of climate-neutrality and environmental impacts/benefits/trade-offs and performances of materials and products. Environmental impacts should include carbon footprint, climate neutrality, biodiversity impacts and any other environmental footprint relevant for the specific bio-based value chain and final products. Metrics on value generated, in the final product, per unit of biological feedstock used, including bio-waste, will be assessed.
- c. Develop guidelines on the design of labels for bio-based products that include the perspectives of public authorities (national, regional, local) and consumers.
- d. Assess existing/develop new monitoring system and indicators of effectiveness and robustness of existing business-to-consumers labels and certification schemes.

e. Demonstrate/test effectiveness of existing (voluntary) business-to-consumers labels and certification schemes and monitor robustness. This action includes the identification of labels and certification schemes and testing of the monitoring system and indicators assessed/developed.

f. Assess costs and benefits from the adoption of business-to-consumers labels and certification schemes in selected bio-based systems.

g. Assess and develop smart options for the consumers in the digital age (e.g. mobile applications) aiming at sound understanding and practical use in support of and complying with the current relevant legal framework.

h. Analyse social measures to enable consumers to switch towards socially and environmentally responsible behaviour within their choices (e.g. regulatory measures, corporate responsibility initiatives, education), ensuring inclusiveness of all actors (NGOs, civil society etc) and taking into account differences between gender, age and socio-economic background.

The proposals should seek complementarities with related actions on bio-based innovation and market measures⁴⁷⁸, e.g. synergies with the food systems if appropriate⁴⁷⁹ or any other sector, and ensure inclusiveness and engagement of all actors along bio-based value chains.

This topic should involve the effective contribution of SSH disciplines.

Missions

Missions aim to address some of the greatest challenges facing our society. They are bold and inspirational with clear objectives that are time-bound, realistic, measurable and targeted.

Rooted in research and innovation, missions aim to tackle societal challenges with systemic solutions, leading to societal transformations and social impact.

Missions will help deliver key EU policy priorities such as the European Green Deal, Europe's Beating Cancer Plan, NextGenerationEU, the EU Industrial Strategy and A Europe fit for the Digital Age, amongst others.

To achieve their goals and promote societal change, missions will implement the reuse and reproducibility of research results such as FAIR research data and open access to scientific publications. Also, the missions will closely involve citizens in their preparation, implementation and monitoring throughout their duration, also showcasing the added value of the EU.

Missions are a novel instrument in Horizon Europe - the Framework Programme for Research and Innovation. For their successful implementation they will work in synergy and coordination with other missions, parts of Horizon Europe, in particular with European Partnerships and Clusters, as well as with other EU funding instruments and policies. Furthermore, they will need to be implemented in close synergy with funding, programmes and strategies both at Member State / Associated Country and regional level, as well as with civil society and the private sector.

Five mission areas have been included in the Horizon Europe Regulation (Adaptation to Climate Change, including Societal Transformation; Cancer; Healthy Ocean, Seas, Coastal and Inland Waters; Climate-Neutral and Smart Cities; Soil Health and Food). Mission boards, comprised of external experts with a wide variety of backgrounds, have been established to advise the Commission on possible missions within the scope of these areas. On the basis of reports from the five mission boards, the Commission has identified the following titles for missions in the Horizon Europe Strategic Plan, subject to further refinement:

- Adaptation to Climate Change;
- Cancer;
- Climate-Neutral and Smart Cities;
- Ocean, Seas and Waters;
- Soil Health and Food.

Each of the five identified missions is now in a preparatory phase, during which implementation plans will be developed, which will include the detailed objectives, specific interventions, investment strategy and performance indicators for each mission. When finalised, within a period of maximum one year, these implementation plans will be assessed against objective criteria 1 . This assessment will form the basis for a decision on which missions will enter full implementation.

This work programme part for the moment contains actions for each of the five missions during their preparatory phase, and will be updated with the full R&I agenda when the implementation phase is launched. The actions included in this work programme are to establish foundations for the missions' implementation phase and thus support rapid development of the R&I actions when these are launched.

