# HORIZON EUROPE POCKET GUIDE on Global Challenges (Pillar 2)

The pillar 2 **Global Challenges and industrial competitiveness** will strengthen the impact of research and innovation in developing, supporting and implementing Union policies to address global challenges. Research and innovation activities will be organised in the following six clusters, which take the place of the H2020 'Societal Challenges':

| Clusters | Areas of intervention | |
|---|---|---|
| **1 - HEALTH** | ▪ Health throughout life course<br>▪ Non-communicable and rare diseases<br>▪ Tools, technologies and digital solutions for health care (including personalized medicine)<br>▪ Environmental and social health determinants<br>▪ Infectious diseases, including poverty-related and neglected disease<br>▪ Health care systems | |
| **2 - CULTURE, CREATIVITY AND INCLUSIVE SOCIETY** | ▪ Democracy and Governance<br>▪ Social and economic transformations<br>▪ Culture, cultural heritage and creativity | |
| **3 - CIVIL SOCIETY FOR SECURITY** | ▪ Disaster-resilient society<br>▪ Protection and Security<br>▪ Cybersecurity | |
| **4 - DIGITAL, INDUSTRY AND SPACE** | ▪ Manufacturing technologies<br>▪ Next generation internet<br>▪ Circular industries<br>▪ Space, including Earth Observation<br>▪ Artificial Intelligence and robotics<br>▪ Low-carbon and clean industry | ▪ Advanced materials<br>▪ Emerging enabling technologies<br>▪ Key digital technologies, including quantum technologies<br>▪ Advances computing and Big Data<br>▪ Emerging enabling technologies |
| **5 - CLIMATE, ENERGY AND MOBILITY** | ▪ Climate science and solutions<br>▪ Energy systems and grids<br>▪ Energy supply<br>▪ Buildings and Industrial facilities in energy transition<br>▪ Energy storage | ▪ Industrial competitiveness in transport<br>▪ Smart mobility<br>▪ Communities and cities<br>▪ Clean, safe and accessible transport and mobility |
| **6 - FOOD, BIOECONOMY, NATURAL RESOURCES, AGRICULTURE AND ENVIRONMENT** | ▪ Environmental Observation<br>▪ Biodiversity and Natural capital<br>▪ Agriculture, forestry and rural areas<br>▪ Seas, Oceans and Inland waters | ▪ Food Systems<br>▪ Bio-based Innovation Systems<br>▪ Circular Systems |

**MISSIONS**

European research and innovation aim to deliver solutions to some of the greatest challenges facing our world. Five mission areas have been identified, each with a dedicated mission board and assembly (link on each logo for details).

Cancer

Soil health and food

Healthy oceans, seas, coastal and inland waters

Adaptation to climate change, including societal transformation

Climate-neutral and smart cities

# SUMMARY OF CLUSTER-SPECIFIC ORIENTATIONS

**CLUSTER 1 HEALTH** aims to promote and protect **human health** and **well-being**, prevent diseases and decrease the burden of diseases and disabilities on people and communities, support the transformation of **health care systems** in their efforts towards fair access to innovative, sustainable and high quality health care for everyone, and foster an innovative, sustainable and globally competitive **European health industry**. Research and innovation actions under this cluster will be key to address the health-related challenges and drivers delivering new knowledge and capabilities, improving our understanding of health and **diseases**, developing innovative methodological and technological solutions to better manage health and diseases, and designing sustainable approaches for the **digital transformation** and delivery of integrated, person-centred and equitable health and care services with improved accessibility and health outcomes supported by needs-driven innovation and reliable supply chains in Europe.

**CLUSTER 2 CULTURE, CREATIVITY AND INCLUSIVE SOCIETY** aims to meet EU goals and priorities on enhancing **democratic governance** and **citizens participation**, and on the safeguarding and promotion of **cultural heritage**, and to respond to multifaceted **social, economic, technological and cultural transformations**. Activities will contribute to expanding civic engagement, boosting transparency, accountability, inclusiveness and legitimacy of governance, improving levels of trust and tackling political extremism. Activities within the Cluster will also promote better access and engagement with cultural heritage and improve its protection, enhancement and restoration. Research and innovation will support **sustainable growth** and job creation through contributing to a European industrial policy for the **cultural and creative industries**. At the same time, actions will help tackle social, economic and political inequalities, support human capital development and contribute to a comprehensive European strategy for inclusive growth. This also involves understanding and responding to the impacts of technological advancements and economic interconnectedness with a view to social resilience. Finally, the Cluster will support **EU migration and mobility policies**, both internal and external, while aiming to promote integration.

**CLUSTER 3 CIVIL SECURITY FOR SOCIETY** aims to contribute to protecting the EU and its citizens from the threats posed by **crime and terrorism** (including in the cyber environment) and from the impacts of **natural and man-made disasters**. As shown in Eurobarometer surveys, security is one of the main concerns of EU citizens and is therefore among the top priorities for the Commission. Modern security threats are evolving rapidly, and **technological and societal changes** are creating unprecedented complexity, but so also are opportunities for addressing them more efficiently. In this regard, security research provides the resources to be able to adequately counter current threats, by enabling the availability of state-of-the-art equipment and knowledge. Furthermore, by working to **anticipate future threats**, security research develops today the capabilities that will be needed in the future.

**CLUSTER 4 DIGITAL, INDUSTRY AND SPACE** will advance key enabling, **digital and space technologies**, underpinning the transformation of our economy and society, support the digitisation and transformation of European industry and contribute to securing global industrial leadership and autonomy/sovereignty in terms of technologies and resources. Furthermore, activities with the Cluster will contribute to growing a **low-carbon, circular and clean industry** respecting planetary boundaries and to fostering inclusiveness in the form of high-quality jobs and societal engagement in the use of technologies. Thereby it will contribute to

addressing the challenges European industry is facing, such as its reliance on imported key technologies and raw materials, the scarcity of resources including energy, as well as skills mismatches and ethical considerations relating to technological progress.

