European
Commission

The potential place for CCU in
Horizon Europe

**THE NEXT EU RESEARCH & INNOVATION
INVESTMENT PROGRAMME (2021 – 2027)**

#HorizonEU

Carmine Marzano
DG RTD
CO2 Value Europe
19/09/2019
Brussels

Research and
Innovation

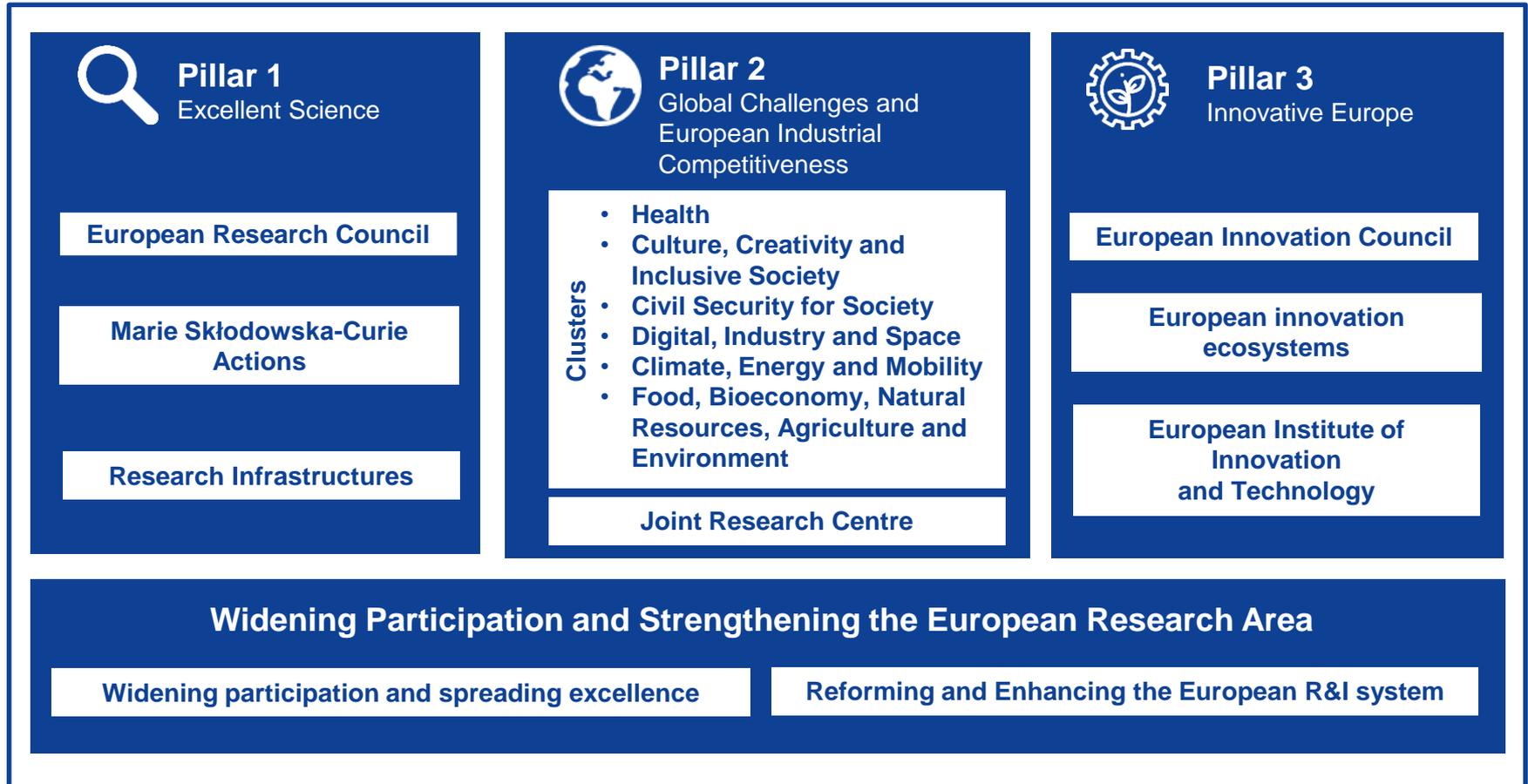| NMBP	Budgets
1. NMBP - ERA-NET on materials, supporting the circular economy and sustainable-development-goals 2. NMBP - Materials life cycle sustainability analysis (RIA) 3. SPIRE - Tapping into the potential of Industrial Symbiosis (IA) 4. SPIRE - Near zero discharge for fresh water used by industry (IA) 5. SPIRE - Mineral waste, by-products and recycled material as feed for high volume production (IA)	118.5 M€
SC5 6. Develop, implement and assess a circular economy oriented product information management system for complex products from cradle to cradle (IA) 7. Raw materials innovation for the circular economy (IA): processing and refining of primary and/or secondary raw materials; recycling of raw materials from end-of-life products & buildings; advanced sorting systems for high-performance recycling of complex end-of-life products, sustainable metallurgical processes 8. Raw materials policy support actions for the circular economy: Expert network on Critical Raw Materials (CSA)	58 M€
SC3 9. Low carbon industrial production using CCUS (IA) 10. Industrial (Waste) Heat-to-Power conversion (IA)	29 M€

