

2018/0225 (COD)

**HORIZON EUROPE - EHLER's FINAL COMPROMISES**

Proposal for a

**DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

**on establishing the specific programme implementing Horizon Europe – the Framework Programme for Research and Innovation**

(Text with EEA relevance)

**CA 12 - All RECITALS and CITATIONS**

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,  
Having regard to the Treaty on the Functioning of the European Union, and in particular Articles 173(3) and 182(4) thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national parliaments,

Having regard to the opinion of the European Economic and Social Committee<sup>1</sup>,

Having regard to the opinion of the Committee of the Regions<sup>2</sup>,

**Having regard to the European Parliament's report on the assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal (2016/2147(INI))**

Acting in accordance with the ordinary legislative procedure

Whereas:

- (1) In accordance with Article 182(3) of the Treaty on the Functioning of the European Union (TFEU), the Horizon Europe - Framework Programme for Research and Innovation ("Horizon Europe"), established by *FP/RfP* Regulation (EU) No ... of the European Parliament and of the Council of...<sup>3</sup>, is to be implemented through specific programmes, which define the detailed rules for their implementation, fix their duration and provide for the means deemed necessary.
- (2) *FP/RfP* Regulation (EU) No ... sets out the general and specific objectives of Horizon Europe, the structure and the broad lines of activities to be carried out, while this specific programme implementing Horizon Europe - the Framework Programme for Research and Innovation (the 'Specific Programme') should define the operational objectives and the activities which are specific to parts of Horizon Europe. The

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<sup>1</sup> OJ C , , p. .

<sup>2</sup> OJ C , , p. .

<sup>3</sup> OJ C , , p. .

provisions on implementation set out in *FP/RfP Regulation* (EU) No ... apply fully to the Specific Programme, including those relating to ethical principles.

- (3) In order to ensure uniform conditions for the implementation of the Specific Programme, ***the Commission should be conferred delegated powers to to adopt Strategic R&I Plans as well as*** implementing powers should be conferred on the Commission to adopt work programmes for the implementation of the Specific Programme. Those powers should be exercised in accordance with Regulation (EU) No 182/2011 of the European Parliament and of the Council<sup>4</sup>.
- (4) The Board of Governors of the Joint Research Centre (JRC), set up by Commission Decision 96/282/Euratom<sup>5</sup> has been consulted on the scientific and technological content of the Specific Programme on the non-nuclear direct actions of the JRC;
- (5) Reflecting the importance of tackling climate change in line with the Union's commitments to implement the Paris Agreement and the United Nations Sustainable Development Goals, this Specific Programme will contribute to mainstream climate actions and to the achievement of an overall target of 25 % of the EU budget expenditures supporting climate objectives. Actions under this Specific Programme are expected to contribute ***at least*** 35% of the overall financial envelope of the Specific Programme to ***EU climate objectives and commitments, where appropriate***. Relevant actions will be identified during the Specific Programme's preparation and implementation, ***monitored, reported***, and reassessed in the context of the relevant evaluations and review processes.
- (6) The Specific Programme's actions should be used to ***reinforce, widen and extend the excellence of the Union's scientific and technological base, tackle major global challenges, increase the Union's industrial leadership, improve quality of life in the Union as well as boost investment***, address market failures or sub-optimal investment situations , ***leveraging additional funding rather than*** crowding out private financing.
- (6a) ***Gender equality is an EU policy priority and a key societal challenge (UN SDG5). Furthermore, the goal of gender equality in society is a crucial driver for the social and industrial transformations required by other SDGs. Gender aspects thus should be appropriately integrated throughout the Programme and specific gender research should be also required to support the implementation and design of better EU gender equality policies.***
- (6b) ***The Specific Programme should be implemented in a transparent, participatory and strategic way ensuring involvement of stakeholders and civil society. Stakeholder representation and civil society involvement should be balanced representing various backgrounds.***
- (7) Reflecting the important contribution that research and innovation should make to address challenges in food, agriculture, rural development and the bioeconomy, ***to make them more sustainable*** and to seize the corresponding research and innovation opportunities in close synergy with Common Agricultural Policy, relevant actions under the Specific Programme will be supported ***in a dedicated*** cluster 'Food, Natural Resources ***and Agriculture***' for the period 2021-2027.
- (7a) ***The European cultural and creative sectors build bridges between arts, culture, business and technology. Cultural heritage is an integral part of European cohesion and supports the link between tradition and innovation. Preserving cultural heritage***

<sup>4</sup> Regulation (EU) No 182/2011 of the European Parliament and of the Council of 16 February 2011 laying down the rules and general principles concerning mechanisms for control by the Member States of the Commission's exercise of implementing powers (OJ L 55, 28.2.2011, p. 13)

<sup>5</sup> Commission Decision 96/282/Euratom of 10 April 1996 on the reorganization of the Joint Research Centre (OJ L 107, 30.4.1996, p. 12).

*and developing creative solutions, in particular in the field of digitalisation, will be a priority of the Programme.*

- ~~(9) The types of financing and the methods of implementation under this Decision shall be chosen on the basis of their ability to achieve the specific objectives of the actions and to deliver results, taking into account, in particular, the costs of controls, the administrative burden, and the expected risk of non-compliance. For grants, this shall include consideration of the use of lump sums, flat rates and scales of unit costs.~~
- (8) The completion of the Digital Single Market and the growing opportunities from the convergence of digital and physical technologies requires a stepping up of investments. Horizon Europe will contribute to these efforts ***with a dedicated cluster*** to ensure that Europe remains at the forefront of global research and innovation in the digital field.
- (8a) ***Reflecting the importance to communicate better and to a wider audience the added value and the impact of EU actions, the Commission should increase its efforts towards the visibility of Horizon Europe. Similarly, beneficiaries should ensure to give visibility to their achievements from EU funding.***

CA 1
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## Article 2

### Operational objectives

1. The Specific Programme shall contribute to the general and specific objectives set out in Article 3 of Regulation ... *FP/RfP Regulation*
2. The Specific Programme has the following operational objectives:
  - (a) ***strengthening and widening Europe's scientific and technological base, reinforcing and spreading excellence;***
  - (b) increasing collaboration across sectors and disciplines;
  - (c) connecting, developing ***and facilitating wide access, including virtually, to*** research infrastructures across the European Research Area;
  - (d) strengthening international cooperation ***in S&T to support Union's excellence;***
  - (e) attracting, training and retaining ***EU and international*** researchers and ***innovators***, including through mobility of researchers, ***with the aim of establishing the European Research Area as the world's most excellent and competitive;***
  - (f) ***fostering open science and open access to results;***
  - (g) actively disseminating and exploiting results in particular for policy development;
  - (h) supporting the implementation of Union policy ***goals and*** priorities;
  - (i) reinforcing the link between research, innovation, ***education, and*** other policies, including the Sustainable Development Goals ***and the Paris Agreement;***
  - (j) delivering, through R&I missions, on ambitious goals within a set timeframe;
  - (k) involving ***relevant R&I stakeholders, including citizens, academia, research organisations and industry, in the*** co-design and co-creation processes;
  - (l) improving science communication

- (m) ***Driving EU*** industrial transformation ***to unlock the potential of Europe's strategic sectors, such as Key Enabling Technologies;***
  - (n) improving skills ***through training and fostering creativity*** for ***research and innovation;***
  - (o) stimulating the creation and scale-up of innovative companies, in particular ***start-ups and SMEs;***
  - (p) improving access to risk finance, including ***through synergies with InvestEU,*** in particular where the market does not provide viable financing;
  - (p a) strengthening gender mainstreaming and the integration of the gender dimension in research and innovation;***
  - (p b) maximising scientific, technological, societal and economic impact.***
3. Within the objectives referred to in paragraph 2, account may be taken of new and unforeseen needs that arise during the period of implementation of the Specific Programme. That may, if duly justified, include responses to emerging opportunities, crises and threats, as well as responses to needs relating to the development of new Union policies.

<b>CA 2</b>
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### Article 3

#### Structure

1. In accordance with Article 4(1) of Regulation ... *FP/RfP Regulation*, the Specific Programme shall consist of the following parts:
  - (1) Pillar I ***'Excellent and Open Science'*** with the following components:
    - (a) the European Research Council (ERC), as described in Annex I, Pillar I, section 1;
    - (b) Marie Skłodowska-Curie actions (MSCA), as described in Annex I, Pillar I, section 2;
    - (c) research infrastructures, as described in Annex I, Pillar I, section 3;
  - (2) Pillar II 'Global Challenges and European Industrial Competitiveness'; ***including a monobeneficiary, grant-based SME instrument as described in article 43.a. of the Regulation and Annex I of the Specific Programme:***
    - (a) cluster 'Health', as described in Annex I, Pillar II, section 1;
    - (b) cluster 'Inclusive and ***Creative*** Society', as described in Annex I, Pillar II, section 2;
    - (b a new) cluster 'Secure Society'***
    - (c) cluster 'Digital, Industry ***and Space***', as described in Annex I, Pillar II, section 3;
    - (d) cluster 'Climate, Energy and Mobility', as described in Annex I, Pillar II, section 4;

- (e) cluster Food, Natural Resources *and Agriculture*, as described in Annex I, Pillar II, section 5;
  - (f) non-nuclear direct actions of the Joint Research Centre (JRC), as described in Annex I, Pillar II, section 6;
- (3) Pillar III '*Innovative Europe*' with the following components:
- (a) the European Innovation Council (EIC), as described in Annex I, Pillar III, section 1; including European innovation ecosystems, as described in Annex I, Pillar III, section 2;
  - (b) the European Institute of Innovation and Technology (EIT), as described in Annex I, Pillar III, section 3.
- (4) Part 'Strengthening the European Research Area' with the following components:
- (a) *spreading excellence and widening participation*, as described in Annex I, Part 'Strengthening the European Research Area', section 1;
  - (b) reforming and enhancing the European R&I system, as described in Annex I, Part 'Strengthening the European Research Area', section 2.
2. The activities to be carried out under the parts referred to in paragraph 1 are set out in Annex I.

<b>CA 3</b>
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*Article 4*

**Budget**

1. In accordance with Article 9(1) of Regulation ... *FP/RfP Regulation*, the financial envelope for the implementation of the Specific Programme for the period 2021 to 2027 shall be EUR **120 000 000 000 in 2018** prices.
2. The amount referred to in paragraph 1 of this Article shall be distributed among the components set out in Article 3(1) of this Decision in accordance with Article 9(2) of Regulation ... *FP/RfP Regulation*. The arrangements of Article 9(3) to (8) of Regulation ... *FP/RfP Regulation* shall apply.

CHAPTER II

**IMPLEMENTATION AND PROGRAMMING**

<b>CA 4</b>
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## Article 5

### Missions

1. For each mission, a mission board *shall* be established *for co-designing and steering implementation*. It shall be composed of *15 to 20 independent* high level individuals including *R&I representatives from various sectors and disciplines, academia, research and technology organisations, industry of all sizes, national, regional authorities and civil society organisations. The members of the mission board shall be appointed by the Commission following an independent and transparent procedure, including an open call for expressions of interest.* The mission board shall advise *on* the following:
  - (a) content of *relevant* work programmes and their revision as needed for achieving the mission objectives;
  - (b) adjustment actions, or termination if appropriate, based on implementation assessments of the mission;
  - (c) selection of expert evaluators, *prevention of conflict of interest of expert evaluators*, briefing of expert evaluators and evaluation criteria and their weighting *in addition to the standard criteria, namely “excellence; impact; and quality and efficiency of the implementation”;*
  - (d) framework conditions which help achieve the objectives of the mission *in line with Union priorities;*
  - (e) communication.

*(e a new) clear and measurable mission targets and possible outcomes;*

*(e b new) evaluation of social impact and business potential of the mission;*
2. Specific provisions to enable an efficient and flexible portfolio approach *shall* ~~may~~ be set out in the work programme provided for in Article 11.
 

(2 a new )

*The content of the missions, details on the implementation, including their scope, indicators, measurable targets and milestones, estimated budget and synergies with other Union funds and links with European Partnerships shall be laid down in Strategic R&I Plans, as outlined in Annex I of this Decision.*

(2 b new)

*Missions shall be implemented through open calls within the work programmes of the relevant clusters, calling for project proposals which are contributing to the mission and which are situated in one or more of the intervention areas of the clusters.*

## Article 6

### European Research Council

#### AM 20, 21, 463 - 468

1. The Commission shall establish a European Research Council ("ERC"), for implementing the actions under Pillar I '*Excellent and Open Science*' which relate to the ERC. The ERC shall succeed the ERC set up by Decision C(2013) 1895<sup>6</sup>.
2. The ERC shall be composed of the independent Scientific Council provided for in Article 7 and the dedicated implementation structure provided for in Article 8.
3. The ERC shall have a President who shall be chosen from among senior and internationally respected scientists.

The President shall be appointed by the Commission following a transparent recruitment process involving an independent dedicated search committee, for a term of office limited to four years, renewable once. The recruitment process and the candidate selected shall have the approval of the Scientific Council.

The President shall chair the Scientific Council and shall ensure its leadership and liaison with the dedicated implementation structure, and represent it in the world of science.

4. The ERC shall operate according to the principles of scientific excellence, autonomy, efficiency, effectiveness, transparency and accountability. It shall ensure continuity with ERC actions conducted under Decision .../EC.
5. The activities of the ERC shall support research carried out across all fields by individual and transnational teams in competition at the European level. *Support to innovation, i.e via the Proof of Concept scheme, should continue in order to encourage faster translation of new discoveries into commercial or socially valuable products, processes, and services. To contribute to this, excellent ERC applicants who have passed the threshold but could not be funded due to lack of resources are eligible to the proof of concept.*
- 5a new *A seal of excellence shall be awarded to a beneficiary of the ERC proof of concept, if the proposal is eligible, has passed applicable thresholds and could not be funded.*

6. The Commission shall act as the guarantor of the autonomy and integrity of the ERC and shall ensure the proper execution of the tasks entrusted to it.

The Commission shall ensure that the implementation of the ERC actions is in accordance with the principles set out in paragraph 4 of this Article as well as with the overall strategy for the ERC, referred to in point (a) of Article 7(2), established by the Scientific Council.

CA 6
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## Article 7

### ERC Scientific Council

1. The Scientific Council shall be composed of scientists, engineers and scholars of the highest repute and appropriate expertise ensuring a diversity of research areas and acting in their personal capacity, independent of extraneous interests.

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<sup>6</sup> OJ C 373, 20.12.2013, p. 23

The members of the Scientific Council shall be appointed by the Commission, following an independent and transparent procedure for their identification agreed with the Scientific Council, including a consultation of the scientific community and a report to the European Parliament and the Council.

Their term of office shall be limited to four years, renewable once, on the basis of a rotating system which shall ensure the continuity of the work of the Scientific Council.

2. The Scientific Council shall establish:

- (a) the overall strategy for the ERC;
- (b) the work programme for the implementation of the ERC activities;
- (c) the methods and procedures for peer review and proposal evaluation on the basis of which the proposals to be funded are determined;
- (d) its position on any matter which from a scientific perspective may enhance achievements and impact of the ERC and the quality of the research carried out;

The Commission shall *establish a code of conduct addressing, inter alia, the avoidance of conflict of interests and* depart from the positions established by the Scientific Council in accordance with points (a), (c), *and* (d) of the first subparagraph only when it considers that the provisions of this Decision have not been respected. In that case, the Commission shall adopt measures to maintain continuity in the implementation of the specific programme and the achievements of its objectives, setting out the points of departure from the Scientific Council positions and duly motivating them.

3. The Scientific Council shall act in accordance with the mandate set out in Pillar I of Annex I, section 1.

4. The Scientific Council shall act exclusively in the interest of achieving the ERC's *goals*, according to the principles set out in Article 6. It shall act with *complete independence*, integrity and probity and carry out its work efficiently and with the greatest possible transparency and *openness maximising ERC's contribution to achieving the EU R&I policy objectives and Horizon Europe's goals in particular*.

CA 7
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## Article 8

### Dedicated ERC implementation structure

- 1. The dedicated implementation structure shall be responsible for the administrative implementation and programme execution, as described in Pillar I of Annex I, section 1. It shall support the Scientific Council in the conduct of all of its tasks.
- 2. The Commission shall ensure that the dedicated implementation structure follows strictly, efficiently and with the necessary flexibility the objectives and requirements of the ERC alone.



**CA 8**

*Article 9*

**The European Innovation Council**

1. The Commission shall establish a European Innovation Council (EIC) *in accordance with article (7a) of the Regulation.*
- 1 a new *The EIC will be built into two instruments, the Pathfinder and the Accelerator, as described in Annex I of this Decision. The EIC instruments shall be continuously evaluated in order to support innovation in a systematic way.*
- 1 b new *Where appropriate, the EIC objectives and actions shall be linked to other parts of the Programme as well as to other national and Union Funds, in particular the EIT and InvestEU.*
2. The EIC shall include the High Level Board ("EIC Board") provided for in Article 10.
3. The Commission shall ensure that the implementation of the EIC is:
  - (a) in accordance with the principles set out in paragraph 1 of this Article, taking due account of the opinion of the EIC Board on the overall strategy for the EIC, referred to Article 10(1)(a); and
  - (b) does not lead to distortions of competition contrary to the common interest.
4. For the purpose of managing EIC blended finance, the Commission shall make use of indirect management, or where this is not possible, may establish a special purpose vehicle. The Commission shall seek to ensure the participation of other public and private investors. Where this is not possible at the initial set up, the special purpose vehicle will be structured in such a way that it can attract other public or private investors in order to increase the leverage effect of the Union contribution.
- 4a new *The Commission shall ensure cooperation between the EIC and EIT, especially through its KICs.*

**CA 9**

*Article 10*

**The EIC Board**

1. The EIC Board shall advise the Commission upon:
  - (a) the overall strategy for the EIC component under Pillar III '*Innovative Europe*';
  - (b) the work programme for the implementation of the EIC actions;
  - (c) the criteria for assessment of the innovativeness and risk profile of the proposals and the appropriate balance of grants, equity and other forms of financing for the EIC accelerator;
  - (d) the identification of strategic portfolio of projects;
  - (e) the profile of programme managers.
- (e a new) *the systematic and continuous evaluation process of the EIC actions;*

2. The EIC Board may upon request, ***and wherever appropriate in coordination with the EIT Governing Board***, address recommendations to the Commission on:
  - (a) any matter which from an innovation perspective may enhance and foster innovation eco-systems across Europe, the achievements and impact of the objectives of the EIC component and the capacity of innovative firms to roll out their solutions;
  - (b) identify in cooperation with relevant Commission services ***and the EIT*** possible regulatory barriers faced by entrepreneurs, in particular those awarded support under the EIC component;
  - (c) emerging technology trends from EIC's portfolio, to inform the programming in other parts of the Specific Programme;
  - (d) identifying specific issues where advice from the EIC Board is needed.

The EIC Board shall act in the interest of achieving the objectives of the EIC ***taking into account EU's industrial strategy, its competitiveness and global challenges***. It shall act with integrity and probity and carry out its work efficiently and with transparency and ***openness, avoiding distortion of competition in the internal market***.

The EIC Board shall act in accordance with its mandate set out in Pillar III of Annex I, section 1.

3. The EIC Board shall be composed of 15 to 20 ***independent*** high level individuals drawn from various parts of Europe's ***research and*** innovation ecosystem, including entrepreneurs ***from companies of all sizes, economists***, investors, researchers ***and academic experts on innovation policy***. It shall contribute to outreach actions, with EIC Board members striving to enhance the prestige of the EIC brand.

The members of the EIC Board shall be appointed by the Commission, following an open call for nominations or for expression of interests or both, whichever the Commission will find more appropriate and taking into account the need for balance in expertise, gender, age and geographical distribution.

Their term of office shall be limited to ***three*** years, renewable ***once***, with a rolling appointments system (***half of the*** members ***exchanged*** every two years).

4. The EIC Board shall have a President who shall be appointed by the Commission following a transparent recruitment process. The President shall be a high profile figure ***with a proven expertise in research and*** innovation.

The President shall be appointed for a term of office limited to ***three*** years, renewable once.

The President shall chair the EIC Board, prepare its meetings, assign tasks to members, and may establish dedicated sub-groups, in particular to identify emerging technology trends from EIC's portfolio. He or she shall promote the EIC, ***its role in achieving the Programme and the Union's R&I goals***, act as interlocutor with the Commission and represent the EIC in the world of ***research and*** innovation. The Commission ***shall*** provide for administrative support for the President to undertake his or her duties.

5. A code of conduct addressing, inter alia, the avoidance of conflict of interests shall be established by the Commission. Members of the EIC Board ***must*** accept the code of conduct upon assuming office.

**CA 10**

*Article 11*

***Strategic Planning and Work programmes***

- 1 a new. ***The implementation of the specific programme shall be based on Specific R&I Plans defined every two years, through delegated acts in accordance with Article 6 of the Regulation and following a transparent, inclusive and strategic multiannual planning process of research and innovation activities, in particular for the pillar 'Global Challenges and European Industrial Competitiveness'. Mandatory multi-stakeholder consultations with national authorities, the European Parliament, and RDI stakeholders' representatives, including civil society, about priorities and the suitable types of action and forms of implementation, including for missions and European partnerships, shall ensure the necessary inter-disciplinary and cross-sectoral perspectives and alignment with other relevant existing initiatives at Union, national and regional level. This will contribute to leveraging additional private and public funding and thereby strengthening the ERA, as described in Annex I of this Decision.***
1. ***Following the strategic R&I plan,*** the Programme shall be implemented by work programmes referred to in Article 110 of Financial Regulation.  
 Work programmes shall set out, where applicable, the overall amount reserved for blending operations.
  2. The Commission shall adopt separate work programmes, by means of implementing acts, for the implementation of actions under the following components, as set out in Article 3(1) of this Decision :
    - (a) the ERC, where the work programme shall be established by the Scientific Council under point (b) of Article 7(2), in accordance with the advisory procedure referred to in Article 12(3). The Commission shall depart from the work programme established by the Scientific Council only when it considers that it is not in accordance with the provisions of this Decision. In that case, the Commission shall adopt the work programme by means of an implementing act in in accordance with the examination procedure referred to in Article 12(4). The Commission shall duly motivate this measure;
    - (b) all clusters under the pillar 'Global Challenges and ***European*** Industrial Competitiveness', MSCA, research infrastructures, support to European innovation ecosystems, ***spreading*** excellence and ***widening participation***, reforming and enhancing the European R&I System, in accordance with the examination procedure referred to in Article 12(4);
    - (c) the EIC, where the work programme shall be prepared following the advice of the EIC Board under point (b) of Article 10(1), in accordance with the examination procedure referred to in Article 12(4);
    - (d) the JRC, where the multi-annual work programme shall take into account the opinion provided by the Board of Governors of the JRC referred to in Decision 96/282/Euratom.
  3. In addition to requirement in Article 110 of the Financial Regulation, the work programmes referred to in paragraph 2 of this Article shall, as appropriate, contain:

- (a) an indication of the amount and ***budgetary share in relation to the Programme*** allocated to each action, mission ***and European Partnership*** and an indicative implementation timetable;
- (b) for grants the priorities, the selection and award criteria and the relative weight of the different award criteria and the maximum rate of funding of the total eligible costs;
- (c) the amount allocated to blended finance in accordance with Articles 41 to 43 of Regulation ... *FP/RfP Regulation*;
- (d) any additional obligations for beneficiaries, in accordance with Articles 35 and 37 of the *FP/RfP Regulation*.

CA 11
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***Article 12 a new  
Steering Board for Health***

***1. The Commission shall establish a Steering Board for Health for implementing the actions under Pillar II 'Global Challenges and Industrial Competitiveness' which relates to 'Health'.***

***2. The Steering Board for Health shall be composed of 15 to 20 high level individuals drawn from across disciplines and activities, in the fields of research, innovation, public health and wellbeing.***

***3. The Steering Board for Health shall focus on the following principles: coordination and synergies between EU and national health programmes, as well as between the Health cluster and other parts of Horizon Europe, including missions and partnerships. The Board will promote patients and society engagement, providing scientific advice and recommendations. The actions should promote value-oriented health research, better health solutions and reduce health inequalities.***

***4. The Steering Board for Health shall contribute to:***

- (a) the strategy for the cluster 'Health',***
- (b) the blueprint for steering coordination and cooperation between the health programmes, related pillars, such as EIC, ERC, as well as within Strategic Partnerships and the EU structural funds. The blueprint shall ensure more visibility and coordination of the existing financial mechanisms allocated to health research, shall steer coordination and cooperation, and shall develop the work programmes and missions related to Health,***
- (c) the methods and procedures for designing, selecting and implementation of the health missions,***
- (a) provide for citizens' participation and engagement in a bottom-up decision making process, (b) foster sustainability in funding strategies and mechanisms allowing for long-term projects and ambitious missions,***
- (b) ensure fruitful transnational research collaborations that maximize the European potential and translate results into health systems,***
- (c) increase the use of multidisciplinary research between disease areas where commonalities exist and thereby decrease duplication and isolated research,***

*(d) increase visibility of Horizon Europe and its benefit for EU citizens, address fragmentation of responsibilities for science and research within the EU governing bodies, streamline the existing funding mechanisms.*

*5. The Steering Board for Health shall provide a comprehensive research strategy and steering in developing the work programmes and missions related to Health in complementarity with the dedicated mission Board.*

*6. The Steering Board for Health shall be an independent science-led stakeholder group, composed of actors from biomedical research and innovation, other relevant sectors of research and industry and with strong participation of patient representatives and citizens.*

*7. The members of the Steering Board for Health shall be appointed by the Commission, following an open call for nominations or for expression of interests or both, as appropriate, and taking into account the need for balance in expertise, gender, age and geographical distribution. Their term of office shall be limited to two years, renewable twice, with a rolling appointments system (members appointed every two years).*

*8. The Steering Board for Health shall have a chair who shall be appointed by the Commission following a transparent recruitment process. The President shall be a high profile public figure linked to the health research field.*

*9. The activities and outcome of the Board shall be reviewed and reported in the Programme's interim evaluation, where measures to prolong, adapt or close the group according to the review shall be identified.*

## ANNEX I

### PROGRAMME ACTIVITIES

<b>CA 13 - Introduction and Pillar I</b>
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The following will be applied in the implementation of the Programme.

#### STRATEGIC PLANNING

The implementation of Horizon *Europe shall be steered by an inclusive and transparent strategic planning process of the research and innovation activities funded by the Programme. The Strategic Planning process shall lead to the implementation of Horizon Europe's programme objectives by defining the funding priorities. It* will provide focus on impact for the Programme and coherence between its different pillars, as well as synergy with other EU programmes and support to other EU policies.