**CLUSTER 5 CLIMATE, ENERGY AND MOBILITY**, aims to fight **climate change** while improving the competitiveness of the **energy and transport industries** as well as the quality of the services that these sectors bring to society. This entails establishing a better understanding of the causes, evolution, risks, impacts and opportunities of climate change, as well as making **energy and mobility systems climate- and environment-friendly, smarter, safer, and more resilient, inclusive, competitive and efficient**. Actions of this Cluster will contribute to the **technological, economic and societal transformations** required to achieve climate neutrality, **adapt** to the locked-in changes that are coming to our climate, and to ensure a **socially fair transition**, as outlined in the Commission's long-term strategy (adopted in November 2018).

**CLUSTER 6 FOOD, BIOECONOMY, NATURAL RESOURCES, AGRICULTURE AND ENVIRONMENT** will advance knowledge, expand capacities and deliver innovative solutions to accelerate the transition towards the **sustainable management of natural resources** (such as biodiversity, water and soils). This will include measures for: **climate adaptation** and **climate neutrality of sustainable primary production** (agriculture, forestry, fisheries and aquaculture), **value chains**, **food systems** and **biobased industries**; optimising **ecosystem services** including for climate mitigation; **reversing biodiversity decline**; and **reducing environmental degradation and pollution**. Activities will benefit people and society by promoting **safe and healthy food** as well as **human well-being**, including through a better understanding of consumer behaviour. Furthermore, activities will help to **develop vibrant rural and coastal areas** and to **establish governance models** for the transition towards sustainability. To this end, actions under this Cluster will lead and support the switch to a competitive, more circular and bio-based, climate-neutral, resilient and environmentally-friendly economy in compliance with the Paris Agreement on Climate Change and the SDGs.

## CONTATTI PER APPROFONDIMENTI:

Direzione Servizi per la Ricerca e Trasferimento Tecnologico
Unità Servizi per la Ricerca

A questo link la **Carta** del **servizio di supporto alla scrittura di proposte progettuali**.
Per accedere ai servizi scrivere a: tecnologi.ricerca@unipi.it

**LIFE SCIENCES** Martina Calamusa

**PHYSICAL SCIENCES AND ENGINEERING** Marco Bargagna / Francesca Ceron

**SOCIAL SCIENCES AND HUMANITIES** Veronica Moretti / Francesca Zampagni

# CLUSTER 1. HEALTH

## Global Challenges and Areas of intervention

| | |
|---|---|
| Staying healthy in a rapidly changing society | Health throughout the Life Course<br>Environmental and Social Health Determinants |
| Living and working in a health-promoting environment | Health throughout the Life Course<br>Environmental and Social Health Determinants |
| Tackling diseases and reducing disease burden | Environmental and Social Health Determinants<br>Non-Communicable and Rare Diseases<br>Infectious Diseases |
| Ensuring access to sustainable and high-quality health care in the EU | Health throughout the Life Course<br>Tools, Technologies and Digital Solutions for Health and Care<br>Health Care Systems |
| Unlocking the full potential of new tools, technologies and digital solutions for a healthy society | Tools, Technologies and Digital Solutions for Health and Care |
| Maintaining a sustainable and globally competitive health-related industry | Tools, Technologies and Digital Solutions for Health and Care<br>Health Care Systems |

## EU Policy Objectives

According to Article 168 of the Treaty on the Functioning of the EU, high level of human health protection shall be ensured in the definition and implementation of all Union policies and activities.
In this context Cluster 1 aims to address the following EU policy objectives:

- To ensure healthy lives and promote well-being for all at all ages
- To protect and improve the health of EU citizens, including environmental and risks factors, cross-border health threats, crisis preparedness and response
- To support equal access to modern, efficient and safe health care for all Europeans, including cross-border health care
- Improve the efficiency of Europe's health systems, including the digital transformation of health and care system


Cluster 1 will contribute to the implementation of internationally agreed United Nation Sustainable Development Goals 3 and its nine health-specific targets aiming for universal health coverage for all at all ages by 2030 and ending preventable deaths.

R&I activities within this Cluster have the potential to support missions in all areas.

## Targeted impacts

To support citizens in pursuing healthy and active lives by providing suitable and tailor-made solutions, including for people with specific needs
To protect citizens' health from negative impacts resulting from environmental and risk factors
To decrease the burden of diseases on citizens and health care systems
To support health care systems in their transformation to ensure fair access to sustainable health care services of high quality for all citizens
To foster the integration and deployment of innovation in health care systems
To develop novel health technologies addressing public health needs and market opportunities

## Key R&I Orientations

### | STAYING HEALTHY IN A RAPIDLY CHANGING SOCIETY

This R&I orientation will support activities aiming at better understanding of specific health and care **needs** throughout the life course, and develop more **effective solutions** for health promotion and disease prevention, including for needs related to **chronic health conditions**. Key to achieving these objectives is the availability and accessibility of **real-world health data**, which will require appropriate support by **research** and **data infrastructures**.

### | LIVING AND WORKING IN A HEALTH-PROMOTING ENVIRONMENT

This R&I orientation will support activities aiming at increasing **knowledge** necessary to identify and assess the **risks** and **benefits** for health, and to enable health promoting and disease **preventive policy actions**. Strong collaborations **across sectors** and with **other** Horizon Europe **clusters** dealing with issues such as agriculture, food, environment, climate, mobility or urban planning will be needed to ensure that maximal **societal benefits** will be reached.

### | TACKLING DISEASES AND REDUCING DISEASE BURDEN

This R&I orientation will support activities aiming to identify **new prevention, diagnostics, vaccines, therapies, alternatives to antibiotics**, as well as to improve existing prevention strategies to create **tangible impacts**.

### | ENSURING ACCESS TO SUSTAINABLE AND HIGH-QUALITY HEALTH CARE IN THE EU

This R&I orientation will support activities aiming at the development of **innovative solutions** for health care systems in all their various **dimensions** (e.g. governance, financing, generation of human and physical resources, health service provision, patient empowerment).