Critical to the success of the missions will be the extent of wide engagement across the EU and Associated Countries and beyond. To facilitate this, an action to develop a network coordinating complementary actions for missions is proposed, with the possibility that this might be extended at a later date with national hubs.

The introduction to this work programme will be updated for the implementation phase, including a more detailed presentation of the relationship between missions and the expected impacts of the Strategic Plan.

Mission: Climate neutral and smart cities

Call – Supporting the transition towards climate neutrality within cities

Topic ID and title	HORIZON-MISS-2021-CIT-01-02: Collaborative local governance models to accelerate the emblematic transformation of urban environment and contribute to the New European Bauhaus initiative of the European Green Deal				
Budget	EUR 2 million	Opening date	22 June 2021	Deadline 1	14 September 2021
Budget per project	EUR 2 million			Deadline 2	/
Type of action	Coordination and Support Actions (CSA)				
FTP subsector	WW				
Keywords					
FTP comments					
FTP SIRA 2030 Challenges addressed				FTP relevance	Low
				Starting TRL	/
				End TRL	/

Expected Outcome:

The action aims at contributing to the objectives and impacts as set-out in the mission introduction, specifically focusing on the renovation of urban spaces combining sustainability, accessibility and aesthetics in a human-centred way. The action will also provide the ground for reflecting the values and principles promoted by the New European Bauhaus initiative⁶⁴ into climate-neutral urban quality transformations, identifying co-creative governance models where citizens and stakeholders' needs and expectations are at the centre. The New European Bauhaus was launched in the frame of the Renovation Wave for Europe Strategy⁶⁵ to act as design lab, accelerator and network at the same time to support the effort of making the Green Deal a cultural, human centred and positive, “tangible” experience.

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

- Accelerate the transition to full climate-neutrality for all European cities aligning with the objective of the European Green Deal, while contributing to the New European Bauhaus initiative;
- Contribute to the objectives of the Renovation Wave for Europe Strategy, the upcoming New EU Strategy on Adaptation to Climate Change ⁶⁶, the European Climate Pact⁶⁷, the 2030 Climate Target plan⁶⁸, the Davos Declaration ‘Towards a

European vision of high-quality Baukultur⁶⁹ as well as of the objectives of having 100 climate neutral cities by 2030 as targeted by the Sustainable and Smart Mobility Strategy⁷⁰;

- Increase awareness among local authorities and citizens on the New European Bauhaus ⁷¹ and the benefits of a climate-neutral urban transition as an opportunity to re-think and co-create qualitative, sustainable, inclusive and aesthetical urban spaces.
- Support for local authorities and citizens' in identifying emblematic projects to transform the quality, sustainability, inclusivity and aesthetics of public landscapes, building upon existing initiatives at national level.

Scope:

In order to contribute to the European Green Deal objectives of climate-neutrality, sustainability, prosperity and inclusiveness, cities will have to undergo a rapid and radical transformation and come up with creative, sustainable and collaborative solutions. Urban areas are characterized by diversity of resources, services, communities, interests and needs, which converge into public spaces design and management. A well co-designed public space provides the unique opportunity to improve its climate-neutrality (i.e. using bio-based and natural materials, nature based solutions, introducing new green spaces and circular economy concepts all across the construction life-cycle, new forms of work and commuting patterns, renewable energies, energy efficient lighting, smart digital services etc.) while increasing their attractiveness and social inclusiveness. As promoted by the New European Bauhaus initiative, a systemic co-designed approach to 'quality climate-neutral urban transformation' can create living space, where the best technical performances meet citizens' social, emotional, cultural and aesthetic needs and values.

Proposals should include the following activities:

- Developing innovative and collaborative models of local governance to engage with citizens and local stakeholders in order to identify urban emblematic projects that simultaneously address the three dimensions of sustainability (including circularity), quality of experience (including aesthetics) and inclusion (including accessibility and affordability).
- Supporting cities in engaging with e.g. schools, universities, culture and arts professionals and institutions, citizens and civil society to harvest the needs, trends, challenges and expectations of citizens and communities in terms of quality climate-neutral urban transformation, in line with the New European Bauhaus initiative's

objectives and to start exploring how to match those needs with the existing possibilities.