Tentative call deadlines:

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2020	
Opening: 27 Jun 2019		
CE-NMBP-41-2020 (ERA-NET-Cofund)	15.00	13 Feb 2020
CE-NMBP-42-2020 (RIA)	6.00	
CE-SC5-08-2020 (CSA)	3.00	
CE-SPIRE-01-2020 (IA) CE-SPIRE-07-2020 (IA) CE-SPIRE-09-2020 (IA)	97.50	
CE-SC5-07-2020 (IA)	40.00	13 Feb 2020 (First Stage)
CE-SC5-31-2020 (IA)	15.00	03 Sep 2020 (Second Stage)
Opening: 01 May 2020		
LC-SC3-CC-9-2020 (IA)	14.00	01 Sep 2020
LC-SC3-NZE-5-2020 (IA)	15.00	
Overall indicative budget	205.50	

Horizon Europe: evolution not revolution
Budget proposed: €100 billion*

Pillar 1
Excellent Science

- European Research Council

- Marie Skłodowska-Curie Actions

- Research Infrastructures

Pillar 2
Global Challenges and European Industrial Competitiveness

Clusters

- Health
- Culture, Creativity and Inclusive Society
- Civil Security for Society
- Digital, Industry and Space
- Climate, Energy and Mobility
- Food, Bioeconomy, Natural Resources, Agriculture and Environment