### | UNLOCKING THE FULL POTENTIAL OF NEW TOOLS, TECHNOLOGIES AND DIGITAL SOLUTIONS FOR A HEALTHY SOCIETY

This R&I orientation will support activities aiming at the implementation of spectrum of **tools** and **technologies** for bio-medical research, prevention, diagnosis, therapy, monitoring and **approaches** owing to powerful **digital solutions** using and processing **big data**, including real-world data, for efficient value **assessment**.

### I MAINTAINING A SUSTAINABLE AND GLOBALLY COMPETITIVE HEALTH-RELATED INDUSTRY

This R&I orientation will support **cross-sectorial** activities, integrating medical technologies, pharmaceuticals, biotechnologies, digital health and eHealth technologies, aiming at **strengthening** the single market, including by implementing the **Digital Single Market** strategy.

## European Partnerships

Large-scale innovation and transformation of health systems in a digital and ageing society; European partnership for chemicals risk assessment; Translational health research; Personalised Medicine; Rare Diseases; EU-Africa research partnership on global health security to tackle infectious diseases; Innovative Health Initiative.

# CLUSTER 2. CULTURE, CREATIVITY AND INCLUSIVE SOCIETY

## Global Challenges and Areas of intervention

**Democracy and Governance** → **Enhancing democratic governance, civic participation, democratic media**

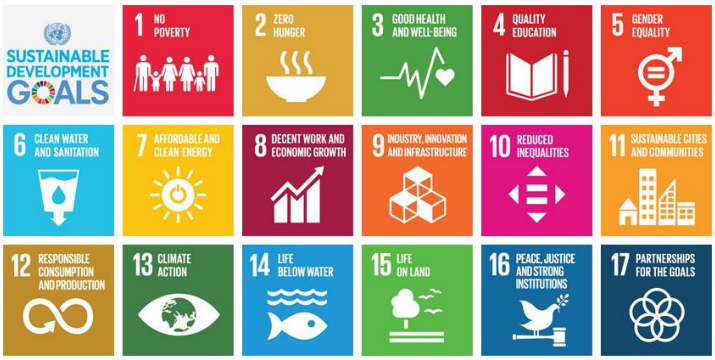
**Culture and Cultural Heritage** → **Promoting Cultural Heritage and Creative Industries**

**Social and Economic transformation** → **Management of Social and Economic transformations, inequality, sustainable development, migration**

## EU Policy Objectives

Cluster 2 aims to address EU priorities that

- give a new push to European democracy, enhancing participation, pluralism, non-discrimination;
- protect cultural heritage, fostering a creative economy as well as sustainable and inclusive business models;
- better manage migration and mobility, enhancing integration;
- reflect on economic growth, reversing inequalities and promoting equal opportunities, fostering social welfare and the transition to a low carbon economy.




Cluster2 will contribute to the implementation of internationally agreed United Nation Sustainable Development Goals.

R&I activities within this Cluster have the potential to support missions in all areas.


## Targeted impacts

Support **policy action in favour of democracy**, its stability, and its further development with a view to enhancing representation, participation, openness, pluralism, cultural participation, respect of diversity, non-discrimination, the protection of fundamental rights and the rule of law

Help tackle political extremism and polarisation and restore trust to governance

Help **protect historical sites and monuments**, cultural landscapes, artefacts, museums, archives, as well as languages, customs, traditions, and values

Promote research and innovation across the culture and creative sectors, fostering the value, protection access to and sustainability of culture across Europe

Support EU migration and mobility policies, both internal and external
Help **reverse social, spatial, economic, cultural and political inequalities** and their causes and promote gender equality
Assess and respond to the social, ethical, political and economic impacts of drivers of change (technology, globalisation, and changing demographics) in the wide variety of social, economic and territorial contexts in Europe

## Key R&I Orientations

### | ENHANCING DEMOCRATIC GOVERNANCE

- Build up evidence and policy recommendations on enhancing democracy and good governance, to help restoring trust in governance, close the gap between perceptions and reality, and respond to threats to the electoral process and democracy.
- Explore the potential of technological and scientific advancements, including big data, online social networks and artificial intelligence on democracy, to increase transparency and accountability of governments and to counterbalance disinformation of public opinion.

### | PROMOTING CULTURAL HERITAGE

- Develop cutting-edge conservation and restoration technologies and methods and provide innovative, integrated, sustainable and participative management models.
- Share and boost access to and participation in cultural heritage through innovative approaches, new and emerging technologies, including digitisation and increased cultural literacy.
- Develop new approaches, concepts and practices for sustainable, accessible and inclusive tourism, including cultural tourism.

### | MANAGEMENT OF SOCIAL AND ECONOMIC TRANSFORMATIONS

- Elucidate the societal – including political, ethical, cultural, gender and economic - effects of technological advancements and the impact of drivers of change (such as globalisation, ageing etc.) on jobs, skills, education, productivity, income, welfare and inequalities.
- Support EU migration and mobility policies. Research will focus on analysing past and current dynamics of migration and integration, future trends and projections, societal impacts of migration of refugees and other migrants, and the effects of migration policies

## European Partnerships

No European Partnerships are currently suggested under this cluster. However, a legislative procedure is ongoing concerning the Commission proposal on the Strategic Innovation Agenda of the EIT 2021-2027 that identifies Cultural and Creative Industries as a priority field for a new Knowledge and Innovation Community.