*The strategic planning process and the adoption of the strategic R&I plan by means of a delegated act will increase ownership and understanding for the purpose of the Programme by a wider public and will allow the co-legislators, stakeholders and Member States to be fully informed on the envisaged initiatives. The Strategic Planning process will help to develop and implement policy for the relevant areas covered, at Union level as well as complementing policies in the Member States while ensuring that main European policy targets are reflected and supported by Horizon Europe with adequate resources. It will allow simplification of the funding landscape, avoid duplication and overlaps between funding possibilities while leveraging additional private and public funding and promote faster dissemination and uptake of research and innovation results.*

A systemic, cross-disciplinary, cross-sectoral and cross-policy approach to research innovation will ensure that *societal and economic* challenges can be tackled, *knowledge is generated and where possible, give rise to new competitive and sustainable businesses and industries, social and technological innovation*, fostering competition, stimulating private investments and preserving the level playing field in the internal market.

The Strategic Planning *process* will promote strong engagement with citizens and civil society organisations in research and innovation, the co-creation of knowledge, effective promotion of gender equality, including the integration of the gender dimension in research and innovation, and will promote the adherence to the highest ethics and integrity standards.

*In order to respond to those objectives, the Commission will launch an open consultation phase* with Member States, the European Parliament, and *a variety of* stakeholders, including the scientific community, *research and technology organisation, industry, civil society organisations, among others. The consultation*

*will cover the Programme's strategic priorities including missions under the Global Challenges and European Industrial Competitiveness pillar, and the suitable types of instruments, in particular the European partnerships. Results of the consultation will be published on a dedicated web page, which should also provide the details on the content and process defining the Strategic Planning.*

*As regards European partnerships, the Strategic R&I Plan will outline and give the rationale for the creation, merge and phasing out of the European partnership. The positively reviewed Joint Technology Initiatives and Contractual Public Private Partnerships, should be considered for continuation beyond 2020 due to their added-value in delivering social and economic impact as well as leveraging private investment and contribution to synergies of funds.*

*On-going and potential new KICs will be defined in the legislative proposal for a Decision of the European Parliament and the Council on the EIT Strategic Innovation Agenda, in line with the Strategic R&I Plan. Nevertheless, the creation of any new KIC should be subject to adequate funding, allowing the existing KICs to develop the ecosystems, build partnerships and pursue and implement efficiently their ambitious objectives.*

*'FET Flagships' supported under Horizon 2020 will continue to be supported under the Programme. As they present substantial analogies with missions, other 'FET flagships', may be supported under this Framework Programme as missions geared towards future and emerging technologies. The missions should strengthen the collaborative aspects of the Programme and complement existing European partnerships, which could work as supporting implementation pillars of the missions. The missions will have technological and societal elements and will also be defined in close cooperation with all relevant DGs. The Strategic Planning process will define the missions according to article 7 of the Regulation and article 5 of this Decision.*

The Strategic Planning process will *identify existing links* between Horizon Europe and other Union Programmes, *and offer possibilities for synergies between EU, regional and national funds. Horizon Europe will become* a point of reference for research and innovation in all related programmes across the EU budget *in order to help deliver the EU's political priorities and objectives.* It will also provide the frame for linking the direct research actions of the Joint Research Centre and other actions supported under the Programme, including the use of results to support policy.

## **FAST TRACK TO RESEARCH AND INNOVATION**

*Horizon Europe will provide the possibility for beneficiaries to apply for funding in a faster manner, where provided for in the Work Programme's of all clusters, EIC and "spreading excellence", covering research and innovation activities. Building on the success of the existing Fast Track to Innovation instrument in Horizon 2020, this approach will have a bottom-up-driven logic on the basis of continuously open calls and "time to grant" not exceeding six months. In the "spreading excellence" part, this approach will support less developed EU countries to access funds in a faster and bottom-up manner. This modality will be applied to at least 15% of the Programme's budget.*

## DISSEMINATION AND COMMUNICATION

Horizon Europe will provide dedicated support for open access to scientific publications, to knowledge repositories and other data sources. Dissemination and knowledge diffusion actions will be supported, also from cooperation with other EU programmes, including clustering and packaging results and data in languages and formats for target audiences and networks for citizens, industry, public administrations, *scientific community*, civil society organisations, and policy makers. For this purpose, Horizon Europe may make use of advanced technologies and intelligence tools.

There will be appropriate support for mechanisms to communicate the programme to potential applicants (e.g. National Contact Points).

The Commission will also implement information and communication activities relating to Horizon Europe, to promote the fact that results were obtained with the support of EU funding. They will also seek to raise public awareness on the importance of research and innovation and the broader impact and relevance of EU funded research and innovation, by means of e.g. publications, media relations, events, knowledge repositories, databases, multi-channel platforms, websites or a targeted use of social media. Horizon Europe will also provide support to the beneficiaries to communicate their work and its impact to society at large.

## EXPLOITATION AND MARKET UPTAKE

The Commission will establish comprehensive measures for exploitation of Horizon Europe results and the knowledge produced, *which will also include promoting standardisation*. This will accelerate exploitation towards market uptake and boost the impact of the Programme.

The Commission will systematically identify and record the results of the research and innovation activities under the Programme and transfer or disseminate these results and knowledge produced in a non-discriminatory fashion to industry and enterprises of all sizes, public administrations, scientific community, civil society organisations and policy-makers, in order to maximise the European added value of the Programme. *A specific monitoring procedure will be implemented for the new European Innovation Council.*

## INTERNATIONAL COOPERATION

Greater impact will be obtained through aligning actions with other nations and regions of the world within an international cooperation effort of unprecedented scale. Based on mutual benefit, partners from across the world, *including the scientific community, industry, civil society organisations, governments and NGOs* will be invited to join EU efforts as an integral part of initiatives in support of EU action for sustainability, reinforced research and innovation excellence, and competitiveness. *The*



***transfer of knowledge, sharing of capacity and infrastructure between the partners internationally will drive shared approaches and regulation that will bring synergistic trading to all parties.***

International joint action will ensure effective tackling of global challenges and Sustainable Development Goals, access to the world's best talents, expertise and resources, and enhanced supply and demand of innovative solutions. ***International collaboration will be designed around common goals. This will facilitate European researchers to engage with the best researchers in their field.***

## **WORKING METHODOLOGIES FOR EVALUATION**

The use of high quality independent expertise in the evaluation process underpins the engagement of the programme across all stakeholders, communities and interests, and is a prerequisite for maintaining the excellence and relevance of the funded activities.

The Commission or funding body will ensure the impartiality of the process, and avoid conflicts of interest in line with Article 61 of the Financial Regulation.

When justified by the requirement to appoint the best available experts and/or by the limited size of the pool of qualified experts, independent experts assisting or being members of the evaluation committee may evaluate specific proposals for which they declare a potential interest. In this case, the Commission or funding body shall take all necessary remedial measures to ensure the integrity of the evaluation process, including in regards to conflicts of interests. The evaluation process will be managed accordingly, including a stage involving an interaction between diverse experts. ***The use of this process will be reported in the annual monitoring report of the Programme. The evaluation committee will take into account the particular circumstances when identifying proposals for funding.***

## **PILLAR I**

### ***EXCELLENT AND OPEN SCIENCE***

The search for breakthroughs in understanding and the acquisition of knowledge; the world class facilities needed to achieve this including physical and *e-infrastructures* for research and innovation as well as the means to openly disseminate and share knowledge; and an adequate supply of excellent researchers *and innovators*; are at the very heart of economic, social and cultural progress in all its forms.

Open and excellent science is inextricably linked to the achievement of world leading innovation. Scientific and technological paradigm shifts have been identified as key drivers for *productivity, sustainable and inclusive* growth and *development*, competitiveness, wealth, and social progress. Such paradigm shifts have historically tended to originate from the public-sector science base before going on to lay the foundations for whole new industries and sectors.

Public investment in research, especially through universities and public research institutions (PRIs) and research facilities, often undertakes the longer-term, higher-risk research and complements the activities of the private sector. Besides this it creates *highly skilled human resources*, knowhow and experience, new scientific instruments and methodologies, as well creating the networks which transmit the latest knowledge.

European science and researchers have been and continue to be at the forefront in many areas. But this is not a position we can take for granted. There is ample evidence to show that as the pace of research continues to grow, so the number of countries competing to be the best is increasing as well. The traditional challenge from countries such as the United States is now being joined by economic giants such as China and India from the newly industrialising parts of the world in particular, and from all countries where governments recognise the manifold and abundant returns which derive from investing in research.

#### **1. EUROPEAN RESEARCH COUNCIL (ERC)**

##### **1.1. Rationale**

The EU remains the largest producer of scientific publications in the world. Compared with the US and now China to some degree, the EU *follows* a 'distributed excellence model' in which resources are spread across a larger number of researchers and research institutions. Another challenge is that in many EU countries the public sector *investment in research is below any acceptable threshold and thus* does not offer sufficiently attractive conditions for the best researchers. These factors compound Europe's relative unattractiveness in the global competition for scientific talent.

The global research landscape is evolving dramatically and becoming increasingly multipolar as a result of a growing number of emerging countries, in particular China,

expanding their scientific production. So whereas the EU and the United States accounted for nearly two-thirds of world expenditure on research and development in 2000, this share had fallen to less than half by 2013. ***In addition, the European Innovation Scoreboard 2018 confirmed that public and private R&D expenditures across the EU remains below 2010 levels and falls short in meeting the long-standing objective to devote 3% of GDP to R&D activities***

The ERC supports the best researchers, ***including young researchers***, with flexible, long-term funding to pursue ground breaking, high-gain/high-risk research. It operates autonomously led by an independent, ***gender and discipline-balanced***, Scientific Council made up of scientists, engineers and scholars of the highest repute and appropriate expertise and diversity. The ERC is able to draw on a wider pool of talents and ideas than would be possible for any national scheme, reinforcing ***excellent research in all fields of science*** through the way in which the best researchers and the best ideas compete against each other.

Frontier research funded by the ERC has a substantial direct impact in the form of advances at the frontiers of knowledge, opening the way to new and often unexpected scientific, technological and ***societal*** results and new areas for research. In turn, this generates radically new ideas which drive innovation and business inventiveness and tackle societal challenges. The ERC also has a significant structural impact, driving up the quality of the European research system over and above the researchers and actions it funds directly. ERC-funded actions and researchers set an inspirational target for frontier research in Europe, raising its profile and making it more attractive for the best researchers worldwide as a place to work, and work with. The prestige of hosting ERC grant- holders creates competition between Europe's universities and research organisations to offer the most attractive conditions for top researchers and can indirectly help them to assess their relative strengths and weaknesses and bring about reforms.

The gap between the research performance of the US and the EU countries has narrowed over the 10 years since the ERC was established. The ERC funds a relatively small percentage of all European research, but from this achieves a disproportionately high scientific impact. The average citation impact of the research supported by the ERC is comparable to that of the world's top elite research universities. The ERC's research performance is extremely high when compared with the world's largest research funders. The ERC funds a great deal of frontier research in many of the research areas that have received the highest numbers of citations, including those areas that are rapidly emerging. Although ERC funding is targeted to frontier research it has resulted in a substantial number of patents.

So there is clear evidence that the ERC attracts and funds excellent researchers through its calls and ERC actions are producing a substantial number of the most significant and high impact research findings worldwide in emerging areas leading to breakthroughs and major advances. ***The work of ERC grantees is expected also to become increasingly interdisciplinary*** and ERC grantees collaborate internationally and publish their results openly across all fields of research including the social sciences and humanities.

There is also already evidence of the longer term impacts of ERC grants on careers, on training highly skilled **researchers, doctoral and post doctoral degree holders**, on raising the global visibility and prestige of European research and on national research systems through its strong benchmarking effect. This effect is particularly valuable in the EU's distributed excellence model because ERC funded status can replace and serve as a **reliable** indicator of research quality than recognition based on the status of institutions. This allows ambitious individuals, institutions, regions and countries to seize the initiative and scale up the research profiles in which they are particularly strong.

## **1.2. Areas of intervention**

### *1.2.1. Frontier Science*

Research funded by the ERC is expected to lead to advances at the frontier of knowledge, with scientific publications of the highest quality, to research results with potential high societal, economic and **environmental** impact and with the ERC setting a clear and inspirational target for frontier research across the EU, Europe and internationally. Aiming to make the EU a more attractive environment for the world's best scientists, the ERC will target a measurable improvement in the EU's share of the world's top 1 % most highly cited publications, and aim at a substantial increase in the number of excellent researchers from outside Europe which it funds. ERC funding shall be awarded in accordance with the following well-established principles. Scientific excellence shall be the sole criterion on which ERC grants are awarded. The ERC shall operate on a 'bottom-up' basis without predetermined priorities.

#### *Broad Lines*

- Long-term funding to support excellent investigators and their research teams to pursue ground-breaking, high-gain/high-risk research;
- Starting researchers with excellent ideas to make the transition to independence while consolidating their own research team or programme;
- New ways of working in the scientific world with the potential to create breakthrough results and facilitate commercial and social innovation potential of funded research;
- Sharing** experience and best practices with regional and national research funding agencies **as well as other Union bodies** to promote the support of excellent researchers;
- Raising the visibility of ERC programmes.

## **1.3. Implementation**

### 1.3.1. The Scientific Council

The Scientific Council is the guarantor of the quality of the activity from the scientific perspective and has full authority over decisions on the type of research to be funded.

In the context of the implementation of the framework programme and in order to carry out its tasks, as set out in Article 7, the Scientific Council will:

- (1) Scientific strategy:
  - establish the overall scientific strategy for the ERC;
  - establish the work programme and develop the ERC's mix of support measures in line with its scientific strategy;
  - establish the necessary international cooperation initiatives including outreach activities, to increase the visibility of the ERC for the best researchers from the rest of the world, in line with its scientific strategy.
- (2) Scientific management, monitoring and quality control:
  - ensure a world-class peer review system based on fully transparent, fair and impartial treatment of proposals by establishing positions on implementation and management of calls for proposals, evaluation criteria, peer review processes including the selection of experts, the methods for peer review and proposal evaluation and the necessary implementing rules and guidelines, on the basis of which the proposals to be funded will be determined under the supervision of the Scientific Council;
  - experts shall be appointed on the basis of a proposal from the ERC Scientific Council in the case of ERC frontier research actions;
  - ensure that ERC grants are implemented according to simple, transparent procedures that maintain the focus on excellence, encourage initiative and combine flexibility with accountability by continuously monitoring the quality of the operations and implementation;
  - periodically submit to external review and assessment*** the ERC's achievements and the quality and impact of the research funded by the ERC and ***accordingly, adopt recommendations and draw guidelines for corrective or future actions***;
  - establish positions on any other matter affecting the achievements and impact of the ERC's activities and the quality of the research carried out.

- (3) Communication and dissemination:
- raise the global profile and visibility of the ERC by conducting communication and outreach activities including scientific conferences to promote the ERC's activities and achievements and the results of the projects funded by the ERC with the scientific community, key stakeholders and the general public;
  - where appropriate, consult with the scientific, engineering and scholarly community, regional and national research funding agencies and other stakeholders.
  - regularly report to the Commission on its own activities.

The members of the Scientific Council shall be compensated for the tasks they perform by means of an honorarium and, where appropriate, reimbursement of travel and subsistence expenses.

The President of the ERC will reside in Brussels for the duration of the appointment and devote most of his/her working time to ERC business. She/he will be remunerated at a level commensurate with the Commission's top management and will be provided by the Dedicated Implementation Structure with the necessary support to carry out his or her functions.

The Scientific Council shall elect from amongst its members three Vice-Chairs who shall assist the President in its representation and the organisation of its work. They may also hold the title of Vice-President of the ERC.

Support will be provided to the three Vice-Chairs to ensure adequate local administrative assistance at their home institutes.

#### *1.3.2. Dedicated Implementation Structure*

The dedicated implementation structure will be responsible for all aspects of administrative implementation and programme execution, as provided for in the ERC work programme. It will, in particular, implement the evaluation procedures, peer review and selection process in accordance with the strategy established by the Scientific Council and will ensure the financial and scientific management of the grants. The dedicated implementation structure will support the Scientific Council in the conduct of all of its tasks as set out above including the development of its scientific strategy, its monitoring of the operations and its review and assessment of the ERC's achievements as well as its outreach and communications activities, provide access to the necessary documents and data in its possession, and keep the Scientific Council informed of its activities.

In order to ensure an effective liaison with the dedicated implementation structure on strategy and operational matters, the leadership of the Scientific Council and the Director of the dedicated implementation structure will hold regular coordination meetings.

The management of the ERC will be carried out by staff recruited for that purpose, including, where necessary, officials from the EU institutions, and will cover only the real administrative needs in order to assure the stability and continuity necessary for an effective administration.

### *1.3.3. Role of the Commission*

In order to fulfil its responsibilities as set out in Articles 6, 7 and 8 and in the context of its own responsibilities for budget execution, the Commission will:

- ensure the continuity and renewal of the Scientific Council and provide support for a standing Identification Committee for the identification of future Scientific Council members;
- ensure the continuity of the dedicated implementation structure and the delegation of tasks and responsibilities to it taking into account the views of the Scientific Council;
- ensure that the dedicated implementation structure carries out the full range of its tasks and responsibilities;
- appoint the Director and the members of the management of the dedicated implementation structure taking into account the views of the Scientific Council;
- ensure the timely adoption of the work programme, the positions regarding implementing methodology and the necessary implementing rules including the ERC Rules of Submission and the ERC Model Grant Agreement, taking into account the positions of the Scientific Council.
- regularly inform and consult the Programme Committee on the implementation of the ERC activities;
- as responsible for the overall implementation of the Research Framework Programme, the dedicated implementation structure;

## **2. MARIE SKŁODOWSKA-CURIE ACTIONS (MSCA)**

### **2.1. Rationale**

Europe needs highly-skilled and resilient human resources in research and innovation that can easily adapt to and find sustainable solutions for *current and* future challenges, such as major demographic changes in Europe. To ensure excellence, researchers need to be mobile, *have access to top quality infrastructure in many fields*, collaborate and diffuse knowledge across countries, sectors and disciplines, with the right combination of knowledge and skills to tackle societal challenges and support innovation.

Europe is a scientific powerhouse with around 1.8 million researchers working in thousands of universities, research centres and world-leading companies. However, it is estimated that the EU will need to train and employ at least one million new researchers by 2027 in order to achieve the targets being set for increased investment in research and innovation. This need is particularly acute in the non-academic sector.

The EU must reinforce its efforts to entice more young women and men to a career in research, to attract researchers from third countries, retain its own researchers and reintegrate European researchers working elsewhere back to Europe.

***To achieve these goals, attention should also be paid to schemes adding more flexibility for researchers of both sexes to ensure work-life balance.***

***Mobility programmes should also ensure effective equal opportunities and include specific measures to remove obstacles to the mobility of researchers, in particular female ones.***

In addition, in order to ***ensure synergies and*** more widely spread excellence, ***the Seal of Excellence label will continue to be applied to calls under MSCA and*** the conditions under which researchers perform must be further improved throughout the European Research Area (ERA). In this respect, stronger links are needed notably with the European Education Area (EEA), the European Regional Development Fund (ERDF), and European Social Fund (ESF+).

These challenges can best be addressed at EU level due to their systemic nature and to the cross-country effort needed to solve them.

The Marie Skłodowska-Curie Actions (MSCA) focus on excellent research that is fully bottom-up, open to any field of research and innovation from basic research up to market take-up and innovation services. This includes research fields covered under the Treaty on the Functioning of the European Union and the Treaty establishing the European Atomic Energy Community (Euratom). If specific needs arise and additional funding sources become available, the MSCA may target certain types of ***activities in specific challenges, including missions, and certain types of*** research and innovation institutions, or geographical locations in order to respond to the evolution of Europe's requirements in terms of skills, research training, career development and knowledge sharing.

The MSCA, ***jointly with the ERC***, are the main instruments at EU-level for attracting researchers from third countries to Europe, thus making a major contribution to global cooperation in research and innovation. Evidence shows that the MSCA not only have a positive impact on individuals, organisations, and at system level, but also yield high-impact and breakthrough research results while at the same time contributing significantly to societal as well as strategic challenges. Long-term investment in people pays off, as indicated by the number of Nobel Prize winners who have been either former MSCA fellows or supervisors.

Through global research competition between scientists and between host organisations from both the academic and non-academic sector, and through the creation and sharing of high-quality knowledge across countries, sectors and



disciplines, the MSCA contribute notably to the goals of the 'Jobs, growth and investment' agenda, the EU Global Strategy and to the United Nations Sustainable Development Goals.

The MSCA contribute to making the ERA more effective, competitive and attractive on a global scale. This can be achieved by focusing on a new generation of highly-skilled researchers and providing support for emerging talent from across the EU and beyond; by fostering the diffusion and application of new knowledge and ideas to European policies, the economy and society, *inter alia* through improved science communication and public outreach measures; by facilitating cooperation between research-performing organisations; and by having a pronounced structuring impact on the ERA, advocating an open labour market and setting standards for quality training, attractive employment conditions and open and **transparent** recruitment for all researchers.

## **2.2. Areas of Intervention**

### *2.2.1. Nurturing Excellence through Mobility of Researchers across Borders, Sectors and Disciplines*

The EU must remain a reference for excellent research and thus attractive for the most promising researchers, European and non-European alike, at all stages of their careers. This can be achieved by enabling researchers and research-related staff to move and collaborate between countries, sectors and disciplines, and thus benefit from high-quality training and career opportunities. This will facilitate career moves between the academic and non-academic sector as well as stimulate entrepreneurial activity.

#### *Broad Lines*

- Mobility experiences within or outside Europe for the best or most promising researchers regardless of nationality to undertake excellent research and develop their skills as well as career in both the academic and non-academic sector,

### *2.2.2. Fostering new Skills through Excellent Training of Researchers*

The EU needs a strong, resilient and creative human resource base, with the right combination of skills to match the future needs of the labour market, to innovate and to convert knowledge and ideas into products and services for **scientific**, economic and social benefit. This can be achieved through training researchers to further develop their core research competences as well as enhance their transferable skills such as a creative and entrepreneurial mindset ***including the understanding of the benefits that standards bring to market new products and services.*** This will allow them to face current and future global challenges, and improve their career prospects and innovation potential. ***This can be achieved, where appropriate, in complementarity with the EIT's educational activities.***

#### *Broad Lines*

- Training programmes to equip researchers with a diversity of skills relevant to current and future global challenges.

#### 2.2.3. *Strengthening Human **Resources** and Skills Development across the European Research Area*

In order to foster excellence, promote cooperation between research-performing organisations and create a positive structuring effect, high-quality training standards, good working conditions and effective career development of researchers need to be more widely spread across the ERA. This will help modernise or enhance research training programmes and systems as well as increasing institutions' worldwide attractiveness, ***developed in cooperation with other parts of Horizon Europe.***

##### *Broad Lines*

- Training programmes to foster excellence and spread best practices across institutions and research and innovation systems;
- Cooperation, production and diffusion of knowledge within the EU and with third countries.

#### 2.2.4. *Improving and Facilitating Synergies*

Synergies between research and innovation systems and programmes at EU, regional and national level need to be significantly strengthened. This can be achieved in particular through synergies and complementarities, with other parts of Horizon Europe such as the European Institute of Innovation and Technology (EIT) and other EU programmes, notably the ESF+, including via a Seal of Excellence.

##### *Broad Lines*

- Training programmes and similar research career development initiatives supported through complementary public or private funding sources at regional, national or EU level.

#### 2.2.5. *Promoting Public Outreach*

The awareness of the programme's activities and the public recognition of researchers need to be enhanced across the EU and beyond, to raise the global profile of the MSCA and to develop a better understanding of the impact of researchers' work on citizens' daily lives, and to encourage young people, ***in particular women,*** to embark on research careers. This can be achieved through better dissemination, exploitation and diffusion of knowledge and practices.

##### *Broad Lines*

- Public outreach initiatives to stimulate interest in research careers, especially amongst young people;

- Promotion activities to raise the global profile, visibility and awareness of the MSCA;
- Diffusion and clustering of knowledge through cross-project collaboration and other networking activities such as an alumni service and ***national contact points***.

### 3. RESEARCH INFRASTRUCTURES

#### 3.1. Rationale

State of the art research infrastructures provide key services to research and innovation communities, playing an essential role in extending the frontiers of knowledge. Supporting ***all types of*** research infrastructures, ***including small and medium-sized ones in particular those financed from ERDF***, at the EU level helps to mitigate what in many cases is the reality of scattered national ***and regional*** research infrastructures, ***complementing and upgrading*** pockets of scientific excellence, as well as ***increasing*** the circulation of knowledge across silos.

The overall aim is to endow Europe with world-class sustainable research infrastructures open and accessible to all researchers and ***innovators*** in Europe and beyond, which fully exploit their potential for scientific advance and innovation. Key objectives are to reduce the fragmentation of the research and innovation ecosystem, ***ensure continuous modernisation***, avoiding duplication of effort, and better coordinate the development, use ***and accessibility*** of research infrastructures.

It is ***also*** crucial to support open access to research infrastructures for all European researchers as well as, through the European Open Science Cloud (hereafter 'EOSC'), increased access to digital research resources, specifically tackling the currently sub-optimal embracement of open science and open data practises. Equally, the EU needs to tackle the rapid increase of global competition for talent by attracting third country researchers to work with European world-class research infrastructures. Increasing the competitiveness of European industry is also a major objective, supporting key technologies and services relevant for research infrastructures and their users, thus improving the conditions for supply ***and utilisation*** of innovative solutions.

Past framework programmes have made a significant contribution towards the more efficient and effective use of national infrastructures ***and towards the removal of barriers for transnational access***, as well as developed with the European Strategy Forum on Research Infrastructures (ESFRI) a coherent and strategy-led approach to policy making on pan-European research infrastructures. This strategic approach has generated clear advantages, including reducing duplication of effort with more efficient overall use of resources, as well as standardising ***and harmonising*** processes and procedures. ***Strengthening and opening existing excellent R&I networks as well as creating new ones where appropriate, will also be a priority under this heading.***

EU supported activity will provide added value through: consolidating and optimised existing research infrastructures, including e-infrastructure, alongside efforts to

develop new infrastructures; establishing the European Open Science Cloud (EOSC) as effective scalable and sustainable environment for data-driven research, the interconnection of national and regional research and education networks, enhancing and securing high-capacity network infrastructure for massive amounts of data and access to digital resources across borders and domain boundaries; overcoming barriers preventing the best research teams from accessing the best research infrastructures services in the EU; fostering the innovation potential of research infrastructures, focused on technology development and co-innovation as well as increased use of research infrastructures by industry.

And the international dimension of EU research infrastructures must be reinforced, fostering stronger cooperation, ***access and connectivity*** with international counterparts and international participation in European research infrastructures for mutual benefit.

Activities will contribute to different Sustainable Development Goals (SDGs) such as: SDG 3 – Good Health and Well-Being for People; SDG 7 – Affordable and Clean Energy; SDG 9 – Industry Innovation and Infrastructure; SDG 13 – Climate Action.