Joint Research Centre

Pillar 3
Innovative Europe

- European Innovation Council

- European innovation ecosystems

- European Institute of Innovation and Technology

Widening Participation and Strengthening the European Research Area

Widening participation and spreading excellence

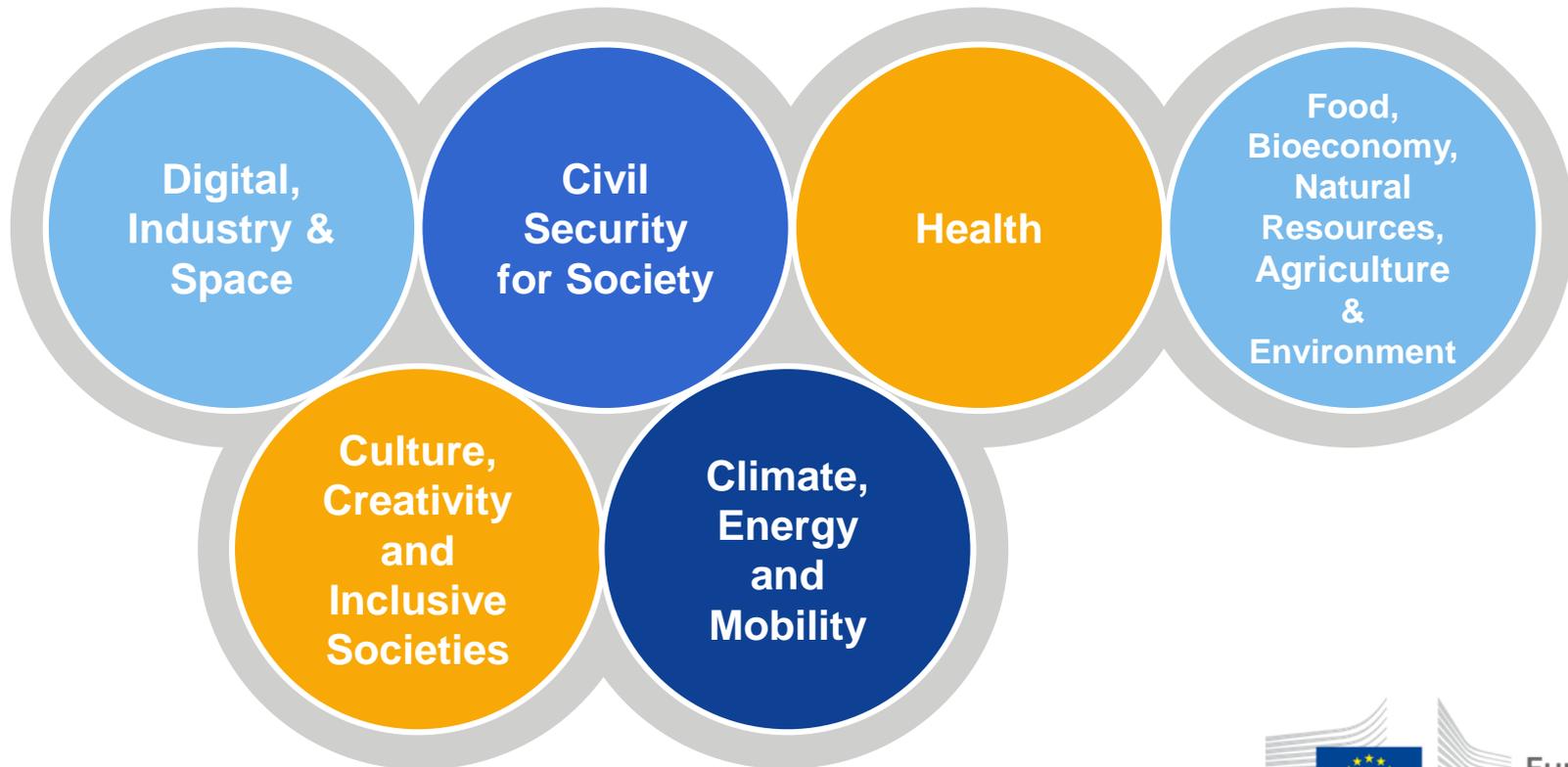Reforming and Enhancing the European R&I system

Pillar 2 - Clusters

Global Challenges & European Industrial Competitiveness: boosting key technologies and solutions underpinning EU policies & Sustainable Development Goals

Commission proposal for budget: € 52.7 billion

Clusters in 'Global Challenges and Industrial Competitiveness'

Clusters	Areas of intervention	
Health	* Health throughout the life course * Non-communicable and rare diseases * Tools, technologies and digital solutions for health and care	* Environmental and social health determinants * Infectious diseases * Health care systems
Inclusive and Secure Societies	* Democracy * Social and economic transformations * Protection and Security	* Cultural heritage * Disaster-resilient societies * Cybersecurity
Digital and Industry	* Manufacturing technologies * Advanced materials * Next generation internet * Circular industries * Space	* Key digital technologies * Artificial intelligence and robotics * Advanced computing and Big Data * Low carbon and clean industry
Climate, Energy and Mobility	* 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 transport and mobility * Energy storage
Food and Natural Resources	* Environmental observation * Agriculture, forestry and rural areas * Food systems * Circular systems	* Biodiversity and natural capital * Sea and oceans * Bio-based innovation systems