# CLUSTER 3. CIVIL SECURITY FOR SOCIETY

## Global Challenges

**A resilient and more stable Europe** → **Cybersecurity; Maritime Security**
**Border management; Terrorism and crime**

**Reduce the effects of disasters** → **Natural and man-made disasters**
**Adaptation to climate change**

**Support a competitive European civil security industry sector**

## EU Policy Objectives

Cluster 3 will exclusive **focus on civil applications** and aims to address EU priorities related to:

- Disaster risk management and then the Union Civil Protection Mechanism, the EU Climate Adaptation Strategy, EU environmental policies;
- Protection and security, including the European Agenda on Security and the development of a Security Union, policies related to the integrated border management, the EU Action Plan on the protection of public spaces, policies and instruments on protecting critical infrastructure, as well as on fighting crime, including cybercrime and terrorism;
- EU Maritime Security Strategy and specifically the EU maritime borders;
- Cybersecurity and in particular the NIS Directive, the GDPR, the EU Cybersecurity Act.


Cluster3 will contribute to the implementation of internationally agreed United Nation Sustainable Development Goals and its sixteen specific targets aiming at promoting just, peaceful and inclusive societies.

R&I activities within this Cluster have the potential to support the mission


## Targeted impacts

Improve **disaster risks management and resilient society**, reducing loss form natural and man-made disasters
Improve **the management of EU external borders**, reducing illegal immigration
Better **protect citizens from attacks in public spaces** through a more effective prevention, preparedness and response
Improve **security and resilience of infrastructure and vital societal functions** such as healthcare, law enforcement, energy, mobility, public services, financial services, communication and logistics infrastructures/networks

Improve **maritime security**, including from man-made and natural disasters and from security challenges such
Fight more effectively against **crime and terrorism** through better prevention of criminal acts enhanced investigation capabilities notably as concerns cybercrime
Promote **cybersecurity** and a **secure online environment**, empowering citizens, public bodies and companies to better protect their data and online activities.

## Key R&I Orientations

### | Disaster Resilient Society

- Promote a deeper understanding of chemical, biological, radiological, nuclear and explosive (CBRN-E) incidents in order to foster the creation of specific measurements, including standards and certification for detection equipment, better comparability of data, both within EU and beyond.
- Improve the ability to forecast the exact occurrences and impacts of climate-related risks and extreme events, such as fires, droughts, floods, heatwaves and storms.
- To be better prepared to respond to geological disasters, such as earthquakes, volcanic eruptions and tsunamis.
- Enhance the capacity to early detect the outbreak of pandemics and emerging infectious diseases (in relation to pandemics and emerging infectious diseases will complement those undertaken under the cluster 'Health).

### | Protection and Security

- Support air land and see border management, ensuring a more effective implementation as a result of improved knowledge about human and societal factors underlying cross-border threats.
- Protect public spaces, while at the same time preserving the open nature of urban public spaces.
- Improve the security and resilience of infrastructure and vital societal functions such as healthcare, law enforcement, energy, mobility, public services, financial services, communication and logistics infrastructures and networks.
- Ensure maritime security, enabling better maritime surveillance, risk awareness and management of EU critical maritime infrastructure border protection and coast guard functions new approaches.
- Fight against crime and terrorism and specifically acting on the prevention, investigation and mitigation of criminal acts' impacts.
- Allow citizens, public bodies and companies to better protect their data and online activities with particular attention to social media, improving knowledge and tools for ensuring cybersecurity.

## European Partnerships

No European Partnerships are currently suggested under this cluster.

# CLUSTER 4. DIGITAL, INDUSTRY AND SPACE

## Areas of intervention

- Manufacturing Technologies
- Advanced Materials
- Next Generation Internet
- Circular Industries
- Space, including Earth Observation
- Emerging Enabling Technologies
- Key digital technologies, including quantum technologies
- Artificial Intelligence and Robotics
- Advance computing and Big Data
- Low Carbon and Clean Industry

## EU Policy Objectives

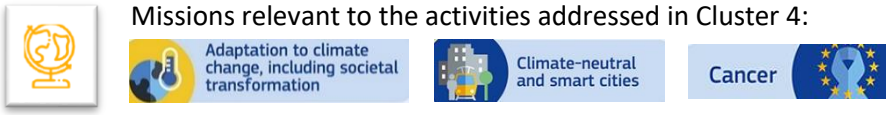
Cluster 4 addresses the following EC priorities:

- An Europe fit for the Digital Age – Competitiveness: for a European industry with global leadership in key areas, fully respecting planetary boundaries, and resonant with societal needs – in line with the renewed EU Industrial Policy Strategy; promoting an ecosystem of technology infrastructures, catering for industry, including SMEs and start-ups, establishing a European data ecosystem, in conjunction with the **Digital Europe Programme**;
- a stronger Europe in the world - Autonomy: ensure a secure, sustainable, responsibly-sourced supply of raw materials and increased autonomy in critical ones;
- a European Green Deal - climate-neutral, circular and clean industry: reducing energy consumption, decarbonise production processes, protect the environment and enable a circular economy;
- an Economy that Works for People – inclusiveness: not leaving anyone behind – and a human-centred approach in technology development, including AI.

Primary UN – SDGs addressed by Cluster 4:


Secondary UN – SDGs addressed by Cluster 4:


Missions relevant to the activities addressed in Cluster 4:




## Targeted impacts

**Digitising and transforming** industry, Increased sovereignty in **key enabling technologies** and **digital technologies**, in strategic value chains, and a secure and sustainable supply of **raw materials**

A European approach, involving a **human-centred and ethical development** and use of new technologies

Industrial leadership in key enabling, digital and space technologies and uptake of new technologies, and **space services and data**, through **technology infrastructures** and increased autonomy in strategic value chains

Achieving increased **autonomy in critical raw materials**, through substitution, resource efficiency and recycling and primary production, world-leading European technologies for climate neutrality and circularity

**Greening ICT**, for instance by developing low energy consumption components and combination of approaches, to enhance the efficiency of computing by several orders of magnitude.