- Promoting the New European Bauhaus principles among national, regional and local authorities, citizens and stakeholders through dedicated local initiatives (i.e. events, contests, citizens' dialogues, living labs) and the development of a dedicated platform for sharing of experience and good practices on participatory governance and co-design at local level.

The project should work in close co-operation with the Horizon Europe Preparatory action 'Coordination of complementary actions for missions' (HORIZON-MISS-2021-COOR-01) and with the one stop shop platform to be established under the Horizon 2020 topic LC-GD-1-2-2020 on 'Towards Climate-Neutral and Socially Innovative Cities'⁷² while embedding citizens social, emotional, cultural and aesthetic needs and values.

The project should as well work in close collaboration with other complementary support actions that will be established in the frame of the New European Bauhaus, such as the technical assistance⁷³ to be published indicatively in Q2 2021 under the European Regional Development and Cohesion Funds.

Destination: Deployment of NEB lighthouse in the context of missions

The New European Bauhaus (NEB) initiative wants to make the European Green Deal a cultural, human-centred, positive and tangible experience. It aims to improve how we live together in the built environment⁸⁶, by fostering innovative solutions that articulate the three NEB core principles of sustainability, aesthetics and inclusion. Horizon Europe missions aim to solve major environmental and societal challenges using ambitious, creative, inclusive and interdisciplinary solutions, bringing the European Green Deal closer to citizens. Missions share many objectives with the NEB initiative. Through a mutually supportive relationship, the NEB and the missions will collaborate on key shared challenges. Missions are ambitious and daring, closely involve stakeholders and citizens, and aim to produce public goods on a European scale. There are therefore numerous similarities with the NEB initiative.

The goal is to launch five lighthouse demonstrators for the NEB initiative, providing valuable lessons and knowledge for the missions' deployment.

This destination will showcase how a co-design process, with architecture, design and culture at its core, can deliver highly innovative solutions to address environmental and societal challenges at the territorial level.

Proposals for the topic under this Destination should set out a credible pathway to contributing to the Destination's goal, and more specifically to all the following impacts:

- Strengthen connections between the missions and the NEB on key environmental and societal challenges;
- Increased preparedness for mission implementation in a multi-level and multidisciplinary approach;
- Demonstrate the benefit of applying an NEB approach (combining sustainability with aesthetics and inclusion) to territorial transformation.

Call – Support the deployment of lighthouse demonstrators for the New European Bauhaus initiative in the context of Horizon Europe missions

Topic ID and title	HORIZON-MISS-2021-NEB-01-01: Support the deployment of lighthouse demonstrators for the New European Bauhaus initiative in the context of Horizon Europe missions				
Budget	EUR 25 million	Opening date	28 September 2021	Deadline 1	25 January 2022
Budget per project	EUR 3 to 5 million			Deadline 2	/
Type of action	Coordination and Support Actions (CSA)				
FTP subsector	WW				
Keywords	New European Bauhaus (NEB), lighthouse demonstrators, Delivery Phase				
FTP comments					
FTP SIRA 2030 Challenges addressed	8	FTP relevance		Medium	
		Starting TRL		/	
		End TRL		/	

Expected Outcome:

Through a mutually supportive relationship, Horizon Europe missions and the New European Bauhaus (NEB) initiative will develop connections on a wide range of topics. For example, there are shared objectives in areas such as climate-neutral and smart cities, adaptation of the built environment to the effects of climate change (while respecting existing aesthetic and historical values), including flooding and sea level rise, sustainable use of soils through better spatial planning, urban greening and nature-based solutions, and cancer prevention and quality of life through healthy lifestyles and a healthy living environment.

This action will offer opportunities to engage with communities on an environmentally sustainable, socially fair, and aesthetically appealing transition, using architecture, design and culture as core resources for a sustainable society. These shared qualities between Horizon Europe missions and the NEB should be capitalised on, leading to increased impact for both initiatives, and providing guidance and insight for the missions' implementation. Horizon Europe missions and the NEB both emphasise the importance of involving citizens in the green transition at the local level, in pursuit of broader societal transformation. Linking the two initiatives can help solidify the concept in the public's collective conscious that the missions embody research and innovation's capacity to positively impact their daily lives.