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Cluster 4, 'Digital, Industry and Space'

- Support the digitisation and transformation of the European industry, and contribute to secure global industrial leadership and autonomy in terms of technologies and resources – including in the strategic domain of Space; to grow a low-carbon, circular and clean industry respecting planetary boundaries; and to foster inclusiveness in the form of high-quality jobs and societal engagement in the use of technologies.

Vison and targeted impacts in cluster 4

Climate-neutral, circular and clean industry

e.g. a large set of plants in several regions with zero emissions and zero waste

Industrial and digital transformation

- appealing, creative jobs in Europe

- autonomy in critical raw materials through substitution, efficiency and recycling

- deploying technologies – technology infrastructures

- securing autonomy in strategic value chains

IMPACTS

Frame photo created by Waewkidja - www.freepik.com

Major contribution to inclusiveness

- two–way engagement a reality

- skills agendas in e.g. advanced manufacturing or digital

Section 4.9 Circular Industries (Narrative)

In a circular economy, the value of products, materials and resources is maintained for as long as possible and waste is minimised. The EU Circular Economy Action Plan includes a wide range of initiatives for a sustainable, low-carbon, resource efficient and competitive economy. It also relies on research and innovation through the entire life-cycle to prevent new and larger waste streams and to tackle scarcity of resources, and price volatility. Also needed are solutions to increase material efficiency and recover the economic value of waste streams, while radically decreasing their environmental footprint.

Circular approaches need to be systemic, connecting people, products and systems. **The focus will be on sectors, products and materials that have the highest impacts and the greatest potential for enhanced circularity.**

These investments should reinforce European autonomy, through access to a sustainable and affordable supply of raw materials, in particular critical raw materials (through substitution, resource efficiency, better recycling and a clean primary production) reduce the dependence on overseas handling and processing of municipal and industrial waste.

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Section 4.9 Circular Industries- Priorities

- **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; and 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