**Space services** contributing to climate mitigation and environmental protection, mobility and security
Increased **inclusiveness**: helping industry provide attractive and creative jobs in Europe; a two-way engagement in the development of technologies; a human-centred approaches; promoting **social innovation**; helping foster skills and **empower the young** in digital and advanced manufacturing areas

## Key R&I Orientations

### | MANUFACTURING TECHNOLOGIES

- Technology-driven innovations; emerging technologies as AI and human-robot collaboration;
- digital industrial platforms, benefitting automotive/aerospace, health/food processing;
- digital transformation for productivity and shorter innovation cycles;
- circular economy, "zero-waste" manufacturing, de- and re-manufacturing;
- bio-integrated manufacturing through biomachining, biomimetics, biomechanics, bio-inspired;
- a "new way to build", for construction with lower environmental footprint.

### | KEY DIGITAL TECHNOLOGIES

- Electronics and photonics components and systems, software technologies and connectivity platforms;
- New materials (such as graphene, flexible substrates);
- Low-power electronics and alternative processing concepts, like neuromorphic, that map cognitive processes into electronic circuits, quantum information processing and open-source hardware;
- Distributed intelligence, integrated smart multisensor-based systems (body, home, automotive etc.);
- Edge computing, advances in modelling and simulation (e.g. digital twins), low-energy computation;
- Artificial Intelligence and big data analytics, novel materials and drugs, smart energy systems;
- Embedded security, reliability and usability, easier programmability, throughout products and services life-cycles, for citizens' confidence in digital technologies.

### | ADVANCED MATERIALS

- Disruptive materials science providing solutions at the industrial scale, e.g. in the form of catalytic systems;
- Lightweight, functional, smart materials to mimic biological functions for commercial product applications;
- Advanced materials for challenges related to health, fire performance and sustainability of building materials;
- "Innovative materials by design" to answer the consumer and for artefacts of cultural heritage protection;
- Innovation ecosystem of materials technology infrastructures (open innovation testbeds and pilot lines);
- Safe, sustainable and competitive new materials within the circular economy, including regulatory and standardisation aspects.

### | EMERGING ENABLING TECHNOLOGIES

Early development (at low TRLs) of a limited number of new enabling technologies by scouting for transformative research themes, building also on the results of Pillars I and III. Success depends on the combination of disciplines, from fundamental research in natural sciences to engineering, manufacturing and computer learning. Examples of technologies include, but are not limited to:

- Future and emerging materials by design;
- Enhanced information-based technologies inspired by the laws of nature and biology;
- The convergence of the "digital" and the "physical" and entirely new forms of digital technologies.

### | ARTIFICIAL INTELLIGENCE AND ROBOTICS

- AI for traffic optimization and autonomous driving AI-based systems to support in specific tasks and improving working conditions;
- AI-based solutions to optimise the resources lifecycle and make it more environmentally and economically sustainable
- Powerful data-intensive machine learning to assist Medical doctors in diagnostic and therapy decisions;
- Robots to support firefighters in approaching hazardous intervention zones;
- AI and robotics supporting European industrial competitiveness and for the reduction of environmental footprints;
- AI and autonomous behaviour in complex, safety- and time-critical systems, such as large transport networks;
- Human-centric, ethical, explainable and trustworthy AI and a trademark for AI developed in Europe;

- Foundational algorithms and hardware research;
- Smart, collaborative, safe and efficient robots and autonomous systems;
- Common AI platforms, sharing tools and resources for research and innovation.

**| NEXT GENERATION INTERNET**

- Key technologies and infrastructures for the Internet of tomorrow, for a human-centric trustworthy internet promoting core European values;
- Smart Networks and Services (including IoT and edge computing infrastructures) and Content platforms;
- Vertical applications supported by platforms including large-scale pilots, use of AI along a continuum of novel data infrastructures and services;
- Trustworthy internet technologies, including open source components and Universal Design;
- Interactive Technologies, immersive technologies and language technologies, combined with AI, for a Next Generation Internet;
- Distributed ledger technologies, for an EU data space empowering citizens, public services and businesses.

**| ADVANCE COMPUTING AND BIG DATA**

- Next generation low power processors and accelerators, novel computing architectures and hybrid/modular systems;
- Novel neuromorphic architectures, quantum computing components, 3D and interposer/chiplet computing architectures;
- Co-designing software, algorithms, programming models, simulations and tools for their integration in novel computing systems for large-scale and industry-led pilot applications and public services;
- Advancing the state-of-the-art of extreme performance data analytics and prediction methods for Big Data processing;
- Methodologies and tools for data interoperability and to track provenance, quality and completeness of data sets;
- Federation of data supporting the creation of a European Health Data Space;
- Reduce the carbon footprint and improve the energy efficiency of ICT processes and technologies, including hardware, software, sensors, networks, storage and data centers;
- Provide metrics and methodologies to measure in a standardised way the carbon footprint and energy efficiency of data processing and transmission chains.

**| A GLOBALLY COMPETITIVE SPACE SECTOR REINFORCING EU SOVEREIGNTY**

- Ultra-high throughput telecommunication, integration of satellites in 5G networks, advanced navigation signals and high-resolution earth observation, supporting the EU space programme components;
- Production of cost-effective space systems including constellations, hybrid, smart and reconfigurable satellites, which can be assembled and serviced directly on-orbit, with a de-orbiting capacity;
- Reducing the production and operation cost such as reusability of launcher components, low cost, high thrust and green propulsion, micro launchers, new types of payloads and space routes;
- Opportunities for in-orbit validation ("IOV") and in-orbit demonstration ("IOD") to de-risk new technologies, concepts and applications operating from modern and flexible launch facilities; new technologies for space traffic management;
- Contribute to critical technologies, space science and missions and outreach and education activities;
- Promote downstream applications and synergies with non-space sectors, including manufacturing technologies, digital technologies, advanced materials, AI and Robotics, advanced Computing and Big data;
- Quantum technologies in space infrastructure and for space-based services, ensuring of security, efficiency and reliability.