### 3.2. Areas of intervention

#### 3.2.1. *Consolidating the Landscape of European Research Infrastructures*

The establishment, operation and long-term sustainability of research infrastructures ***including the ones*** identified by ESFRI, ***as well as maximising their involvement in excellent Horizon Europe's projects***, is essential for the EU to ensure a leading position in frontier research, the creation and use of knowledge and the competitiveness of its industries.

The European Open Science Cloud (EOSC) should become an effective and comprehensive delivery channel for research infrastructures services and should ***allow*** Europe's research communities ***to develop*** the next generation of data services for harvesting, storing, processing (e.g. analytics, simulation, visualisation services) and sharing big science data. The EOSC should also provide researchers in Europe with ***services encouraging the storage and processing of*** the majority of data generated and collected by ***researchers inside and outside of*** research infrastructures ***and should as well give access*** to HPC and exascale resources deployed under the European Data Infrastructure (EDI)<sup>2</sup>.

The pan-European research and education network will link together and enable remote access to research infrastructures and research resources, by providing interconnectivity between universities, research institutes and research and innovation communities at EU level as well as international connections to other partner networks worldwide.

#### *Broad Lines*

- The life-cycle of pan European research infrastructures through the design of new research infrastructures; their preparatory and implementation phase, their early-phase operation in complementarity with other

funding sources, as well as the consolidation and optimisation of the research infrastructure ecosystem by monitoring the ESFRI landmarks and facilitating service agreements, evolutions, mergers or decommissioning of pan-European research infrastructures;

- The European Open Science Cloud, including: scalability and sustainability of the access channel; effective federation of European, national, regional and institutional resources; its technical and policy evolution to cope with new research needs and requirements (e.g. usage of sensitive data sets, privacy by design); data inter-operability and compliance with the FAIR principles; and a wide user base;
- The pan-European research and education network underpinning the EOSC and EDI as well as enabling the delivery of HPC/data services in a cloud based environment capable of coping with extreme large data sets and computational processes.

### *3.2.2. Opening, Integrating and Interconnecting Research Infrastructures*

The research landscape will be significantly enhanced through ensuring openness to key international, national and regional research infrastructures for all EU researchers and *innovators* and integrating their services when necessary so as to harmonise access conditions, improve and enlarge service provision and encourage common development strategy of high tech components and advanced services through innovation actions.

#### *Broad Lines*

- Networks that bring together national and regional funders of research infrastructures for the co-funding of trans-national access of researchers;
- Networks of *pan-European*, national and regional research infrastructures, *including small and medium-sized ones*, for the provision of access to researchers as well as for the harmonisation and improvement of the infrastructures' services;
- Integrated networks of research infrastructures for development and implementation of a common strategy/roadmap for technological development required to improve their services through partnership with industry; as well as high-tech components in areas such as scientific instrumentation; and for fostering the use of research infrastructures by industry, e.g. as experimental test facilities.

### *3.2.3. Reinforcing European Research Infrastructure policy and International Cooperation*

Support is needed so that policy makers, funding bodies or advisory groups such as ESFRI are well-aligned towards developing and implementing a coherent and long-term EU strategy on research infrastructures.

Similarly, support to strategic international cooperation will strengthen of the position of European research infrastructures at international level, ensuring their global networking and interoperability and reach.

*Broad Lines*

- Survey, monitoring and assessment of research infrastructures at EU level, as well as policy studies, communication and training actions, international cooperation actions for research infrastructures, and specific activities of relevant policy and advisory bodies.

## PILLAR II

### GLOBAL CHALLENGES AND EUROPEAN INDUSTRIAL LEADERSHIP

<b>CA 14 - Introduction of Pillar II</b>
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*In an interconnected world, many of the challenges* which confront the EU are also **global**. The scale and complexity of the problems are vast, and need to be matched by the appropriate **financial and human** resources and effort in order to find solutions. These are precisely the areas where the EU must work together; smart, flexible and joined-up for the benefit and well-being of our citizens.

Greater impact can be obtained through aligning actions with other nations and regions of the world within an unprecedented international cooperation **as** indicated by the Sustainable Development Goals and the Paris climate agreement. Based on mutual benefit, partners from across the world will be invited to join EU efforts as an integral part of research and innovation for sustainability.

Research and innovation are key drivers of **sustainable development, including** growth and industrial competitiveness, and they will contribute to finding solutions to today's problems, to reverse as quickly as possible, the negative and dangerous trend that currently links economic development, the use of natural resources and social issues, and turn it into **jobs and** new business opportunities **and economic, social and environmental development**.

The EU will benefit as user and producer of **knowledge**, technologies and industries. It can showcase how modern industrialised, sustainable inclusive, open and democratic society and economy can function and develop. The growing economic-environmental-social examples of the sustainable industrial economy of the future will be fostered and boosted, be they for: health and well-being for all; or inclusive **and creative societies**; or secure societies; or available clean energy and mobility; or a digitised economy and society; or a transdisciplinary and effective industry; or space marine or land-based solutions; or food and nutrition solutions; sustainable use of natural resources climate protection and **mitigation**, all generating wealth in Europe and offering higher quality jobs. Industrial transformation will be crucial.

Research and innovation under this pillar of Horizon Europe is grouped into integrated clusters of activities. Rather than addressing sectors, the investments aim at systemic changes for our society and economy along an **inclusiveness and** a sustainability vector. These will only be achieved if all actors, both private and public, engage in co-designing and co-creating

research and innovation; bringing together end-users, **researchers**, scientists, technologists, **designers**, producers, innovators, businesses, educators, citizens and civil society organisations. Therefore, none of the thematic clusters is intended for only one set of actors.

***Clusters will support knowledge creation in all its stages of development, including early stage research activities, complemented by cross-cutting support to ambitious, long-term, large-scale research initiatives geared towards future and emerging technologies (FET Flagships) initiated under the previous framework programme: Human Brain Project, Graphene, Quantum Technologies and Future Battery Technologies.***

Clusters will **also** develop and apply digital, key enabling and **future** emerging technologies as part of a common strategy to promote the EU's industrial leadership. Where appropriate this will use EU space-enabled data and services.

There will be support to bring technology from lab to market and to develop applications including pilot lines and demonstrators, measures to stimulate market uptake and to boost private sector commitment. Synergies with other **parts of Horizon Europe, especially the EIT, as well as other** programmes will be maximised.

The clusters will boost the quick introduction of first-of-its-kind innovation in the EU, **while studying its impact on society**, through a broad range of embedded activities, including communication, dissemination and exploitation, standardisation as well as support to non-technological innovation and innovative delivery mechanisms, helping create innovation friendly societal, regulatory and market conditions such as the innovation deals. Pipelines of innovative solutions originating from research and innovation actions will be established and targeted to **leverage additional** public and private investors as well as other relevant EU and national programmes.

***Especial attention will be put into supporting SMEs across Pillar 2 in collaborative parts and via a dedicated mono-beneficiary, grant-based SME Instrument. All clusters shall dedicate an appropriate amount to the SME instrument, which will be fully bottom up, with continuously open calls and a number cut off dates, dedicated exclusively to incremental innovation. Only SMEs will be allowed to apply for funding, including via collaborations or subcontracting. Projects must have a clear European dimension and contribute to EU added value.***

***Support via the SME instrument will be provided in three phases, based on the model on Horizon Europe:***

***— Phase 1: Concept and feasibility assessment:***



*SMEs will receive funding to explore the scientific or technical feasibility and the commercial potential of a new idea (proof of concept), including for the development of business plans, in order to develop an innovation project. A positive outcome of this assessment, in which the linkage between project-topic and potential user/buyer needs is an important issue, will allow for funding under the following phase(s).*

**— Phase 2: R&D, demonstration, market replication:**

*With due attention to the innovation voucher concept, research and development will be supported with a particular focus on demonstration activities (testing, prototype, scale-up studies, design, piloting innovative processes, products and services, validation, performance verification etc.) and market replication encouraging the involvement of end users or potential clients. Innovation Vouchers will promote the participation of young entrepreneurs.*

**— Phase 3: Commercialisation:**

*This phase will not provide direct funding other than support activities, but aims to facilitate access to private capital and innovation enabling environments. Links with the EIC and InvestEU will be foreseen. SMEs will also benefit from support measures such as networking, training, coaching and advice. In addition, this phase may connect to measures promoting pre-commercial procurement and procurement of innovative solutions.*

<b>CA 15 - CLUSTER 'HEALTH'</b>
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## **1. CLUSTER 'HEALTH'**

### **1.1. Rationale**

The EU Pillar of Social Rights asserts that everyone has the right to timely access to preventive and curative health care of good quality. This underlines the EU's commitment to the UN's Sustainable Development Goals calling for universal health coverage for all at all ages by 2030, leaving no one behind, and ending preventable deaths.

A healthy population is vital for a stable, sustainable and inclusive society, and improvements in health are crucial in reducing poverty, in fostering social progress and prosperity, and in increasing economic growth.

According to the OECD a 10% improvement in life expectancy is also associated with a rise in economic growth of 0.3-0.4% a year. Life expectancy in the EU increased by 12 years since its establishment as a

result of tremendous improvements achieved in the quality of life, ***including*** education ***and*** health. In 2015, overall life expectancy at birth was 80.6 years in the EU compared to 71.4 years globally. In the past years, it increased in the EU on average by 3 months annually.

Health research and innovation have played a significant part in this achievement but also in improving productivity and quality in the health and care industry ***as well as in providing the knowledge basis for healthier people and for better patient care. Health research has unique features, connecting and interacting closely with innovation, patient care and population health, and operating in a multidisciplinary environment with complex regulation.***

However, the EU continues to face novel, newly emerging or persisting challenges that are threatening its citizens and public health, the sustainability of its health care and social protection systems, as well as the competitiveness of its health and care industry. Major health challenges in the EU include: ***the increased cases of cancer***; the lack of effective health promotion and disease prevention; the rise of non-communicable diseases; the spread of antimicrobial drug resistance and the emergence of infectious epidemics; increased environmental pollution; the persistence of health inequalities among and within countries affecting disproportionately people that are disadvantaged or in vulnerable stages of life; the ***early*** detection, understanding, control, prevention and mitigation of health risks in a rapidly changing social, urban and natural environment; ***increasing the number of healthy life years***; ***the high costs of some innovative health tools and technologies for end-users***; the increasing costs for European health care systems and the progressive introduction of ***precision*** medicine approaches ***including the relevant research*** and digitalisation in health and care; and the increasing pressure on the European health and care industry to remain competitive in and by developing health innovation vis-a-vis new and emerging global players.

***Digital health solutions have created many opportunities to solve the problems of care services and to address the other emerging issues of ageing society. Challenges also include taking full advantage of the progressive introduction of the opportunities that digitalisation in health and care provide without jeopardising the right to privacy and data protection. Digital devices and software have been developed to diagnose treat and facilitate patients' self management of illness, including chronic diseases. Digital technologies are also increasingly used in medical training and education and for patients and other healthcare consumers to access, share and create health information.***

*Today's* health challenges are complex, interlinked and global in nature and require multidisciplinary, cross-sectorial, **translational** and transnational collaborations, including with low-and middle-income **countries**. Research and innovation will build close linkages between clinical, epidemiological, **ethical**, environmental and socio-economic research as well as with regulatory sciences. They will harness the combined skills of academia and industry and foster their collaboration with health services, patients, policy-makers, **civil society organisations** and citizens in order to leverage on public funding and ensure the uptake of results in clinical practice as well as in health care systems. They will foster strategic collaboration at EU and international level in order to pool the expertise, capacities and resources needed to create economies of scale, scope and speed as well as to share the expected benefits and financial risks involved. ***Studies and research under this cluster shall take into account the gender perspective and differences.***

The research and innovation activities of this global challenge will develop **the human resources and** knowledge base, build the research and innovation capacity and develop the solutions needed for a more effective promotion of health and the prevention, treatment and cure of diseases. Improving health outcomes will in turn result in increased life expectancy, **generalised** healthy **and** active lives and productivity of working age people, and sustainability of health and care systems. ***Innovation in the field of rapid diagnostic techniques and new antibiotics may prevent the development of antimicrobial resistance and will be promoted.***

Addressing major health challenges will contribute to the EU's policy goals and strategies, notably to the EU Pillar of Social Rights, the EU Digital Single Market, the EU Directive on cross-border healthcare, and the European One Health Action Plan against antimicrobial resistance (AMR), and to the implementation of the relevant EU regulatory frameworks. It will also support the EU's commitment to the United Nation's 2030 Agenda for Sustainable Development and those in the context of other UN organisations and international initiatives, including the global strategies and plans of action of the World Health Organization (WHO).

***A High-Level group will support achieving these aims, namely, the Steering Board for Health. It shall ensure coordination with other EU and national research programmes as well as synergies between the health cluster and other parts of Horizon Europe, including missions and partnerships. It will be science-led and include all relevant stakeholders, with strong participation of society, citizens and patients. It will be tasked to provide steering and advice in developing the work programme and missions related to health.***

Activities will contribute directly to the following Sustainable Development Goal (SDGs) in particular: SDG 3 – Good Health and Well-Being for

People; SDG13 – Climate Action; *and indirectly to SDGs 1 - No poverty; SDG 5 - Gender equality ; SDG 6 - Clean water and sanitation; SDG 10 - Reduced inequalities.*

## 1.2. Areas of Intervention

### 1.2.1. Health throughout the Life Course

People in vulnerable stages of life (birth, infancy, childhood, adolescence, pregnancy, mature and late adulthood), including people with disabilities, *special needs* or injuries, have specific health needs that require better understanding and tailored solutions. This will allow reducing related health inequalities and improving health outcomes to the benefit of active and healthy ageing throughout the life course, in particular through a healthy start of life reducing the risk of mental and physical diseases later in life.

#### *Broad Lines*

- *Age-related diseases* and the aging process throughout the life course;
- Maternal, paternal, infant and *child* health, *including child and maternal survival*, as well as the role of parents;
- *Health needs and long-term consequences associated with high mortality and long-term morbidity, especially related to childhood issues;*
- Health needs of adolescents, *including psychological wellbeing*;
- *Aetiology of disabilities and health* consequences of disabilities and injuries;
- Independent and active life for the elderly and/or disabled people;
- Health education and digital health literacy;
- *Regeneration of aged or damaged organs and tissue;*
- *Angiogenesis, arterial pathology, myocardial ischemia and structural pathology of the heart and biomarkers and genetics of cardiovascular diseases.*
- *Treatment of chronic diseases;*

### 1.2.2. Environmental and Social Health Determinants

Improved understanding of health drivers and risk factors determined by the social, economic and physical environment in people's everyday life and at the workplace, including the health impact of digitalisation, pollution, *rapid urbanisation*, climate change and other *national and transnational* environmental issues, will contribute to identify, *prevent* and mitigate

health risks and threats; **to identifying and to reducing** death and illness from exposure to chemicals and environmental pollution; to supporting **safe** environmental-friendly, healthy, resilient and sustainable living and working environments; to promoting healthy lifestyles and consumption behaviour; and to developing an equitable, inclusive and trusted society.

#### *Broad Lines*

- **Safe and effective** technologies **and methodologies** for assessing hazards, exposures and health impact of chemicals, pollutants and other stressors, including climate-related and environmental stressors, and combined effects of several stressors;
- Environmental, **including built environment (design and construction)**, occupational, **economic, political**, social and behavioural factors impacting physical and mental health and well-being of people and their interaction, with special attention to vulnerable and disadvantaged people **as well as people with disabling or impairing conditions**;
- Risk assessment, management and communication, **including information sharing**, supported by improved tools for evidence-based decision-making, including alternatives to animal testing;
- Capacity and infrastructures to collect, share and combine data on all health determinants, including exposure, health and diseases at EU and international level;
- Health promotion and primary prevention interventions.

#### *1.2.3. Non-Communicable and Rare Diseases*

Non-communicable diseases (NCDs), including rare diseases, pose a major health and societal challenge and call for more effective approaches in prevention, **diagnosis**, treatment and cure, including **precision** medicine approaches.

#### *Broad Lines*

- Diagnostics for earlier and more accurate diagnosis and for **timely** patient-adapted treatment;
- **Infrastructure and capabilities to harness the potential of genomic medicine advances into standard clinical practice.**
- Prevention and screening programmes;

- Integrated solutions for self-monitoring, health promotion, disease prevention, and management of chronic conditions and multi-morbidities;
- Safe, effective and accessible*** treatments, cures ***or other therapeutic strategies***, including both pharmacological and non-pharmacological treatments;
- Palliative care;
- ***Collaborative research on molecular, structural and cell biology, experimental therapies, genetics, genomics and environmental bases of human cancer.***
- ***The genomic frontier, epidemiology, bioinformatics, pathology and challenges of precision medicine in rare diseases, neurodegenerative diseases and oncology.***
- Areas of high-unmet clinical need, such as rare cancers including paediatric cancers;***
- Assessment of comparative effectiveness of interventions and solutions;
- Implementation research to scale up health interventions and support their uptake in health policies and systems.

#### *1.2.4. Infectious Diseases*

Protecting people against ***communicable diseases and*** cross-border health threats is a major challenge for public health, calling for effective international cooperation at EU and global level. This will involve prevention, preparedness, early detection, treatment and cure of infectious diseases, and also tackling antimicrobial resistance (AMR) following a 'One Health approach'. ***The continue spread of antimicrobial resistant bacteria, including super bacteria, will equally have significant detrimental impact on the economy and environment. Preventing their development and spread will also be one of the priorities under this heading. In addition, The World Health Organisation has defined a list of neglected diseases that lack private sector R&I investments due to limited commercial incentives. More ambitious public investments are needed to address the burden of such poverty-related and neglected diseases.***

#### *Broad Lines*

- Drivers for the emergence or re-emergence of infectious diseases and their spread, including transmission from animals to humans (zoonosis), or from other parts of the environment (water, soil, plants, food) to humans ***and the implementation***

*of empirical preventive solutions that minimize transmission;*

- Prediction, early detection and surveillance of infectious diseases, including antimicrobial resistant pathogens, healthcare-associated infections and environmental related factors;
- ***Suitable, safe and efficient diagnostics, medical technologies, treatments and vaccines for prevention and prophylaxis of infectious diseases, including research and discovery of novel vaccine, advance immunization technologies and regulatory sciences;***
- Effective health emergency preparedness, response and recovery measures and strategies, involving communities;
- Barriers to the implementation and uptake of medical interventions in clinical practice as well as in the health system;
- Trans-border aspects of infectious diseases and specific challenges in low- and middle-income countries (LMICs), such as ***neglected*** tropical diseases, ***AIDS, tuberculosis and malaria. Development of new treatment methods for infectious diseases to counteract antimicrobial resistance.***

*1.2.5. Tools, Technologies and Digital Solutions for Health and Care*

Health technologies and tools are vital for public health and contributed to a large extent to the important improvements achieved in the quality of life, health and care of people, in the EU. It is thus a key strategic challenge to design, develop, deliver and implement suitable, trustable, safe and cost-effective tools and technologies for health and care, taking due account of the needs of people with disabilities and the aging society. These include the ***key enabling*** technologies, ***artificial intelligence, robotics, big data, quantum technology and other digital tools and technologies***, offering significant improvements over existing ones, as well as stimulating a competitive and sustainable health-related industry that creates high-value jobs. The European health-related industry is one of the critical economic sectors in the EU, accounting for 3% of GDP and 1.5 million employees.

*Broad Lines*

- Tools and technologies for applications across the health spectrum, ***including the manufacturing of health technologies*** and any relevant medical indication, including functional impairment;
- ***Artificial intelligence and robotics for health technologies and tools;***

- Integrated tools, technologies and digital solutions for human health, including mobile and telehealth;
- ***Personalised, digital health approaches based on "Digital Twins", accurate data-driven computer models of key biological processes of the human body, allowing identification of the best therapy per individual, health prevention and maintenance measures;***
- Piloting, large-scale deployment, optimisation, and innovation procurement of health and care technologies and tools in real-life settings including clinical trials and implementation research;
- Innovative processes and services for the development, manufacturing and rapid delivery of care tools, technologies, ***medicines and vaccines;***
- The safety, efficacy and quality of tools and technologies for health and care as well as their ethical, legal and social impact;
- Regulatory science for health technologies and tools.
- ***Tools, technologies and digital solutions to increase the safety of medical decisions;***

#### 1.2.6. Health Care Systems

Health systems are a key asset of the EU social systems, accounting for 24 million employees in the health and social work sector in 2017. It is a main priority to render health systems accessible, cost-effective, resilient, sustainable and trusted as well as to reduce inequalities, including by unleashing the potential of data-driven and digital innovation for better health and person-centred care building on open European data infrastructures. This will advance the digital transformation of health and care. ***The future infrastructure should rely on secure storages, such as 5G deployment, conditions for IoT development as well as high performance computing centres.***

#### *Broad Lines*

- Reforms in public health systems and policies in Europe and beyond;
- New models and approaches for health and care and their transferability or adaptation from one country/region to another;
- Improving health technology assessment;
- Evolution of health inequality and effective policy response;



- Future health workforce and its needs;
- Develop schemes for specialised training of healthcare professionals, training and developing technical know-how and new ways of working meeting innovation in e-health;*
- Improving *timeliness and quality of* health information, *as well as the infrastructure for the effective collection* and use of health data, including electronic health records, with due attention to security, privacy, interoperability, standards, comparability and integrity; health information and use of health data, including electronic health records, with due attention to security, *trust*, privacy, interoperability, standards, comparability, integrity;
- Health systems resilience in absorbing the impact of crises and to accommodate disruptive innovation;
- Solutions for citizen and patient empowerment, self-monitoring, and interaction with health and social care professionals, for more integrated care and a user-centred approach;
- Data, information, knowledge and best practice from health systems research at EU-level and globally.

<b>CA 16 - CLUSTER 'INCLUSIVE AND CREATIVE SOCIETY'</b>
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## **2. CLUSTER 'INCLUSIVE AND CREATIVE SOCIETY'**

### **2.1. Rationale**

The EU stands for a unique way of combining *prosperity*, economic growth and *sustainability* with social policies, with high levels of social inclusion, shared values embracing democracy, human rights, gender equality and the richness of diversity. This model is constantly evolving and needs to deal with the challenges from amongst other things, digitalisation, globalisation, and technological *evolution*.

The EU must promote a model of inclusive and sustainable growth while reaping the benefits of technological advancements, enhancing trust in and promoting innovation of democratic governance, combatting inequalities, unemployment, marginalisation, discrimination and radicalisation, guaranteeing human rights, fostering cultural diversity and European cultural heritage and empowering citizens through social innovation. The management of migration and the integration of migrants will also continue to be priority issues.

The role of research and innovation in the social sciences and the humanities and in the *cultural and creative sector*, in responding to these challenges and

achieving the EU's goals is fundamental. Due to its *broad spectrums, size, and impact in today's digital transformation, these sectors contribute significantly to our economy. As interrelations between social and technological innovation are complex, and rarely linear, further research, including cross-sectoral and multidisciplinary research, is needed into the development of all types of innovation and activities funded to encourage its effective development into the future.*

Research and Innovation activities in this Global Challenge will be overall aligned with the Commission's priorities on Democratic Change; Jobs, Growth and Investment; Justice and Fundamental Rights; Migration; A Deeper and Fairer European Monetary Union; Digital Single Market. It will respond to the commitment of the Rome Agenda to work towards: "a social Europe" and "a Union which preserves our cultural heritage and promotes cultural diversity". It will also support the European Pillar of Social Rights.

Activities will contribute directly to the following Sustainable Development Goals (SDGs) in particular: SDG 1 - No Poverty; SDG 4 - Quality Education; SDG 8 – Decent Work and Economic Growth; ***SDG 5 Gender***, SDG 9 – Industry, Innovation and Infrastructure; SDG 10 - Reducing Inequalities; SDG 11- Sustainable Cities and Communities; ***SDG 12 Responsible consumption and production***; SDG 16 – Peace, Justice and Strong Institutions, ***SDG 17 Partnership for the goals***.

## **2.2. Areas of Intervention**

### **2.2.1. Democracy**

Trust in democracy and political institutions seems to be receding. Disenchantment with politics is increasingly articulated by anti-establishment and populist parties and a resurgent nativism. This is compounded by socio-economic inequalities, high migration flows and security concerns. Responding to present and future challenges requires new thinking on how democratic institutions at all levels must adapt in a context of greater diversity, global economic competition, rapid technological advancements and digitisation, with citizens' experience of democratic discourses and institutions being crucial.

#### *Broad Lines*

–The history, evolution and efficacy of democracies, at different levels and in different forms, *such as movements for dialogue among cultures, cooperation among nations and peace among religions*; digitisation aspects *including media and digital literacy* and the effects of social network communication and the role of education, youth policies and

***cultural participation*** as cornerstones of democratic citizenship

- Innovative approaches to support the transparency, responsiveness, accountability effectiveness and legitimacy of democratic governance, ***including fight against corruption***, in full respect of fundamental ***and human*** rights and of the rule of law,
- ***Impact of technologies on individual lifestyles and behaviours.***
- Strategies to address populism, extremism, radicalisation, ***discrimination and hate speeches***, terrorism and to ***actively*** include, ***empower*** and engage disaffected, ***vulnerable*** and marginalised citizens;
- ***New approaches to deal with the link between immigration and xenophobia, and the causes of migration.***
- Better understand the role of journalistic standards and user-generated content in a hyper-connected society and develop tools to combat disinformation;
- The role of multi-cultural citizenship and identities in relation to democratic citizenship and political engagement;
- The impact of technological and scientific advancements, including big data, online social networks and artificial intelligence on democracy;
- Deliberative and participatory democracy and active and inclusive citizenship, including the digital dimension;
- The impact of economic and social inequalities on political participation and democracies, demonstrating how reversing inequalities and combatting all forms of discrimination including gender, can sustain democracy.
- ***New approaches to science diplomacy;***

#### 2.2.2. ***Culture and Creativity***

***The European Cultural and Creative sector builds bridges between arts, culture, business and technology. Furthermore, especially in the field of digitalisation, Cultural and Creative Industries (CCIs) play a key role in reindustrialising Europe, are a driver for growth and are in a strategic position to trigger innovative spill-overs in other industrial sectors, such as tourism, retail, media and digital technologies and engineering. In Horizon Europe, creativity and design will be a cross-cutting issue that will be integrated in projects throughout the programme in order to support***

*new technologies, business models and competences as well as translating creative and interdisciplinary solutions into economic and social value.*

Cultural heritage is *an integral part of the cultural and creative sectors. Cultural heritage represents traces and expressions from the past that gives attributed-meaning to and is used by* communities, groups and societies, giving a sense of belonging. It is the bridge between the past and the future of our societies. It is a driving force of local economies and a powerful source of inspiration for the creative and cultural sector. Accessing, conserving, safeguarding and restoring, interpreting and harnessing the full potential of our cultural heritage are crucial challenges now and for future generations. Cultural heritage is the major input and inspiration for the arts, traditional craftsmanship, the cultural, *the creative* and the entrepreneurial sectors that are drivers of sustainable economic growth, new job creation and external trade.