Section 4.10 Low-carbon and clean industries

Energy-intensive industries have a central role in the EU's industrial value chains. Heavily reliant on energy and non-energy raw materials, they will need to supply products with zero net emissions for downstream manufacturing.
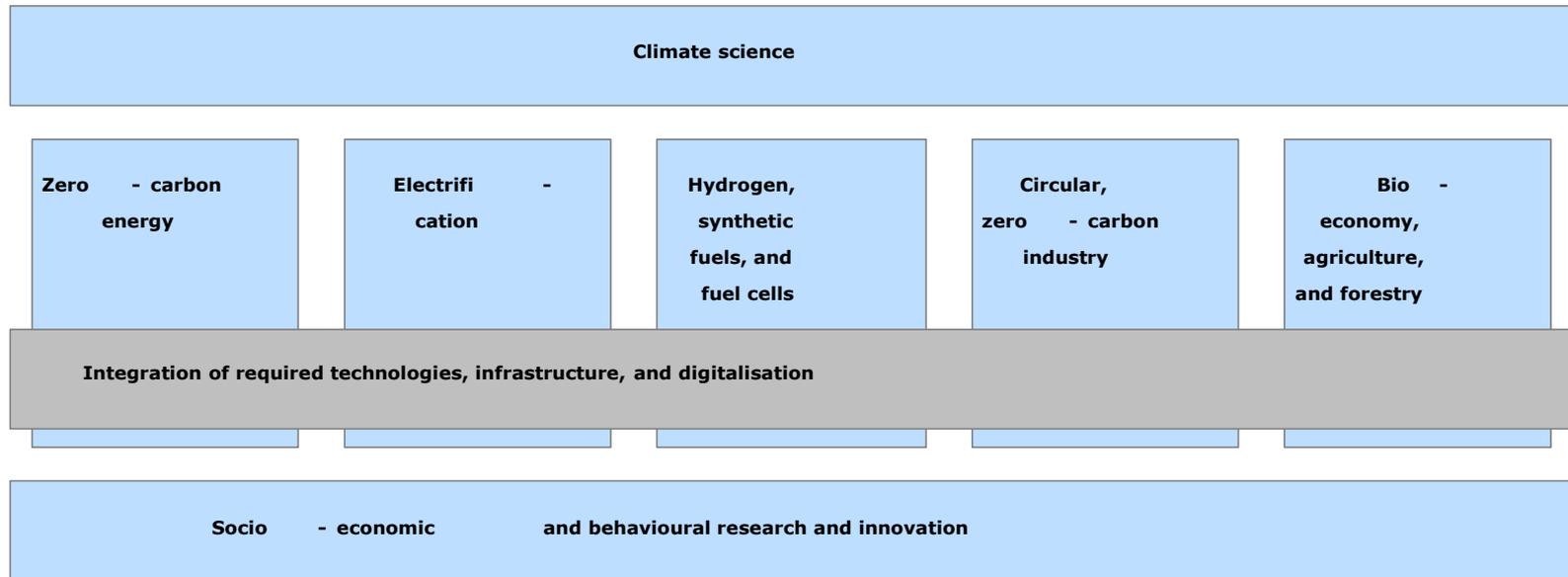
Deep decarbonisation calls for breakthrough technologies in all major emitting industrial sectors, in terms of: the underlying production processes (e.g. for steel, cement and chemicals); substitutes for carbon-intensive products; and decarbonised energy and feedstock. By 2030, Europe's regions should benefit from entirely new types of industrial plants producing sustainably with zero greenhouses gas and polluting emissions and zero waste while being globally competitive.

The required technologies include process and heat electrification, switch to decarbonised energy and feedstock, **CO2 capture and usage**, catalysis and artificial photosynthesis, waste heat recovery, and materials for re-use and recycling, all of which need to be developed and demonstrated in industrially relevant or operational environments before the first market deployment in the EU. Industries will need to coordinate innovations and investments in clean energy systems, with a much higher share of renewables, far beyond what is already foreseen for 2030 (32.5%). A closer integration is needed across value chains, giving rise to new business models, processes and technologies in which waste and emissions would be either avoided or transformed into valuable resources for new innovative processes and industries.

Co-located industrial plants, which can adapt their production to fluctuations in energy and resource flows, would ensure flexibility in energy and feedstock utilisation, including through industrial symbiosis amongst adjacent plants.

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Section 4.10 Low-carbon and clean industries

A closed-loop system, based on complex flows of resources, energy and information, would be supported, including through artificial intelligence-based technologies. Long-lasting arrangements are needed with renewable energy and storage providers to develop the necessary capacity, reduce security of supply risks and channel resources where they are most needed. These approaches also call for new business models, skills, and financial solutions; and need to be developed in conjunction with the priority 'support industrial facilities in the energy transition' under the Cluster 'Climate, Energy and Mobility'. **By 2030, these investments should lead to a large set of industrial plants in several regions, with zero net emissions of greenhouse gases, zero waste and zero polluting emissions - and by 2050, to factories that are climate-neutral, resource-efficient and fully integrated in the circular economy.**

Figure 3 Relevant research and innovation areas for decarbonisation

Cluster 5, 'Climate, Energy and Mobility'

Climate science

Zero - carbon energy	Electrifi - cation	Hydrogen, synthetic fuels, and fuel cells	Circular, zero - carbon industry	Bio - economy, agriculture, and forestry

Integration of required technologies, infrastructure, and digitalisation

Socio - economic and behavioural research and innovation

"Support decarbonisation, create inclusive growth and employment in Europe, bringing down costs for consuemrs and reduce our energy import dependency by developing energy efficient demand side solutions"

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Section 4.3.3 Develop CCUS solutions for the power sector and energy intensive industries

Challenge:
Carbon Capture, Utilisation and Storage is a major CO2 emission abatement that holds great potential for the power sector and especially for industries with high process emissions such as cement and steel. It is also an indispensable technology to allow the production of large volumes of zero-carbon ('blue') hydrogen from natural gas to kick-start the decarbonisation of sectors such as steel or refineries, until sufficient renewable ('green') hydrogen becomes available.