**| CIRCULAR INDUSTRIES**

- Design of circularity enabled products, implementation of circular supply chains and systematic cradle-to-cradle life cycle assessment both for new and existing products;
- Product life extension through predictive maintenance, repair, re-use, and refurbishment leading to value loops at European scale;
- Advanced solutions and conditions for the sustainable exploration, extraction and processing of raw materials; and also their substitution, recycling and recovery in industrial symbiosis settings;
- New automated technologies to sort, dismantle and remanufacture or recycle products; efficient processes to handle mixed waste sources;

- Digital and industrial technologies like robotics, artificial intelligence, and digital platforms for energy-intensive industries leading e.g. to fully fledged cognitive plants;

  The focus will be on sectors, products and materials that have the highest impacts and the greatest potential for enhanced circularity.

**| LOW-CARBON AND CLEAN INDUSTRIES**

- Innovative technologies for process and heat electrification, switch to decarbonised energy and feedstock, usage of hydrogen, CO2 capture and usage, catalysis and artificial photosynthesis, waste heat recovery, materials for re-use and recycling;
- Integration across value chains and new business models, processes and technologies for avoiding waste and emissions or recover valuable resources;
- Co-located plants and industrial symbiosis amongst plants, adapting production to energy and resource flows;
- Closed-loop system, based flows of resources, energy and information supported by AI-based technologies;
- "Hubs for Circularity", industrial and public facilities achieving circularity and carbon neutrality in resources use.

**| NEW SERVICES FROM SPACE FOR THE EU SOCIETY AND ECONOMY**

- R&I for the next generation and applications of European Global Navigation Satellite Systems (Galileo/ EGNOS) for intelligent mobility, lowering CO2 emissions, connectivity and infrastructures, a non-dependent and sustainable supply chain, and integration with 5G;
- Support core services of the European Union Earth Observation System (Copernicus) and develop new service elements or products, cross-cutting applications and products and information in areas as climate mitigation, monitoring GHG, environment, including Arctic regions, agriculture and urban planning, security;
- developments in sensors technologies and data processing and new services for Space Surveillance and Tracking (SST),
- Research on space traffic management, space weather and near Earth objects necessary to ensure the security of critical infrastructure both in space and on Earth for Space Situational Awareness (SSA);
- Support user equipment and system solutions for space and ground infrastructure for Satellite communications for EU governmental actors (GOVSATCOM) and applications for citizens and businesses;

  Synergies between Galileo/Copernicus will be reinforced, and the availability of space assets and data from other organizations (e.g. EUMETSAT, ESA) better exploited.

## European Partnerships

- Made in Europe; - Key Digital Technologies; - Photonics; - Artificial Intelligence, data and robotics; - Smart Network and Services; - HPCT; - Circular and Climate-neutral industries; - Clean Steel; - Metrology; - Globally Competitive Space Systems; - Geological Service for Europe (candidate partnership). The cluster is also closely related to EIT Raw Materials, EIT Manufacturing and EIT Digital.

# CLUSTER 5. CLIMATE, ENERGY AND MOBILITY

## Areas of intervention

- Climate science and solutions
- Energy systems and grids
- Communities and cities
- Industrial competitiveness in transport
- Smart mobility
- Energy supply
- Buildings and industrial facilities in energy transition
- Clean, safe and accessible transport and mobility
- Energy storage

## EU Policy Objectives

Cluster 5 addresses EU priorities aiming at:

- technological, economic and societal transformations required to achieve climate neutrality, and ensuring a socially fair transition that does not leave any EU citizens or regions behind;
- better air quality, increased employment, social inclusion, sustainable resource management (including biodiversity), and reduced dependency on fossil fuels;
- development of a wide portfolio of cost-effective carbon-free alternatives for each GHG-emitting activity, based on often in combination with enhanced sector coupling, digitalisation and system integration.

Primary UN – SDGs addressed by Cluster 5:


Secondary UN – SDGs addressed by Cluster 5:


Missions relevant to the activities addressed in Cluster 5:


## Targeted impacts

Achieving an advanced knowledge base in **climate science** that can guide the development of required policy measures and **low-and zero-carbon technologies** essential to catalyse the transition to a climate-neutral emissions economy and society and for adaptation to the unavoidable climate change impacts.

**New cross-sectoral energy/transport solutions** enabling both the clean and sustainable energy transition and the decarbonisation of transport.

Achieve **cleaner, more efficient, more secure and competitive energy supply**, notably by boosting cost performance and reliability of renewable energy solutions and by making the energy grid more flexible and secure.

Support **cleaner, safer, affordable and sustainable energy demand side solutions** for all users, ensuring a just transition towards fully decarbonised, more energy efficient and renewable energy system reducing any negative impacts, and European dependency on energy import.

Significantly contribute to **net-zero greenhouse gas emissions and reduced air pollutants in and across all transport modes** protecting human health and achieving at the same time strengthened global competitiveness of the European transport sector, through the development and usage of new technological solutions in all transport modes.

**New, affordable smart, inclusive and sustainable mobility services** which will result in significant safety, environmental, health, economic and social benefits such as reduced accidents, decreased congestion, reduced energy consumption and emissions of vehicles, increased efficiency and productivity of transport operations, improved working conditions and the creation of new jobs.

## Key R&I Orientations

**| ADVANCE CLIMATE SCIENCE AND SOLUTIONS FOR A CLIMATE NEUTRAL AND RESILIENT SOCIETY**

The efficient transition to a net-zero greenhouse gas emissions economy resilient to the impacts of climate change requires profound knowledge in various fields of research. Advancing climate science and creating a knowledge base to inform societal and social transition and to guide the development of policy measures, low-, zero-, and carbon negative technologies, as well as other solutions.

**| CROSS-SECTORAL SOLUTIONS FOR DECARBONISATION**

The energy sector and the two main sectors of energy use in cities and communities (housing and mobility) are closely interlinked and face many common challenges:

- Establish a competitive and sustainable European **battery value chain**;
- Strengthen the European value chain for near-zero carbon **hydrogen and fuel cells**;
- Develop sustainable infrastructure, services and systems for s**mart and sustainable communities and cities**;
- **Empowering citizens** to engage in the transformation to a decarbonised society;
- Foster **emerging breakthrough technologies and climate solutions**.