#### *Broad Lines*

- Heritage studies and sciences, with cutting edge technologies including digital ones;
- Access to and sharing of cultural heritage and *related information*, with innovative patterns and uses and participatory management models;
- Connect cultural heritage with emerging creative sectors;
- The contribution of cultural heritage to sustainable development through conservation, safeguarding, *development* and regeneration of cultural landscapes, with the EU as a laboratory for heritage-based innovation and cultural tourism;
- Conservation, safeguarding, enhancement and restoration of cultural heritage, languages *and traditional skills and crafts* with the use of cutting edge technologies including digital.
- Importance of pluralistic and diverse* traditions, customs, perceptions and beliefs on values *in the development of communities.*
- *Establish a “European Cultural Heritage Cloud”, a research and innovation collaboration space granting accessibility of cultural heritage through new technologies as well as encouraging and facilitating transmission of know-how and skills, providing the opportunity to set up individual workgroups and project structures, and constituting a European cultural counterpart to commercially driven cloud services. This will be preceded by an impact assessment.*

### 2.2.3. Social, **Cultural** and Economic Transformations

European societies are undergoing profound socio-**cultural**-economic transformations, especially as a result of globalisation and technological innovations. At the same time there has been an increase in income inequality in most European countries. Forward-looking policies are needed, with a view to promoting inclusive growth and reversing inequalities, boosting productivity (including advancements in its measurement) and human capital, **improving citizens living and working conditions**, responding to migration and integration challenges and supporting intergenerational solidarity and social mobility **and cultural integration**. **Accessible, inclusive, innovative and high-quality**, education and training systems are needed for a more equitable and prosperous future.

#### *Broad Lines*

- Knowledge base for advice on investments and policies especially education and training, for high value added skills, productivity, social mobility, growth, social innovation and job creation. The role of education and training to tackle inequalities;
- Cross-scientific research combining economic cultural and social impact of technological change***
- Social sustainability beyond GDP only indicators, especially new economic and business models, ***such as social economy*** and new financial technologies;
- Statistical and other economic and ***quantitative*** tools for a better understanding of growth and innovation in a context of sluggish productivity gains;
- New types of work, the role of work, trends and changes in labour markets and income in contemporary societies, and their impacts on income distribution, non-discrimination including gender equality and social inclusion;
- Tax and benefits systems together with social security and social investment policies, ***tax havens and tax justice*** with a view to reversing inequalities and addressing the negative impacts of technology, demographics and diversity;
- ***Strategies to address demographic change, urbanisation versus outward migration from rural areas, tackling socio-economic exclusion and enhancing quality of life in rural areas, including through the use of cutting edge technology and digital solutions;***

- Human mobility in the global and local contexts for better migration governance, integration of migrants including refugees; respect of international commitments and human rights; greater, improved access to quality education, training, support services, active and inclusive citizenship especially for the vulnerable;
- Education and training systems to foster and make the best use of the EU's digital transformation, also to manage the risks from global interconnectedness and technological innovations, especially emerging online risks, ethical concerns, socio-economic inequalities and radical changes in markets;
- Modernisation of public authorities to meet citizens' ***expectations and needs*** regarding service provision, transparency, accessibility, openness, accountability and user centricity;
- Efficiency of justice systems and improved access to justice based on judiciary independence and rule of law principles, with fair, efficient, ***accessible*** and transparent procedural methods both in civil and criminal matters.
- ***Identification of existing and emerging gender gaps and needs related to global transformations, and development of innovative methods to deal with gender stereotypes and gender biases.***

#### **2.2.4. Social sciences and humanities**

***Social sciences and humanities research shall be integrated into each of the priorities of Horizon Europe, contributing in particular to the evidence base for policymaking at international, Union, national, regional and local level. In addition to this integration, specific support shall be provided along the following broad lines, also support policy-making.***

##### ***Broad lines***

- ***Analysis and development of social, economic and political inclusion and inter-cultural dynamics in Europe and with international partners;***
- ***Greater understanding of the societal changes in Europe and their impact;***
- ***Tackling of major challenges concerning European models for social cohesion, immigration, integration, demographic change, ageing, -disability, education, poverty and social exclusion;***
- ***Support research to understand identity and belonging across communities, regions and nations;***

CA 17 - CLUSTER <b>'SECURE SOCIETY'</b>
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## 2.a) CLUSTER 'SECURE SOCIETY'

### 2a.1 Rationale

*In a context of transformations and growing global interdependencies and threats, research and innovation to ensure Europe's security is paramount.*

*Despite the fact that Europe is free from large-scale military aggressions, there is now the need to respond to the challenges arising from new security threats. Terrorist attacks of various kind, violent radicalisation, as well as cyber-attacks and hybrid threats, raise major security concerns and put particular strain on societies. EU has to tackle these challenges and ensure public safety while preserving individual freedom and fundamental rights.*

Security research is part of the wider EU efforts to meet this and other challenges. It contributes to the capability development process by enabling future availability of technologies, solutions and applications to fill gaps identified by policy-makers, and end-users, especially public authorities.

Such research and innovation responds to the commitment of the Rome Agenda to work towards "a safe and secure Europe", contributing to the Security Union. Synergies with the Justice Programme and with the Rights and Values Programme, which support activities in the area of access to justice, victims' rights, gender equality, non-discrimination, data protection and promotion of the European citizenship will be exploited.

Full use will be made of available instruments, including the European space programme (Galileo and EGNOS, Copernicus, Space Situational Awareness and Governmental Satellite Communications).

*Europe needs to continue its research and innovation efforts to improve cybersecurity, digital privacy, personal data protection and combat the spread of false and harmful information in order to safeguard prosperity, democratic and economic stability. Terrorism, violent radicalisation, ideologically motivated violence, cultural goods trafficking, cyber-attacks, organised crime, taxes avoidance and environmental crime and disasters, are some examples of areas to be tackled under this cluster.*

*In order to anticipate, prevent and manage risks and threats, it is not only necessary to commit to research but furthermore to develop and apply innovative technologies, solutions, foresight tools and knowledge, stimulate cooperation between providers and public users, find solutions, prevent and combat the abuse of privacy and breaches of human rights, while ensuring European citizens' individual rights and freedom.*

*To enhance complementary in research and innovation, public security authorities shall be enforced in efforts of multi- and international exchange and cooperation. Public security authorities shall be invigorated to participate in EU research and innovation efforts to further their capabilities to cooperate and communicate on all appropriate levels, to*

*exchange data, to benefit from common standards in technologies, procedures, equipment, and up-to-date results in crime related sciences, training, and supporting advantages of expert knowledge.*

*Furthermore, procurement shall be developed to support prototypes and facilitate the testing and acquisition of pre-market innovative solutions by public entities.*

Activities will contribute directly to the following Sustainable Development Goals (SDGs) in particular: SDG 1 - No Poverty; SDG 4 - Quality Education; SDG – Decent Work and Economic Growth; SDG 9 – Industry, Innovation and Infrastructure; SDG 10 - Reducing Inequalities; SDG 11- Sustainable Cities and Communities; SDG 16 – Peace, Justice and Strong Institutions.

#### ***2a.2.1 Organised Crime; Terrorism, Extremism, Radicalisation and Ideologically Motivated Violence***

*Organised Crime, terrorism, extremism, violent radicalisation and ideologically motivated violence cause high risks to citizens as well as to Europe's society, economy and democratic stability. The perpetrators range from individual actors to highly organised criminal structures, also operating internationally. Research and innovation, including in humanities and technologies are required to detect, prevent and counter their activities and their causes.*

##### **Broad Lines**

- Human and social dimensions of criminality and violent radicalisation, in relation to those engaged or potentially engaged in such behaviour as well as to those affected or potentially affected;
- Innovative approaches and technologies for security end-users, especially public security authorities;
- Technologies and standards of operation *for protecting infrastructure, open and public spaces;*
- *Prediction, detection, prevention, and protection against attempts and perpetrators of serious and organised crime, ideologically motivated radicalisation, violence, and terrorism, including support to its victims;*

#### ***2a.2.2. Border Protection Management***

*To advance safety and security within the EU requires research and innovation to strengthen the abilities of border protection and management. This includes area reconnaissance and surveillance (air, ground, sea), stable cooperation and data-exchange with foreign authorities, including interoperability capabilities with local, regional, national and international command-, control- and communication-centres as well as implementing solutions for border-protection, incident responding, risk-detection and crime-prevention. Further, to include is research on predictive policing and algorithm-based early warning applications, automated surveillance technologies using various kinds of sensors, while taking into account*



*fundamental rights. While evaluating their impact and potential to enhance security efforts and solution, technologies and equipments should contribute to the integrity of those approaching external borders by especially land and sea.*

*Research should support the improvement of the integrated European border management, including through increased cooperation with candidate, potential candidate and EU Neighbourhood Policy countries. It will further assist EU efforts managing migration.*

#### *Broad Lines*

- *Identifying forged and otherwise manipulated documents;*
- *Detecting illegal transportation/trafficking of persons and goods;*
- *Furthering response capabilities to border incidents;*
- *Modernisation of border aerial reconnaissance and surveillance equipment;*
- *Improving direct cooperation of security authorities of both sides in the respective border area for cross-border measures to ensure continuous persecution of offenders and suspects.*

#### *2a.2.3 Cyber-Security, Privacy, Data Protection*

*Malicious and hostile cyber activities threaten our societies and citizens, the stable and secure functioning of public authorities and institutions, economies and also the very functioning of Europe's democratic institutions, our freedoms and values. Incidents involving public institutions have occurred already and are likely to increase in the course of further integration of digital and cyber applications in administrative and economic procedures as well as in private and individual use.*

*Cybercrime is on the increase, related risks are diversifying as the economy and society digitalise further on. Europe needs to continue its efforts to improve cybersecurity, digital privacy, personal data protection and combat the spread of false and harmful information in order to safeguard democratic and economic stability.*

*Future security and prosperity depend on improving abilities to protect the EU against such threats, to prevent, detect and counter malicious cyber activities, often requiring close and rapid cross-border cooperation. Especially the digital transformation requires improving cybersecurity substantially, to ensure the protection of the huge number of IoT devices expected to be connected to the internet; Europe must keep up all efforts to enforce resilience to cyber-attacks and promote effective deterrence.*

#### *Broad Lines*

- *Combatting disinformation and fake news with implications for security, including the protection of electoral registration and evaluation/counting systems and*

- communication (election security); developing capabilities to detect the sources of manipulation, while preserving freedom of speech and access to information.*
- *Expanding detection, prevention, defence and countering technologies;*
  - *Strengthening abilities to decipher and decrypt cyber-attacks for public authorities;*
  - *Technologies to detect and monitor illicit electronic way of payment and financial flows;*
  - *Increase scientific and technological abilities of responsible authorities, especially European Police Office, European Cybercrime Centre and European Network and Information Security Agency;*
  - Ensuring the protection of personal data in law enforcement activities, particularly in view of rapid technological developments;
  - Technologies across the digital value chain (from secure components to cryptography, *distributed ledger technologies, behavioural based security and resilient and self-healing software and networks*);
  - Technologies, *methods and best practices to address, prevent, mitigate and recover from* cybersecurity threats, anticipating future needs, and sustaining a competitive industry *with high availability, including improving knowledge and awareness concerning cybersecurity risks and consequences;*
  - *Improving the protection of personal data by promoting easy-to-use solutions for devices used by citizens and consumers;*
  - *Secure software and hardware development and test facilities for security testing of software and hardware;*

#### **2.a.2.4 Protecting Critical Infrastructures and Improving Disaster Response**

*New technologies, processes, methods and dedicated capabilities will help to protect critical infrastructures, including e-infrastructures, systems and services which are essential for the proper functioning of society and economy, including communications, transport, finance, health, food, water, energy, logistic and supply chain, and environment.*

Disasters arise from multiple sources, whether natural, man-made *or* resulting *from* cascading risks. *Efforts are required to limit the effects on lives and livelihoods.* The aim is to prevent and reduce-harm to health and the environment, economic and material damage, *to ensure food and medicine supply, security and basic means of communication.*

### **Broad Lines**

- Technologies and capabilities for first responders for emergency operations in crisis and disaster situations *including disaster response for victims and early warning systems*;
- Capacities of society to better manage and reduce disaster risk, including through nature *and community know-how*-based solutions, by enhancing prevention, preparedness and response to existing and new risks, *improving the resilience of these various infrastructures, including through disaster-resilient institutional, political and governance structures*;
- *Enhancing moving capabilities for search and rescue equipment, vehicles, supply and forces*;
- *Technologies, equipment and procedures to prevent the outbreak of or to contain pandemics*;
- *Improving multi-layer public alert systems, especially considering vulnerable persons*;
- *Improvement of the availability of specialised air- and ground vehicles to fight large-scale and forest fires as well as improving its rapid deployment*;

#### **2a.2.5 Piracy and Counterfeit of Products**

*Countering piracy and counterfeit of products remain of serious concern for the European economy, cultural and creative sector and citizens alike. These illicit activities cause serious losses of taxes, revenues and personal income as well as putting employment in Europe at risk.*

*Deficient products imply risks for causing damage to persons and property. Such impacts need to be addressed and solutions be found to tackle piracy and counterfeit of products as well as to enforce appropriate public authorities to prevent, detect, investigate and counter these crimes and related illegal activities in cooperation.*

*To include are efforts to promote the protection of intellectual property.*

### **Broad Lines**

- *Promoting techniques of identifying products*;
- *Enhancing protection of original parts and goods*;
- *Technologies to control transported products (real-time) and data-exchange between producers, transporter, custom-authorities and recipients*

#### ***2a.2.6 Supporting the Union's external security policies through conflict prevention and peace-building***

***Research, new technologies, capabilities and solutions are required to support the Union's external security policies in civilian tasks, ranging from civil protection to humanitarian relief, border management or peace-keeping and post-crisis stabilisation, including conflict prevention, peace-building and mediation.***

##### ***Broad lines:***

- Research on conflict resolution and restoration of peace and justice, on early identification of factors leading to conflict and on the impact of restorative justice processes.***
- Promoting interoperability between civilian and military capabilities in civilian tasks ranging from civil protection to humanitarian relief, border management or peace-keeping.***
- Technological development in the area of dual-use technologies to enhance interoperability between civil protection and military forces and amongst civil protection forces worldwide, as well as reliability, organisational, legal and ethical aspects, trade issues, protection of confidentiality and integrity of information and traceability of all transactions and processing.***
- Developing of command and control capabilities for civil missions.***

#### ***2a.2.7 Promoting Coordination, Cooperation and Synergies***

***To ensure the ability to deploy, manage, control and command inter-authority procedures up-to-date technology and standards are required. The aim ought to be to equip public authorities and other forces to be deployed with exchangeable equipment, to integrate EU-wide standard procedures of operation, responding, reporting and data-exchange.***

***An adequate budget should be allocated to agencies to further promote their ability to participate in as well as from EU research and innovation and in order to manage relevant projects, to exchange demands, results and ambitions as well as to cooperate and coordinate efforts with other agencies and certain non-EU authorities like Counter-Terrorism Group and Interpol. As for security related research and innovation these are especially European Policy College, European Aviation Safety Agency, European Centre for Disease Prevention and Control, European Monitoring Centre for Drugs and Drug Addiction, European Maritime Safety Agency, European Network and Information Security Agency, European Agency for the operational management of large-scale IT Systems in the area of freedom, security and justice, European Union Intellectual Property Office, European Police Office, European Border and Coast Guard Agency and European Union Satellite Centre.***

***To enhance synergies with EU-funded defence research, exchange and consultation mechanisms should be put in place with defence research associated authorities for civilian purposes.***

*Standards will play an important role as they ensure common development, production and implementation as well as abilities of exchange, interoperability and compatibility of services, procedures, technologies and equipment.*

***Broad Lines***

- *Technologies and equipment with basic operation requirements to be applicable by all Member States authorities of the same line (police, rescue, disaster management, communication etc.) equally;*
- Interoperability of equipment and procedures to facilitate cross-border and inter-agency operational ability;

<b>CA 18 - CLUSTER 'DIGITAL, INDUSTRY AND SPACE'</b>
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### **3. CLUSTER 'DIGITAL, INDUSTRY AND SPACE'**

#### **3.1. Rationale**

To ensure industrial competitiveness and the capacity to address the global challenges ahead, the EU must reinforce and maintain its technological and industrial capacities in the key areas that underpin the transformation of our economy and society.

EU industry provides one out of five jobs and two thirds of private sector R&D investments and generates 80% of EU exports. A new wave of innovation, involving a merging of physical and digital technologies, will trigger huge opportunities for EU industry and improve the quality of life for EU citizens.

Digitisation is a major driver. As it continues at a rapid pace across all sectors, investment in priority areas ranging from artificial intelligence to next generation internet, high performance computing, photonics, **quantum technologies**, nano-electronics, **smart data** etc. becomes essential for the strength of our economy. Investing, producing and using ICT provides a major boost to EU economic growth, amounting to an increase of 30% between 2001 and 2011 alone.

Key enabling technologies<sup>4</sup> underpin the blending of the digital and the physical worlds, central to this new global wave of innovation. Investing in the development, demonstration, deployment **and standardisation** of key enabling technologies, and ensuring a secure, sustainable and affordable **sourcing, use and management** of raw and advanced materials, will secure EU strategic autonomy and help EU industry to significantly reduce its carbon and environmental footprints and **hence costs for society in terms of externalities**.

Specific future and emerging technologies **should** also be pursued as **the grounds on which next breakthroughs innovations are based**.

Space is of strategic importance; around 10% of the EU's GDP depends on the use of space services. The EU has a world-class space sector, with a strong satellite manufacturing industry and a dynamic downstream services sector. Space provides important tools for communication, navigation, and surveillance and opens up many **research, innovation and** business opportunities especially in

combination with digital technologies and other sources of data. The EU must make the most of these opportunities by fully exploiting the potential of its space programmes Copernicus, EGNOS and Galileo, *as well as encouraging amongst other the development of the downstream sector and the applications for the final users* and by protecting space and ground infrastructures against threats.

The EU has the unique chance of being a global leader and increase its share of world markets, by showcasing how digital transformation, leadership in key enabling and space technologies, *unlocking scenarios for the transition towards net-zero GHG emissions economy including low-carbon technologies and strategies for decarbonisation, bio-based and circular economy, ensuring competitiveness and societal understanding of these technologies and evolutions.*

To make the digitised, circular, low carbon and low-emission economy a reality, action is needed at EU level because of the complexity of value chains, the systemic and multi-disciplinary nature of the technologies and their high development costs, and the cross-sectoral nature of the problems to be addressed. The EU must ensure that all industrial players, and society at large, can benefit from advanced and clean technologies and digitisation. Developing technologies alone will not suffice. *New sustainable business models*, industrially-oriented infrastructures, including pilot lines, will help set up EU businesses and in particular SMEs deploy these technologies and improve their innovation performance. *In this context cultural and creative sector also play a major role as drivers of digital transformation and ICT-driven innovation in Europe.*

*Therefore*, a strong engagement of industry is essential in setting priorities and developing research and innovation agendas, increasing the leverage of *additional* public *and private* funding, and ensuring the uptake of results. Societal understanding and acceptance are key ingredients for success, as well as a new agenda for industry-relevant skills and standardisation.

*Bringing* together activities on digital, key enabling and space technologies, as well as a sustainable supply of raw materials, will allow for a more systemic approach, and a faster and more profound digital and industrial transformation. *This* will ensure that research and innovation in these areas feed into, and contribute to the implementation of, the EU's policies for industry, digitisation, environment, energy and climate, *mobility*, circular economy, raw and advanced materials and space.

Complementarity will be ensured with activities under the Digital Europe Programme, to respect the delineation between both Programmes and avoid any overlaps.

Activities will contribute directly to the following Sustainable Development Goals (SDGs) in particular: SDG 8 - Decent Work and Economic Growth; SDG 9 - Industry, Innovation and Infrastructure; SDG 12 - Responsible Consumption and Production; SDG-13 Climate Action.

### **3.2. Areas of Intervention**

#### **3.2.1. Manufacturing Technologies**

Manufacturing is a key driver of employment and prosperity in the EU, producing over three quarters of the EU's global exports and providing over a 100 million direct and indirect jobs. The key challenge for EU manufacturing is to remain competitive at a global level with smarter, more customised and *more*

***energy and resource efficient*** products of high added value ***and reduced carbon footprint in line with the Union climate goals, including less waste and pollution.*** Creative and cultural inputs, ***as well as perspectives from social sciences and humanities on the relation between technology and people,*** will also be vital to ***achieve these goals.***

#### *Broad Lines*

- Breakthrough manufacturing technologies such as additive manufacturing, ***modelling, simulation,*** industrial ***automation and*** robotics, human integrated manufacturing systems, also promoted via an EU network of industrially-oriented infrastructures;
- Breakthrough innovations using different enabling technologies (e.g. converging technologies, artificial intelligence, data analytics, industrial robotics, ***sustainable*** bio-manufacturing, advanced batteries technologies) across the value chain;
- Skills and workspaces fully adapted to the new technologies, ***including ergonomics,*** and which are in line with European social values ***and needs;***
- Flexible, high-precision, zero-defect and zero-waste cognitive plants and smart and ***energy efficient*** manufacturing systems meeting customer needs;
- Breakthrough innovations in techniques for exploring construction sites, for full automation for on-site assembly and prefabricated components.

#### 3.2.2. *Key Digital Technologies*

Maintaining and autonomously developing strong design and production capacities in essential digital technologies such as micro- and nano-electronics, photonics, software and systems, and their integration and ***standardisation, as well as*** advanced materials for these applications will be essential for a competitive EU. ***Key enabling digital technologies are essential to fill the gap between cutting edge research and market creating innovations.***

#### *Broad Lines*

- Nano-electronics design and processing concepts responding to the specific requirements of digital transformation and global challenges, in terms of ***performance,*** functionality, energy ***sharing*** and consumption ***and efficiency*** and integration;
- Sensing technologies and their co-integration with computational units as the enabler of the Internet of Things, including innovative solutions on flexible and conformable materials for ***safe, secure,*** human-***and environment-***friendly interacting objects;
- Technologies as complements or alternatives to nano-electronics, such as neuromorphic computing powering artificial intelligence applications, or integrated quantum computing;
- Computing architectures and low-power processors for a wide range of applications including edge computing, digitisation of industry, ***automation and robotics,*** big data and cloud, smart energy and connected and automated driving;
- Computing hardware designs delivering strong guarantees of trusted execution, with built-in privacy and security protection measures for input/output data as well as processing instructions;

- Photonics technologies enabling applications with breakthrough advances in functionality, **integration** and performance;
- System engineering technologies to support and fully autonomous systems for trustworthy applications interacting with the physical world, including in industrial and safety critical domains;
- Software and **hardware** technologies enhancing quality, security and reliability with improved service life, increasing development productivity **and interoperability**, and introducing built-in artificial intelligence and resilience in software;
- Emerging technologies expanding digital technologies and bridging the gap from proofs of concept in research to industrial feasibility for relevant markets.
- Digital Technologies **for cultural and creative sector, including audio-visual, archives and libraries, publishing, to develop new tools to create access, exploit and preserve digital content.**
- **Development of novel eco-innovation business models and alternative resource and energy-efficient production approaches.**

### 3.2.3. *Advanced Materials*

The EU is a global leader in advanced materials and associated processes, which make up 20% of its industry base and form the root of nearly all value chains through the transformation of raw materials. To remain competitive and meet citizens' needs for sustainable, safe and advanced materials, **including eco-friendly alternatives**, the EU must improve the **durability, reusability and** recyclability of materials, reduce the carbon and environmental footprint, and drive cross-sectoral industrial innovation by supporting new applications **and standardisation** in all industry sectors.

#### *Broad Lines*

- Materials (including plastic, **bioplastics**, bio-, nano-, two-dimensional, smart and multi-materials) designed with new properties and functionalisation and meeting regulatory requirements (while not leading to increased environmental pressures and **negative externalities** during their production, use or end-of-life);
- Integrated materials processes and production following a customer-oriented and ethical approach, including pre-normative activities and life-cycle assessment, **sustainable** sourcing and management of raw materials, durability, reusability and recyclability, safety, risk assessment and management;
- Materials enablers like characterisation (e.g. for quality assurance), modelling, piloting and upscaling;
- An EU innovation **network** of **research and** technology infrastructures<sup>5</sup>, identified and prioritised in agreement with Member States **and taking into account the ESFRI roadmap**, which provide services to accelerate technological transformation and uptake by EU industry, notably by SMEs, this will cover all key technologies necessary to enable innovations in the field of materials;
- Analysis of future and emerging trends in advanced materials and other key enabling technologies;
- Solutions based on design, architecture and general creativity, with a strong user orientation, for adding value to industrial sectors and the creative industries, **including the fashion industry.**



### 3.2.4. *Artificial Intelligence and Robotics*

Making any object and device intelligent is one of the megatrends. Researchers and innovators developing Artificial Intelligence (AI) and offering applications in Robotics and other areas will be key drivers of future economic and productivity growth. Many sectors including health, **transport**, manufacturing, construction, and farming will use and further develop this key enabling technology, in other parts of the Framework Programme. Developments must ensure the safety of AI-based applications, assess **their** risks and mitigate **their** potential for malicious use and unintended discrimination such as gender or racial bias. It must also be ensured that AI is developed within **an ethical** framework which respects the EU's values and the Charter of Fundamental Rights of the European Union.

#### *Broad Lines*

- Enabling AI technologies such as explainable AI, unsupervised machine learning and data efficiency and advanced human-machine interactions;
- Safe, smart and efficient robotics and complex embodied systems;
- User-driven AI technologies for AI-based solutions;
- Developing and networking the research **and innovation** competences of AI competence centres across Europe.
- Technologies for open AI platforms including software algorithms, data repositories, robotics and autonomous systems platforms.

### 3.2.5. *Next Generation Internet*

The Internet has become a key enabler of the digital transformation of all sectors of our economy and society. The EU needs to take the lead in driving the next generation Internet towards a human-centric ecosystem and **technical development towards accessible, secure and reliable network services**, in line with our social and ethical values. Investing in technologies and software for the Next Generation Internet will improve EU competitiveness in the global economy. Optimising EU wide take up will require large-scale cooperation across stakeholders **and the development of European and international standardisation**.