Targeted impact: To accelerate the development of CCUS as a CO2 emission mitigation option in electricity generation and industry applications. This includes CCS in combination with bioenergy (BECCS), resulting in 'negative' CO2 emissions. It can also address the conversion of CO2 to products either to replace the use of fossil fuel feedstock (i.e. production of synthetic fuels) or to store it for a climate-relevant time horizon (e.g. mineralisation), in collaboration with cluster 'Digital, Industry and Space'.

Potential research challenges:
☐ Development and demonstration of novel energy efficient, cost-effective and environmentally friendly capture technologies, including using new materials;
☐ Development of new storage sites (including operational best practices and public engagement); ☐ Feasibility studies for the development of CC(U)S hubs and clusters;
☐ Improving the CO2 balance and energy performance of CO2 conversion to value-added products.

Implementation: Potential research challenges and topics will be addressed through collaborative R&I actions, in particular with cluster 'Digital, Industry and Space' which includes industrial CCUS applications in the co-programmed partnership 'zero-carbon and circular industries'. International cooperation will be pursued both with other technology leaders (in particular through the Mission Innovation Carbon Capture Challenge) and with carbon-intensive technology followers to enhance the EU energy and climate diplomacy.

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Section 4.4.3 Support industrial facilities in the energy transition

Challenge: Industry has a key role in the clean energy transition, and also needs to become climate-neutral by 2050 while remaining competitive at global level. This needs to go handin-hand with an industrial transformation towards a circular industry. The efficient use of energy and resources will be optimised at all levels: at plant, industrial hub and energy system level. This priority, which focuses on the interfaces of the industrial plants and hubs with the wider energy system, will therefore be implemented jointly with Cluster 'Digital, industry and space' (cluster 4). Industry will switch to renewable and low-carbon energy sources, either produced locally or procured via electricity and gas (including hydrogen) grids. Through flexibility and demand response, industry will also contribute to the stability of energy grids supplied with a growing share of variable renewable sources.

Targeted impact: Enable competitiveness and carbon-neutrality of industry through the integration of renewable and low-carbon energy sources and the optimisation of energy flows across integrated industrial installations and the wider energy system. Potential research challenges: ☐ Develop and demonstrate technologies, planning and modelling tools and infrastructure for optimising the energy flows (e.g. electricity, heat, Hydrogen) between industrial plants/hubs and the energy grids, so as to enable contribution to the integration of RES, energy efficiency and stability of energy grids; ☐ Develop and improve technologies to use industrial waste energy (heat, cold …), including its conversion to other energy vectors, so that it can be re-commercialised in the energy system;

Implementation: Potential research challenges and topics will be addressed via collaborative R&I. To ensure complementarity across different parts of Horizon Europe, these will be addressed through, or in close cooperation with, industry-related R&I initiatives, notably with 'Climate neutral and circular industries' in Cluster 'Digital, industry and space'.

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R&I Missions

R&I Missions ▶ Relating EU's research and innovation better to society and citizens' needs; with strong visibility and impact

A mission is a portfolio of actions across disciplines intended to achieve a **bold and inspirational and measurable goal** within a set timeframe, with **impact** for society and policy making as well as relevance for a significant part of the European population and wide range of European citizens.

Horizon Europe defines mission characteristics and elements of governance, and 5 missions areas.