**| DEVELOP COST-EFFICIENT, NET ZERO-GREENHOUSE GAS EMISSIONS ENERGY SYSTEM CENTRED ON RENEWABLES**

The transition of the energy system will rely on reducing the overall energy demand and decarbonising the energy supply side. In particular:

- Achieve global leadership in **renewable energy**;
- Develop flexible, zero greenhouse gas emission and citizen-centred **energy systems and grids**;
- Develop **carbon capture, utilisation and storage (CCUS)** solutions for the power sector and energy-intensive industries;
- Develop flexible and efficient **energy storage** solutions;
- Leverage more **public and private investments** in clean energy systems.

**| DEVELOP DEMAND SIDE SOLUTIONS TO DECARBONISE THE ENERGY SYSTEM**

Research and innovation actions aiming at fostering demand side solutions and improving energy efficiency are among the most cost effective ways to support decarbonisation. In particular:

- Achieve a highly **energy-efficient and decarbonised EU building stock**;
- Support **industrial facilities** in the energy transition.

**| DEVELOP LOW-CARBON AND COMPETITIVE TRANSPORT SOLUTIONS ACROSS ALL MODES**

Research and innovation activities are needed across all transport sectors, in order for the EU to reach its policy goals. In particular:

- Achieve **zero-emission road transport**;
- Enhance the competitiveness of **rail** as a low-carbon mode of transport;
- Make **aviation** cleaner and more competitive;
- Enable low-carbon, smart, clean and competitive **waterborne** transport;
- Reduce the **impact of transport on the environment and human health**.

**| DEVELOP SEAMLESS, SMART, SAFE, ACCESSIBLE AND INCLUSIVE MOBILITY SYSTEMS**

Europe needs to maintain the competitiveness of its transport industry and manage the transformation of supply-based transport to demand-driven, safe and sustainable mobility services. In particular:

- Make **automated and connected road transport** safe and competitive;
- Develop efficient and innovative **transport infrastructure**;
- Develop the future **transport network** and integrated **traffic management**;
- Enable **multimodal freight logistics** and **passenger mobility services**;
- Increase **transport safety** – per mode and across modes.

## European Partnerships

Transforming Europe's rail system; Integrated Air Traffic Management; Clean Aviation; Clean Hydrogen; People-centric sustainable built environment; Towards zero-emission road transport; Mobility and Safety for Automated Road Transport; Batteries: Towards a competitive European industrial battery value chain; Clean Energy Transition; Sustainable, Smart and Inclusive Cities and Communities; Zero-emission waterborne transport.

# CLUSTER 6. FOOD, BIOECONOMY, NATURAL RESOURCES, AGRICULTURE AND ENVIRONMENT

## Areas of intervention

- Environmental Observation
- Food Systems
- Biodiversity and Natural capital
- Bio-based Innovation Systems
- Agriculture, forestry and rural areas
- Circular Systems
- Seas, Oceans and Inland waters

## EU Policy Objectives

Cluster 6 will be instrumental in supporting the design, implementation and evaluation of initiatives of the **European Green Deal**, as part of the Commission 2019-2024 political guidelines, related to:

- Climate change;
- Biodiversity Strategy for 2030;
- "Farm to Fork" Strategy;
- Cherishing and protecting rural areas and investing in their future;
- Zero-pollution ambition;
- A comprehensive strategy on Africa and trade agreements with sustainable development chapter.

In addition, several EU policies and strategies related to the European Green Deal will benefit from the results of research and innovation in Cluster 6, notably:

- Common Agricultural Policy;
- Common Fisheries Policy;
- Maritime Policy;
- EU Arctic Policy;
- EU General Food Law;
- EU Bioeconomy Strategy;
- Blue Growth Strategy;
- EU environmental legislation and policies targeting biodiversity, water, soil and air.

UN SDGs


**Missions** relevant to the activities addressed in Cluster 6:

## Targeted impacts

Improved knowledge and innovations build the foundations for **climate neutrality** by reducing GHG emission and enhancing the sink and storage functions in production systems and ecosystems, and foster **adaptation** of ecosystems, water management and production systems as well as of rural, coastal and urban areas to **climate change**.

**Halt of biodiversity decline and restoration of ecosystems** enabled through improved knowledge and innovative solutions towards reaching the global vision for biodiversity 2050.

Better understanding of planetary boundaries facilitates innovative solutions for **sustainable and circular management and use of natural resources** as well as **prevention and removal of pollution**, guaranteeing healthy soils and clean water and air for all as well as boosting competitiveness, value creation and attractive jobs.

Improved knowledge and innovations enhance **sustainable primary production, food and bio-based systems, which are inclusive, safe and healthy** and ensure food and nutrition security for all within planetary boundaries.

Better understanding of the **behavioural, socio-economic and demographic changes** leads to innovative approaches that **drive sustainability** and a **balanced development of vibrant rural, coastal, peri-urban and urban areas**.

Environmental observations, strengthened evidence base and tools are delivered and used for the **establishment and monitoring of governance models enabling sustainability**.

## Key R&I Orientations

### | ENVIRONMENTAL OBSERVATION

The **disruptive technologies emerging in the digital economy** offer many opportunities in the field of Environmental Observation to deliver information for EU strategy and policies in **bio-economy**, **food**, **agriculture**, **natural resources**, and the **environment**. The main challenge in this intervention area is to deliver more reliable and standardised information, building on the FAIR principle, to **better understand the impact of global changes** and to feed into sound decision making on the big challenges our society faces.