#### *Broad Lines*

- Technologies and systems for trusted and energy-efficient smart network and service infrastructures (connectivity beyond 5G, software defined infrastructures, Internet of things, cloud infrastructures, cognitive clouds), enabling real-time capabilities, virtualisation and decentralised management (ultrafast and flexible radio, edge computing, **cryptography based technologies, distributed ledgers**, shared contexts and knowledge);
- Next Generation Internet applications and services for consumers, industry and society building on trust, interoperability, **interconnectivity**, better user control of data, transparent language access, new multi modal interaction concepts, inclusive and highly personalised access to objects, information and content,

including immersive and trustworthy media, social media and social networking *as well as solutions for secure transactions and services over shared infrastructures*;

- Software-based middleware, including distributed ledger technologies, working in highly distributed environments, facilitating data mapping and data transfer across hybrid infrastructures with inherent data protection, embedding artificial intelligence, data analytics, security and control in Internet applications and services predicated on the free flow of data and knowledge.
- *Technologies and tools for system of systems integration for societal and industrial applications to ensure scalable, efficient and reliable network performance suited for massive service deployment.*

### 3.2.6. *Advanced Computing and Big Data*

High Performance Computing and Big Data have become indispensable in the new global data economy, where to out-compute is to out-compete. High Performance Computing and Big Data analytics are critical to support policy making, scientific leadership, innovation and industrial competitiveness, and to maintain national sovereignty.

#### *Broad Lines*

- High Performance Computing (HPC): *development of the* next generation of key exascale and post-exascale technologies and systems (e.g. low-power microprocessors, software, system integration); *dedicated hardware*, algorithms, codes and applications, and analytic tools and test-beds; industrial pilot test-beds and services; supporting research and innovation for a world-class HPC infrastructure, including the first hybrid HPC / Quantum computing infrastructure in the EU;
- Big Data: Extreme-performance data analytics; *secure and integrity-preserving* "Privacy by design" in the analysis of personal and confidential Big Data; technologies for full-scale data platforms for re-use of industrial, personal and open data; data management, interoperability and linking tools; data applications for global challenges;
- Reduced carbon footprint of ICT processes, covering hardware, software, sensors, networks, storage and data centres, and including standardised assessments.

#### 3.2.6 a. *Quantum Technologies*

*Quantum Technologies (QT) exploit the enormous advancements in our ability to detect and manipulate single quanta (atoms, photons, electrons). This could revolutionize the whole information value chain from software to hardware and from communications to data mining and AI. Europe is home to world leading researchers in this field and there is currently a global race to transfer scientific advances into market-ready applications. This key enabling technology will have a profound cross-sectorial impact, providing European citizens and industry for example with fundamentally more performing computation (leading, amongst other, to more reliable healthcare, improved chemicals and materials, optimized and thus more sustainable use of resources, more efficient engineering), more secure telecommunications, and many other revolutionary applications.*

#### *Broad Lines*

- *Quantum computing and simulation, including hardware development of different architectures and physical platforms, and algorithm and software development;*

- *Quantum networks for secure transmission of data and for sharing quantum resources, both ground- and space-based;*
- *Quantum sensors, imaging systems and metrology standards, exploiting coherent quantum systems and entanglement;*
- *Testbeds and user facilities for the above-mentioned technologies.*

### 3.2.7. *Circular Industries*

Europe is at the forefront of the global transition towards a circular economy. Europe's industry should become a circular industry: the value of resources, materials and products should be maintained much longer compared to today, even opening up new value chains.

Primary raw materials will continue to play an important role in the circular economy and attention must be paid to their sustainable *sourcing, usage and* production. In addition, entirely new materials, products and processes should be designed for circularity. Building a circular industry will have several advantages for Europe: It will lead to a secure, sustainable and affordable supply of raw materials, which will in turn protect the industry against scarcity of resources and price volatility. It will also create new business opportunities and innovative, more efficient ways of producing.

The objective is to develop affordable breakthrough innovations and deploy a combination of advanced *and digital* technologies and processes so as to extract maximum value from all resources.

#### *Broad Lines*

- Industrial symbiosis with resource flows between plants across sectors and urban communities; processes and materials, to transport, transform, re-use and store resources, combining the valorisation of by-products, waste.
- Valorisation and life-cycle assessment of materials and product streams with use of new alternative feedstocks, resource control, *including new business models, automation and digital technologies for* material tracking and sorting;
- Products *development, including their design*, for enhanced life-cycle performance, durability, *re-usability, repairability*, upgradeability and ease *remanufacturing*, repair, dismantling and recycling;
- Recycling industry, maximising potential and safety of secondary materials and minimising pollution, quality downgrading, and quantity dropouts after treatment;
- Safe heading* and elimination of substances of concern in the production and end-of-life phases; safe substitutes, and safe and cost-efficient production technologies;
- Sustainable supply *and/or* substitution *options* of raw materials, including critical raw materials, covering the whole value chain.

### 3.2.8. *Low-Carbon and Clean Industries*

Industrial sectors, including energy-intensive industries, contribute millions of jobs and their competitiveness is key for the prosperity of our societies. However, they account for 20% of the global

greenhouse gas emissions and have a high environmental impact (particularly in terms of air, water and soil pollution). *Therefore, industries, especially those that are energy-intensive, should further improve energy efficiency in order to gain in competitiveness and lower EU's energy demand. An increased integration of renewable energy sources through the development of new power-driven industrial techniques and processes is of major importance for industrial transformation.*

*Large-scale* breakthrough *scientific and technological research* to achieve significant *energy* reductions in greenhouse gases and pollutants, combined *for example* with technologies for circular *economy and digital technologies*, will lead to strong industrial value chains, revolutionise manufacturing capacities at the same time make key contributions to our targets for climate action and environmental quality.

#### *Broad Lines*

- Process technologies, including heating and cooling, *process agents and* digital tools, *especially in the form of* large-scale demonstrations for process performance and efficiency; substantial reductions or avoidance of industrial emissions of greenhouse gases and pollutants, including particulate matter;
- Industrial CO<sub>2</sub> valorisation, *including technologies and solutions to reduce GHG emissions from fossil fuel-based power generation, via CO<sub>2</sub> capture and utilisation.*
- Carbon direct avoidance through the application of renewable based electrolytical hydrogen and renewable electrical power;*
- Electrification and use of *clean* energy sources within industrial plants, *in order to reduce fossil energy carriers, in particular for energy intensive industrial processes;*
- Industrial products *and materials* that require low or zero carbon emissions production processes.

#### 3.2.9. *Space*

EU space systems and services reduce costs and improve efficiency, offer solutions to societal challenges, increase societal resilience and foster a competitive and sustainable economy. EU support has been instrumental in helping to realise these benefits and impacts. EU space programmes must evolve to remain at the forefront.

The EU will support synergies between space and key enabling technologies (big data, advanced manufacturing, *quantum technologies*, robotics and artificial intelligence); *will* foster a thriving and entrepreneurial and competitive space sector; and *will* help *to* secure non-dependence in accessing and using space in a safe and secure manner. *Upstream activities will* be roadmap-based, taking account of the ESA harmonisation process and relevant Member States initiatives, and will be implemented with ESA, as appropriate. *Downstream activities will be market driven and respond to user needs and will be implemented with the Agency for the Space Programme.*

#### *Broad Lines*

- European Global Navigation Satellite Systems (Galileo and EGNOS): innovative applications, global uptake including international partners, solutions improving robustness, authentication, integrity of services, development of fundamental elements such as chipsets, receivers and antennas, sustainability of supply chains, new technologies (e.g. quantum technologies, optical links, reprogrammable payloads), **improved accessibility and increased diversity of applications** towards sustained exploitation of services for impact on societal challenges. Next generation systems development for new challenges such as **natural disaster risk reduction**, security or autonomous driving;
- Copernicus: innovative applications, global uptake and international partners, robustness and evolution of services, sustainability of supply chains, sensors, systems and mission concepts (e.g. High Altitude Platforms, drones, light satellites); calibration and validation; sustained exploitation of services and impact on societal challenges; Earth observation data techniques, big data, computing resources and algorithmic tools. Next generation systems development for new challenges such as **disaster risk reduction**, climate change, and security;
- Space Situational Awareness: robust EU capacity to monitor and forecast state of the space environment e.g. space weather, space debris and near Earth objects, **sensors**, and new service concepts, such as space traffic management, applications and services to secure critical infrastructure in space and on Earth;
- Secure, **quantum-safe** satellite communications for EU governmental actors: solutions for the widest possible range of governmental users and associated user equipment in architectural, technological and system solutions for space infrastructure, supporting the EU's autonomy;
- End-to-end satellite Communications for citizens and businesses: cost-effective, advanced satellite communications to connect assets and people in underserved areas, as part of 5G-enabled ubiquitous connectivity and development of the Internet of Things (IoT), and contributing to the Next Generation Internet (NGI) infrastructure. Enhanced ground segment and user equipment, standardisation and interoperability to ensure EU industrial leadership;
- Non-dependence and sustainability of the supply chain: increased technology readiness levels in satellites and launchers; associated space and ground segments, and production and testing facilities. To secure EU technological leadership and autonomy, improved supply chain sustainability, reduced dependence on non-EU critical space technologies and improved knowledge of how space technologies can offer solutions to other industrial sectors;
- Space ecosystem: in-orbit validation and demonstration services, including rideshare services for light satellites; space demonstrators in areas such as hybrid, smart or reconfigurable satellites, in-orbit manufacturing and assembly, launcher reusability, in-orbit servicing and micro-launchers; breakthrough innovations, and technology transfer, in areas such as recycling, **clean space**, green space, artificial intelligence, robotics, digitisation, cost-efficiency, miniaturisation;
- Space science: exploitation of scientific data delivered by scientific and exploration missions, combined with the development of innovative instruments in an international environment; radiation measurements, phenomena in upper atmosphere connected to space weather, contribution to precursor scientific missions for the evolution of the Space Programme.
- **Space AI and robotics: novel solutions for space missions e.g. space assembly, space manipulation, cognitive space systems, robot-human collaboration in space.**

## CA 19 - CLUSTER 'CLIMATE, ENERGY AND MOBILITY'

**4. CLUSTER 'CLIMATE, ENERGY AND MOBILITY'****4.1. Rationale**

The intersection of research and innovation on climate, energy and mobility will address, in a highly integrated and effective way, one of the most important global challenges for the sustainability and future of our environment, *economy* and way of life.

To meet the objectives of the Paris Agreement the *Union* will need to *unlock scenarios for the transition towards net-zero GHG emissions economy including low-carbon technologies and strategies for decarbonisation*. This will *entail* profound changes in *the* technology and services, *that underpin the ways in which industries produce, and* businesses and consumers behave. *The transformation of the energy market will take place through interaction of technology, infrastructure, the market as well as policy and regulatory frameworks including* new forms of governance. *Therefore, there is a need for systematic innovations in the energy, buildings, industry and transport sectors.*

Limiting the increase of global average temperature to well below 2°C, and pursuing efforts to limit the temperature increase to 1.5°C, *requires reductions in* greenhouse-gas (GHG) emissions *through decarbonization, energy savings, and the deployment of renewable energy sources and the electrification of industrial processes which encompass both the energy and the* transport sectors<sup>7</sup>. *Currently, the transport sector represents almost a quarter of the Union's GHG emissions.*

New impetus *is needed* to accelerate the pace of developing next-generation breakthroughs as well as demonstrating and deploying innovative technologies and solutions, using also the opportunities provided by *key enabling technologies*, digital *technologies* and space technologies. This will be pursued through an integrated approach encompassing decarbonisation, *renewable energy* resource *and energy* efficiency, reduction of air pollution, access to raw materials, *including critical raw materials*, and *the* circular economy. *Particular attention should be paid to sector coupling (i.e. of electricity, heating and cooling, industry and transport sector) in all intervention areas, which is important for a successful energy and transport transition.*

*To achieve this, the Union will also foster participatory approaches to research and innovation, including the multi-actor approach and develop knowledge and innovation systems at local, regional, national and European levels. Insights from social sciences and humanities, social innovation with citizens' engagement will be crucial to encourage new governance models, production and consumption patterns.*

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Substantial decarbonisation of other sectors is addressed in other areas of the Horizon Europe Global Challenges and Industrial Competitiveness pillar.

Progress in the **energy and transport** sectors - **and** also across the spectrum of EU industry including agriculture, buildings, industrial processes and product-use, and waste management **and recycling** - will require **continued and reinforced** efforts to better understand the mechanisms of climate change and the associated impacts across the economy and society, exploiting synergies with national activities, other **Union** types of actions and international cooperation.

Over the past decade, considerable advances have been made in climate science, in particular in observations and data assimilation and climate modelling. However, the complexity of the climate-system and the need to support implementation of the Paris Agreement, the Sustainable Development Goals and EU policies necessitate a reinforced effort to fill the remaining knowledge gaps.

The EU has established a comprehensive policy framework in the Energy Union strategy, with binding targets, legislative acts and research and innovation activities aiming to lead **to a highly energy efficient and renewables based energy system**.

Transport ensures the mobility of people and goods necessary for an integrated European single market, territorial cohesion and an open and inclusive society. At the same time, transport has significant negative effects on human health, congestion, land, air quality and noise, as well as safety resulting in numerous premature deaths and increased socio-economic costs. Therefore, mobility and transport networks, **in particular in urban areas**, need to become clean, **efficient, environmentally- and economically-sustainable**, safe, smart, **innovative**, secure, silent, reliable and affordable, offering a seamless integrated door-to-door service.

The issues faced by the transport and energy sectors go, however, beyond the need for emission reduction. There are several challenges to be tackled, including **renewable energy, sustainable fuels, energy storage and security of supply**, the increasing penetration of digital, **automated**, and space-based technologies, changes in user behaviour and mobility patterns, new market entrants and disruptive business models, globalisation, increasing international competition and an older, more urban and increasingly diverse, population.

Both **the energy and the transport** sectors are major drivers of Europe's economic competitiveness and growth. The EU has upwards of 1.6 million people working in the field of renewables and energy efficiency. Transportation and the storage sectors employ more than 11 million in the EU, accounting for around 5% of GDP and 20% of exports. The EU is a world leader in vehicle, aircraft and vessel design and manufacturing, while patenting of innovative clean energy technologies, **including technologies in renewable energy**, places the EU in second place worldwide.

Finding new ways to accelerate the deployment of **renewable-based and energy-efficient** technologies and **other non-technological** solutions for the decarbonisation of the European economy requires also increased demand for innovation. This can be stimulated through the empowerment of citizens as well as socio-economic and public sector innovation **and public procurement** and will lead to approaches broader than technology-driven innovation. Socio-economic research covering inter alia user needs and patterns, foresight activities,

environmental, economic, social and behavioural aspects, business cases and models and pre-normative research for standard setting, will also facilitate actions fostering regulatory, financing and social innovation, skills, as well as engagement and empowerment of *all* market players and consumers. ***Technologies that advance sector coupling also have the potential to strengthen the domestic manufacturing industry. In the transport sector, the role of applied research and trials aiming at market deployment of innovations is crucial.***

Activities under this Cluster contribute in particular to the goals of the Energy Union, ***the Paris Agreement commitments***, as well as to those of the Digital Single Market, the Jobs, Growth and Investment agenda, the strengthening of the ***Union*** as a global actor, the new ***Union*** Industrial Policy Strategy, the ***Circular Economy Action Plan***, ***the European Battery Alliance initiative***, the Raw Materials Initiative, ***the EU Bioeconomy Strategy***, the Security Union and the Urban ***Agenda***, ***the*** Common Agricultural Policy of the ***Union***, as well as ***Union*** legal provisions to reduce noise and air pollution. ***They also contribute to helping Member States achieve the national emission reduction targets. Complementarity and synergies with activities under other Union Programmes should be ensured.***

***Given the number of European Technology and Innovation Platforms (ETPs) on this field, calls within this cluster should take into account their recommendations.***

Activities will contribute directly to the following Sustainable Development Goals (SDGs) in particular: SDG 7 - Affordable and Clean Energy; SDG 9 - Industry, Innovation and Infrastructure; SDG 11 - Sustainable Cities and Communities; SDG 13 - Climate Action.

## ***4.2 Areas of Intervention***

### **4.2.1 Climate Science and Solutions**

Effective implementation of the Paris Agreement has to be based on science, requiring continuously updating of our knowledge on the climate-earth system, as well as the mitigation and adaptations options available, allowing for a systemic and comprehensive picture of challenges and opportunities for the ***Union's*** economy. On this basis, science-based solutions for a cost-effective transition towards a low carbon ***or net-zero GHG emission economy*** will be developed.

#### ***Broad Lines***

- ***Identifying key processes in the polar regions for a better development of management options that minimise the negative impacts on ecosystems and improve insight into global climate;***
- Knowledge base on the functioning and future evolution of the earth-climate system, as well as associated impacts, risks, and opportunities;
- ***GHG emission reduction pathways, mitigation*** actions and policies covering all sectors of the economy, compatible with the Paris Agreement and the United Nations Sustainable Development Goals;
- Climate projections and techniques for predictability and climate services for businesses, public authorities and citizens;



- Adaptation pathways and policies, including improved risk assessment and **reduction** tools, for vulnerable ecosystems, critical economic sectors, **critical infrastructure and urban environments at local, regional, national and Union levels**;
- **Models for strengthening climate diplomacy as a driver for international cooperation.**

#### 4.2.2 Energy Supply

The EU aims to be **the** world leader in affordable, secure, sustainable and **renewable** energy technologies, **thus** improving its competitiveness in global value chains and its position in growth markets. Diverse climatic, geographical, environmental and socio-economic conditions in the EU as well as the need to ensure **the reduction of energy consumption, energy efficiency**, security **energy supply** and access to raw materials, **especially critical ones**, dictate a broad portfolio of energy solutions, including **those** of non-technical nature. **The energy transition will challenge the EU to lead in developing solutions for an upgraded market design while system integration needs to be significantly improved.** As regards renewable energy technologies, costs need to decrease further **and** performance must improve. **This requires support for incremental and disruptive research in advanced technologies. In addition, new** breakthrough technologies need to be developed **and deployed, while established technologies need to be improved.** As regards fossil fuels **and feedstock, reducing** their usage will be essential to meet the climate objectives.

##### *Broad Lines*

- Renewable energy technologies, **including marine energy generation and its different sub-sectors, such as wind, current and wave power**, heating and cooling, fuels, intermediate carriers, **such as power-to-gas and hydrogen**, at various scales and development stages, adapted to geographic conditions and markets, both within the **Union** and worldwide;
- **Highly energy efficient low-carbon or decarbonised solutions for power generation**
- Disruptive renewable energy technologies for **both new, established or highly-enhanced** applications and breakthrough solutions;
- **Next generation technology solutions, including the development of new materials, manufacturing processes and operations methods to increase industrial competitiveness in clean energy technology;**
- **Research and development of new business models, solution and services for creating favourable market conditions at the regulatory, administrative and financing levels for renewables, end-user energy efficient technologies and solutions.**

#### 4.2.3 Energy Systems and Grids

The **expected** growth of variable electricity production and **the** shift towards more electric heating, cooling and transport **needs** new approaches **towards the management of energy**

grids *and the deployment of decentralised energy solutions. In addition, gas infrastructures also plays an important role in integrating renewable and low-carbon gases.*

*In addition to the reduction of GHG emissions*, the goal is to ensure energy affordability, *energy savings*, security and stability of supply. *This can be* achieved through investments in *sector coupling and related* innovative network infrastructure *and* technologies, *increased flexibility of dispatchable power generation, notably from flexible renewable sources*, innovative system management, *as well as by facilitating actions fostering regulatory and social innovation, skills, and engaging and empowering market players, consumers and communities*. Energy storage in different forms will play a key role in providing services to the grid, *and in* improving and reinforcing network capacities. Exploiting synergies between different networks (e.g. electricity grids, heating and cooling networks, gas networks & *storage*, transport recharging and refuelling infrastructure, hydrogen *infrastructure*, and telecom networks) and actors (e.g. industrial sites, *network operators*, data centres, self-producers *and consumers, renewable energy communities*), *as well as increasing demand-response and developing and integrating European and international standards*, will be crucial *to enable* the smart, integrated operation of the relevant infrastructures.

#### *Broad Lines*

- Technologies and tools for *existing* networks to integrate renewables and new loads such as electro-mobility, *electrolysers, fuel cells*, heat pumps, *industrial hydrolysis, electricity storage and decentralized renewable energy, as key-elements for a cost-efficient, secure, highly energy efficient and renewables based energy system*;
- Pan-European energy network approaches to management;
- *Demonstration of stable and reliable energy systems and grids on local and regional level, driven by variable and flexible renewable energy*
- Integrated approaches to *increase, improve and* match renewable energy production and consumption at local level including on islands, based on *new services and technologies (including peer-to-peer, distributed ledger technologies, virtual net metering arrangements)*, *as well as community initiatives (including active consumers and renewable energy self-consumers, acting individually or jointly, renewable energy communities and local energy communities)*;
- *Systemic impact analysis of new energy technologies, like flexible renewable generation, renewable based hydrogen and synthetic gas for energy storage; research and integrated approaches to convert natural gas grids into green hydrogen grids or grids transporting bio-methane or synthetic methane*;
- Network *and generation* flexibility *and supply reliability, including demand-response*, and synergies between the different energy sources, networks, infrastructures (*including existing ones*) and actors; *sector-coupling technologies in order to facilitate storage and harness the transportation potential of energy*;
- *Clean solutions that can deliver on system reliability, complementing and going beyond renewables and electrification-based storage*;

#### 4.2.4 Buildings in Energy Transition

Buildings play an increasingly active role in their interaction with the energy system. Therefore, they are crucial elements in the transition *towards* renewable energy *sources and high energy efficiency*.

Buildings are an important factor for *the* quality of life of citizens. Integrating different technologies, appliances, systems *and standards* and linking various energy uses, buildings as well as their inhabitants and users represent a very high potential for *climate change mitigation*, energy generation, *energy savings and* storage and efficiency improvements.

##### *Broad Lines*

- Electricity and heat *exchanges* between *buildings*, industrial plant and an energy system operator;
- Tools and infrastructure for process control of production plants to optimise energy flows in interaction with the energy system;
- *optimisation and sustainability of* relevant processes, design and materials;
- Smart buildings and large mobility hubs (ports, airports, *railway stations and* logistic centres) as active elements of wider energy networks and of innovative mobility solutions;
- *New modalities, including smart tools and appliances, for* life-cycle design, construction (*including using light-weight and renewable materials*), operation and dismantling *of buildings*, taking into account circularity, environmental performance, *sustainability and economic efficiency* for energy and resource efficiency, climate resilience, *impact in terms of GHG emissions* and recycling;
- New business models, approaches and services for renovation financing, *such as prefinancing schemes with on-bill repayment*, enhancement of construction skills, engagement of buildings occupants and other market actors, *such as local authorities or renewable energy communities*;
- Energy performance of buildings monitoring and optimisation, *in line with the objectives laid out in the Energy Performance of Building Directive (Directive 2018/844)*, *including use of advanced building energy management systems*;
- Renovation processes of existing buildings towards 'Nearly Zero Energy Buildings' *and innovative technologies*;
- *Flexible energy production, demand-response, optimisation of energy storage.*

##### *4.2.4 a. Industrial facilities in the Energy Transition*

Industries, and especially those that are energy-intensive, should further improve energy efficiency and *reduce their energy* consumption, and favour the integration of renewable energy sources. *Industrial facilities' role in the energy system is changing, due to the need to reduce emissions, based on direct or indirect electrification, also a source of materials for production processes (e.g. hydrogen). Industrial and manufacturing complexes where*

*many different processes take place near to each other can optimise the exchange of flows of energy and other resources (raw materials) between them.*

#### **Broad lines**

- *Conversion technologies for the sustainable utilization of carbon sources to increase resource efficiency and reduce emissions, including hybrid energy systems for the industry and energy sector with a decarbonisation potential;*
- *Demonstration of direct and indirect electrification of energy intensive industrial processes;*
- *Tools and infrastructure for process control of production plants to optimise energy flows and materials in interaction with other production plants and the energy system;*
- *Flexibility and efficiency of electricity, feedstock and heat in industrial plants and the energy system;*
- *Improved or new processes, design and materials to efficiently use or produce heat, cold, energy storage;*
- *Improved material efficiency, which reduces the demand for energy intensive bulk materials.*

#### **4.2.4b Coal regions in transition**

*Nearly half of the Member States are challenged to prepare coherent strategies focusing on regions facing the challenges of phasing out lignite, coal and other fossil fuel-based energy generation. This priority will seek complementarities with other EU instruments and programmes.*

#### **Broad lines**

- *Support the development of inclusive and just transitions strategies; addressing societal, socio-economic and environmental impacts along with reconversion of sites;*
- *Technologies and models to unlocking the potential of these regions; including how to best attract alternative innovative business;*
- *Research on how to revitalise these regions in terms of sustainable employment and growth perspectives, including research on reskilling of workers;*

#### **4.2.5 Communities and Cities**

It is estimated that by 2050, more than 80% of the EU's population will live in urban areas, consuming the lion's share of available resources, including energy, and being areas particularly vulnerable to the adverse meteorological change impacts worsen by climate change and natural disasters already now and increasingly in the future. A key challenge is to significantly increase the overall energy and resource efficiency as well as climate-resilience of Europe's **communities and** cities in a holistic fashion, targeting the building stock, energy systems, **transport and** mobility, climate change **mitigation**, as well as water, soil, air

quality, waste and noise. Synergies with ERDF - funded urban policy and actions should be investigated and exploited.

*Broad Lines*

- City/district/**rural** energy/mobility systems towards the **Union**-wide deployment of low-carbon, Positive Energy Districts and zero-emission mobility and logistics by 2050, boosting the global competitiveness of integrated EU solutions;
- Urban **and rural** planning, infrastructures and systems including mutual interfaces and interoperability, **standardisation**, nature-based solutions, and the use of **secure** digital technologies and space based services and data, taking into account the effects of projected climate change and integrate climate **change mitigation**;
- Quality of life for the citizens, safe **and multi-modal** mobility **including walking and cycling**, urban **and rural** social innovation, cities' circular and regenerative capacity, reduced environmental **impact** and pollution;
- Global cities research agenda.

#### 4.2.6 Industrial Competitiveness in Transport

The shift towards clean technologies, connectivity and automation will depend on the timely design and manufacture of aircraft, vehicles and vessels integrating different technologies and accelerating their introduction. Increasing comfort, efficiency, affordability, while minimising lifecycle impact **on the climate**, on the environment, human health and on energy use remain objectives of paramount importance. Innovative, highly capable transport infrastructure is essential for the proper functioning of all transport modes in view of increased mobility demand and rapidly changing technology regimes. An integrated approach to infrastructure and vehicle/vessel/aircraft development deserves particular attention also in order to minimise energy and environmental impact.

*Broad Lines*

- Merging of physical and digital vehicle/vessel/aircraft design, manufacturing, operations, standardisation, certification and regulations and integration (including integration between digital design and digital manufacturing);
- Vehicle/vessel/aircraft concepts and designs, including their spare parts, **module elements**, using improved **advanced** materials and structures, **software solutions and updates**, **advanced security systems against piracy**, efficiency, energy storage and recovery, safety and security features with **minimised** environment and health impact.
- On-board technologies and sub-systems, including automated functions, for all modes of transport taking account of relevant infrastructure interface needs and exploring; technological synergies between modes; avoidance systems and enhancing cybersecurity; developing the human-machine interface;

- New materials techniques and methods of construction, operations and maintenance of infrastructures, ensuring reliable network availability and full life-cycle approach;
- Infrastructure maintenance, regeneration and upgrading transport integration, interoperability and intermodality.