Proposals are expected to demonstrate all of the outcomes listed below:

- The projects should have a clear expected transformational impact both on the built environment, and on how people live and interact in that environment. The pilots will fully embrace the mission objectives and NEB principles, acting as "lighthouse demonstrators", serving as test-beds for the implementation of Horizon Europe mission objectives and innovative solutions.
- Deliver, by the end of the project, 'tangible' and replicable results, leading to benefits in the long-term.
- The grants leading to the design and deployment of the initial implementation phase are meant to catalyse substantial additional investments (e.g. partnerships of national, regional, local public and private sources, including EU Structural Funds) to ensure the implementation of the full-scale project after the design phase.
- A clear demonstration effect in relation to the operationalisation of the triangle of sustainability, inclusion and aesthetics, serving as reference for the broader implementation of the NEB initiative, as well as for the uptake and support of the Horizon Europe missions by national, regional and local authorities, other stakeholders, and European citizens, thus enabling a rapid scale-up of Horizon Europe missions' activities.

Scope:

This action will contribute to the Delivery Phase of the NEB, by deploying mission-oriented pilot projects that will act as 'lighthouse demonstrators' across the territory of the European Union and Associated Countries. They should embrace the key principles of the NEB initiative (sustainability, inclusion and aesthetics), using architecture, design and culture as core resources for a sustainable society, and the mission-oriented approach (impactful, measurable, targeted) in an innovative and exemplary manner. They should address one or more relevant challenges that represent the wide scope of the NEB initiative, such as:

- Environmental and climate adaptation challenges, environmental and climate risks, prevention and resilience
- Economic and territorial changes linked to the green transition
- Social challenges (poverty, segregation, social exclusion, etc.)
- Challenges linked to the use, preservation and reconversion of existing infrastructure and heritage

- Demographic challenges (ageing, migration, depopulation, changes in property market due to tourism, etc.)

Proposals should include:

- The development of an ambitious, mission-oriented, quality co-design process, based on citizens' and stakeholders' participation and multidisciplinary (e.g. arts, architecture, design, heritage, engineering, physical and spatial planning, manufacturing, technology, environmental and social sciences, etc.) and multilevel collaboration (e.g. civil society, public and private actors), also capable of addressing the relevant objectives of the Horizon Europe missions.
- An ambitious and credible executive plan that identifies and analyses the challenges and resources of a given territory (e.g. neighbourhood, district, ecosystem) in terms of sustainability (in line with the European Green Deal), inclusiveness (including accessibility and affordability) and aesthetics (including functionality, comfort, attractiveness, etc.).
- The detailed outlined, through feasibility studies, of highly innovative, cutting-edge solutions, associating meaningful, inclusive social purpose with strong aesthetic values and sustainability, in line with the European Green Deal, to address emblematic environmental and societal challenges at the territorial level.
- Deployment of an initial set of solutions as demonstrators within a two-year timeframe, accompanied by a rigorous impact evaluation methodology, measuring the impact of the adopted methodologies. Involvement and testing of the demonstrators with international experts.
- A detailed roadmap for implementation, with a sustainable financial plan quantifying and identifying substantial additional investment based on involvement and partnerships with different actors (national, regional, local, public and private sources).
- Evidence of developed relationships and partnerships with responsible authorities and/or representatives (on planning, permits, property rights, financing, impact assessments, etc.).
- Exchange and dissemination of co-design methodology at European Union and Associated Countries level.
- Contribution to the outreach, dissemination and communication strategy and plan of the NEB and of Horizon Europe missions.

- The NEB initiative, launched in late 2020, will undergo rapid development in an open community. Potential applicants are invited to join this community under [https://europa.eu/new-european-bauhaus/index_en] to contribute to the discussion on the application of the NEB principles in the 21st, and their role in the twin green and digital transitions, and recovery from the COVID-19 crisis.
- Projects are expected to participate in European-level networking opportunities in the context of the NEB initiative.