### | BIODIVERSITY AND NATURAL CAPITAL

This orientation will support R&I and investment activities to guide the development of new methodologies, technologies and solutions, appropriate policy design, and behavioural and economic change to enable the **protection, restoration and sustainable management of ecosystems and natural capital**. Biodiversity and natural capital are essential for **mitigating and adapting to climate change**. To enhance this potential, inter-relations between biodiversity, ecosystem services and climate change mitigation and adaptation, including **carbon sequestration dynamics** from land and sea, must be better understood. EU R&I will contribute to accelerate the uptake of **ecosystem-based approaches** and **nature-based solutions** to climate mitigation and adaptation, to restore fully functional ecosystems so that they can play their role as carbon sinks contributing to the aims of the Paris Agreement, and explore complementary action in digital, regulatory framework and standards, education, market, investment, insurance, behavioural and socio-economic areas. A better understanding of biodiversity and ecosystem services, and impacts of their decline, will mobilise capacities and investments for their **conservation, restoration and sustainable management**, also through in-situ research across multiple ecosystem types, and thus facilitate the continued provision of all ecosystem services, including for **water quality**, which underpin our economy and society.

### | AGRICULTURE, FORESTRY AND RURAL AREAS

**Sustainable, climate-friendly and resilient farming and forestry systems** provide economic, environmental and social benefits. In addition to contributing to **food and nutrition security**, feeding into dynamic value chains, providing millions of jobs and securing well-being of people, EU's farmers and foresters are important stewards of the natural environment, and thus have significant potential to **shape and maintain rural landscapes**, **promote healthy ecosystems**, **mitigate the effects of climate change** and **halt the loss of biodiversity**. Vibrant rural areas are essential for farmers, foresters and other rural dwellers to keep managing EU's land and resources for the rest of society and to achieve the EU's objectives for territorial cohesion. EU R&I activities under this intervention area will advance knowledge, build capacities and develop solutions to **use land in more sustainable ways** and to **move to climate-friendly, resilient and socially inclusive agriculture and forestry systems**. This transition will be supported by applying

principles of agro- and forest ecology and making better use of ecosystem services. R&I will contribute to providing consumers with **healthy and nutritious food** and to developing **new value chains** (including urban farming) in rural and urban areas. It will further contribute to a more balanced development of rural areas, based on implementation of effective, evidence-based policies.

**| SEAS, OCEANS AND INLAND WATERS**

Seas, oceans and inland waters have a central role in climate processes and in the provision of food, biodiversity, critical ecosystem services, renewable energy and other resources. Oceans, seas and inland waters can deliver **food with lower carbon and freshwater footprints** than land-based production, while boosting profitability in the sector. **Sustainable fisheries and mariculture** are set to play an increasing role on food and nutrition security and be part of the forthcoming sustainable food from "farm to fork" strategy. The **health of the ocean and freshwater ecosystems**, its conservation and protection are a prerequisite to benefit from their services. By 2100, without significant changes, more than half of the world's marine species may stand on the brink of extinction. Activities will underpin EU's leading position to **advance restoration of biodiversity and ecosystems** and its commitment in **halting the decline of marine and freshwater species**.

**| FOOD SYSTEMS**

The global food system is facing a range of challenges including **malnutrition** (undernutrition, over-nutrition and micronutrient deficiencies), **climate change**, **resource scarcity**, **biodiversity loss**, including in soils, **growing and ageing population**, **urbanization**, **food waste** and **food poverty**. Food systems are also an important part of the bio-economy in terms of turnover and employment, and because of their common ecosystems. This creates synergies, but limits must be respected. A **food systems' transformation** is required which shifts towards **more sustainable and healthy diets** and aims to ensure **food and nutrition security for all**, thus contributing to the "farm to fork" strategy for sustainable food. The Food 2030 initiative is a useful model to follow with its four priority areas of nutrition and health, climate and sustainability, circularity and resource efficiency and innovative communities. Its goal is to use systemic approach to transition and future-proof our food systems.

**| BIO-BASED INNOVATION SYSTEMS**

Bio-based innovation has a major role to play in the sustainable and just transition to a **"green" economy** that is climate neutral and circular and operates within planetary boundaries. Building on the use of **biological renewable resources**, as a substitute for fossil- and mineral-based ones, it fosters **climate neutrality** in very significant parts of European industrial and economic sectors. It contributes to achieving the **resource-efficiency goals of the circular economy**. At the same time, it capitalises on the enormous advances of biosciences and biotechnology to deliver **greener and innovative products, processes and services**.

**| CIRCULAR SYSTEMS**

The EC report on the implementation of the Circular Economy Action Plan, the EU Strategy for Plastics in Circular Economy, the updated EU Bioeconomy Strategy, the reflection paper towards a Sustainable Europe by 2030 and the Clean planet for all strategic vision acknowledged the need for further progress in scaling up circular economy, reducing pressure on the environment and consolidating the competitive advantage it brings to EU businesses. There is need to:

- Continue supporting R&I and investments to develop and demonstrate **innovative systemic solutions** in various sectors and reap their full benefits to circularity and **cut greenhouse emissions and other forms of pollution**;
- Address the challenges related to the **circular use of natural resources**, including recycling, energy and material efficiency;
- Support **new circular business models**, and consumption and production patterns;
- Enhance circularity and **sustainable water use** and circular nutrient and manure management;
- Develop indicators and governance systems to monitor and measure the progress and **accelerate the transition to the circular economy**, and tools that could allow consumers/citizens to make better informed choices;
- Integrate **circular approaches in all phases of a product life cycle**, from design to re-use, recycling and disposal.

## European Partnerships

Two institutionalised partnerships: BioBased Industries and PRIMA. Cluster 6 will collaborate with relevant EIT KICs: EIT Climate-KIC and EIT Food. Furthermore, the following 8 areas for future partnerships have been identified:

Towards more sustainable farming: agro-ecology living labs and research infrastructures; European Partnership on Animals and Health; Environmental Observations for a sustainable EU agriculture (Agriculture of data); Rescuing biodiversity to safeguard life on Earth; A climate neutral, sustainable and productive Blue Economy; Safe and Sustainable Food Systems for People, Planet & Climate; European Partnership for a Circular bio-based Europe: sustainable innovation for new local value from waste and biomass; Water4All: Water security for the planet.