#### 4.2.7 Clean Transport and Mobility

Reaching air quality, climate, and energy goals, as well as noise reduction, will require the Union to rethink the whole mobility system including users, vehicles, fuels, ***CO2 measure schemes***, infrastructures, ***space use, as well as new transport solutions***. The Union will also require the deployment of low-emission alternative energies and market uptake of zero-emission vehicles/vessels/aircrafts. In addition to the harmful effects of greenhouse gas emissions, transport contributes significantly to poor air quality and noise in Europe, with negative consequences for the health of citizens<sup>8</sup>. Building on existing progress with ***the production and use of alternative fuels***, electrification, ***hydrogen technologies, biofuels and biogas***, the use of fuel cells, ***the improvement of combustion engines and their adaptation to renewable fuels and other sustainable technologies*** for cars, buses, ***trucks*** and light duty vehicles, it is essential to accelerate research and innovation solutions for other sectors such as aviation, ***the rail sector***, maritime and inland navigation.

##### *Broad Lines*

- ***Decarbonisation*** of all transport modes, including through ***electro mobility*** (e.g. ***recyclable*** batteries, fuel cells, ***all types of*** hybridisation, etc.) ***and*** new technologies for vehicle/vessel/aircraft powertrains, fast charging/refuelling, energy harvesting and user-friendly and accessible interfaces with the ***re-fuelling and*** charging infrastructure, ensuring interoperability and *a* seamless services provision; development and deployment of competitive, safe, high-performing, ***recyclable*** and sustainable batteries for low and zero-emission vehicles;
- Sustainable new fuels and and new smart vehicles/vessels/aircraft for existing and future mobility patterns and supporting infrastructure; technologies and user-based solutions for interoperability and seamless services provision; ***quieter and more environmentally friendly aircraft***;
- ***Minimising*** the impact of mobility on the environment and human health, ***including by exploring the potential of a new generation of remote sensors to measure pollution in the mobility sector***.

#### 4.2.8 Smart Mobility

Smart mobility will help ensure the efficiency, safety and resilience of door-to-door mobility and all its components, in particular by using ***new*** digital technologies, advanced satellite navigation (EGNOS/Galileo), and artificial intelligence. New technologies, ***including system***

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<sup>8</sup> Around one-third of EU citizens live in urban areas with concentration levels of pollutants above legal thresholds

*of systems*, will help to optimise the use and efficiency of transport infrastructure and networks, improving multi-modality and connectivity, optimising, traffic management, enable innovative transport solutions, **standards** and services, thus reducing congestion and negative environmental impacts, providing better mobility and logistics services for citizens and businesses. Connected and automated mobility together with the enabling infrastructure will improve efficiency and safety in all transport modes..

*Broad Lines*

- Digital network, traffic, **space use** and management: advanced decision support systems; next generation traffic management (including multi-modal network and traffic management); contributing to seamless, multimodal and interconnected mobility for passengers and freight; use and limitations of big data; use of innovative satellite positioning/navigation (EGNOS/Galileo) **understanding new behaviour related to changing mobility**;
- Single European Sky: solutions for higher degrees of automation, connectivity, safety, interoperability, performance, emission reduction and service;
- Rail technologies and operations for a high-capacity, **attractive**, silent, **fully connected**, interoperable, **cross-border** and automated railway system **for passenger as well as freight transport requirements**;
- Connected, cooperative **interoperable** and automated mobility systems and services, including technological solutions and non-technological issues **such as changes in user behaviour and mobility patterns**;
- **New or improved services and business models through which the user interacts with the different smart modalities**;
- **Concept, development, consequences, design, research, validation and methods as part of safe automated vehicle driving in mixed traffic**;
- **Smart shipping solutions for safer, more efficient waterborne operations**;
- **New systems and technologies for port management and connection.**

#### 4.2.9 Energy Storage

Massive, concentrated and decentralised storage solutions (comprising chemical, electrochemical, electrical, mechanical and thermal) for the energy system will increase efficiency, flexibility, technology independence and accessibility as well as the security of supply. Low-emission, decarbonised transport will require a growing share of electrical and/or other alternatively fuelled vehicles, with better-performing and cheaper, **highly** recyclable and reusable batteries **with a low environmental impact**, as well as the local provision of fuels such as **low-carbon or renewables based** hydrogen and innovative solutions for on-site storage.

*Broad Lines*

- Technologies including liquid and gaseous **low carbon** fuels and their associated value chains, for daily to seasonal energy storage needs, **including their impacts on the environment and climate**;

- Batteries and the EU value chain, including design, large-scale battery cell production technologies, ***high power and high energy density, fast charging rates, low environmental impact, reuse and high recyclability, advanced materials solutions for energy storage methods as well as standardisation needs;***
- ***Renewables based, electrolyzes, fuel cells, across the EU value chain from design to end use across various applications.***

<b>CA 20 - CLUSTER 'FOOD, NATURAL RESOURCES AND AGRICULTURE'</b>
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## **5. CLUSTER 'FOOD, NATURAL RESOURCES AND AGRICULTURE'**

### **5.1. Rationale**

Human activities are exerting increasing pressure on soils, seas and oceans, water, air, biodiversity and other natural resources. Nourishing the planet's growing population is directly dependent on the health of natural systems and resources. However, combined with climate change, humanity's growing demand for natural resources creates environmental pressures that go far beyond sustainable levels, affecting ecosystems and their capacity to provide services ***maintaining human well-being in the long term. Growth in food production is not matching growth in the global population and therefore we require breakthroughs in intensification of sustainable food production. At the same time, we must ensure that nutrition and health are central to our food production systems.***

The concepts of the circular economy, ***agroecology, sustainable agriculture***, bioeconomy and the blue economy provide an opportunity to balance environmental, social and economic goals and to set human activities on a path to sustainability.

Meeting the goals of sustainable development, ***and greenhouse gas (GHG) emission reduction***, guaranteeing the production and consumption of safe and healthy food, promoting sustainable practices in agriculture, ***livestock***, aquaculture, fisheries and forestry, ensuring access to clean water, soil and air for all, cleaning up the seas, oceans ***and inland waters***, preserving and restoring the planet's vital natural systems and environment requires that we harness the potential of research and innovation. But the pathways for the transition to sustainability and ways to ***overcome resilient*** barriers are hardly understood. Making the transition to sustainable ***production***, consumption and restoring ***ecosystems and natural resources, as well strengthening and nourishing the resource base upon which agriculture depends*** require ***investment in scientific and technological research, standardisation*** and new business models ***that support*** social and environmental innovation, ***including internalizing costs to the environment in our economies, gathering more and better quality data on the impact of different policies.*** This creates new opportunities for a sustainable, resilient, innovative and responsible European economy, boosting resource efficiency, ***the capacity and status of natural resources, long-term*** productivity and competitiveness, ***rural viability, as well as high-quality jobs and sustainable economic and social growth.***



***Multi- and trans-disciplinary approaches utilising the expertise and experience of actors along value chains will help*** build a knowledge base and deliver solutions to: ***protect***, sustainably manage and use natural resources from land ***and water***; enhance the ***sustainable growth*** of terrestrial and aquatic systems; ***increase carbon sequestration***; ensure ***sufficient*** food and nutrition security, ***avoid waste and overproduction and*** provide safe, healthy and nutritious diets; accelerate the transition ***towards sustainable approaches in all forms of agriculture, including conventional and organic agriculture***; ***accelerate the transition*** from a fossil-based linear economy to a resource efficient, resilient, low emission, low-carbon circular economy, and supporting the development of a sustainable bio-based economy and the blue economy; and develop resilient and vibrant rural, coastal and urban areas.

***Furthermore, meeting these goals*** will help to maintain and enhance the provision of biodiversity, ***both wild and cultivated***, and ***to*** secure the long-term provision of ecosystem services, climate ***change mitigation and*** adaptation and carbon sequestration (both on land and ***water***). They will help ***maintain biodiversity and secure the long-term provision of ecosystem services as well as*** reduce GHG and other emissions, waste and pollution from primary production (both terrestrial and aquatic), processing, consumption and other human activities. They will trigger investments, supporting the shift towards a circular economy, ***sustainable agriculture***, bioeconomy and blue economy, whilst protecting environmental health, ***sustainability*** and integrity. ***This priority will also aim to improving the knowledge base on the state of biodiversity by developing, validating and standardising comparable Union-wide methodologies.***

They will also foster participatory approaches to research and innovation, including the multi-actor approach and develop knowledge and innovation systems at local, regional, national and European levels. ***Including all actors along the agri-food supply chain in the co-creation and sharing of knowledge would support the development and implementation of sustainable agriculture innovations that address food system challenges, including adaptation to climate change and mitigation.*** Social innovation with citizens' engagement and trust in innovation will be crucial to encourage new governance, production and consumption patterns.

As these challenges are complex, interlinked and global in nature, activities will ***also*** follow a systemic approach, cooperating with Member States and international partners, with other funding sources and with other policy initiatives. This will involve user-driven exploitation of environmental big data sources, such as those from Copernicus, EGNOS/Galileo, INSPIRE, EOSC, GEOSS, CEOS, EMODnet.

Research and innovation activities under this Cluster contribute in particular to the implementation of the goals of: the Environmental Action Programme, the Common Agricultural Policy, the Common Fisheries policy, the Food Law legislation, the Maritime policy, the Circular Economy Action Plan, the EU Bioeconomy Strategy, ***the EU 2020 Biodiversity Strategy, the EU Green Infrastructure strategy, the EU Forest Strategy***, the ***EU's climate and energy framework in consistency with the Paris Agreement***, as well as EU legal provisions to reduce air pollution. ***Actions will be strongly linked to existing Union partnerships, in particular PRIMA, also in view of contributing to science diplomacy.***

Activities will contribute directly to the Sustainable Development Goals (SDGs) in particular: SDG 2 – Zero Hunger; **SDG 3 – Good Health and Wellbeing**; **SDG 6 – Clean Water and Sanitation**; SDG 11 – Sustainable Cities and Communities; SDG 12 – Responsible Consumption and Production; SDG 13 – Climate Action; SDG 14 – Life Below Water; SDG 15 – Life on Land.

## 5.2. Areas of intervention

### 5.2.1 Environmental Observation

The capacity to observe the environment underpins research and innovation<sup>9</sup> for the sustainable use and monitoring of food and natural resources. Improved spatio-temporal coverage and sampling intervals at reduced cost, as well as big data access and integration from multiple sources provide new ways to monitor, understand and predict the Earth system. There is a need for a wider deployment, exploitation and update of new technologies and continued research and innovation to address gaps in Earth Observation (EO) on land and **water** and in the atmosphere, collaborating in particular through the Global Earth Observation System of Systems (GEOSS) and its European component EuroGEOSS.

#### *Broad Lines*

- User driven and systemic approaches including open data, to environmental data and information for complex modelling and predictive systems;
- Extension of the Copernicus product and service portfolio;
- Biodiversity status, **assessment of ecosystem services and their value**, ecosystem protection, climate **change** mitigation, **the adaptation of species and ecosystems**, food security, agriculture, **soil fertility** and forestry, land use and land use change, **rural**, urban and peri-urban development, natural **protection, restoration and** resources management, ocean, **sea and inland water conservation and exploitation**, maritime security, and other relevant domains;
- User oriented applications including their scaling up, to contribute to the **preservation, restoration and** management of European natural resources and ecosystems services and their related value chain.
- **Comprehensive and sustainable global environmental observation and information system, including through fostering cooperation between climate modelling communities and environmental observation and data management communities.**
- **Effects of invasive alien species on biodiversity, ecosystem services and productivity, including new tools to prevent and combat them;**
- **Improved integrated forecasting, assessment of risks and vulnerability to disasters linked to natural and man-made disturbances, including developing early warning systems;**

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<sup>9</sup> Earth Observation will support research and innovation under other intervention areas within this Global Challenge as well as other relevant parts of Horizon Europe.

- *Ecological and socio-cultural coherence of territorial models, with particular attention to the interaction of nature and society resulting from territorial policy and strategies;*

### 5.2.2. Biodiversity and Natural Capital

Improved understanding of biodiversity and ecosystems, the multiple services they provide and planetary 'boundaries' as well as solutions harnessing nature's power and complexity is needed to address societal challenges, to enhance sustainability and to attain the EU objective of 'Living well within the limits of our planet' by 2050 as laid down in the 7<sup>th</sup> EU Environmental Action Programme. Due account must be taken throughout whole value chains of potential upstream impacts. International cooperation and contribution to international efforts and initiatives, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, are essential to achieve the objectives in this area. There is a need to better understand the governance of the transition to sustainability in the economic, social and natural system, from the local to the global level.

#### *Broad Lines*

- The state and value of **global and local biodiversity**, terrestrial and marine **and aquatic** ecosystems, natural capital and ecosystem services; **analysis on the causes and potential solutions for decline in biodiversity.**
- Holistic and systemic approaches within a socio-ecological framework for the links between biodiversity, ecosystems and ecosystem services and their causality relationships with drivers of change, across different scales and economic activities, including the governance of transition processes to sustainability;
- Modelling of trends and integrated scenarios for biodiversity, ecosystem services and good quality of life at different scales and horizons; the potential contribution of biotopes and ecosystems as carbon sinks under various climate change scenarios;
- Ecotoxicology of compounds and new pollutants, **chemical substances and** their interactions and environmental behaviour, and altered biochemical loops under changing climate;
- Mainstreaming biodiversity and ecosystem services in decision-making frameworks and accounting systems of governments and businesses, as well as quantification of their benefits;
- Adaptable and multi-functional nature-based solutions, addressing challenges in cities, rural and coastal areas related to climate change, natural disasters, biodiversity loss, ecosystem degradation, pollution, and citizens' health and well-being;
- Multi-actor living labs approaches engaging authorities, stakeholders, business and civil society in co-designing and co-creating systemic solutions for the preservation, restoration and sustainable use of natural capital the governance of the transition to sustainability and sustainable management options in economic activities throughout whole value loops.

### 5.2.3 Agriculture, Forestry and Rural Areas

Resilient and sustainable farming and forestry systems provide economic, environmental and social benefits in a changing context for primary production. In addition to contributing to food and nutrition security, they feed into dynamic value chains, manage land and natural resources as well as deliver a range of vital public goods including carbon sequestration, biodiversity preservation, pollination, *as well as* public health *and wellbeing*. Integrated approaches are needed to promote the multiple functions of agro- and forest (eco)systems taking into account the changing context for primary production, notably in relation to climate and environment, resource availability, demography and consumption patterns. It is also necessary to address the impact and spatial and socio-economic dimension of agriculture and forestry activities and mobilise the potential of rural areas.

#### *Broad Lines*

- *Improving monitoring and indicators of biodiversity, ecosystem functions and services in rural areas and agroecological systems, and supporting public participation in co-learning and improving the status of farming ecosystems;*
- Methods, technologies and *innovative* tools for sustainable and resilient production in farming, *including terrestrial and marine*, and forestry, *and for the most efficient use of water resources;*
- Sustainable management and efficient use of natural resources (e.g. soils, water, nutrients and biodiversity including genetic resources) in agriculture and forestry; alternatives to fossil-based resources and adoption of circular economy principles;
- Climate and environmental impact of activities in the primary sector *and along the value chain; the* potential of agriculture and forestry *in increasing substitution and carbon storage, for example through sustainable biomass production* and for mitigation of greenhouse gas emissions including negative emissions approaches;
- Plant pests and diseases and animal health and welfare; alternatives to the use of contentious chemical pesticides, antibiotics and other substances, taking into account biodiversity conservation and high biodiversity agro-ecosystem approaches;
- *Open data systems which foster the sharing of plant, pathogen and environmental data and knowledge that enable further scientific research, environmental planning and development of commercial products;*
- Antimicrobial resistance and threats from biological and agrochemical hazards as well as chemical contaminants tackling the links between plant, animal, ecosystems and public health from One-Health and Global-Health perspectives;
- The use and delivery of ecosystems services in agriculture and forestry systems applying ecological approaches and testing nature-based solutions from farm to landscape levels for an environmentally friendly agriculture *addressing challenges related to climate change, biodiversity loss, ecosystem degradation, agricultural pollution, and citizens' health and well-being*;

- ***Innovative*** agricultural and forestry systems from farm to landscape levels; the use and delivery of ecosystem services in primary production;
- Innovations in farming at the interfaces between agriculture, aquaculture and forestry and in urban ***and rural*** areas;
- Land use, rural development and territorial linkages; capitalising on the social, cultural, economic and environmental assets of rural areas for new services, business models, value chains and public goods;
- Digital innovations in farming ***and*** forestry, ***including precision farming and forestry techniques***, across value chains and rural areas through the use of data and development of infrastructures, ***AI, machine learning algorithms, robotics*** technologies and governance models ***including the development of demonstration farms***;
- Agricultural knowledge and innovation systems and their interconnection at various scales; advice, building skills and information sharing.
- ***Transition towards integrated and diversified food and farming systems and agronomic practices, including the use of precision technologies, agroecological and ecological intensification approaches to benefit all types of agriculture;***
- ***New plant breeding strategies aimed at sustainable higher yield, improved quality and added economic and environmental benefits;***
- ***Development of products, tools and practices, to support sustainable agricultural practices, including improving knowledge on the impact of different agricultural practices on soil quality and regeneration;***

#### 5.2.4 Seas, Oceans, Inland Waters and the Blue Economy

***The rich biodiversity of seas, oceans and inland waters offers*** significant socio-economic and welfare benefits. This potential is at risk because of the severe pressure from human and natural stressors such as pollution, overfishing, climate change, sea-level rise, ***unsustainable water use*** and extreme weather events. To prevent seas, oceans and ***and inland waters*** from reaching a point of no return, it is necessary to strengthen our knowledge and understanding in order to sustainably manage, protect and restore marine and coastal ecosystems, prevent marine pollution, in a context of an improved and responsible ocean governance framework. This will also include research to sustainably unlock the vast and unexploited economic potential of seas, oceans ***and inland waters***, aiming at producing more food without increasing pressure and also alleviate pressure on land ***and water*** resources. There is a need for partnering approaches, including sea basin and macro-regional strategies, extending beyond the EU (e.g. in the Mediterranean, the Baltic, the Black Sea, the Atlantic, the Caribbean Sea and in the Indian Ocean); and for contributing to International Ocean Governance commitments, ***the Sustainable Development Goals***, initiatives like the United Nations Decade of Ocean Science for Sustainable Development and commitments linked to the conservation of marine biological diversity in areas beyond national jurisdiction.

*Broad Lines*

- Sustainable fisheries and ***responsible aquaculture*** for food, including alternative sources of protein with increased food security, food sovereignty and climate resilience;
- ***Developing new bio products based on marine organisms, with a wide range of applications opening new products and services opportunities.***
- Strengthened resilience of marine ecosystems thereby ensuring the health of seas, ocean ***and inland waters***, ***preventing***, combating and mitigating the effects of natural and human pressures like pollution, ***chemicals*** and plastics, ***including micropastics, overfishing***, eutrophication, acidification, warming, ***invasive species***, sea level rise, considering the intersection between land, ***aquatic environment*** and fostering a circular approach;
- Ocean governance at global and regional levels to ensure conservation, and sustainable use of the seas, oceans ***and inland waters*** resources and ***its natural capital***;
- Technologies for the digital ocean (seafloor, water column and water surface) connecting services and communities in land-based, climate, space and weather related activities, and promoted through the Blue Cloud as part of the European Open Science Cloud;
- Monitoring and predictive/forecasting capacities including sea-level rise and other natural hazards e.g. storms surges, tsunamis;
- Blue value-chains, the multiple-use of space and growth of the renewable energy sector from seas, oceans ***and inland waters***, including sustainable ***production of*** micro- and macro- algae; ***modern aquatic production systems on land supporting an environmentally-neutral biomass production***;
- Nature-based solutions based on ***aquatic*** and coastal ecosystem dynamics, biodiversity and multiple ecosystem services, which will enable systemic approaches to sustainably use the resources of seas, oceans and ***inland water***, contribute to environmental (***including coastal***) protection, ***restoration and*** management, and adaptation to climate change;
- Blue innovation including in the blue and digital economies, across coastline areas, coastal cities and ports, in order to strengthen resilience of coastal areas and increase citizens' ***and visitor*** benefits.
- Better understanding of the role of oceans ***and other aquatic environments*** for climate change mitigation and adaptation.

### 5.2.5. Food Systems

The combined effects of population growth, resource scarcity and overexploitation, environmental degradation, climate change and migration create unprecedented challenges which require food system transformation (FOOD 2030).<sup>10</sup> Current food production and consumption are largely unsustainable while we are confronted with the double burden of malnutrition, characterised by the coexistence of undernutrition and obesity. Future food systems need to deliver sufficient safe, healthy and quality food for all, underpinned by resource efficiency, sustainability (including the

<sup>10</sup>

SWD(2016) 319 final: European Research and Innovation for Food and Nutrition Security

reduction of GHG emissions, pollution and waste production), linking land and ***aquatic environments***, reducing food waste, enhancing food production and encompassing the entire 'food value chain' from producers to consumers – and back again. This needs to go hand in hand with development of the food safety system of the future and the design, development and delivery of tools, technologies and digital solutions that provide significant benefits for consumers and improve the competitiveness, ***efficiency*** and sustainability of the food value chain. Furthermore, there is a need to foster behavioural changes in food consumption and production patterns, ***for example via food labelling***, as well as to ***better engage all actors, including consumers***, primary producers, industry (including SMEs), retailers, food service sectors, consumers, and public services.

#### *Broad Lines*

- Sustainable and healthy diets for people's well-being across their lifespan; ***ensuring that food production and processing systems are designed from the ground up with nutritional needs in mind;***
- ***The use of new genomic and metabolomics technologies to recognise and meet the different nutritional needs of our global population;***
- ***New nutrition approaches*** especially for vulnerable groups, to mitigate the risk factors for diet-related and non-communicable diseases, ***including food intolerance;***
- Consumers' behaviour, lifestyle and motivations, ***analyzed from a multi-disciplinary perspective (psychological and cultural)***, promoting social innovation and societal engagement for better health and environmental sustainability, throughout the entire food value chain;
- Modern food safety, ***traceability*** and authenticity systems, enhancing consumer confidence in the food system;
- ***Identification of protein sources and further development of protein plants and their processing for use as food and feed;***
- Food system mitigation of and adaptation to climate change, including the exploration of the potential and use of the microbiome, forgotten crops, alternative proteins;
- Environmentally sustainable, circular and resource efficient food systems from land and ***aquatic environments***, towards zero food waste throughout the entire food system, through reuse of food and biomass, recycling of food waste, new food packaging, demand for tailored and local food;
- Innovation and food systems for place-based innovation and empowerment of communities, fostering fair trade and pricing, inclusiveness and sustainability through partnerships between ***industries***, local authorities, researchers and society.
- ***The development of the circular bioeconomy, maximising food production and processing cycles to optimise the value of our resources and minimise environmental impact;***

### 5.2.6. Bio-based Innovation Systems

Bio-based innovation lays the foundations for the transition away from a fossil-based economy by encompassing the sustainable sourcing, industrial processing and conversion of biomass from land and **water** into bio-based materials and products. It also capitalises on the potential of living resources, life sciences and industrial biotechnology **as well as ongoing standardisation work** for new discoveries, products and processes. Bio-based innovation, including technologies, can bring new economic activities and employment to regions and cities, contribute to revitalising rural and coastal economies and strengthen the circularity of the bioeconomy, **thus supporting the transition towards a low-carbon resource efficient society**.

***Bio-based innovation systems require collaboration across the sectors and the value chain. Potential and impact of the various sources of biomass should be carefully assessed.***

#### *Broad Lines*

- Sustainable **and equitable** biomass sourcing and production systems, focusing on high-value applications and uses, social, **economic** and environmental sustainability, impact on climate and biodiversity reduction targets and overall resource efficiency;
- Life sciences and their convergence with digital technologies for prospecting, understanding and sustainably use biological resources;
- Bio-based value chains, materials, including bio-inspired materials, products and processes with novel qualities, functionalities and improved sustainability (including reducing greenhouse gases emissions), fostering the development of advanced biorefineries using a wider range of biomass **and further developing existing and new biogenic fuels; better use of bio-based waste and sidestreams**;
- Biotechnology, including cross sectoral cutting-edge biotechnology, for application in competitive, sustainable and novel **agricultural**, industrial processes, environmental services and consumer products<sup>11</sup>;
- Circularity of the bio-based economy through technological, systemic, social and business model innovation to increase the value generated per unit of biological resources, keeping the value of such resources in the economy for longer and supporting the **transition towards sustainable materials and the** principle of the cascading use of sustainable biomass through research and innovation;
- **Bio-based value chains including new innovative material, material combinations and other innovative concepts and products**;
- Inclusive bioeconomy patterns with different actors participating in the creation of value, maximising societal impact.
- Increased understanding of the boundaries of the bio-based economy and its synergies and trade-offs with a healthy environment.

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<sup>11</sup> Health biotechnology applications will be addressed by the Health cluster under this pillar.



### 5.2.7 Circular Systems

Circular production and consumption systems will provide benefits to the European economy **and society** by reducing resource dependency and increasing the competitiveness of enterprises, and to European citizens by creating new job opportunities and reducing pressures on the environment and climate. Beyond industrial transformation, the transition to a low-emission, resource efficient and circular economy will also need a broader system shift that requires systemic eco-innovative solutions, new business models, markets and investments, **revision or development of new standards** enabling infrastructure, social innovation changes in consumer behaviour, and governance models stimulating multi-stakeholder collaboration to ensure that the intended system change achieves better economic, environmental and social outcomes<sup>12</sup>. **Where appropriate**, opening for international cooperation **can** be important for comparability, generating and sharing knowledge and avoiding duplication of efforts, e.g. through international initiatives such as the International Resource Panel.