Specific missions will be programmed within the Global Challenges and European Industrial Competitiveness pillar (drawing on inputs from other pillars)

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Adaptation to climate change, including societal transformation

Healthy oceans, seas, coastal and inland waters

Mission areas

Cancer

Climate-neutral and smart cities

Soil health and food

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New approach to European Partnerships

New generation of objective-driven and more ambitious partnerships in support of agreed EU policy objectives

Key features

- **Simple architecture and toolbox**
- **Coherent life-cycle approach**
- **Strategic orientation**

Co-programmed

Based on Memoranda of Understanding / contractual arrangements; implemented independently by the partners and by Horizon Europe

Co-funded

Based on a joint programme agreed and implemented by partners; commitment of partners for financial and in-kind contributions
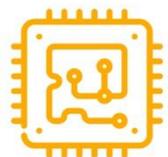
Institutionalised

Based on long-term dimension and need for high integration; partnerships based on Articles 185 / 187 of TFEU and the EIT-Regulation supported by Horizon Europe

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Areas for possible Institutionalised European partnerships (based on Article 185/7 TFEU)

Health innovations

Key digital and enabling technologies

Metrology

EU air traffic, aviation and rail

Sustainable bio-based solutions

Hydrogen and sustainable energy storage

Clean, connected mobility

Innovative SMEs

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R&I Orientations 2021-24

3 New partnerships

- **Made in Europe -** co-programmed European Partnership
  - ✓ Wider set of stakeholders, incl. societal organisations
  - ✓ Relevant for cluster 4 (centre of gravity but also 5, 6 and 1)
  - ✓ Linked to Digitising industry, Robotics/AI, Electronics, Photonics, Internet of Things, Blockchain, Circular economy, Food, Transport

- **Climate Neutral and Circular Industry -** co-programmed European Partnership
  - ✓ Wider set of stakeholders, incl. materials' community, recycling industry and societal organisations
  - ✓ Relevant for cluster 4 (centre of gravity), but also 5 and 6
  - ✓ Linked to Raw Materials, Energy, Materials, Steel, Climate, Environment

✓ **Clean Steel Partnership –** co-programmed European Partnership
  - ✓ Breakthrough technologies required for high impact results are <u>sectorial, particularly for steel</u>.
  - ✓ RFCS can contribute to the partnership part of the European Community on Coal and Steel (ECSC) assets in liquidation (up to EUR 350 million).

Horizon Europe – Strategic Planning Co-Design with Stakeholders

Public Consultation Open: Have your say

1) Co-design 2021-2024. Focus on clusters 4 and 5

Link:

https://ec.europa.eu/eusurvey/runner/HorizonEurope_Codesign_2021-2024

~~Deadline 8 September 2019~~ Extended 4 October 2019

Major Co-design event to finalise strategic planning:

2) European Research and Innovation Days

Dates: 24 to 26 September 2019 (~4000 People expected, +100 sessions).

https://ec.europa.eu/info/research-and-innovation/events/upcoming-events/european-research-and-innovation-days_en

Conclusion

- *The proposal put forward by the EC for Horizon Europe its very ambitious proposing 100 Billion Euro of budget.*

- *The strategic planning text of Cluster 4, 'Digital, Industry and Space' and Cluster 5 Cluster 4, 'Digital, Industry and Space' clearly refers to lowering emissions, circular technologies and CCUS leaving ample space to develop CCU technologies.*

- *Two co-programmed partnerships highly relevant for CO2 utilisation are currently being discussed under Clusters 4 and 5, in pillar II. Some institutionalized partnerships might also be relevant (e.g. Bio-based, Hydrogen and transport).*

- *Stakeholders can still participate to the co-design of the strategic planning of Horizon Europe for the years 2021-2024, as the public consultation has been prolonged and will be open till the 4th of October.*

Thank you!

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http://ec.europa.eu/horizon-europe

Link to pre-published WP Cross-Cutting:
https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/nmbp_h2020-cross-2018-2020_draft.pdf