#### *Broad Lines*

- Systemic transition to a resource-efficient and circular economy, with new paradigms in consumer interaction, new business models for resource **and energy** efficiency and environmental performance; products and services stimulating resource efficiency during the whole lifecycle; systems for sharing, reuse, repair, remanufacturing, recycling and composting;
- Metrics and indicators for measuring the circular economy and life cycle performance; governance systems which accelerate expansion of the circular economy and resource efficiency while creating markets for secondary materials; multi-stakeholder and cross-value chain collaboration; instruments for investment in the circular economy;
- Solutions for sustainable and regenerative development of cities, peri-urban **and rural** areas and regions, integrating the circular economy transformation with nature-based solutions, technological, digital, social, cultural and territorial governance innovations;
- ***Adaptation to a fully circular approach involving innovative waste management and treatment solutions that allows for the recovery of resources and nutrients as well as food waste management in urban areas;***
- Eco-innovation for prevention and remediation of environmental pollution from hazardous substances and chemicals of emerging concern; looking also at the interface between **ecosystems**, chemicals, products and waste;
- Circular use of water resources including reduction of water demand, prevention of losses, water reuse, recycling and valorisation of wastewater and governance models for smart water allocation, addressing sources of pollution and tackling other pressures on water resources.
- Increased understanding of the drivers and barriers for an up-take of bio-based products through research on circular economy marking, labelling, application

<sup>12</sup> The activities in Circular Systems Area of Intervention are complementary to those of Low-Carbon and Clean Industry in the Digital and Industry cluster.

of standards, certification schemes, public procurement and regulatory activities, including from a global competition perspective.

<b>CA 21 - JRC</b>
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## **6. NON-NUCLEAR DIRECT ACTIONS OF THE JOINT RESEARCH CENTRE**

### **6.1. *Rationale***

High-quality and trusted scientific evidence is essential for good public policies. New initiatives and proposals for EU legislation need transparent, comprehensive and balanced evidence, whereas implementation of policies needs evidence ***and transparency*** to measure and monitor their impact and progress.

The JRC adds value to EU policies because its science is excellent, multi-disciplinary and independent of national, private and other external interests. Serving all areas of EU policy, it provides the cross-sectoral support that policymakers need to tackle increasingly complex societal challenges. The JRC's independence from special interests combined with its scientific-technical reference role enable it to facilitate consensus building between stakeholders and policy makers and to help diffusing sensitive situations. With its capacity to respond rapidly to policy needs, the JRC's activities are complementary with indirect actions aiming at supporting longer term policy objectives.

The JRC performs its own research and is a strategic manager of knowledge, information, data and competences to deliver high quality and relevant evidence for smarter policies. To achieve this, the JRC works together with the best organisations world-wide, and with international, national and regional stakeholders. Its research contributes to the general objectives and priorities of Horizon Europe and is focussed on European policy priorities, supporting a Europe that is safe and secure, prosperous and sustainable, social and stronger on the global scene.

### **6.2. *Areas of intervention***

#### **6.2.1. *Strengthening the knowledge base for policy making***

Knowledge and data are growing exponentially. If policy makers are to make sense and use of this they must be reviewed and filtered. There is also a need for cross-cutting scientific methods and analytical tools for use by all Commission services, especially to anticipate ***and/or to timely react to*** upcoming societal challenges and support better regulation. This includes innovative processes to engage stakeholders and citizens in policy-making issues.

#### *Broad Lines*

–Modelling, micro-economic evaluation, risk assessment methodologies, quality assurance tools for measurements, design of monitoring

schemes, indicators and scoreboards, sensitivity analysis and auditing, lifecycle assessment, data and text mining, (big) data analytics and applications, design thinking, horizon scanning, anticipation and foresight studies, behavioural research, and stakeholders and citizen engagement;

- Knowledge and competence centres;
- Communities of practice and knowledge sharing platforms;
- FAIR** data management, data sharing and coherence.

### 6.2.2. *Global Challenges and European competitiveness*

The JRC will contribute to the specific EU policies and commitments addressed by the *six* Global Challenges clusters, notably the EU's commitment to the Sustainable Development Goals.

#### *Broad Lines*

##### **1. Health**

- Scientific and technical policy support for improved public health and health care systems, including medical devices and health technology assessments, databases, digitisation;
- Safety assessment methods for potential health and environmental risks posed by chemical substances and pollutants;
- EU Reference Laboratory for Alternatives to Animal Testing;
- Quality assurance tools such as certified reference materials for health biomarkers;
- Research on newly emerging health issues and health threats.

##### **2. Inclusive and creative society**

- Research on inequality, poverty and exclusion, social mobility, cultural diversity, and skills; assessment of social, demographic, **geographic** and technological transformations on the economy and on society;
- **Research on the economic and social contribution of the cultural and creative sectors, including the development of statistics and** support to the preservation of **tangible and intangible** cultural heritage;
- Knowledge centre for migration and demography;
- Research on the social impact of scientific and technological changes on Member States and regions, including citizens.**

##### **2.a. Secure society**

- Knowledge centre for disaster risk management;

- Support to security policies in the areas of protection of critical infrastructures and public spaces, CBRN-E (Chemical, Biological, Radiological, Nuclear, and Explosive materials) and hybrid threats, border protection and document security, and information and intelligence for countering terrorism;
- Technologies for CBRN-E materials detection, biometric systems, and intelligence-gathering techniques;
- Support to the EU's security position in the world; assessment of competitiveness and innovation of the Union defence industry; exploitation of security-defence synergies;
- Research for reinforced Cybersecurity capabilities, cyber-resilience, and cyber-deterrence.

### **3. Digital, Industry and Space**

- Implications of digitisation, with a focus on new and emerging ICT technologies such as machine learning and artificial computing, distributed ledgers, Internet of Things, and High-Performance Computing;
- Digitisation in individual sectors, such as energy, transport, construction, health and government;
- Industrial metrology and quality assurance tools for smart manufacturing;– Research on nanotechnology and other Key Enabling Technologies;
- Research on best available techniques and environmental management practices, techno-economic analyses and life cycle assessment of industrial processes, waste management, water reuse, raw materials, critical raw materials and quality criteria for recovered materials, all supporting circular economy;
- Implementation of Copernicus actions;
- Technical and scientific support for applications of the EU Global Navigation Satellite System Programmes.

### **4. Climate, Energy and Mobility**

- Support to implementation of the EU climate, energy and transport policies, ***unlocking scenarios for the transition towards net-zero GHG emissions economy including low-carbon technologies and strategies for decarbonisation***; analysis of integrated national climate and energy plans; assessment of decarbonisation pathway in all sectors, including agriculture and Land Use Land Use Change and Forestry;
- Assessment ***of risks and potential solutions*** for vulnerable ecosystems and critical economic sectors and infrastructure, with focus on ***mitigation and*** adaptation strategies;

- Analysis of the R&I dimension of Energy Union; assessment of EU competitiveness in the global clean, *in particular renewables*, energy market;
- Assessment of deploying renewables and clean energy production technologies;
- Analysis of energy use *and climate change mitigation potential* of buildings, smart and sustainable cities, and industries;
- Technical and socio-economic analysis of energy storage, particularly sector coupling and batteries;
- Analysis of the EU's energy security of supply, including energy infrastructure, and energy markets;
- Support the transition towards *decarbonised energy systems, including highly efficient and renewable base systems*.
- Integrated analysis for deployment of Cooperative, Connected and Automated Mobility;
- Integrated analysis for development and deployment of the next generation of battery technologies;
- Harmonised test procedures and market surveillance for CO<sub>2</sub> and air pollutant emissions from vehicles, assessment of innovative technologies;
- Assessment of smart transport, traffic management systems and congestion indicators;
- Analyses of alternative fuels and related infrastructure needs.

## **5. Food, Natural Resources and Agriculture**

- Research on land, soil, forests, air, water, marine resources, raw materials and biodiversity to support the effective preservation, restoration and sustainable use of natural capital, including *equitable and* sustainable resources management in Africa ;
- Knowledge centre for global food nutrition security;
- Assessment of climate change and potential mitigation and adaptation measures for agricultural, fisheries *and forestry* policies, including food security;
- Monitoring and forecasting of agricultural *and forestry* resources in EU and neighbourhood countries;
- Research for sustainable and economically thriving aquaculture and fisheries, and for Blue Growth and the Blue Economy;
- Validated methods, laboratory proficiency tests and new analytical tools for implementing food safety;

- EU Reference Laboratories on Feed Additives, Genetically Modified Organisms and Food Contact Materials;
- Knowledge centre for food fraud and quality;
- Knowledge centre for bioeconomy.

#### 6.2.3. *Innovation, economic development, and competitiveness*

The JRC will contribute to innovation and technology transfer. It will support the functioning of the internal market and the economic governance of the Union. It will contribute to development and monitoring of policies targeting a more social and sustainable Europe. It will support the EU's external dimension and international goals and help in promoting good governance. A well-functioning internal market with a strong economic governance and fair social system will foster innovation, competitiveness, ***jobs creation, social inclusion and well-being***.

##### *Broad Lines*

- Analysis of innovation policies;
- Economic, financial and fiscal analysis;
- Pre-normative research and testing for harmonisation and standardisation;
- Production of certified reference materials;
- Market surveillances activities;
- Management of intellectual property rights;
- Promotion of technology transfer cooperation.

#### 6.2.4. *Scientific Excellence*

The JRC shall pursue excellence in research and extensive collaboration with top level research institutions worldwide. It will carry out research in emerging fields of science and technology and promote open science and open data as well as knowledge transfer.

##### *Broad Lines*

- Exploratory research programmes;
- Dedicated collaborative and exchange programmes with research institutions and scientists;
- Access to JRC research infrastructures;
- Training of scientists and national experts;
- Open science and open ***FAIR*** data.

#### 6.2.5. *Territorial development and support for Member States and Regions*

The JRC will contribute to regional and urban policies, with focus on innovation-led territorial development, and with a view to reducing disparities between regions. It will also offer technical assistance to Member States and third countries and support the implementation of European legislation and actions.

##### *Broad Lines*

- Implementation of regional and urban policies, smart specialisation strategies, strategies for economic transformation of regions in transition, integrated urban **and rural** development strategies and data;
- Capacity building of local and regional actors for implementation of macro-regional strategies;
- Knowledge centre for territorial policies;
- ‘On demand’ advice and tailored support to Member States, regions or cities, including through a virtual network of Science4Policy Platforms.

<b>CA 22 - PILLAR III</b>
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### **PILLAR III - INNOVATIVE EUROPE**

Open innovation is a vital paradigm for the EU to continue delivering prosperity to its citizens and meeting challenges of the future. Implementing it requires a systemic, cross-cutting and multifaceted approach. Europe's economic progress, social welfare and quality of life rely on its ability to boost productivity and growth, which, in turn, depends heavily on its ability to innovate. Innovation is also key to solving the major challenges that lie ahead for the EU.

Like its predecessors, innovation is at the heart of Horizon Europe. The quest for new ideas, products and processes is driving Horizon Europe objectives and implementing modalities, from strategic programming to calls, and is present from the onset to the end of any project supported, from 'blue-sky' research to industrial or technological roadmaps and missions.

Yet, innovation deserves specific measures, as the EU must decisively enhance the conditions and environment European innovation can thrive, so that ideas are quickly shared between actors in the innovation ecosystem, and new ideas and technologies swiftly transformed into the products and services needed for the EU to deliver.

Recent decades have seen the emergence of major and global new markets in entertainment, media, **communication**, health care, lodging and retail, based on breakthrough innovations in ICT, biotech, internet and the platform economy. These market-creating innovations, which

impact the EU economy as a whole, are deployed by fast growing and often new companies. But only a few originate ***and thrive*** in the EU.

A new global wave of breakthrough ***and disruptive*** innovation, ***including social and technological***, is coming up, one that will be based on more 'deep-tech' technologies such as block-chain, artificial intelligence, genomics and robotics, and other technologies, which may ***not only*** emerge ***from companies or research organisations, but also*** from individual innovators and communities of citizens. They have in common that they are taking shape at the intersection between different technologies, industry sectors and scientific disciplines, offering radically new combinations of products, processes, services, ***standards*** and business models, and have the potential to open up new markets worldwide. Additional sectors such as manufacturing, financial services, transport or energy will also be impacted.

Europe has to ride that wave. It is well positioned as the new wave comes in 'deep-tech' areas, such as artificial intelligence, quantum technologies, clean energy sources, where Europe has some competitive advantages regarding science and knowledge, and can build on close public-private cooperation (e.g. in health care or energy).

For Europe to lead that new wave of breakthrough innovation, the following underlying challenges need to be met:

- Improve the transformation of science into innovation in order to accelerate the transfer of ideas, technologies and talent from the research base into start-ups and industry;
- ***Increase the collaboration between all types of innovators, in particular between start-ups, SMEs and larger companies, improving their driving force and creating new ecosystems;***
- Speed up industrial transformation: European industry is lagging behind in embracing new technologies and scaling up: 77% of the young and big R&D companies are in US or Asia and only 16% are based in Europe;
- Increase risk finance to overcome financing gaps: Europe's innovators suffer from a low supply of risk finance. Venture capital is key to turning breakthrough innovations into world-leading companies but, in Europe, it is less than a quarter of the amounts raised in the US and in Asia. Europe must bridge the 'Valleys of death', whereby ideas and innovations fail to reach the market due to the gap between public support and private investment, in particular with regard to high-risk breakthrough innovations and long-term investments;
- Enhance and simplify the European landscape for funding and supporting research and innovation: the multitude of funding sources provides a complex landscape for innovators. EU intervention has to cooperate and coordinate with other initiatives at European, national and regional level, public and private, to better enhance and align supporting capacities, and provide for an easy-to-navigate landscape for any European innovator;
- Overcome fragmentation to the innovation ecosystem. While Europe is home to a growing number of hotspots, these are not well connected. Companies with international growth potential have to cope with fragmentation of national markets with their diverse languages, business cultures and regulations.

In order to cope with that new global wave of breakthrough innovation, EU support to breakthrough innovators requires an agile, simple, seamless and tailored approach. Policy to develop and deploy breakthrough innovations and scale-up companies has to be bold in taking



risks and must take into account the above-mentioned challenges and add value to related innovation activities implemented by individual Member State.

Horizon Europe's **Innovative Europe** pillar, in cooperation with other EU policies and in particular the InvestEU Programme, is designed to deliver such tangible results. It builds on lessons learned and on experience gained under the previous framework programmes, in particular from activities targeting future technologies and innovation (such as Future Emerging Technologies (FET) and Fast Track to Innovation (FTI)), SMEs (such as the SME Instrument), but also private and corporate finance (such as FP7 RSFF, Horizon 2020 InnovFin), all part of the 'EIC pilot' activities launched for the period 2018-2020.

Based on these experiences, this Pillar provides for the launch of the European Innovation Council (EIC), which will promote breakthrough **research and** innovation with rapid scale-up potential at global level and with dedicated types of actions and activities:

- Supporting the development of future and emerging breakthrough innovations, **including through targeted collaborative research**;

- **Promoting the spreading and uptake of innovation in industrial and other economic value chains**;

- Bridging financing gaps in the development, deployment and scaling up of market creating innovations;

- Increasing the impact and visibility of EU innovation support;

- **Creating synergies in other parts of the Programme.**

Whilst the EIC will directly support breakthrough innovations, the overall environment from which European innovations nurture and emerge must be further developed and enhanced: it must be a common European endeavour to support innovation all across Europe, and in all dimensions and forms, including through complementary EU and national policies, and resources whenever possible. Hence, this Pillar provides also for:

- Renewed and reinforced coordination and cooperation mechanisms with Member States and Associated Countries, but also with private initiatives, in order to support all types of European innovation ecosystems and their actors;

- **Enhanced** support to the European Institute of Innovation and Technology (EIT) and Knowledge and Innovation Communities (KICs).

Additionally, as a continued effort to enhance risk-finance capacities for research and innovation in Europe and where necessary, this pillar will link with the InvestEU programme. Building on the successes and the experiences gained under Horizon 2020 InnovFin, as well as under EFSI, the InvestEU Programme will enhance access to risk finance for bankable research organisations, innovators and entrepreneurs, in particular for SMEs and small midcaps, as well as for investors.

## **1. THE EUROPEAN INNOVATION COUNCIL (EIC)**

## 1.1. Areas of Intervention

The objective of the EIC is to identify, *develop* and deploy breakthrough and disruptive innovations (including *radically new* technologies) and support the rapid scale-up of innovative firms at EU and international levels along the pathway from ideas to market.

The EIC will be implemented primarily through two complementary types of action, namely the *EIC* Pathfinder for advanced research, for the early stages of *scientific and technological research and* development, and the *EIC* Accelerator for innovation and market deployment actions, including the pre-mass commercialisation stages and company growth. With the idea to offer a single one-stop shop and a single process of support, the *Accelerator* will award blended finance, combining grants with equity investments. It will in addition also channel access to loans *and guarantees* provided under the InvestEU programme. *At least 70% of the EIC's budget will be dedicated to start-ups and SMEs.*

These two complementary types of actions will share common characteristics. They will:

- Focus on breakthrough and disruptive innovations, including social, that have the potential to create new markets *or enable new solutions*, as well as *research on potential radically new technologies*;
- Be mainly bottom-up, open to *targeted* innovations *and research* from all fields of science, technology and applications in any sector, while also enabling targeted support for emerging breakthrough or disruptive technologies of potential strategic significance;
- Innovations *and research* that cut across different scientific, technological (e.g. combining physical and digital) fields and sectors will be encouraged;
- They will be centred on innovators and *researchers*, simplifying procedures and administrative requirements, making use of interviews to help assess applications, and ensuring fast decision making;
- They will support high-risk innovations where the risks, whether technological, market and/or regulatory, cannot be borne by the market alone or exclusively supported by financial instruments under InvestEU.
- They will be managed pro-actively with milestones to gauge progress and the possibility to reorient projects where needed.

As well as financial support, innovators will have access to EIC business advisory services providing to projects coaching, mentoring and technical assistance, and pairing innovators with peers, industrial partners and investors. Innovators will also have facilitated access to expertise, facilities (including *research infrastructures and* innovation hubs<sup>13</sup>) and partners from across EU supported activities (including those of the EIT, in particular through its KICs).

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<sup>13</sup> These are public or private facilities that offer access to latest knowledge and expertise on digital and related enabling technologies necessary for companies to become more competitive with regard to production, services and business processes

***In addition***, particular attention will be paid to ensuring proper and efficient complementarity with individual or networked Member States initiatives, including in the form of European Partnerships.

#### *1.1.1. The **EIC** Pathfinder for Advanced Research*

The Pathfinder's will provide grants to high-risk cutting-edge projects exploring new territories aiming to develop into potentially radical innovative technologies of the future and new market opportunities. It will build on the experience from the Future and Emerging

Technology (FET) schemes supported under FP7 and Horizon 2020, including the Horizon 2020 FET-Innovation Launchpad, as well as the Horizon 2020 SME Instrument Phase 1.

The Pathfinder overall objective will be to nurture potential market creating innovation out of breakthrough ***scientific and*** technological ideas, and bring them to demonstration stage or development of business cases or strategies for further take-up by the Accelerator or any other market deployment solution. To that end, the Pathfinder will initially support the earliest stages of scientific and technological research and development, including ***cutting-edge research***, proof of concept and prototypes for technology validation.

In order to be fully open to broad-sweeping explorations, opportunities of serendipity and unexpected ideas, concepts and discoveries, the Pathfinder will be mainly implemented through continuous, ***competitive and*** open calls for bottom-up proposals ***with cut off dates***. The *Pathfinder* will also provide for competitive challenges to develop key strategic objectives<sup>14</sup> calling for deep-tech and radical thinking. Regrouping of selected projects into thematic or objective driven portfolios will allow establishing critical mass of efforts and structuring new multidisciplinary research communities.

These portfolios of selected projects<sup>15</sup> will be further developed and enhanced, each along a vision developed with their innovators, but also shared with the research and innovation community at large. The Pathfinder's Transition activities will be implemented to help innovators develop the pathway to commercial development, such as demonstration activities and feasibility studies to assess potential business cases, and support the creation of spin offs and startups. These Pathfinder's Transition activities may also consist of complementary grants

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<sup>14</sup> These could include topics such as Artificial Intelligence, Quantum technologies, Biocontrol or Second generation digital twins, or any other topics identified in the context of the Horizon Europe Strategic programming (including with Member States' networked programmes).

<sup>15</sup> These may also include projects selected under Horizon 2020 programmes such as FET. These may also include other EU supported relevant activities and funded Seal of Excellence stemming from *Pathfinder* calls.

to top-up or enlarge the scope of previous and on-going actions, to bring in new partners, to enable collaboration within the portfolio and to develop its multidisciplinary community.

The Pathfinder will be open to all types of innovators, from individuals to universities, research **and technology** organisations and companies, in particular start-ups and SMEs, and from single beneficiaries to multi-disciplinary consortia. In the case of single beneficiary projects, larger companies will not be permitted. ***In order to ensure synergies and avoid duplication, the Pathfinder will be implemented in close coordination with other parts of Horizon Europe, in particular with the European Research Council (ERC), the Marie Skłodowska-Curie Actions (MSCA), and the European Institute of Innovation and Technology (EIT) activities. It will also be implemented in close coordination with Member States programmes and activities.***

### *1.1.2. The Accelerator*

Available private and corporate financing remains scarce between late stage of research and innovation activities and market take-up for high-risk breakthrough and market-creating innovations. In order to bridge the 'valley of death', in particular for 'deep tech' innovations that are key to Europe's future growth, public support must develop a radically new approach. Where the market does not provide viable financial solutions, public support should provide for a specific risk-sharing mechanism, bearing more if not all of the initial risk of potential breakthrough market-creating innovations to attract alternate private investors in a second stage, as operations unfold and the risk is lowered.

Consequently the Accelerator will provide financial support to not yet 'bankable' or investors-attractive innovators and companies that have the ambition to develop and deploy in EU and international markets their breakthrough innovations and to scale up rapidly. For that purpose it will build on the experience from the Phases 2 and 3 of Horizon 2020 SME Instrument and from Horizon 2020 InnovFin, in particular through the addition of non-grant components and the ability to support larger and longer investments. ***Cooperation with EIT and its KICs and synergies with their accelerators' activities will be ensured.***

The Accelerator will support in the form of EIC blended finance, a mix of:

- Grant or reimbursable advance<sup>16</sup>, to cover innovation activities;
- Support for investment in equity<sup>17</sup> or other repayable forms, so as to bridge innovation activities with effective market deployment, including scale-up, in a manner that does not crowd out private investments or distorts competition in the internal market. When relevant it

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<sup>16</sup> Reimbursable advance shall be paid back to the EU on an agreed schedule or be transformed into equity, if the beneficiary so chooses.

<sup>17</sup> Usually no more than 25% of the voting rights. In exceptional cases, the EU may secure the acquisition of a blocking minority to protect European interests in essential areas, e.g. cyber security.

will channel the innovator to access to debt financing (e.g. loans *or guarantees*) provided by the InvestEU programme.

Support will be awarded through a single process and with a single decision, providing the supported innovator with a single global commitment to financial resources covering the various stages of innovation down to market deployment including pre-mass commercialisation. The full implementation of the awarded support will be subject to milestones and review. The combination and volume of financing will be adapted to the needs of the *beneficiary*, its size and stage, the nature of the technology/innovation and the length of the innovation cycle. It will cover financing needs until replacement by alternative sources of investment.

For innovations with high risks (for example, 'deep tech') the support will always include a grant component covering the innovation activities, *which may be performed in collaboration with public research organisations as partner or through subcontracting*. Where the various risks are reduced (technological, market, regulatory, etc.), the relative importance of the reimbursable advance component is expected to increase.

While the EU may bear alone the initial risk of selected innovation and market deployment actions, the aim will be to de-risk these and stimulate, from the on-set and during the development of the action, co-investments from alternative sources and even substitutive investors. Where relevant, milestones will establish co-investment objectives. Once de-risked and meeting the conditions established under Article 209(2) of the Financial Regulation, operations will be proposed for support to implementing partners under InvestEU.

The Accelerator will mainly operate through a continuously open, *competitive* and bottom-up call *with cut-off dates*, targeting individual entrepreneurs (mainly start-ups and SMEs), with a particular attention paid to young and to women innovators. This open and bottom-up call will be complemented by targeted support for on emerging breakthrough or disruptive *innovations and* technologies of potential strategic significance. Proposals may also be submitted by investors, including public innovation agencies, but the support will be awarded to the company.

The Accelerator will allow for fast-track take-up of innovations stemming from supported projects from the Pathfinder, from similar Member States 'advanced research programmes', *from the EIT KICs* and from other pillars of the EU Framework Programme<sup>18</sup>, in order to support them to reach the market. This identification of projects supported in other pillars of Horizon Europe and also previous Framework Programmes will be based on pertinent methodologies, such as the Innovation Radar.

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<sup>18</sup> Such as ERC Proof of Concept, from projects supported under the 'Global Challenges and Industrial Competitiveness' Pillar, startups emerging from the KICs of the European Institute of Innovation and Technology, ... Including from Horizon 2020 activities, particularly project selected under Horizon 2020 SME Phase 2 and related Seal of Excellence financed by Member States, (existing and future) European Partnerships.

### 1.1.3. Additional EIC activities

Additionally, EIC will also implement:

- EIC business acceleration services in support of *Pathfinder* and *Accelerator* activities and actions. The aim will be to connect the EIC Community of funded innovators, including funded Seal of Excellence, to investors, partners, public **and private** buyers. It will provide a range of coaching and mentoring services to EIC actions. It will provide innovators with access to international networks of potential partners, including industrial ones, to complement a value chain or develop market opportunities, and find investors and other sources of private or corporate finance. Activities will include live events (e.g. brokerage events, pitching sessions) but also, the development of matching platforms or use of existing ones, in close relation with financial intermediaries supported by the InvestEU and with the EIB Group. These activities will also encourage peer exchanges as a source of learning in innovation ecosystem, making particular good use of Members of the High Level Advisory board of the EIC and EIC Fellows. ***These additional EIC activities focused on breakthrough/high-risk innovations will complement the similar portfolio of the EIT activities targeting entrepreneurs, innovators and start-ups. EIC is encouraged to make use of the KICs expertise and experience when providing support to innovators.***
- EIC Fellowship to honour the EU's leading innovators. They will be awarded by the Commission on the advice of the High Level Advisory Board to recognise them as ambassadors for innovation;
- EIC Challenges, i.e. inducement prizes, to help develop ***new breakthrough innovations***, bring in new actors, develop new ***R&I communities and networks as well as give visibility to achievements from EU funding***. EIC recognition prizes will include iCapital, ***the EU Challenge Prize***, the Social Innovation Inducement Prize, and the Women Innovators' Prize. ***The design and implementation of these prizes will be linked with other parts of the Programme, including the missions and the EIT in order to ensure complementarity and avoid duplications.*** Opportunities for cooperation with organisations (such as enterprises, universities, research organisations, business accelerators, charities and foundations) will be explored.
- EIC Innovative Procurement, to procure prototypes, or develop first purchase programme to facilitate the testing and acquisition of pre-market innovative technologies by public entities.

## 1.2. Implementation

The implementation of the EIC calls for the deployment of specific management features, to reflect its innovator-centric approach and types of actions.

### 1.2.1. The EIC Board

The High Level Advisory Board of the EIC (*EIC Board*) will assist the Commission in implementing the EIC. *It will be composed of representatives including academic experts on innovation policy, research and technology organisations, entrepreneurs, venture capitalists, among others, in accordance with Article 9 of this Decision.*

*For the implementation of the EIC, the Commission will, with the support of the EIC Board, provide:*

- *clear differentiation between the addressed targeted groups and their distinct needs;*
- *details on how it will implement the mixed support (grant, equity, loan and guarantee);*
- *solid mechanism for systematic and real-time evaluation of the instruments to ensure quick policy learning process and development of innovation patterns, including the selection and implementation of indicators;*
- *cooperation between EIC and the EIT to ensure complementarity and avoid duplication.*
- *further definition of the role and responsibilities of the programme managers;*
- *description of tools to attract risk capital investors in case of highly risky projects;*
- *definition of the innovation objectives in terms of product, process, marketing and services;*
- *measurement of the driving force of beneficiaries;*

*The Board will also advise on the EIC work programmes, management and follow up actions. It will have a communication function, with members playing an ambassadorial role helping to stimulate innovation in the EU. Communication channels will include attendance at key innovation events, social media, constitution of an EIC community of innovators, engaging with key media with a focus on innovation, common events with incubators and acceleration hubs. The EIT's Governing Board and EIC Board will cooperate to exploit synergies and increase added value to innovators and entrepreneurs in the Union.*

The EIC Board along with the EIT Governing Board will provide recommendations to the Commission regarding innovation trends or initiatives needed to enhance and foster the EU innovation ecosystem, including potential *technical as well as* regulatory barriers. The Board's advice should also identify emerging areas of innovation to be taken into account in the activities under the Global Challenges and Industrial Competitiveness pillar and missions. In this way, the Board is expected to contribute to the overall coherence of the Horizon Europe programme.

#### *1.2.2. EIC programme managers*

The Commission will take a pro-active approach to the management of high risk projects, through access to the necessary expertise.

The Commission will appoint on a temporary basis a number of EIC programme managers to assist it with technology-based vision and operational guidance.

Programme managers will come from multiple spheres, including companies, universities, national laboratories and research centers. They will bring deep expertise from personal experience and years in the field. They will be recognised leaders, either having managed multidisciplinary research teams or directing large institutional programs, and know the importance of communicating their visions tirelessly, creatively, and broadly. Lastly, they will have experience in overseeing important budgets, which require sense of responsibility.

Programme managers will be expected to boost the impact of EIC funding by fostering an « active management » culture, a hands-on approach involving development at portfolio and projects levels of vision-based budgets, timelines and milestones EIC projects must meet to receive continued funding.

In particular, programme managers will oversee the implementation of *Pathfinder* calls, and propose evaluation rankings, ***based on clear and transparent criteria as defined in the Regulation***, consistent ***with a*** strategic portfolio of projects, expected to make essential contributions to the emergence of potential ***scientific***, societal or economic ***radically new future technologies or*** market creating innovations.

Programme managers will have the task of nurturing Pathfinder portfolios by developing together with beneficiaries a common vision and a common strategic approach that leads to a critical mass of effort. This will involve building up and structuring of new communities, with the objective of bringing transforming breakthrough ideas into genuine and mature market creating innovations. Programme managers will implement transition activities, further developing portfolio with additional activities and partners, and closely monitoring potential spin-offs and start-ups.

Programme managers will review Pathfinder and Accelerator's projects, for each milestone or at relevant intervals, to assess whether they should be continued, reoriented or terminated according to defined methods and procedures for project management. Such assessments may involve external experts.

Given the high risk nature of the actions, it is expected that a significant number projects will not reach completion. Budget decommitted from such terminations will be used to support other EIC actions.

### *1.2.3. Implementation of the EIC blended finance*

The Commission will manage all operational elements of Accelerator projects, including the grant or other non-repayable forms of support.

For the purpose of managing EIC blended finance, the Commission may make use of indirect management, or where this is not possible, may establish a special purpose vehicle (EIC SPV). The Commission shall seek to ensure the participation of other public and private investors. Where this is not possible at the initial set up, the special purpose vehicle will be structured in such a way that it can attract other public or private investors in order to increase the leverage effect of the Union contribution.



The EIC SPV will proactively leverage from the on-set co- and alternate public and private investments into individual *Accelerator*'s operations and the SPV, perform due diligence, and negotiate technical terms of each investment in compliance with the principles of additionality and prevention of conflict of interests with other activities of the entities or counterparts. The EIC SPV will also define and implement an exit strategy for equity participation, which may include proposing to implementing partners financing under InvestEU, where appropriate and for operations whose risks have been sufficiently lowered so that they meet criteria of Article 209(2) of the Financial Regulation.

## 2. EUROPEAN INNOVATION ECOSYSTEMS

### 2.1. Rationale

To fully harness the potential of innovation involving researchers, entrepreneurs, industry and society at large, the EU must improve the environment within which innovation can flourish at all levels. This will mean contributing to the development of an effective innovation ecosystem at EU level, and encouraging cooperation, networking and the exchange of ideas, ***developing open innovation processes***, funding and skills among national and local innovation ecosystems.

The EU must also aim to develop ecosystems that support social innovation, and ***encourage knowledge transfer*** and public sector innovation, in addition to innovation in private enterprises. Indeed, the government sector must innovate and renew itself in order to be able to support the changes in regulation, and governance required to support the large-scale deployment of ***innovations, including*** new technologies and a growing public demand for the more efficient and effective delivery of services. Social innovations are crucial to enhance the welfare of our societies. ***As Europe's largest innovation network, the EIT KICs will play an important role in the development of such ecosystems and in the implementation of this priority. They make the case for desired interregional cooperation by linking innovation ecosystems on a pan-European scale.***

### 2.2. Areas of intervention

As a first step the Commission will organise ***an Innovation*** Forum of Member States and Associated countries' public authorities and bodies in charge of national innovation policies and programmes, with the aim of promoting coordination and dialogue on the development of the EU's innovation ecosystem. Within this ***Innovation*** Forum, the ***involved stakeholders and EU bodies, including the EIT, the EIC Board and the Commission*** will:

- Discuss the development of innovation-friendly regulation, through the continued application of the Innovation Principle and development of innovative approaches to public procurement including developing and enhancing the Public Procurement of Innovation (PPI) instrument to drive innovation. The Observatory of Public Sector Innovation will also continue to support internal government innovation efforts, alongside the revamped Policy Support Facility;

- Promote the alignment of research and innovation agendas with EU efforts to consolidate an open market for capital flows and investment, such as the development of key framework conditions in favour of innovation under the Capital Markets Union;
- Enhance coordination between national, *the EIT as well as the* EIC so as to stimulate operational synergies and avoid overlap, by sharing data on programmes and their implementation, resources and expertise, analysis and monitoring of technological and innovation trends, and by interconnecting respective innovators' communities;
- Establish a joint communication strategy on innovation in the EU. It will aim at stimulating the EU's most talented innovators, entrepreneurs, particularly young drivers, SMEs and start-ups, also from fresh corners of the EU. It will stress the EU added-value that technical, non-technical, and social innovators can bring to EU citizens by developing their idea/vision into a thriving enterprise (social value/impact, jobs and growth, societal progression).

Activities will be implemented to ensure effective complementarity *and cooperation* between *EIT and* EIC's types of action and their specific focus on innovation, with activities implemented by Member States and Associated Countries, but also by private initiatives, in order to support all types of innovation, reach out to all innovators across the EU, and provide them with enhanced and adequate support.

To that end, the *involved EU bodies* will:

- Promote and co-fund joint innovation programmes managed by authorities in charge of public national, regional or local innovation policies and programmes, to which private entities supporting innovation and innovators *should* be associated. Such *supply and* demand-driven joint programmes may target, among others, early stage and feasibility study support, cooperation *between academia*, research *organisations and enterprises*, support to high-tech SMEs' collaborative research, technology and knowledge transfer, internationalisation of SMEs, market analysis and development, digitalisation of low-tech SMEs, financial instruments for close to market innovations activities or market deployment, social innovation. They may also include joint public procurement initiatives, enabling innovations to be commercialised in the public sector, in particular in support of the development of new policy. This could be particularly effective to stimulate innovation in public service areas and to provide market opportunities to European innovators. *When managed at the local level, these programmes should allow transnational partnerships, should be coherent with the smart specialisation strategies and support synergies with ERDF in the involved regions.*
- Support also joint programmes for mentoring, coaching, technical assistance and other services that are delivered close to innovators, by networks such as Enterprise Europe Network (EEN), clusters, pan-European platforms such as Startup Europe, local innovation actors, public but also private, in particular incubators and innovation hubs that could moreover be interconnected to favour partnering between innovators. Support *should* also be given to promote soft skills for innovation, including to networks of vocational institutions and in close cooperation with the EIT.

–Improve data and knowledge about innovation support, including mapping of support schemes, establishing data sharing platforms, benchmarking and evaluation of support schemes;

The EU will also launch actions necessary to further monitor and nurture the overall innovation landscape and innovation management capacity in Europe.

The ecosystem support activities will be implemented by the Commission, supported by an executive agency for the evaluation process.

### **3. EUROPEAN INSTITUTE OF INNOVATION AND TECHNOLOGY (EIT)**

#### **3.1. Rationale**

As the report of the High Level Group on maximising the impact of EU research and innovation (the Lamy High level Group) clearly states, the way forward is 'to educate for the future and invest in people who will make the change'. In particular, European universities are called to stimulate entrepreneurship, tear down disciplinary borders and institutionalise strong non-disciplinary academia-industry collaborations. According to recent surveys, access to talented people is by far the most important factor influencing the location choices of European founders of start-ups. Entrepreneurship education and training opportunities play a key role in cultivating future innovators and in developing the abilities of existing ones to grow their business to greater levels of success. Access to entrepreneurial talent, together with access to professional services, capital and markets on the EU level, and bringing key innovation actors together around a common goal are key ingredients for nurturing an innovation ecosystem *and creating successful innovation models and best practices at regional, national, and European levels*. There is a need to coordinate efforts across the EU in order to create a critical mass of interconnected EU-wide entrepreneurial clusters and ecosystems.

*The EIT is today's Europe's largest integrated innovation ecosystem, with over 1,000 excellent partners from business, research and education and beyond. The EIT's innovation model works and remains particularly relevant in removing barriers to innovation at Member State and regional level. The EIT will address these issues by promoting structural changes in the European innovation landscape. It will do so by fostering the integration of education, research and innovation of the highest standards, notably through its Knowledge and Innovation Communities (KICs), thereby creating new environments conducive to innovation, and by promoting and supporting a new generation of entrepreneurial people and by stimulating the creation of innovative spin-offs and start-ups.*

Efforts are still needed to develop *and promote* ecosystems where researchers, innovators, industries and governments can easily interact. Innovation ecosystems, in fact, still do not work optimally due to a number of reasons such as:

- Interaction among innovation players is still hampered by organizational, regulatory and cultural barriers between them;
- Efforts to strengthen innovation systems lack coordination and a clear focus on specific objectives and impact.

To address future challenges, embrace the opportunities of new technologies and contribute to sustainable economic growth, jobs, competitiveness and the well-being of Europe's citizens, there is the need to further strengthen Europe's capacity to innovate by: fostering the creation of new environments conducive to collaboration and innovation; strengthening the innovation capabilities of academia and the research sector; supporting a new generation of entrepreneurial **and research** people; stimulating the creation and the development of innovative ventures, **as well as promoting and giving visibility to the research and innovation achievements from EU funding to the wider public.**

The nature and scale of the innovation challenges require liaising and mobilising players and resources at European scale, by fostering cross-border collaboration. There is a need to break down silos between disciplines and along value chains and nurture the establishment of a favorable environment for an effective exchange of knowledge and expertise, and for the development and attraction of entrepreneurial talents.

***The EIT will address these challenges in line with its strategic objectives for the period 2021-2027, to be laid down in the legal proposal for the Strategic Innovation Agenda of the EIT.***

### **3.2. Areas of Intervention**

#### ***3.2.1. Sustainable innovation ecosystems across Europe***

The EIT will play a reinforced role in strengthening sustainable innovation ecosystems across Europe, ***providing solutions to the most pressing global challenges our societies are facing***. In particular, the EIT will continue to operate primarily through its Knowledge and Innovation Communities (KICs), the large-scale European partnerships that address specific societal challenges. The KICs will continue to strengthen innovation ecosystems around them, by fostering the integration of research, innovation and education. Furthermore, EIT will contribute to bridge existing gaps in innovation performance across Europe by expanding its Regional Innovation Scheme (EIT RIS). The EIT will work with innovation ecosystems that exhibit high innovation potential based on strategy, thematic alignment and impact, in close synergy with Smart Specialisation Strategies and Platforms.

*Broad Lines*

- Reinforcing the effectiveness of the existing KICs and setting up new ones *to tackle global challenges*;
- Accelerating regions towards excellence in countries that are modest or moderate innovators *in close cooperation with relevant regional funds*.

### 3.2.2. *Entrepreneurial and innovation skills in a lifelong learning perspective and the entrepreneurial transformation of EU universities*

The EIT education activities will be reinforced to foster innovation and entrepreneurship through better education and training, *including vocational training*. A stronger focus on human capital development will be grounded on the expansion of existing EIT KICs education programmes in the view of continuing to offer students and professionals high quality curricula based on innovation and entrepreneurship in line in particular with the EU industrial and skills strategy. This may include researchers and innovators supported by other parts of Horizon Europe, in particular MSCA. The EIT will also support the renewal of European Universities and their integration in innovation ecosystems by stimulating and increasing their entrepreneurial potential and capabilities and encouraging them to better anticipate new skills requirements.

#### *Broad Lines*

- Development of innovative curricula, taking into account the future needs of industry *and society*, and cross-cutting programmes to be offered to students, entrepreneurs and professionals across Europe and beyond where specialist and sector specific knowledge is combined with entrepreneurial and innovation oriented skills, such as digital and key enabling technologies high-tech skills such as digital and key enabling technologies high-tech skills;
- Strengthening and expanding the EIT label in order to improve the quality of education programmes based on partnerships between different higher education institutions, research centres and companies and offering learning-by-doing curricula and robust entrepreneurship education as well as international, inter-organisational and cross-sectorial mobility;
- Development and dissemination of innovation and entrepreneurship capabilities of the higher education sector, by leveraging *and promoting* the EIT Community expertise in linking education, research and business;
- Reinforcing the role of the EIT Alumni community as role model for new students and strong instrument to communicate EIT impact.

- EIT Awards, i.e. the EIT's well-established recognition prize for the development of novel solutions to global challenges and the reward of young talents and innovators.***

### 3.2.3. *New solutions to **address global challenges***

The EIT will facilitate and empower entrepreneurs, innovators, **designers**, educators, students and other innovation actors to work together in cross-disciplinary teams to generate ideas and transform them into both incremental and disruptive innovations. Activities will be characterised by an open innovation and cross-border approach, with a focus on including relevant Knowledge Triangle activities that are pertinent to making them a success (e.g. project's promoters can improve their access to: specifically qualified graduates, start-ups with innovative ideas, non-domestic firms with relevant complementary assets etc.).

#### *Broad Lines*

- Support to ***turn research into*** the development of new products, services ***and markets*** where Knowledge Triangle actors will collaborate to ***bring*** solutions ***to global challenges***;
- Provision of high-level services and support to innovative businesses, including technical assistance to fine-tuning of products or services, substantive mentoring, support to secure target customers and raise capital, in order to swiftly reach the market and speed up their growth process.

### 3.2.4. *Synergies and value added within Horizon Europe*

The EIT will step up its efforts to capitalise on synergies and complementarities with different actors and initiatives at EU and global levels and extend its network of collaborating organisations at both strategic and operational levels.

#### *Broad Lines*

- Cooperation with the EIC in streamlining the support (i.e. funding and services) offered to highly innovative ventures in both start-up and scale-up stages, in particular through KICs;
- Planning and implementation of EIT activities in order to maximise synergies and complementarities with the actions under the ***Excellent and Open Science and Global Challenges*** and ***European Industrial Competitiveness Pillars*** ***and when appropriate, contribution to these actions***;
- Engage with EU Member States at both national and regional level, establishing a structured dialogue and coordinating efforts to enable synergies with existing ***and future*** national initiatives, in order to identify, share and disseminate good practices and learnings;

- *Share and disseminate innovative practices and learnings and contribute to innovation policy in Europe, where appropriate in conjunction and close cooperation with other parts of Horizon Europe.*
- Provision of input to innovation policy discussions and contribution to the **design and** implementation of EU policy priorities by continuously working with all relevant European Commission services, other EU programmes and their stakeholders, and further exploring opportunities within policy implementing initiatives;
- Exploitation of synergies with other EU programmes supporting human capital development and innovation (e.g. ESF+, ERDF and Erasmus);
- Building strategic alliances with key innovation actors at EU and international level, and support to KICs to develop collaboration and linkages with key Knowledge Triangle partners from third countries, with the aim of opening new markets for KICs’-backed solutions and attract talents from abroad.

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## **PART IV - STRENGTHENING THE EUROPEAN RESEARCH AREA**

The EU has a history of world-class scientific and technological achievements, but its research and innovation potential fails to be fully exploited. Despite much progress in developing the European Research Area (ERA), Europe has still a fragmented research and innovation landscape, and all Member States face bottlenecks in their research and innovation systems which require policy reforms. In some areas, progress is too slow to catch-up with an increasingly dynamic research and innovation ecosystem.

The level of research and innovation investment in Europe is still far below the policy objective of 3% of GDP and continues to grow less than our main competitors such as US, Japan, China or South-Korea.

Meanwhile, there is a growing disparity in Europe between the innovation-leading and the innovation-lagging regions. Change is needed if Europe as a whole is to capitalise on excellence from across the continent, maximise the value of public and private investments, and their impacts on productivity, economic growth, job creation and well-being.

In addition, research and innovation are seen by some as distant and elitist without clear benefits for citizens, instilling attitudes that hamper the creation and uptake of innovative solutions, and scepticism about evidence-based public policies. This requires better linkages between scientists, citizens and policy-makers, and more robust approaches to pooling scientific evidence itself.

The EU now needs to raise the bar on the quality and impact of its research and innovation system, requiring a revitalised European Research Area (ERA), better supported by the EU's research and innovation Framework Programme. Specifically, a well-integrated yet tailored set of EU measures is needed, combined with reforms and performance enhancements at national level (to which the Smart Specialisation Strategies supported under the European Regional Development Fund can contribute ***substantially, if consistent with strong national research strategies and funding*** and, in turn, institutional changes within research funding and performing organisations, including universities. By combining efforts at EU level, synergies can be exploited and the necessary scale can be found to make support to national policy reforms more efficient and impactful.

The activities supported under this part addresses ERA policy priorities, while generally underpinning all parts of Horizon Europe. Activities may also be established to foster brain circulation across ERA through mobility of researchers and innovators.

The goal is for an EU where knowledge and a highly skilled workforce circulate freely, research outputs are shared rapidly and efficiently, researchers benefit from attractive careers and gender equality is ensured, where Member States develop common strategic research agendas, aligning national plans, defining and implementing joint programmes, and where the outcomes of research and innovation are understood and trusted by informed citizens and benefit society as a whole.

This part will contribute *de facto* to all Sustainable Development Goals (SDGs), but directly to the following: SDG 4 - Quality Education; SDG 5 - Gender Equality; SDG 9 - Industry, Innovation and Infrastructure; SDG 17 - Partnership for the Goals.

## **1. SPREADING EXCELLENCE AND WIDENING PARTICIPATION**

Reducing disparities in research and innovation performance by sharing knowledge and expertise across the EU ***and by widening participation in the programme*** will help countries and regions that are lagging behind in terms of research and innovation performance, including the EU outermost regions ***and less developed regions***, to attain a competitive position in the global value chains ***and the Union to fully benefit from R&I potential of all Member States***. Activities may also be established to foster brain circulation right across ERA and better exploitation of existing (and possibly jointly managed EU programmes) research infrastructures in the targeted countries through mobility ***and virtual collaboration*** of researchers and innovators ***and strengthening, and where appropriate, setting up new R&I networks and R&I initiatives on the base of those infrastructures***.

Further action is therefore needed to counter the trend for closed collaborations, which can exclude large number of promising institutions, and to exploit the potential of the EU's talent pool by maximising and sharing the benefits of research and innovation across the EU.



### *Broad Lines*

–Teaming, to create new centres of excellence or upgrade existing ones in eligible countries, ***including small and medium sized research infrastructures and those funded by ERDF, by ensuring cooperation in all stages of research*** between leading scientific institutions and partner institutions; ***Applicants need to clearly show that projects are linked with national and/or regional R&I strategies to be able to apply for funding under this broad line.***

–Twinning, to significantly strengthen a university or research organisation from an eligible country ***in all fields of research*** by linking it with internationally-leading research institutions from other Member States or Associated Countries. ***Applicants need to clearly show that projects are linked with national and/or regional R&I strategies to be able to apply for funding under this broad line.***

–ERA Chairs, to support universities or research organisations attract and maintain high quality human resources under the direction of an outstanding researcher and research manager (the 'ERA Chair holder'), and to implement structural changes to achieve excellence on a sustainable basis.

–European Cooperation in Science and Technology (COST), involving ambitious conditions regarding the inclusion of eligible countries, and other measures to provide scientific networking, capacity building and career development support to researchers from these target countries. 80% of the total budget of COST will be devoted to actions fully aligned with the objectives of this intervention area.

- ***“Excellence Initiatives”, to support innovative initiatives aiming to strengthen research and innovation excellence in the eligible countries, including supporting training to improve R&I managerial skills, attractiveness prizes, strengthening innovation ecosystems as well as the creation of R&I networks, including on the basis of research infrastructures financed by the EU. Applicants need to clearly show that projects are linked with national and/or regional R&I strategies to be able to apply for funding under this broad line.***

- ***Widening fellowships and prizes, to attract and enable excellent researchers of any nationality to acquire and transfer new knowledge into widening countries. Prizes shall be awarded in particular to projects attracting scientists wishing to establish themselves in widening countries. This scheme will be complementary with other parts of the Programme, in particular with Marie Skłodowska Curie actions.***

The above mentioned funding lines will facilitate specific research elements customised to the particular needs of the actions.

The ***Spreading Excellence and widening participation priority*** will support the Horizon Europe specific objectives: Spread and connect excellence across the EU ***and widen participation in the Programme***; reinforce the creation of high quality knowledge; Increase cross-sectorial, cross-disciplinary cross-border cooperation. ***All actions will encourage synergies with other national and EU funds, particularly with ERDF, Cohesion Policy and ESF+, in line with regional research and innovation smart specialisation strategies and operational programmes.***

## 2. REFORMING AND ENHANCING THE EU RESEARCH AND INNOVATION SYSTEM

Policy reforms at national level will be mutually reinforced through the development of EU-level policy initiatives, research, networking, partnering, coordination, data collection and monitoring and evaluation.

### *Broad Lines*

- Strengthening the evidence base for research and innovation policy, for a better understanding of the different dimensions and components of national research and innovation systems, including drivers, impacts, associated policies;
- Foresight activities, to anticipate emerging needs, in coordination and co-design with national agencies and future-oriented stakeholders, in a participative manner, building on advances in forecasting methodology, making outcomes more policy relevant, while exploiting synergies across and beyond the programme;
- Accelerating the transition towards open science, by monitoring, analysing and supporting the development and uptake of open science policies and practices at the level of Member States, regions, institutions and researchers, in a way that maximises synergies and coherence at EU level;
- Support to national research and innovation policy reform, including through a strengthened set of services of the Policy Support Facility (PSF) (i.e. peer reviews, specific support activities, mutual learning exercises and the knowledge centre) to Member States and Associated Countries, operating in synergy with the European Regional Development Fund, the Structural Reform Support Service (SRSS) and the Reform Delivery Tool;
- Providing researchers with attractive career environments, skills and competences needed in the modern knowledge economy. Linking the ERA and the European Higher Education Area by supporting the modernisation of universities and other research and innovation organisations, through recognition and reward mechanisms to spur actions at national level, as well as incentives promoting the adoption of open science practices, entrepreneurship (and links to innovation ecosystems), trans-disciplinarity, citizen *and civil society* engagement, international and *cross* sectoral mobility, gender equality plans and comprehensive approaches to institutional changes. In that context, also complementing the Erasmus programme support for the European Universities initiative, in particular *through financing research and innovation projects within these networks*, as part of developing new joint and integrated long term and sustainable strategies on education, research and innovation based on trans-disciplinary and cross-sectoral approaches to make the knowledge triangle a reality, providing impetus to economic growth.
- Citizen science supporting all types of formal, non-formal and informal science education, including *assessing the barriers for and encouraging* engagement of citizens in the co-design of research and innovation agenda settings and policy, in the co-creation of scientific content and innovation through transdisciplinary activities.
- Supporting gender equality in scientific careers and in decision making, as well as the integration of the gender dimension in research and innovation content;
- Ethics and integrity, to further develop a coherent EU framework in adherence with the highest ethics standards and the European Code of Conduct for Research Integrity;

–Supporting international cooperation, through bilateral, multilateral and bi-regional policy dialogues with third countries, regions and international fora will facilitate mutual learning and priority setting, promote reciprocal access and monitor impact of cooperation;

–Scientific input to other policies, through the creation and maintenance of structures and processes to ensure that EU policy-making is based on the best available scientific evidence and high-level scientific advice;

–EU research and innovation programme implementation, including the collection and analysis of evidence for the monitoring, evaluation, design and impact assessment of the Framework Programmes; strengthening dedicated support structures and facilitating trans-national cooperation among them (e.g. building on activities of National Contact Points in previous Framework Programmes); dissemination and exploitation of research and innovation results, data and knowledge, including through dedicated support to beneficiaries; fostering synergies with other EU programmes; targeted communication activities to raise the awareness of the broader impact and relevance of EU funded research and innovation.

## **ANNEX II**

### **Programme Committee configurations**

List of configurations of the Programme Committee in accordance with Article 12(2):

1. Strategic configuration: Strategic overview of the implementation of the whole programme, coherence across the different parts of the programme, missions and Strengthening the European Research Area
2. European Research Council (ERC) and Marie Skłodowska-Curie Actions (MSCA)
3. Research Infrastructures
4. Health
5. Inclusive and *Creative* Society
6. *Secure Society*
7. Digital, Industry *and Space*
8. Climate, Energy and Mobility
9. Food, Natural Resources *and Agriculture*
10. The European Innovation Council (EIC) and European Innovation ecosystems

### **ANNEX III**

#### ***Information to be provided by the Commission in accordance with Article 12(6)***

1. Information on individual projects, enabling the monitoring of the entire lifetime of each proposal, covering in particular:

- submitted proposals,
- evaluation results for each proposal
- grant agreements,
- completed projects.

2. Information on the outcome of each call and project implementation, covering in particular:

- results of each call,
- outcome of negotiations on grant agreements,
- project implementation, including payment data and outcome of projects.

3. Information on programme implementation as well as the synergies with other relevant Union programmes.

4. Information on the execution of the Horizon Europe budget, including information on commitments and payments for initiatives under Articles 185 and 187 TFEU.